Pulse Secure®

Pulse Policy Secure

Administration Guide

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Pulse Secure, LLC
2700 Zanker Road, Suite 200
San Jose, CA 95134
https://www.pulsesecure.net

Pulse Policy Secure Administration Guide

The information in this document is current as of the date on the title page.

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Revision History

The following table lists the changes to this document from the previous release.

Table 1 Lists changes to this document from the previous release

Feature	Add/Update/Remove	Document Published Date/Document Version	Effective Release	Notes
Backup configs and archived logs on AWS S3/Azure Storage	Updated the “Archiving” section.	July 2019/1.1	9.1R2	
OPSWAT V3 to V4 SDK migration	Added OPSWAT V3 to V4 SDK migration	July 2019/1.1	9.1R2	
Alert Based Admission Control using Nozomi Networks	Added “Alert Based Admission Control using Nozomi Networks” section.	July 2019/1.1	9.1R2	
Event Types supported by Nozomi Networks	Added “Event Types supported by Nozomi Networks” section.	July 2019/1.1	9.1R2	
EasiSMS support for SMS Gateway	Added EasiSMS configuration	July 2019/1.1	9.1R2	
Migration Wizard	Added PPS Migration Wizard section.	July 2019/1.1	9.1R2	
TOTP Auth Server	Added “Using a Time-Based One-Time Password (TOTP) Authentication Server” section	April 2019/1.0	9.1R1	
SAML Auth Server	Added “Using the SAML Server” section.	April 2019/1.0	9.1R1	
Session Migration support using Cert Auth	Added “Configuring Session Migration for Pulse Client” section.	April 2019/1.0	9.1R1	
Cisco Meraki WLC support for Guest Access	Added “Cisco Meraki WLC Configuration” section.	April 2019/1.0	9.1R1	
SNMP ACL enforcement	Added “Configuring SNMP Policy Enforcement using ACL” section. Modified “Configuring SNMP Policy Enforcement using VLAN”.	April 2019/1.0	9.1R1	
Machine Certificate support fro MAC OS	Updated the “Support Platform Matrix” in Host Checker.	April 2019/1.0	9.1R1	

Feature	Add/Update/Remove	Document Published Date/Document Version	Effective Release	Notes
TACACS+ support for Juniper and F5 switches	Updated “Configuring Shell Policies” section	April 2019/1.0	9.1R1	
Agentless Session bridging for Linux Clients	Updated “Host Checking with Native Supplicant” section.	April 2019/1.0	9.1R1	
AD legacy mode is not supported	Removed “Legacy Mode configuration” in AD.	April 2019/1.0	9.1R1	
WAN clustering	Added “WAN Clustering” section.	April 2019/1.0	9.1R1	
RADIUS server on external port.	Added a note in “Configuring 802.1X on PPS” section.	April 2019/1.0	9.1R1	
DNS traffic over any physical interface	Updated “Configuring Network Services” section.	April 2019/1.0	9.1R1	

Abbreviated Table of Contents

Table of Contents

About This Guide

Objectives

This guide provides detailed information on configuring, authenticating, securing, managing, and troubleshooting Pulse Policy Secure.

Audience

This guide is written for network administrators who are configuring and maintaining Pulse Policy Secure. This guide assumes that you have a working knowledge of networking principles and applications, and have experience as a network system administrator.

Documentation Conventions

Table 1 defines the notice icons used in this guide. Table 2 defines text conventions used throughout this documentation.

Table1: Notice Icons

Icon	Meaning	Description
	Informational note	Indicates important features or instructions.
	Caution	Indicates a situation that might result in loss of data or hardware damage.
	Warning	Alerts you to the risk of personal injury or death.
	Laser warning	Alerts you to the risk of personal injury from a laser.

Table2: Text Conventions

Convention	Description	Examples
Bold text like this	• Represents keywords, scripts, and tools in text. • Represents a GUI element that the user selects, clicks, checks, or clears.	• Specify the keyword **exp-msg**. • Run the **install.sh** script. • Use the **pkgadd** tool. • To cancel the configuration, click **Cancel**.
Bold text like this	Represents text that the user must type.	**user@host# set cache-entry-age**

`Fixed-width text like this`	Represents information as displayed on your terminal's screen, such as CLI commands in output displays.	`nic-locators {`
		`  log in {`
		`  resolution {`
		`  resolver-name /realms/ log in/A1;`
		`  key-type LoginName;`
		`  value-type SaeId;`
		`  }`

Regular sans serif typeface	• Represents configuration statements. • Indicates CLI commands and options in text. • Represents examples in procedures. • Represents URLs.	• **system ldap server{ stand-alone;** • Use the **request sae modify device failover** command with the **force** option • **user@host# . . .** • https://www.pulsesecure.net/
Italic sans serif typeface	Represents variables in CLI commands.	user@host# **set local-address**
Angle brackets	In text descriptions, indicate optional keywords or variables.	Another runtime variable is <gfwif>.
Key name	Indicates the name of a key on the keyboard.	Press Enter.
Key names linked with a plus sign (+)	Indicates that you must press two or more keys simultaneously.	Press Ctrl + b.
Italic typeface	• Emphasizes words. • Identifies book names. • Identifies distinguished names. • Identifies files, directories, and paths in text but not in command examples.	• There are two levels of access: *user* and *privileged*. • *SRC-PE Getting Started Guide.* • *o=Users, o=UMC* • The */etc/default.properties* file.
Words separated by the | symbol	Represent a choice to select one keyword or variable to the left or right of this symbol. (The keyword or variable may be either optional or required.)	diagnostic | line

Documentation

For a list of related Pulse Policy Secure (PPS) documentation, see http://www.pulsesecure.net/support. If the information in the latest PPS Release Notes differs from the information in the documentation, follow Pulse Policy Secure Release Notes.

Obtaining Documentation

To obtain the most current version of all Pulse Policy Secure technical documentation, see the products documentation page at https://www.pulsesecure.net/techpubs.

Documentation Feedback

We encourage you to provide feedback, comments, and suggestions so that we can improve the documentation. You can send your comments to techpubs-comments@pulsesecure.net.

Requesting Technical Support

Technical product support is available through the Pulse Secure Global Support Center (PSGSC). If you have a support contract, then file a ticket with PSGSC.

- Product warranties—For product warranty information, visit https://www.pulsesecure.net/techpubs.

Self-Help Online Tools and Resources

For quick and easy problem resolution, Pulse Secure, LLC has designed an online self-service portal called the Customer Support Center (CSC) that provides you with the following features:

- Find CSC offerings: https://www.pulsesecure.net/support
- Search for known bugs: https://www.pulsesecure.net/support
- Find product documentation: https://www.pulsesecure.net/techpubs/pulse-policy-secure/pps/
- Find solutions and answer questions using our Knowledge Base: https://www.pulsesecure.net/support
- Download the latest versions of software and review release notes: https://www.pulsesecure.net/support
- Search technical bulletins for relevant hardware and software notifications: https://www.pulsesecure.net/support
- Open a case online in the CSC Case Management tool: https://www.pulsesecure.net/support

To verify service entitlement by product serial number, use our Serial Number Entitlement (SNE) Tool: https://www.pulsesecure.net/support

Opening a Case with PSGSC

You can open a case with PSGSC on the Web or by telephone.

- Use the Case Management tool in the PSGSC at https://www.pulsesecure.net/support.
- Call 1-844-751-7629 (toll-free in the USA).

For international or direct-dial options in countries without toll-free numbers, see https://www.pulsesecure.net/support.

Introduction

This part covers the following chapter:

- Introduction to Pulse Policy Secure
- Pulse Secure Profiler
- Roles, Realms and Sign-In Policy

Introduction to Pulse Policy Secure

This chapter provides an overview of the Pulse Policy Secure. It includes the following information:

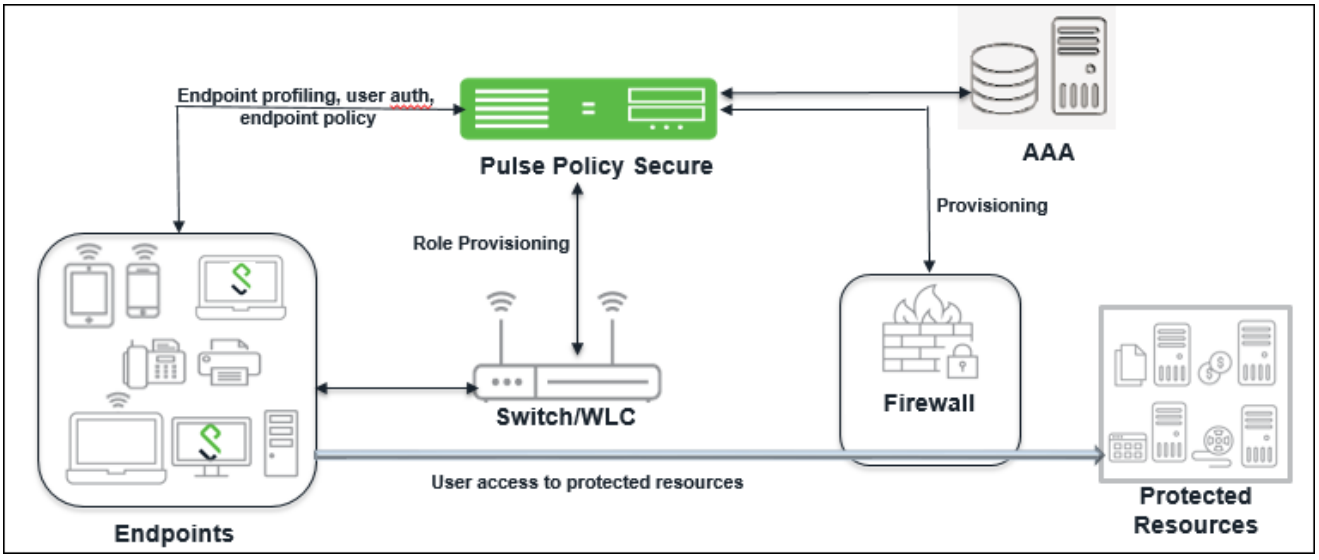
Overview

Pulse Policy Secure (PPS) is a network access control (NAC) solution which provides network access only to authorized and secured users and devices. It protects your network and guards mission critical applications and sensitive data through comprehensive NAC management, visibility, and monitoring.

It reduces the cost and complexity of delivering and deploying granular, identity, and role enabled access control from the branch to the corporate data center. It also addresses most NAC challenges, which includes insider threats, guest access control, and regulatory compliance.

The PPS solution leverages AAA framework, which contains the user profiles, attributes, group roles and identities. It then binds the user identity information to the endpoint and to the network and uses the resultant policy to map the user to the appropriate role during the access session.

Figure 1: Pulse Policy Secure



PPS solution uses endpoint validation to place the users into specific access groups. The groups can be provisioned access to different resources based on access control mechanisms such as virtual LANs (VLAN), filters, or access control lists (ACL). You can also define additional QoS parameters for the session for role-based policy enforcement so that only authorized users can access the application and data. The solution allows access only from users who are compliant with the security policies that you define. PPS also works well with unmanaged devices, such as printers, VoIP phones, and IP enabled cameras. You can configure typical hosts, such as VoIP phone, that is not 801.1X enabled to be permitted to the

network using SNMP enforcement and the Pulse Secure Profiler. The integration with Pulse Secure Profiler enables PPS to build a database of the unmanaged devices on the network and have the same access security as managed devices. PPS solution is extremely flexible and offers numerous options for integration into your existing network. When an endpoint connects to the network, PPS gathers user authentication data, endpoint security state data, and device location. It combines the information to create dynamic policies or uses the user created policies, which are then propagated to enforcement points. The enforcement can be either at the edge of the network prior to granting an IP address using 802.1X, within the network on the firewall, or both for greater granularity.

PPS Components

PPS solution consists of the following main components:

- Pulse Policy Secure (PPS)—A central policy management server that validates the user's identity, determines the endpoint's security compliance, and manages network policies.
- Enforcer—Policy enforcement points for user authentication. For example, switches, firewall, and WLCs.
- Pulse Client—Client running on endpoints for user authentication, device compliance using PPS.
- Pulse Secure Profiler—It dynamically identifies and classifies endpoints across managed and unmanaged endpoint devices, so that access to network and resources can be controlled based on the type of the device.

PPS offers the following benefits:

- Centralized management of Access and Compliance policies.
- Easy integration with several Authentication, Authorization, and Accounting (AAA) servers.
- Role-based, application-level enforcement.
- Allows context-aware policy enforcement for wired and wireless connections across desktop and mobile platforms.
- Distributed enforcement of network access policies.
- Dynamic endpoint assessment and enforcement.
- Supports compliance based network access for endpoints.
- Supports comprehensive network visibility with simplified auditing, and monitoring of devices.
- Supports interoperability with existing network infrastructure such as switches, wireless controllers, AD, firewalls, IDS, and Security Information and Event Management (SIEM).
- Extends policy enforcement with information from Enterprise Mobility Management (EMM) solutions. PPS supports leading global-device management solutions from Pulse Workspace (PWS), MobileIron, AirWatch, and Microsoft Intune. PPS works with the Mobile Device Management (MDM) solution to evaluate whether the BYOD or corporate devices are compliant with organizational and MDM policies.
- Supports automated device onboarding, self-service enrollment, and integration with existing infrastructure to simplify deployments.
- Supports Simple Network Management Protocol (SNMP) in the network device definition for the Profiling service to communicate with the network devices and profile endpoints that are connected to the network devices.
- Delivers guest user access control capabilities for simple, seamless, and authorized network access to guests.
- Supports captive portal capabilities for allowing users onto their guest networks and capturing relevant information.

PPS Enforcement Modes

To provision resource access policies, you can use 802.1X Layer 2 switch, access point, or firewall within any enterprise class network edge infrastructure that supports 802.1X and Remote Authentication Dial-In User Service (RADIUS).

The following types of devices can be used as PPS enforcement points:

- Infranet Enforcer (Firewall) —Devices that control traffic flow based on Layer 3 data. You can use Palo Alto, Check Point, Fortinet, Juniper Networks SRX series and Screen OS firewalls as enforcers. For more information, see Layer 3 Enforcement.
- 802.1X devices—You can use any 802.1X enabled switches or access points with PPS. The 802.1X protocol provides port based authenticated access to LAN. This standard applies to both wireless and wired networks. For more information, see Layer 2 Enforcement.

You can use 802.1X enabled switches or access points with or without the Infranet Enforcer as part of the solution. If you do not deploy the Enforcer, the 802.1X enabled switch or access point functions as the enforcement point. You can create different security zones by configuring VLANs on the network and assigning different roles to the appropriate VLAN.

Pulse Secure Profiler

Overview

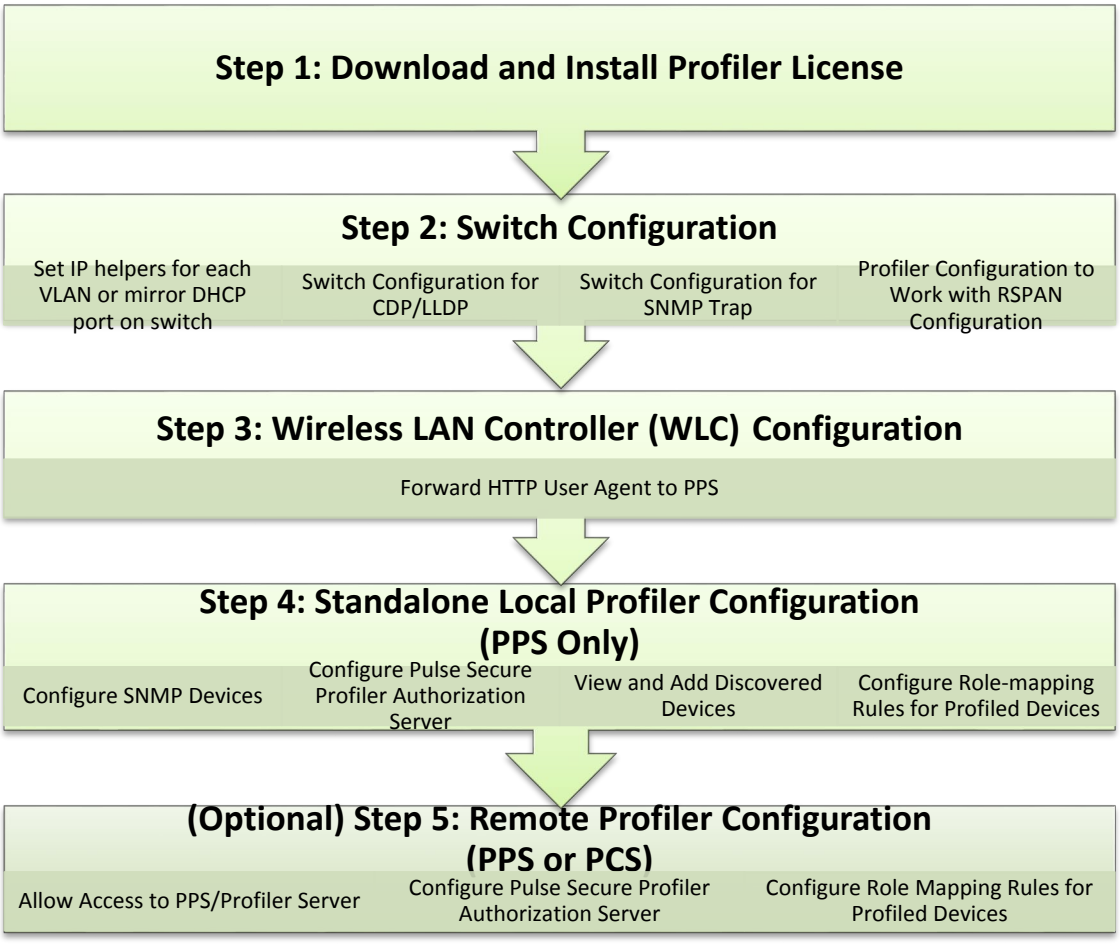
Pulse Secure Profiler dynamically identifies and classifies endpoints across managed and unmanaged endpoint devices, so that access to network and resources can be controlled based on the type of the device. It also helps you to get visibility and enforce your security policies for corporate access, BYOD, and guest access.

The Pulse Secure Profiler has the capability to:

- Detect and classify devices using DHCP fingerprinting.
- Provide access control for devices based on the device profile - mainly characterized by Manufacturer, Operating System, and Device Category.
- Provide visibility into IP-enabled devices connecting to the network.
- Enable MAC Authentication.
- Enable granular policies based on device attributes.

A high-level overview of the configuration steps needed to set up and run Pulse Secure Profiler is shown below.

Figure 2: Pulse Secure Profiler Configuration Overview



For more information on deployment and configuration, see Pulse Secure Profiler Deployment Guide.

Roles, Realms and Sign-In Policy

Overview

PPS access management framework allows only qualified users to access protected resources. The policies are created to allow or deny access to resources based on user's role and user's endpoint device compliance. The access management framework comprises of the following key elements:

- User Roles
- Authentication Realm
- Sign-in Policies

User Roles

User role is used to categorize a group of users and accordingly provide access to a set of protected resources for these group of users. User role defines the type of access and the permissions required for accessing a protected resource. Administrator can define multiple user roles for the end users.
For example:

- Employees- Users who require access to all the company resources.
- Contractors- Users who work on a contract basis and require access to selected network resources.
- Guests- Users who visit the company and require limited access to network resources.

Authentication Realm

Authentication realm specifies the conditions that users must meet to sign-in to the system. A realm contains details about the authentication server with which the user is authenticated and list of restrictions/checks that needs to be passed on the client machine.
It also includes mapping of different users to different groups or roles with the use of role mapping rules.

- Authentication Server- An authentication server is a database that stores user credentials (username, password, group, and attribute information). The user logs-in to PPS through a specific authentication realm, which is associated with an authentication server, PPS forwards the user's credentials to the authentication server to verify the user's identity through AAA framework.
  The PPS supports the following authentication servers:
  - Active Directory
  - RADIUS
  - LDAP
  - NIS
  - RSA ACE/Server
  - Anonymous
  - Certificate
  - SAML Server
  - SiteMinder
  - Mac Address Authentication
  - Local Authentication Server

  For more information, see AAA servers.
- Authentication Policy- It is a set of rules and restrictions to control resource access.
- Role-Mapping- It consists of conditions a user must meet for PPS to map the user to one or more user roles. These conditions can be based on either the username, certificate, user information returned by the realm's directory server, or other administrator defined criteria.

The high-level configuration workflow is as follows:

1. Configure the Authentication Server

2. Configure User Roles
3. Configure Restrictions
4. Configure Authentication Realm
5. Configure Sign-in Policy

Sign-in Policy

Sign-in policies define the URLs that users and administrators use to access the device and connect to the network. This also provides option to the administrator to select the set of pages that users see during the sign-in process. Note that, these pages can be customized by using Custom Sign-in Pages option. See
For example, if the enterprise has both PC users and mobile users, the admin can define two different URLs so that different authentication methods can be used. The PCs could log in to the PPS with an RSA token and their AD username and password. The mobile device use a client certificate (provided by an MDM solution) and the AD username and password.

User Roles

The user can be assigned to one or more roles during the sign-in process. A role is an entity which defines user session settings, role restrictions, appearance of the welcome page, and type of access methods (Pulse Client, or agentless).

This section covers the following topics:

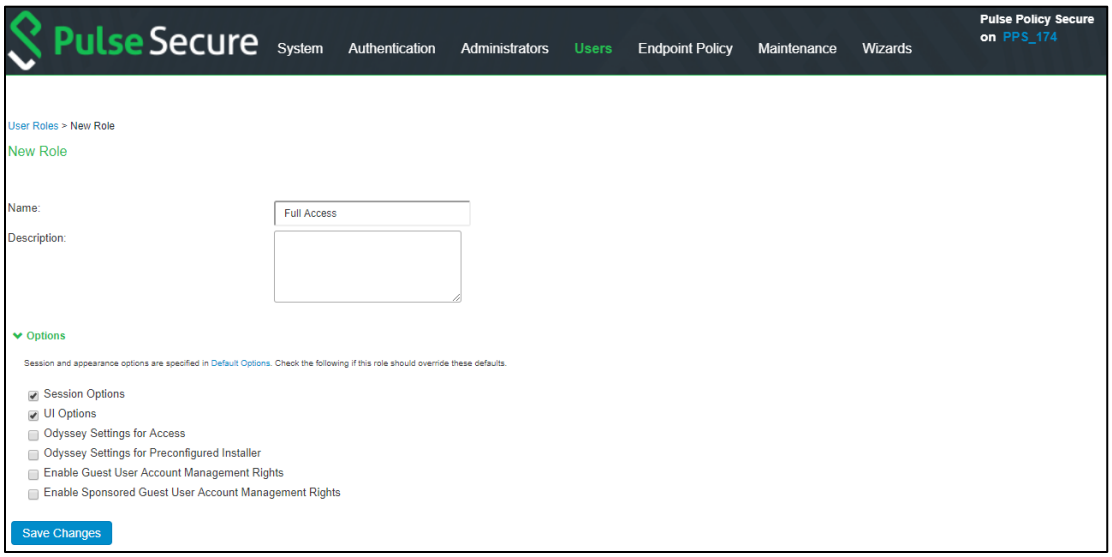
- Creating Roles
- Configuring User Access Options
- Customizing UI Options
- Customizing the Session Options
- Configuring Role Restrictions

Creating Roles

To create a user role:

1. Select **Users > User Roles.** For creating Administrator role, select **Administrators > Admin Role**.
   An administrator role specifies system management functions and session properties for administrators who map to the role. You can customize an administrator role by selecting the feature sets and user roles that members of the administrator role can view and manage
2. Click **New Role** and then enter a name and, optionally, a description. This name is displayed in the list of Roles on the Roles page.
3. Under Options, specify the session and appearance details.
   - Session Options—Sets timeouts and user permissions that apply to each session established through the role.
   - UI Options—Sets the appearance of agentless log in pages.
   - Enable Guest User Account Management Rights—Provides limited permissions to allow users assigned to this role to create guest accounts. Users who are assigned to the role can provision guest accounts.
   - Enable Sponsored Guest User Account Management Rights—Provides limited permission to allow users assigned to this role to create sponsored guest accounts.

Figure 3: User Roles



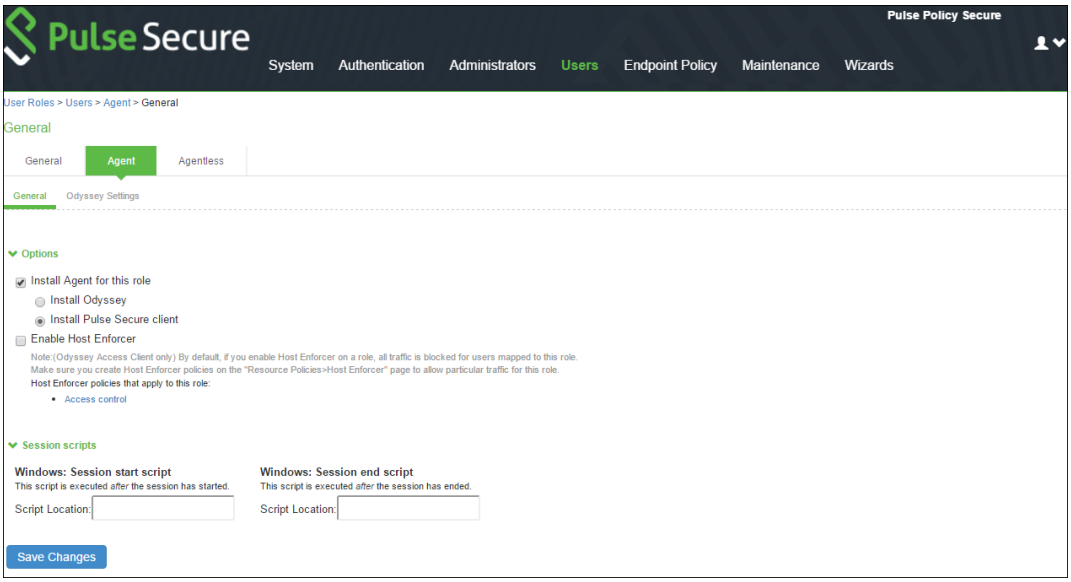
Configuring User Access Options

PPS supports connection through an agent (software) installed on the client device. The supported agent is Pulse Client. The Administrator can configure what agent to install on the client device and the corresponding settings to push during the installation.

To configure the user access options:

1. Select **Users > User Roles > Role Name > Agent**.

Figure 4: Agents



2. To allow Pulse to download automatically on Windows endpoints, select Install Agent for this role, and then select the Install **Pulse Secure Client** option.
3. Under **Session Scripts**, specify scripts to run on Windows endpoints for users assigned to a role. For example, you can specify a script that maps network drives on an endpoint as a session start script, and you can specify another script that disconnects the mapped network drives as session end script.

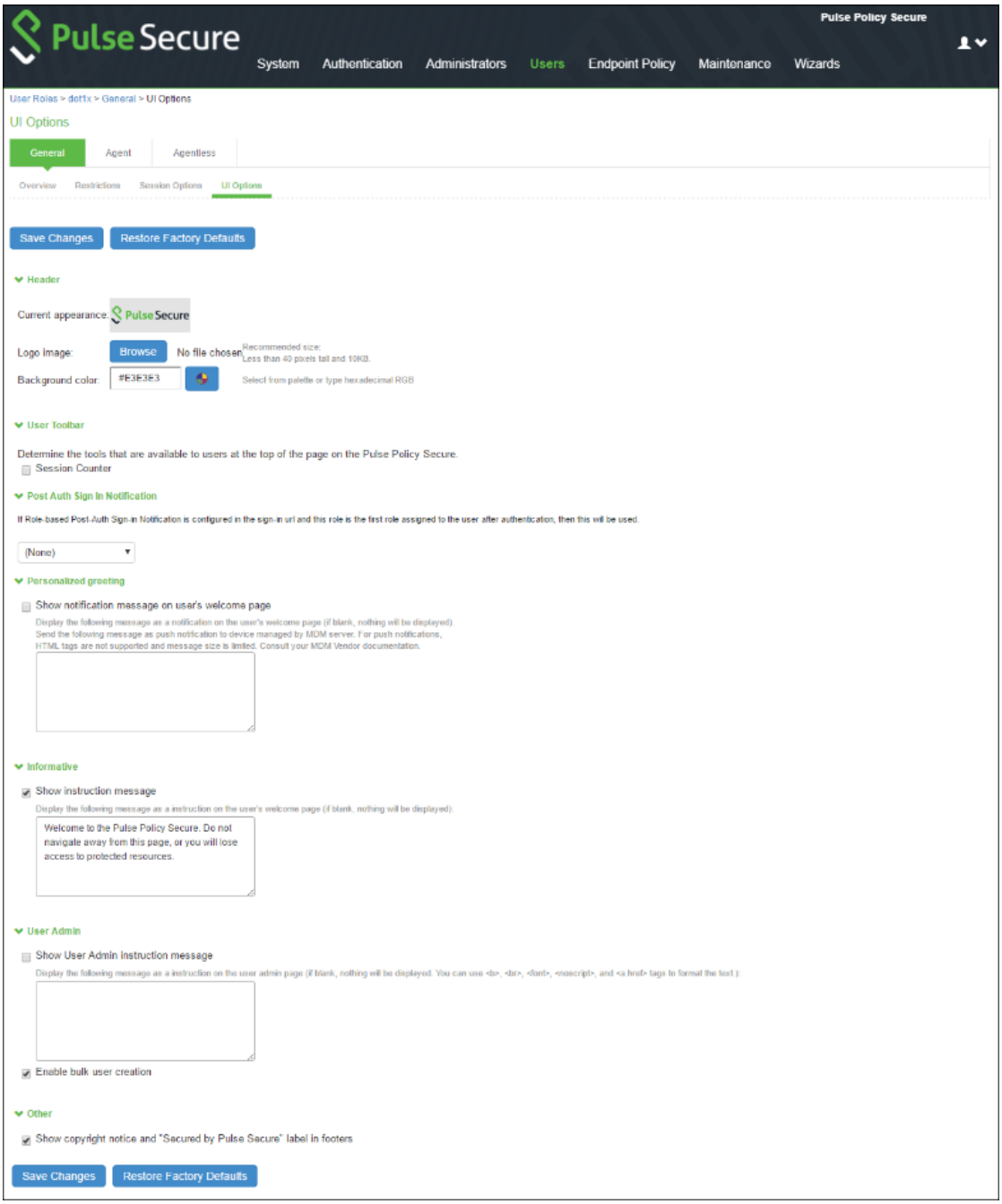
Customizing UI Options

PPS provides options to administrators in customizing the page that gets displayed to the end users during sign-in process. These customization options are applied based on the list of user roles that are getting assigned to the end user. Using these options, administrators can change the logo, background and the welcome message that gets displayed to the end users during the sign-in process.

To customize the welcome page:

1. Select **Users > User Roles > Role Name > General > UI Options**.

Figure 5: User Roles UI Options



2. (Optional) Under **Header**, specify a custom logo and alternate background color for the header area of the welcome page:
   - Click **Browse** and locate your custom image file. The new logo is displayed in the **Current appearance** box only after you save your changes.
   - Type the hexadecimal number for the background color, or click the Color Palette icon and select a color. The Current appearance box updates immediately.
3. Under **User Toolbar**, select the Session Counter check box to display both a session countdown timer and an Extend button that allows agentless users to extend their session time to the maximum session length if the Enable Session Extension option is selected.
4. (Optional) Under **Post-Auth Sign-In Notification**, select a post authentication message that you configured earlier. If you select this option, the user receives an information page (for example, an end-user license agreement [EULA]) that you have created.
5. (Optional) Under **Personalized greeting**, select the Show notification message check box, and enter a message in the associated text box. The message is displayed as a header on the welcome page after the user is authenticated. You can format text and add links using the following HTML tags: <i>, <b>, <br>, <font>, and <a href>. This information does not appear on the initial sign-in page that is displayed prior to authentication. You can also use system variables and attributes in this field. The length of the personalized greeting cannot exceed 12K, (12288 characters). If you use unsupported HTML tags in your custom message, the system might display the user's home page incorrectly.
6. (Optional) Under **Informative**, select the Show instruction message check box and specify any instructions to appear on the welcome page. For example, you could advise users of company privacy notices or usage restrictions, or you can link to another site for more information.
7. If you include a link to an external website, a warning message appears informing the user of loss of access privileges if they leave the current page. To avoid this, add a tag for opening links in a new browser window.

For example: Google displays the linked text "Google," and the link opens in a new browser window.

The instruction message supports non-English languages.

8. (Optional) Under **User Admin**, select the Show User Admin instruction message checkbox and specify any instructions to appear on the user admin page. Select Enable bulk user creation to create bulk user accounts for numerous users.
9. (Optional) Under **Other**, specify whether to display the copyright notice and label in the footer. This setting applies only to users whose license permits disabling the copyright notice. For more information about this feature, call Pulse Secure Support.
10. (Optional) Click **Restore Factory Defaults** to reset all user-interface options back to factory defaults.
11. Click **Save Changes**.

Note:

- If a user maps to more than one role, then the system displays the user interface settings that correspond to the first role to which the user is mapped.
- Sign-in pages can also be customized using the Custom Sign-In page functionality. For more information, see Configuring Custom Sign-In Pages.

Customizing the Session Options

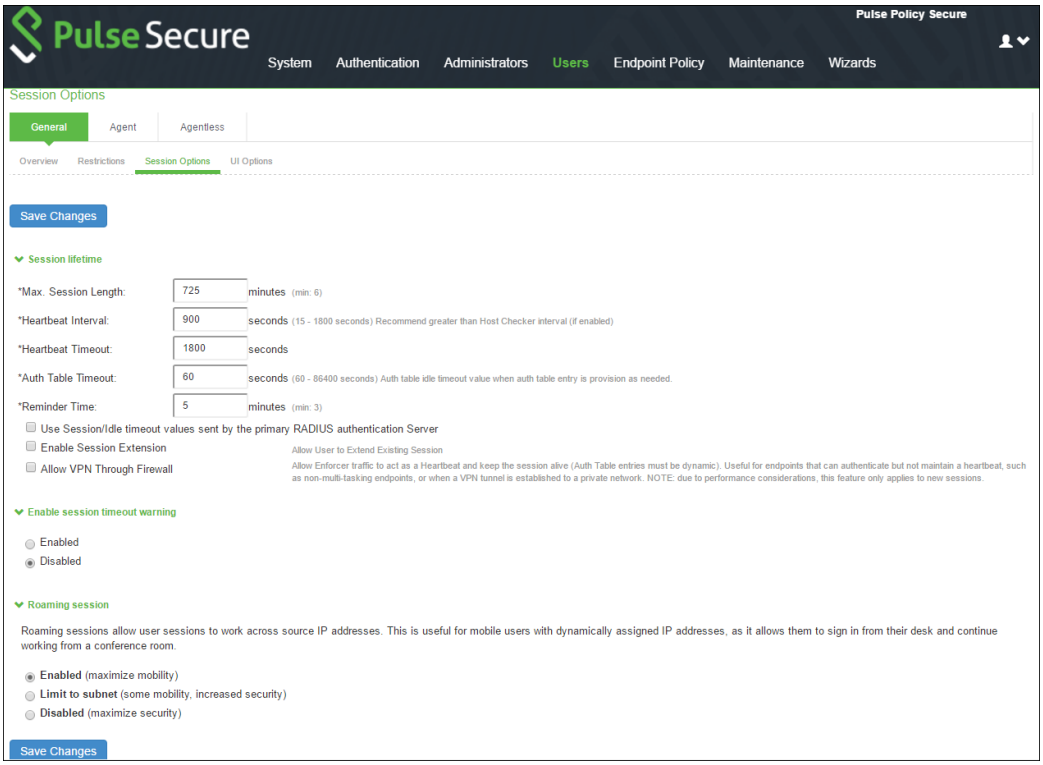
PPS provides option to administrators for configuring the maximum session length and heartbeat interval for the end user sessions. Using these options Administrators can control how long the user sessions are allowed and the interval within which server should receive heartbeat from client device.

PPS also provides option to enable session roaming so that mobile users can continue to have the connection with server while roaming.

To specify general session options:

1. Select **Users > User Roles > Role Name > General > Session Options**.

Figure 6: Session Options



2. For **Max. Session Length**, specify the number of minutes an active non-administrative user session can remain open before ending. The minimum is 6 minutes. The maximum is 725 minutes.

3. For **Heartbeat Interval**, set the frequency at which the endpoint sends out a heartbeat to PPS to keep the session alive. For agentless access, the browser refreshes the page with every heartbeat.

4. For Heartbeat Timeout, specify the amount of time the system should “wait” before terminating a session when the endpoint does not send a heartbeat response.

5. For Auth Table Timeout, enter a timeout value for the auth table entry to be provisioned as needed. This parameter allows you to specify how long a user with no activity (for example, a user reading a static web page), can remain in the auth table before the auth table entry is cleared by the Infranet Enforcer.

6. Enter the reminder time in minutes.

7. Guest users (users created by guest user account managers) can log in with their guest account, and then tunnel into their corporate Virtual Private Network (VPN). In this case, the heartbeat connection to PPS is lost, and the user is disconnected after the heartbeat timeout expires. To prevent this, use firewall traffic as the heartbeat by selecting the **Allow VPN Through Firewall** check box.

This feature applies only to new sessions.

Note:

- When the “Disable use of **Allow VPN Through Firewall** check box is not checked (the default setting), AJAX requests are sent to the PPS at the configured interval. If the Use Traffic as Heartbeats option is enabled, AJAX heartbeat errors are masked.
- If a guest user is assigned two roles, and one of the roles has a Host Checker policy and one doesn't, the user loses the role with the Host Checker policy if the Host Checker policy expires while the user is accessing a VPN through a tunnel. The user will lose access to the resources associated with the Host Checker role.

8. For agentless users, you can select the **Enable Session Extension** check box to allow users with a Layer 2 or Layer 3 connection to continue a session beyond the maximum session length.

   If this feature is enabled, users with agentless access can be reauthenticated and extend their current session without interruption.

   When the user session nears the end of maximum session length, a pop up a new sign-in page for agentless. When the user enters credentials, Host Checker verifies that the user is still compliant and the session continues.

   When the user extends the session before its expiration, the session time is restored to the original maximum session length time that you have specified for the role, and the log indicates the new session time. If the user fails to extend the session before session time expires, the session is terminated.

   For agentless access, you must select the Session Counter option on the UI Options tab to enable the session timer.

   Under Enable Session timeout warning, specify:

   - **Enabled**—To enable expiration warning for users using Pulse Client.
   - **Disabled**—To disable expiration warning message.

9. Under Roaming session, specify:

   - **Enabled**—To enable roaming user sessions for users mapped to this role. A roaming user session works across source IP addresses, which allows mobile users (laptop users) with dynamic IP addresses to sign in from one location and continue working from another. Disable this feature to prevent users from accessing a previously established session from a new source IP address. This prevents the spoofing attack on the user’s session.
   - **Limit to subnet**—To limit the roaming session to the local subnet specified in the Netmask box. Users may sign in from one IP address and continue using their sessions with another IP address if the new IP address is within the same subnet.
   - **Disabled**—To disable roaming user sessions for users mapped to this role. Users who sign in from one IP address may not continue an active session from another IP address. User sessions are tied to the initial source IP address.

   Note: You must enable roaming for roles that are created for security policies that classify sessions into VLANs, for example, VLANs that have been provisioned for Users or Remediation. A session stores the client IP address. If the session gets placed in a different VLAN transition, the control channel is re-established, and a new IP address is sent to the server. If the remediation role does not have roaming enabled, the server terminates the session. This can lead to repeated problems. When the session is terminated, it causes a new log on, which reconnects to the same session, resulting in the same

roaming problem. The Pulse client sets a connection roaming error and logs the server FATAL_ERROR message.

10. Click **Save Changes**.

Configuring Role Restrictions

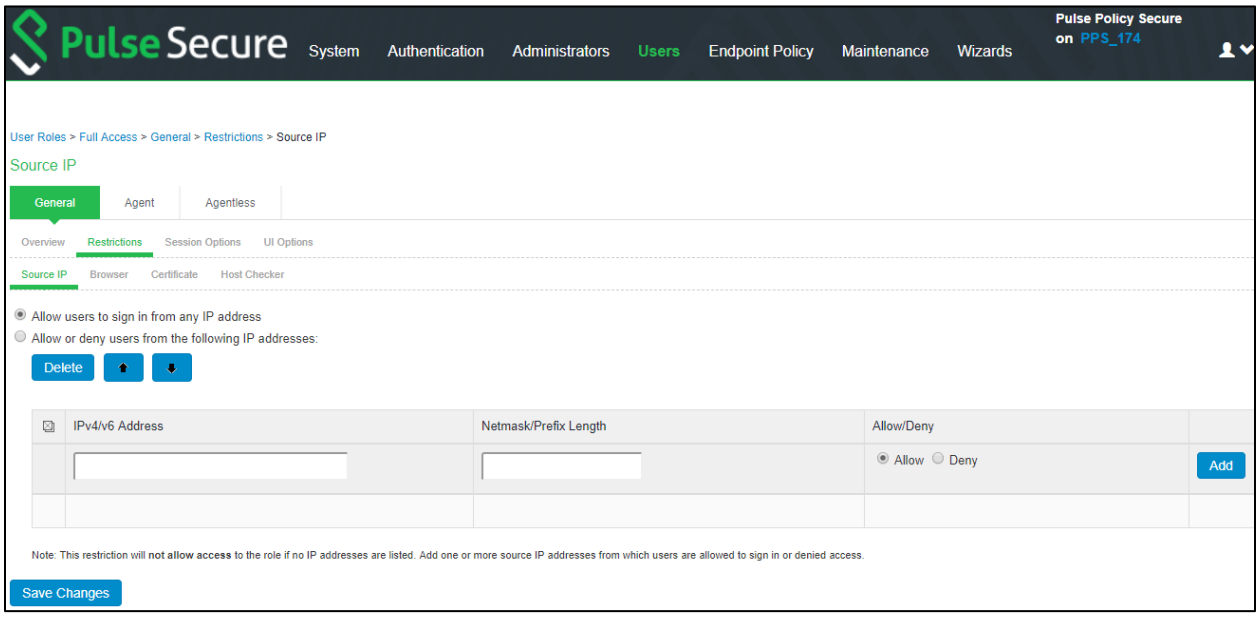
The role restrictions allow only a valid user to access the network and prevents unauthorized access. You can specify security requirements based on source IP address, certificate, browser type, and Host Checker policies. If the user does not meet the requirements specified in the restriction, then the user is not allowed to access the protected resource.

Source IP Access Restriction

Use a source IP restriction at the role to control from which IP addresses users can access a sign-in page. You must specify one or more IP addresses otherwise; no IP address restriction applies.

To enable Source IP access restriction:

1. Select **Users > User Roles > Select Role > General > Restrictions > Source IP**.
2. Assign the Source IP restrictions on roles.
   - **Allow users to sign-in from any IP address**- You can allow or deny access to any IP address/netmask combination. For example, you can deny access to all users on a wireless network (10.64.4.100), or you can allow access to all other network users (0.0.0.0).
   - **Allow or deny users from following IP address**- Enter the IPv4/IPv6 address, network/prefix length and choose whether to allow or deny access. Click **Add**.
3. Click **Save Changes**.

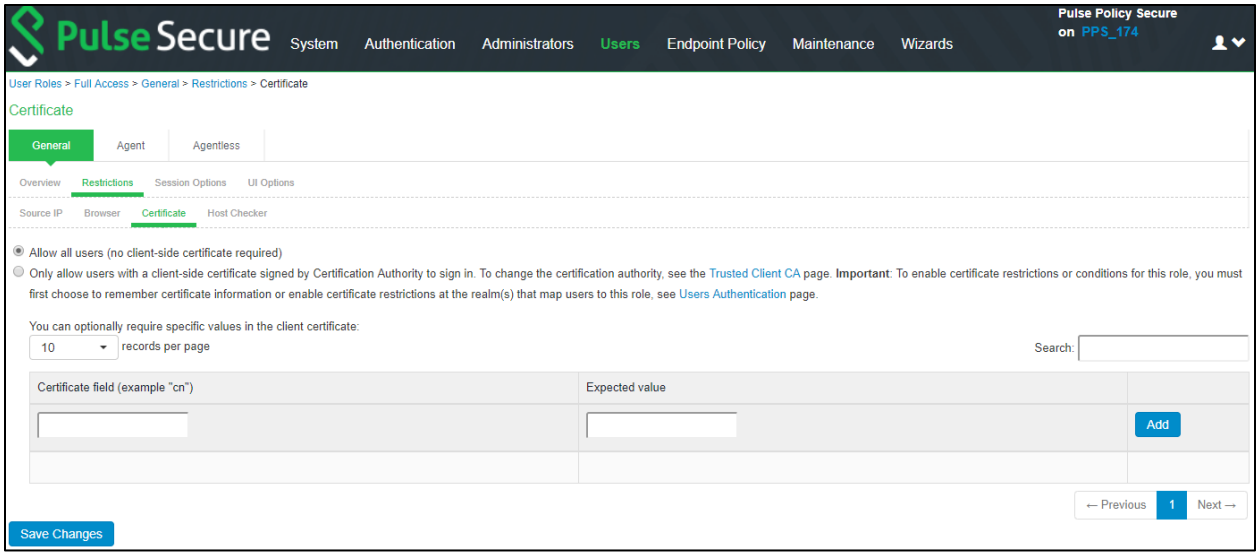


Certificate Access Restriction

Certificate access restriction restricts access only to clients that have a client-side certificates. You can further restrict access using specific certificate attribute and value pairs.

To enable certificate access restriction:

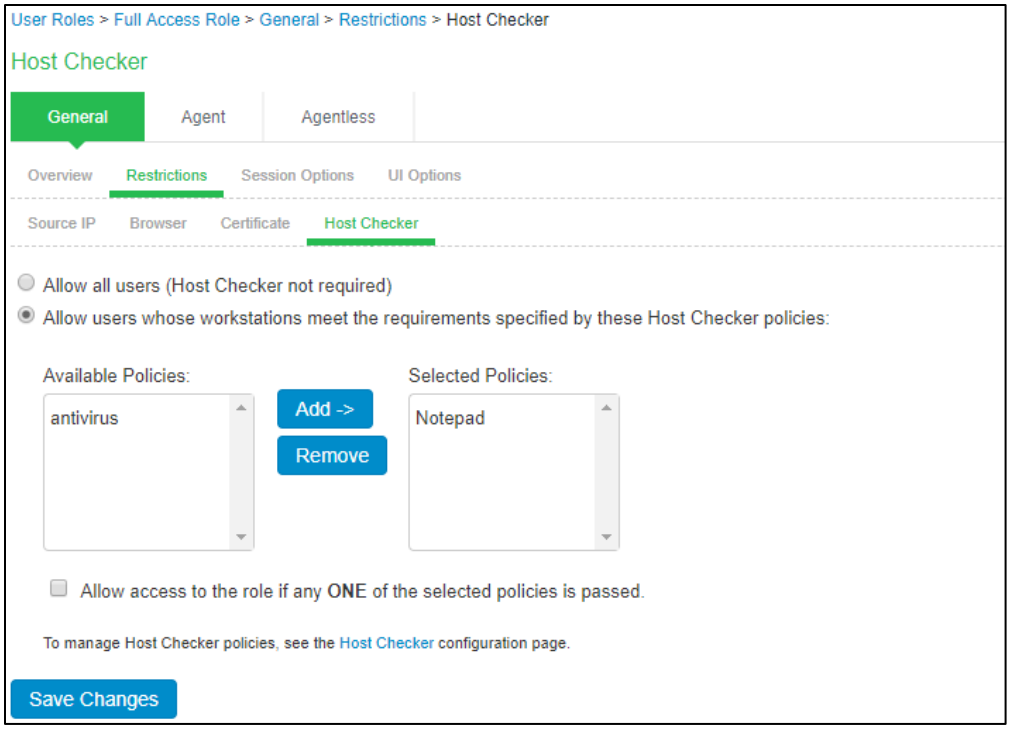
1. Select **Users > User Roles > Select Role > General > Restrictions > Certificate**.
2. Select the **Only allow users with a client certificate signed by Certificate Authority (CA)**.
3. Create a field/value pair check based on attributes within the client certificates. Enter the “Certificate field” and the expected value. Click **Add**. The value in the field depends on the naming attributes in the Relative Distinguished Name(RDN) in the subject DN of the certificate.
   For example, if the subject DN is cn=user1, uid=uid1, sn=lastname, E=user1@sample.net, OU=QA, O=company, C=US, you can use ‘cn’, ‘uid’, ‘sn’, ‘E’, ‘ou’, ‘o’, ‘c’.
4. Click **Save Changes**.



Host Checker Restrictions

To specify Host Checker restrictions:

1. Select **Users > User Roles > Select Role > General > Restrictions > Host Checker**.
2. Select **Allow only users whose workstations meet the requirements specified by these Host Checker policies** to apply HC restrictions.
3. Select the Host Checker policy from the Available Policies list and click **Add**.
4. Select the Allow access to role if any ONE of the selected policies is passed check box if you do not want to require users to meet all of the requirements in all of the selected policies.
5. Click **Save Changes**.



Browser Restriction

To specify browser restrictions:

1. Select **Users > User Roles >** Select Role > **General > Restrictions > Browser.**
2. Select **Only allow users matching the following user-agent policy** to define browser access control rules.

To create a rule:

a. For the **user-agent** string pattern, enter a string in the format *<browser_string>*
where asterisk (*) is an optional character used to match any character and <browser_string> is a case-sensitive pattern that must match a substring in the user-agent header sent by the browser. You cannot include escape characters (\) in browser restrictions.

b. Select either:

• **Allow** to allow users to use a browser that has a user-agent header containing the <browser_string> substring.

• **Deny** to prevent users from using a browser that has a user-agent header containing the <browser_string> substring.

c. Click **Add**.

3. Click **Save Changes**.

Rules are applied in order, so the first matched rule applies. Literal characters in rules are case sensitive, and spaces are allowed as literal characters. For example, the string *Opera* matches any user-agent string that contains the substring Opera.

Authentication Realm

An authentication realm defines the authentication server with which end user is authenticated and the list of restrictions that must be satisfied on the client machine during sign-in. It also provides role mapping option to administrators for configuring the list of roles that needs to be assigned to the user. Role mapping provides flexibility to administrators in configuring how different set of roles need to be assigned to the user.

This section covers the following topics:

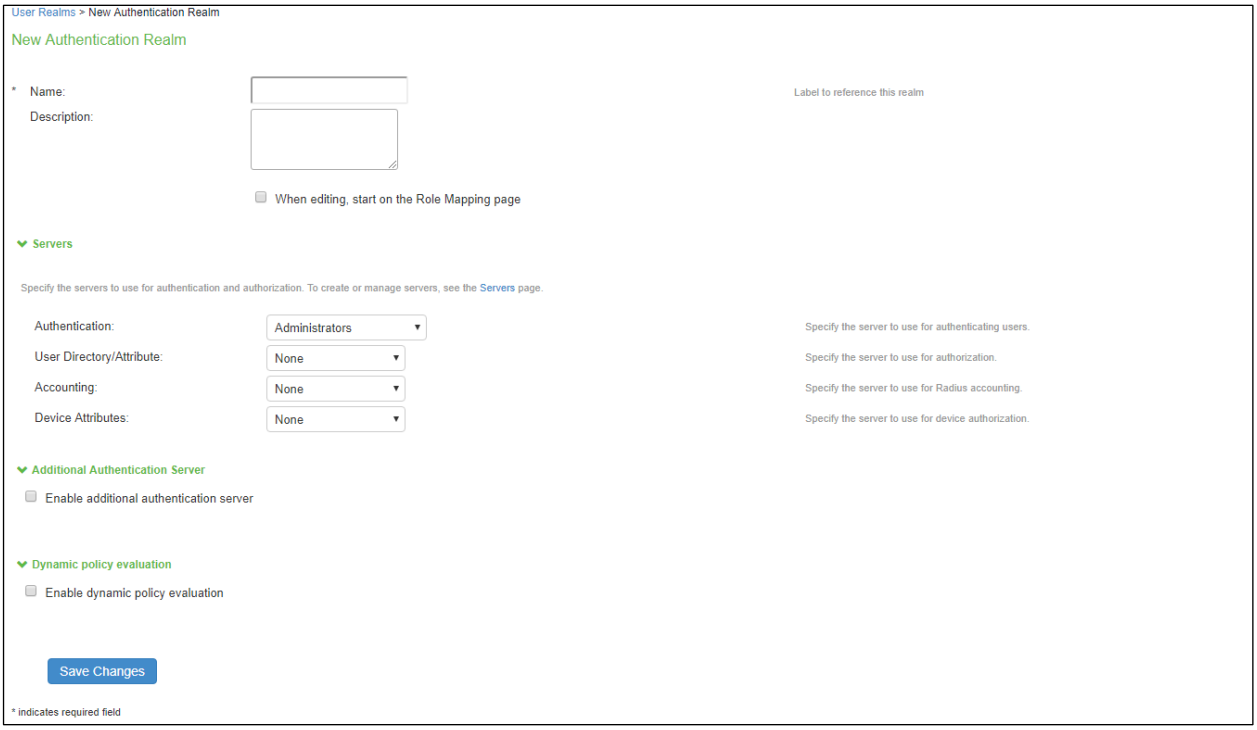
- Creating an Authentication Realm
- Configuring Admin/User Realm to associate an additional Authentication Server
- Configuring Realm Restrictions
- Configuring Role Mapping
- User Role Evaluation

Creating an Authentication Realm

To create an authentication realm:

1. Select **Administrators > Admin Realms** or **Users > User Realms**.
2. On the respective Authentication Realms page, click **New.**

Figure 7: Authentication Realm



3. Enter a name to label this realm and, optionally, a description.
4. Select **When editing, start on the Role Mapping page** if you want the Role Mapping tab to be selected when you open the realm for editing.
5. Under Servers, specify:
   - An authentication server to use for authenticating users who sign in to this realm.
   - (Optional) A directory/attribute server to use for retrieving user attribute and group information for role-mapping rules and resource policies.
   - (Optional) A RADIUS accounting server to use to track when a user signs in and out.
   - Device attributes server to use the device attributes.
6. If you previously selected a RADIUS server for Authentication, the RADIUS Proxy option buttons appear. Select **Proxy Outer Authentication** or **Proxy Inner Authentication** to allow the system to proxy EAP authentication methods. Select **Do not proxy** if you do not want to use RADIUS proxy.
7. Select Enable additional authentication server to specify an additional authentication server.
8. To use dynamic policy evaluation for this realm, select **Dynamic policy evaluation** to enable an automatic timer for dynamic policy evaluation of this realm's authentication policy, role-mapping rules, and role restrictions. Then:
   - Select the **Refresh interval** option to specify how often to perform an automatic policy evaluation of all currently signed in realm users. Specify the number of minutes (5 to 1440).
   - Select **Refresh roles** to refresh the roles of all users in this realm. (This option does not control the scope of the **Refresh Now** button.)
   - Select **Refresh resource policies** to also refresh the resource policies (not including Meeting and e-mail Client) for all users in this realm. (This option does not control the scope of the Refresh Now button.)
   - Click **Refresh Now** to manually evaluate the realm's authentication policy, role-mapping rules, role restrictions, user roles, and resource policies of all currently signed-in realm users. Use this button if you make changes to an authentication policy, role-mapping rules, role restrictions, or resource policies and you want to immediately refresh the roles of this realm's users.

- To use session migration for endpoints with the Pulse client, select the **Session Migration** check box. Then enter the Authentication Group and specify whether you want to receive user attributes from IF-MAP or from a directory server. Note that you must also configure IF-MAP Federation for all of PPS nodes in a session migration network.
- Click **Save Changes** to create the realm. The General, Authentication Policy, and Role Mapping tabs for the authentication realm appear.

9. Perform the next configuration steps:

   - Configure one or more role-mapping rules.
   - Configure an authentication policy for the realm.
   - After you configure the authentication realm, select **Authentication > Signing In > Sign-in Policies**, add the realm to a sign-in policy, and associate the realm with an authentication protocol set.

Configuring Admin/User Realm to associate an additional Authentication Server

To configure a user realm:

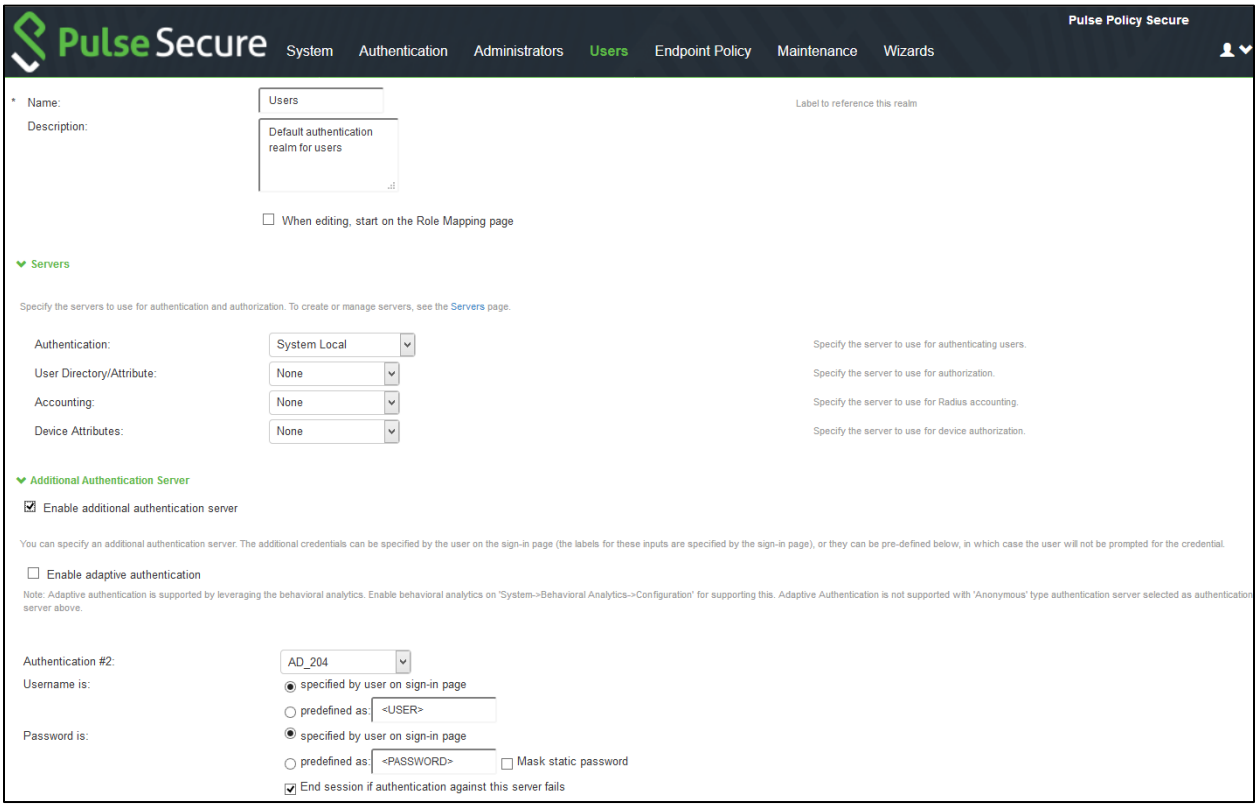
1. Select **Users > User Realms > New User Realm**.
2. Complete the settings for the user-realm.
3. Under **Additional Authentication Server**, select the **Enable additional authentication server** option.
4. Select any already created authentication-server from the Authentication #2 dropdown.
5. Specify the username and password.

   Username: Specified by user on the sign-in page/Predefined as <*USER*>

   Note: Configure Predefined as <*NTUSER*> if Primary Authentication server is AD server.

   Password: Specified by user in sign-in page options/Predefined as <*PASSWORD*>/Mask static password.
6. Click **Save Changes**.

   Figure: Configuring Admin/User Realm to associate an additional authentication Server



Note: Certificate Auth Server and SQL Auth Server are currently not supported as secondary authentication server.

Configuring Realm Restrictions

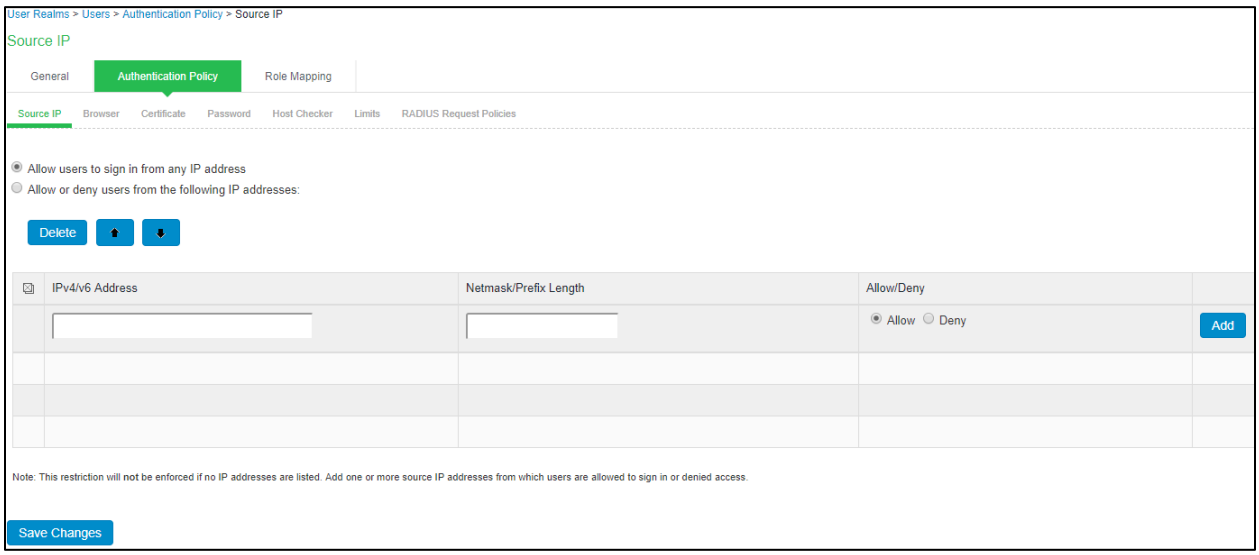
Source IP Access Restriction

Use a source IP restriction at the realm to control from which IP addresses users can access a sign-in page.

To enable Source IP access restriction:

1. Select **Users > User Realm >** Select Realm **> Authentication Policy > Source IP**.

2. Select one of the following options:
   - **Allow users to sign-in from any IP address**- You can allow or deny access to any IP address/netmask combination. For example, you can deny access to all users on a wireless network (10.64.4.100), or you can allow access to all other network users (0.0.0.0).
   - **Allow or deny users from following IP address**- Enter the IPv4/IPv6 address, network/prefix length and choose whether to allow or deny access. Click **Add**.
3. Click **Save Changes**.

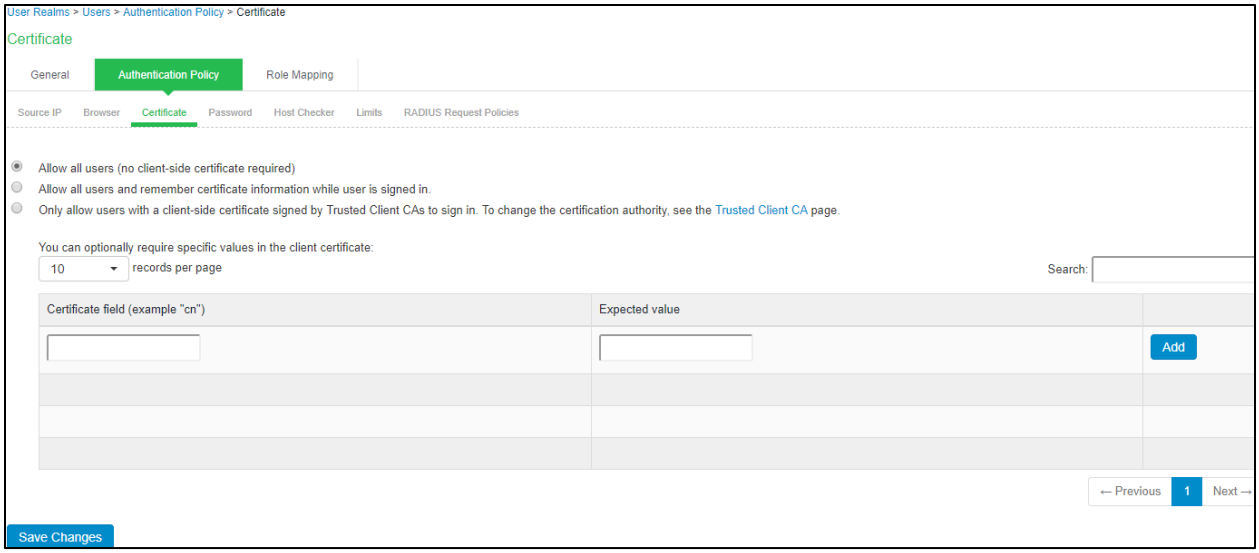


Certificate Access Restriction

Certificate access restriction restricts access only to clients that have a client-side certificates. You can further restrict access using specific certificate attribute and value pairs.

To enable certificate access restriction:

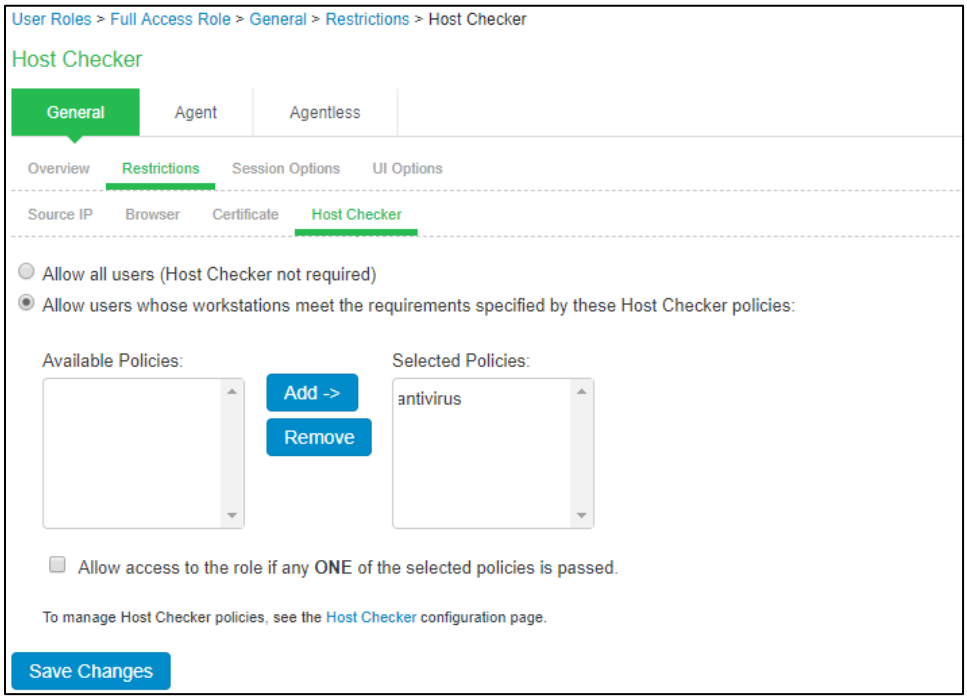
1. Select **Users > User Realms >** Select Realm **> Authentication Policy > Certificate**.
2. Select one of the following options:
   - **Allow all users**- Requires no client certificate.
   - **Allow all users and remember certificate information while user is signed in.** –Client certificate information is saved.
   - **Only allow users with a client certificate signed by Certificate Authority (CA)**. –Requires client certificate signed by CA.
3. Create a field/value pair check based on attributes within the client certificates. Enter the “Certificate field” and the expected value. Click **Add**. The value in the field depends on the naming attributes in the Relative Distinguished Name(RDN) in the subject DN of the certificate.
   For example, if the subject DN is cn=user1, uid=uid1, sn=lastname, E=user1@sample.net, OU=QA, O=company, C=US, you can use ‘cn’, ‘uid’, ‘sn’, ‘E’, ‘ou’, ‘o’, ‘c’.
4. Click **Save Changes**.



Host Checker Restrictions

To specify Host Checker restrictions:

1. Select **Users > User Roles > Select Realm > General > Restrictions > Host Checker**.
2. Select **Allow users whose workstations meet the requirements specified by these Host Checker policies** to apply HC restrictions.
3. Select the Host Checker policy from the Available Policies list and click **Add**.
4. Select the Allow access to role if any ONE of the selected policies is passed check box if you do not want to require users to meet all of the requirements in all of the selected policies.
5. Click **Save Changes**.



Browser Restriction

To specify browser restrictions:

1. Select **Users > User Realms >** Select Realm > **Authentication Policy > Browser.**
2. Select **Only allow users matching the following user-agent policy** to define browser access control rules.

To create a rule:

a. For the **user-agent** string pattern, enter a string in the format *<browser_string>*
where asterisk (*) is an optional character used to match any character and <browser_string> is a case-sensitive pattern that must match a substring in the user-agent header sent by the browser. You cannot include escape characters (\) in browser restrictions.

b. Select either:

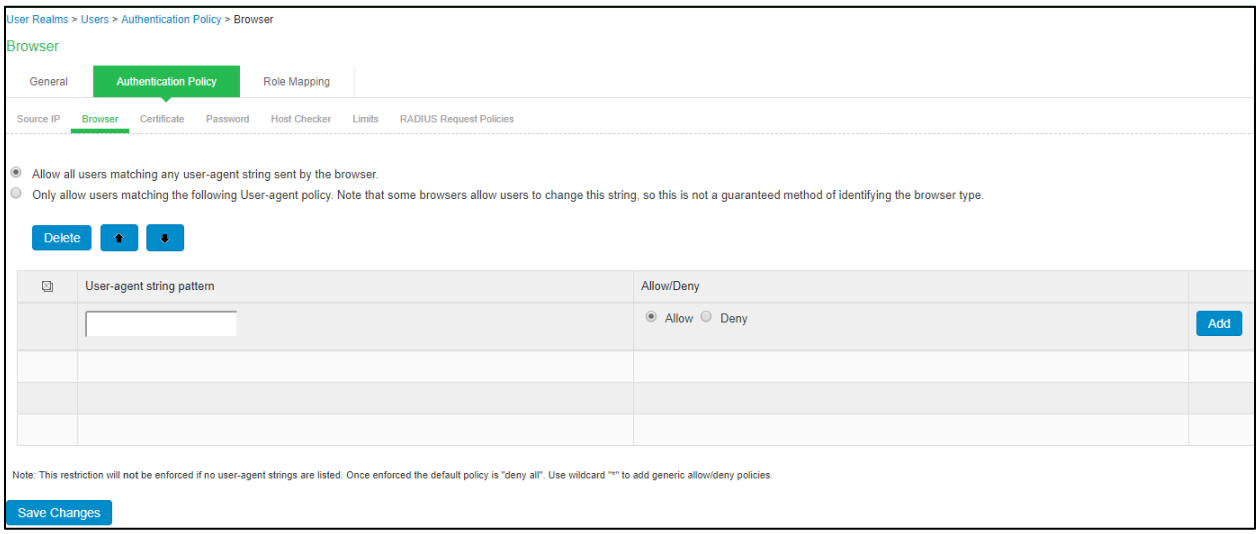
• **Allow** to allow users to use a browser that has a user-agent header containing the <browser_string> substring.

• **Deny** to prevent users from using a browser that has a user-agent header containing the <browser_string> substring.

c. Click **Add**.

3. Click **Save Changes**.

Rules are applied in order, so the first matched rule applies. Literal characters in rules are case sensitive, and spaces are allowed as literal characters. For example, the string *Opera* matches any user-agent string that contains the substring Opera.



Password Access Restriction

You can restrict network and resource access by password-length when administrators or users try to sign in. The user must enter a password whose length meets the minimum password-length requirement specified for the realm. Note that local user and administrator records are stored in the local authentication server. This server requires that passwords are a minimum length of 6 characters, regardless of the value you specify for the realm's authentication policy.

To specify password restrictions:

1. Select **Users > User Realms >** Select Realm > **Authentication Policy > Password.**

2. Select one of the following options:

- **Allow all users (passwords of any length)** — Does not apply password restrictions on password length.
- **Only allow users that have passwords of a minimum length** — Requires the user to enter a password with a minimum length that you specify.

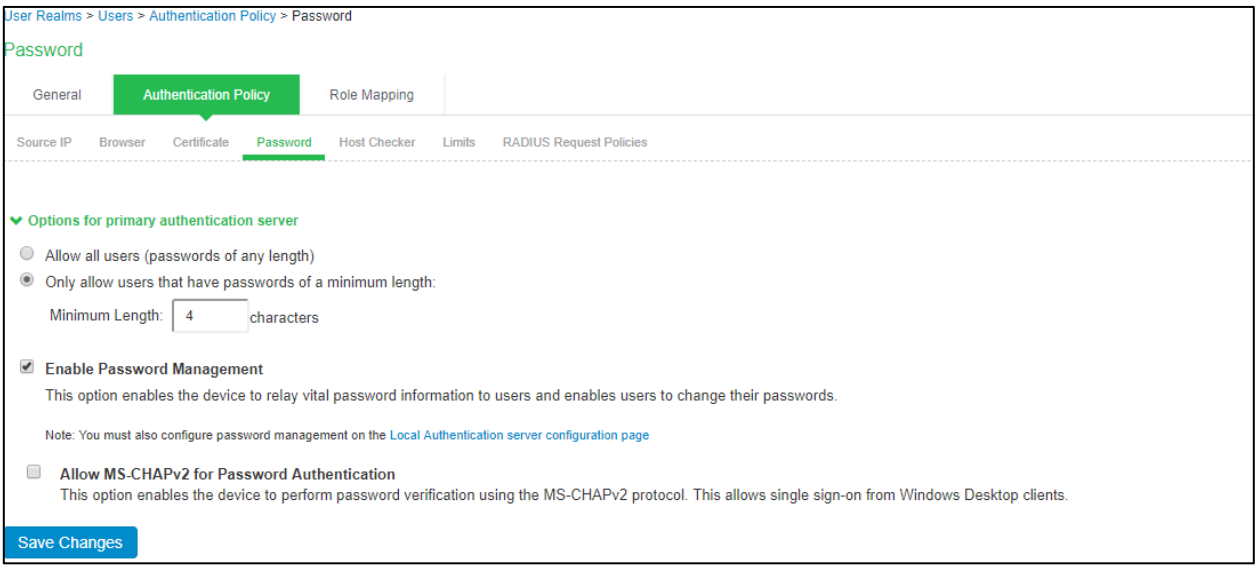
3. Select **Enable Password Management** to enable password management.

   You must also configure password management on the authentication server configuration page (local authentication server) or through an LDAP server.

4. Select **Allow MS-CHAPv2 for Password authentication** to perform password authentication using MS-CHAPv2 prtotocol to allow single sign-on for Windows desktop clients.

5. Click **Save Changes**.

   By default, the system requires that user passwords entered on the sign-in page be a minimum of four characters. The authentication server used to validate a user's credentials might require a different minimum length. For example, the local authentication database requires user passwords to be a minimum length of six characters.



Limits

To limit the number of simultaneous sessions:

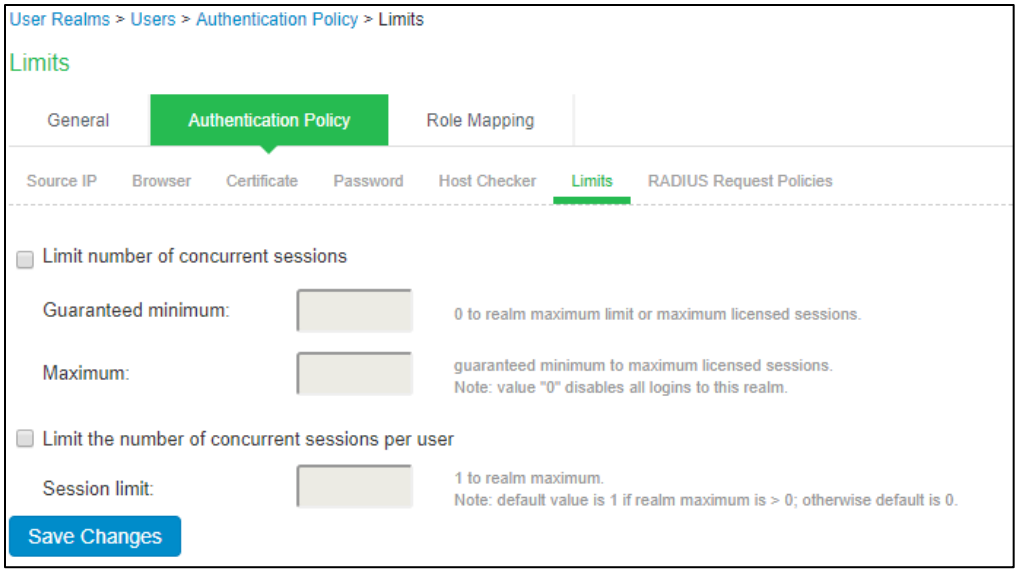
1. Select **Users > User Realms** > Select Realm > **Authentication Policy > Limits**.

2. To limit the number of concurrent sessions, select the check box for Limit number of concurrent sessions, and type either a Guaranteed minimum and/or Guaranteed maximum.

3. To limit the number of sessions for users, select Limit the number of concurrent sessions for users.

4. Specify the number of sessions permitted for users in the Session Limit text box. By default, the number is 1 if the realm maximum is greater than 0; otherwise, the default is 0. The maximum number must be no greater than the maximum number of concurrent users for the realm.

5. Click **Save Changes**.



RADIUS Request Policies

You can create RADIUS request attribute policies to require authentication requests to contain specific RADIUS attribute values. If an endpoint attempts to access a realm with a RADIUS request attribute policy, the endpoint must meet the conditions specified in the policy.

To add a RADIUS request attribute policy to a realm:

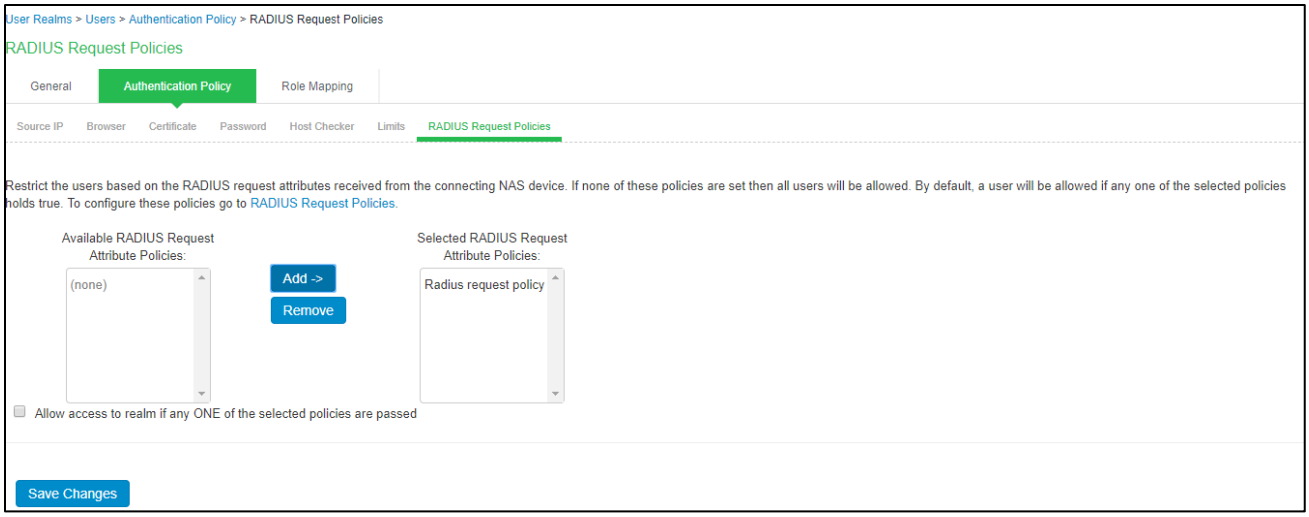
1. Select a user realm on which you want to implement a RADIUS request attributes policy by selecting **Users > User Realms** > Select Realm **> Authentication Policy > RADIUS Request Policies**.

2. Click **Add** to populate the Selected RADIUS Request Attributes Policies list from the available RADIUS Request Attribute Policies.

The RADIUS request policies selected must be passed to allow users to access a realm. To configure RADIUS request policies, see here.

Select the Allow access to realm if any ONE of the selected policies are passed check box if you would like to allow access if any one of the selected policies is passed.

4. Click **Save Changes**.



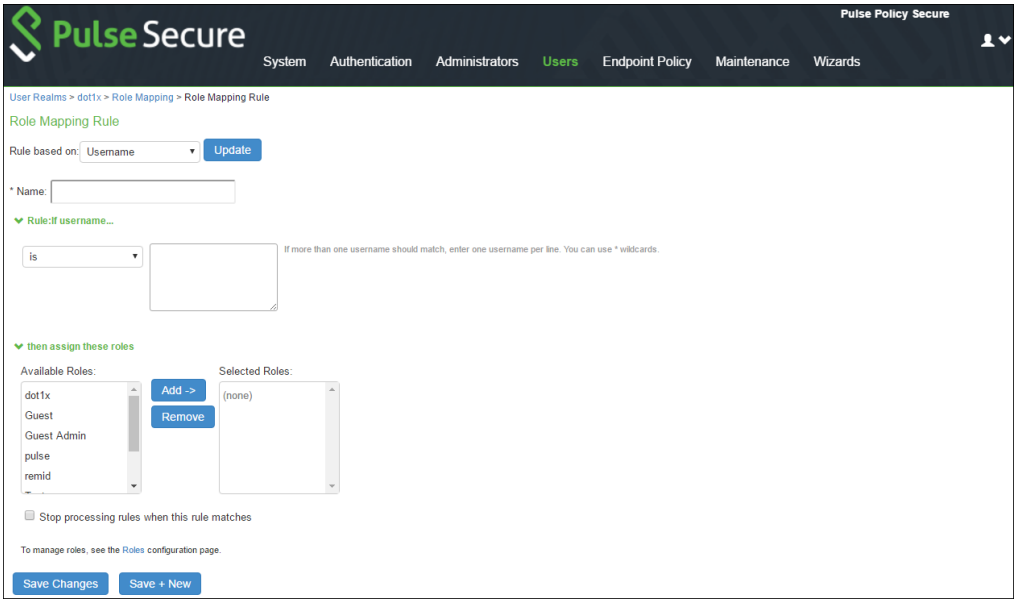
Configuring Role Mapping

Role-mapping rules are conditions a user must meet to map to user roles.

To specify role-mapping rules for an authentication realm:

1. Select **Administrators > Admin Realms, Users > User Realms**.
2. Select a realm and then click the **Role Mapping** tab.
3. Click **New Rule** to access the Role Mapping Rule page. This page provides an inline editor for defining the rule.

   Figure 8: Role Mapping



4. In the Rule based on list, select one of the following:
   - **Username**—The system username entered on the sign-in page. Select this option if you want to map users to roles based on their usernames. If this is a RADIUS realm, and you are using RADIUS proxy for outer authentication, you cannot configure a role-mapping rule with a username.

- **User attribute**—A user attribute from a RADIUS, LDAP, or SiteMinder server. Select this option if you want to map users to roles based on an attribute from the corresponding server. This type of rule is available only for realms that use a RADIUS server for the authentication server, or that use an LDAP or SiteMinder server for either the authentication server or the directory server. After choosing the **User attribute option**, click **Update** to display the Attribute list and the Attributes button. Click the **Attributes** button to display the server catalog.
- **Certificate or Certificate attribute**—Certificate or Certificate attribute is an attribute supported by the users' client-side certificate. Select this option to map users to roles based on certificate attributes. The Certificate option is available for all realms. The Certificate attribute option is available only for realms that use LDAP for the authentication or directory server. After choosing this option, click Update to display the Attribute text box.
- **Group membership**—Group membership is group information from an LDAP or native Active Directory server that you add to the server catalog Groups Tab. Select this option to map users to roles based on either LDAP or Active Directory group information. This type of rule is available only for realms that use an LDAP server for either the authentication server or directory server or that use an Active Directory server for authentication. (Note that you cannot specify an Active Directory server as an authorization server for a realm.)
- **Custom Expressions**—Custom Expressions is one or more custom expressions that you define in the server catalog. Select this option to map users to roles based on custom expressions. This type of rule is available for all realms. After you select this option, click Update to display the Expressions lists. Click the Expressions button to display the Expressions tab of the server catalog.
- Anomaly Attribute—Select this option for behavioral analytics.

5. Under Rule, specify the condition to evaluate, which corresponds to the type of rule you select and consists of the following:

    CAUTION: If you are creating a role mapping rule for a MAC address authentication realm, the attributes list cannot be edited. If there is an LDAP server assigned to this MAC authentication server and you want to use and edit the attributes assigned to that LDAP server, please specify the LDAP server as the Directory/Attribute server.

   - Specifying one or more usernames, SiteMinder user attribute cookie names, RADIUS or LDAP user attributes, certificate attributes, LDAP groups, or custom expressions.
   - Specifying to what the value must equate, which might include a list of usernames, user attribute values from a RADIUS, SiteMinder, or LDAP server, client-side certificate values (static or LDAP attribute values), LDAP groups, or custom expressions.

For example, you can choose a SiteMinder user attribute cookie named "department" from the Attribute list, choose is from the operator list, and then enter "sales" and "eng" in the text box.

Alternatively, you can enter a custom expression rule that references the SiteMinder user attribute cookie named department:

<userAttr.department = ("sales" and "eng")>

6. Under ...then assign these roles:

   - Specify the roles to assign to the authenticated user by adding roles to the Selected Roles list.
   - Select **Stop processing rules when this rule matches** if you want the system to stop evaluating role-mapping rules if the user meets the conditions specified for this rule.

7. Click **Save Changes** to create the rule on the Role Mapping tab. When you finish creating rules, be sure to order role-mapping rules in the order in which you want the system to evaluate them. This task is particularly important when you want to stop processing role-mapping rules when a match is identified.

User Role Evaluation

Administrator can configure the role mapping rules for determining the list of roles that need to be assigned to the users. In case of multiple role assignment, PPS merges the various role settings using permission merge. Administrators can also configure how different rules can be evaluated and merged using the options provided on role mapping rules page.

NOTE: If you assign a role to a RADIUS proxy realm, role restrictions cannot be enforced. Host Checker policies, source IP restrictions, and any other limits that have been assigned are bypassed. Use RADIUS proxy only if no restrictions have been applied. Additionally, outer proxy cannot be used if a role-mapping rule based on usernames is being used, because the system cannot see the username, and a session cannot be created.

A permissive merge is a merge of two or more roles that combines enabled features and settings according to the following guidelines:

- Any enabled access feature in one role takes precedence over the same feature set to disabled in another role. For example, if a user maps to two roles, one of which disables the Host Enforcer while the other role enables the Host Enforcer, the system enables the Host Enforcer for that session.
- In the case of user interface options, the system applies the settings that correspond to the user's first role.
- In the case of maximum session lengths, the system applies the greatest value from all the roles to the user's session.
- If more than one role enables the Roaming Session feature, then the system merges the netmasks to formulate a greater netmask for the session

The system performs the following security checks before creating a session for a role:

1. The system begins rule evaluation with the first rule on the Role Mapping tab of the authentication realm to which the user successfully signs in. During the evaluation, the system determines if the user meets the rule conditions. If so, then:
   - The system adds the corresponding roles to a list of eligible roles available to the user.
   - The system determines if the "stop on match" feature is configured. If so, then the engine proceeds.
2. The system evaluates the next rule on the authentication realm's Role Mapping tab according to the process in Step 1 and repeats this process for each subsequent rule. When the system evaluates all role-mapping rules, it compiles a comprehensive list of eligible roles.
3. The system evaluates the definition for each role in the eligibility list to determine whether the user complies with any role restrictions. The system then uses this information to compile a list of valid roles, whose requirements the user also meets.

   If the list of valid roles contains only one role, then the system assigns the user to that role. Otherwise, the system continues the evaluation process.
4. The system evaluates the setting specified on the Role Mapping tab for users who are assigned to more than one role:
   - **Merge settings for all assigned roles**—If you select this option, the system performs a permissive merge of all the valid user roles to determine the overall (net) session role for a user session.
   - **User must select from among assigned roles**—If you select this option, the system presents a list of eligible roles to an authenticated user. The user must select a role from the list, and the system assigns the user to that role for the duration of the user session.
   - **User must select the sets of merged roles assigned by each rule**—If you select this option, the system presents a list of eligible rules to an authenticated user (that is, rules whose conditions the user has met). The user must select a rule from the list, and the system performs a permissive merge of all the roles that map to that rule.

If you use automatic (time-based) dynamic policy evaluation or if you perform a manual policy evaluation, the system repeats the role evaluation process described in this section.

Sign-in Policies

Sign-in policies define the URL's that any user needs to use for accessing the network. PPS provides support for sign-in URL's for administrators and end users. Administrators can login to PPS using the administrator sign-in URL and configure/monitor the server. The user's login using the user sign-in URL's for connecting to the network. The sign-in URL's are configured with authentication realm so that authentication of the users is performed during the sign-in process. Administrators can also use the custom sign-in pages on the sign-in URL's so that pages displayed for the users are customized.

This section covers the following topics:

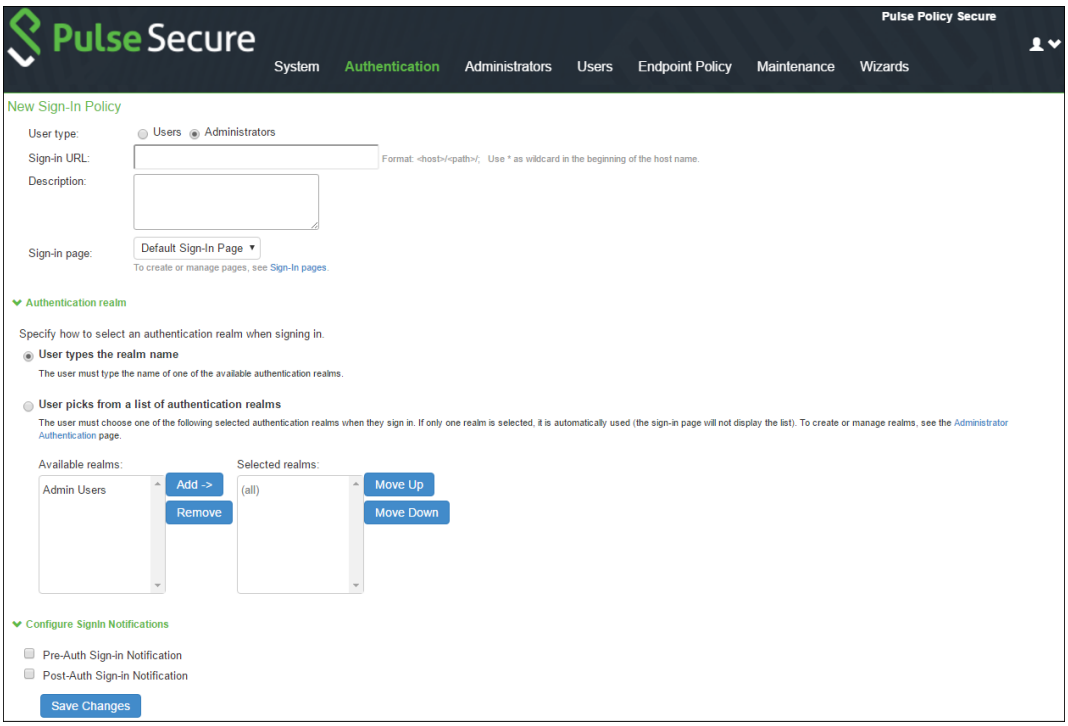
- Configuring Administrator Sign-In Policies
- Configuring User Sign-In Policies
- Associating Authentication Realms and Protocols with User Sign-in Policies

Configuring Administrator Sign-In Policies

To configure administrator sign-in policy:

1. Select **Authentication > Signing In > Sign-in Policies.**
2. To create a new sign-in policy, click **New URL**. To edit an existing policy, click a URL in the **Administrator URLs** or the **User URLs** column.

   Figure 9: Sign-in Policy



3. To create an administrator sign-in policy, select the **Administrators** option button at the top of the page. (By default, the **Users** option button is selected.)
4. In the **Sign-in URL** field, enter the URL to associate with the policy. Use the format <*host*>/<*path*> where <*host*> is the hostname of PPS, and <*path*> is any string users must enter. For example: users1.yourcompany.com/ic. To specify multiple hosts, use the asterisk (*) wildcard character. For instance:

To specify that all administrator URLs must use the sign-in page, enter */admin.

Note: Use wildcard characters (*) only at the beginning of the hostname portion of the URL. The system does not recognize wildcards in the URL path.

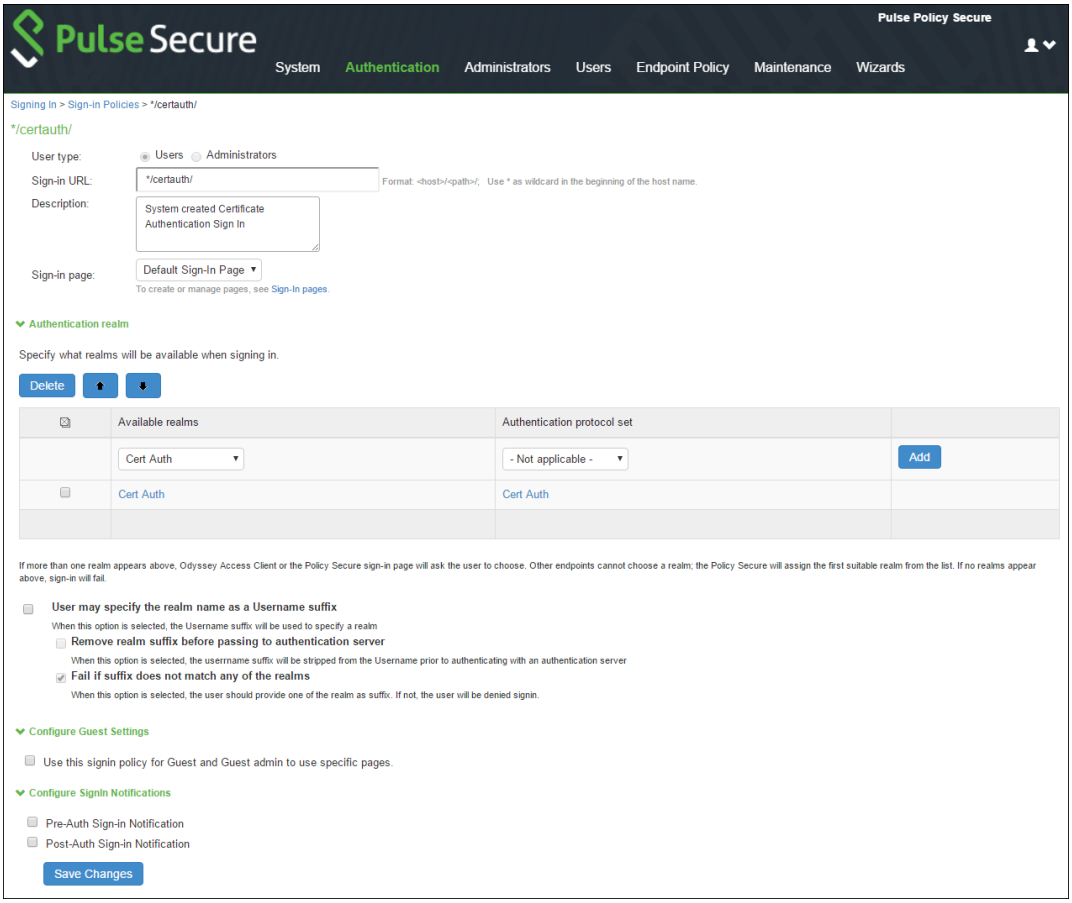
5. (Optional) Enter a **Description** for the policy.
6. From the Sign-in Page list, select the page that you want to associate with the policy. You can select the default page, a variation of the standard sign-in page, or a custom page that you create using the customizable UI feature.
7. For administrator sign-in policies, under Authentication realm, specify which realm maps to the policy, and how users and administrators must choose from among realms. If you select:
   - **User types the realm name**—The system maps the sign-in policy to all authentication realms but does not provide a list of realms from which the administrator can choose. Instead, the administrator must manually enter the realm name into the sign-in page.
   - **User picks from a list of authentication realms**—The system maps the sign-in policy to only the authentication realms that you choose. The system presents this list of realms when the administrator signs in and allows a realm to be chosen from the list. (Note that the system does not provide a list of authentication realms if the URL is mapped only to one realm. Instead, only the realm you specify is displayed).
8. Click the **Add** button to add available realms to the Selected realms box.
9. Click **Save Changes**.

Configuring User Sign-In Policies

To create or configure user sign-in policies:

1. Select **Authentication > Signing In > Sign-in Policies**.
2. To create a new sign-in policy, click **New URL**. To edit an existing policy, click a URL in the **Administrator URLs** or **User URLs** column.

   Figure 10: User Sign-in Policy



3. In the **Sign-in URL** field, enter the URL that you want to associate with the policy. Use the format <*host*>/<*path*>, where <*host*> is the host name of PPS, and <*path*> is any string users must enter. For example: users1.yourcompany.com/ic. To specify multiple hosts, use the asterisk (*) wildcard character. For example, to specify that all end-user URLs must use the sign-in page, enter */.
4. Under **Authentication realm**, specify the realms that must be mapped to the sign-in policy. Under **Available realms**, select realms from the menu. The system maps the sign-in policy only to the authentication realms that you add.
5. Under **Authentication protocol set**, select an authentication protocol set that you have configured previously. If endpoints will connect with a PPS agent, select the default 802.1X protocol set. The protocol set used with a realm must be compatible with the authentication server that is associated with the realm.
6. Click **Add** to add the new realm and authentication protocol pair.
7. Select the **User may specify the realm name as a username suffix** check box to allow non- PPS endpoints to access the system by entering their credentials (in the format *user@realm*).

8. Select the **Remove realm suffix before passing to authentication server** check box for users to enter their credentials with a suffix to send the username without the suffix. Most authentication servers are not compatible with a realm suffix or decorated username.
9. Click **Save Changes**.

Associating Authentication Realms and Protocols with User Sign-in Policies

Different types of endpoints can request authentication through PPS, including PPS agents, third-party 802.1X supplicants (including 802.1X IP phones), switches, and endpoints that request authentication with agentless access.

A PPS agent is software that can use the JUAC protocol. PPS agents include Pulse client, and the Java agent. By default, PPS can communicate with PPS agents, the Java agent, and endpoints with agentless access. To accommodate other types of endpoint clients, you might need to create authentication protocol sets within sign-in policies.

When you add a realm in a sign-in policy, you select an authentication protocol set to be used with that realm. There are two default authentication protocol sets. For PPS agents, use the default 802.1X authentication protocol set. For 802.1X IP phones, use the default 802.1X-Phones protocol set.

Third-party 802.1X supplicants cannot use the preconfigured 802.1X protocol set that is used by default with PPS agents. For example, some switches can request authentication using CHAP or EAP-MD5-Challenge. You must define a specific authentication protocol set for these requests.

To define an endpoint's authentication method, you add authentication realms to sign-in policies. You configure authentication protocol sets as required, based on authentication methods that are compatible with the authentication server that you are using. PPS maps the sign-in policy to the authentication realms that you choose. Users who sign in using the URL that you provide have access only to those realms that you specify.

For non- PPS agents, you must select the protocols that the client and the authentication server are compatible with. See the below table for details of what authentication protocols are compatible with different authentication servers.

Table3: RADIUS Sub-Protocols and Compatible Authentication Servers

Protocols	Authentication Servers					
	Certificate	Local	LDAP	Active Directory	ACE	Mac Auth
EAP-GTC	-	-	-	-	Y	-
PAP	-	Y	Y	Y	Y	-
CHAP, EAP-MD5-Challenge	-	Y	Y	-	-	-
MS-CHAP	-	Y	Y	Y	–	
MS-CHAP-V2, EAP-MS-CHAP-V2	-	Y	Y	Y	-	-
EAP-TLS	Y	-	-	-	-	-
Mac-based auth	-	-	-	-	-	Y
EAP-JUAC	Y	Y	Y	Y	Y	-

Note: For 802.1X, AD authentication server used as LDAP is not supported for the following protocols: MS-CHAP, MS-CHAP-V2, and EAP-MS-CHAP-V2.

The decision of what realms are available to the user within a sign-in policy is based on two factors. First, the order of realms in the list is considered. Realms at the top of the list are attempted. Second, the authentication protocol set that you choose must be compatible with the client or supplicant.

To determine a compatible realm, the system looks for a RADIUS subprotocol that is compatible with the client or supplicant's available protocols, and the system automatically selects compatible realms. If the endpoint is using a Pulse Policy Secure agent, the system presents a list of realms. Any realm with both outer and inner protocols that match the outer and inner protocols on the client is considered compatible.

Protocol compatibility does not guarantee authentication. For example, CHAP and EAP-MD-5 challenge sign-in succeeds only if the stored password is retrievable as clear text. In addition, if the client or supplicant is configured with a non-JUAC protocol (for example, the Windows Vista supplicant), the system searches for a realm without TNC Host Checker restrictions, browser restrictions, or certificate restrictions.

Note: If you are configuring a realm for a Windows client, with a Statement of Health Host Checker policy, you must use an authentication protocol set with the EAP-SOH protocol. When you select EAP-SOH in an authentication protocol set, EAP-SOH is always offered first, regardless of protocol ordering.

If an endpoint is using PPS agent software, the system presents the list of realms to the user or administrator when the user signs in and allows the user to choose a realm from the list. The system does not display a list of authentication realms if the URL is mapped only to one realm. Instead, it automatically uses the realm you specify.

For endpoints that use a non- PPS agent, you can select the **User may specify the realm name as a username suffix** check box. When the user provides a username with a suffix in the format user@realm, the suffix determines the realm assignment. If you do not select this option, the endpoint is assigned to the first realm in the list whose authentication server is a match with the endpoint's software. For example, if the endpoint's software is configured for tokens (EAP-Generic Token Card), and if the sign in policy permits EAP-GTC, the endpoint is assigned the first realm in the list whose authentication server supports tokens.

When an 802.1X IP phone connects through a realm with the 802.1X-Phone protocol set selected, the device is automatically directed to the proper realm for authentication based on the compatible protocol.

If you are using inner or outer RADIUS proxy with a selected realm, routing with respect to authentication protocols is different. PPS forwards all traffic to a proxy target, which rejects protocols it does not support. With an outer proxy realm, PPS ignores the authentication protocol set. For an inner proxy realm, the authentication protocol set directs PPS as it negotiates the outer protocol (EAP-PEAP or EAP-TTLS) but does not affect the inner protocol.

Managing Sign-In Policies

This topic describes how to configure and manage user sign-in policies. It includes the following information:

- Enabling and Disabling Sign-in Policies
- Specifying the Order of Evaluation

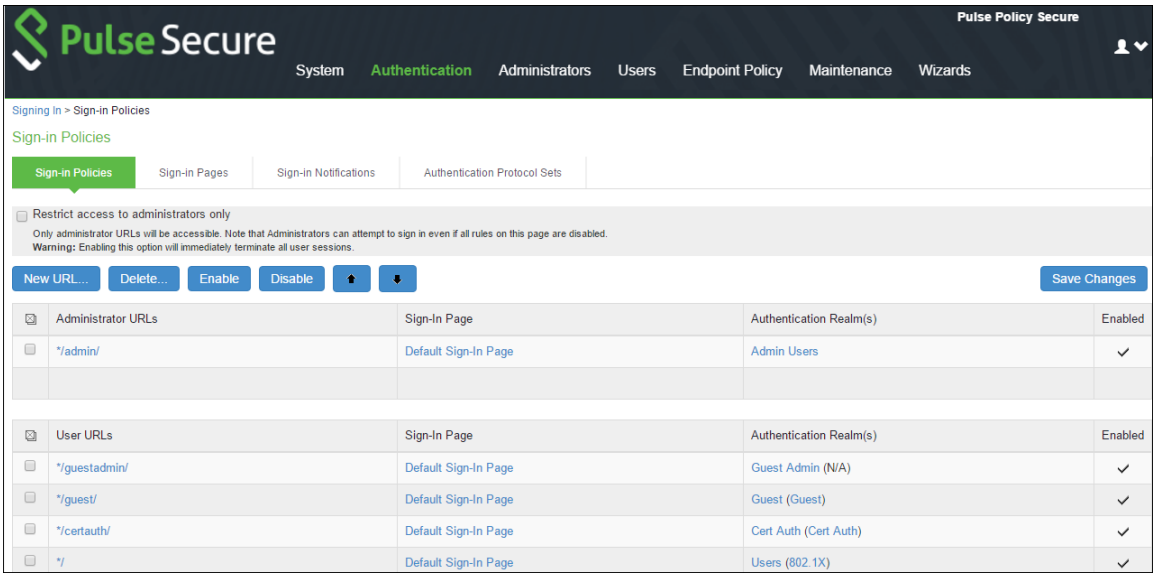
Enabling and Disabling Sign-in Policies

PPS provides an option to control the list of sign-in URL's that can be used by the users for logging into the network. The Administrator can control the list of sign-in URL's that are allowed for sign-in process using enable/disable functionality. Sign-in URLs that are disabled on Pulse Policy Secure cannot be used by the users for connecting to the network.

To enable and disable sign-in policies:

1. Select **Authentication > Signing In > Sign-in Policies**.

   Figure 11: Sign-in Policy Enabling



2. Select the check box for the policy that you want to change then click **Enable** or **Disable** for enabling or disabling an individual policy.
3. Select or clear the **Restrict access to administrators only** check box at the top of the page to enable or disable the policy or all user policies.
4. Click **Save Changes**.

Specifying the Order of Evaluation

The PPS evaluates sign-in policies in the same order that you list them on the Sign-in Policies page. When it finds a URL that matches exactly, it stops evaluating and presents the appropriate sign-in page to the administrator or user. For example, for 2 administrator sign-in policies with different URLs:

- The first policy uses the URL */admin and maps to the default administrator sign-in page.
- The second policy uses the URL yourcompany.com/admin and maps to a custom administrator sign-in page.

If you list the policies in this order on the Sign-in Policies page, the system never evaluates or uses the second policy because the first URL encompasses the second one. Even if an administrator signs in using the yourcompany.com/admin

URL, the system displays the default administrator sign-in page. If you list the second policy first, however, the system displays the custom administrator sign-in page to administrators who access the system using the yourcompany.com/admin URL.

Note that the system accepts only wildcard characters in the hostname section of the URL and matches URLs based on the exact path. For example, two administrator sign-in policies with two different URL paths:

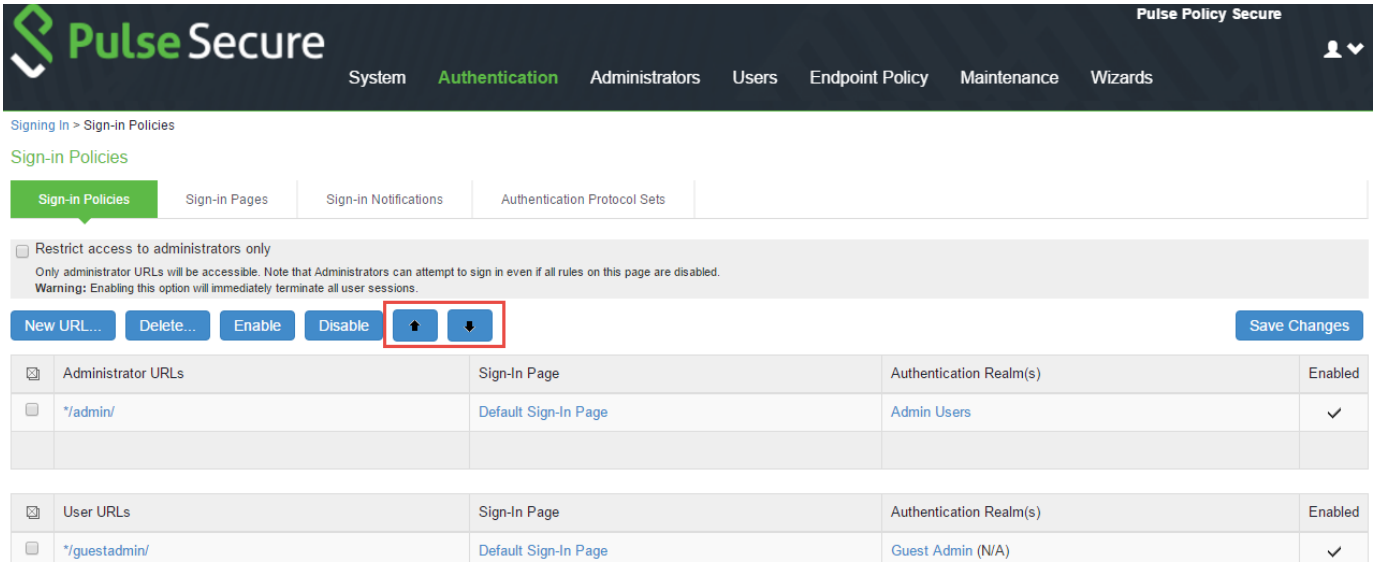
- The first policy uses the URL */marketing and maps to a custom sign-in page for the entire Marketing Department.
- The second policy uses the URL */marketing/joe and maps to a custom sign-in page designed exclusively for Joe in the Marketing Department.

If you list the policies in this order on the Sign-in Policies page, the system displays Joe's custom sign-in page to him when he uses the yourcompany.com/marketing/joe URL to access the system. He does not see the Marketing sign-in page, even though it is listed and evaluated first, because the path portion of his URL does not exactly match the URL defined in the first policy.

To change the order in which administrator sign-in policies are evaluated:

1. Select **Authentication > Signing In > Sign-in Policies**.
2. Select a sign-in policy in the **Administrator URLs** or **User URLs** list.
3. Click the up or down arrow to change the selected policy's placement in the list.
4. Click **Save Changes**.

Figure 12: Evaluation



Configuring Sign-In Notifications

With sign-in notifications, you can create and configure detailed notification messages that appear for Pulse clients and for agentless access endpoints when the user attempts to sign in. For example, you can configure a notification message that explains terms of use, company-specific policies, a welcome page, an end user license agreement (EULA), or a message of the day.

For a browser-based (agentless) log in, the notification message appears in a separate page either before (pre-auth) or after (post-auth) user authentication during the sign-in process. For a Pulse client log in, the notification messages appear in a Pulse message box. The user is expected to read the content of the sign-in notification message and acknowledge by clicking a Proceed button. The user may indicate disagreement by clicking a Decline button, which ends the log in attempt.

You can configure a sign-in policy to use a sign-in notification either as pre-auth or post-auth (or both). In the case of post-auth configuration, you can either use a common message for all roles or use separate messages for each role.

You can create a multi-language sign-in notification package that relies on the language setting of the endpoint. You can customize the sign-in notification page appearance for browser-based log ins by modifying the related fields in a sign-in page in the Admin UI or by using a custom sign-in page.

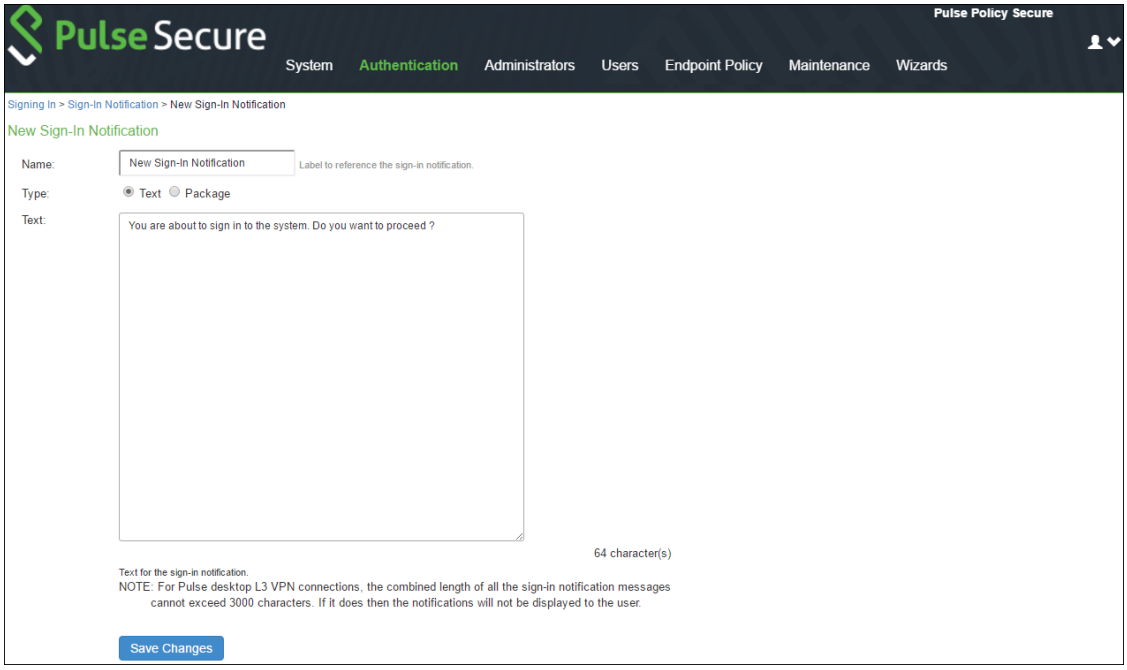
Configuring and Implementing Sign-In Notifications

Sign-in notifications appear for Pulse client and for browser-based logins when the user attempts to sign in.

To configure and implement sign-in notifications:

1. Select **Authentication > Signing In > Sign-in Notifications**.
2. Click **New Notification**.

Figure 13: Sign-in Notifications



3. Specify a Name for the notification. This name appears in the sign-in policies page, and in the UI Options page for a selected role.
4. Select **Text** or **Package**.

- If you select **Text**, type the desired sign-in notification message, or copy and paste the relevant text into the Text field.
- If you select **Package**, click the **Browse** button and navigate to a previously prepared .zip file. A package is typically used to provide different language versions of the notification message.
    - The zip file should include a default.txt file and one or more <language>.txt files (Example: en.txt).
    - Language-abbreviations should be strings that can appear in Accept-Language header of an HTTP request.
    - The character encoding supported is UTF-8.

5. Click **Save Changes**. To enable sign-in notifications:
6. Click **Authentication > Signing In > Sign-in Policies**.
7. Under Configure Sign-in Notifications, select the check box for **Pre-Auth Sign-in Notification**, **Post-Auth Sign-in Notification**, or both.
    - After Pre-Auth Sign-in Notification, select a previously configured sign-in notification from the drop-down menu.
    - After Post-Auth Sign-in Notification, select the option for **Use a common Sign-in Notification for all roles** or **Use the Sign-in Notification associated to the assigned role**.
    - If you select **Use a common Sign-in Notification for all roles**, select a previously configured sign-in notification from the drop-down menu.

- If you select **Use the Sign-in Notification associated to the assigned role**, the sign-in notification configured for the assigned role will be used.
- Prevent the Post-Auth sign-in notification from being displayed to users who have seen it before, by selecting the **Skip if already shown** check box. (This is only a hint to the system and might not be honored in all environments.)

8. Click **Save Changes**.
9. You can customize the appearance of the sign-in notification message by selecting **Authentication > Signing In > Sign-in Pages** and creating a sign-in page or using an existing page.
10. Under Sign-in Notification appearance, customize UI options for Pre-Auth Notifications and Post-Auth Notifications by changing the following items:

    - For **Notification Title** enter the text that appears at the top of the sign-in notification page.
    - In the **Proceed Button** box, enter the text for the button that the user clicks to proceed with the sign-in. This text applies to browser-based log ins only. A Pulse client log in always displays Proceed.
    - Optionally, clear the check box for **Display "Decline" Button**. If this box is not checked, the user does not have the option to decline.
    - In the **Decline Button** box, enter the text for the button that the user clicks to decline.

    This text applies to browser-based log ins only. A Pulse client log in always displays Decline.
    In the **Message on Decline** box, enter the text that you would like to appear when a user clicks the Decline button.
11. Click **Save Changes**.

    Note: If you enabled **Use the Sign-in Notification associated to the assigned role** you must complete the implementation by selecting the sign-in notification on the Users > User Roles > *Role Name* > General > UI Options page or Administrators > Admin Roles > *Role Name* > General > UI Options page, as applicable.

    If more than one role is available to a user, the sign-in notification associated with the first role assigned is displayed.
12. Add the sign-in page in which you have customized the sign-in notification appearance to the sign-in policy.

Configuring Sign-In Pages

A *sign-in page* defines the customized properties in the end-user's welcome page such as the welcome text, help text, logo, header, and footer. The system allows you to create two types of sign-in pages to present to users and administrators:

This section covers the following topics:

- Configuring Standard Sign-In Pages
- Configuring Custom Sign-In Pages

Configuring Standard Sign-In Pages

Standard sign-in pages are included with the default system. You can modify standard sign-in pages. You can modify the default sign-in page that the system displays at sign-in. You can also create new standard sign-in pages that contain custom text, logo, colors, and error message text.

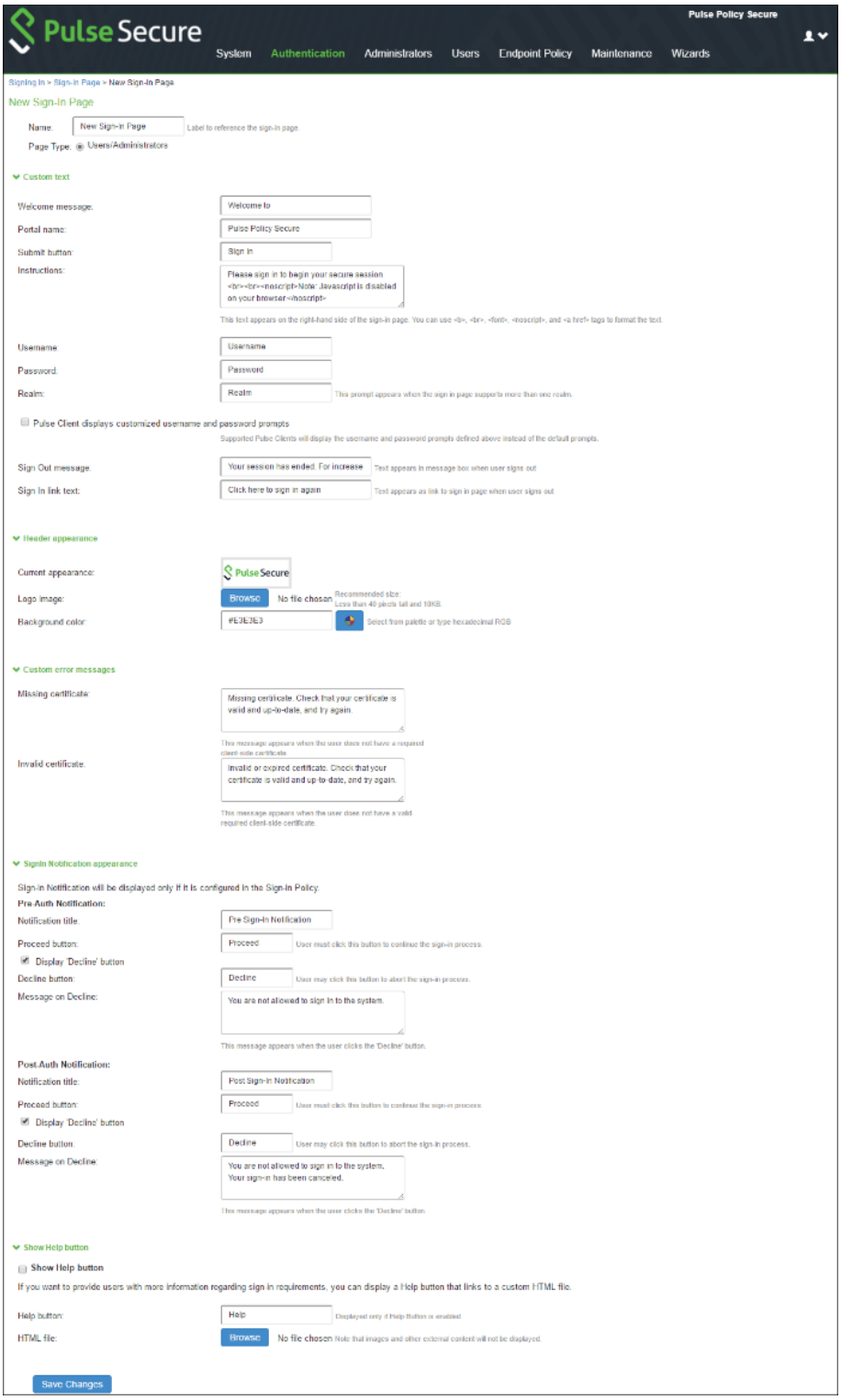
To create or modify a standard sign-in page:

1. Select **Authentication > Signing In > Sign-in Pages**.
2. Click **New Page**. To modify an existing page, select the link for the page you want to modify.
3. Enter a name to identify the page.
4. In the Custom text section, revise the default text used for the various screen labels. When you add text to the Instructions field, you can format text and add links using the following HTML tags: <i>, <b>, <br>, <font>, and <ahref>. However, the system does not rewrite links on the sign-in page (because the user has not yet been authenticated), so point only to external sites. Links to sites behind a firewall will fail.

   If you use unsupported HTML tags in your custom message, the system might display the end-user's home page incorrectly.
5. (Optional) In the Header appearance section, specify a custom logo image file for the header and a different header color.
6. (Optional) In the Custom error messages section, revise the default text that is displayed to users if they encounter certificate errors.

   You can include <<host>>, <<port>>, <<protocol>>, and <<request>> variables and user attribute variables, such as <<userAttr.cn>> in the custom error messages. These variables must be in the format <*variable*> to distinguish them from HTML tags that have the format <*tag*>.
7. (Optional) To provide custom help or additional instructions for your users, select **Show Help button**, enter a label to display on the button, and specify an HTML file to upload. Note that the system does not display images and other content referenced in this HTML page.
8. Click **Save Changes**. The changes take effect immediately, but users with active sessions might need to refresh their Web browser. Click **Restore Factory Defaults** to reset the sign-in page, user home page, and admin console appearance.

Figure 14: Standard Sign-in Page



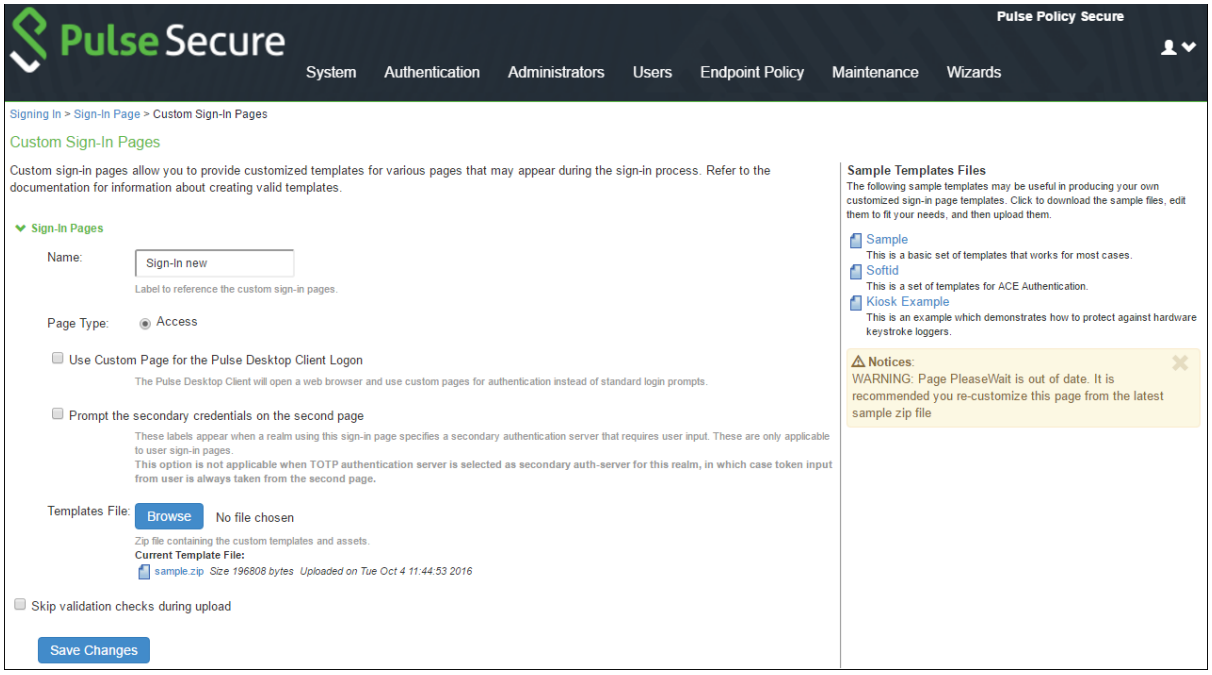
Configuring Custom Sign-In Pages

Customized sign-in pages are THTML pages that you produce using the Template Toolkit and upload in the form of an archived ZIP file. The customized sign-in pages enable you to use your own pages rather than modify the standard sign-in pages.

To upload Custom Sign-In Pages:

1. Select **Authentication > Signing In > Sign-in Pages**.
2. Click **Sample** to download the Sample Folder as ZIP and save it on local disk.

Figure 15: Custom Sign-in Pages



3. Copy the following files after unzipping the folder (locally saved in previous step):
   a. UserAdmin-add-user.thtml
   b. UserAdmin-add-bulk-users.thtml
   c. UserAdmin-update-user.thtml
   d. Logout.thtml
   e. PleaseWait.thtml
4. Open the previously downloaded Sample Custom Sign-in folder and replace the files.
5. Select all the files and create *.ZIP file for uploading custom sign-in page.
6. Upload the new custom sign-in page and click **Save Changes**.

Initial Configuration

This part covers the following chapter:

- Using the Initial Setup Wizard

Using the Initial Setup Wizard

This chapter provides an overview of the initial setup wizard. It includes the following information:

- Overview
- Configuring PPS using Initial Setup Wizard
- Verification and Troubleshooting

Overview

The initial setup wizard allows you to quickly configure PPS to ensure that the PPS device is configured effectively and efficiently. You can open the initial setup wizard through Wizards > Initial Setup > Configure. As a best practice, it is recommended to configure Profiling as a first step so that all the network devices are discovered. You can then launch the wizard to configure the enforcement policies on the discovered devices.

Using the initial setup wizard, you can configure PPS for the following use cases:

- Network visibility using Pulse Secure Profiler functionality
- Layer 2 enforcement through 802.1X, MAC authentication, and SNMP for endpoints.
- Easy deployment for guest or BYOD access

Benefits

The initial setup wizard provides the following benefits:

- Provides quick onboarding of existing Pulse Connect Secure (PCS) users to PPS with a mechanism to import existing PCS policy configuration into PPS.
- Allows users to easily and quickly deploy PPS based for the desired use case (network visibility, enforcement, and guest access).

Prerequisites

You must keep the following information ready before configuring the PPS device:

- NTP server address and other details.
- The license SKU or license server details. The PPS appliance is added as a license client with necessary licenses to be leased.
- Fingerprint database, subnets to scan, and switch details for Profiling the network.

- Authentication servers (AD/LDAP) must have groups defined for different roles so that corresponding access can be configured for L2 enforcement use case.
- The list of switches along with IP address and other parameters such as VLAN information for different set of users.
- Administrator account details of PCS for fetching the authentication server and role details.

Limitations

The following are the limitations:

- Supports only layer 2 enforcement use cases.
- The initial setup wizard is supported only with the new UI.
- You can configure each use case only once using the wizard and cannot edit the configurations once it is completed.

Configuring PPS using Initial Setup Wizard

This section covers the configuration using initial setup wizard. The following procedure lists the configuration steps:

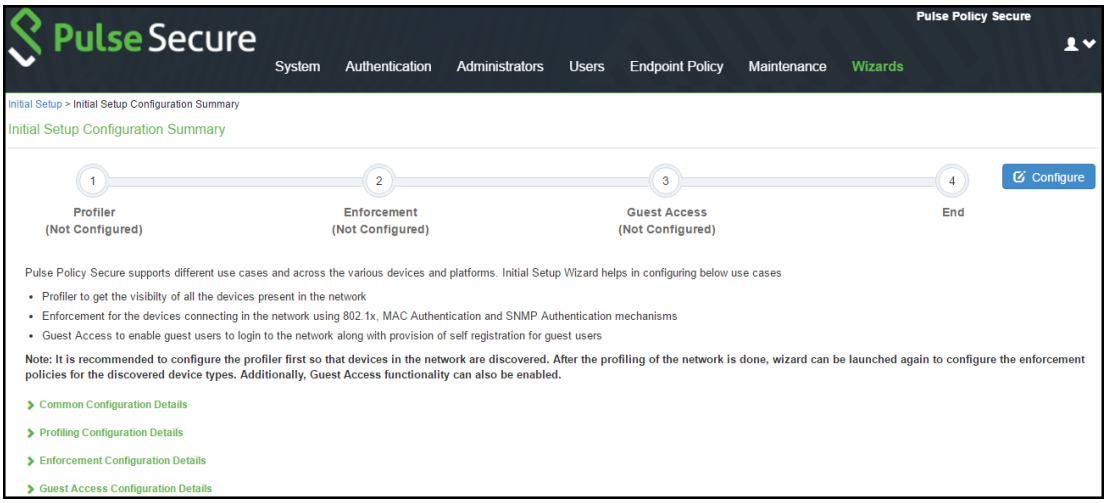
- Basic Settings
- Configuring Profiling for Network Visibility
- Configuring Layer 2 Enforcement
- Configuring Guest Authentication

You can launch the initial setup wizard using:

- Select **Wizards > Initial Wizard > Configure**
- Select **Wizards > Initial Wizard > Configuration Summary**

The configuration summary page shows the configured/not configured use cases and the corresponding details. It is recommended to configure the use cases using the configuration summary page.
The below figure shows the configuration summary page for a fresh installation.

Figure 16: Initial Setup Configuration Summary Page



Basic Settings

This section covers the following topics:

- Configuring system date and time
- Configuring license

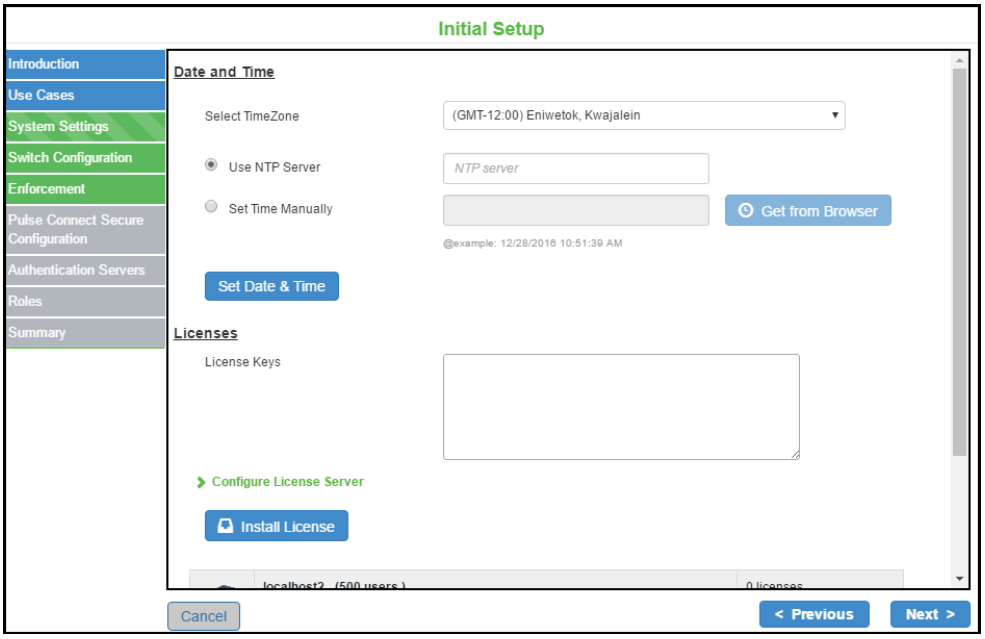
Configuring System Date and Time

The time synchronization between PPS and another component is very critical. You can easily configure the system date and time using the initial setup wizard. The system date and time can be configured manually or you can configure a network time protocol (NTP) server. It is recommended to use a public NTP server for time synchronization.

To set the system date and time:

1. Select **Wizards > Initial Setup > Configure**.
2. Select the deployment use case.
3. Select your time zone. Selecting the appropriate time zone enables the system to automatically adjust the time for Daylight Saving Time changes.
    - Use NTP Server- Enter the fully qualified domain name or IP address for the NTP server.
    - Set Time Manually- Enter the date (MM/DD/YY) and time. You can click **Get from Browser** to automatically populate the Date and Time.
4. Click **Set Date and Time**.

Figure 17: Initial Setup Configuration Page



Configuring License

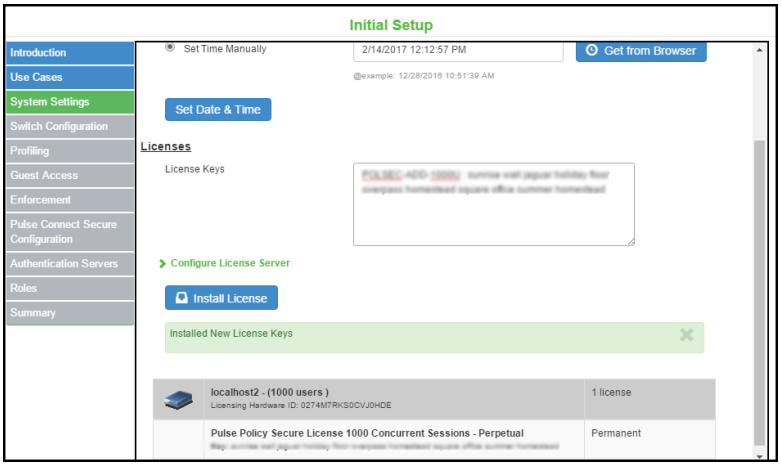
The license can be applied in 2 ways:

- Manually by entering the license key
- License Server

To apply the license manually:

1. Enter the license keys obtained through license key generation.
2. Click **Install License.**

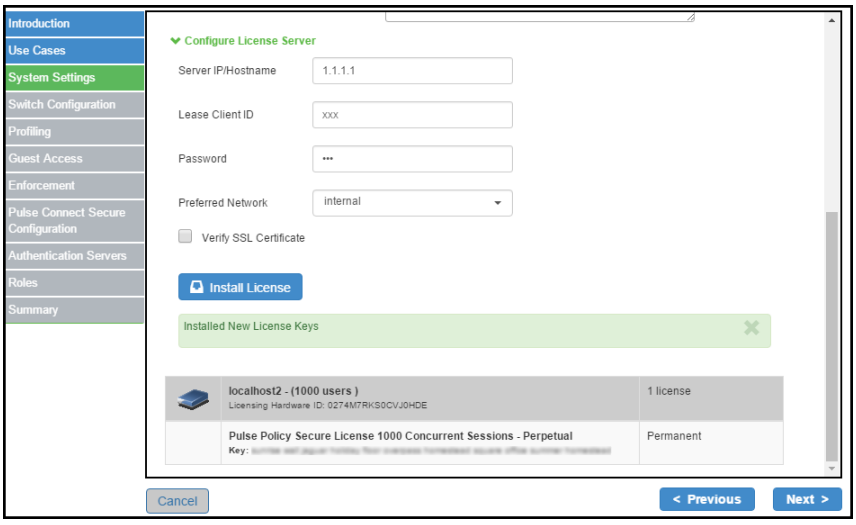
Figure 18: Configure license



To configure through the license server:

1. Enter IP address or hostname of license server.
2. Enter a unique ID for the client. This ID is used to communicate and verify the client with the license server.
3. Select the network to communicate with the license server from the Preferred Network menu. The available options are internal (default), external, and management.
4. Select the **Verify SSL Certificate** check box if you want the client to verify the server's SSL certificate when establishing communication with it.

Figure 19: License Server



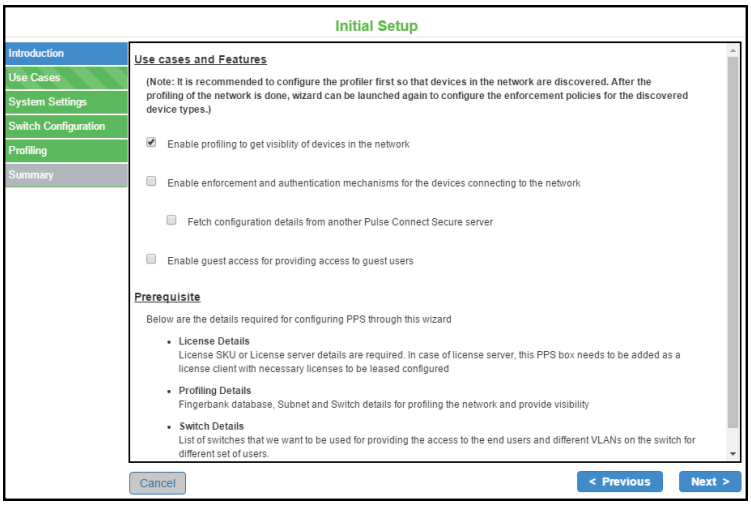
Configuring Profiling for Network Visibility

Pulse Secure Profiler dynamically identifies and classifies endpoints across managed and unmanaged endpoint devices, so that access to network and resources can be controlled based on the type of the device. It also helps you to get visibility so that necessary security policies for corporate access, BYOD, and guest access can be enforced.

To enable profiling on your network:

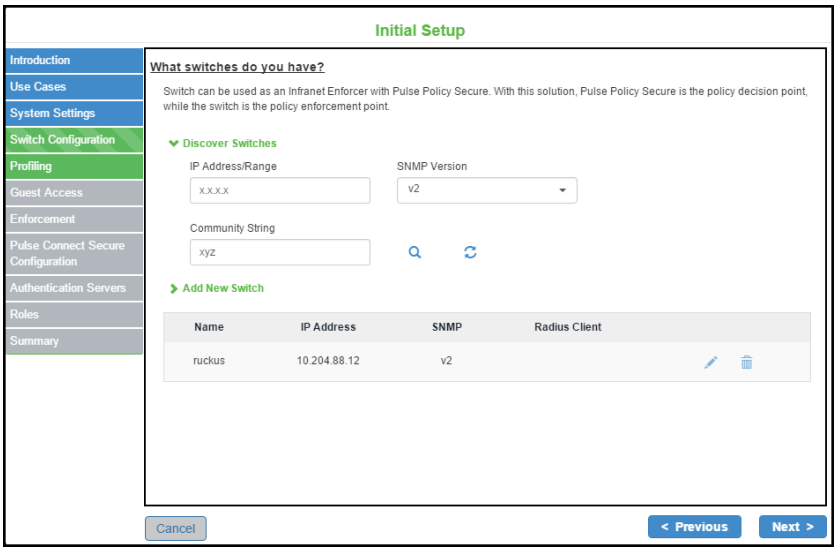
1. Select **Enable Profiling to get visibility of devices in the network**.

Figure 20: Initial Setup Configuration Page- Profiling



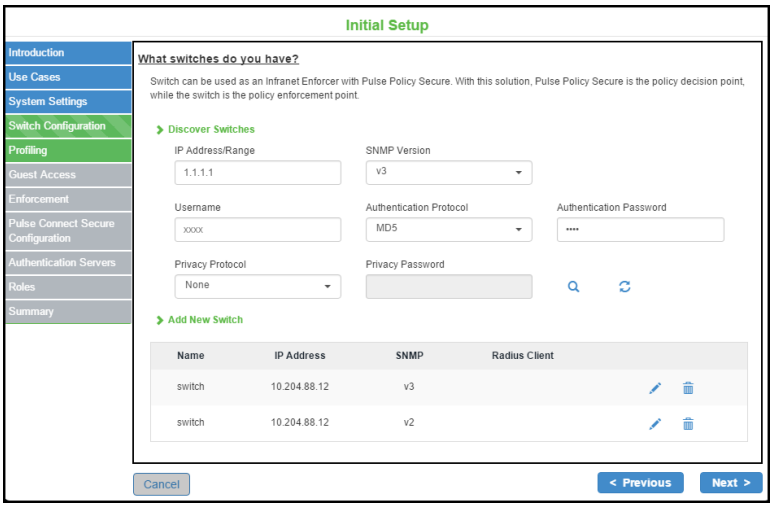
2. Configure system date and time. See Configuring System Date and Time.
3. Configure license. See Configuring License.
4. You can add an SNMP device manually through Add New Switch configuration or automatically discover SNMP devices through Device Discovery.
5. To discover SNMP v2 devices:
   - Select the SNMP version as v2
   - Enter the IP address/range and community string.

Figure 21: Initial Setup Configuration Page- Discover Switch SNMPv2



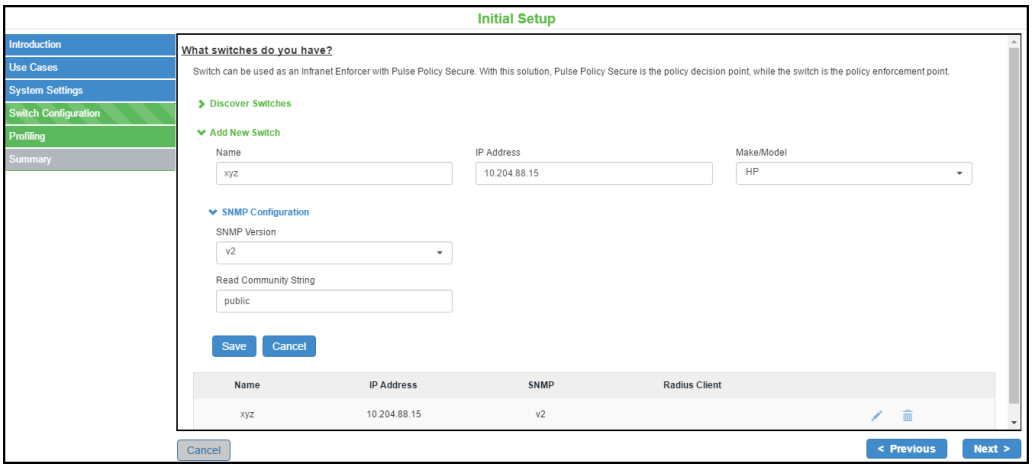
6. To discover SNMP v3 devices:
   - Enter the IP address/range
   - Select the SNMP version as v3
   - Select the desired Authentication protocol and Privacy protocol.
   - Enter the Authentication password and Privacy password.
   - Click the search icon.

Figure 22: Initial Setup Configuration Page- Discover Switch SNMPv3



7. To add a new switch:
   - Enter the name and IP address of the switch
   - Select the Make/Model of the switch
   - Under SNMP configuration, select the SNMP version- v2/v3
     - For SNMP v2, enter the read community string.
     - For SNMPv3, enter the authentication password, privacy password and select the authentication protocol and privacy protocol.
   - Click Save.

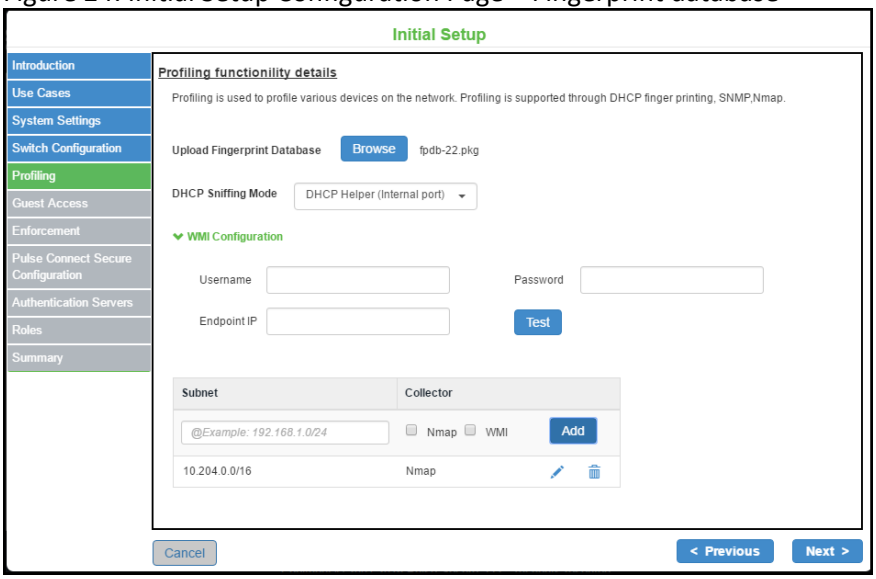
Figure 23: Initial Setup Configuration Page- Add Switch SNMPv2



8. Click **Next**.

9. Select **Browse** and upload the fingerprint database downloaded from the Pulse Secure portal.
10. Select the DHCP sniffing mode that is whether to run the DHCP sniffing on DHCP helper (Internal Port) or RSPAN (External Port).
11. Under WMI configuration, specify WMI profiler user name and password to fetch endpoint information from remote desktops running Microsoft Windows. The WMI profiler collects granular OS level information such as accurate OS version and patch level.
12. Add one or more subnets that can be included or excluded for fingerprinting devices using Nmap target scans. Note: Nmap target scan is only performed on valid IP addresses in the subnet.
13. Enter the subnet details and Click **Add**.

Figure 24: Initial Setup Configuration Page – Fingerprint database



Configuring Layer 2 Enforcement

The following enforcements are supported for the devices connecting to the network.

- 802.1X
- MAC Authentication
- SNMP

Before you begin:

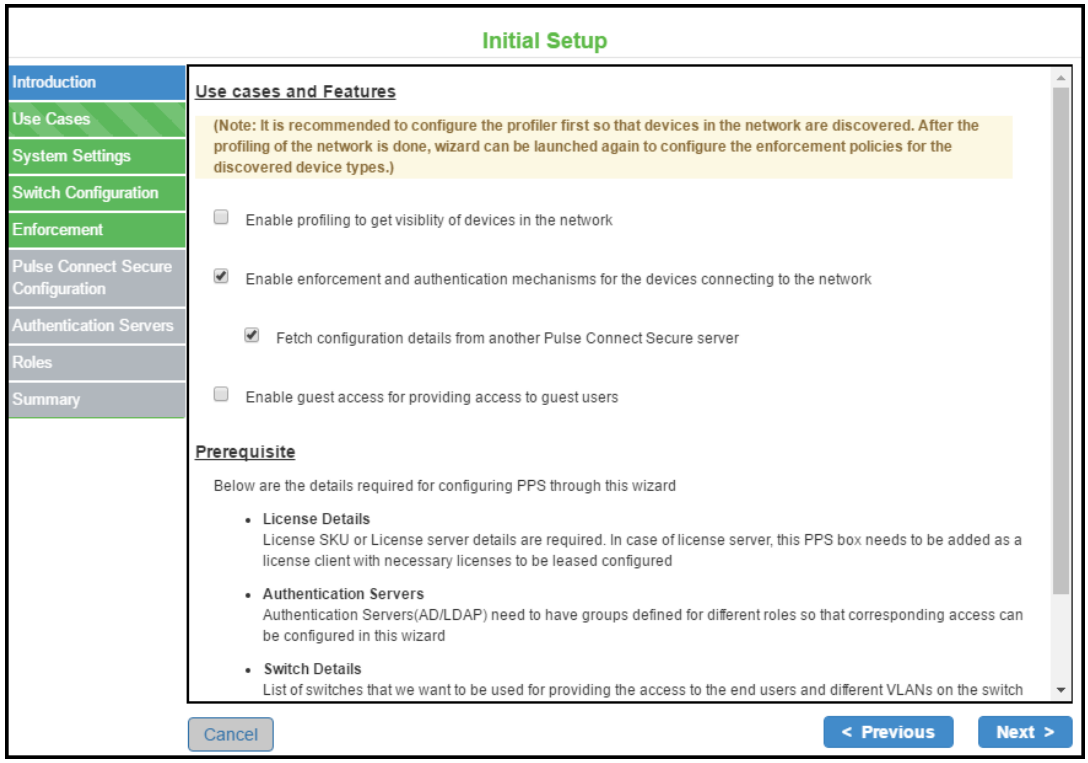
As a best practice, it is recommended to configure Profiling as a first step so that all the network devices are discovered. You can then launch the wizard to configure the enforcement policies on the discovered devices.

To configure enforcement and authentication mechanism:

1. Select **Enable enforcement and authentication mechanism for the devices connecting to the network**.

NOTE: Profiling is enabled by default when you enable enforcement and authentication.

Figure 25: Initial Setup Layer2 Enforcement



2. Configure basic settings. See Basic Settings.
3. Configure the switch. Complete the configurations as described in table below.

Table 4: Configuring Switches

Discover Switches	
SNMP v2	Enter the IP address/range and community string.
SNMP v3	• Enter the IP address/range • Select the desired Authentication protocol and Privacy protocol.

	• Enter the Authentication password and Privacy password. • Click the search icon.
Add New Switch	
Name	Enter a name to label the RADIUS client. You can assign any name to a RADIUS client entry, use the device's SSID or IPv4/IPv6 address to avoid confusion.
IP Address	Enter the IPv4/IPv6 address of the switch.
Make/Model	Select the make/model of the switch vendor. The make/model selection tells PPS which dictionary of RADIUS attributes to use when communicating with this client.
RADIUS Client Configuration	
IP Address Range	Enter the number of IP addresses in the IP address range for the switch/WLC, starting with the address you specified for IP Address. You can specify a range up to a maximum of 32,768 addresses.
Shared Secret	Enter the RADIUS shared secret. A RADIUS shared secret is a case-sensitive password used to validate communications between PPS and switch.
SNMP Configuration	
SNMP Version	Select the SNMP version (v2/v3). • For SNMP v2, enter the read community string. • For SNMPv3, enter the authentication password, privacy password and select the authentication protocol and privacy protocol. • Select **Use for enforcement** to use the SNMP device for SNMP enforcement.

Figure 26: Add Switch – SNMPv2

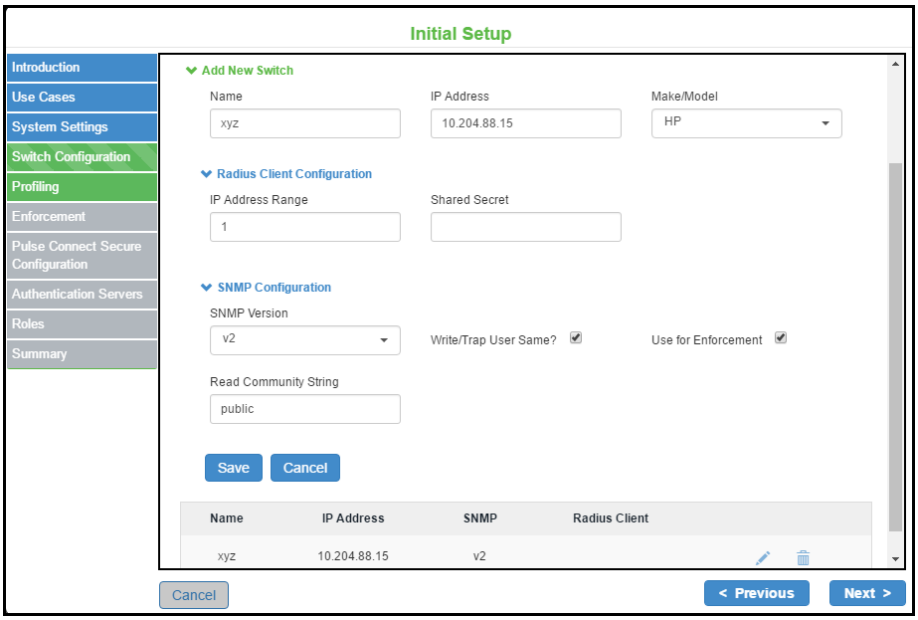
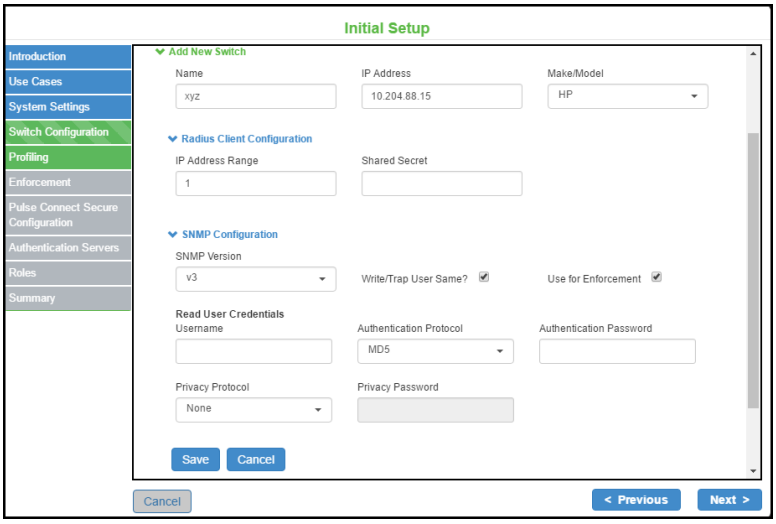


Figure 27: Add Switch – SNMPv3



4. Configure the enforcement for devices, which includes laptops, smart phones, VOIP phones, and unmanaged devices.

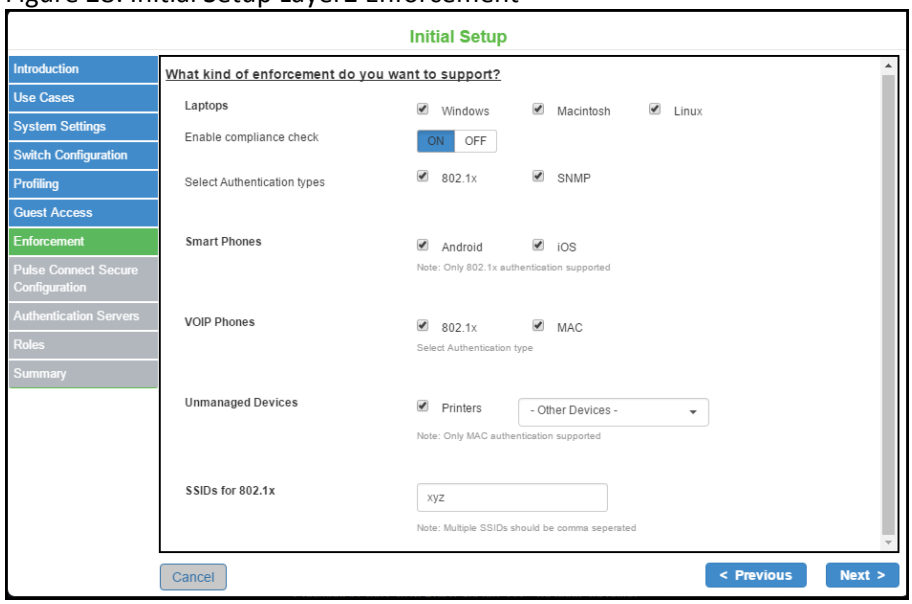
NOTE: If profiling is enabled the device platform types are automatically enabled.

Table 5: Enforcement

Device Type	Platforms	Authentication Type	Additional Support
Laptops	• Windows • MAC • Linux	• 802.1X • SNMP	Host Checker
Smart phones	• Android • iOS	• 802.1X	NA
VOIP phones	NA	• 802.1X • MAC	NA
Unmanaged devices	NA	MAC	NA

5. Enter the SSID for 802.1X. Use comma as a delimiter for entering multiple SSID's.

Figure 28: Initial Setup Layer2 Enforcement



Importing Configurations from Pulse Connect Secure

The existing configurations in PCS can be imported to PPS for quickly configuring the PPS device.

The following configurations can be imported from PCS:

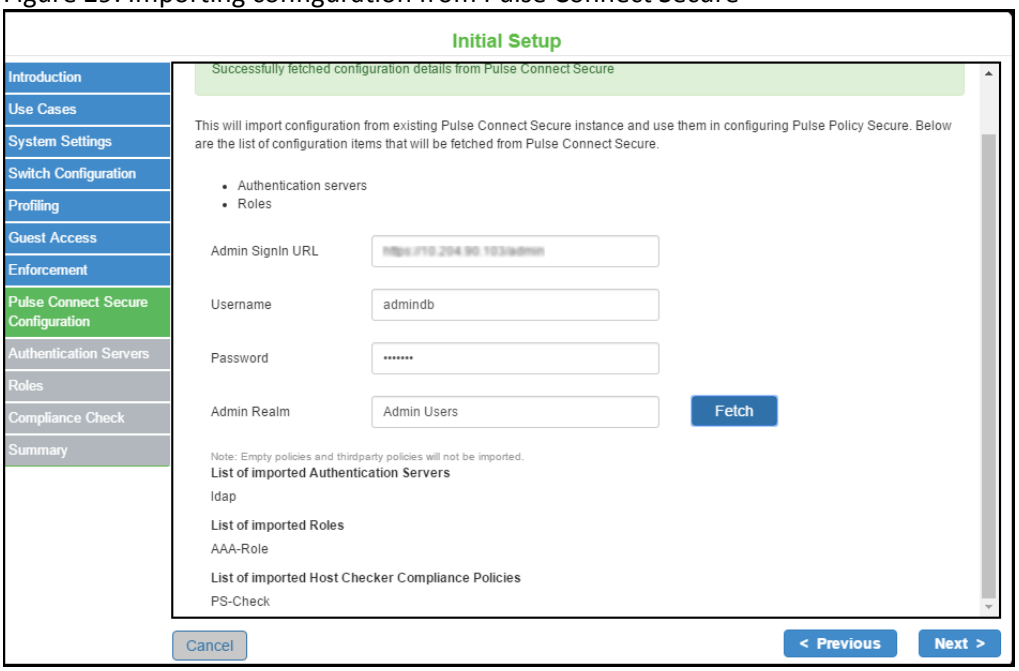
- Authentication servers
- Role names
- Host Checker compliance policies

To import the PCS device configurations to PPS device:

1. Select **Fetch configuration details from another Pulse Connect Secure server**.
2. Enter the PCS sign-in URL.
3. Enter the admin username.
4. Enter the password
5. Enter the realm information.
6. Click **Fetch**. The list of imported authentication servers, roles, and Host Checker compliance policies are displayed.

NOTE: If you try to import the configuration multiple times. The configurations will be overwritten with the newer configuration.

Figure 29: Importing configuration from Pulse Connect Secure



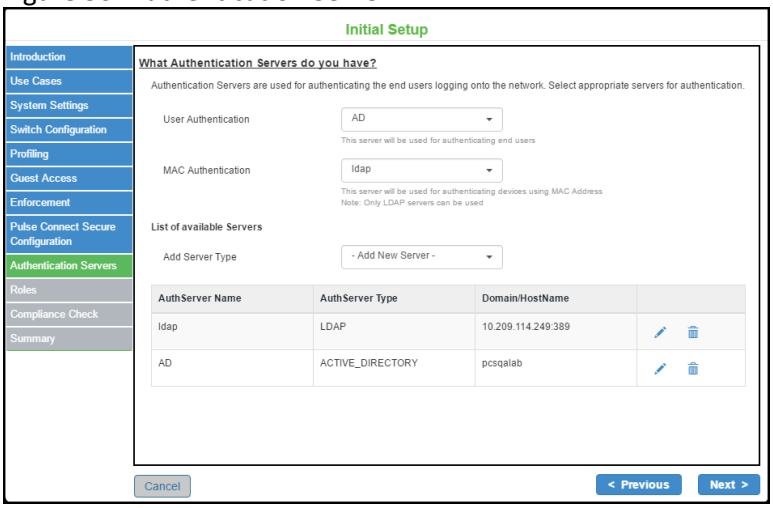
Authentication Server

Authentication server is used for authentication and verifying group membership. It validates the user credentials and then provides the required access. It also maps users to roles based on either Light Weight Directory Access protocol (LDAP) or Active Directory (AD) group information. The initial setup wizard supports AD and LDAP authentication servers for user authentication. LDAP is supported for device authentication based on MAC address.

To add the authentication server:

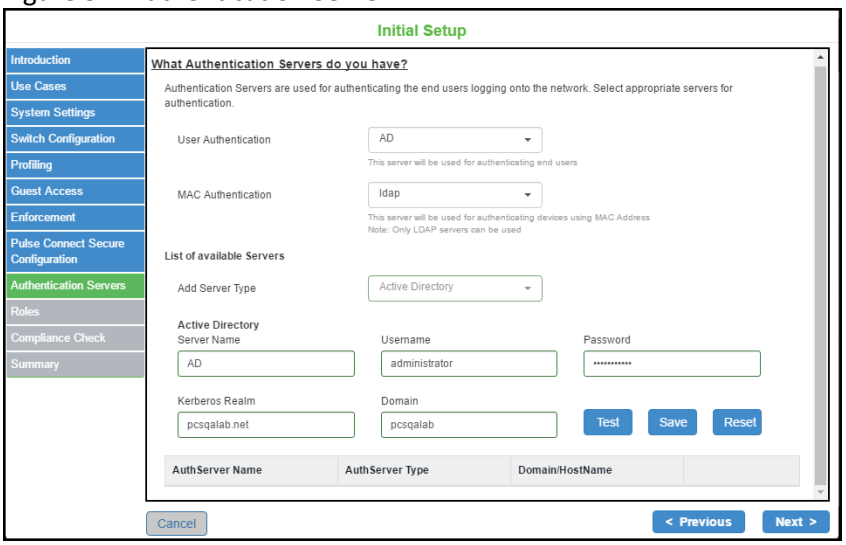
1. Select the **Server Type** (AD/LDAP).

Figure 30: Authentication Server



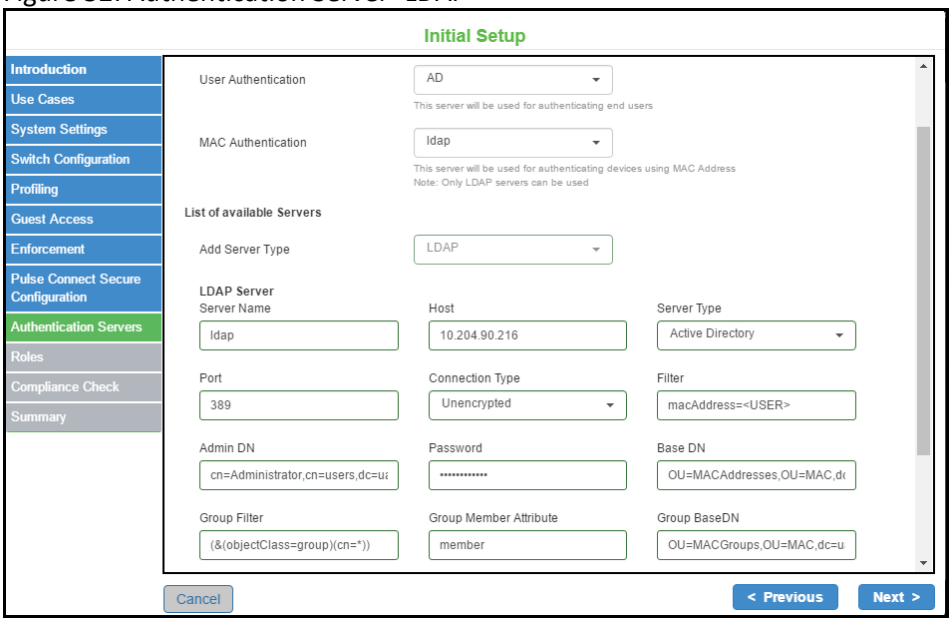
2. For Active Directory, enter the server name, user credentials, Kerberos realm, and domain. You can click **Test** to verify the configuration.

Figure 31: Authentication Server- AD



3. For LDAP, enter the server name, LDAP server type (Generic, AD, iPlanet, Novell eDirectory, Profiler), connection type, filter, admin DN, base DN, unique variable for filtering, group member attribute, and group base DN.

Figure 32: Authentication Server- LDAP



4. Configure the required authentication server for user authentication and machine authentication.

Roles

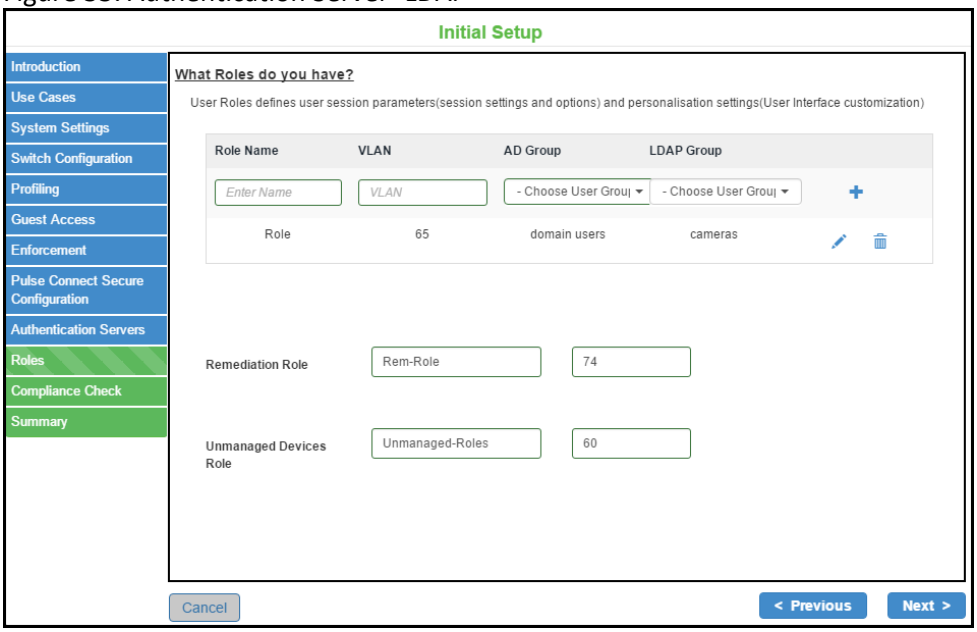
A user role defines user session parameters (session settings and options) and personalization settings (user interface customization).

NOTE: You can reuse the roles imported from PCS and then configure the VLAN and group information.

To add a role name:

1. Enter the role name and VLAN information.
2. Select the **AD group** or **LDAP group**.
   Note: If the AD or LDAP group information is not available you must add the group information manually.
3. Click Add (**+**) icon.
4. Enter the remediation role and the VLAN information.
5. Enter the role name and the VLAN information for unmanaged devices.

Figure 33: Authentication Server- LDAP



Compliance Check

PPS offers a variety of endpoint host checks to ensure compliance, including predefined checks for third-party endpoint security software including anti-virus, firewall, anti-malware/anti-spyware applications.

NOTE: You can reuse the compliance policies from PCS.

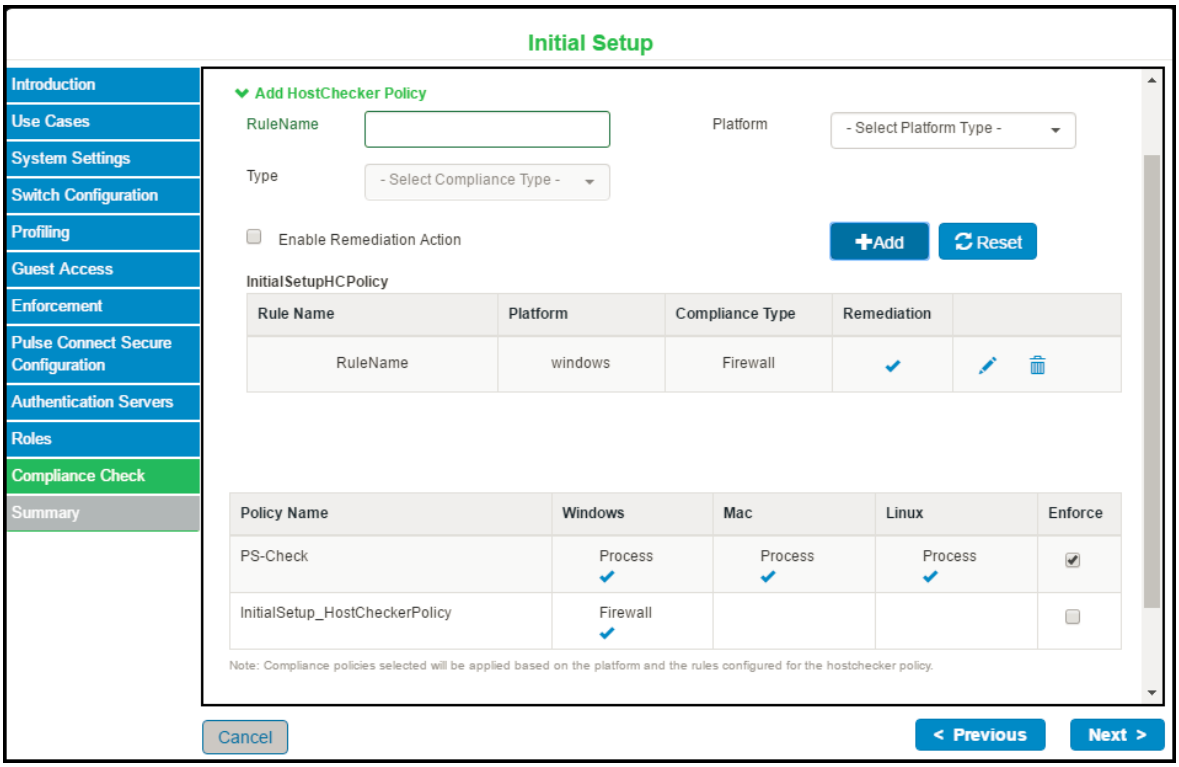
To configure PPS for endpoint compliance:

1. Enter the rule name.
2. Select the platform type- Windows, Linux, MAC.
3. Select the rule type.

NOTE: Antivirus, Firewall, and Process policies are supported for Windows and MAC platforms. Process policy is supported for Linux platform.

4. To enable remediation action, select **Enable Remediation Action**.
5. Click + **Add**.

Figure 34: Compliance Check



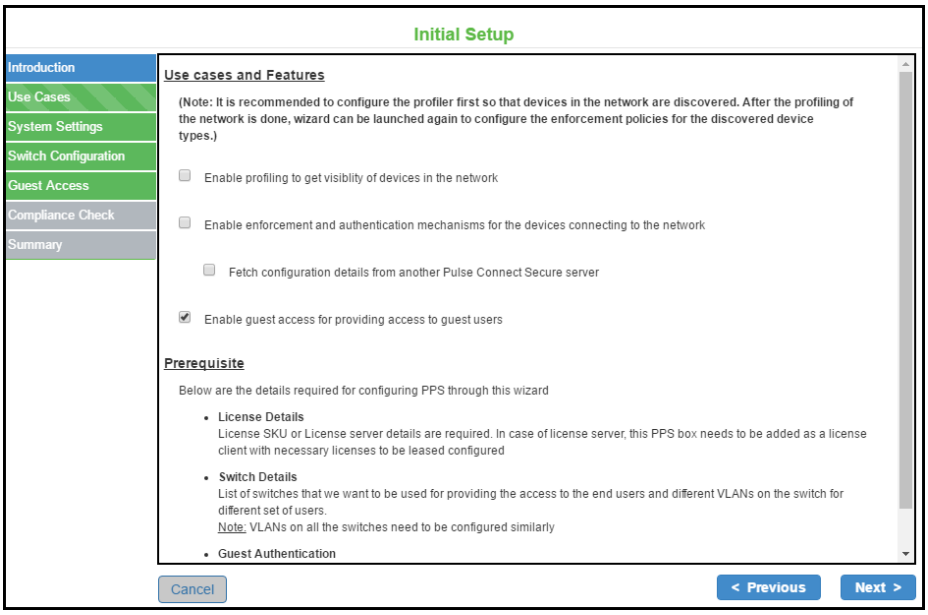
Configuring Guest Authentication

Guest access feature on PPS enables guest users to access the network through a self-registration process. The guest users self-register for network access from their device. Upon successful registration, the guest users are notified with the user credentials and other details through SMS or email.

To configure guest authentication:

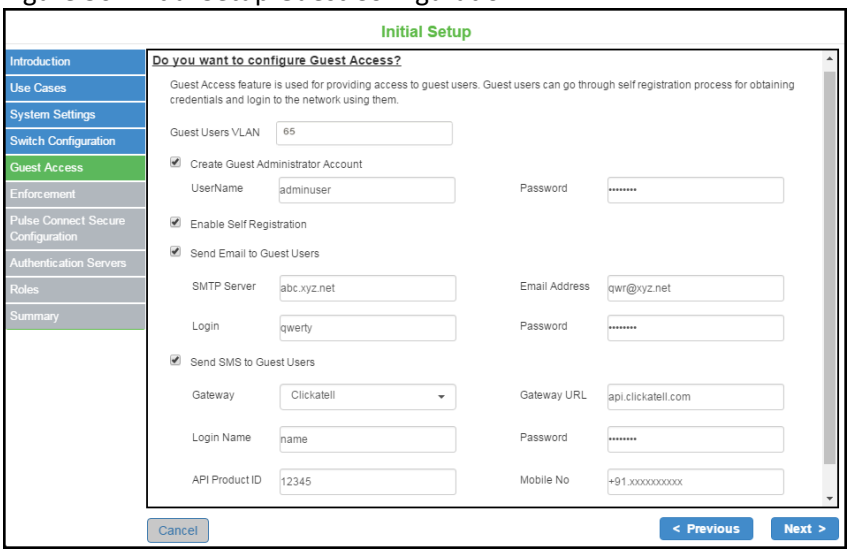
1. Select **Wizards > Initial Setup > Configuration Summary**.
2. Select **Enable guest access for providing access to guest users**.

Figure 35: Initial Setup Guest Configuration



3. Enter the VLAN information for the guest user.

Figure 36: Initial Setup Guest Configuration



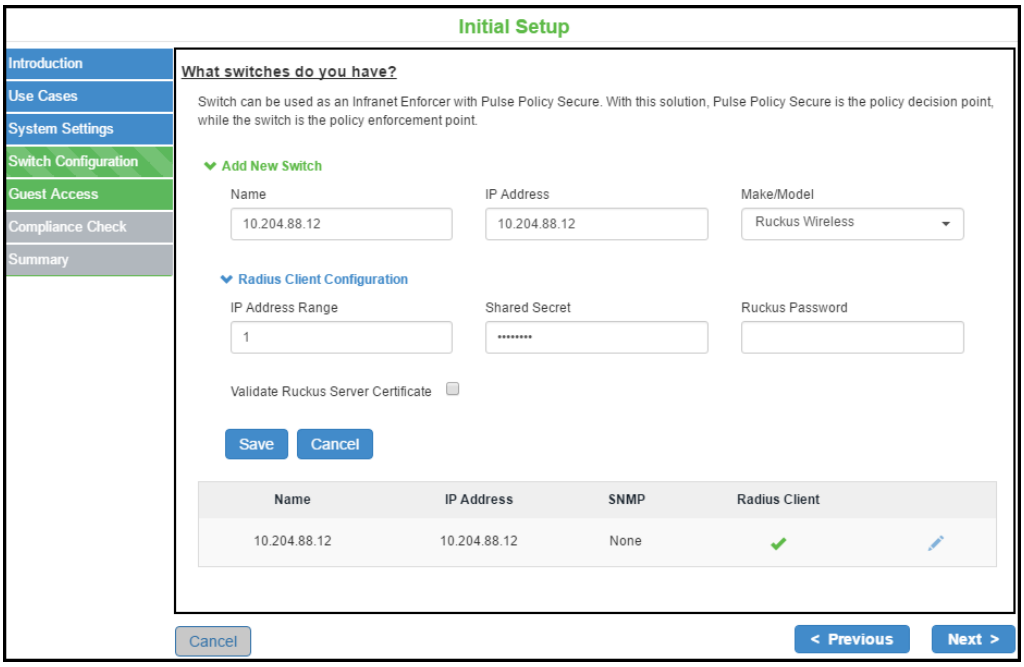
4. (Optional) Select **Create Guest Administrator Account** and enter the username and password.

5. (Optional) Select **Enable Self Registration**.
   The SMTP and SMS configuration settings must be configured to enable guest users to create user accounts on their own.
6. (Optional) Select **Send Email to Guest Users** and then enter the IP address or host name of the SMTP server, email address, and log in credentials of the SMTP server.
7. (Optional) Select **Send SMS to Guest Users** and then select the SMS gateway type, gateway URL, SMS gateway log in credentials, API ID, and the mobile number of the guest user.
8. Configure the switch as described in table below.

Table 6: Add switch

Add New Switch	
Name	Enter a name to label the RADIUS client. You can assign any name to a RADIUS client entry, use the device's SSID or IPv4/IPv6 address to avoid confusion.
IP Address	Enter the IPv4/IPv6 address of the switch.
Make/Model	Select the make/model of the switch vendor. The make/model selection tells PPS which dictionary of RADIUS attributes to use when communicating with this client.
RADIUS Client Configuration	
IP Address Range	Enter the number of IP addresses in the IP address range for the switch/WLC, starting with the address you specified for IP Address. You can specify a range up to a maximum of 32,768 addresses.
Shared Secret	Enter the RADIUS shared secret. A RADIUS shared secret is a case-sensitive password used to validate communications between PPS and switch.

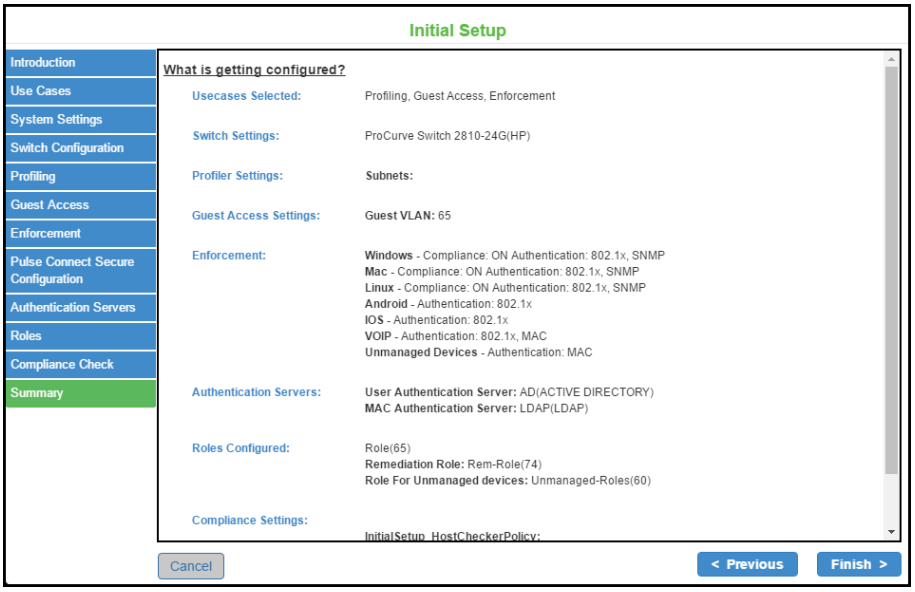
Figure 37: Initial Setup Guest Configuration- Add switch



Verification and Troubleshooting

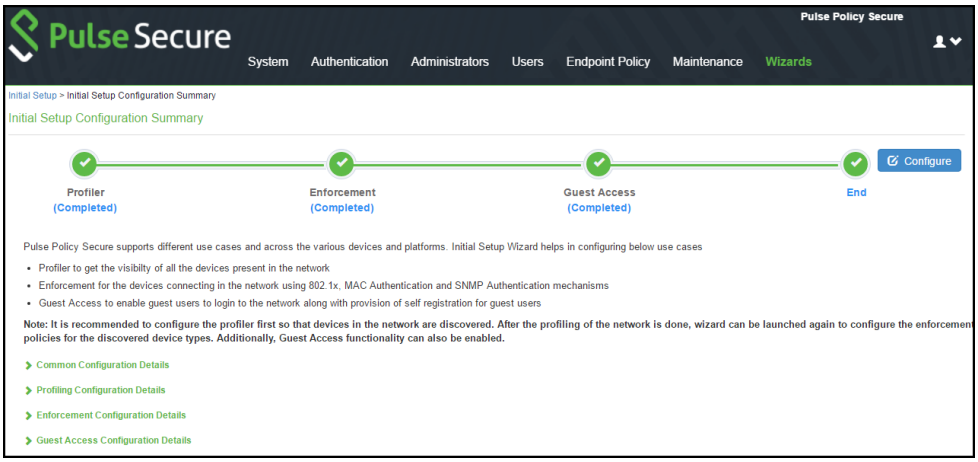
You can verify the configuration summary page for any errors during the initial setup configuration and perform the troubleshooting task based on the issue. The wizard captures the summary of the configurations before proceeding with enabling the corresponding use case on PPS. If needed you can modify the required configurations before completing the configuration.

Figure 38: Summary



The below figure shows the final configuration summary page. You can verify the common configuration, profiling, enforcement, guest access configuration details.

Figure 39: Configuration Summary



PPS Migration Wizard

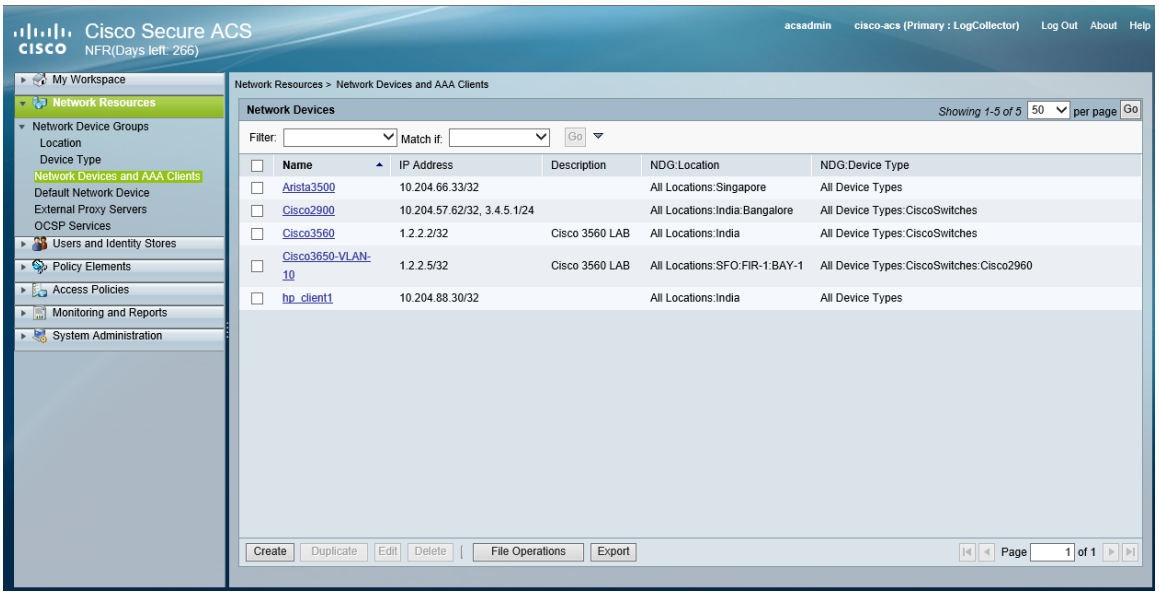
PPS Migration wizard enables seamless migration of RADIUS and TACACS+ configuration, and also automatically creates basic PPS configuration needed for these use cases to work right after migration is complete.

Prerequisites

Before proceeding with the PPS Migration wizard, export the RADIUS/TACACS+ clients' details in the form of CSV file from Cisco ACS.

Follow the below steps to export the RADIUS/TACACS+ clients' details:

1. Log in to Cisco ACS GUI.
2. Navigate to **Network Resources > Network Devices and AAA Clients**.
3. Select all the clients.
4. Click **Export**.

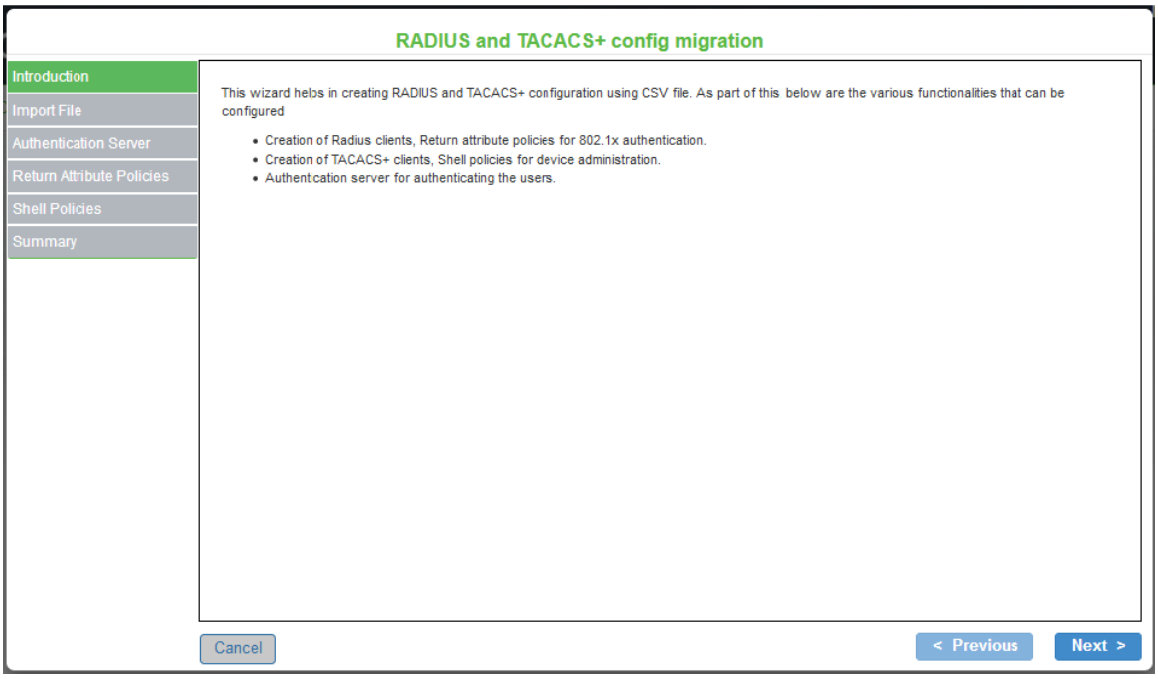


Configuring RADIUS and TACACS+ Migration using PPS Migration Wizard

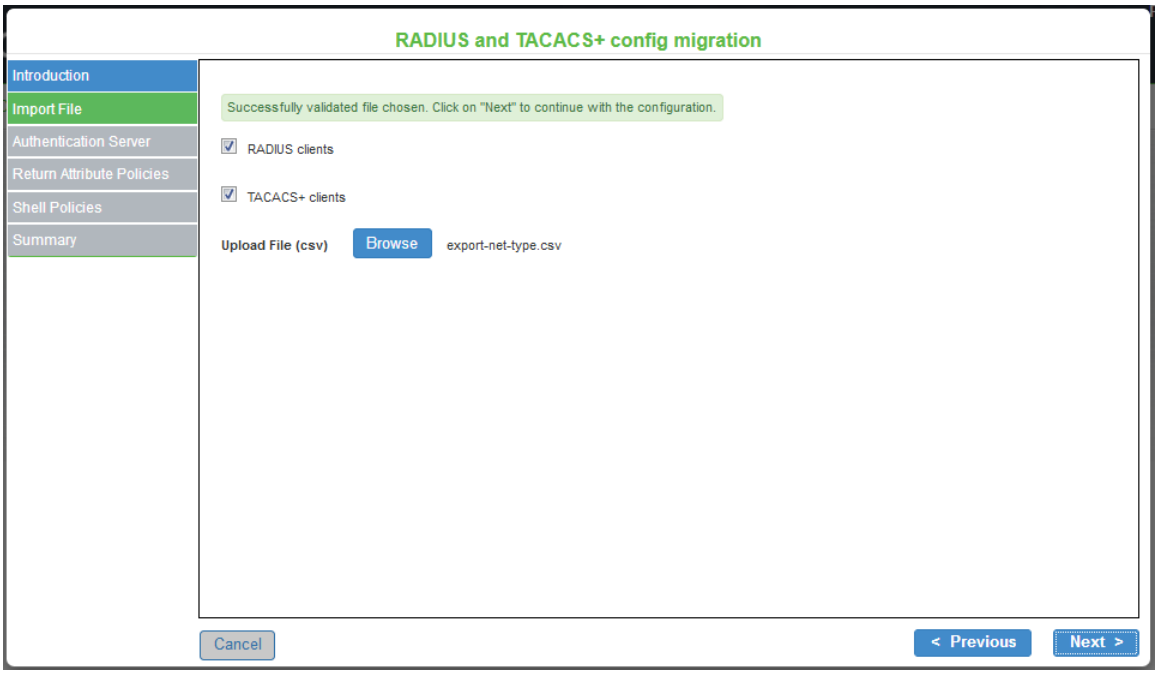
The PPS Migration wizard helps administrators in creating RADIUS and TACACS+ configuration using the CSV file exported from Cisco ACS.

To configure RADIUS and TACACS+ migration using PPS Wizard:

1. Log in to the PPS Admin console.
2. Select **Wizards > Migration > RADIUS and TACACS+ config migration**.The Introduction window lists the configuration steps.
3. Click **Next**.

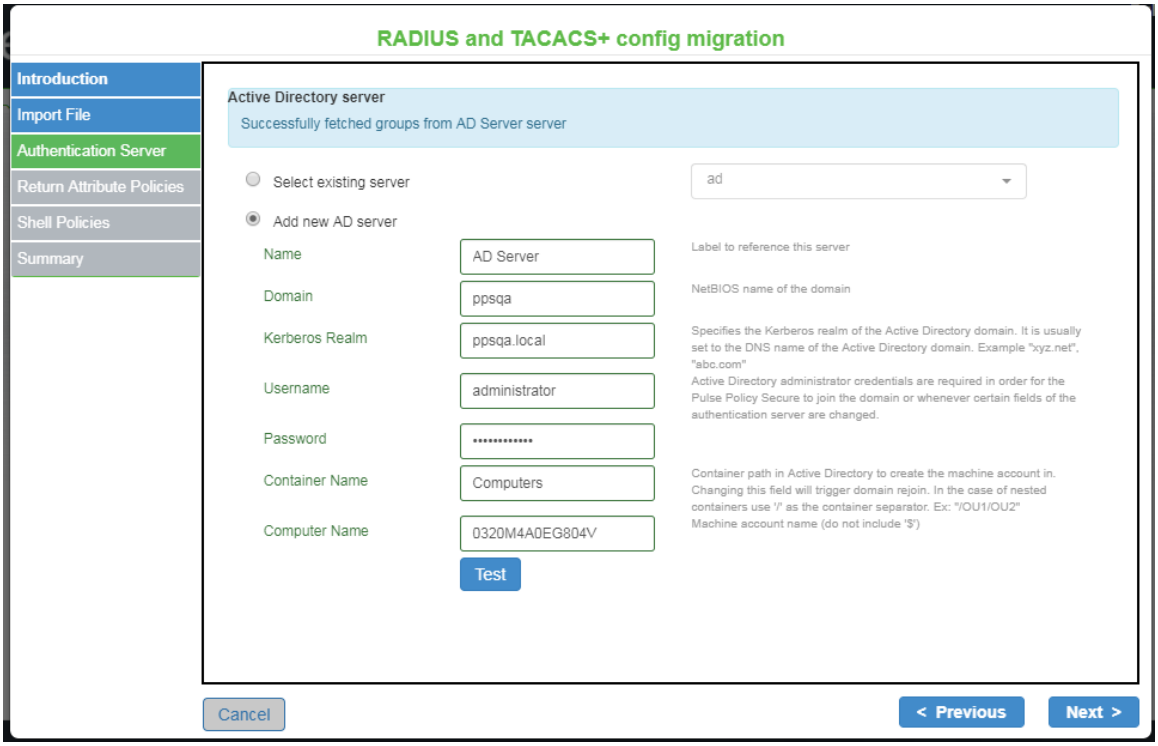


4. In the Import File window, choose the use cases for configuration import – the **RADIUS clients** check box or **TACACS+ clients** check box or both. Based on these selections, migration wizard provides steps to create the Radius policies followed by the Shell policies.
5. Click **Browse** and select the CSV file that is exported from Cisco ACS.
6. Click **Next**. After receiving confirmation for successful upload, click **Next**.



Note: At any stage of the migration wizard, you can click **Previous** to go back to the previous window or click **Cancel** to cancel the migration.

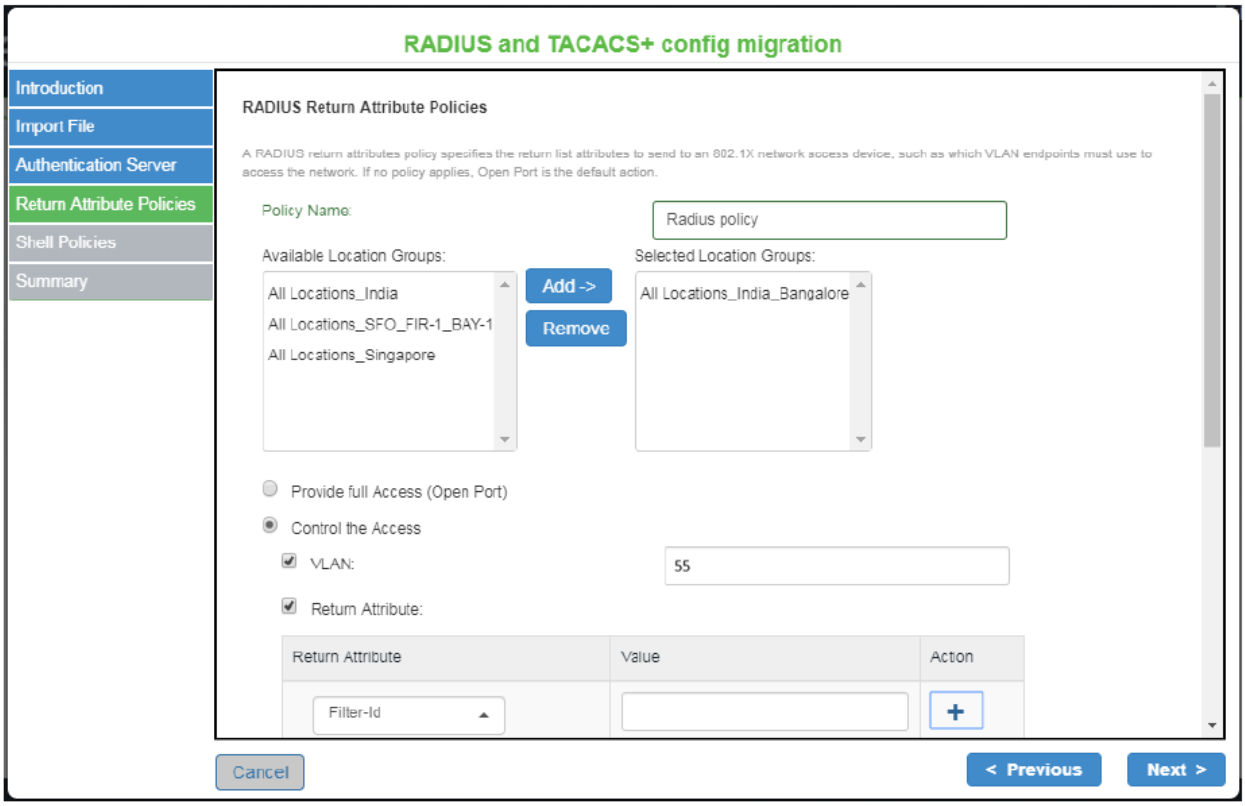
7. Next step is to configure the Active Directory server. You can select one from the existing list of AD servers or add a new AD server.
   - To select from the existing list, click **Select existing server** and choose the required AD server from the list.
   - To add a new AD server, click **Add new AD server**. Enter the name, domain name, Kerberos realm, user name, password that matches with the ACS configurations.
8. Click **Test** to validate the Active Directory configuration. This will take a few seconds to complete.
9. Once the validation is successful, click **Next**.

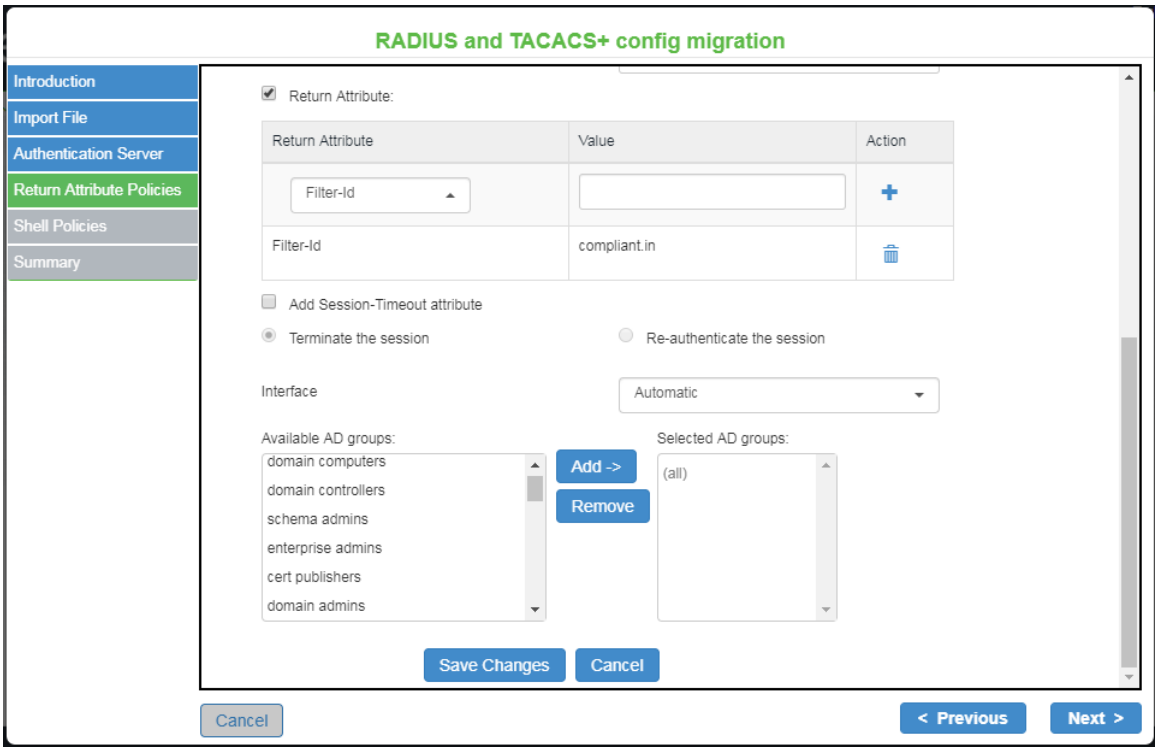


10. In the RADIUS Return Attribute Policies window, click **New Policy** and enter a name to the Radius policy.
11. Select Location Groups.

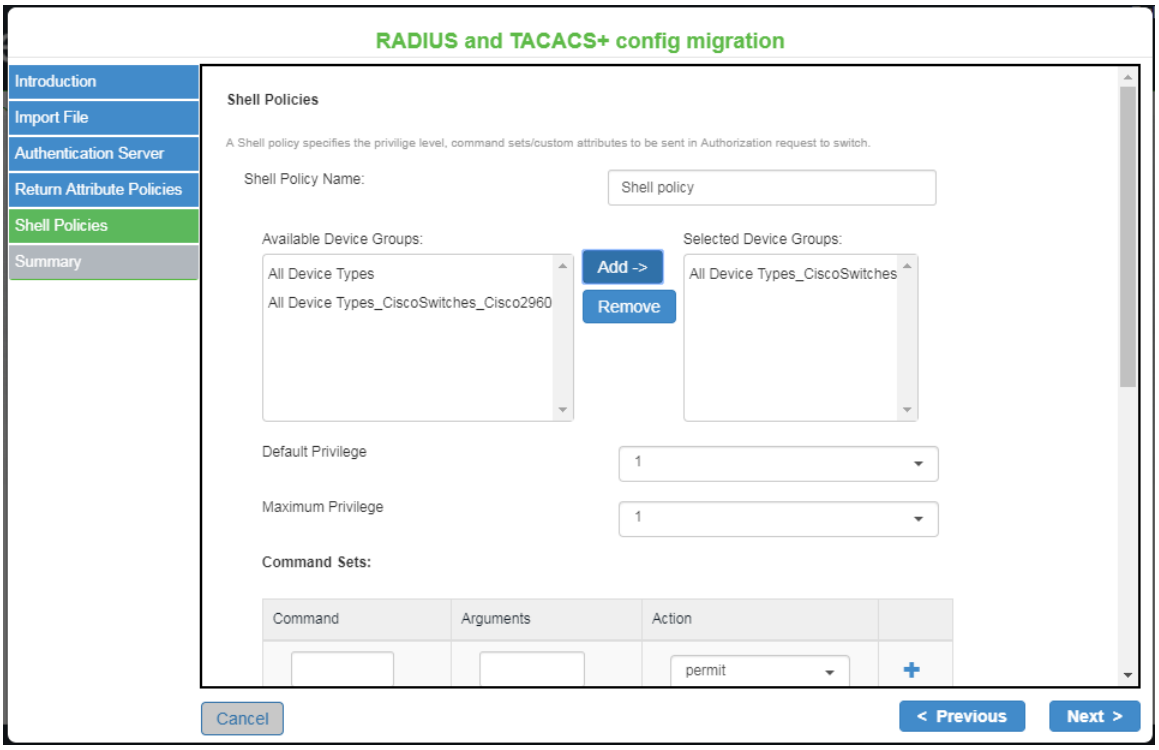
Note: PPS supports single location group; nested location groups are not supported. The subgroups created on ACS have to be configured as individual groups in PPS.

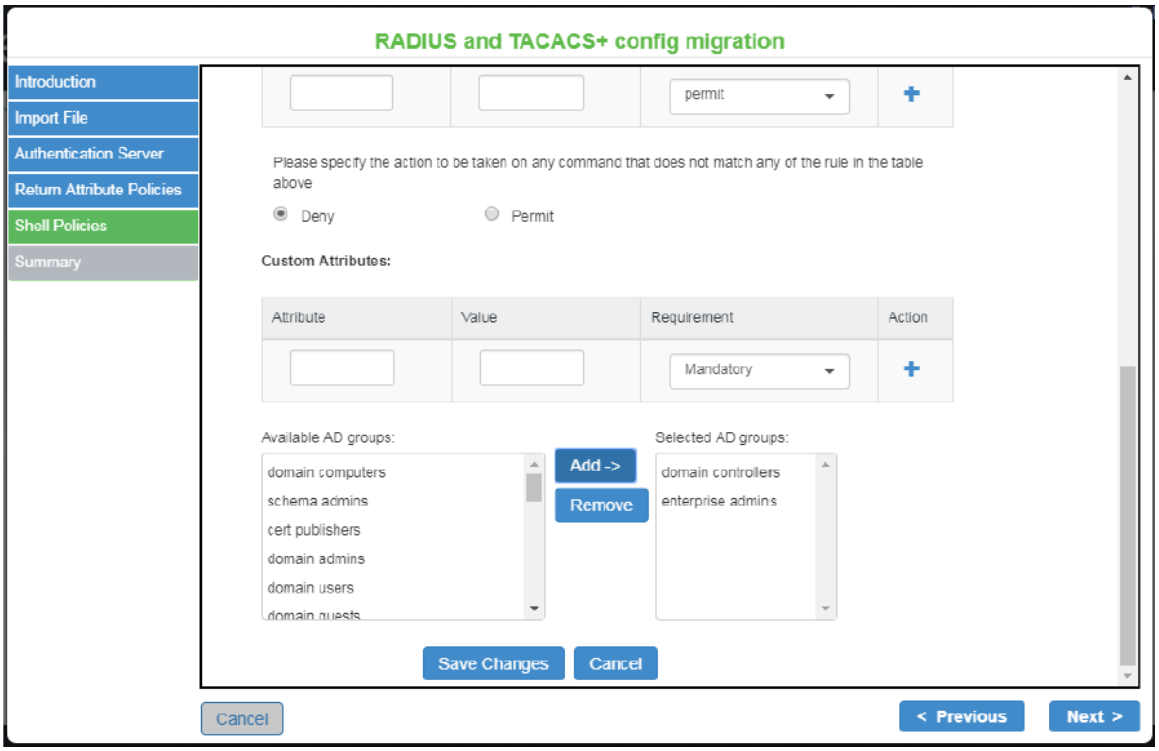
12. Select the **Return Attribute** check box. Select appropriate Vendor Specific Attribute as Return Attribute. In the **Value** field, define the ACL/Firewall Filter. For example, Return Attribute is **Filter-Id** and Value is **compliant.in**.
13. Click **Save Changes** to save the configuration.
14. Click **Next**.



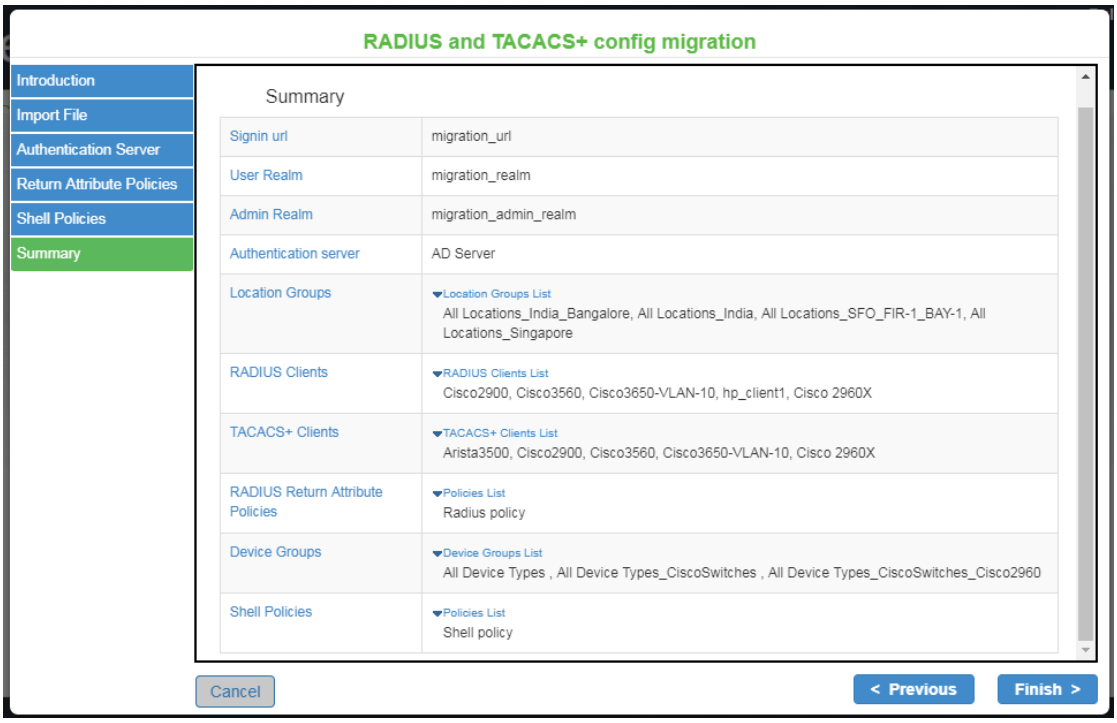


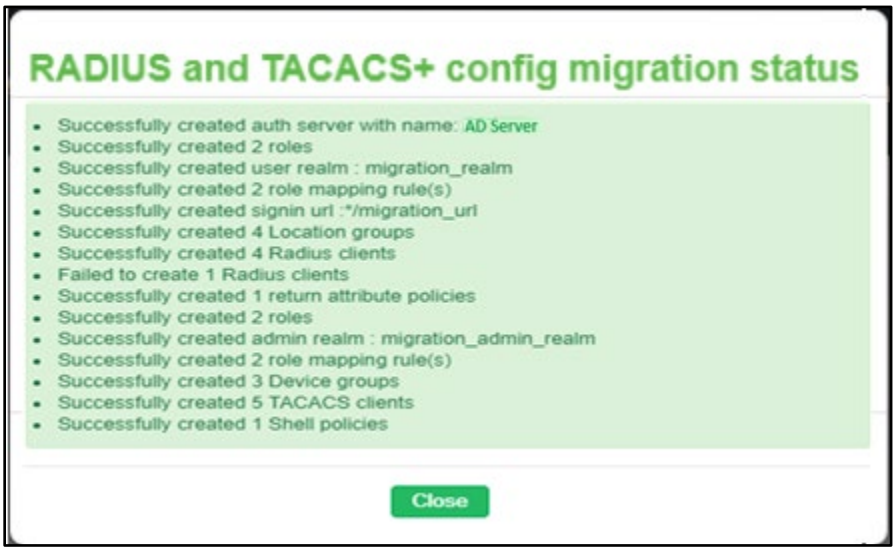
15. In the Shell Policies window, click **New Policy** and enter a name to the Shell policy.
16. Define external group, device type, shell profile and the command set.
17. Click **Save Changes** to save the configuration.
18. Click **Next**.





19. In the Summary window, verify the details and click **Finish** to complete the RADIUS and TACACS+ configuration migration.





References

For more information on 802.1X authentication and troubleshooting, see 802.1X Authentication with Cisco Switch cook book

Layer 2 Enforcement

Layer 2 enforcement means controlling network access at the point where the user attaches to the network. In a wired network, this control is at the switch port; in a wireless network the control is at the wireless access point. The network access control is accomplished through 802.1X authentication protocol (implemented on the switch or wireless AP) in conjunction with RADIUS return attributes to control switch or AP operation such as VLAN assignment and filtering.

Using the 802.1X standard we can create a strong network perimeter defense through strong admission controls that do not allow users onto the network unless they are compliant with specified policy.

This part covers the following chapters:

Policy Enforcement using 802.1X

This chapter provides an overview of the 802.1X. It includes the following information:

Overview

802.1X is an IEEE standard for port-based network access control. It provides an authentication mechanism for devices and users attempting to connect to wired and wireless LANs so that only authorized connections are allowed.

The basic components of 802.1X are:

- Endpoints- The endpoint is the device being authenticated. The supplicant is an agent running on the endpoint. For example, Pulse client, native supplicant, and non-Pulse Secure supplicant.
- Authenticator/Switch-The authenticator is a network device a managed switch or wireless access point that facilitates authentication by relaying credentials between the supplicant and authentication server.
- Authentication Server– PPS acts as an authentication server (typically a RADIUS server) and validates the credentials of the supplicant requesting access.

The 802.1X standard specifies the Extensible Authentication Protocol (EAP) as its encrypted message format for transmission between supplicant and authenticator.

Benefits of 802.1X Authentication

The following are the benefits of 802.1 authentication:

- Supports dynamic authentication policy using 802.1X, RADIUS, and RADIUS proxy.
- Supports RADIUS Change of Authorization (CoA) and RADIUS Disconnect, which allows devices to change the VLAN/ACL for the endpoint based on roles.
- Supports hybrid NAC deployment (802.1X for wireless network and SNMP for wired network).
- Supports backend third-party RADIUS servers through RADIUS proxy.
- Supports native client, pulse client, and third party supplicants.

Deployments using 802.1X Authentication

The 802.1X provides authenticated access to LAN, which applies to both wireless and wired networks. In a wireless network, the 802.1X authentication occurs after the client has associated to an access point using an 802.11 association method. The wired networks use the 802.1X standard without any 802.11 association by connecting to a port on an 802.1X enabled switch.

Using 802.1X, the user is authenticated to the network by means of user credentials, such as a password, certificate, or a token card. The keys used for data encryption are generated dynamically. The authentication is not performed by the switch, but rather by PPS as the RADIUS server. The 802.1X method uses EAP messages to perform authentication. The newer EAP protocols can dynamically generate the Wired Equivalent Privacy (WEP), Temporary Key Integrity Protocol (TKIP), or Advanced Encryption Standard (AES) keys that encrypt data between the client and the wireless access point. Dynamically created keys are more difficult to break than preconfigured keys because their lifetime is much shorter. The known cryptographic attacks against WEP can be prevented by reducing the length of time that an encryption key remains in use. The encryption keys generated using EAP protocols are generated on a per-user and per-session basis. The keys are not shared among users, as they must be with preconfigured keys or preshared passphrases.

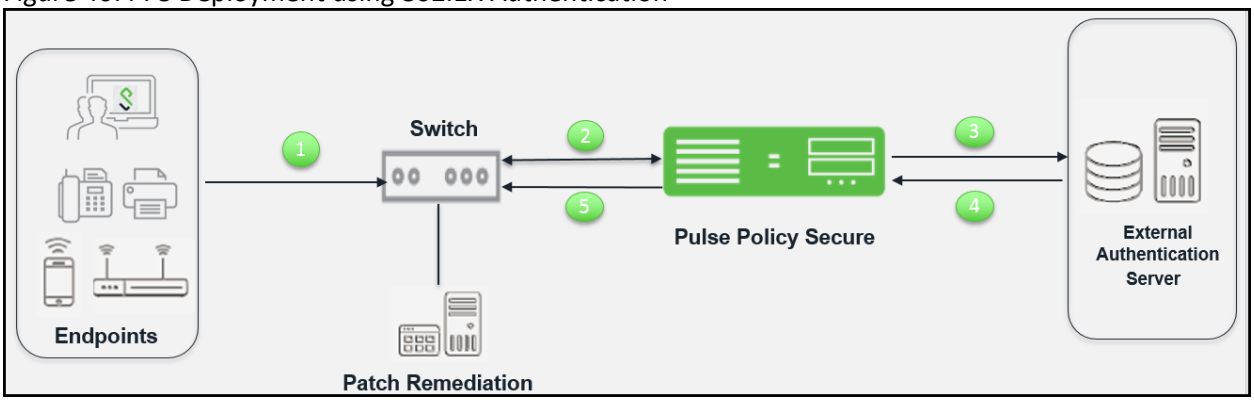
This topic covers the following deployment scenarios:

- Deployment of PPS with External Authentication Server
- Deployment of PPS as a RADIUS Server
- Deployment of PPS as a RADIUS Proxy

Deployment of PPS with External Authentication Server

It is difficult or impossible to maintain a centralized database of users in environments with many distributed users. You can easily pair PPS with an organization's other identity databases, such as LDAP and Active Directory to leverage existing credentials. PPS RADIUS server can forward authentication requests from a network access device (NAD) to an external Authentication server.

Figure 40: PPS Deployment using 802.1X Authentication



The authentication process is described below:

1. The endpoint connects to an 802.1X enabled switch/WLC. The endpoint exchange EAP messages using 802.1X, which contain information about user credentials and the health of the endpoint.
2. The switch receives the request and starts the RADIUS authentication with PPS.
3. PPS receives the request and then converts the request to the required format for the external authentication server.

4. If PPS successfully authenticates the user, it sends a message to the switch/WLC to allow the endpoint access to the network. The type of access granted depends on the user's identity and the health of the endpoint. For example, if the endpoint meets the requirements of all Host Checker policies, the user can have full network access. If the endpoint does not meet some security requirements, the user can be granted access to a remediation server. If the endpoint is using Pulse Client as its 802.1X supplicant, PPS and the endpoint exchange messages as necessary throughout a session (for example, to monitor the endpoint's security compliance). If the endpoint is using a native supplicant, Host Checker is not supported.
5. If the endpoint is using Pulse Client, and the endpoint meets the requirements of all Host Checker policies then PPS allows user to access the protected resources.

The user's identity and the endpoint health assessment are used to determine which VLAN to use for the switch port that the endpoint is connected to. Typically, if the endpoint does not meet minimum criteria for health assessment as defined by the administrator, the endpoint will be placed on a restricted VLAN which allows access to servers which can aid in remediating the endpoint.

You define VLAN policies for endpoints that access switches using 802.1X. After an authenticated endpoint, has been mapped to a set of roles, the VLAN policies are evaluated and the VLAN information is communicated to the switch through RADIUS attributes. RADIUS attributes vary by make and model of switch. You specify the make and model when configuring a RADIUS client on PPS.

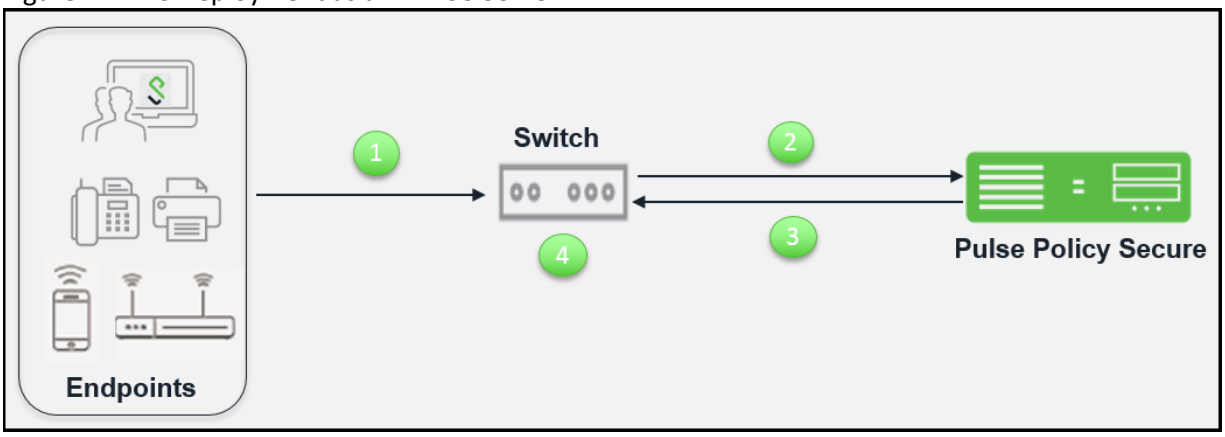
In addition to authenticating endpoints with 802.1X PPS RADIUS server can be used to authenticate 802.1X IP phones, switches.

Deployment of PPS as a RADIUS Server

PPS provides the RADIUS server functionality for layer 2 enforcement. Using the PPS internal RADIUS server, you can provision 802.1X authentication for endpoints. Layer 2 authentication and enforcement is used to control network access policies at the edge of the network using an 802.1X enabled switch or access point.

A RADIUS license allows you to use the PPS series device as a RADIUS appliance. To apply your initial license or to upgrade your license, select System > Configuration > Licensing in the left navigation pane.

Figure 41: PPS Deployment as a RADIUS Server



The authentication process is described below:

1. The endpoints connect to switch over 802.1X using EAP protocol.
2. The switch receives the request and starts the RADIUS authentication with PPS.
3. PPS integrated RADIUS server receives the request and performs the authentication and then returns the attributes for controlling user access.
4. The switch uses the returned attributes to control the user access privileges on the port or service set identifier (SSID).

The following RADIUS configuration options are available only with RADIUS license.

- Host Checker Custom: Statement of Health policy- When you apply both a RADIUS license and an MS-NAP license, you can configure an Endpoint Security policy by way of the Host Checker policy. If you have only a RADIUS license, the Endpoint Security menu is not available.
- RADIUS User Count- This feature allows you to create RADIUS users. To view the number of RADIUS users, select System > Status. The number of RADIUS users does not count against the concurrent user license if you have both a RADIUS license and a user license installed.

The following features are not available with RADIUS only license:

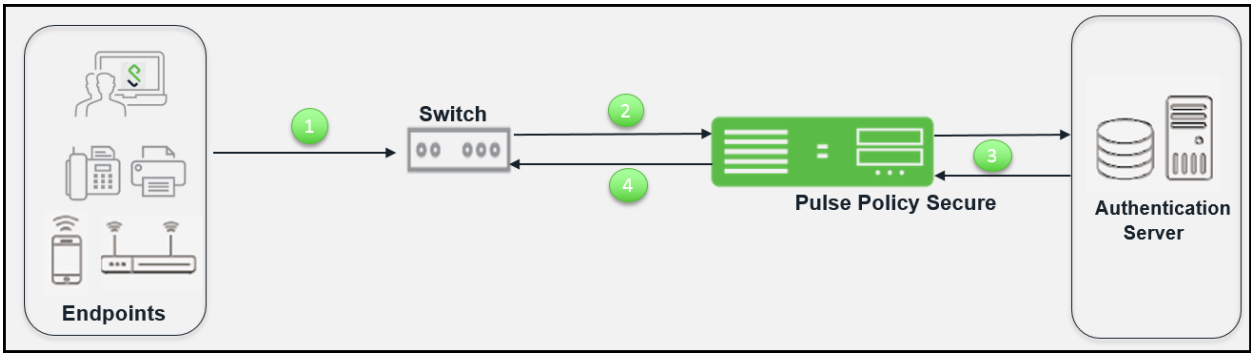
- IF-MAP Federation
- Infranet Enforcer
- Host Enforcer
- Endpoint Security
- Push Configuration
- SiteMinder and MDM Authentication servers
- Sign-in Notifications
- Sensors
- Agent and Agentless tabs do not appear on the Overview page.
- Enterprise onboarding

Deployment of PPS as a RADIUS Proxy

In environments with many distributed users, it can be difficult or impossible to maintain a centralized database of users. Using RADIUS proxy, PPS RADIUS server can forward authentication requests from a network access device (NAD) to an external RADIUS server.

You can configure PPS to proxy RADIUS inner or outer authentication to an external RADIUS server. Proxying inner or outer authentication gives you the flexibility to direct requests for authentication through whatever realm is most appropriate for each user.

Figure 42: PPS Deployment as a RADIUS Proxy



The authentication process when using an external authentication server is described below:

1. The endpoints connect to switch.
2. The switch receives the request and starts the RADIUS authentication with PPS.
3. PPS receives the request and then forms another RADIUS request and forwards it to the external RADIUS server.
4. If authentication succeeds the PPS assigns the user the appropriate roles, and then passes the associated RADIUS attributes back to the access device.

With RADIUS proxy enabled, PPS acts as a simple relay agent and does not participate in the accounting and authorization process. You must configure all attributes for authenticator configuration on the external RADIUS server.

You can specify the outer or inner proxy as follows:

- Outer proxy requires that the external RADIUS server presents a certificate to the supplicant. The result is a secure tunnel between the supplicant and the external server.
- Inner proxy uses the PPS certificate to establish the secured tunnel, but relays the supplicant authentication data to the external RADIUS server. The secured tunnel is established between the supplicant and PPS. The data passes between the PPS and the external RADIUS server in clear text.

Configuring 802.1X on PPS

This section covers the configuration for 802.1X authentication. It involves configuring the various elements necessary for performing 802.1X authentication between the endpoint and PPS.

- Configuring Authentication Protocol Set
- Creating and modifying the sign-in policy
- Configuring a Location Group
- Configuring the network access device as a RADIUS Client
- Configuring Role and Role Mapping
- Configuring RADIUS Attributes Policies
- Verifying the RADIUS Dictionary
- Verifying RADIUS Vendor List
- Additional Configurations

Note: 802.1X authentication is also supported on external port. As a prerequisite, the Admin must enable Global Setting with Auth Traffic Control option. For configuration procedure, see AAA Traffic Management.

Configuring Authentication Protocol Set

Authentication protocol is a method of defining how endpoints are authenticated through PPS. PPS supports a set of authentication protocols. You can configure sign-in policy with combination of authentication protocol set and associate them with realms to determine how endpoints connect and authenticate using 802.1X. The PPS supports a variety of EAP and non-EAP authentication methods to allow you to determine how endpoints authenticate. For example, you can use the default EAP methods with Pulse client, or you can use different methods to permit authentication with different endpoints, such as non-Pulse Secure 802.1X supplicants and IP phones.

For PPS agents (Pulse, the Java agent, and Host Checker agentless access), authentication is supported through EAP-TTLS and EAP-PEAP as the outer protocols and EAP-JUAC (a proprietary protocol) by default.
EAP-TTLS first authenticates the server and sets up an encrypted Transport Layer Security (TLS) tunnel for secure transport of authentication information. Within the TLS tunnel, a second authentication protocol is used to authenticate the user. EAP-TTLS is the “outer” authentication, while the second protocol is the “inner” authentication.

The following is a list of supported EAP types:

- EAP-PEAP uses server-side public key certificates to authenticate clients with server. The PEAP authentication creates an encrypted SSL / TLS tunnel between the client and the authentication server. The exchange of information is encrypted and stored in the tunnel ensuring the user credentials are kept secure.
- EAP-JUAC is a proprietary protocol that enables host check, firewall provisioning, and IP address restrictions.
- EAP-TTLS uses server-side certificates to set up authentication between clients and servers.
- EAP-SoH allows the endpoint to exchange state of health messages with PPS to assess endpoint qualification for passing Statement of Health rules in a Host Checker policy. It is used only with Windows native 802.1X supplicants.
- EAP-Generic Token Card (EAP-GTC) supports the use of authentication tokens.
- PAP supports the exchange of plaintext passwords.
- CHAP support includes MS-CHAP, MS-CHAPv2, EAP-Message Digest 5 (EAP-MD5), and EAP-MS-CHAPv2
- Password Authentication Protocol (PAP) with plain-text passwords.
- EAP Transport Layer Security (EAP-TLS) allows non-Pulse Secure 802.1X supplicants to authenticate through a certificate authentication server.

PPS supports these authentication protocols as non-tunneled authentication methods as well as inner authentication methods, depending on the policies that you configure. You can configure protocol sets with or without EAP, with the

exception of MD5, EAP-GTC, EAP-TLS, and EAP-SOH, which are supported only for EAP. To use EAP-SOH, you must use EAP-PEAP as an outer authentication protocol.

If you use a protocol set with inner and outer authentication, both protocols must match the inner and outer protocol that is configured for the endpoint.

PPS uses two default preconfigured protocol sets.

- 802.1X protocol set that is used by default with PPS agents.
- 802.1X-phones protocol set that is used for authenticating 802.1X IP phones.

Third-party supplicants cannot use the preconfigured 802.1X protocol set. For example, some switches can request authentication using CHAP, or EAP-MD5-Challenge. For such devices, you must define an authentication protocol set.

The below table lists the available authentication protocol combinations and provides usage recommendations for various combinations.

Table7: Authentication Protocols

Outer	Inner	Basis	Usage recommendation
PAP [1]	n/a	Password	Local auth server, Active Directory, LDAP [2] Cisco switch authentication
CHAP [1]	n/a	Password	Captive portal or authentication of switch administrators for HP ProCurve switch
EAP-MD5-Challenge [1]	n/a	Password	Captive portal or authentication of switch administrators, some IP phones
MS-CHAP [1]	n/a	Password	-
MS-CHAP-V2 [1]	n/a	Password	-
EAP-MS-CHAP-V2 [1]	n/a	Password	-
EAP-GTC [1]	n/a	Token	-
EAP-TLS	n/a	User Certificate	802.1X supplicant, some IP phones
EAP-PEAP			Non-Pulse Secure 802.1X supplicant
	EAP-MS-CHAP-V2	Password	Local or Active Directory server
	EAP-GTC	Token	802.1X supplicant
	EAP-TLS	User Certificate	-
	EAP-JUAC	Various	Pulse Client
	EAP-SOH	System Health	Windows supplicant with Statement of Health Host Checker policy
EAP-TTLS			Pulse Client, other supplicant
	PAP		LDAP authentication server
	CHAP		-
	EAP-MD5-Challenge		-
	MS-CHAP		-
	MS-CHAP-V2		-
	EAP-MS-CHAP-V2		Local or Active Directory server
	EAP-GTC		802.1X supplicant
	EAP-JUAC		Pulse Client

The following additional information is intended to help you understand the protocols that have been implemented for our 802.1x solution:

- Pulse always uses EAP-TTLS/EAP-JUAC.
- EAP-TTLS, EAP-PEAP, and EAP-TLS are based on TLS and therefore secure. We recommend protecting other protocols by putting them into an EAP-TTLS or EAP-PEAP tunnel, if the supplicant supports one of these tunnels.
- With LDAP, there are 3 protocol possibilities:
    - If the LDAP server is also an Active Directory server, configure the server on PPS as an Active Directory server, not as an LDAP server. On PPS, PEAP-MS-CHAP-V2 is enabled by default. You can also enable MS-CHAP and MS-CHAP-V2 if necessary.

- If passwords in the LDAP server are stored irreversibly hashed, CHAP family protocols will not work, only PAP and TTLS-PAP will work. On PPS TTLS-PAP is enabled by default. You can enable PAP if required, but this is the least secure protocol.
- Some LDAP servers allow you to store the passwords in clear text or reversibly encrypted. In this situation, all the CHAP family protocols will work.

During RADIUS authentication, if a user's password has expired then the user is prompted to change the password if the protocol is:

- EAP-MSChapV2
- PEAP with EAP-MSChapV2
- TTLS with EAP-MSChapV2
- TTLS with Non-EAP MSChapV2
- Plain Non-EAP MSChapV2
- EAP-JUAC

The following table summarizes additional usage guidelines.

- Password- The protocols that support password changing on PPS include JUAC, MS-CHAP-V2, EAP-MS-CHAP-V2, and EAP-GTC. If you use CHAP, PAP or MS-CHAP for a Layer 2 connection (for example, with an Active Directory Server), password changing is not supported through PPS.
- Expired passwords- You can direct users with expired passwords to a Web interface to access a default VLAN to allow users to log in with a clear text password and change their password.
- Password restrictions- Password restrictions (for example, password length) cannot be enforced if you use the CHAP family protocols for authentication.
- Default protocols for Pulse- The 802.1X protocol set is used by default for endpoints that connects with Pulse. If you disable the JUAC protocol (a proprietary protocol) on Pulse Client or on PPS, Pulse Client have only the features of a standard non-Pulse Secure supplicant.

To configure an authentication protocol set:

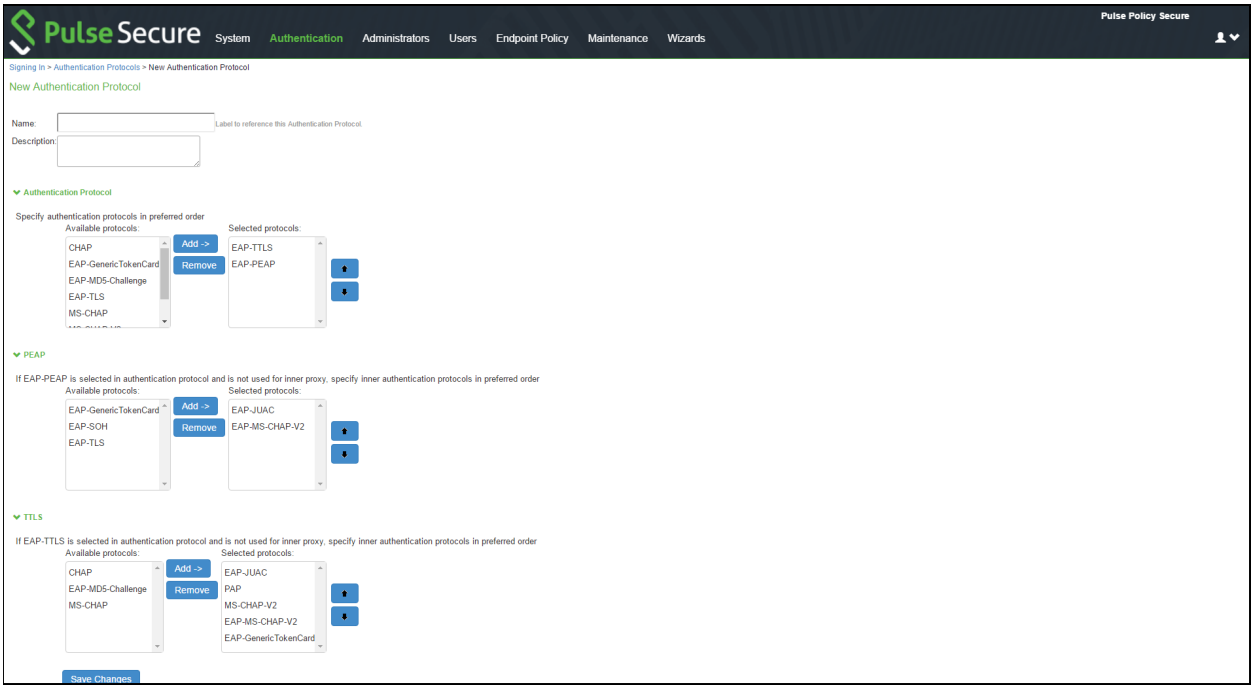
1. Select **Authentication > Signing In > Authentication Protocols**.

NOTE:

- The default 802.1X protocol set is configured with EAP-TTLS and EAP-PEAP as primary (outer) authentication protocols.
- EAP-JUAC, EAP-MSCHAP- V2 are used as inner authentication for EAP-PEAP.
- EAP-JUAC, PAP, MSCHAP- V2, EAP-MS-CHAP-V2, or EAP-Generic Token Card are used as inner authentication for EAP-TTLS.

2. To create a new protocol set, click **New Authentication Protocol**, or select the check box beside the existing 802.1X protocol set and click **Duplicate**.

Figure 43: Authentication Protocol Set Configuration Page



3. Enter a name, and optionally a description for the new authentication protocol set. You select the protocol set by name when you create a sign-in policy.
4. Under Authentication Protocol, select authentication protocol(s) from the Available Protocol list. Click **Add**.
5. For non-tunneled protocols, create an authentication protocol set, which includes CHAP, PAP or EAP-MD5 Challenge.
6. If you select EAP-PEAP as the main authentication protocol, under PEAP select an inner authentication protocol from the Available Protocol list. Click **Add**.
7. If you select EAP-TTLS as the main authentication protocol, under TTLS select an inner authentication protocol from the Available Protocol list. Click **Add**.

   Note: If you are using inner RADIUS proxy, do not select an inner protocol with EAP-PEAP or EAP-TTLS.
8. Click **Save Changes** to save your selections. When you configure a sign-in policy, you associate this authentication protocol set with an authentication realm.

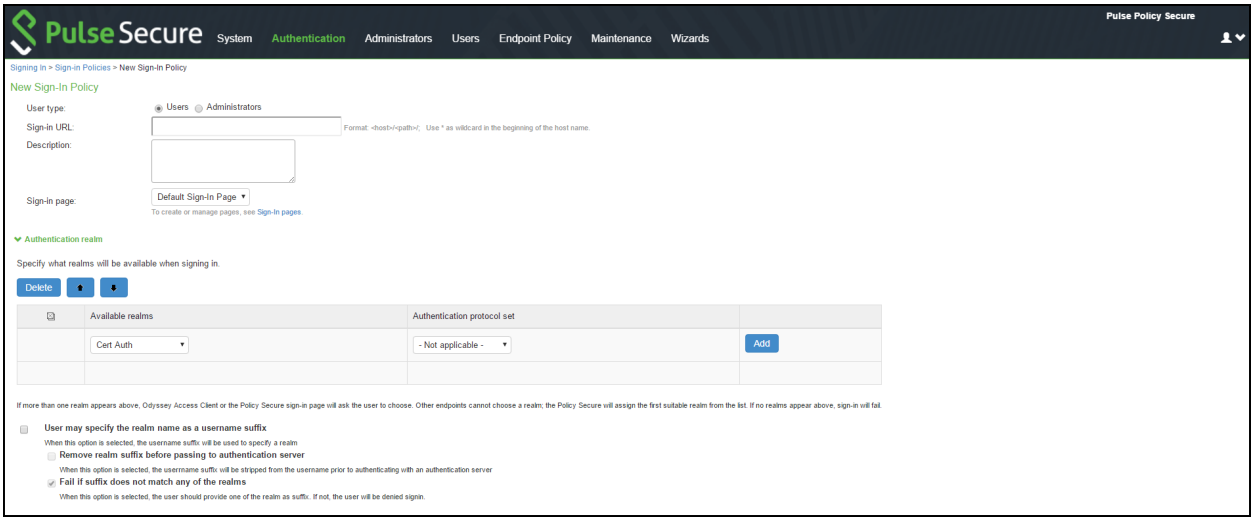
Creating and modifying the sign-in policy

Sign-in policies define both the URLs that users and administrators use to access the network and to view the sign-in pages. PPS has two types of sign-in policies—one for users and one for administrators. When you configure sign-in policies, you associate realms, sign-in pages, and URLs that are provided for users when they first log in.

To modify the authentication protocol set used by a specific authentication realm:

1. Select **Authentication > Signing In > Sign-In Policies** and click **New URL**.

Figure 44: Sign-in Policy Page



2. Under Authentication realm, add a new realm or modify an existing realm.
3. Select the desired authentication protocol set.
4. Click **Save Changes**.

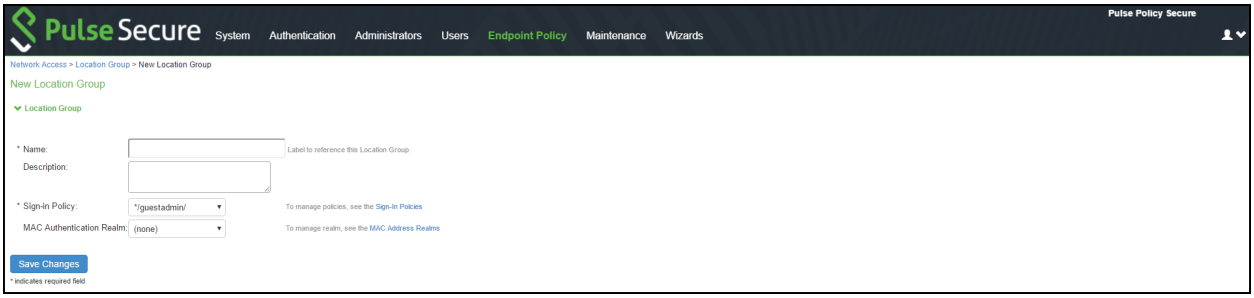
Configuring a Location Group

Location groups let you organize or logically group network access devices by associating the devices with specific sign-in policies. Sign-in policies provide a way to define and direct independent access control policies with the network. For example, you can create location group policies to logically group the switch/WLC in each building at a corporate campus. You can also use location group policies to specify a special realm for MAC address authentication.

To configure a location group:

1. Create a sign-in policy to associate with the location group.
2. Select **Endpoint Policy > Network Access > Location Group**.

Figure 45: Location Group Configuration Page



3. On the New Location Group page, enter a name to label this location group and optionally a Description.
4. For Sign-in Policy, select the sign-in policy associate with the location group.
5. Click **Save Changes**.

NOTE: Location groups allows you to block Layer 2 endpoints in specific locations from using particular authentication protocols, realms, and roles. For example, you can block endpoints in unsecure locations from accessing sensitive roles. However, RADIUS clients should not be placed in insecure locations. To ensure that RADIUS clients are not compromised and do not violate these policies, all the network RADIUS clients should be securely protected.

Configuring the network access device as a RADIUS Client

A RADIUS client policy specifies the information required for an 802.1X network access device to connect as a RADIUS client of the PPS.

When you select the device's make and model in a RADIUS client policy, you are selecting a dictionary file that contains the vendor-specific attributes (VSAs) for that device. Whenever PPS receives a RADIUS packet from that device, it consults the dictionary file for any nonstandard attributes that it encounters in the packet. If you do not know the make and model of a device, you can use the standard RADIUS attributes by choosing the Standard RADIUS setting in a RADIUS client policy.

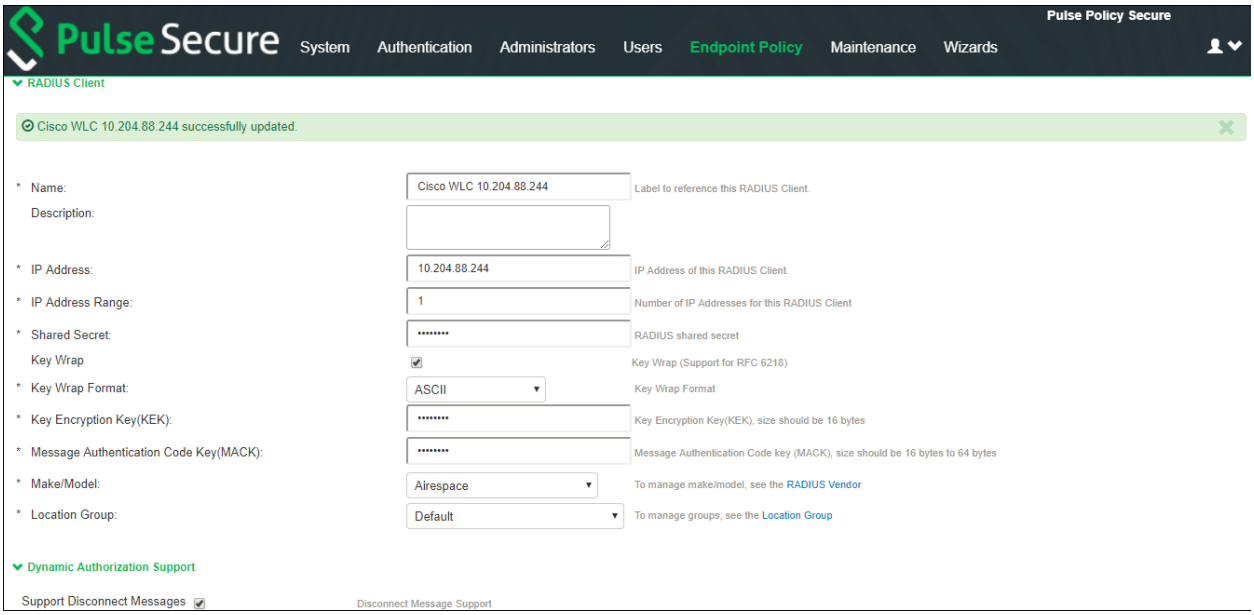
In addition to the configuration on PPS, you must configure the NAD with information about PPS, including:

- IP address
- Shared secret specified in the RADIUS client policy for the device

To configure a RADIUS client:

1. Select **Endpoint Policy > Network Access > RADIUS Client**.
2. Click **New RADIUS Client**.

Figure 46: RADIUS Client Configuration Page



3. On the RADIUS Client page, enter a name to label the RADIUS client. You can assign any name to a RADIUS client entry, use the device's SSID or IPv4/IPv6 address to avoid confusion.
4. (Optional) Enter a purpose or description of the configuration so that other users are aware of it.
5. Enter the IPv4/IPv6 address of the switch.

   Note: If you specify the Switch Address as IPV6, PPS will allow Pulse Client to connect only using Client's IPv6 address in 802.1x Connection Type.
6. (Optional) For **IP Address Range**, enter the number of IP addresses in the IP address range for the switch/WLC, starting with the address you specified for IP Address. You can specify a range up to a maximum of 32,768 addresses.
7. For **Shared Secret**, enter the RADIUS shared secret. A RADIUS shared secret is a case-sensitive password used to validate communications between PPS and NAD. PPS supports shared secrets of up to 127 alphanumeric characters, including spaces and the following special characters:
   ~!@#$%^&*()_+|\=-'{}[]:"';<>?/.,

8. For **Make/Model**, select the make and model of the NAD. The make/model selection tells PPS which dictionary of RADIUS attributes to use when communicating with this client.
   Note that **Ruckus Request Password** needs to be configured only for **SmartZone Guest Access**.
9. (Support for RFC 6218: Cisco/Airespace Switches). If you are configuring a new RADIUS authentication server and want to enable AES key wrap, which makes the shared secret between the controller and the RADIUS server more secure, follow these steps:
   a. Enable the Key Wrap checkbox.
   b. From the Key Wrap Format drop-down list, choose ASCII or HEX to specify the format of the AES key wrap keys: Key Encryption Key (KEK) and Message Authentication Code Key (MACK)
   c. Enter the 16-byte KEK used for encrypting the key generated by the server
   d. Enter the 16-64 bytes MACK used for authenticating the messages.

Note: AES key wrap is designed for Federal Information Processing Standards (FIPS) customers and requires a key-wrap compliant RADIUS authentication server.

10. For **Location Group**, select the location group to use with this NAD.
11. Under **Dynamic Authorization support**, Select the **Support Disconnect Messages** check box to send disconnect messages to supplicants if access is no longer authorized. If this check box is selected, a disconnect request is sent to the NAD any time a session is deleted. PPS can also send disconnect messages upon a role event that includes a VLAN change or a change in RADIUS attributes.
12. Select **Support CoA Messages** to enable CoA messages and disconnect messages support for the client. Ensure that Pulse Client is configured with EAP-JUAC in EAP-TTLS inner protocol as most preferred protocol.
    RADIUS CoA feature provides a mechanism to change the attributes of an authentication, authorization, and accounting (AAA) session after it is authenticated. Using the existing session, RADIUS CoA allows devices to change the VLAN/ACL for the endpoint based on roles. CoA works on role mapping associated with every user. As the device state changes, the user is put in to various roles based on the Host Checker assessment or compliance check. During the dynamic assessment, CoA requests such as filter-id or any other return attributes that suites the role is sent to the NAD to provide the required access for the device. PPS receives CoA-NAK request if the NAD is not able to apply filter-id or any other return attributes.
13. (Optional) Enter a new **Dynamic Authorization Port** (Default port is 3799). The default port might vary depending on the manufacturer. NAD listens to UDP port to receive RADIUS CoA messages from PPS.
14. Click **Save Changes**.

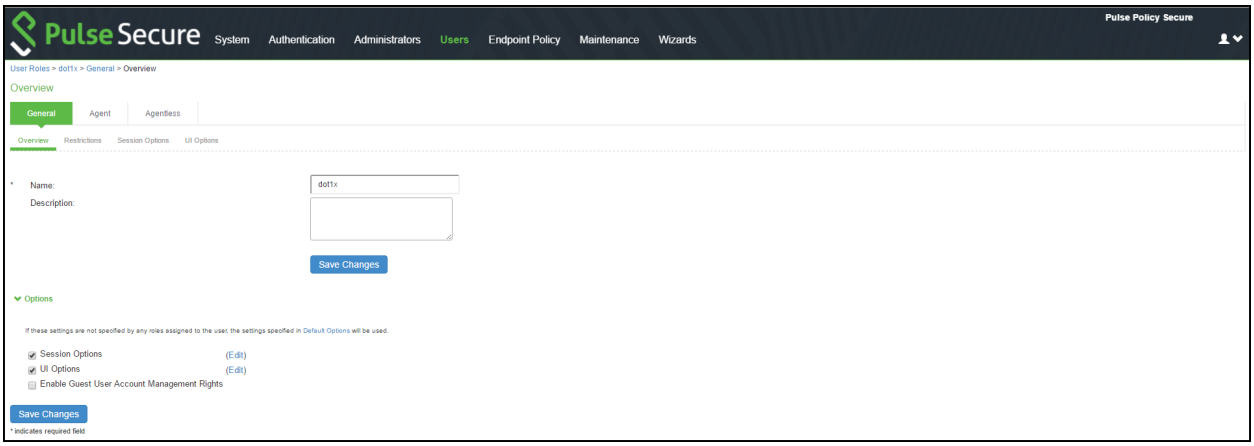
Configuring Role and Role Mapping

PPS access management framework evaluates authentication requests to match endpoints to roles. You must configure user roles for the various types of endpoints authenticated.

To create a user role:

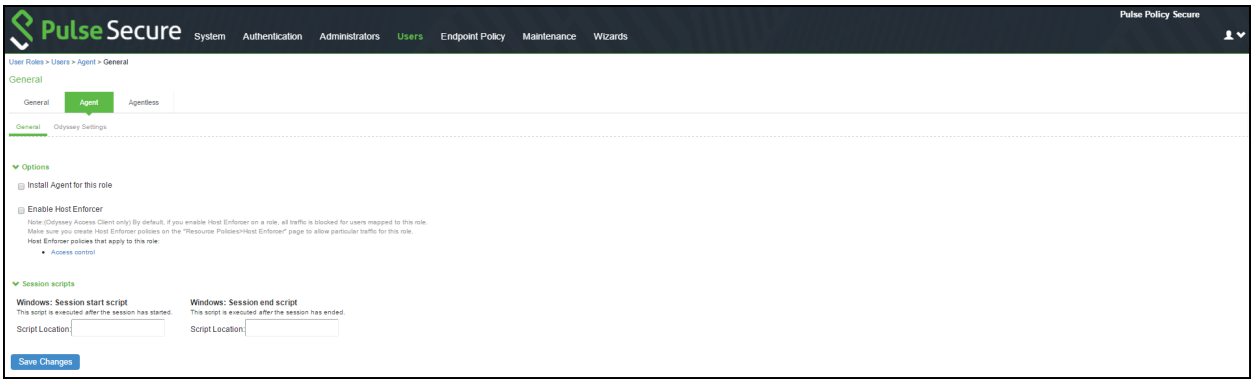
1. Select **Users > User Roles.**
2. Click **New Role**.
3. Complete the name and description configuration and then save the configuration.

Figure 47: User Role General Configuration



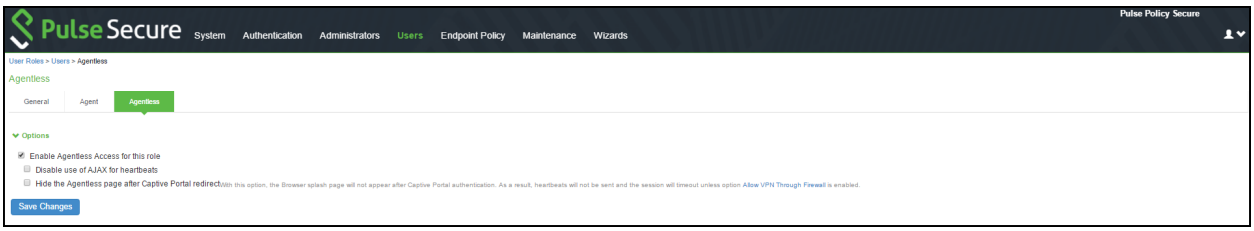
4. Click **Agent** and deselect agent options and then save the configuration.

Figure 48: User Role Agent Configuration



5. Click **Agentless** and enable agentless access and then save the configuration.

Figure 49: User Role Agentless Configuration

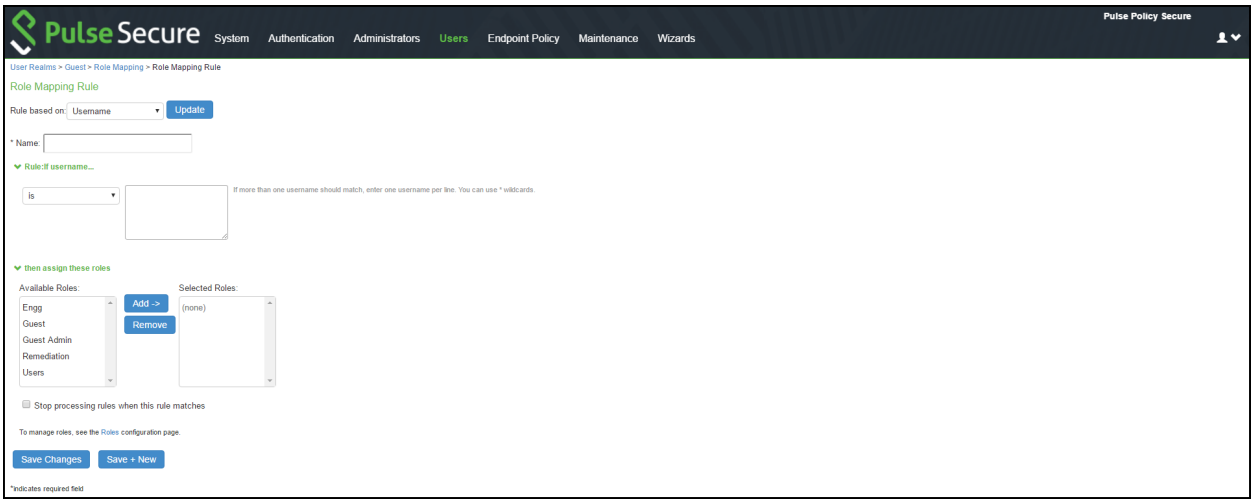


Role mapping rules define how endpoints are assigned to roles.

To configure the role mapping rules for User Realms:

1. Select **Users > User Realm**.
2. Click **New** to display the User Realm configuration page and create a user realm.
3. Click the **Role Mapping** tab to display the role mapping configuration page for the realm.
4. On the role mapping configuration page, click **New Rule** to display the role mapping rule configuration page.

Figure 50: Role Mapping



   a. (Optional) For Name, enter a name to label this role mapping rule.
   b. Select the rule from the Rule based list and provide the appropriate details.
   c. Select the appropriate role and click **Add**.
5. Click **Save Changes** to save the configuration.

Configuring RADIUS Attributes Policies

This section describes the configuration information for RADIUS return attributes policy that is applied on switch, request attribute policy, which can be used along with sign-in policies for realm selection, policy realm restrictions, and authentication/accounting reporting for RADIUS authentication events.

The following procedure lists the configuration information for RADIUS attributes:

- Configuring RADIUS Return Attributes
- Configuring RADIUS Request Attribute Policies
- Configuring a RADIUS Request Policy Realm Restriction
- Configuring RADIUS Attribute Logging
- Verifying the RADIUS Request Attribute Policy Configuration

Configuring RADIUS Return Attributes

RADIUS attributes policies sends the return list of attributes to an 802.1X switch. For example, you can specify which VLAN endpoints must be used to access the network. You can also configure other functions on a NAD's port based on the role assigned to the user who is currently using that port. For example, a Switch might let you use return list of attributes to configure Quality-of-Service (QoS) functions (Bandwidth or Priority) on the device's port based on the current user's role.

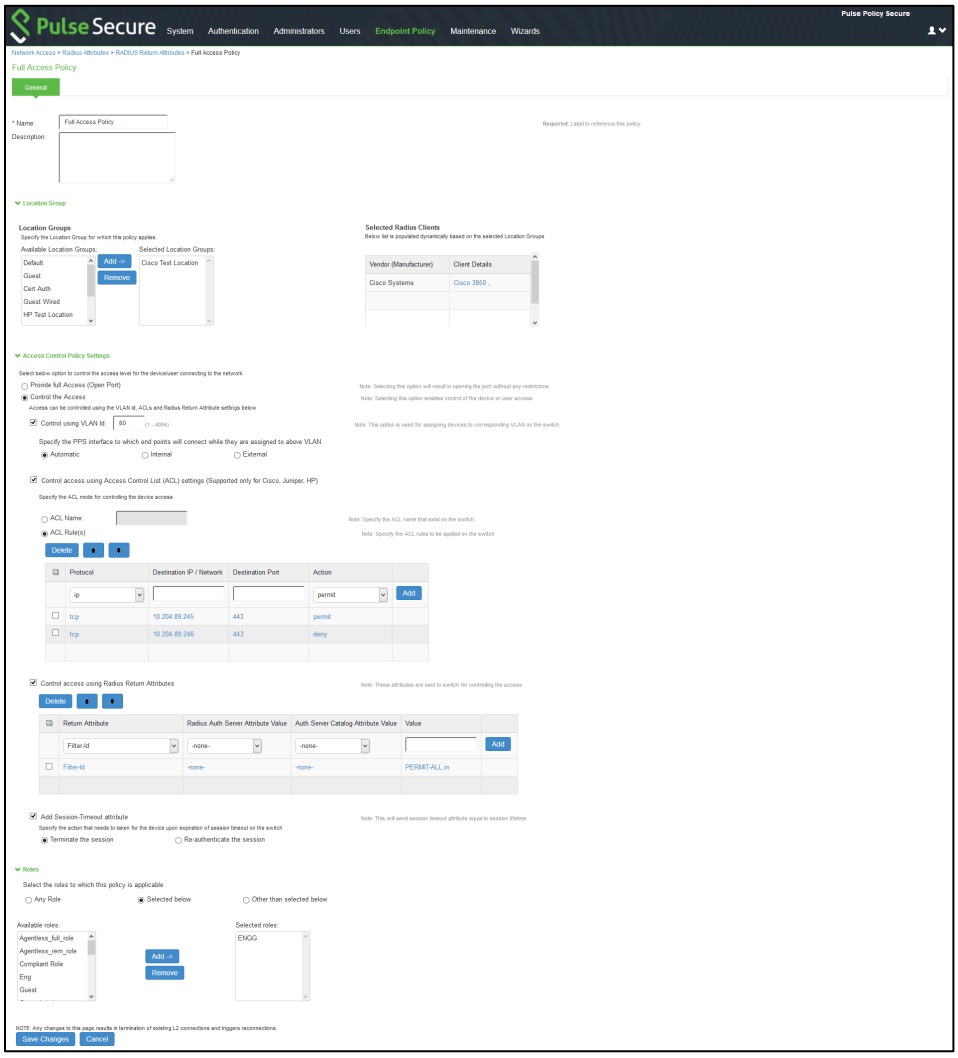
A return list is a set of attributes that PPS returns to the NAD after authentication. The return list usually provides additional parameters that the NAD needs to complete the connection. Return list attributes are authorization configuration parameters.

In the RADIUS attributes policy, you can select RADIUS attributes by name from a predefined list. For each attribute, you specify values using strings or numbers. By default, PPS sends a session timeout value on all RADIUS accepts that is equal to the timeout value of the configured session length. You can bypass the default timeout.

To configure a RADIUS attributes policy:

1. Select **Endpoint Policy > Network Access > RADIUS Attributes**.
2. Click **New Policy**.

Figure 51: RADIUS Attribute Policy Configuration Page



3. On the New Policy page, enter a name for the policy.
4. (Optional) For Description, enter a description for the policy.
5. Under Location Group, select the location groups to which you want to apply this policy, and click **Add**. To apply the policy to all location groups, do not add any location groups and use the default setting (all) listed in the Selected Location Groups list. The selected Radius clients table is dynamically updated based on the selected Location Groups.
6. Under Access Control Policy Settings, select from the following options:

a. **Provide full Access (Open Port)**—Check this option if you do not want to assign endpoints to a VLAN or return any RADIUS attributes. Selecting this check box disables all other RADIUS Attributes options.
b. **Control the Access**—Select this option to control access using VLAN ID, ACLs and RADIUS return attributes.
    i. Control using VLAN Id: Enter the VLAN ID (1-4094) used for assigning devices to corresponding VLAN on the switch.
        1. For Interface, specify PPS network interface that endpoints affected by this policy to use to connect to PPS:
            a. **Automatic (use configured VLANs)**—Select this option to use VLAN tagging. You must also connect the internal interface to the trunk port on a VLAN-enabled Switch that sees all the VLAN traffic.
            b. **Internal**— Select this option if the endpoints using this RADIUS attributes policy should use the IP address of the internal interface.
            c. **External**—Select this option if the endpoints on the configured VLAN should use the IP address of the external interface.
    ii. Control access using Access Control List (ACL) settings (Supported only for Cisco, Juniper, HP)
        1. Specify the ACL Name for controlling the device access or specify the ACL Rule to be applied on the Switch.
        2. Select the Protocol (IP/TCP/UDP/ICMP), Destination IP/Network Mask, Destination Port, Action (Permit/Deny) and Click **Add**.

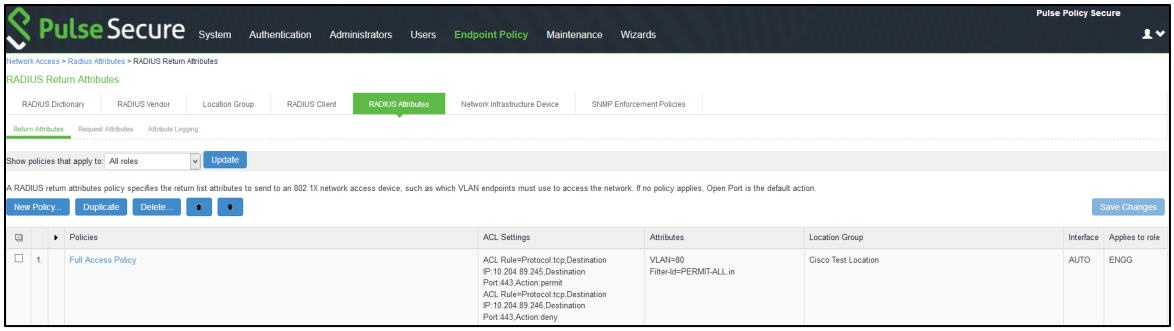
Note: The supported RADIUS clients for ACL mode are Cisco, Juniper, and HP switches. If there are any unsupported clients listed in the Supported RADIUS client table then the ACL configuration will be disabled.

    iii. **Control Access using Radius Return Attribute**—Select this option to specify the return attributes you want sent to the Switch/WLC.
        - Select the return attribute to send from the attribute list. Enter the value for the selected attribute and then click **Add**.
        - You can specify multiple return attributes and values for this policy.
        - To rearrange the order in which you want to send the return attributes, select the check box next to the attribute name and then click the up or down arrow.
        - To delete an attribute, select the check box next to the attribute name then click **Delete**.
    iv. **Add Session-Timeout attribute**—Select this option to specify the action (Terminate the session or reauthenticate the session) taken upon on the expiration of session timeout.

7. Under Roles, specify:
    - **Any role**—To apply the policy to all users.
    - **Selected roles**—To apply this policy only to users who are mapped to roles in the Selected roles list. You must add roles to this list from the Available roles list.
    - **Roles other than those selected below**—To apply this policy to all users except for those who map to the roles in the Selected roles list. You must add roles to this list from the Available roles list.
8. Click **Save Changes**.

Note: VLAN change using CoA is not supported with Cisco Switches. It is recommended to use RADIUS disconnect for VLAN change.

The policy output example is shown below.



Example configuration for parsing ACL rule name (HP, Cisco, and Juniper)

PPS ACL rule configuration	tcp | 10.xx.xx.x | 443 | Permit
HP 2920 expansion	HP-nas-filter-rule=permit in tcp from any to 10.xx.xx.x 443
Cisco 3850 expansion	ip:inacl#100=permit tcp any host 10.xx.xx.xxx eq 443
Juniper – EX 2200 expansion	Juniper-Switching-Filter='Match Destination-ip 10.xx.xx.x Ip-protocol 6 Destination-port 443 Action allow'

Example configuration for parsing ACL name (HP, Cisco, and Juniper)

Vendors	**Cisco**	**HP**	**Juniper**
RADIUS VSA	filter-id	filter-id	filter-id
Example- RADIUS VSA value	<ACL-NAME>.in	<ACL-NAME>.in	ACL-Name

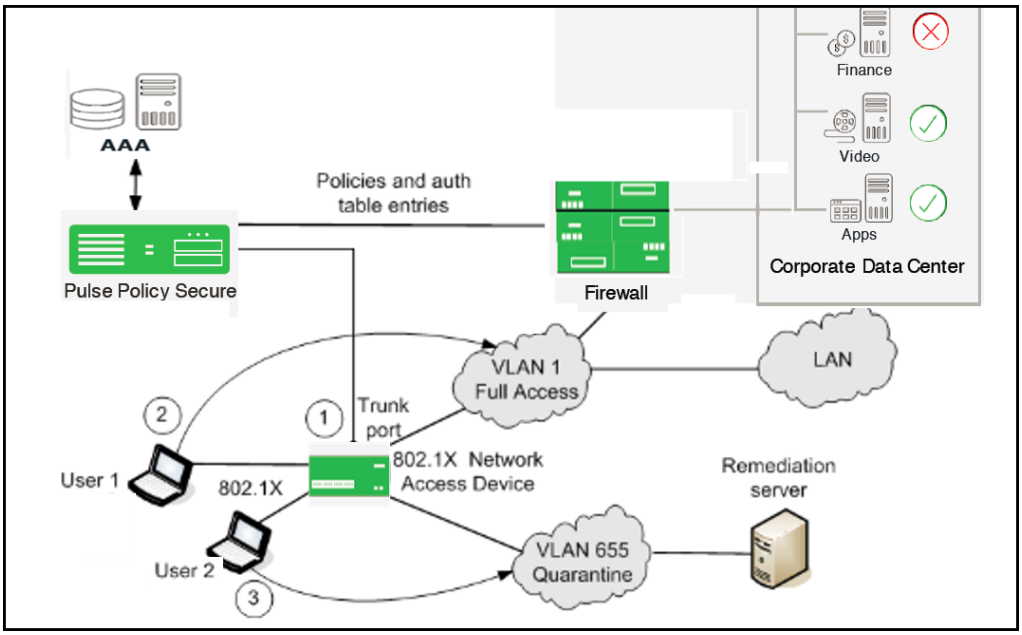
Example: RADIUS Attribute Policies

You can configure RADIUS attributes in the PPS to send return list attributes to an 802.1X network access device. For example, you can specify which VLAN the endpoint must use to access the network. You can also configure other functions on the network devices port based on the role assignment. For example, a particular Switch might let you use return attributes to configure QoS functions (bandwidth, priority, or both) on the device port based on the user role.
The example illustrates a RADIUS attribute policy to specify VLANs for endpoints, using the following steps:

- If you are using more than two VLANs, connect PPS internal interface to the trunk port on a VLAN-enabled switch that detects all the VLAN traffic.
- You can also configure a RADIUS attributes policy with the Automatic setting, which enables PPS to take advantage of VLAN tagging. When connected to a trunk port on a VLAN-enabled switch, PPS detects traffic from all VLANs.
- You can also configure routing on the network to enable endpoints to access PPS over the network. In this case, you must configure RADIUS attributes policies with the VLAN IDs you are using for endpoints, but you do not need to configure any VLAN ports on PPS.

The below figure illustrates an example of using a RADIUS attributes policy to specify VLANs for endpoints.

Figure 52: Using a RADIUS Attributes Policy to Specify VLANs for Endpoints



- If the user 1 is authenticated and the endpoint complies with Host Checker security policies, then the user is assigned a role on the Full Access VLAN that allows full network access and access to protected resources.
- If user 2 is authenticated but the endpoint does not comply with Host Checker security policies. The user is assigned a role on the Quarantine VLAN that only allows access to a remediation server.

Example: Configuring various RADIUS Return Attribute Policies

This section covers the following configurations:

- Configuring VLAN assignment using RADIUS return Attribute policy
- Configuring VLAN assignment along with other RADIUS return attribute policies
- Configuring filter-id using RADIUS return attribute policy
- Configuring VLAN assignment in a multi-vendor switch environment

Configuring VLAN Assignment using RADIUS return Attribute Policy

This configuration describes how to send VLAN assignment to the Switch/WLC by returning RADIUS attributes.

1. Select **Pulse Policy Secure > Network Access > RADIUS Return Attributes**
2. Under Access Control Policy Settings, select **Control the Access > Control using VLAN ID**.
3. Specify a **VLAN ID**.

Configuring VLAN Assignment along with other RADIUS return Attributes Policies

This configuration describes how to send VLAN assignment and other attributes to the Switch/WLC by returning RADIUS attributes.

1. Select **Pulse Policy Secure > Network Access > RADIUS Return Attributes**
2. Under Access Control Policy Settings, select **Control the Access > Control using VLAN ID**.
3. Specify a VLAN ID.
4. Select Control Access using Radius Return Attributes.
5. Select the attribute you want to return from the Attribute list.
6. For Value, specify an attribute value.

Configuring Filter-ID using RADIUS Return Attribute Policy

This configuration describes how to send Filter-ID to switch/WLC by using the Filter-ID return attribute.

1. Select **Endpoint Policy > Network Access > RADIUS Return Attributes**.
2. Under Access Control Policy Settings, select Control Access using Radius Return Attributes.
3. Select **Filter-ID** from the Attribute list.
4. For value, specify the policy name.
5. Configure the filter on the NAD.

Configuring VLAN Assignment in a multi-vendor Switch Environment

This configuration describes how to send VLAN assignment in a multi-vendor switch environment that includes switch/WLC from different vendors. For example, you might have one type of switch that supports RADIUS tunnel attributes only, a second type of switch that supports the Filter-ID return attribute only, and a third type of switch that supports both.

1. Select **Endpoint Policy > Network Access > Location Group** and create a location group policy for each type of NAD.
2. Create a location group policy for switches that support RADIUS tunnel attributes only.
3. Create a second location group policy for switches that support the Filter-ID return attribute only.
4. Create a third location group policy for switches that support both RADIUS tunnel attributes and the Filter-ID return attribute.
5. Select **Endpoint Policy > Network Access > RADIUS Client**. Then, follow these steps to create a RADIUS client policy for each type of NAD and associate each RADIUS client policy with the appropriate location group.
6. Create a RADIUS client policy and specify a make/model for Make/Model that supports the RADIUS tunnel attributes. Associate this policy with the location group policy for switches that support RADIUS tunnel attributes only.
7. Create a second RADIUS client policy and specify a make/model that supports the Filter-ID return attribute. Associate this policy with the location group policy for switches that support the Filter-ID return attribute only.
8. Create a third RADIUS client policy and specify a make/model that supports the both RADIUS tunnel attributes and the Filter-ID return attribute. Associate this policy with the location group policy for switches that support both RADIUS tunnel attributes and the Filter-ID return attribute.
9. Select **Endpoint Policy > Network Access > RADIUS Attributes** and then follow these steps:
    - Create a RADIUS Attributes policy that specifies only the VLAN option and a value for VLAN ID. Associate this policy with the location group policy for switches that support RADIUS tunnel attributes only.
    - Create a second RADIUS Attributes policy that specifies only the Filter-ID option from the Attribute list and a policy name for Value. Associate this policy with the location group policy for switches that support the Filter-ID return attribute only.
    - Create a third RADIUS Attributes policy that specifies both the VLAN option and a value for VLAN ID, and the Filter-ID option with a policy name for Value. Associate this policy with the location group policy for switches that support both RADIUS tunnel attributes and the Filter-ID return attribute.

Configuring RADIUS Request Attribute Policies

RADIUS request attribute policies allows you to enforce the authentication requests based on information in the RADIUS packet. RADIUS request attribute policies consist of rules. Each rule consists of one attribute and some number of values. The type of value depends on the type of rule chosen. For example, if you select a rule with the User-Name attribute, you enter a string.

NOTE:

- RADIUS request attribute policy names must be unique.
- Each request page includes guidance on what type of value is expected.

If you select a rule with the Login-IP-Host attribute, you enter an IP address and an optional netmask. The default netmask value is 255.255.255.255. The value of the attribute must fall within the specified IP address and netmask to pass the policy.

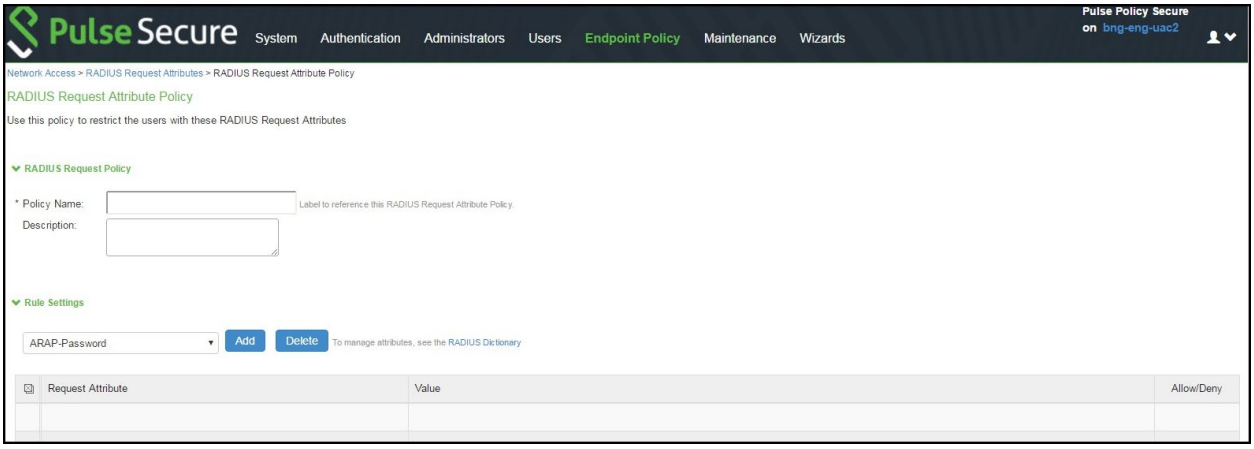
The RADIUS Access-Request attribute policy performs two tasks:

- Determines communication with the RADIUS client, indicating that the specified attributes must be sent in the Access-Request message.
- Parses the attribute-value pairs that are sent in the Access-Request message against the allow/deny rules you configure. The result of rules processing can be enforced in a realm restriction.

To configure a RADIUS Request attribute policy:

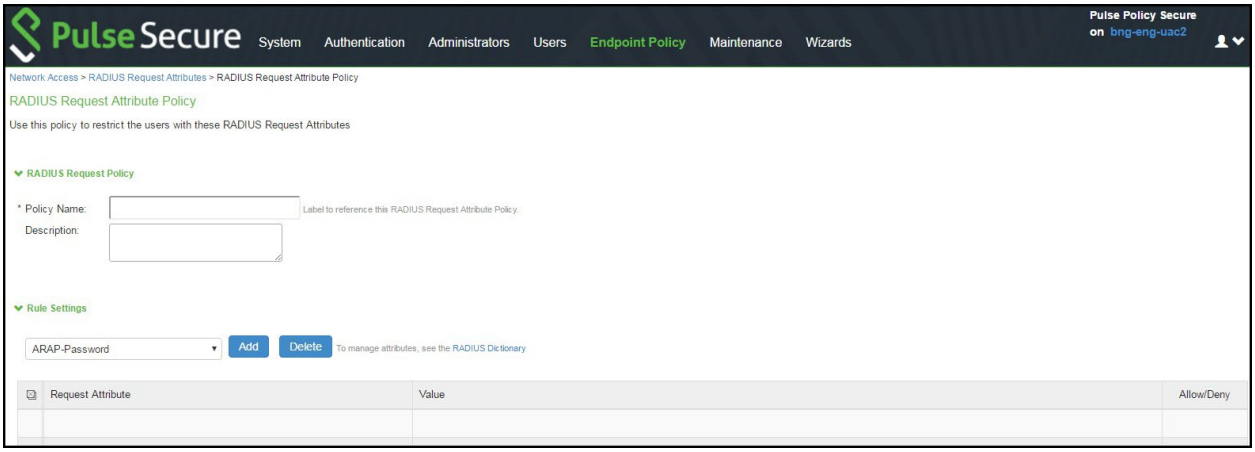
1. Select **Endpoint Policy > Network Access > RADIUS Attributes > Request Attributes** to display the configuration summary page.
2. Click **New** to display the policy configuration page.

Figure 53: RADIUS Request Attribute Policy Configuration Page



3. Specify a policy name and description.
4. Under Rule Settings, select a RADIUS Access-Request attribute and click Add to display the rule configuration page.

Figure 54: RADIUS Request Attribute Policy Configuration Page



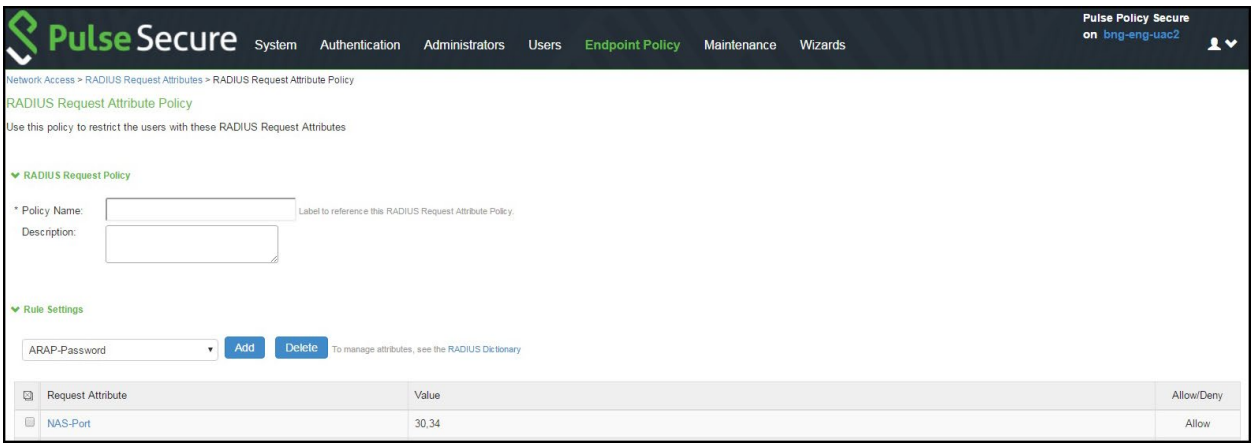
5. Complete the rule configuration as described below.

Table 8: RADIUS Request Attribute Policy – Rule Configuration Guidelines

Settings	Guidelines
Add	Specify values or a pattern for rule matching. The system parses wildcards and value expressions as follows: String—An asterisk (*) matches multiple characters and a question mark (?) matches a single character. Integer—An asterisk (*) matches any value. You can use a hyphen to specify a range of values, for example **1-99**. Hexadecimal—An asterisk (*) matches any value. Click **Add** again to add more attribute values, as necessary. The result of adding multiple values is a comma-separated list.
Allow / Deny	Select **Allow** to permit access to matching sessions. Select **Deny** to deny access to matching sessions.

6. Save the rule configuration and return to the policy configuration page.

Figure 55: RADIUS Request Attribute Policy Configuration Page



Configuring a RADIUS Request Policy Realm Restriction

RADIUS request attribute policies can be assigned with a realm restriction. Any authentication request that comes from a realm with attribute policy requirements sends the RADIUS attributes specified in the policy, otherwise the authentication request is not granted. If multiple rules are configured in a policy, then all rules in the policy must pass otherwise the authentication fails.

If a user authentication fails based on the RADIUS request attribute policy, a user event log message is displayed. Debug logs allow the administrator to determine that a user met the policies, or indicate that the user failed a RADIUS return attribute policy.

To configure a RADIUS Request realm restriction:

1. Select **Endpoint Policy** > **Network Access > RADIUS Attributes > Request Attributes** to display the configuration summary page.
2. Click **New** to display the policy configuration page.
3. Complete the configuration as described in Table.
4. Click **Save**.

Figure 56: Realm Restriction Policy – RADIUS Request Policies Configuration Page

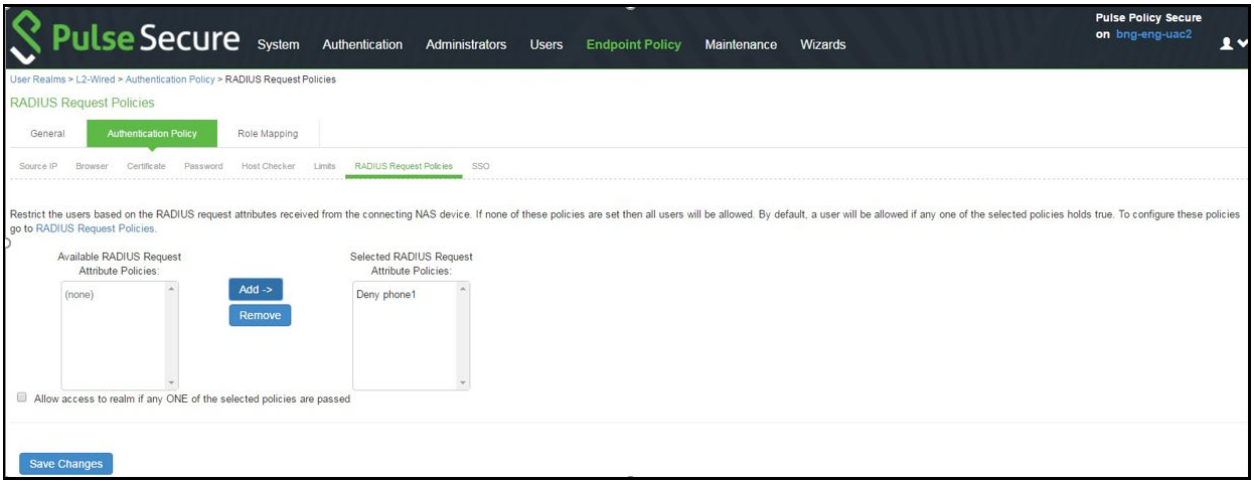


Table 9: Realm Restriction Policy – RADIUS Request Policies Configuration Guidelines

Settings	Guidelines
Policy list	Use the Add and Remove buttons to create a policy list. The available policies are populated by the RADIUS request policies configured in the prior procedure.
Allow access to realm if any one of the selected policy is passed.	This option determines what happens when multiple policies match. Select this option to allow access to the realm if any of the matching policies allow access (Ignoring any matching deny policies). Do not select this option if you want to deny access if one of the matching policies deny access (Ignoring any matching allow policies).

Configuring RADIUS Attribute Logging

You can configure PPS to enable or disable authentication reporting for RADIUS authentication events. Using this feature you can obtain a granular record of authentication attempts using configurable and detailed authentication reports.

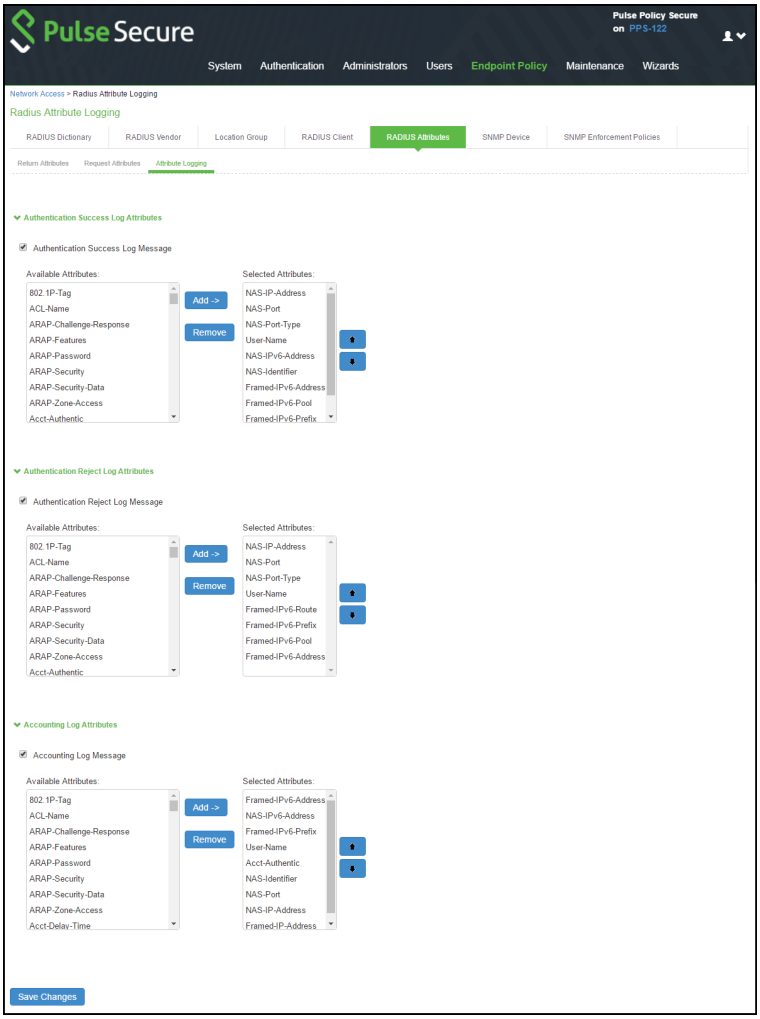
You can selectively choose events to record based on both successful and unsuccessful authentication attempts. If you select an attribute to be recorded and the value is not present in the authentication request/response, an entry is made in the debug log and in the RADIUS log. You can also specify accounting log messages.

The byte limit for log entries is 2048. If a message exceeds the byte limit the last value is trimmed and an entry is made in the debug and RADIUS logs.

To configure RADIUS attribute logging:

1. Select **Endpoint Policy > Network Access > RADIUS Attributes > Attribute Logging**.

Figure 57: RADIUS Attribute Logging



2. Select Authentication Success Log Message and Authentication Reject Log Message.
3. Select the **Accounting Log Message** option to specify the accounting log messages.
4. Select **Available attributes** from the lists, and click **Add** to populate the Selected Attributes lists.
5. Click **Save Changes**.

NOTE:

- To include the RADIUS accounting messages in user access logs, select **System > Log/Monitoring > User Access > Settings** and enable **RADIUS Accounting Messages**.

- The order of RADIUS attributes in the user access log is based on the order you select the attributes from the RADIUS attributes logging page.

Verifying the RADIUS Request Attribute Policy Configuration

When a user authentication fails because it did not meet the requirements specified in the RADIUS request attribute policy, a user event log message is displayed that includes information about which policies the user met or failed.

To display the User Access log:

1. Select **System Log/Monitoring**.
2. Click the **User Access** tab.
3. Click the **Log** tab.

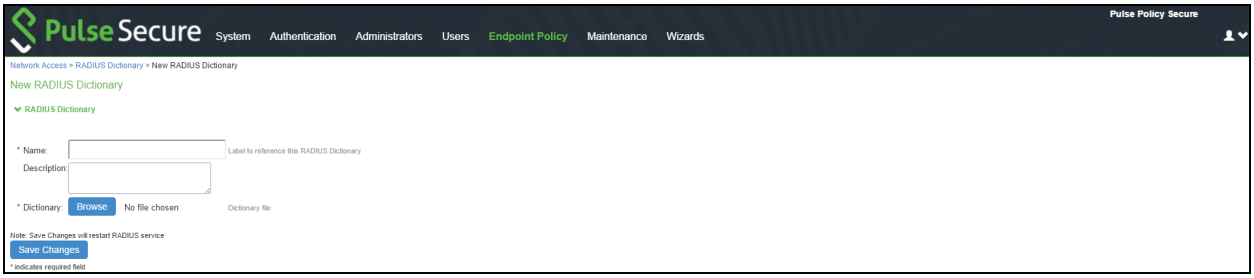
Verifying the RADIUS Dictionary

PPS supports many specific network access devices (NAD) by using its built-in standard RADIUS and vendor-specific, proprietary dictionary files. You can upload new dictionaries to add new RADIUS clients. PPS uses the dictionary files to store lists of RADIUS attributes, parse authentication requests, and generate responses.

To upload a new RADIUS dictionary:

1. Select **Endpoint Policy > Network Access > RADIUS Dictionary** to display the preconfigured dictionaries and their associated vendors.
2. Click **New RADIUS dictionary**.

Figure 58: RADIUS Dictionary



3. Enter a Name and optionally a description for the new dictionary.
4. Click **Browse** to search for the dictionary file (.dct) on a local or connected drive, then click **Save Changes**. The uploaded dictionary is displayed on the main RADIUS Dictionary page, and in the Make/Model list on the RADIUS Client page.
5. Click **Save Changes**.

NOTE:

- You can only remove dictionaries that are not associated with a vendor.
- You can download any dictionary from the list, including preinstalled dictionaries. You can modify the downloaded dictionary and then upload it as a new make/model.

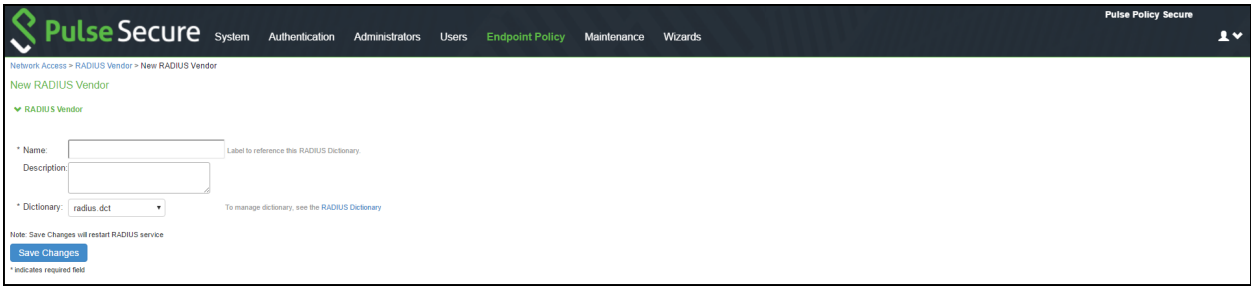
Verifying RADIUS Vendor List

RADIUS server contains a file with the list of manufacturers for the access devices, which communicate with the RADIUS server.

To verify the vendor and the associated dictionary on the RADIUS Vendor page:

1. Select **Network Access > RADIUS Vendor**.
2. Click **New RADIUS Vendor**, enter the name and then select the imported dictionary.

Figure 59: RADIUS vendor



3. Click **Save Changes**.

Additional Configurations

Configuration Commands for Cisco Switch

The below example shows a sample configuration of 802.1X authentication on Cisco switch. Only sample commands are documented in this example. For more information, see Cisco documentation.

The configuration involves the following:

1. Configuring PPS server as a RADIUS server in configuration mode.
2. Configuring 802.1X on the switch port in configuration mode.

Configuring PPS server as a RADIUS server

The sample configuration below shows how to add PPS server as a RADIUS authentication and accounting server on Cisco switch.

You must execute the following commands in the CLI configuration mode.

--Execute this command to add PPS as a RADIUS server
radius server <*RADIUS SERVER NAME*>
****Note* PPS listens to both 1812/1813 and 1645/1646 ports. Default is 1645 and 1646.***
address ipv4 <*RADIUS SERVER IP*> auth-port 1645 acct-port 1646
key <*SHARED-KEY*>

--Execute these commands to create a RADIUS Server Group, and associate your PPS appliances to the group.

aaa group server radius <*RADIUS-GROUP*>
server name <*RADIUS SERVER NAME*>
****Note* Repeat for every PPS Appliance.***

--Execute these commands to turn on AAA

aaa new-model
aaa session-id common
aaa authentication dot1x default group <*RADIUS-GROUP*>
aaa authorization network default group <*RADIUS-GROUP*>
aaa authorization auth-proxy default group <*RADIUS-GROUP*>
aaa accounting send stop-record authentication failure
aaa accounting identity default start-stop broadcast group <*RADIUS-GROUP*>
aaa accounting update newinfo

-- Execute this command to configure RADIUS CoA
aaa server radius dynamic-author
client <RADIUS SERVER IP> server-key <*SHARED-KEY*>
auth-type all
ignore session-key
port 3799
****Note* Default is 1700***
--Optional commands for DHCP snooping and IP device tracking for dACL or filter id attributes
ip device tracking
ip dhcp snooping
ip http server
ip http secure-server

Configuring 802.1x and MAC Authentication on the Switch Port

The below example shows a sample configuration of 802.1X and MAC Address authentication on Cisco switch interface. You must execute the following commands in CLI configuration mode.

```
interface GigabitEthernet1/0/24
switchport access vlan 60
switchport mode access
--Execute this command to trigger re-authentication from PPS
authentication periodic
authentication timer reauthenticate server
--Execute this command for configuring 802.1X
access-session port-control auto
dot1x pae authenticator
--Execute this command for configuring MAC BYPASS
mab

spanning-tree portfast
service-policy type control subscriber POLICY_Gi1/0/24
--POLICY_Gi1/0/24 is a policy map configuration. See the POLICY_MAP configuration for more details.
--Specify the order of execution
authentication order mab dot1x
authentication priority dot1x mab
--Execute this command for viewing the status of the session on Cisco OS version 15.x and above
Show access-session interface gi-X/Y/Z detail
--Execute this command for viewing the status of the session on Cisco OS version 12.x
Show authentication session interface gi-X/Y/Z detail
```

POLICY_MAP configuration

```
--Execute this command to define POLICY_MAP configuration
--Define class-map Policies
class-map type control subscriber match-all DOT1X
match method dot1x
!
class-map type control subscriber match-all DOT1X_FAILED
match method dot1x
match result-type method dot1x authoritative
!
class-map type control subscriber match-all DOT1X_MEDIUM_PRIO
match authorizing-method-priority gt 20
!
class-map type control subscriber match-all DOT1X_NO_RESP
match method dot1x
match result-type method dot1x agent-not-found
!
class-map type control subscriber match-all DOT1X_TIMEOUT
match method dot1x
match result-type method dot1x method-timeout
!
class-map type control subscriber match-all MAB
match method mab
!
class-map type control subscriber match-all MAB_FAILED
match method mab
match result-type method mab authoritative

--Define policy-map using class-map
sh run | beg POLICY_Gi1/0/24
policy-map type control subscriber POLICY_Gi1/0/24
event session-started match-all
  10 class always do-until-failure
   10 authenticate using mab priority 10
event authentication-failure match-first
  5 class DOT1X_FAILED do-until-failure
   10 terminate dot1x
   20 authentication-restart 60
  10 class MAB_FAILED do-until-failure
```

```
   10 terminate mab
   20 authenticate using dot1x priority 20
  20 class DOT1X_NO_RESP do-until-failure
   10 terminate dot1x
   20 authentication-restart 60
  40 class always do-until-failure
   10 terminate mab
   20 terminate dot1x
   30 authentication-restart 60
event agent-found match-all
  10 class DOT1X_MEDIUM_PRIO do-until-failure
   10 authenticate using dot1x priority 20
event authentication-success match-all
  10 class always do-until-failure
   10 activate service-template DEFAULT_LINKSEC_POLICY_SHOULD_SECURE
```

Configuration Commands for Huawei Switch

The below example shows a sample configuration of 802.1X authentication on Huawei switch (S5720). Only sample commands are documented in this example. For more information, see Huawei documentation.

```
# Creation of VLAN
vlan batch 100 200

# Creation of dot1x profile
dot1x-access-profile name <dot1x-profile-name>
authentication trigger-condition dhcp

# Creation of authentication profile mapped to dot1x-access-profile
authentication-profile name <auth-profile-name>
dot1x-access-profile <dot1x-profile-name>
authentication mode multi-authen max-user 100
# For MAC auth (MAB), enable below 2 commands
mac-access-profile <Mac-profile-name>
authentication dot1x-mac-bypass

# Domain in which authentication happens
domain isp

# When Switch acts as CoA server, decoding of calling-station-id format has to be specified.
radius-server authorization calling-station-id decode-mac-format ascii hyphen-split common

# Create PPS as radius-server, which will be mapped in aaa profile. Enter the same shared key as configured in PPS.
radius-server template rd-server-pps
radius-server shared-key cipher %^%#~SZ#Wvmi~*}.Q`L'"|s;q9ci)(u&U4'!>:1Ja]T(%^%#
radius-server authentication <Radius-Server-IP> <1812> weight 80
radius-server accounting <Radius-Server-IP> <1813> weight 80
calling-station-id mac-format hyphen-split mode2 uppercase

# Configure the switch to support dynamic authorisation
radius-server authorization 192.168.10.11 shared-key cipher %^%#qIj!'3LZN1TkF=JkGF:Gx:U$:!c]HES=$BG.*HwY%^%#

# Configure aaa profile
aaa
  authentication-scheme <auth-scheme>
    authentication-mode radius
  authorization-scheme default
  accounting-scheme <accounting>
    accounting-mode radius
    accounting realtime 15
  domain isp
    authentication-scheme <auth-scheme>
    accounting-scheme <accounting>
```

```
radius-server <rad-server-pps>

# Create VLAN interfaces which will be used for enforcement
# Endpoint will get IP address in the VLAN to which it is assigned.
interface Vlanif100
ip address 192.168.10.10 255.255.255.0
dhcp select interface

interface Vlanif200
ip address 192.168.20.10 255.255.255.0
dhcp select interface

# Access Interface having authentication-profile as dot1x
interface GigabitEthernet0/0/17
description "EP Interface"
port link-type hybrid
Port hybrid untagged vlan 100 200
authentication-profile <auth-profile-name>

# Interface Connected to PPS server
interface GigabitEthernet0/0/19
description "connected to PPS"
port link-type access
port default vlan 100
```

Configuration Commands for Juniper EX Series Switch

The below example shows a sample configuration of 802.1X authentication on Juniper EX switch.

The configuration involves the following:

1. Configuring PPS server as a RADIUS server in edit mode.
2. Configuring 802.1x on the switch port in edit mode.

Configuring PPS server as a RADIUS server

The sample configuration below shows how to add PPS server as a RADIUS authentication and accounting server on Juniper EX switch. You must execute the following commands in edit mode.

```
set access radius-server <RADIUS SERVER IP> secret <SHARED-KEY>
set access radius-server <RADIUS SERVER IP> source-address 10.204.88.30
--Execute this command for configuring RADIUS CoA
set access radius-server <RADIUS SERVER IP> dynamic-request-port 3799
--Execute this command to add PPS as a RADIUS server
set access profile 802.1X-access-profile authentication-order radius
set access profile 802.1X-access-profile accounting order radius
set access profile 802.1X-access-profile radius authentication-server <RADIUS SERVER IP>
set access profile 802.1X-access-profile radius accounting-server <RADIUS SERVER IP>
```

Configuring 802.1x on the Switch Port

The below example shows a sample configuration of 802.1X / MAC address authentication on Juniper EX switch interface. You must execute the following commands in edit mode.

```
--Execute this command for 802.1X
set protocols dot1x authenticator authentication-profile-name 802.1X-access-profile
set protocols dot1x authenticator interface ge-0/0/0.0 supplicant multiple
--Execute this command for configuring MAC BYPASS
```

set protocols dot1x authenticator interface ge-0/0/0.0 mac-radius --**Execute this command for viewing the status of the session** Show dot1x interface ge-X/Y/Z detail

RADIUS Dictionary Files

This section contains dictionary translations for parsing requests and generating responses. All transactions are composed of Attribute/Value Pairs. The value of each attribute is specified as one of these valid data types shown in the below table.

Table10: Valid Data Types

Data	Description
hexadecimal	Hexadecimal string
hex1, hex4	1- or 4-byte hexadecimal number
string	0-254 octets (includes null terminator)
stringnz	0-254 octets (without null terminator)
ipv6addr	16 octets in network byte order (per RFC-3162)
ipv6prefix	2-18 octets in network byte order (per RFC-3162)
ipv6interface	8 octets in network byte order (per RFC-3162)
ipaddr	4 octets in network byte order
ipaddr-pool	IP address selected from an IP address pool
ipxaddr-pool	IPX network number selected from an IPX address pool
integer	32-bit value in big endian order (high byte first)
int1, int4	1- or 4-byte decimal number (integer is equivalent to int4)
time	32-bit value in big endian order; seconds since 00:00:00 GMT, Jan. 1, 1970

All attribute names and value names in the supplied radius.dct dictionary are derived from the RADIUS specification by replacing all nonalphanumeric characters with dashes (-).

The following dictionary format provides a mechanism for including secondary dictionaries from the text of a primary dictionary. For example, only the attribute/value definitions that differ from the RADIUS specification need to be listed in a primary dictionary for a vendor specific implementation. Definitions for the attribute/values that are common to both are brought in by including the radius.dct dictionary anywhere within the vendor dictionary.

The following rules apply to the creation and use of dictionaries:

- All comments begin with a pound sign (#) in column 0 OR appear on an attribute or value line with <white space>#<white space> as the Mandatory delimiter between dictionary data and comment text. (This is a simple parser.)
- Include another dictionary file with an at sign (@). The (@) character must be in column 0.
- All attribute and attribute value names and numeric codes must be unique within a single dictionary. Conflicts between dictionaries are resolved according to the following rules:
  - Attributes and values have precedence over any that are parsed later, and parsing is depth first.
  - For example, to override a baseline attribute, create a file with that attribute in it, followed by an include of the baseline file. Because the baseline file is parsed later than the desired override, the baseline file is ignored.
  - When two secondary dictionary definitions of an attribute or value conflict, the earlier include takes precedence.
  - Other than include files, there are two meaningful line entry formats in a dictionary -one for attributes and one for attribute values.

    - ATTRIBUTE_KEY ATTRIBUTE_NAME ATTRIBUTE_CODE DATA_TYPE FLAGS [COMMENT_DELIMITER COMMENT_TEXT]
    - VALUE_KEY ATTRIBUTE_NAME VALUE_NAME VALUE_CODE [COMMENT_DELIMITER COMMENT_TEXT]
- The legend for the last column of an attribute entry should be:
    - 'c' indicates a SINGLE value attribute that is a candidate for inclusion in a user's checklist.
    - 'C' indicates a MULTI value attribute that is a candidate for inclusion in a user's checklist.
    - 'r' indicates a SINGLE value attribute that is a candidate for inclusion in a user's reply list.
    - 'R' indicates a MULTI valued attribute that is a candidate for inclusion in a user's reply list.
    - 'o','O' ordered attribute, some attributes (such as Reply-Message) might need to be presented in a particular order to make sense.

 NOTE:

- The absence of {C,c,R,r} flags indicates an item that is neither a reply nor a check list item (such as State, Proxy-State).
- All FLAG characters on a given attribute line must be clustered together to parse properly. No white space is allowed between individual characters.

Policy Enforcement using SNMP/SSH

This chapter provides an overview of the SNMP enforcement. It includes the following information:

About SNMP Enforcement

Overview

PPS supports device visibility and policy enforcement on switches using SNMP as an alternative to 802.1X. Using SNMP enforcement, you can easily deploy and achieve comprehensive compliance and role based access.

Benefits of SNMP Enforcement

The following are the benefits of SNMP enforcement:

- Supports SNMP enforcement for MAC based authentication and role assignment.
- Supports network visibility using SNMP v1/v2/v3.
- The endpoints are discovered through SNMP traps (Linkup/Down, MAC notification, and Port security).
- Supports easy NAC deployment with SNMP enforcement based on compliance and role-based access.
- Supports Non-802.1X compliance endpoints.
- Supports SNMP discovery for L2/L3 switches.
- Supports Pulse session after SNMP MAC authentication.
- Supports hybrid deployment- 802.1X for wireless network and SNMP for wired network.

Policy Enforcement Using Simple Network Management Protocol/SSH

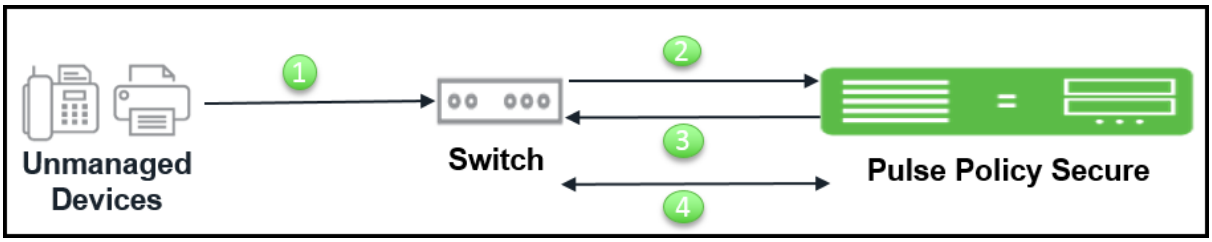
This section covers the following deployment scenarios:

- Policy Enforcement using SNMP for unmanaged devices
- Policy Enforcement using SNMP for managed devices

Policy Enforcement using SNMP for Unmanaged Devices

To deploy policy enforcement using SNMP for unmanaged devices, add the switch as an SNMP Agent and the PPS device as an SNMP server in the switch and then configure the SNMP Enforcement Policies in PPS.

Figure 60: Policy Enforcement using SNMP for unmanaged devices



The workflow for the SNMP policy enforcement using ***linkup/MAC address Notification traps*** is described below:

1. Unmanaged corporate devices such as phones, printers, and cameras connect to SNMP switch. The SNMP switch is configured for linkup/MAC address Notification trap. The SNMP switch generates the SNMP trap. See the Appendix section for switch configuration.
2. PPS learns or receives the MAC address.
3. PPS performs the MAC authentication and sets the VLAN/ACL based on the role assigned using SNMP.
4. When the user disconnects the device from the switch by plugging out the cable, PPS receives an SNMP trap and it deletes the session from the PPS server and sets the switch port to the default VLAN/ACL.

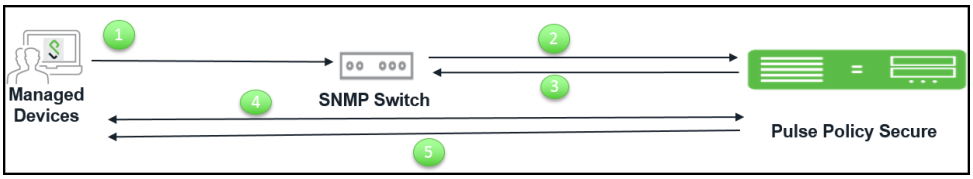
The workflow for the SNMP policy enforcement using ***port-security trap*** is described below:

1. Unmanaged corporate devices such as phones, printers, and cameras connect to SNMP switch. The SNMP switch is configured for port-security trap. A dummy static MAC address is configured on the port. Since machine's MAC address does not match with the configured dummy mac address, it generates a security violation and a port security trap is sent to PPS. See the Appendix section for switch configuration.
2. PPS learns or receives the MAC address.
3. PPS performs the MAC authentication and the dummy MAC address configured on the interface is replaced with the endpoint MAC address thus authorizing the endpoint on the switch and sets the VLAN based on the role assigned.
4. When the user disconnects the device from the switch by plugging out the cable, the session is not deleted from the PPS. However, the session is deleted only after the session timeout.

Policy Enforcement using SNMP for Managed Devices

To deploy policy enforcement using SNMP for managed devices, add the switch as an SNMP Agent and the PPS device as an SNMP server in the switch and then configure the SNMP Enforcement Policies in PPS.

Figure 61: Policy enforcement using SNMP for managed devices



The workflow for the SNMP policy enforcement using ***link-up/MAC address Notification traps*** is described below:

1. Managed corporate client (Pulse Desktop client is installed) such as Windows/MAC OSX machine connects to SNMP switch port. The SNMP switch is configured for link-up/MAC address Notification trap. The SNMP switch generates the SNMP trap. See Appendix section for switch configuration.
2. PPS learns or receives the MAC address.
3. PPS performs the MAC authentication and sets the VLAN/ACL based on the role assigned using SNMP.
4. The user connects to PPS using Pulse Client. Host checker evaluates the compliance status of machine. If machine is compliant with Host Checker policy.
5. PPS sets the VLAN/ACL configured for compliant role using SNMP and if machine is non-compliant with Host Checker policy then PPS sets the VLAN/ACL configured for non-compliant role using SNMP.
6. When the user disconnects the Pulse client. PPS reevaluates the role and sets the VLAN/ACL based on the role assigned.
7. When the user disconnects the endpoint from the switch by plugging out the cable, session from the PPS server is deleted and the switch port is set to the default VLAN/ACL.

The workflow for the SNMP policy enforcement using ***port-security trap*** is described below:

1. Managed corporate client (Pulse Desktop client is installed) such as Windows/MAC OSX machine connects to SNMP switch port.

   The SNMP switch need to be configured for port-security trap. A dummy static MAC address is configured on the port. Since the machine's MAC address does not match with the configured dummy mac address, it generates a security violation and a port security trap is sent to PPS.

2. PPS learns or receives the MAC address.
3. PPS performs the MAC authentication and the dummy MAC address configured on the interface is replaced with the endpoint MAC address thus authorizing the endpoint on the switch and sets the VLAN based on the role assigned.
4. When the user disconnects the device from the switch by plugging out cable, the session is not deleted from the PPS. However, the session is deleted only after the session timeout.
5. PPS sets the VLAN configured for compliant role using SNMP and if machine is non-compliant with Host Checker policy then PPS sets the VLAN configured for non-compliant role using SNMP.
6. When the user disconnects the Pulse client. PPS reevaluates the role and sets the VLAN based on the role assigned.
7. When the user disconnects the device from the switch by plugging out the cable, the session is not deleted from the PPS. However, the session is deleted only after the session timeout.

Note:

- If the SNMP switch supports MAC Notification traps (MAC added notification trap), you must enable the traps in addition to the Link Up / Link Down traps.
- If Port Security traps are enabled, LinkUp/LinkDown or MAC Added Notification traps should not be enabled.
- PPS does not support MAC removed notifications trap. It tracks the session / MAC address associated with a particular interface and removes it once a link down trap is received.
- MAC notification traps are supported only for Cisco and HP switches.
- SNMP Enforcement using ACL is not supported using Port-Security traps.

Configuring SNMP Policy Enforcement using VLAN

This section covers the configuration for SNMP policy enforcement. SNMP based policy enforcement is applied to endpoints running Pulse Client, and to clientless endpoints where the MAC address is discovered through SNMP. For endpoints running Pulse Client, role assignment is based on compliance; for clientless endpoints, role assignment is based on MAC address.

The configuration procedure for SNMP policy enforcement is described below:

- Configuring a MAC address Authentication Server
- Configuring a MAC address Authentication Realm and Role Mapping
- Configuring a Location Group
- Configuring SNMP Devices
- Verifying the status of SNMP Devices
- Configuring SNMP Enforcement Policy

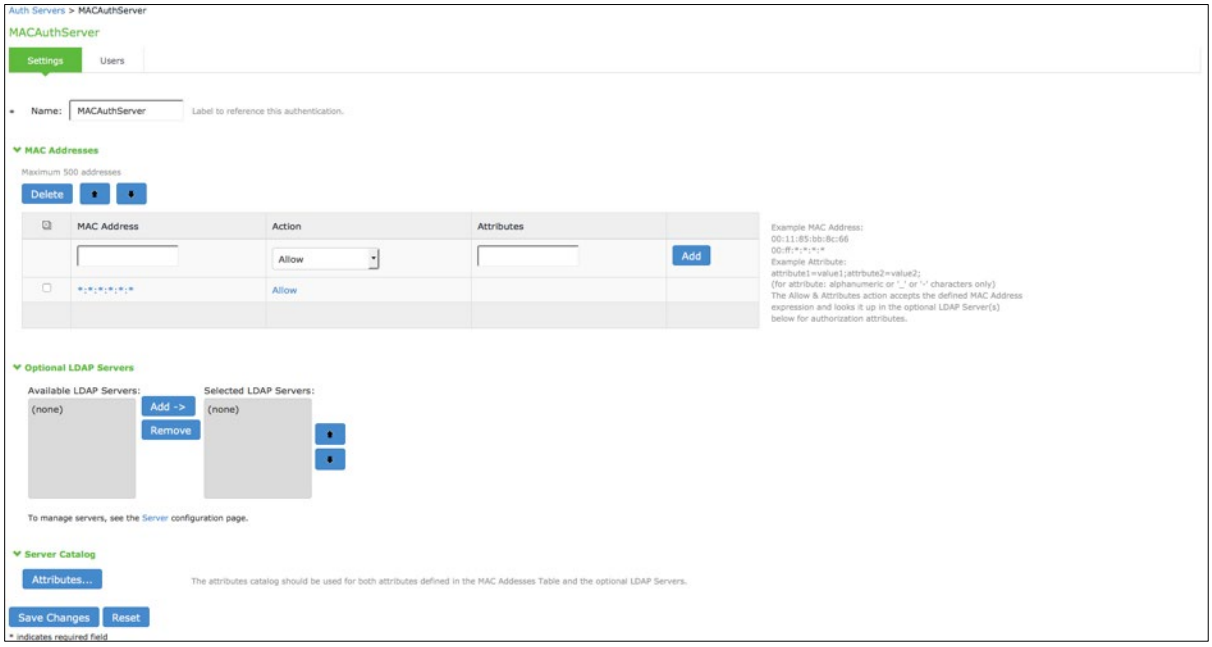
Configuring a MAC address Authentication Server

A MAC address authentication server defines how endpoints are authorized using the MAC address. You can choose to allow or deny a MAC address or use wildcards to allow or deny groups of MAC addresses.

To configure a MAC address authentication server:

1. Select **Authentication > Auth Server**.
2. Select **MAC Address Authentication** and click **New Server** to display the MAC Address Authentication Server configuration page as shown in Figure.

Figure 62: MAC Address Authentication Server



3. On the MAC address authentication server configuration page:
    a. For Name, enter a name to label this MAC address authentication server.
    b. Under MAC Addresses, enter the MAC address(es) to whitelist.
    c. Select an action to take when the MAC address matches:
        i. **Allow**—Signal successful authentication.
        ii. **Deny**—Signal unsuccessful authentication.

iii. **Allow and Attributes**—Typically, a match terminates the search. If you select **Allow and Attributes**, the search is not terminated; instead, the system searches the LDAP servers for a match in order to retrieve the LDAP authorization attributes.

d. Specify a name-value pair to associate the MAC address with a particular group or organization.
e. Under Optional LDAP servers, Use the **Add** and **Remove** selector buttons to add LDAP servers to the list of selected servers. Use the up and down buttons to order the list. The order in which the LDAP servers are listed is important.
f. Under Server Catalog, Click the **Attributes** button to display the LDAP server catalog, which you can use to select or add attributes to be retrieved from the LDAP servers.

4. Click **Save Changes** to save the configuration.

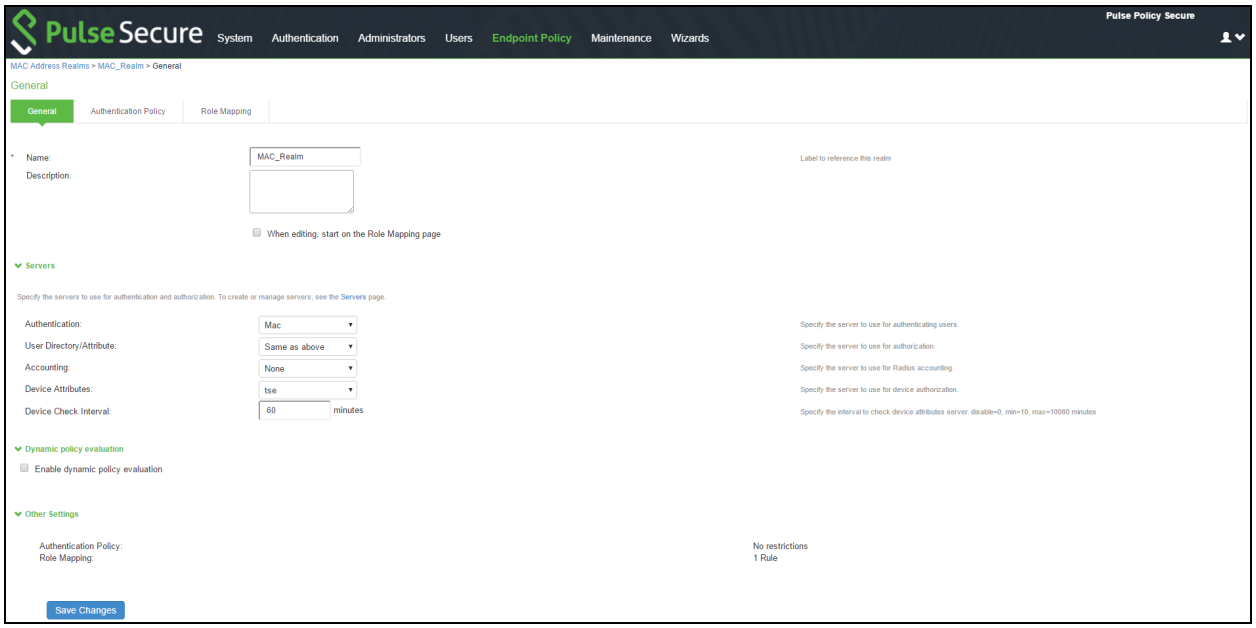
Configuring a MAC address Authentication Realm and Role Mapping

A MAC address authentication realm uses a MAC address authentication server and role mapping rules to sort MAC address authentication requests into roles.

To configure a MAC address authentication realm:

1. Select **Endpoint Policy > MAC Address Realms**.
2. Click **New** to display the MAC Address Realm configuration page.

Figure 63: MAC Address Realm



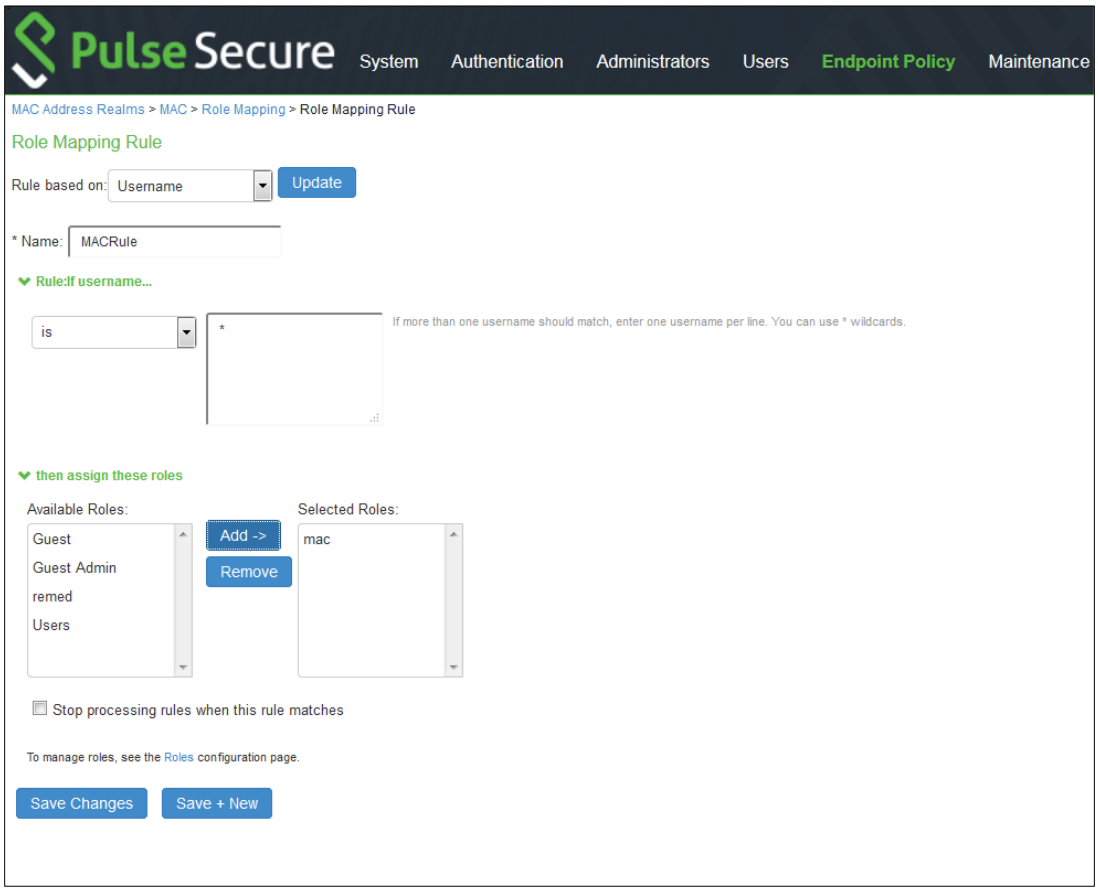
3. On the MAC address realm configuration page:
   a. For Name, enter a name to label this MAC address realm.
   b. (Optional) For description, enter a description.
   c. For Authentication Server, select the MAC address authentication server configured earlier.
   d. For User Directory/Attribute Server, select "Same as above".
   e. For accounting, select the authentication server.
   f. For device attribute, select the server for device authorization. For profiler, select the name of the local profiler.
   g. Specify the device check interval in minutes.
   h. Select the **Enable dynamic policy evaluation** to automatically or manually refresh the assigned roles of users by evaluating a realm's authentication policy, role-mappings, role restrictions, and resource policies.
4. Click **Save Changes** to save the configuration.

Role mapping rules define how endpoints are assigned to roles.

To configure the role mapping rules for your MAC Address Realm:

1. Click the **Role Mapping** tab to display the role mapping configuration page for the realm.
2. Click **New** to display the MAC Address Realm configuration page.
3. On the role mapping configuration page, click **New Rule** to display the role mapping rule configuration page.

Figure 64: MAC Address Realm - Role Mapping



   a. (Optional) For Name, enter a name to label this role mapping rule.
   b. Select the rule from the Rule based list and provide the appropriate details.
   c. Select the appropriate role and click **Add**.
4. Click **Save Changes** to save the configuration.

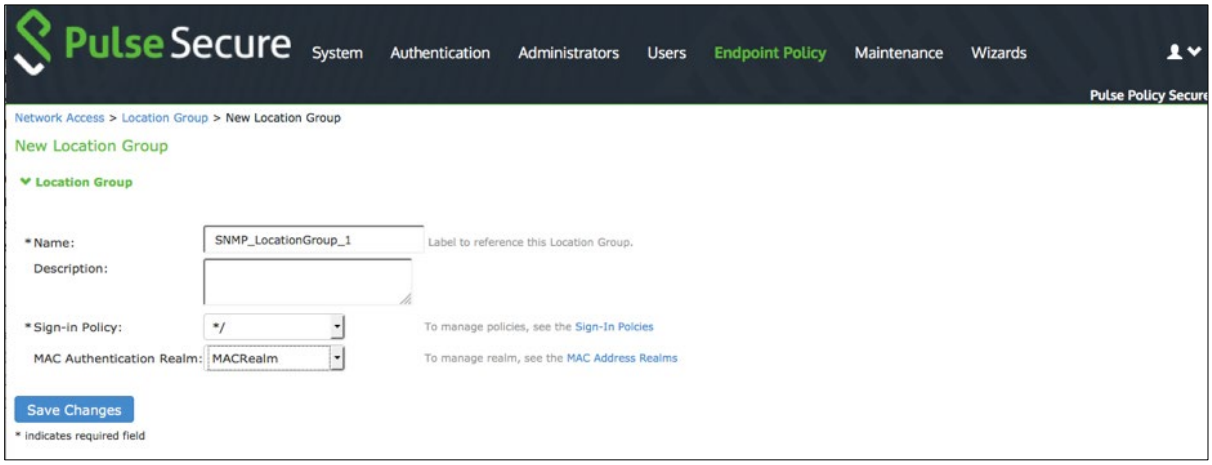
Configuring a Location Group

A location group enables association of a sign-in policy and MAC address realm for network access policy enforcement.

To configure a location group:

1. Select **Endpoint Policy > Network Access > Location Group**.
2. Click **New Location Group** to display the Location Group configuration page.

Figure 65: New Location Group



3. On the location group configuration page:
   a. Enter a name or label to describe the location group.
   b. Enter a description.
   c. Select the default sign-in policy as it is not applicable for SNMP enforcement. For example, default */ sign-in policy.
   d. Select the MAC authentication realm which was configured earlier.
4. Click **Save Changes** to save the configuration.

Configuring SNMP Devices

You can add an SNMP device manually through SNMP device configuration or automatically discover SNMP devices through SNMP Device Discovery configuration.

The following procedure explains the types of SNMP configuration:

- Manual addition of SNMP devices
- Auto discovery of SNMP devices

Manual Addition of SNMP Devices

You can manually add SNMP devices from PPS. This section describes the SNMP device configuration for switches with different versions.

- Configuring devices with SNMP v1/v2c
- Configuring devices with SNMP v3

Configuring Devices with SNMP v1/v2c

To configure the device with SNMP v1/v2c:

1. Select **Endpoint Policy** > **Network Access > Network Infrastructure Device** and click New Network Infrastructure Device.
2. Enter a name to label this SNMP device.
3. For Description, enter a description. (Optional)
4. Enter the IP address of the SNMP device. You must enter a single IP address, not an IP address range or subnet.
5. Select the device vendor. SNMP VLAN enforcement check box will appear only for vendors who support SNMP enforcement. VLAN enforcement is supported only for HP and Cisco switches.
6. Under Enforcement, enable the **VLAN Enforcement** checkbox for using the device for SNMP enforcement using VLAN.
   For Profiler, you must disable SNMP enforcement; the **Location Group**, **Default VLAN, Write Community and Trap Community String** fields are not applicable for profiling. A device so added is not used for enforcement.
   a. For Location Group, select the location group configured earlier. Only location groups which have MAC Address Realms associated will be available for selection.
   b. For Default VLAN, enter the VLAN to be provisioned when the SNMP user session is deleted or no endpoint is connected.
7. Under SNMP Settings, select **SNMP version v1/v2c**.
8. To use different credentials for write and trap community strings, disable the “Use same credentials for write and trap operations” check box.
9. Enter the community string(s) for the Read community.
10. Click **Save Changes** to save the configuration.

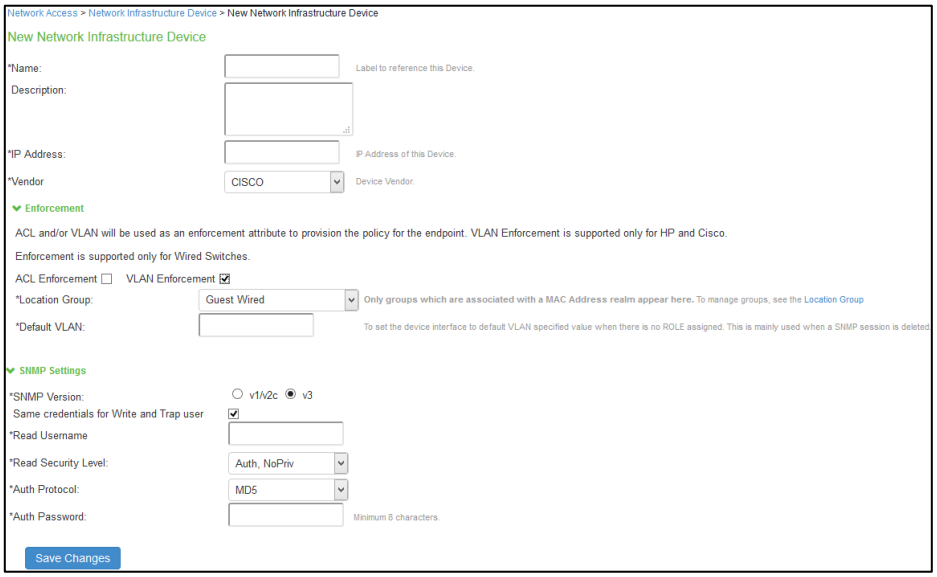
Figure 66: SNMP Device Configuration - SNMP Version v1/v2c

Configuring Devices with SNMP v3

To configure the switch with SNMP v3:

1. Select **Endpoint Policy > Network Access > Network Infrastructure Device**.
2. Click **New Infrastructure Device**.
3. Enter a name to label this SNMP device.
4. For Description, enter a description. (Optional)
5. Enter the IP address of the SNMP device. You must enter a single IP address, not an IP address range or subnet.
6. Select the device vendor. SNMP VLAN enforcement check box will appear only for vendors who support SNMP enforcement. VLAN enforcement is supported only for HP and Cisco switches.
7. Under Enforcement, enable the **VLAN Enforcement** checkbox for using the device for SNMP enforcement using VLAN.
   For Profiler, you must disable SNMP enforcement; the **Location Group**, **Default VLAN, Write Community and Trap Community String** fields are not applicable for profiling. A device so added is not used for enforcement.
   a. For Location Group, select the location group configured earlier. Only location groups which have MAC Address Realms associated will be available for selection.
   b. For Default VLAN, enter the VLAN to be provisioned when the SNMP user session is deleted or no endpoint is connected.
8. Under SNMP Settings, select **SNMP version v3** and define the SNMP switch settings:
9. Enter the Read Username, select the Read Security Level and Auth Protocol, and enter the Auth Password.
10. To use different credentials for write and trap community strings, disable the “Use same credentials for write and trap operations” check box.
11. Click **Save Changes** to save the configuration.

Figure 67: SNMP Device Configuration - Version v3



Note: If you unplug a cable from an interface, the associated session would be deleted only if link down traps are enabled. If the port security traps are configured on the device, unplugging of the cable does not cause session deletion.

Auto Discovery of SNMP Devices

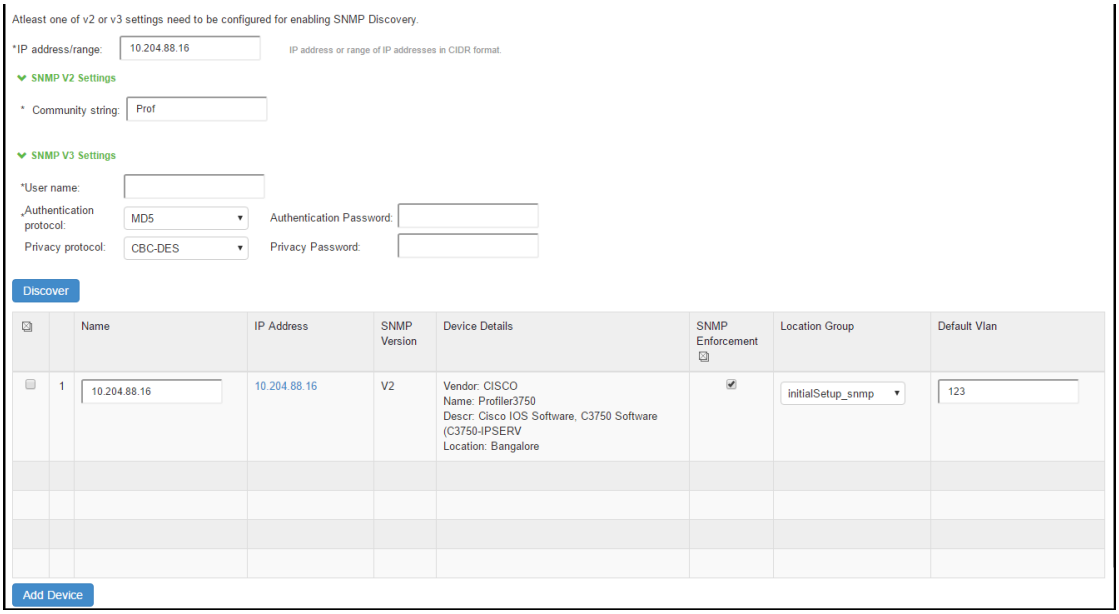
PPS provides an optional SNMP Device Discovery option. You can specify a range of IP addresses and other details needed for SNMP configuration to perform discovery of SNMP enabled devices.

PPS discovers all SNMP enabled L2 or L3 devices. SNMP enabled devices, which are not supported are listed as unsupported and cannot be added to the SNMP devices page.

To discover SNMP enabled devices:

1. Select **Endpoint Policy > Network Access > Network Infrastructure Device > Discovery**.

   Figure 68: SNMP Enabled Device Discovery



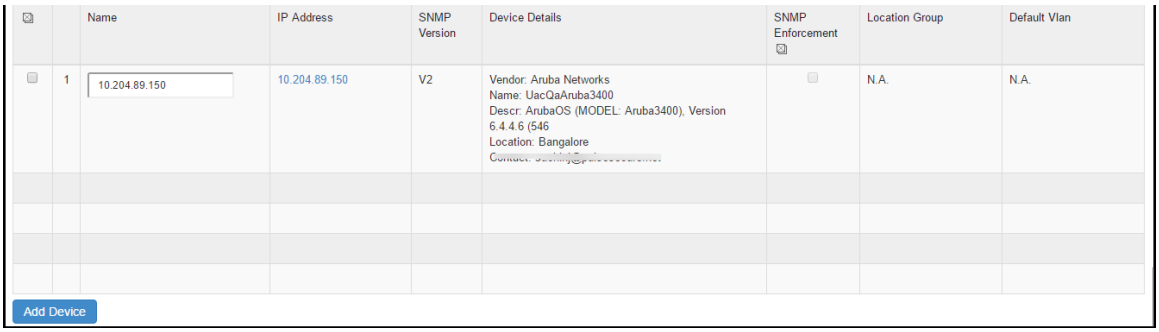
2. On the SNMP device discovery configuration page:
   a. For IP Address Range, enter a range of IP addresses in CIDR format (for example, 10.204.88.0/28) to discover SNMP devices.
   b. To discover SNMP v1/v2c devices, enter the community string to use with SNMP v1/v2c device.
   c. To discover SNMP v3 devices, enter the user name to use with SNMP v3 devices. Enter the Authentication protocol, Authentication password, Privacy protocol and Privacy password for SNMP v3 devices.
   d. Click **Discover** to start the discovery process.

   Once the devices are discovered, you must complete the following configuration for SNMP enforcement on each device:

   1. Choose a location group from the dropdown list.
   2. You can enable the SNMP VLAN enforcement for the supported switches (HP/Cisco).
   3. Specify a default VLAN.
   4. Select the devices to be added and click **Add Device**.
   5. Click **Save Changes**.

   The SNMP enforcement option is disabled for the Switches, which don't support SNMP enforcement.

Figure 69: SNMP Enabled Device Discovery



Note:

- Discovery of SNMP-enabled devices applies only to L2 and L3 devices which support Bridge MIB configuration.
- Enable the SNMP Enforcement checkbox for using the device for SNMP enforcement and then define the location group and the default VLAN. For Profiler, you must disable SNMP enforcement; the Location Group, Default VLAN fields are not applicable for profiling.
- Admin can modify the added SNMP client to enable the ACL enforcement if required. See Adding SNMP Client

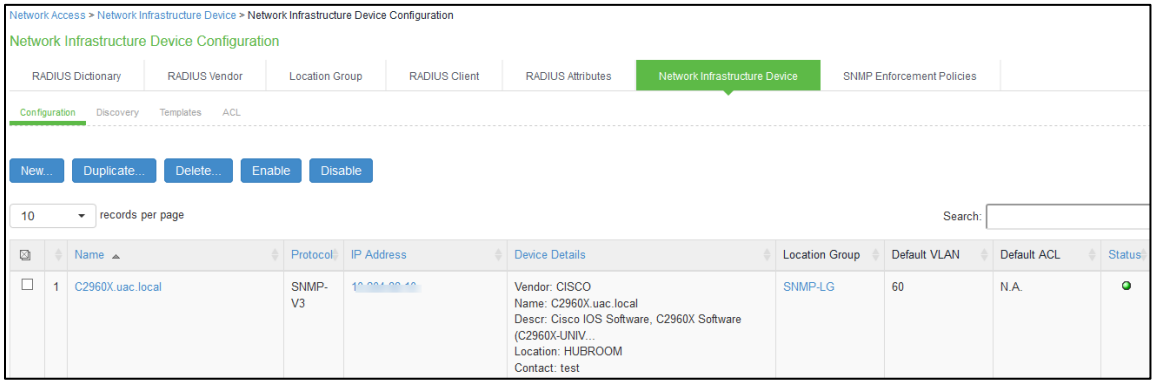
Verifying the status of SNMP Devices

You can view the SNMP device status from the SNMP Device page. You can view details such as device name, device location, device description, device contact information, SNMP version, IP Address, model, location group, default VLAN, default ACL, and the current status of the added device.

To view the status of SNMP devices:

1. Select **Endpoint Policy > Network Access > Network Infrastructure Device.**
2. Click **Configuration**.

Figure 70: SNMP Device Status



Configuring SNMP Enforcement Policy

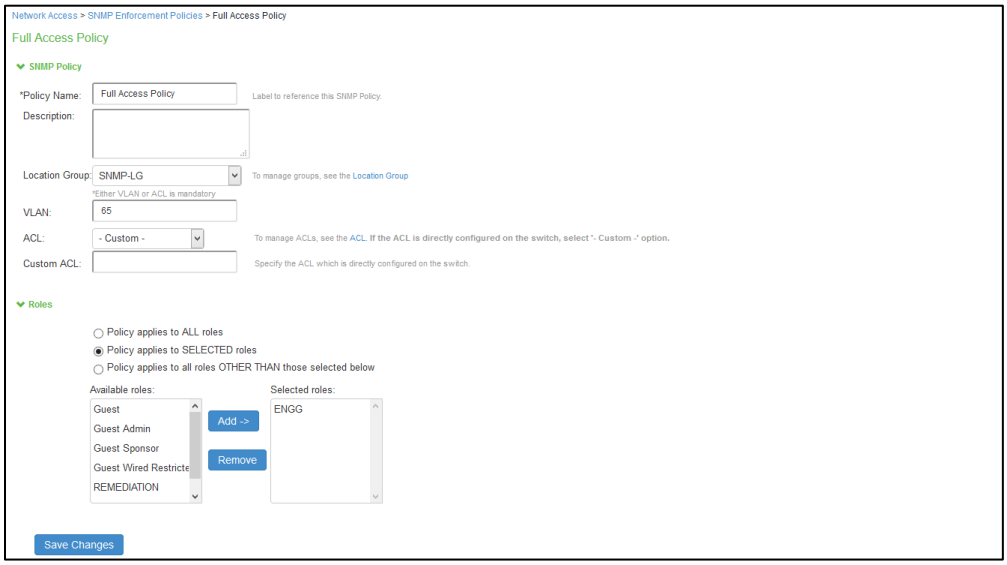
SNMP Enforcement Policy is used for dynamic VLAN assignment and modification, which is based on role assignment.

Note:You must ensure that the session roaming is enabled on the roles for SNMP enforcement.

To configure an SNMP Enforcement Policy:

1. Select **Endpoint Policy > Network Access > SNMP Enforcement Policies.**
2. Click **New SNMP Policies** to display the New SNMP Policy configuration page.

Figure 71: SNMP Enforcement Policy Configuration



3. On the SNMP policy configuration page:
   a. Enter a label for the SNMP enforcement policy.
   b. Enter a description for the SNMP policy.
   c. For VLAN, specify the VLAN to assign.
   d. Choose a location group from the dropdown menu.
   e. Under Roles, select Policy Applies to Selected Role; choose a role from the Available Roles and click Add to add it to the Selected Roles list.
2. Click **Save Changes** to save the configuration.

Configuring SNMP Policy Enforcement using ACL

Policy enforcement using ACLs is achieved through both SNMP and SSH. The SNMP traps are received through SNMP and ACL enforcement is done using CLI (SSH).

Pre-requisites

- The user must be logged in with highest privilege level for ACL enforcement using SSH.
- ACLs should be configured either manually on the Switch or pushed from PPS through ACL creation.
- Default templates are available for Cisco, Juniper and HP. For other Switch models/vendors the admin can create new template. See Creating Template or using Existing Template.
- Enable SNMP diagnostic logging to capture the CLIs sent to the Switch.

The configuration procedure for SNMP policy enforcement using ACL is described below:

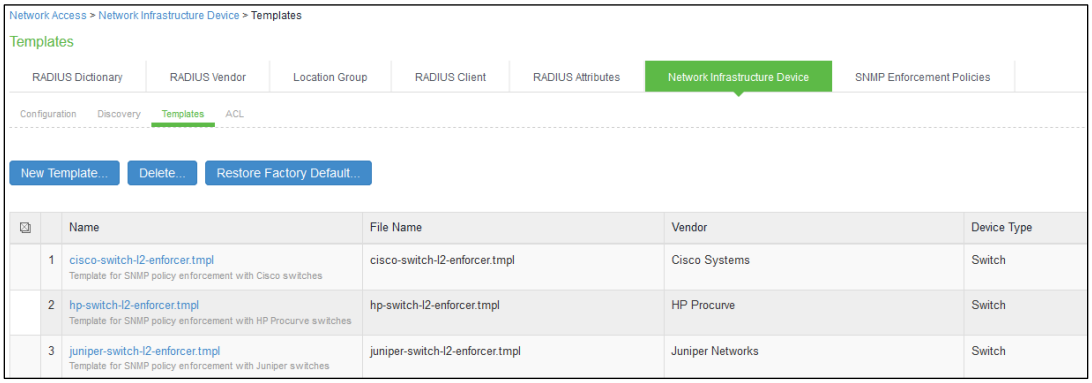
- Creating Template or using Existing Template
- Creating an ACL
- Adding SNMP Client
- SNMP Enforcement Policies

Creating Template or using Existing Template

Template is required to specify the CLI format for each vendor. Admin can upload/download the templates which will be in pre-defined format. Using the template, CLIs are formed to enforce the ACL on to the interface.

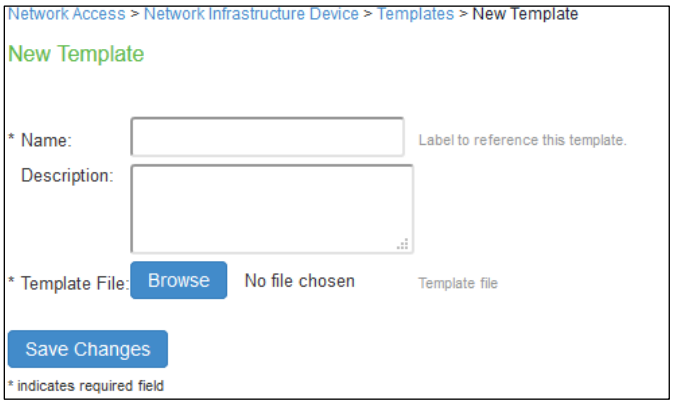
To view and add the templates:

1. Select **Network Access > Network Infrastructure Device > Templates**.
   Note: Cisco, Juniper and HP switch templates are available by default.



2. Admin can also choose to create a new template. Click **New Template**.

Figure 72: Template



3. Enter the template name.
4. Enter the description.
5. Click **Browse** and upload the created template file.
6. Click **Save Changes**.

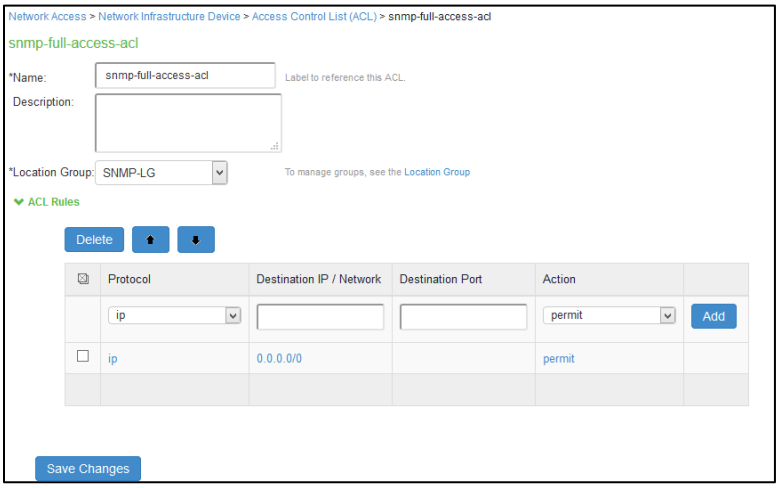
Creating an ACL

The Admin can configure ACL in 2 ways:

- Logging into the Switch console and creating the ACLs manually. Ensure that the configured ACL name is same while creating the SNMP client and policy in PPS.
- Creating the ACLs on PPS, which will push the ACLs to the switches belonging to the corresponding Location Group.

To create an ACL on PPS:

1. Select Endpoint Policy > **Network Access > ACL**.
2. Click New ACL.
3. Enter the Name
4. Set the Location Group.
5. Under ACL Rules:
    a. Specify the Protocol.
    b. Enter the Destination IP address
    c. Enter the Destination Port
    d. Specify the action as either permit or deny.
    e. Click **Add**.



6. Click **Save Changes**.

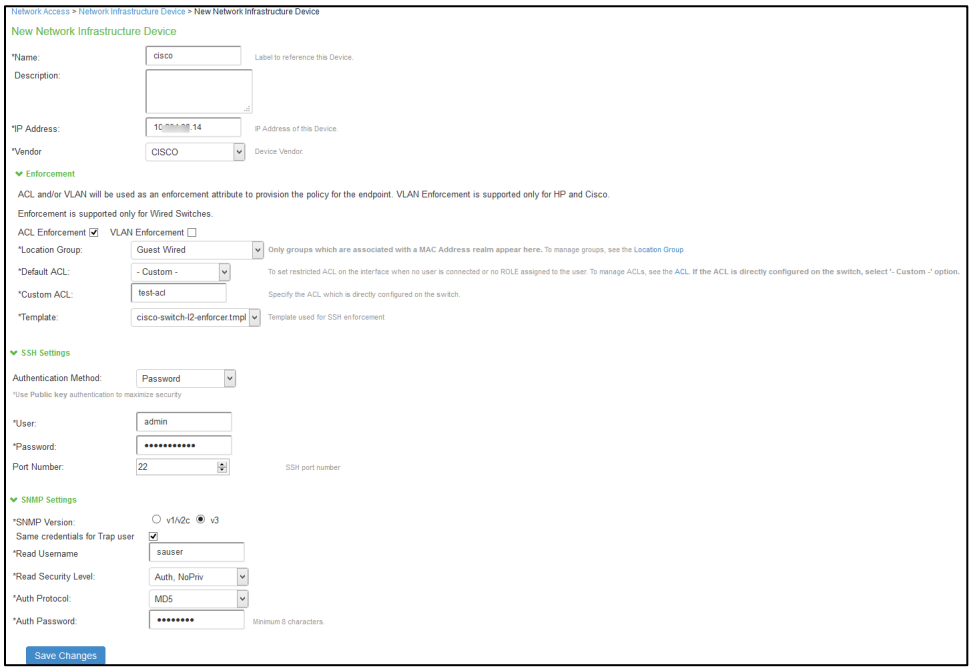
Note:

- Admin can login to the Switch and verify if the ACL is properly configured. ACL name is prefixed with *PPS-* to distinguish between the ACLs created manually and the one's pushed from PPS.
- ACL name modification is not allowed.
- When deleting an ACL from PPS ensure that it is not applied on any interface or port. Otherwise, deletion of ACL will not succeed on the Switch.
- ACL configured from PPS should not be modified manually.

Adding SNMP Client

To add a client:

1. Select **Network Access > Network Infrastructure Device**.
2. Click **New**.
3. Enter the name of the client that will be added in the PPS.
4. Enter the description.
5. Enter the IP address of the client.
6. Under Enforcement, select **ACL Enforcement**.
   Note: ACL enforcement is supported for all Switches supporting SSH.
7. Select the Location Group.
8. Select default ACL from the drop down.
   Note: Select the Custom option and enter the ACL name if the ACL is configured manually on the Switch.
9. Select the template corresponding to the selected vendor.
10. Under SSH settings:
    a. Specify the Authentication Method.
    b. Enter the user name, password and port number if authentication method is Password OR
    c. Enter the user name, key and pass-phrase if the authentication method is Public Key.
11. Under SNMP settings, specify the SNMP version.
12. Specify the Read username, Read Security Level, Auth Protocol, and Auth Password.
13. Click **Save Changes**.



Note: Admin can select both VLAN and ACL enforcement for an SNMP client.

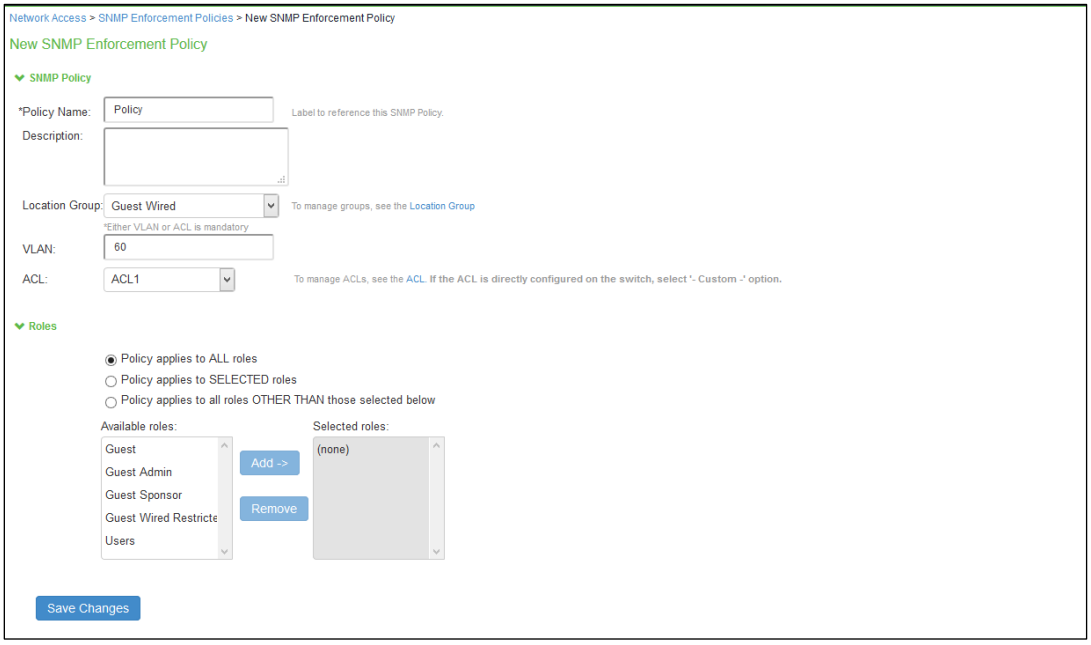
SNMP Enforcement Policies

To create SNMP Enforcement policies:

1. Select **Endpoint Policy > Network Access > SNMP Enforcement Policies**
2. Click **New Policy**.
3. Enter the policy name.
4. Enter the Description.

5. Select the Location Group.
6. Select the ACL from the drop down.
   Note: Select the Custom option and enter the ACL name if the ACL is configured directly on the Switch.
7. Under **Roles**, specify:
   - Policy applies to ALL roles—To apply the policy to all users.
   - Policy applies to SELECTED roles—To apply this policy only to users who are mapped to roles in the Selected roles list. You must add roles to this list from the Available roles list.
   - Policy applies to all roles OTHER THAN those selected below—To apply this policy to all users except for those who map to the roles in the Selected roles list. You must add roles to this list from the Available roles list.
8. Click **Save changes**.

Figure 73: SNMP Enforcement Policies



Note: Either VLAN and/or ACL must be configured in the SNMP policy.

Appendix

Configuration Commands for Cisco

The following is a sample configuration for linkup/linkdown/MAC notification traps for SNMP v2c. In the below configuration snmp server is configured as PPS, which is receiving SNMP traps.

You must execute the following commands in configuration mode.

```
Execute the following command to globally enable linkup and linkdown traps.
snmp-server enable traps snmp linkdown linkup
snmp-server enable traps mac-notification
Execute the following command to configure PPS as an snmp-server host, which receives SNMP notifications.
snmp-server host <PPS IP Address> trap version 2c public snmp mac-notification
mac-address-table notification interval 0
mac-address-table notification
mac-address-table aging-time 3600
snmp-server community string ro
snmp-server community string rw
```

Cisco SNMP v3 configuration

The following commands show a sample configuration for configuring SNMP v3 on Cisco switch. In the below configuration snmp server is configured as PPS, which is receiving SNMP traps.

You must execute the following commands in configuration mode.

```
snmp-server view <Read-View Name> iso included
snmp-server view <Write-View Name> iso included
The below configuration applies when the SNMP v3 settings for Security Level is “Auth, Prev” on PPS.
snmp-server group <snmpv3 group name> v3 priv context vlan- match
snmp-server group <snmpv3 group name> v3 priv read <Read-View Name> write <Write-View Name>
snmp-server user <snmpv3 username> <snmpv3 group name> v3 auth sha/md5 <auth password> priv aes/des <128>
<password>
snmp-server enable traps snmp authentication linkdown linkup coldstart warmstart
snmp-server host <PPS IP Address> version 3 auth/priv <snmpv3 username>  snmp
```

The below configuration applies when the SNMP v3 settings for Security Level is “Auth, NoPrev” on PPS.

```
snmp-server group <snmpv3 group name> v3 auth read <Read-View Name> write <Write-View Name>
snmp-server group <snmpv3 group name> v3 auth context vlan- match prefix
snmp-server user <snmpv3 username> <snmpv3 group name> v3 auth sha/md5 <auth password>
snmp-server host <PPS IP Address> version 3 auth <snmpv3 username>
```

The following sample shows the command, which are executed at interface level.

```
switchport mode access
switchport access vlan 4
snmp trap mac-notification added
```

Configuring Port Security Traps

The following sample shows the commands that is executed at global set up level for configuring port security traps.

```
snmp-server enable traps port-security
snmp-server enable traps port-security trap-rate 1
snmp-server host 192.168.1.5 version 2c public port-security
```

The following sample shows the commands, which are executed at interface level.

```
switchport access vlan <default vlan>
switchport port-security
switchport port-security maximum 2
switchport port-security maximum 1 vlan access
switchport port-security violation restrict
switchport port-security mac-address <dummy mac address>
```

Configuring Cisco ACL

The following sample shows the command for default ACL.

```
#show ip access-lists snmp-default-acl
Extended IP access list snmp-default-acl
    10 deny ip any any
#show run int gi 1/0/7
interface GigabitEthernet1/0/7
The default ACL is pushed from PPS
 ip access-group <Default-ACL>
 end
```

The following sample shows the command for Restrict ACL.

```
#show ip access-lists snmp-restrict-acl
Extended IP access list snmp-restrict-acl
    10 permit tcp any host <PPS-IP Address>
    20 permit tcp any host <PPS-IP Address> eq 443
    30 permit tcp any host <PPS-IP Address> eq www
    100 deny ip any any
#show run int gi 1/0/7
interface GigabitEthernet1/0/7
The Restict ACL name is pushed from PPS.
  ip access-group <restrict-ACL name>
end
```

The following sample shows the command for Full Access ACL.

```
#show ip access-lists snmp-full-access-acl
Extended IP access list snmp-full-access-acl
    10 permit ip any any
#do sh runn int gi 1/0/7
interface GigabitEthernet1/0/7
The Full access ACL is pushed from PPS
ip access-group <Full-Access-ACL name>

end
```

Configuration Commands for HP

HP SNMPv2 Commands

The following is a sample configuration for MAC notification traps for SNMP v2c. In the below configuration snmp server is configured as PPS, which is receiving SNMP traps. Execute the following commands in configuration mode.

```
snmp-server community "public"
snmp-server community "private" unrestricted
snmp-server host 10.204.89.131 community "public" trap-level all
```

The following command shows an example for configuring linkup, linkdown, and MAC notification traps.

```
--Execute the following commands for enabling linkup and linkdown traps.
snmp-server enable traps link-change 5
--Execute the following command for enabling mac notification.
snmp-server enable traps mac-notify
```

HP SNMPv3 Commands

The following commands show a sample configuration for configuring SNMP v3 on switch. In the below configuration snmp server is configured as PPS, which is receiving SNMP traps.

Execute the following commands in configuration mode.

```
snmpv3 enable
snmpv3 only
snmpv3 restricted-access
snmpv3 group managerpriv user sec-model ver3
snmpv3 notify "procurve" tagvalue "procurve"
snmpv3 targetaddress "procurve" params "procurve" 10.204.89.131 filter all taglist "procurve"
snmpv3 params "procurve" user sec-model ver3 message-processing ver3 priv
snmpv3 community index "20" name "public" sec-name tag "procurve"
snmpv3 user
no snmpv3 user initial
```

The following command shows an example configuration for configuring port security trap.

```
snmp-server enable traps port-security
```

ACL Configuration for Default, Restricted, and Full Access Role

Restricted ACL, give access to DHCP server and PPS

```
ip access-list extended <”Remediation-ACL”>
10 permit udp <Source-Address><wildcard/mask> eq <port number> <Destination-Address> <wildcard/mask>  eq <port number>
20 permit tcp 0.0.0.0 255.255.255.255 10.204.61.3 0.0.0.0 eq 443
30 permit tcp 0.0.0.0 255.255.255.255 10.204.61.3 0.0.0.0 eq 80
exit

ip access-list extended <”Default-ACL-Name”>
10 deny 0.0.0.0 255.255.255.255
exit

ip access-list extended <”Full-Access-ACL”>
10 permit 0.0.0.0 255.255.255.255
exit
```

Policy Enforcement using MAC Authentication

This chapter provides an overview of the MAC authentication and enforcement using MAC authentication. It includes the following information:

Overview

Media Access Control (MAC) authentication is used to authenticate devices based on their physical MAC addresses. Using MAC authentication PPS accepts the device MAC address as user credentials, matches it with the local database or LDAP server and then assigns the port connecting the device to a predetermined VLAN. MAC addresses can be easily spoofed so we recommend you to create separate VLANs or filters specifically for devices using MAC authentication. For example, you can create separate a special VLAN or separate filters for each of the device type such as printers, VOIP phones, and so on. You can also use Pulse Secure profiler for device validation and MAC authentication. For more information, see Pulse Secure Profiler.

MAC based authentication is not as secure as agent access or agentless access authentication. MAC addresses are not generally guarded as secrets, so an attacker can spoof a MAC address and impersonate a device to gain network access. To reduce risk of an exploit, create a special VLAN for each device type.

Benefits of MAC authentication

The benefits of MAC authentication are:

- PPS supports MAC authentication using both a local database and with LDAP servers.
- Supports authentication for unmanageable devices, such as printers, VOIP phones, and so on.
- Supports device validation and MAC authentication using Pulse Secure Profiler.

Deployments using MAC Authentication

MAC address authentication is port-based security typically deployed at the edge of the network to enable secure access for devices, such as IP phones, printers, and network attached storage devices. The PPS MAC address authentication solution uses PPS 802.1x framework. When a device connects to a switch, the switch forwards the MAC address as the log in credential to PPS RADIUS server. Using MAC based authentication, the MAC address serves as both the username and the password. The RADIUS server consults the authentication server and sends back a RADIUS return attribute based on the authentication results.

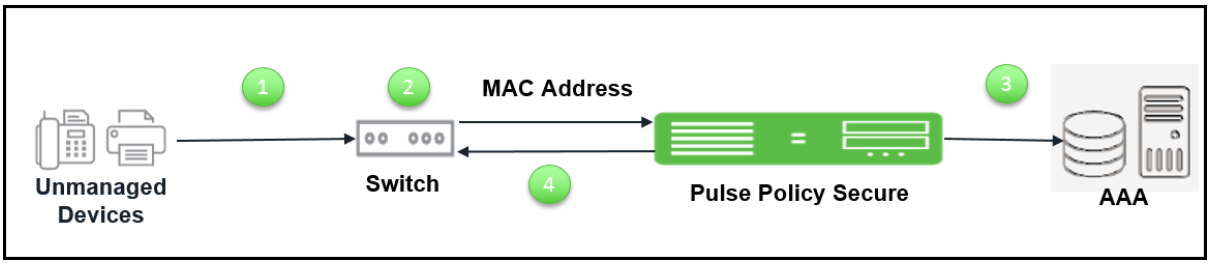
This section covers the following deployment scenarios:

- Deployment of PPS using Local MAC Authentication Server
- Deployment of PPS using Pulse Secure Profiler

Deployment of PPS using Local MAC Authentication Server

PPS supports MAC address authentication using a local Mac Authentication server. You can configure the PPS server to act as the authentication and policy server for MAC address authentication and optionally a separate directory/attribute server. You cannot use a RADIUS server with outer proxy authentication for MAC address authentication.

Figure74: PPS Deployment using Local MAC Authentication Server



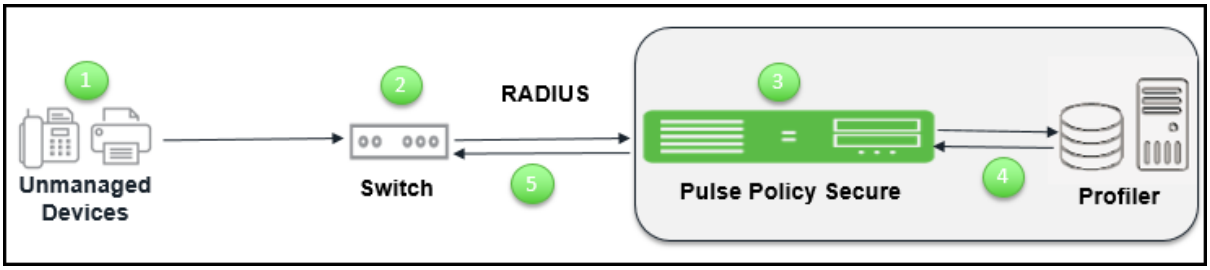
The authentication process is described below:

1. Unmanaged devices connect to network switch.
2. PPS accepts the device MAC address as username and password using MAC Authentication.
3. PPS matches the MAC address with the entries either in a local database or external database and then assigns a port connecting the device to a predetermined VLAN or filter id.
4. If the device MAC address is not found, then PPS places the device in a specified default VLAN.

Deployment of PPS using Pulse Secure Profiler

PPS supports the device validation using Pulse Secure profiler. Pulse Secure Profiler dynamically identifies and classifies endpoints across managed and unmanaged endpoint devices, so that access to network and resources can be controlled based on the type of the device.

Figure75: PPS Deployment using Pulse Secure Profiler



The authentication process is described below:

1. Pulse Secure profiler discovers and classifies the endpoints on the network.
2. Unmanaged devices connect to network and the switch sends MAC RADIUS query.
3. PPS verifies the MAC address in Pulse Secure Profiler database.
4. PPS then assigns role based on device attributes.
5. PPS assigns the switch port to appropriate VLAN or filter id.

For more information on Pulse Secure Profiler, see Pulse Secure Deployment Guide.

Configuring MAC Authentication on PPS

To allow access for unmanageable devices, configure the necessary VLANs on your internal network to accommodate the different devices that you want to allow. On PPS, you assign devices to VLANs through the location groups that are added to RADIUS attributes policies.

This section covers the configuration for MAC authentication.

- Configuring the MAC Address Authentication Server
- Configuring the MAC Address Authentication Realm and Role Mapping Rules
- Configuring User Roles for the MAC Address Authentication Realm
- Configuring a Location Group
- Configuring RADIUS Client
- Configuring RADIUS Attributes

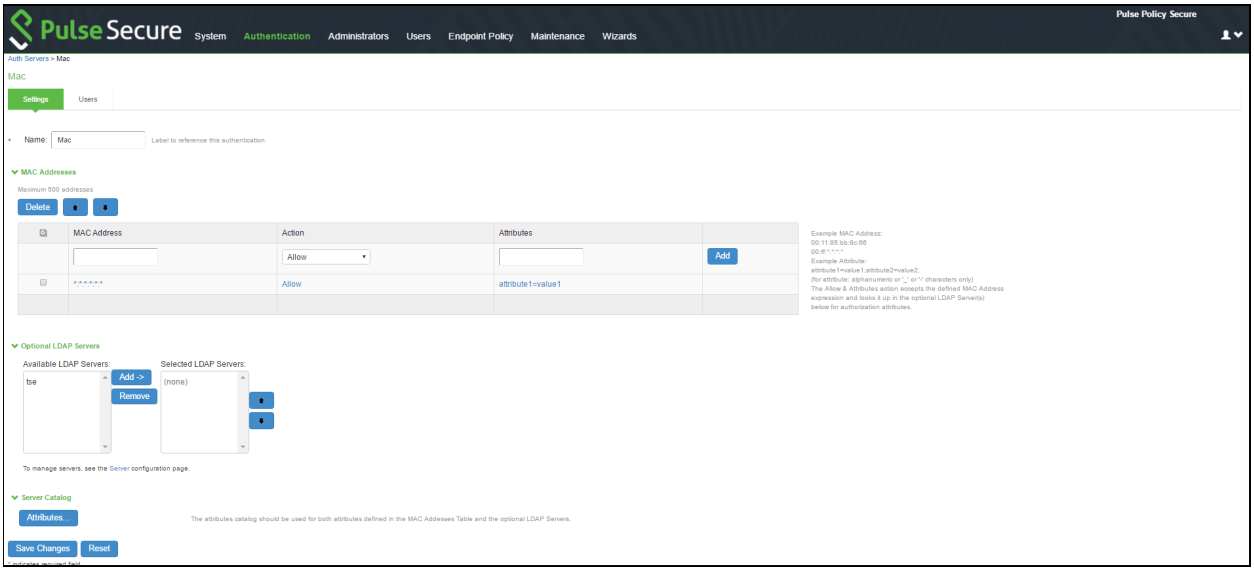
Configuring the MAC Address Authentication Server

To support MAC authentication, add a MAC authentication server to PPS. You can either configure the MAC addresses directly on PPS or you can associate the MAC authentication server with an LDAP server.

To configure the MAC address authentication server:

1. Select **Authentication > Auth.Servers**.
2. Select **MAC Address Authentication** and click **New Server** to display the configuration page MAC address authentication server configuration page.

Figure76: New MAC Address Authentication Server Configuration Page



3. Complete the configuration as described in the below table.
4. Click **Save Changes** to save the configuration.

Table11: MAC Address Authentication Server Settings

Settings	Guidelines
Name	Specify a name to identify the configuration. Follow a convention that is helpful to you and others who might perform administration tasks.
MAC Addresses	
MAC Address	Enter a MAC address. The system supports various formats, including no-delimiter (003048436665), single dash (003048-436665), multidash (00-30-48-43-66-65), and multicolon (00:30:48:43:66:65). The system supports wildcards (00:30:*:*:*:*). In the user log, entries appear in the multicolon format.
Action	Select an action to take when the MAC address matches: **Allow**—Signal successful authentication. **Deny**—Signal unsuccessful authentication. **Allow and Attributes**—Typically, a match terminates the search. If you select **Allow and Attributes**, the search is not terminated; instead, the system searches the LDAP servers for a match to retrieve the LDAP authorization attributes.
Attributes	Specify a name-value pair to associate the MAC address with a particular group or organization. For example, dept=eng is a name-value pair that associates the MAC address with a department (engineering). When you create the MAC address realm, you can create a custom expression to assign the MAC address to a specific role.
Optional LDAP Servers	
Available / Selected LDAP Servers	Use the **Add** and **Remove** selector buttons to add LDAP servers to the list of selected servers. Use the up and down buttons to order the list. The order in which the LDAP servers are listed is important. The system searches for MAC address matches in the following order: If the MAC address of the endpoint matches a manual entry, the system does not query servers in the LDAP server list. If no manual entries match, the system tries the first LDAP server. If the request times out or gets rejected, the system tries the second, then the third, and so on. NOTE: Each LDAP server that must be queried affects performance.
Server Catalog	
Attributes	If you have selected LDAP servers in the configuration, save the configuration. After you have saved the configuration, the Attributes button is displayed. Click the **Attributes** button to display the LDAP server catalog, which you can use to select or add attributes to be retrieved from the LDAP servers.

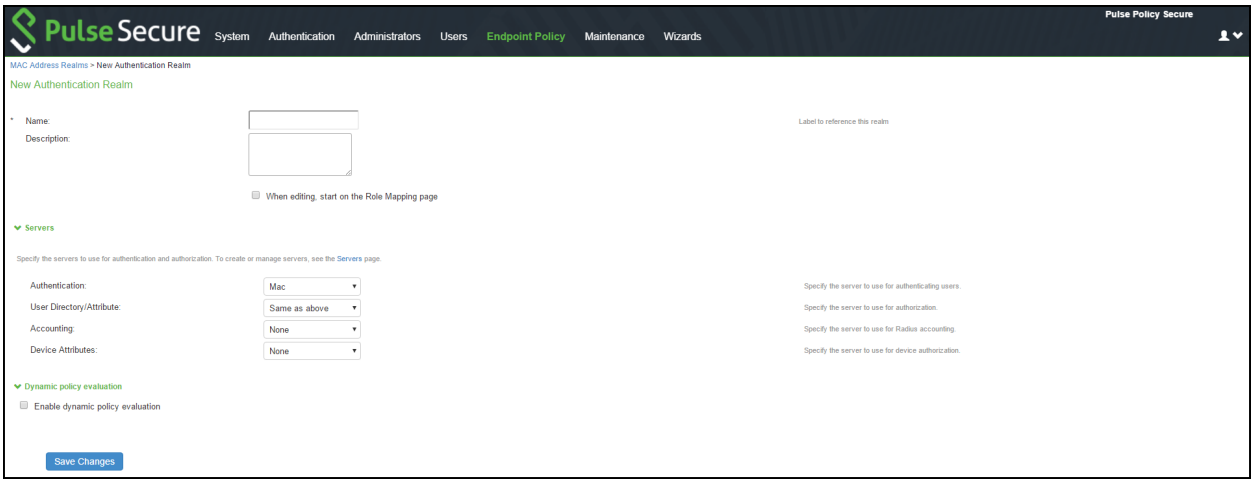
Configuring the MAC Address Authentication Realm and Role Mapping Rules

The MAC address authentication framework uses a special realm called the MAC Address Authentication Realm. You need not configure a sign-in policy while using MAC address authentication realm. The MAC Address authentication realm uses any username credential that matches one of the common variants of a MAC address format (colon-separated, dash-separated, and the like) and sends it to the MAC authentication realm based on its format.

To configure the MAC Address authentication realm and role mapping rules:

1. Select **Endpoint Policy > MAC Address Realm**.
2. Click **New** to create a new configuration.

Figure77: MAC Address Authentication Realm Settings



3. Complete the configuration. The below table summarizes the key settings.

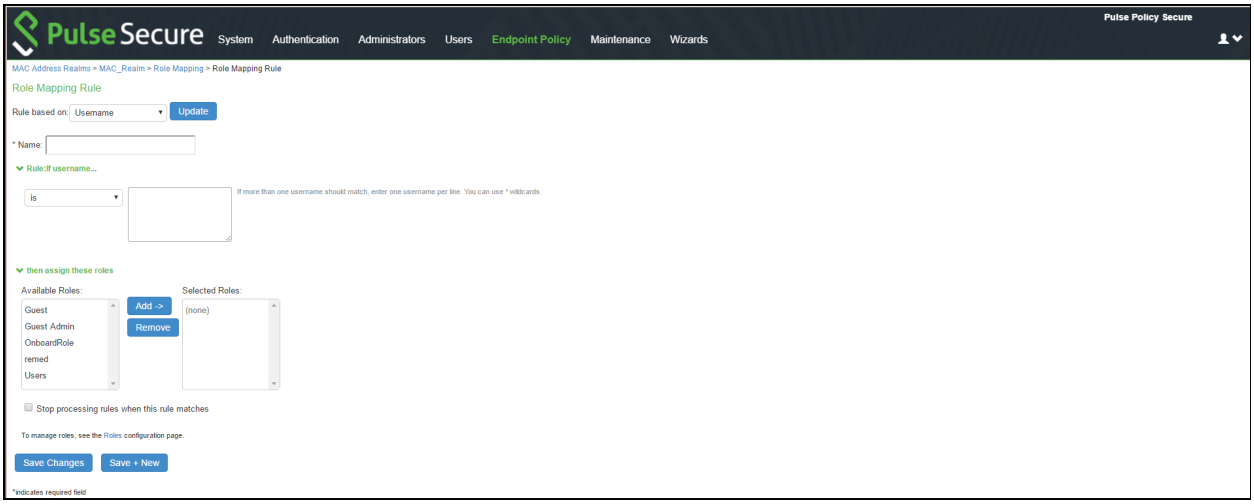
Table12: Key MAC Address Authentication Realm Settings

Setting	Guideline
Name	Enter the name of the realm.
Description	Enter the description for identifying the realm.
Server	
Authentication server	Select the MAC Address authentication server configured.
User Directory/Attribute	Select the LDAP authentication server configured.
Accounting	Select the MAC Address authentication server configured.
Device attribute	Specify the server for device authorization. For profiler, select the name of the local profiler.
Dynamic Policy Evaluation	
Dynamic Policy Evaluation	Select this option to automatically or manually refresh the assigned roles of users by evaluating a realm's authentication policy, role-mappings, role restrictions, and resource policies.

4. Save the configuration. Upon saving the new realm, the system displays the role mapping rules page. Under Role Mapping tab, click **New Rule**. Role Mapping Rule page appears.
5. Select **Device Attribute** under **Rule based on** tab and click **Update**. Enter the name for the rule.

6. Select the relevant Attribute under Attributes tab for Role Mapping and enter an appropriate value.
7. Select an appropriate role from Available Roles and Click **Add** to Selected Roles.
8. Click **Save Changes** to save the configuration settings.

Figure78: MAC Address Authentication Realm Role Mapping Settings



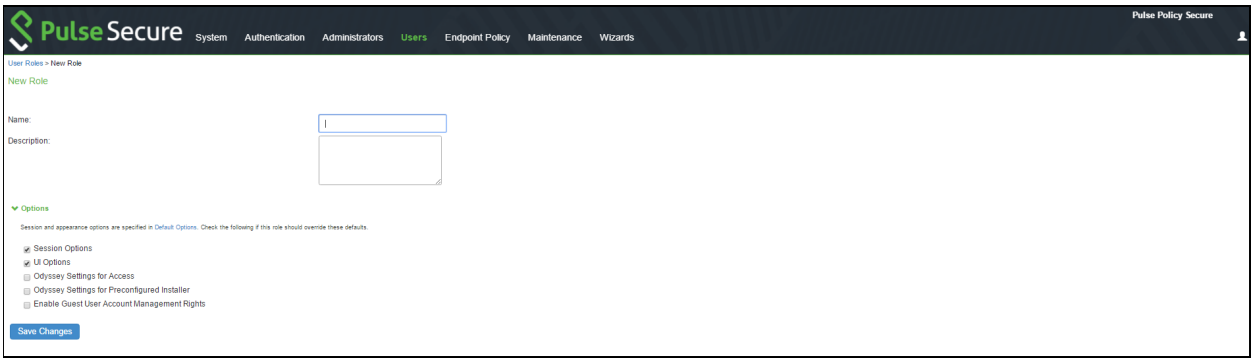
Configuring User Roles for the MAC Address Authentication Realm

PPS access management framework evaluates authentication requests to match endpoints to roles. You must configure user roles for the various types of endpoints authenticated by the MAC address authentication framework.

To create a user role:

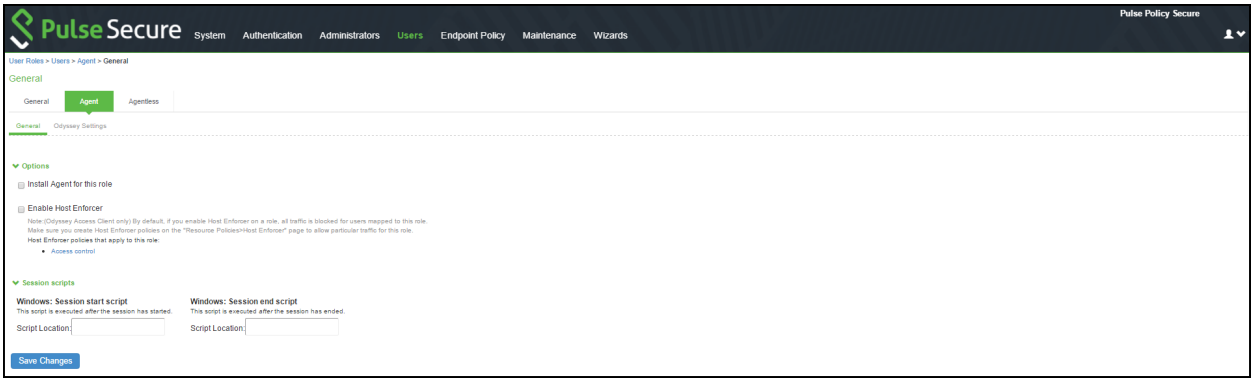
1. Select **Users > User Roles**.
2. Click **New Role**.
3. Complete the name and description configuration and then save the configuration.

Figure79: User Role General Configuration



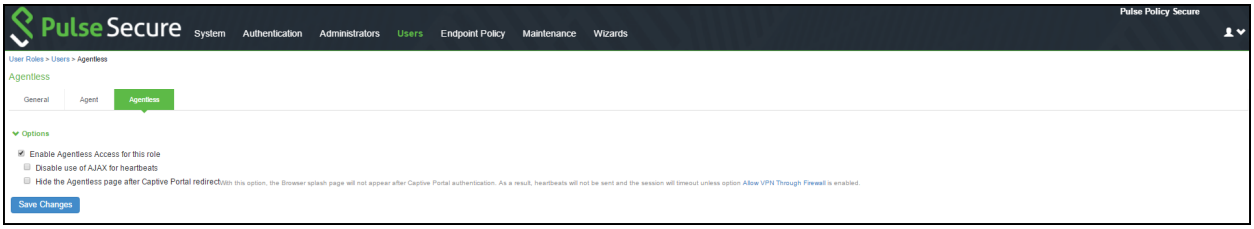
4. Click **Agent** and deselect agent options and then save the configuration.

Figure80: User Role Agent Configuration



5. Click **Agentless** and enable agentless access and then save the configuration.

Figure81: User Role Agentless Configuration



NOTE: Do not configure role restrictions for roles used with a MAC address authentication realm.

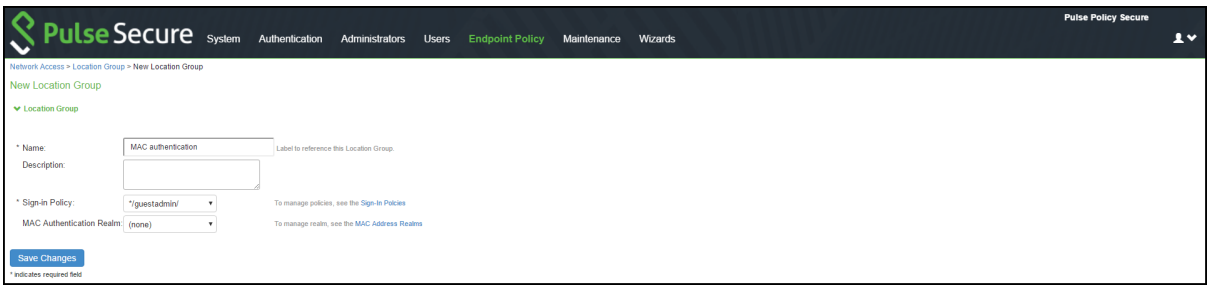
Configuring a Location Group

Location groups let you organize or logically group network access devices by associating the devices with specific sign-in policies. Sign-in policies provide a way to define and direct independent access control policies with the network. For example, you can create location group policies to logically group the network access devices in each building at a corporate campus. You can also use location group policies to specify a special realm for MAC address authentication.

To configure a location group:

1. Create a sign-in policy to associate with the location group.
2. Select **Endpoint Policy > Network Access > Location Group**.

Figure82: Location Group Configuration Page



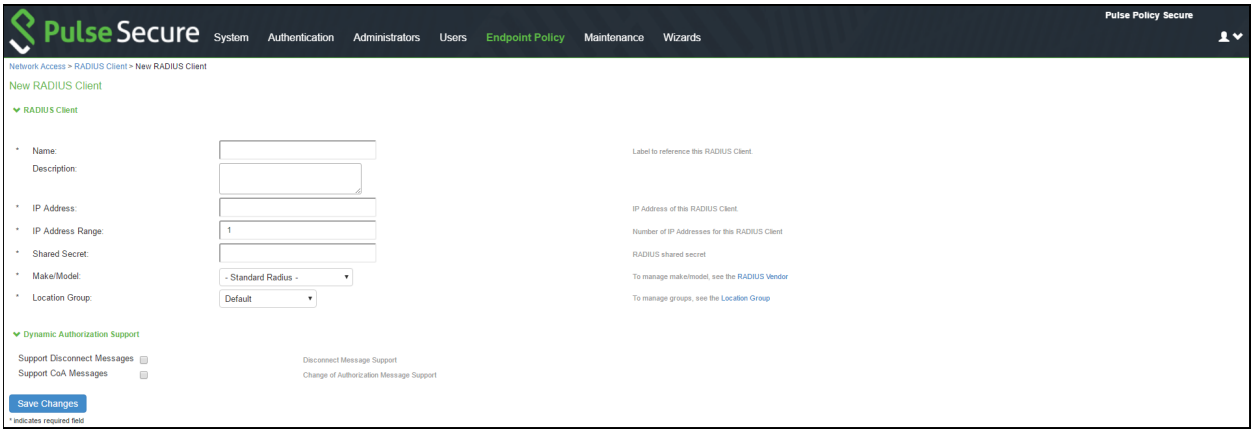
3. On the New Location Group page, enter a name to label this location group and optionally a Description.
4. For Sign-in Policy, select the sign-in policy associate with the location group.
5. For controlling an unmanageable device using MAC address authentication, select a MAC Authentication Realm that you created from the list.
6. Click **Save Changes**.

Configuring RADIUS Client

A RADIUS client policy specifies the information required for unmanaged devices to connect as a RADIUS client of the PPS. To configure a RADIUS client:

1. Select **Endpoint Policy > Network Access > RADIUS Client**.
2. Click **New RADIUS Client**.

Figure 83: RADIUS Client Configuration Page



3. On the RADIUS Client page, enter a name to label the RADIUS client. You can assign any name to a RADIUS client entry, use the device's SSID or IPv4 address to avoid confusion.
4. Enter a purpose or description of the configuration so that other users are aware of it.
5. Enter the IP address of the NAD.
6. (Optional) For **IP Address Range**, enter the number of IP addresses in the IP address range for the switch/WLC, starting with the address you specified for IP Address. You can specify a range up to a maximum of 32,768 addresses.
7. For **Shared Secret**, enter the RADIUS shared secret. A RADIUS shared secret is a case-sensitive password used to validate communications between PPS and NAD. PPS supports shared secrets of up to 127 alphanumeric characters, including spaces and the following special characters:
   ~!@#$%^&*()_+|\=-‘{}[]:”’;<>?/.,
8. For **Make/Model**, select the make and model of the NAD. The make/model selection tells PPS which dictionary of RADIUS attributes to use when communicating with this client.
9. For **Location Group**, select the location group to use with this NAD.
10. Under **Dynamic Authorization support**, Select the **Support Disconnect Messages** check box to send disconnect messages to supplicants if access is no longer authorized. If this check box is selected, a disconnect request is sent to the NAD any time a session is deleted. PPS can also send disconnect messages upon a role event that includes a VLAN change or a change in RADIUS attributes.
11. Select **Support CoA Messages** to enable CoA messages and disconnect messages support for the client.
12. (Optional) Enter a new **Dynamic Authorization Port** (Default port is 3799). The default port might vary depending on the manufacturer. NAD listens to UDP port to receive RADIUS CoA messages from PPS.
13. Click **Save Changes**.

Note: MAC address authentication must be enabled on the switch port. See Configuring 802.1x and MAC Authentication on the Switch Port for switch configuration.

Configuring RADIUS Attributes

This configuration describes the configuration information for RADIUS return attributes policy that is applied on switch, request attribute policy, which can be used along with sign-in policies for realm selection, policy realm restrictions, and authentication/accounting reporting for RADIUS authentication events.

This configuration describes how to send VLAN assignment and other attributes to the switch/WLC by returning RADIUS attributes.

1. Select **Pulse Policy Secure > Network Access > RADIUS Attributes**, select VLAN.
2. Specify a VLAN ID.
3. Select Return Attribute.
4. Select the attribute you want to return from the Attribute list.
5. For Value, specify an attribute value.

For more information on RADIUS attribute policies, see Configuring RADIUS Attributes Policies.

Policy Enforcement using 802.1X Native Supplicant

This chapter provides an overview of enforcement using native supplicant. It includes the following information:

Overview

PPS supports 801.X authentication using native supplicants. The Native supplicant is the default Operating System (OS) agent, which runs on the client machine. The mobile platforms and laptops have native supplicant support.

Benefits

- Supports simplified access to applications from personally owned devices, addressing the Bring Your Own Device (BYOD) users.
- Devices that do not have Pulse Secure client can authenticate with PPS and get the realm and roles applied.

Deployments using 802.1X Authentication with Native Supplicant

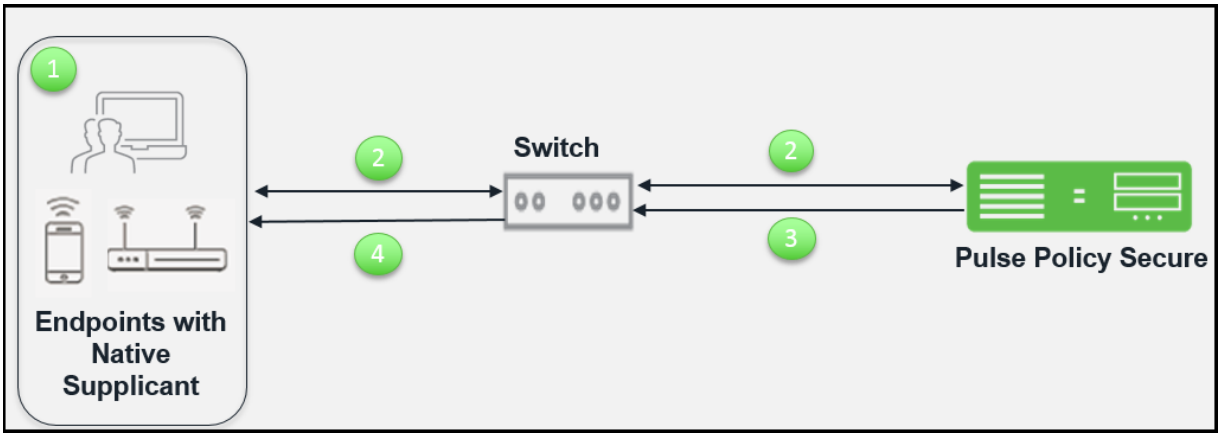
This section covers the following topics:

- 802.1X Authentication with Native Supplicant
- Agentless Host Checking with Native Supplicant
- Host Checking with Native Supplicant

802.1X Authentication with Native Supplicant

Using PPS, you can provision 802.1X authentication for endpoints using native supplicant. The Layer 2 authentication and enforcement is used to control network access policies at the edge of the network using an 802.1X enabled switch or access point.

Figure 84: 802.1X Authentication with Native supplicant



The workflow for 802.1X authentication with native supplicant is described below:

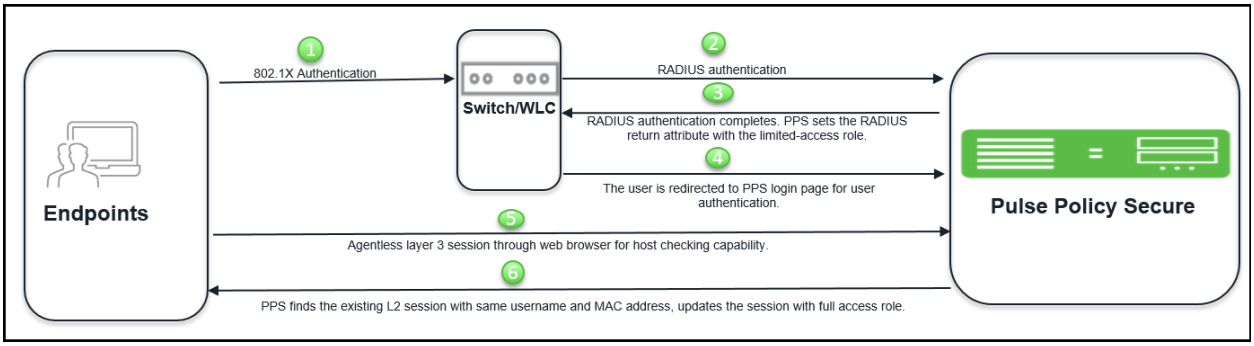
1. Configure the endpoints protocols from the Adapter settings as per the PPS configured protocols. Once the client adapter is online the authentication starts automatically.
2. Switch receives the request and starts RADIUS authentication with PPS. The user is prompted for user credentials.
3. PPS assigns the roles based on the credentials provided by the user. PPS communicates the enforcement rules to switch in form of RADIUS return attributes (For example, Change of VLAN) for the authenticated user.
4. Switch provides access and IP address to the endpoints based on the RADIUS return attributes.

Agentless Host Checking with Native Supplicant

As many users bring their own devices, additional intelligence must be applied to eliminate intrusions and protect sensitive information. The IT administrators need the ability to control where devices are allowed on the network, based on the device type, operating system, owner of the device and user log in credentials of the device. The network resource request must be handled appropriately and appropriate action must be taken for any violation, which includes limiting access to internet only.

The PPS solution provides endpoint compliance for BYOD devices for providing seamless access to protected resources with native supplicant. For example, enterprise users need to provide onsite access to employees and contractors. To provide network access, the BYOD devices from contractor must be compliant to host checker security policies. For such users, you can use 802.1X authentication using native supplicant and then endpoint compliance check is achieved using a web browser. A single session is created for both the connections and a single license is consumed.

Figure 85: Agentless Host Checking with Native Supplicant



The workflow is described below:

1. The contractor user connects to network, performs layer 2 authentication using AD credentials. For 802.1X, AD username and password is used for authentication. For MAC authentication, endpoints MAC address or device attributes for profiler is used for authentication.
2. The endpoint host check is not performed and hence the user gets limited connectivity. The user must be compliant to host check security policy for full access.
3. PPS sets the RADIUS return attribute with limited access role. Limited access role is applied on the endpoint.
4. The user is redirected to a PPS log in page for user authentication.
5. The user opens the web browser and enters the AD username and password. The agentless Host Checker provides the compliance details to PPS.
6. PPS finds the existing session with the same username and MAC address and then updates the session with full access role.

The user gets the required full access to protected resources if the system is compliant to HC security policies.

Note:

- The user can choose to remember the username and password to avoid entering it multiple times for layer 2 and layer 3 connections.
- This feature is supported for Windows and MAC OSX.
- For configuration, see Configuring Agentless Host Checking with Native Supplicant.

Host Checking with Native Supplicant

On Mac OSX, Windows, and Linux endpoint using native supplicant, PPS Host checking can be enforced only for Layer 3 connection. Once the endpoint gets authenticated using native supplicant and gains network access, you can launch and install Pulse Secure client using web browser deployment or SCCM advertisement to establish a Layer 3 session. This evaluates the health status of the endpoints and thereby ensuring legitimate resource access behind PPS Enforcer.

There will be only one session for Layer 2 and Layer 3 connections on PPS which will consume single license.

For agentless host checking, native supplicant is used to perform 802.1x authentication. The compliance check is performed using browser based agentless L3 session. The L2 and agentless L3 session are bridged on PPS to provide compliance based layer 2 access control. For access control, RADIUS return attribute Filter-ID with Radius COA is used.

Note:

- The Host Checker functionality is not supported on the native Mozilla browser on MAC OSX. As a workaround disable the Captive Network Assistant feature, which is enabled by default or open the Pulse Secure client using a different web browser.
- Using Native Supplicant the Host Checker functionality is not supported. This is possible through Configuring Agentless Host Checking with Native Supplicant.
- Agentless Session Bridging requires Host Checker functionality to be executed on Linux via JAVA NPAPI plugin, which is only supported on Firefox ESR browser with v52.0 and lower.

Configuring Agentless Host Checking with Native Supplicant

The access control for this use case can be achieved through RADIUS CoA and a sample workflow is described below:

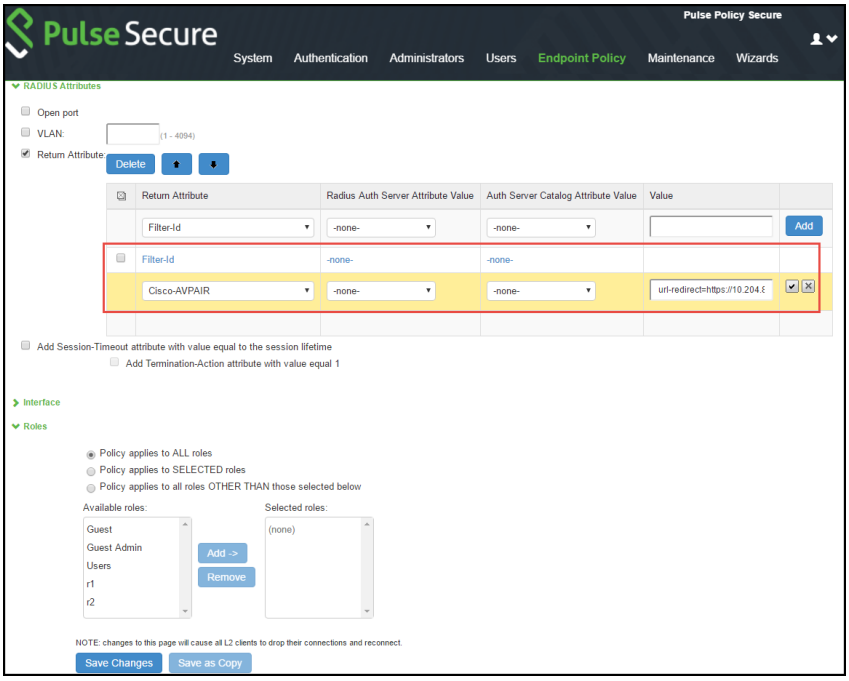
1. The native supplicant performs 802.1X authentication and PPS creates a session. The PPS assigns a limited access role since the host check is not performed.
2. The user configures the RADIUS URL-redirection attributes on the Cisco Switch. Using RADIUS URL-Redirection return attributes the Cisco switch redirects any initial HTTP/s traffic to PPS so that Layer 3 authentication is performed along with compliance check. Upon successful Host Check, a different set of radius attributes is pushed using Radius CoA to seamlessly access any resource.

   You must configure the following return attributes (supported only on Cisco switches):

   ```
   Cisco-AVPAIR=url-redirect-acl=REDIRECT_To_PPS
   Cisco-AVPAIR=url-redirect=https://<PPS-SIGN-IN-URL>/
   ```

   The below figure shows a sample PPS configuration for URL-redirection on Cisco switch.

   Figure 86: RADIUS URL-Redirection on Cisco switch



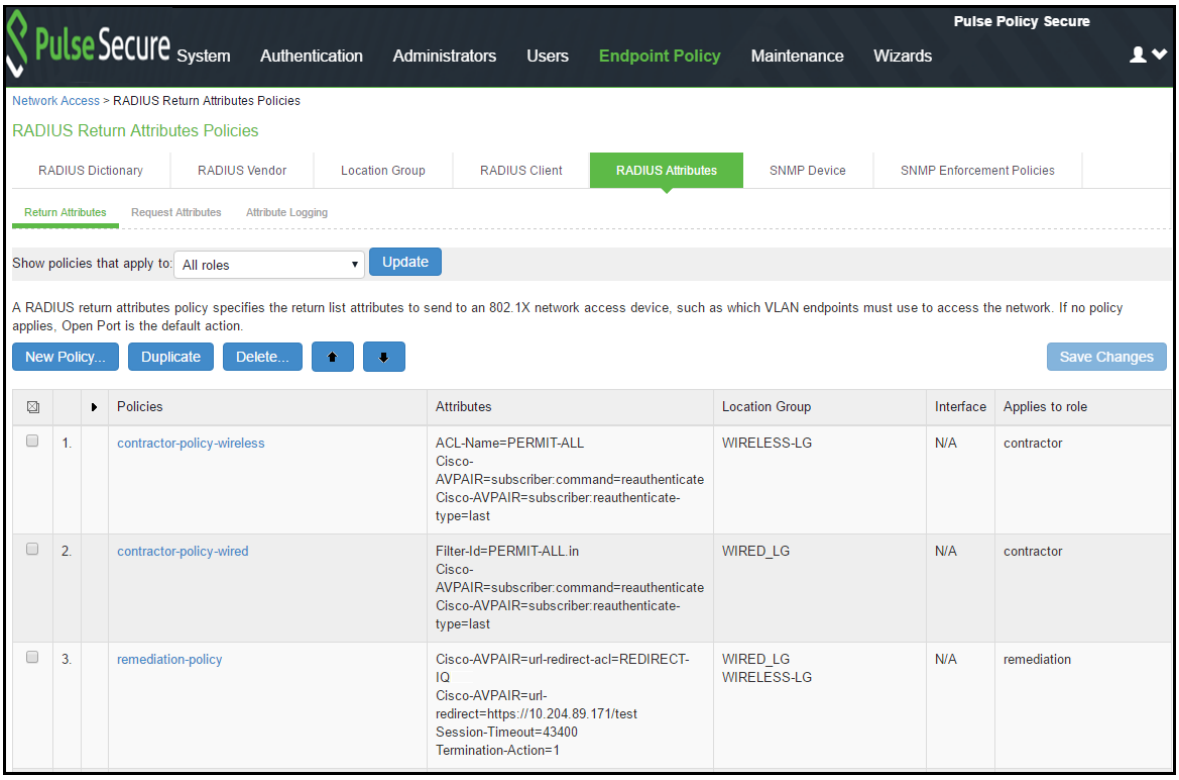
3. The user configures the RADIUS CoA attributes. The recommended radius return attribute to perform access control using RADIUS CoA is Filter-ID for wired devices and ACL-name for WLC.

   You must configure the following return attributes on PPS:

   ```
   Filter-Id=PERMIT-ALL.in
   CiscoAVPAIR=subscriber:command=reauthenticate
   Cisco-AVPAIR=subscriber:reauthenticate-type=last
   ```

   The below figure shows a sample PPS configuration for RADIUS CoA.

Figure 87: RADIUS Return Attributes for CoA



4. The agentless L3 authentication is done through web browser and host check is performed. If host check passes the user receives new role (for example, full-access), which provides full access to authorized resources.

Note:

- The L2 and L3 connections are merged and the merged session receives full-access role.
- The change of role triggers new RADIUS return attribute policy. The new policy triggers RADIUS CoA and applies new radius attribute, which provides full access to authorized resources.
- VLAN change using CoA is not supported with Cisco Switches. It is recommended to use RADIUS disconnect for VLAN change.
- The RADIUS CoA configuration for various Cisco switch platforms is described below.

Cisco Platform	IOS Version	RADIUS CoA Configuration
3850	16.3	`Filter-Id=PERMIT-ALL.in`
2960X	15.2	`Filter-Id=PERMIT-ALL.in`

2960	12.2	`Filter-Id=PERMIT-ALL.in`
		`Cisco-AVPAIR=subscriber:command=reauthenticate`
		`Cisco-AVPAIR=subscriber:reauthenticate-type=last`

Configuring 802.1X for Native Supplicant on PPS

This section covers the procedure for configuring 802.1X authentication on PPS. It covers the PPS configuration that is used for native supplicant:

- Configuring Authentication Protocol Set
- Creating and modifying the sign-in policy
- Configuring a Location Group
- Configuring Role and Role Mapping
- Configuring RADIUS Attributes Policies

Note:

- Authentication Protocol Set configuration varies among different platforms. For example, MAC OSX supports EAP-TTLS/PAP, EAP-TTLS/MS-CHAP-V2 and PEAP/EAP-MS-CHAP-V2 authentication protocol set when PPS is configured with AD server for user authentication.
- EAP-TTLS/CHAP are supported with local authentication server and not supported on Active Directory.

Configuring Native Supplicant for 802.1X Authentication

This section covers the following topics:

- Example: Configuring windows 7 native supplicant for 80.2.1X Authentication
- Example: Configuring MAC OSX native supplicant for 802.1X Authentication

Example: Configuring Windows 7 Native Supplicant for PPS 802.1X Authentication

The 802.1X wired LAN Authentication gives you the possibility to connect your device using the cable network (wired). You can use the windows native supplicant for 802.1X authentication.

Requirements

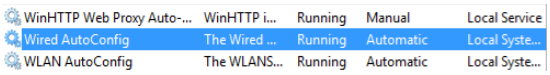
- Your device must be equipped with a LAN interface and meet the standards for connecting to enterprise networks requiring 802.1X authentication.
- Local admin privileges are required on the endpoint.
- The OS security updates are installed and an Antivirus Software is present and up-to-date.
- It is recommended to disable all third-party connection management tools so that the native Windows tool is used.

Configuring the Windows Native Supplicant

To configure the native supplicant:

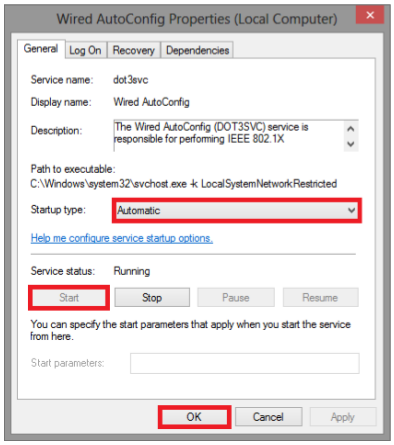
1. Select **Control Panel > System and Security > Administrative Tools** and access the Services tool.
2. In the services window locate the service named **Wired Autoconfig** and double click the service.

Figure 88: Service Tool



3. Select the Startup type **Automatic** and click **Start**.

Figure 89: Wired Autoconfig Properties

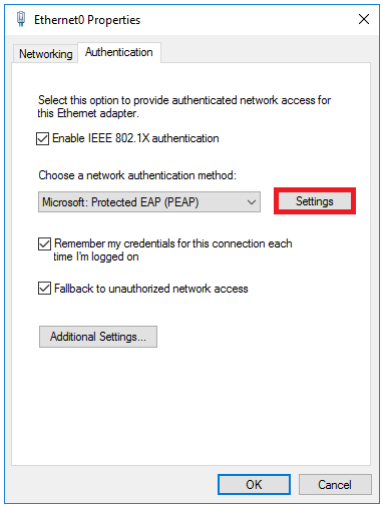


4. Click **Start > Control Panel > Network and Internet** > **Network and Sharing Center**.

5. Select **Change adapter settings** and then right click on the LAN adapter, **Ethernet** or **Local Area Connection** and select **Properties**.
6. Click the **Authentication** tab at the top of the window. Select **Enable IEEE 802.1X authentication** and **Fallback to unauthorized network access**. From the dropdown list about the network authentication, choose **Microsoft: Protected EAP (PEAP)**.
7. Click **Settings** to choose the authentication method and then click **OK** to proceed.

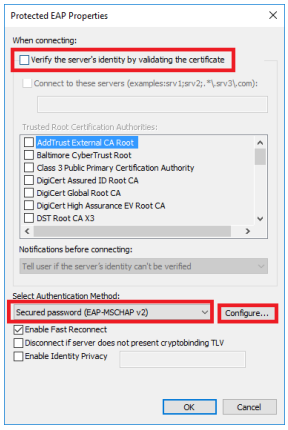
   Note: If you choose **Remember my credentials for this connection each time I'm logged on** the user credentials are not prompted for every log in. Don't use this option if multiple people are using the device.

Figure 90: Ethernet Properties



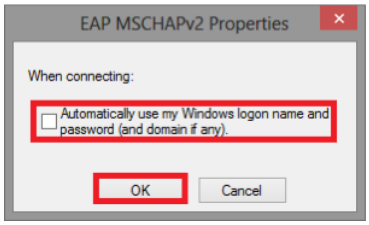
8. Uncheck **Verify the server's identity by validating the certificate** and select the **Enable Fast Reconnect** option. Click **Configure** to continue.

Figure 91: Protected EAP Properties



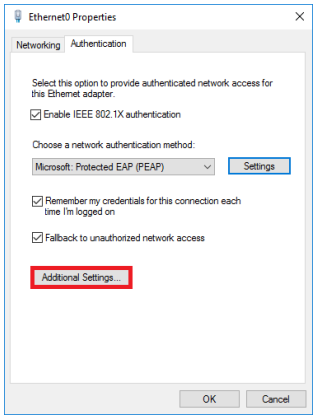
9. Uncheck **Automatically use my Windows logon name and password** and click **OK** to confirm.

Figure 92: EAP MSCHAPv2 Properties



10. Click **Additional Settings**.

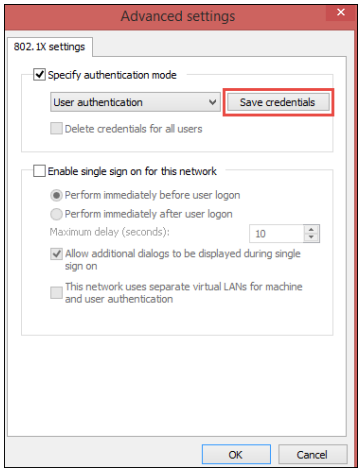
Figure 93: Ethernet Properties



11. Select **Specify authentication mode** and choose **User authentication** from the list.

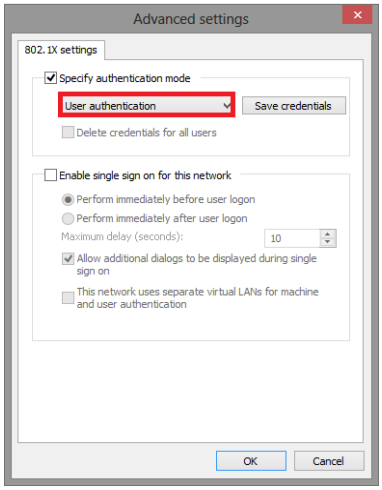
12. If you are using Cisco switch/WLC then you can use **Save credentials** to save the user credentials.

Figure 94: Advanced Settings



13. Click **Additional Settings** and choose **User authentication** and then Click **OK**.

Figure 95: Advanced Settings



14. Plug the network cable and If already inserted, unplug it and attach it again.
15. A log in window pops to enter **Username** and **Password**.

Example: Configuring Mac OSX Native Supplicant for PPS 802.1X Authentication

This section details the procedure for configuring native Mac OSX supplicant for PPS 802.1X authentication.

Requirements:

- Apple Mac OSX endpoint
- iPhone Configuration utility

Configuring MAC OSX Native Supplicant

Authentication to a PPS 802.1X server in MAC OSX endpoints is achieved using Apple Configurator. This tool allows you to easily create, maintain, and install configuration profiles, track and install provisioning profiles, and capture device information including console logs.

Note: The latest MAC OSX endpoints can be configured using Apple Configurator 2 tool.

This section covers the following configuration:

- Configuring 802.1X profiles
  - Configuring TTLS-PAP authentication profile
  - Configuring TTLS/MS-CHAP-V2 authentication profile
  - Configuring PEAP authentication profile

Configuring 802.1x profile

You can create various profiles (TTLS/PAP, TTLS/MS-CHAP-V2, and PEAP/MS-CHAP-V2) required for PPS 802.1x authentication using Apple Configurator. The generated configuration profiles can be exported to a Mac OSX endpoint. To create profiles, install the profiles (by double clicking on the exported files) on their OSX endpoints and that will provision Layer 2 access when connected to 802.1x enabled switch port.

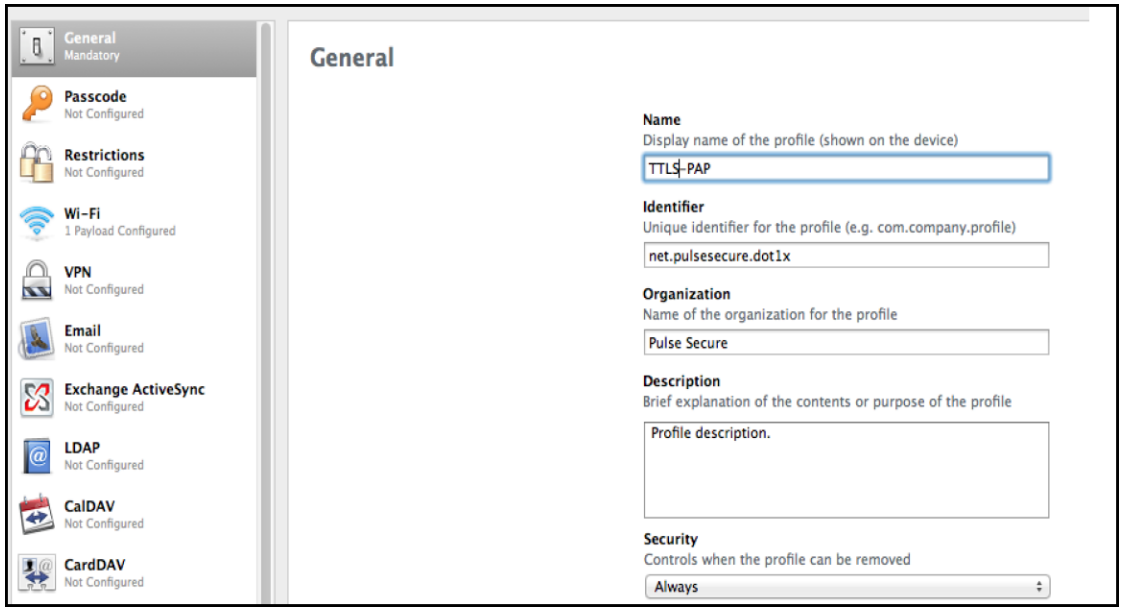
Configuring 802.1x profiles -TTLS/PAP, TTLS/MS-CHAP-V2, and PEAP/MS-CHAP-V2 applies only for General and Wi-Fi settings. If the authentication server is LDAP, use TTLS-PAP for LDAP servers. If the authentication server is Active Directory or local, use TTLS-MSChapV2 or PEAP-MSChapV2.

Configuring TTLS-PAP Authentication Profile

To configure TTLS-PAP profile, perform the following:

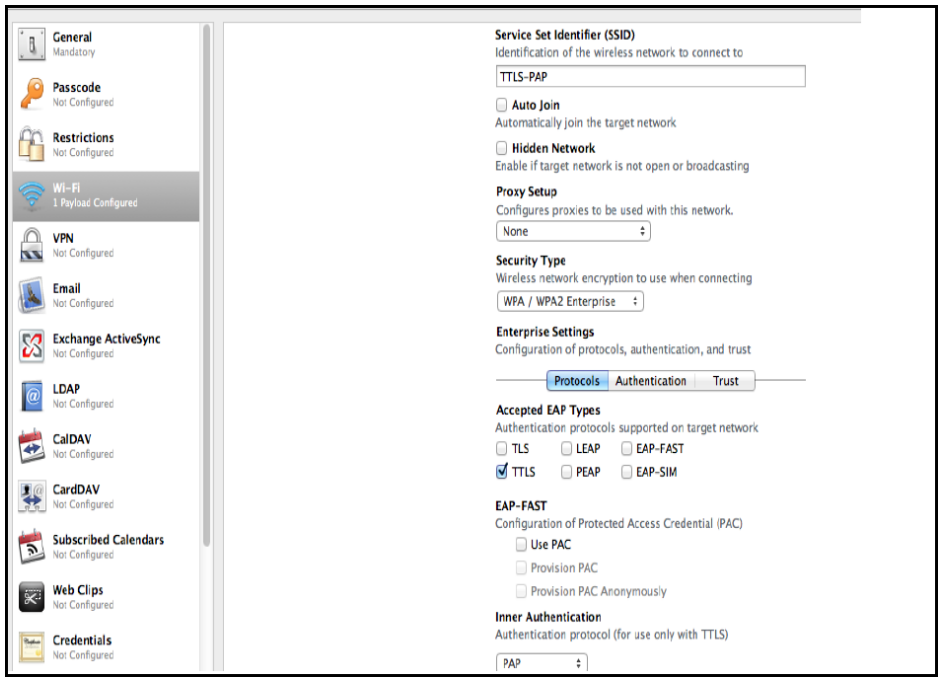
1. On the iPhone configuration utility (IPCU) navigate to **Configuration Profiles** tab.
2. On configuration Profiles page, select **General** and enter the required values.

Figure 96: TTLS: PAP General Configuration



3. Select Wi-Fi and enter the required values.

Figure 97: TTLS: PAP Wi-Fi

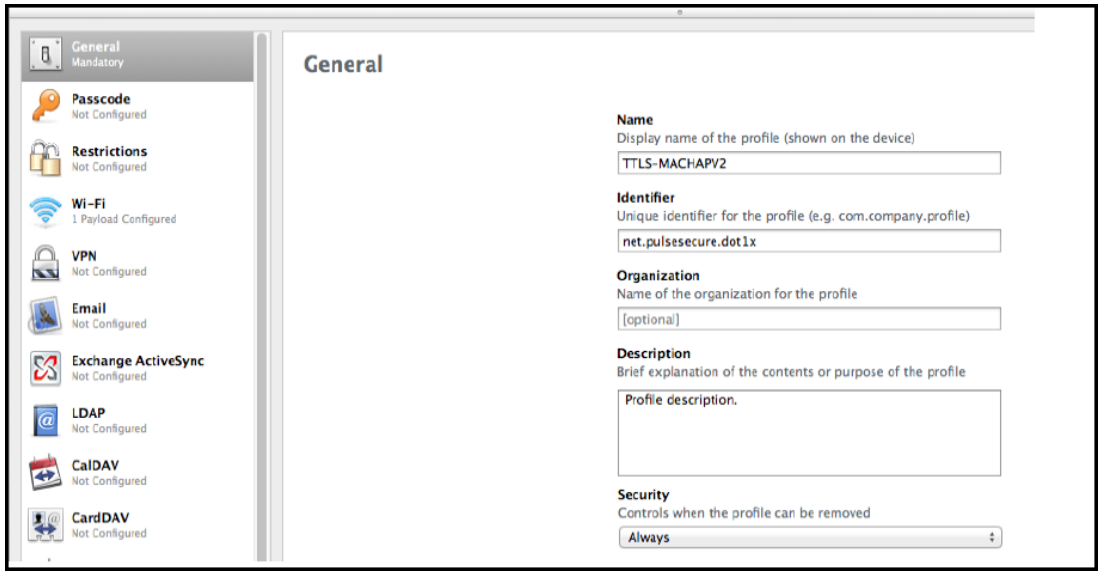


Configuring TTLS/MS-CHAP-V2 Authentication Profile

To configure TTLS/MS-CHAP-V2, perform the following:

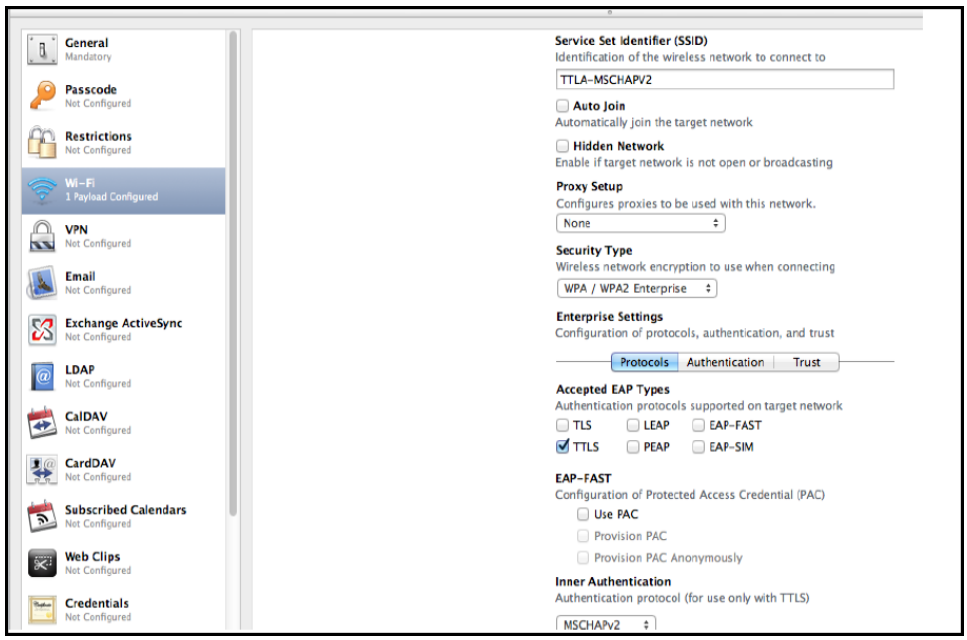
1. On the iPhone configuration utility (IPCU) navigate to **Configuration Profiles** tab.
2. On configuration Profiles page, select **General** and enter the required values.

Figure 98: TTLS: CHAP-v2 General



3. Select **Wi-Fi** and enter the required values.

Figure 99: TTLS: CHAP-v2 Wi-Fi

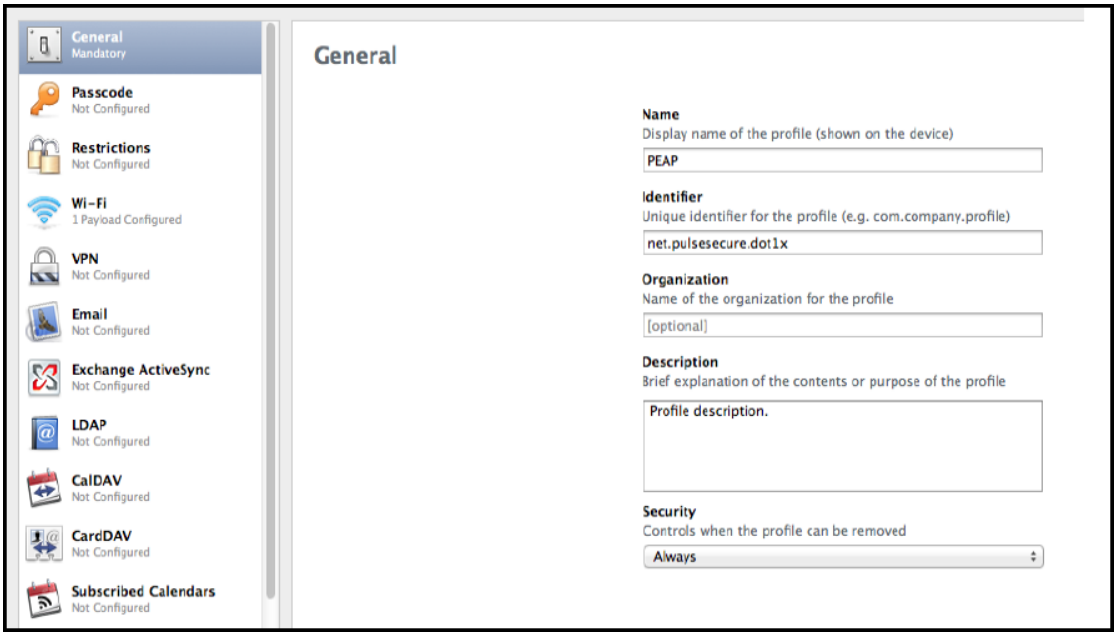


Configuring PEAP Authentication Profile

To configure PEAP, perform the following:

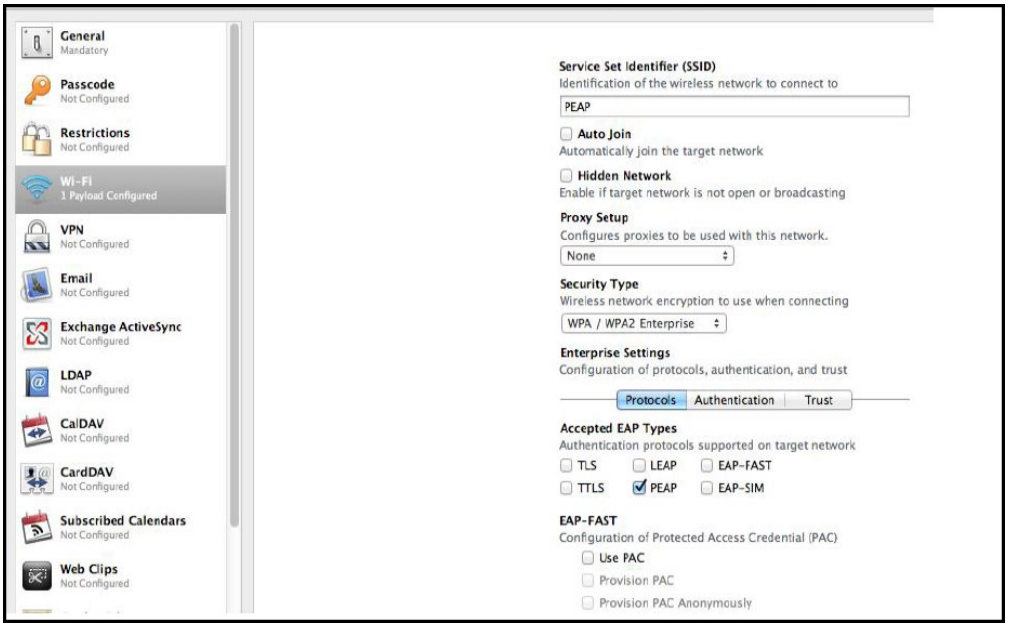
1. On the iPhone configuration utility (IPCU) navigate to **Configuration Profiles** tab.
2. On configuration Profiles page, select **General** and enter the required values.

Figure 100: PEAP: CHAP-v2 General



3. Select **Wi-Fi** and enter the required values.

Figure 101: PEAP: CHAP-v2 Wi-Fi



Layer 3 Enforcement

Layer 3 enforcement means using devices other than L2 switches or wireless access points for enforcement. This includes adding SRX, ScreenOS, Palo Alto, Fortigate, and Check Point firewall as enforcement points.

This part covers the following chapters:

Enforcement using Check Point Next-Generation Firewall

This chapter provides an overview of enforcement using Check Point Next-Generation Firewall. It includes the following information:

Overview

PPS delivers layer 3 network access control solution when deployed with Check Point Next-Generation Firewall (NGFW). PPS authenticates users, ensures that the endpoints meet security policies, and then dynamically updates the firewall enforcement point with the resulting user session information. Upon successful user authentication with PPS, the access to protected resources behind the firewall is based on the user identity, IP address, and user role information provided by PPS.

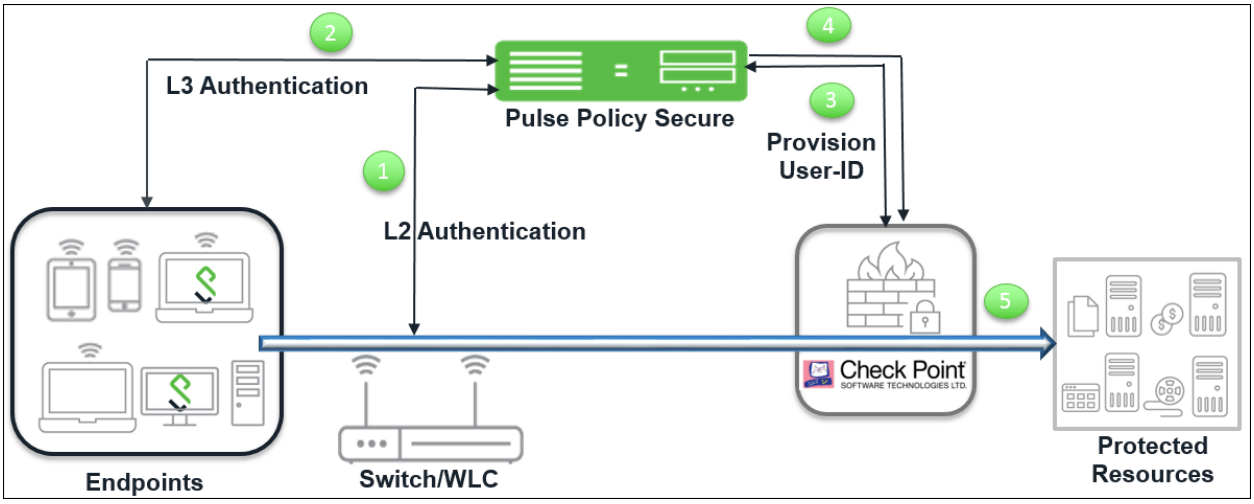
The PPS and Check Point firewall integration provides identity enabled layer 3 enforcement for BYOD, guests, and enterprise employees and protects corporate sensitive data from unauthenticated access and attacks.

Deployment of PPS using Check Point Next-Generation Firewall

This section describes the integration of PPS with Check Point Next-Generation Firewall. The Check Point Next-Generation Firewall controls the access to resources (for example, internet, CRM systems, Wikis and so on.) based on policy settings that defines the access. The Check Point Next-Generation Firewall allows integration with directory sources (For example, AD or LDAP) to get user and group information. The policies are then defined based on user role information.

PPS serves as the provider of identity information (For example, user-ID, IP address, and roles) for Check Point Next-Generation Firewall. The Check Point Next-Generation Firewall uses the identity information provided by the PPS for deciding the resource access.

Figure102: Integrating Check Point with PPS



The authentication process is described below:

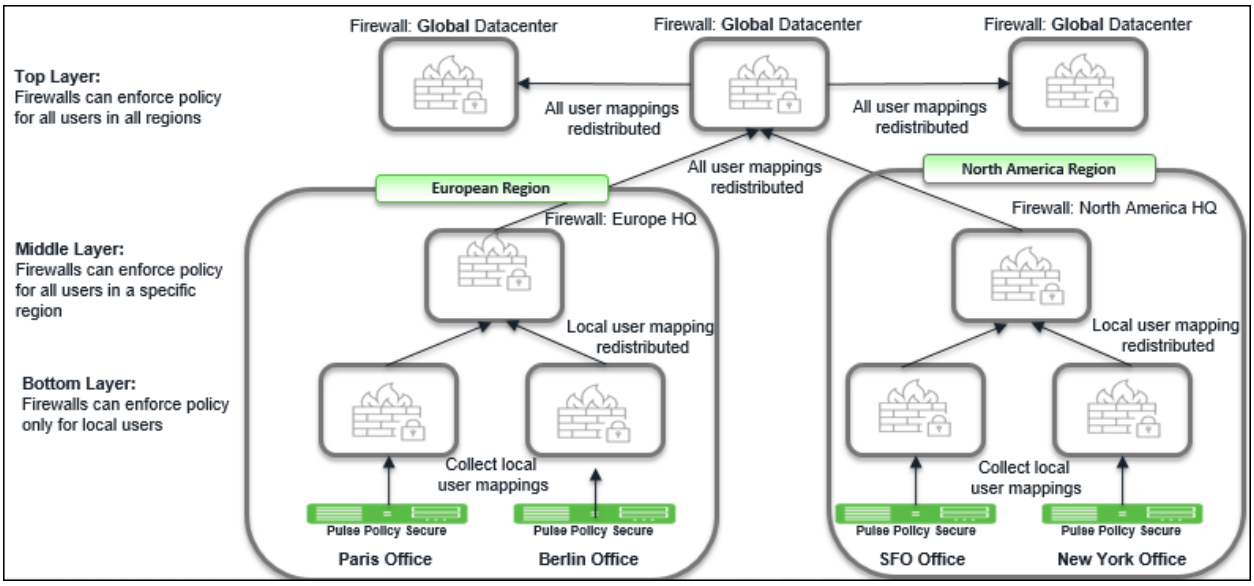
1. The endpoints connect to Switch/WLAN and performs the layer 2 authentication with PPS.
2. PPS performs the layer 3 authentication and performs compliance check on the endpoint and detects for any unauthorized behavior. PPS can also learn endpoint IP address using accounting and provision mapping.
3. PPS provisions the auth table entries (user-ID, IP address, and roles) on the Check Point Next-Generation Firewall.
4. The user role changes, which includes any unauthorized behavior are dynamically updated on the firewall. PPS provisions the auth table with changes in role information if any on Check Point Next-Generation Firewall. The access is based on roles.
5. The Check Point Next-Generation Firewall applies policies to allow or block user access to protected resources.

Deployment of PPS with Check Point Next-Generation Firewall for a Large Enterprise

For an enterprise with remote branch offices connected to the headquarters with VPN, deploy the Security Gateway at the remote branch offices. When you enable Identity Awareness on the branch office Security Gateway, users are authenticated before they reach internal resources. The identity data on the branch office Security Gateway is shared with other Security Gateways to avoid unnecessary authentication.

For more information see, Identity Awareness feature of Check Point.

Figure103: Check Point with PPS



Configuring PPS with Check Point Next-Generation Firewall

This section covers the configuration of PPS for adding Check Point Next-Generation Firewall as an Infranet Enforcer.

The following are the configuration steps:

- Configuring Check Point Infranet Enforcer in PPS
- Configuring Auth Table Mapping Policies

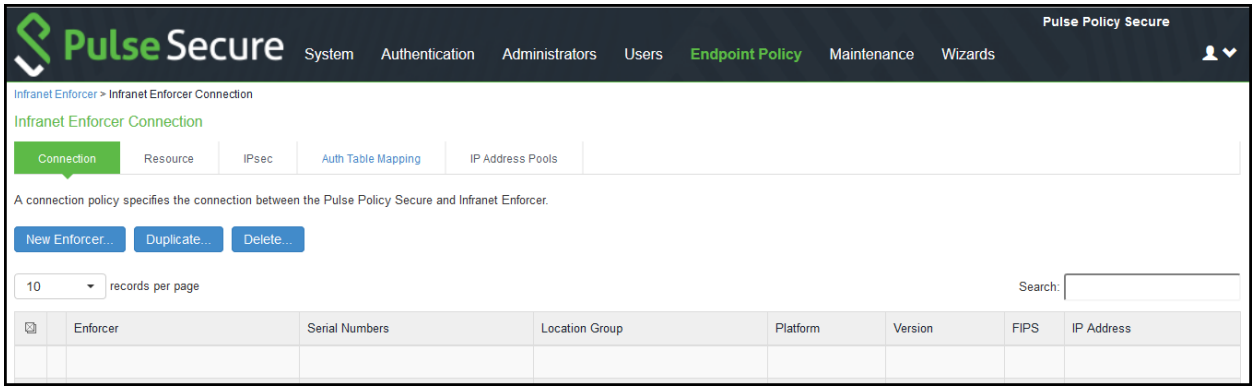
Configuring Check Point Infranet Enforcer in PPS

The PPS configuration requires defining a new Check Point Infranet Enforcer instance on PPS and then fetching the pre-configured shared secret key from the firewall. The shared secret key is used to communicate between the Check Point firewall and PPS. The standard user authentication / authorization configurations such as Auth Table Mapping Policies should also be created and associated with the required roles.

To configure a Check Point Firewall Infranet Enforcer in PPS:

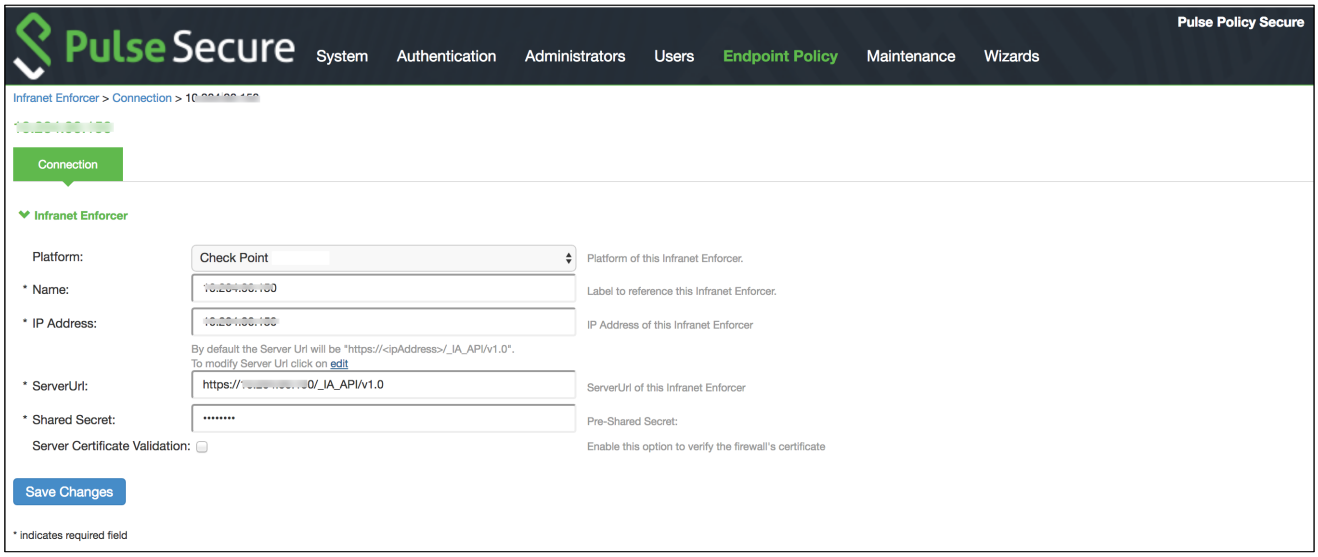
1. Select **Endpoint Policy > Infranet Enforcer**.

Figure 104: Infranet Enforcer



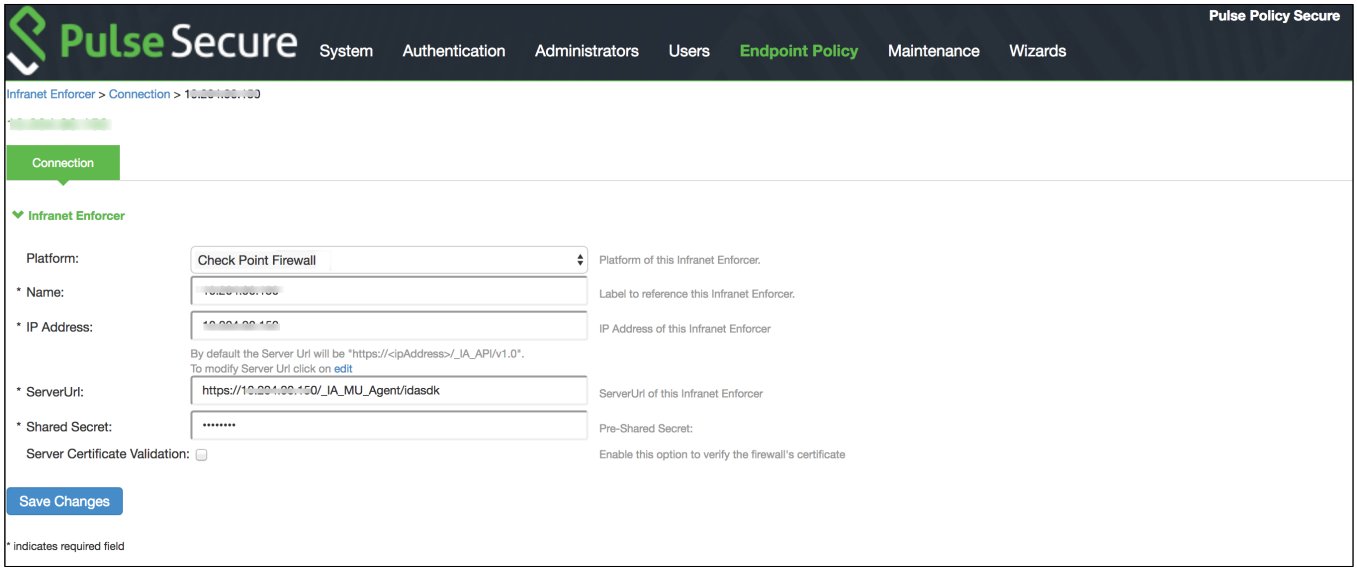
2. Click **New Infranet Enforcer** and select **Check Point Firewall** in the **Platform** drop down.
3. Enter the **Name** and **IP Address** of the Check Point Next-Generation Firewall and enter the shared secret between PPS and Check Point.
   Note: PPS has the default server URL for Check Point R80.10.

Figure105: Check Point Firewall



For previous version of Check Point (R77.30), edit the server URL manually to *https://<IP_Address>/IA_MU_Agent/idasdk*

Figure106: Check Point Firewall



4. (Optional) Select **Server Certificate Validation** to verify the firewall certificate.
5. Click **Save** Changes.

Configuring Auth Table Mapping Policies

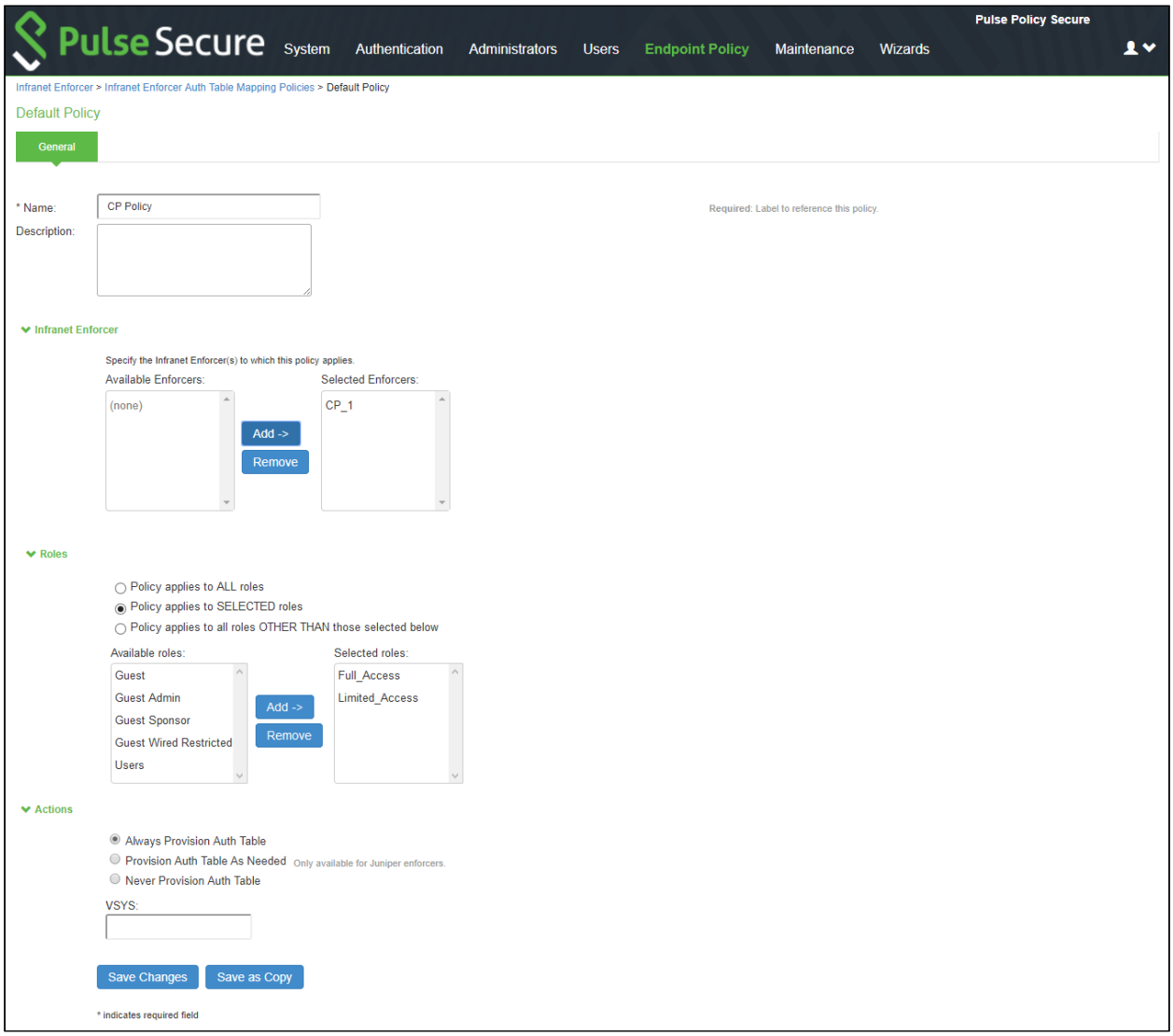
An auth table entry consists of the user's name, a set of roles, and the IP address of the user device. An auth table mapping policy specifies which enforcer device (Firewall) can be used for each user role. These policies prevent the PPS from creating unnecessary auth table entries on all connected enforcer devices.

PPS's default configuration includes only one default auth table mapping policy. When the default auth table mapping policy is enabled, PPS pushes one auth table entry for each authenticated user to the selected Check Point Next-Generation Firewall configured as Infranet Enforcers in PPS.

To configure an Auth Table Mapping Policy:

1. Select **Endpoint Policy** > **Infranet Enforcer** > **Auth Table Mapping** and click **New Policy**.

Figure 107: Check Point Firewall Configuration



2. On the New Policy page:

1.1. For Name, enter a name to label the auth table mapping policy.

1.2. (Optional) For Description, enter a description.

1.3. In the Enforcer section, specify the Infranet Enforcer firewall(s) to which you want to apply the auth table mapping policy.

1.4. In the Roles section, specify:

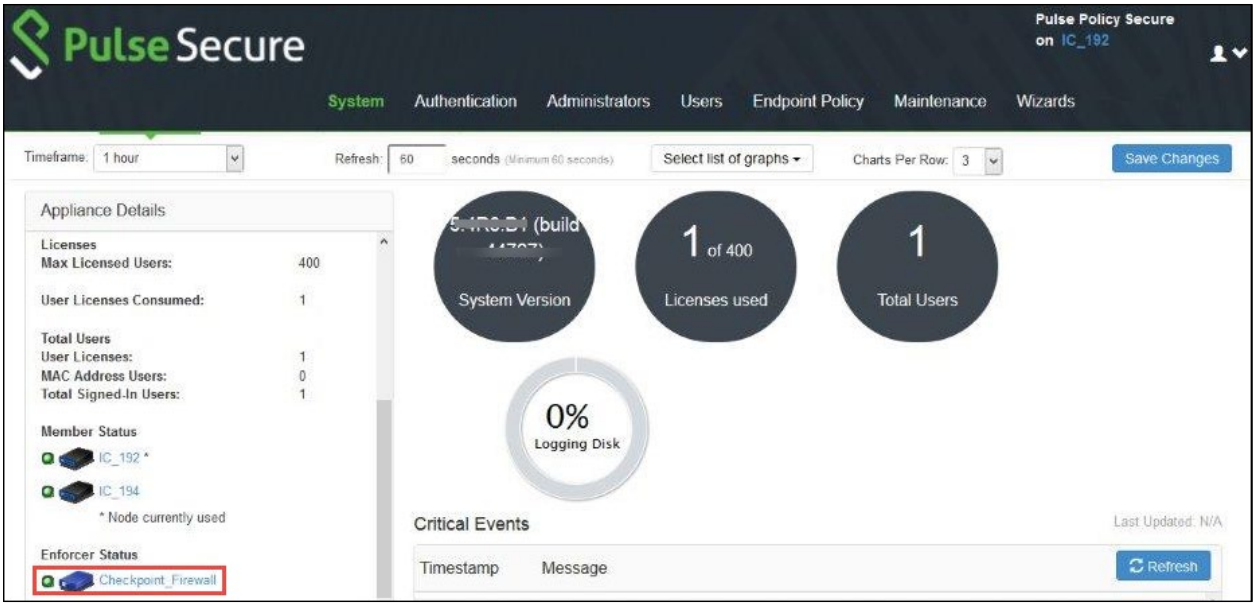
- Policy applies to ALL roles—Select this option to apply the auth table mapping policy to all users.
- Policy applies to SELECTED roles—Select this option to apply the auth table mapping policy only to users who are mapped to roles in the SELECTED roles list. You can add roles to this list from the available roles list.
- Policy applies to all roles OTHER THAN those selected below—Select this option to apply the auth table mapping policy to all users except for those who map to the roles in the SELECTED roles list. You can add roles to this list from the available roles list.

1.5. In the Action section, specify auth table mapping rules for the specified Infranet Enforcer.

- Always Provision Auth Table—Select this option to automatically provision auth table entries for chosen roles on the specified Infranet Enforcer.
- Provision Auth Table as Needed—Select this option to provision auth table entries only when a user with a chosen role attempts to access a resource behind the specified Infranet Enforcer. This option is greyed out for Check Point Firewall Enforcers since it is not supported.
- Never Provision Auth Table—Select this option to prevent chosen roles from accessing resources behind the specified Infranet Enforcer.

2. You must delete the Default Policy if you configure any custom auth table mapping policies. PPS's default configuration includes this default auth table mapping policy that allows all source IP endpoints to use all Infranet Enforcers.

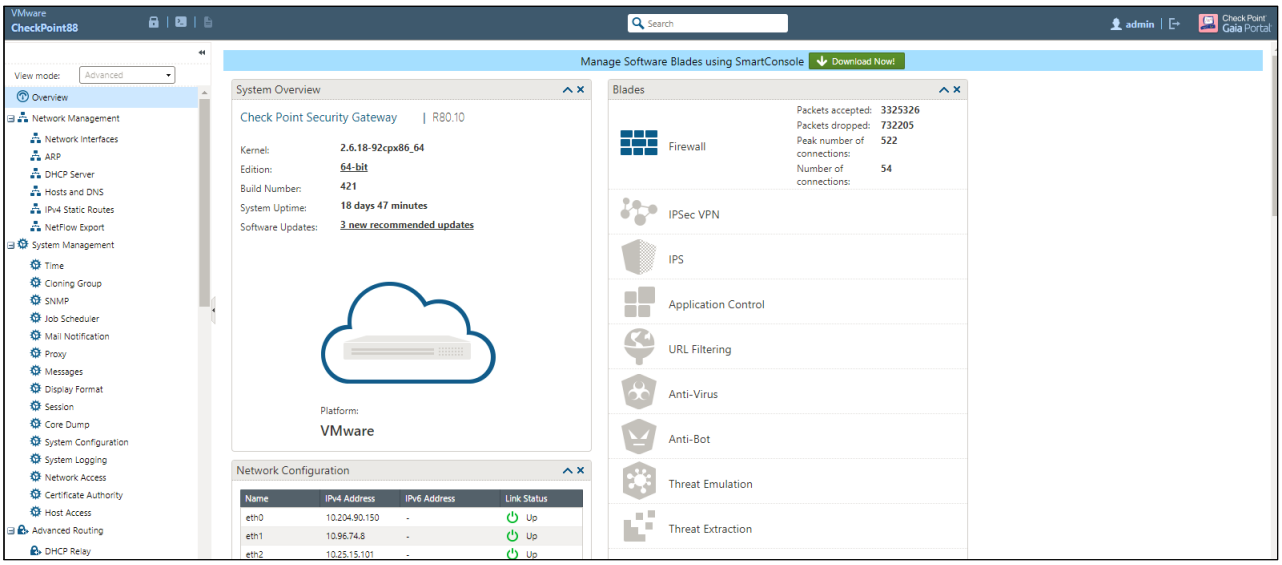
3. Click **Save Changes**.



Configuring Check Point Next-Generation Firewall

Check Point firewall detects traffic from an endpoint that matches a configured security policy using the access roles. It determines the role(s) associated with that user, and allows or denies the traffic based on the actions configured in the security policy.

The network interfaces are configured on the Check Point Next-Generation firewall and the remaining configurations are done on the Check Point Smart Console.



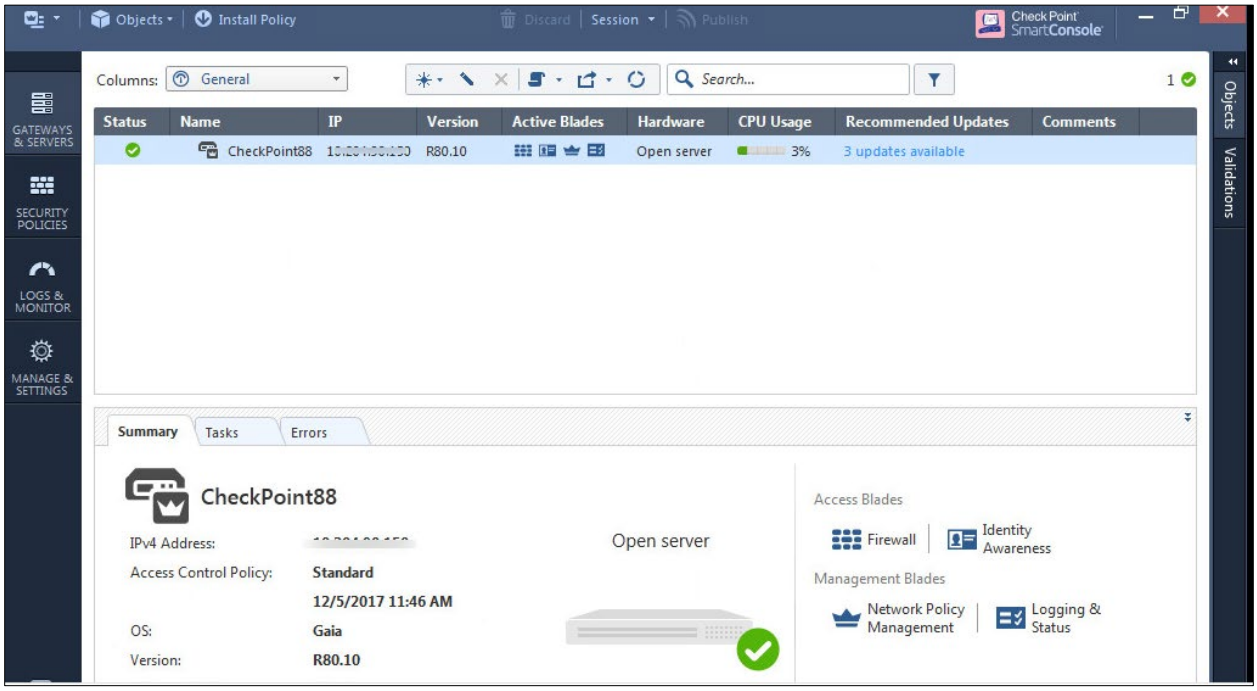
Configuring Identity Awareness in SmartConsole

The Identity Awareness lets you easily configure network access and auditing based on network location, identity of user, and identity of the device. When Identity Awareness identifies a source or destination, it shows the IP address of the user or computer with a name. For example, this lets you create firewall rules with any of these properties. You can define a firewall rule for specific users when they send traffic from specific computers or a firewall rule for a specific user regardless of which computer they send traffic from.

To enable Identity awareness:

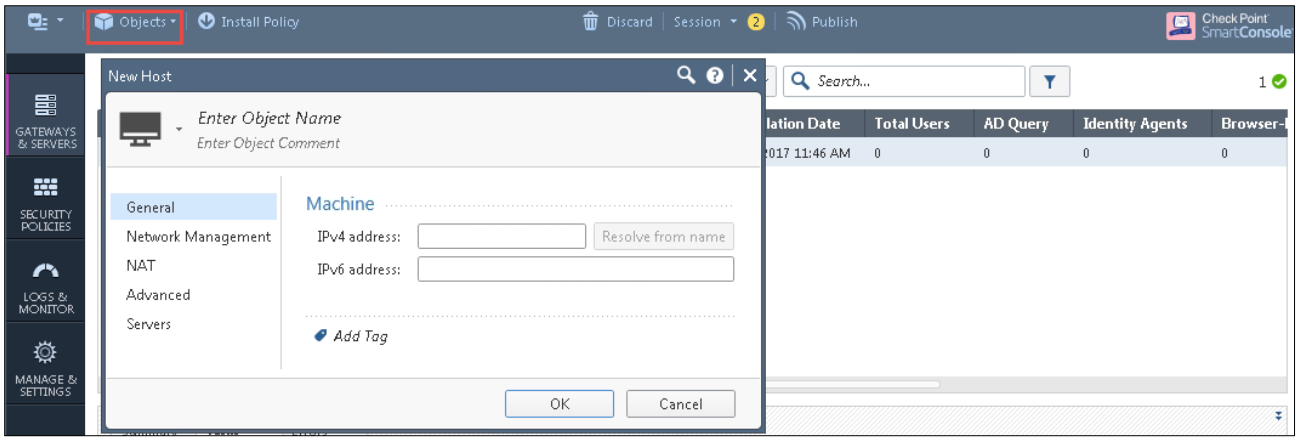
1. Login to the Check Point SmartConsole.
2. From the **Security & Gateways** view, double-click the Security Gateway on which to enable identity awareness.

Figure108: SmartConsole



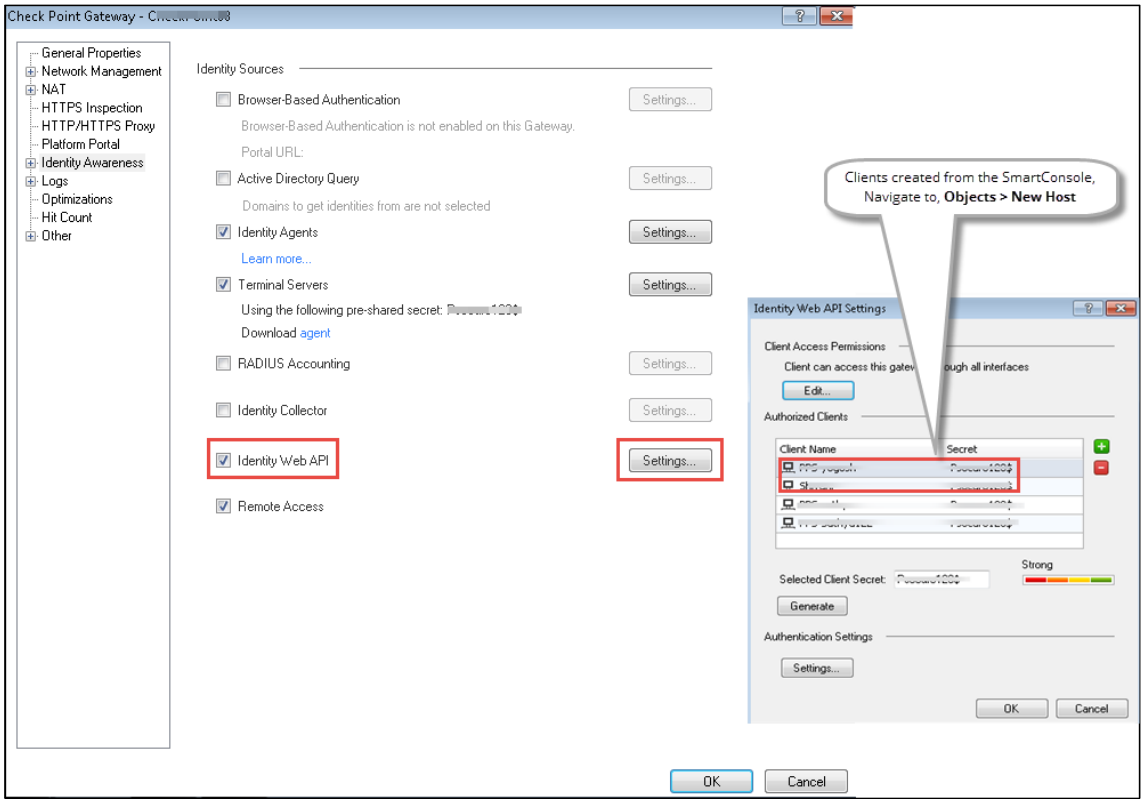
3. Create an object for PPS. Select **Objects > New Host** and enter the PPS IP address. Under Servers, enable **Web Server** and click **OK**.

Figure109: Host



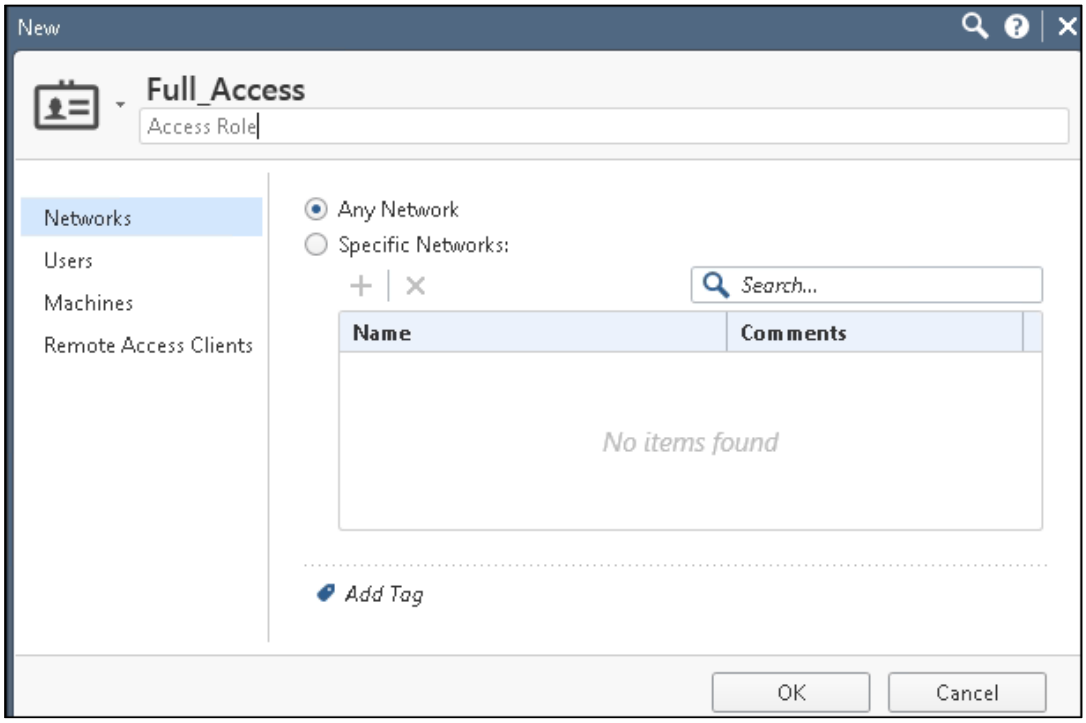
4. Select **Gateways & Servers** > **Identity Awareness** .and enable the following options:
   - **Terminal Servers-** Note down the pre-shared secret key.
   - **Identity Web API**- Click **Settings** and add the PPS device as Authorised Clients.

Figure 110: Identity Awareness



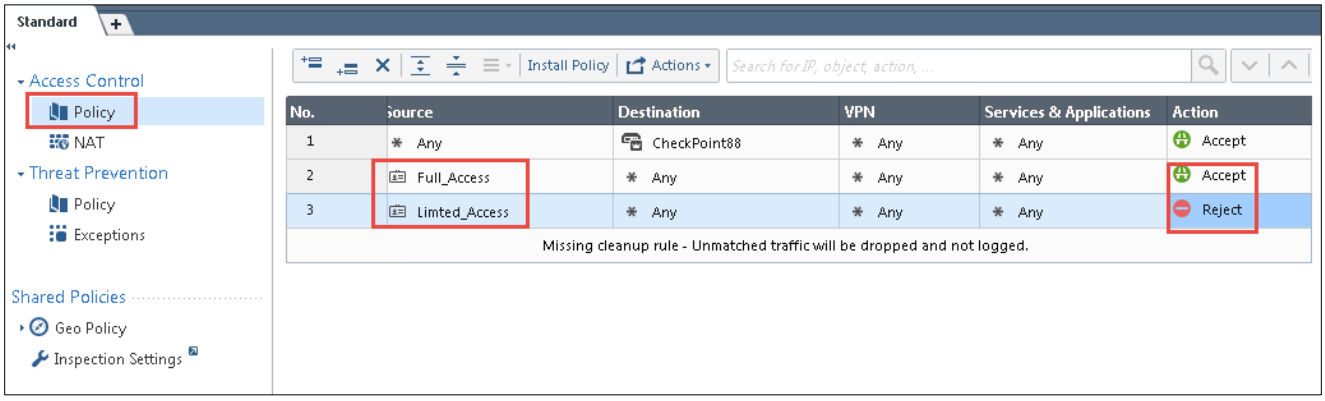
5. Click **Install Policy**.
6. From the Object Explorer create an object for Identity matching by creating user roles. Select **Objects > Object Explorer** and Click **New > Users > Access Role**
   Note: The role names must match with the Role names created on PPS.

Figure 111: Creating Access Roles



7. From the SmartConsole, create a security policy by keeping the Access Role in Source column. Select **Security Policies > Access Control** > **Policy** and then configure the required policies. For example, Full_Access policy allows traffic from Client with Full_Access role, Limited_Access role policy denies traffic from Client with Limited_Acces role, and default_allow policy which allows all traffic. The Full_Access role is on the top of the list since it should be considered first.

Figure 112: Security Policy based on Access Roles



8. Click **Install Policy**.

Troubleshooting

You can use the following CLI commands (Expert Mode) on the Check Point firewall for troubleshooting:

- *pdp monitor all* — Displays the table of user identities mapped to IP addresses.

Unsupported Features

The following features are not supported:

- IP Address Pools
- IPsec Enforcement
- IDP Sensors
- Virtual Systems (VSYS)
- Enforcement for endpoints behind Network Address Translation (NAT)
- Resource access policies. The administrator should configure all firewall policies on the firewall through smartboard

Enforcement using Palo Alto Networks Firewall

This chapter provides an overview of enforcement using Palo Alto firewall. It includes the following information:

Overview

PPS delivers layer 3 network access control solution when deployed with Palo Alto Networks next-generation firewalls. PPS authenticates users, ensures that the endpoints meet security policies, and then dynamically updates the firewall enforcement point with the resulting user session information. Upon successful user authentication with PPS, the access to protected resources behind the firewall is based on the user identity, IP address, and user role information provided by PPS.

The PPS and PAN integration provides identity enabled layer 3 enforcement for BYOD and guests as well as enterprise employees, with the end authentication and comprehensive compliance checks from PPS.

Deployment of PPS using PAN Firewall

This section describes the integration of PPS with Palo Alto Networks next-generation firewall. The PPS and PAN firewall integration allows users to enforce role based access to network resources and web applications and ensures endpoint compliance. The integrated solution provides policy enforcement for end to end protection of sensitive corporate data from unauthenticated access and attacks.

PPS combines user identity and device security state information with network location to create a unique, session specific access control policy for each user. The Palo Alto Networks firewall provides a feature called User Identification (User-ID) that creates policies and performs reporting based on users and groups rather than individual IP addresses. PPS uses the User-ID XML API to send the IP address to user and IP address to Group (Role) mapping information to the Palo Alto Networks firewall. PAN firewall enables the flexibility to apply different rules to the same server based on tags. A tag is a metadata element, which defines its role on the network, the operating system, or the different kinds of traffic it processes.

The Palo Alto Networks firewall compares the user information against the tag that is associated to a security rule. If the User Role name matches the tag, then traffic is either allowed or denied based on the configuration. When a user logs in, Pulse Policy Secure provisions their user ID, IP address of the endpoint, and role information to the Palo Alto Networks firewall; that enables firewall policies based on any of these attributes to be enforced.

Similarly, when a user logs out, the user ID, IP address of the endpoint, and role information is removed from the firewall. More importantly, when a user's role changes, the role change information is dynamically updated on the firewall, so that access based on the updated roles is automatically changed based on the policy matched by the new information.

With Palo Alto Networks firewall integration, all users' role changes, which includes compliance check failure or unauthorized behavior are dynamically updated on the firewall. The access is based on user roles and not merely on source IP addresses.

PPS is the policy decision point that determines which users and endpoints can access protected resources. Palo Alto Networks Next Gen firewalls serve as the policy enforcement points to provide the ultimate protection to ensure that network assets are secured.

Palo Alto Networks integration with Pulse Policy Secure leverages dynamic role information provisioned to the firewall upon user session establishment and for the duration of the session. Pulse Policy Secure also communicates user information to the Palo Alto Networks firewall when users log in or log out from their device.

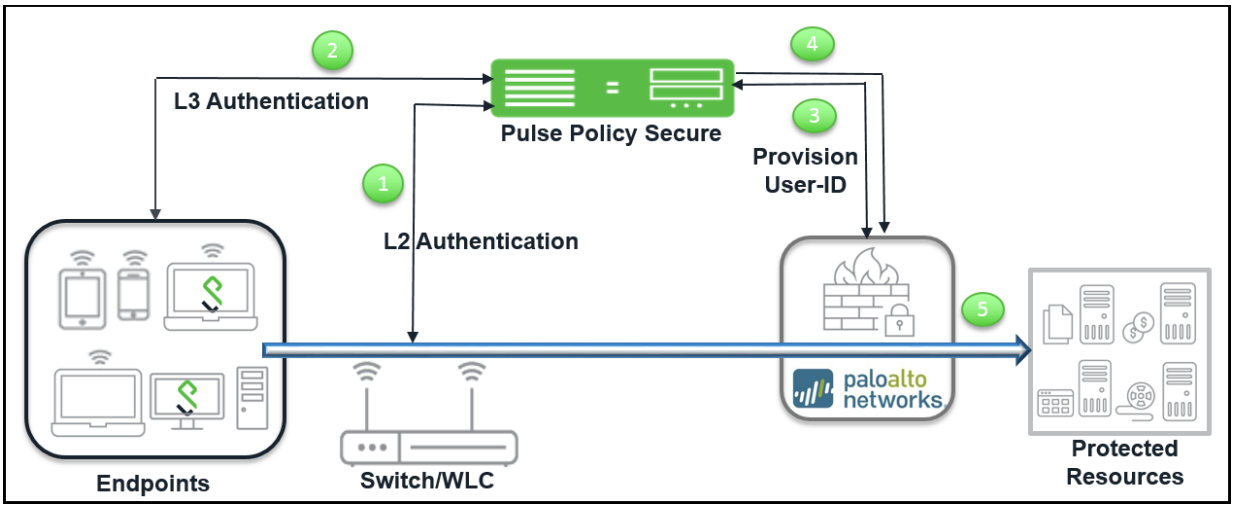
This section covers the following deployment scenarios:

- Deploying PPS with a PAN firewall for a Small Enterprise
- Deploying multiple PPS with PAN firewall
- Deploying PPS with PAN firewall for a Large Enterprise

Deploying PPS with a PAN firewall for a Small Enterprise

PPS and PAN integration can be used for role based layer 3 access control. For small scale enterprise deployment, you can use a single PPS and PAN firewall as it involves less number of users. For example, employees, contractors, and guest users. A single PPS device provisioning to a PAN firewall can handle up to 30,000 user sessions. The following is a sample deployment with a PPS device along with a PAN firewall.

Figure113: Single PPS Deployment



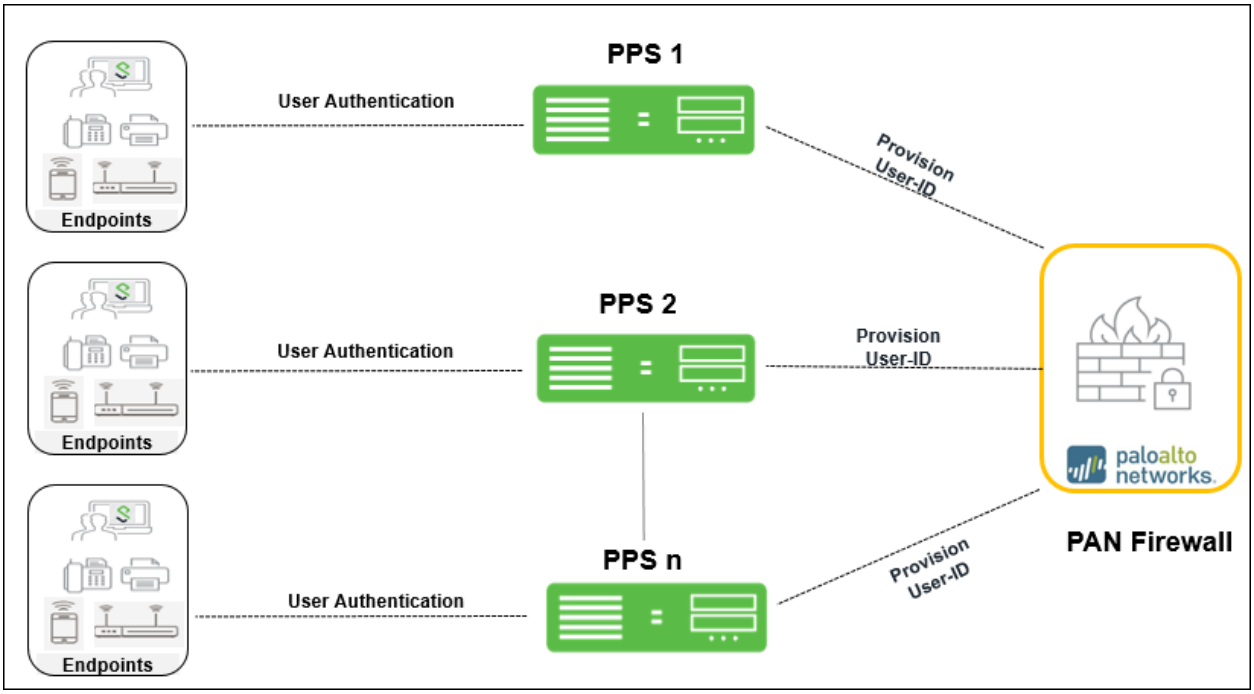
The authentication process is described below:

1. The endpoints connect to switch/WLAN and performs the layer 2 authentication with PPS.
2. PPS performs the layer 3 authentication and performs compliance check on the endpoint and detects for any unauthorized behavior.
3. PPS provisions the auth table entries on the PAN firewall.
4. PPS provisions the auth table with changes in role information if any on PAN firewall. The user role changes, which includes any unauthorized behavior are dynamically updated on the firewall. The access is based on roles, rather than only on source IP addresses.
5. The PAN firewall applies policies to allow or block user access to protected resources.

Deploying multiple PPS with PAN firewall

The deployment example describes an enterprise environment with multiple PPS servers where different users are authenticated using different PPS servers. For such deployments, multiple PPS servers can be configured to communicate with a single PAN firewall. The multiple PPS servers sends user-ID entries to a single PAN firewall.

Figure114: Deploying multiple PPS with a PAN Firewall

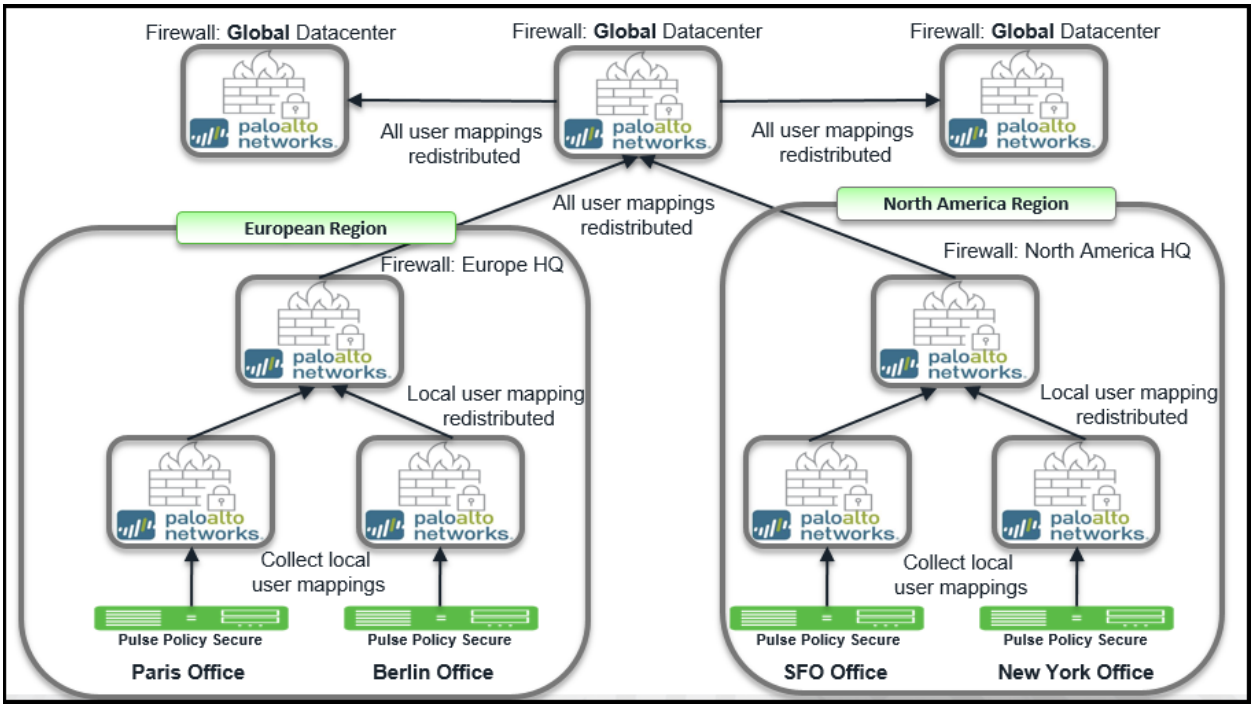


Deploying PPS with PAN firewall for a Large Enterprise

A large-scale enterprise network uses multiple firewalls to enforce policies. You can reduce the resources that the firewalls and information sources use in the querying process by configuring some firewalls to acquire mapping information. You can enable the firewall to enforce user based policies when users rely on local sources for authentication (for example, regional directory services) but need access to remote resources (for example, global data center applications).

The deployment example describes how a global datacenter resources is distributed across the branches and shared across the local offices. It also shows how you can organize the redistribution sequence in layers, where each layer has one or more firewalls. In this example, bottom-layer firewalls in local offices rely on PPS for authentication and then redistribute the mapping information to middle-layer firewalls in regional offices, which redistribute to one top-layer firewall in a global data center. The data center firewall redistributes the mapping information to other data center firewalls so that they can enforce global policies for all users.

Figure115: Large Scale Deployment



Specification for deploying PPS and PAN Appliances

The firewall provides access to resources based on the user role. You can use the IP role mapping on the PAN firewall for role based access. The maximum number of IP addresses that can be registered for each PAN device is different. The following table describes the specifics for different PAN firewall appliances and the recommended PPS appliance for your deployment.

Table 1: Recommendations for deploying PPS and PAN firewall

PAN Appliance	Maximum number of dynamically registered IP addresses	IP Address Tag	Recommended PPS Appliance
PA 500	1,000	32	PSA 5000
PA3020	5,000	32	PSA 5000
PA 5020	20,000	32	SM 360, PSA 7000
PA 7000	44,000	32	PSA 7000

Note:

- The IP role mapping scale limit or the maximum number of dynamically registered IP addresses for a unique endpoint is based on the PAN appliance.
- The maximum number of IP address tags supported is also based on the PAN appliance.
  The IP Address tag is a metadata element or attribute-value pair that is registered on the firewall. For example, IP1 {tag1, tag2,.....tag32}, where the IP address and the associated tags are maintained as a list; each registered IP address can have up to 32 tags such as the operating system, the datacenter or the switch to which it belongs.

Configuring PPS with PAN Firewall

This section covers the configuration of PPS for adding PAN firewall as an Infranet Enforcer.

The following are the configuration steps:

- Configuring PAN Infranet Enforcer in PPS
- Configuring Auth Table Mapping Policies

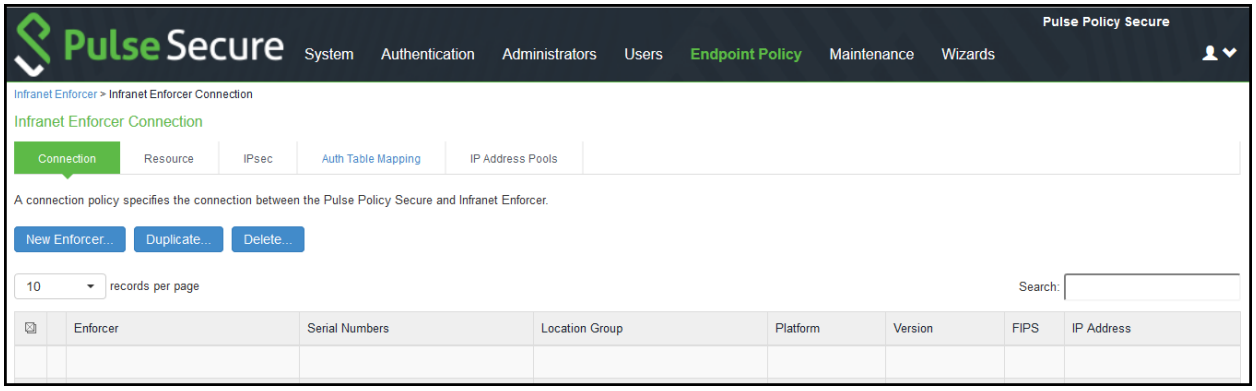
Configuring PAN Infranet Enforcer in PPS

The PPS configuration requires defining a new Palo Alto Networks Firewall Infranet Enforcer instance on PPS and then fetching the API key from the firewall. The API key is used to communicate between the Palo Alto Networks firewall and PPS. The standard user authentication / authorization configurations such as Auth Table Mapping Policies should also be created and associated with the required roles.

To configure a Palo Alto Networks Firewall Infranet Enforcer in PPS:

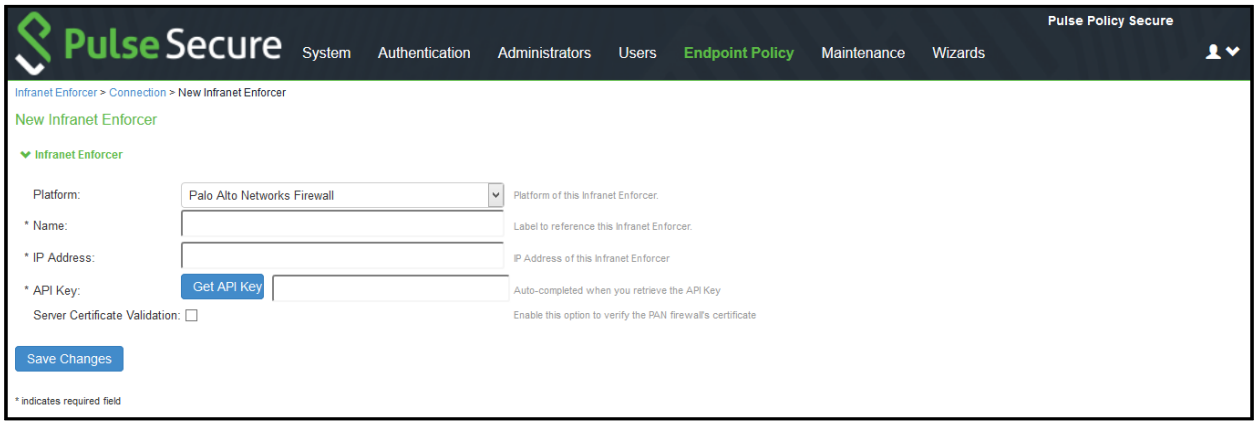
1. Select **Endpoint Policy > Infranet Enforcer**.

Figure 116: Infranet Enforcer



2. Click **New Infranet Enforcer** and select **Palo Alto Networks Firewall** in the **Platform** drop down.

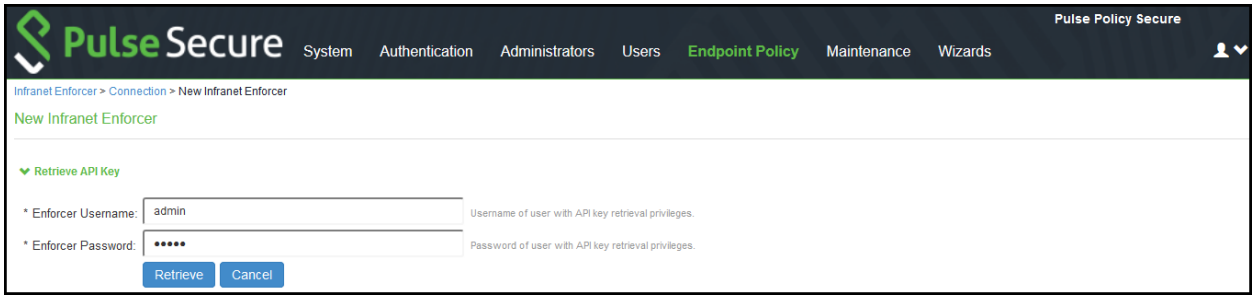
Figure117: Palo Alto Networks Firewall



.

3. Enter the **Name** and **IP Address** of the Palo Alto Networks firewall and then click **Get API Key** which opens a new page:

Figure 118: API Key



4. Enter the **Admin Username** and **Admin Password** of the Palo Alto Networks firewall and then Click **Retrieve**. This enables PPS to fetch the API key of the firewall. Once the API key is retrieved, the page automatically redirects back to the New Infranet Enforcer page as shown above and updates the API Key Field.
   See Configuring PAN Device Certificates for understanding the validation procedure.

5. Click **Save** Changes.

Configuring Auth Table Mapping Policies

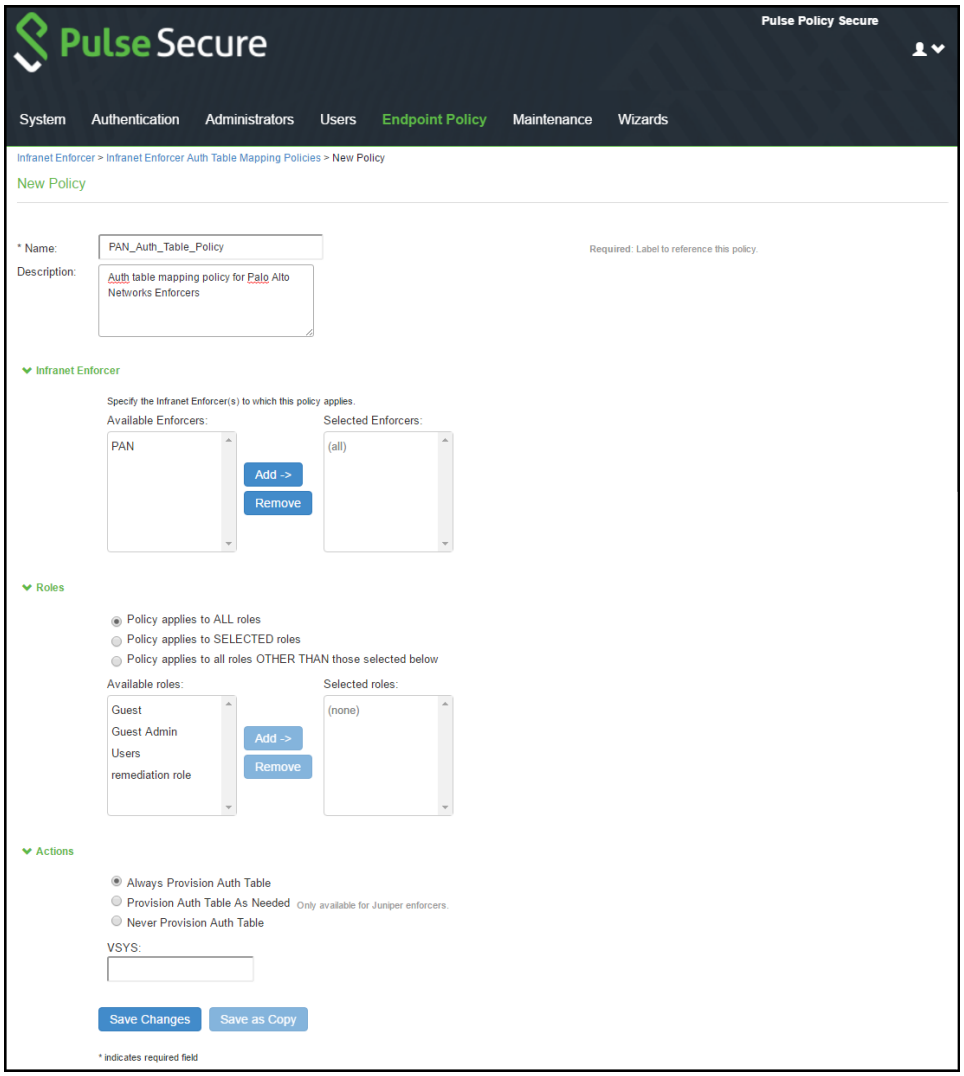
An auth table entry consists of the user's name, a set of roles, and the IP address of the wired, wireless, or virtual adapter. An auth table mapping policy specifies which enforcer device can be used for each user role. These policies prevent the PPS from creating unnecessary auth table entries on all connected enforcer devices.

PPS's default configuration includes only one default auth table mapping policy. When the default auth table mapping policy is enabled, PPS pushes one auth table entry for each authenticated user to all Palo Alto Networks firewalls configured as Infranet Enforcers in PPS.

To configure an Auth Table Mapping Policy:

1. Select **Endpoint Policy** > **Infranet Enforcer** > **Auth Table Mapping** and click **New Policy**.

Figure 119: Palo Alto Networks Firewall Configuration



2. On the New Policy page:

3.1. For Name, enter a name to label the auth table mapping policy.

3.2. (Optional) For Description, enter a description.

3.3. In the Enforcer section, specify the Infranet Enforcer firewall(s) to which you want to apply the auth table mapping policy.

3.4. In the Roles section, specify:

- Policy applies to ALL roles—Select this option to apply the auth table mapping policy to all users.
- Policy applies to SELECTED roles—Select this option to apply the auth table mapping policy only to users who are mapped to roles in the SELECTED roles list. You can add roles to this list from the available roles list.
- Policy applies to all roles OTHER THAN those selected below—Select this option to apply the auth table mapping policy to all users except for those who map to the roles in the SELECTED roles list. You can add roles to this list from the available roles list.

3.5. In the Action section, specify auth table mapping rules for the specified Infranet Enforcer.

- Always Provision Auth Table—Select this option to automatically provision auth table entries for chosen roles on the specified Infranet Enforcer.
- Provision Auth Table as Needed—Select this option to provision auth table entries only when a user with a chosen role attempts to access a resource behind the specified Infranet Enforcer. This option is greyed out for Palo Alto Networks Firewall Enforcers since it is not supported.
- Never Provision Auth Table—Select this option to prevent chosen roles from accessing resources behind the specified Infranet Enforcer.

4. You must delete the Default Policy if you configure any custom auth table mapping policies. PPS's default configuration includes this default auth table mapping policy that allows all source IP endpoints to use all Infranet Enforcers.

5. Click **Save Changes**.

Configuring Palo Alto Networks Firewall

Palo Alto Networks firewall detects traffic from an endpoint that matches a configured security policy using the endpoint's auth table entry. It determines the role(s) associated with that user, and allows or denies the traffic based on the actions configured in the security policy.

The configuration on the Palo Alto Networks firewall includes:

- Configuring User Identification on Security Zones
- Configuring Dynamic Address Groups
- Configuring Security Policies
- Configuring PAN Device Certificates

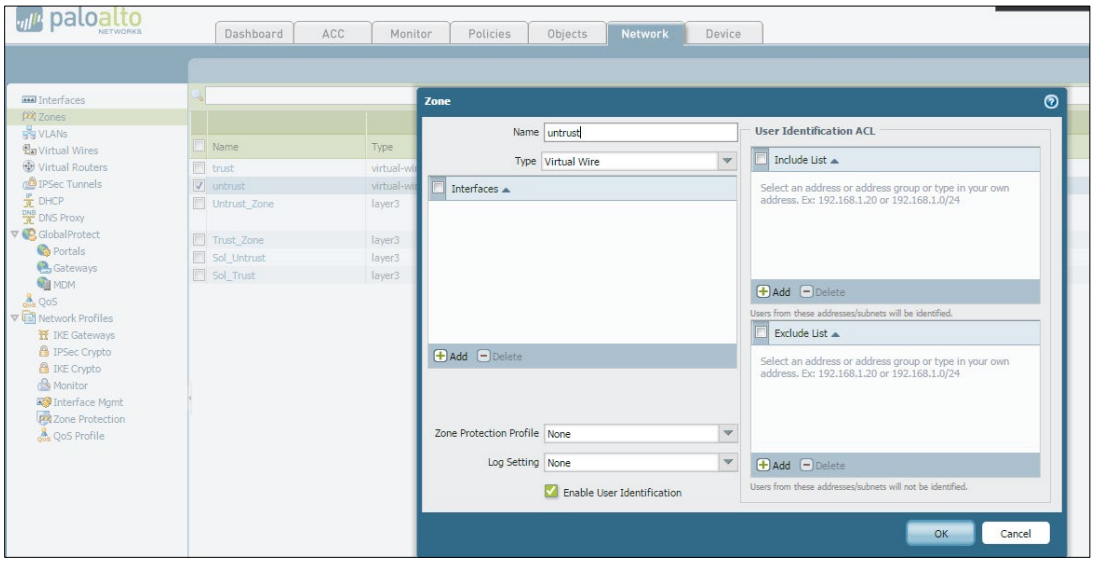
Configuring User Identification on Security Zones

Policy rules on the firewall use security zones to identify the source and the destination of the traffic. The data traffic flows freely within a zone and not between different zones until you define a security policy rule that allows it. To enable User-ID enforcement, you must enable User Identification on both inbound and outbound zones traversed by the end-user traffic.

To enable User Identification:

1. Select **Palo Alto Networks** > **Network** > **Zones**.
2. For each zone that serves as an inbound or outbound zone for enforced traffic, click the zone name (For example, trust, untrust, and so on).
3. Select **Enable User Identification** and click **OK**.

Figure120: Enabling User Identification on a Zone



Note: Provisioning of Resource Access Policies from PPS to the Palo Alto Networks Firewall Enforcer is not supported. You must configure the required security policies on the firewall.

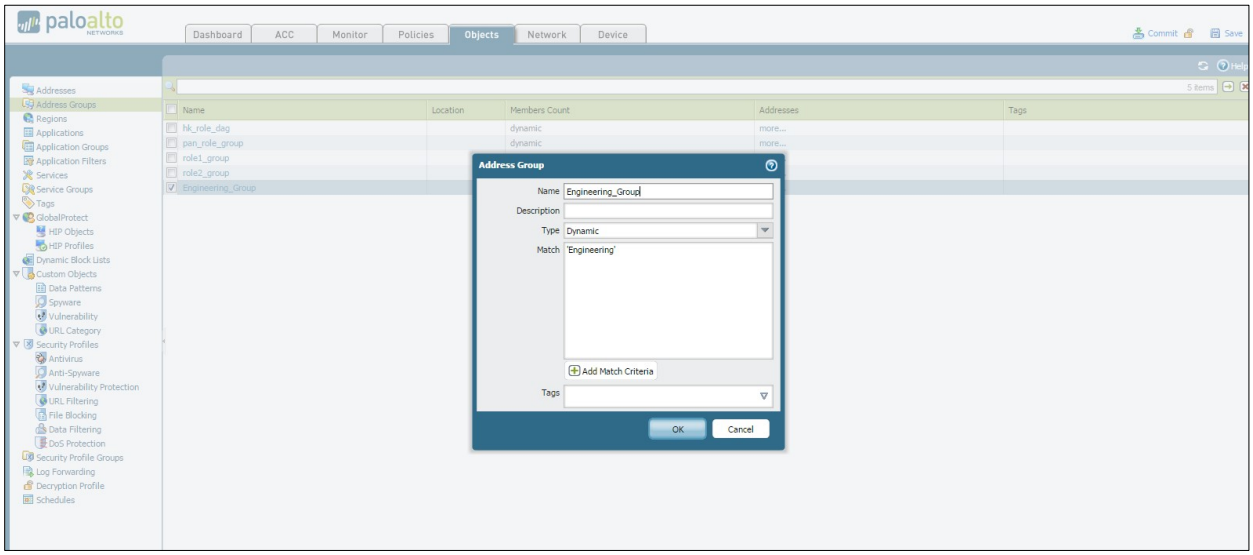
Configuring Dynamic Address Groups

Dynamic address groups allow you to create policy that automatically adapts to changes—adds, moves, or deletions of servers. It also enables the flexibility to apply different rules to the same server based on its role on the network or the different kinds of traffic it processes.

To configure a dynamic address group:

1. Select **Palo Alto Networks > Objects > Address Groups**.

Figure121: Address Groups



2. Click Add and enter a Name and a Description for the address group.
3. Select Type as **Dynamic**. Define the match criteria. You can select dynamic and static tags as the match criteria to populate the members of the group.
4. Enter the role name of the users. The role name in the Match section should match the roles that are configured in PPS.
5. Click **OK**.

Note: Dynamic discovery of users and their roles is not supported on the Palo Alto Networks firewall.

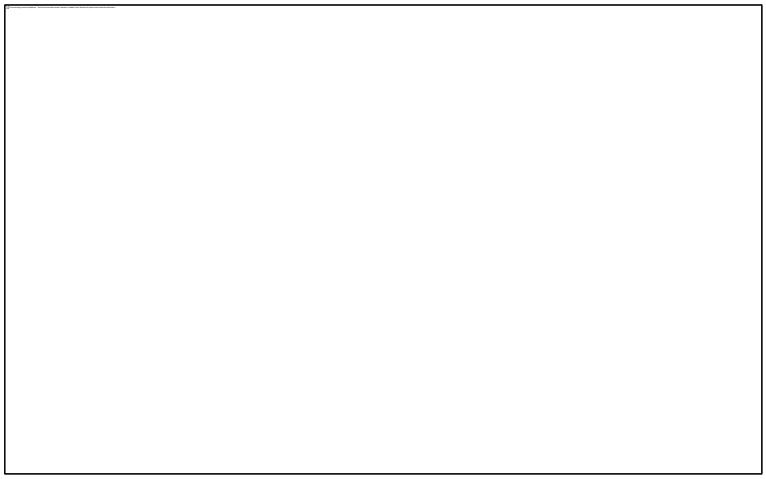
Configuring Security Policies

Security policies protect network assets from threats and disruptions and aid in optimally allocating network resources for enhancing productivity and efficiency in business processes. On the Palo Alto Networks firewall, security policies determine whether to block or allow a session based on traffic attributes such as the source and destination security zone, the source and destination IP address, the application, user, and the service.

To configure security policies associated with dynamic address groups:

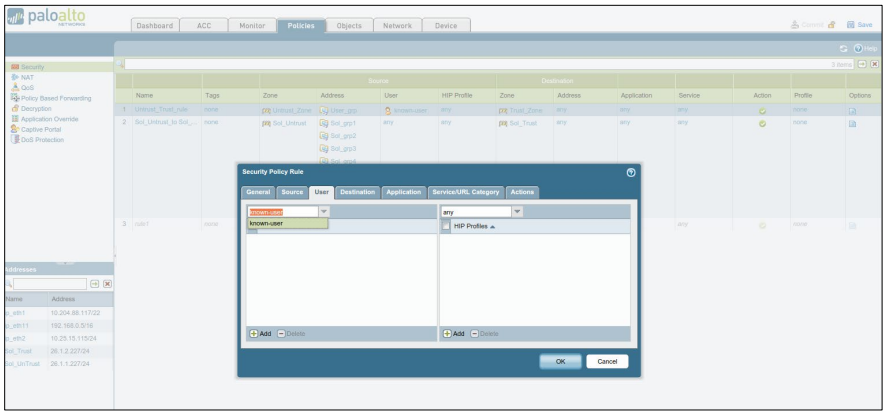
1. Select **Palo Alto Networks** > **Policies** > **Security**.
2. Click Add to create a new security policy rule. In the Source Address tab, select the previously-configured address group, as shown in figure.

Figure 122: Security Policy Rule - Source Address Configuration



3. In the User tab, enable **known-user**.

Figure 123: Security Policy Rule - User Configuration

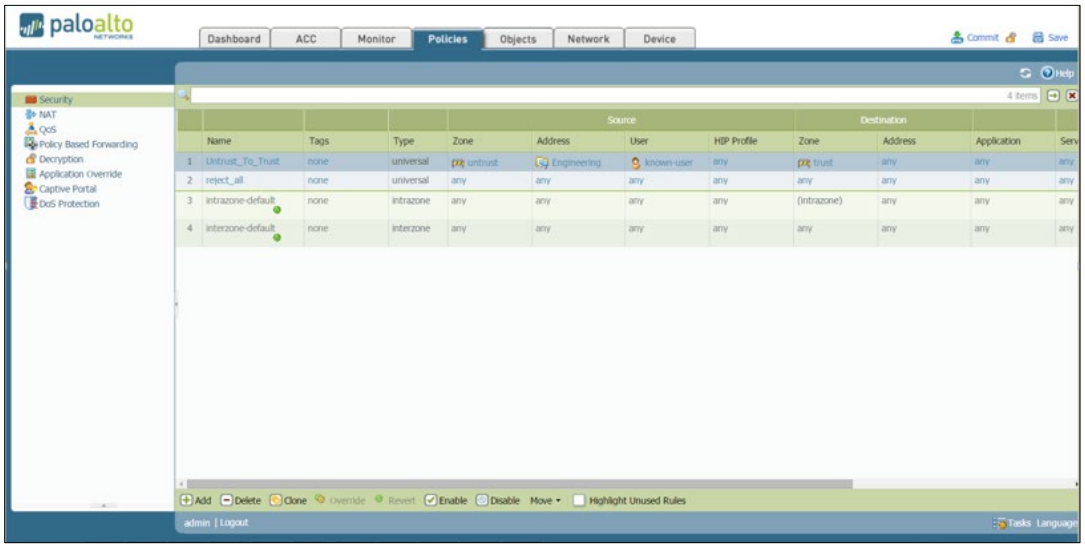


Note: When the **known-user** is enabled, the resource access is revoked immediately once the user disconnects from PPS.

4. Configure the other options to meet your security requirements. Traffic from the endpoint is allowed or blocked based on the action chosen under the Action tab.

5. Click **Commit** to complete the configuration. The completed security configuration on the Palo Alto Networks firewall is shown below.

Figure 124: Completed Security Policy Rule



Configuring PAN Device Certificates

PAN device certificate validation enhances the security between PPS and the PAN device. It allows PPS to verify whether the server certificate is from a trusted source. This topic describes how to configure the PPS for validating device certificates, creating certificates on PAN, and checking the validity of the certificate.

This section covers the following configuration:

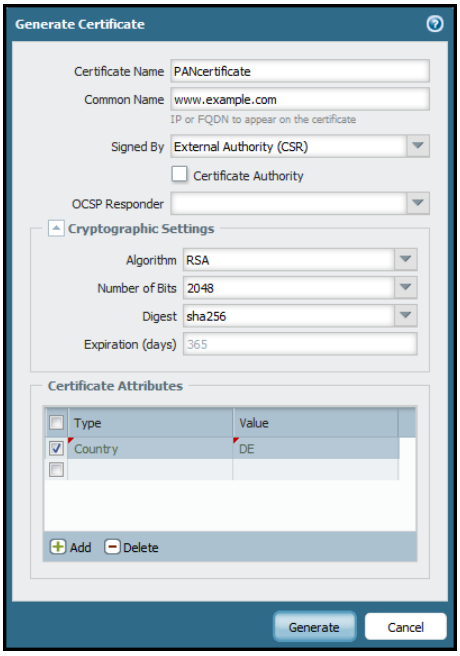
- Creating a Certificate Signing Request (PAN 6.0 and later)
- Exporting the CSR and Importing the Signed Request
- Importing the Certificate on PPS
- Adding PAN Device to PPS

Creating a Certificate Signing Request (PAN 6.0 and later)

To create a Certificate Signing Request (CSR) for sending to public third-party Certificate Authority (like Verisign, Globalsign, Entrust, and so on). For more information, see https://www.paloaltonetworks.com/documentation/60/pan-os/pan-os/certificate-management/obtain-certificates

1. Select **Device > Certificate Management > Certificates > Device Certificates**.

Figure 125: Certificate Signing Request



2. Enter a **Certificate Name** (save this name for later).
3. In the Common Name field, enter the IP address of the interface where you will configure the service that will use this certificate.
4. Select the **Certificate Authority** (CA) check box for self-signed root CA certificate. Exporting the CSR and Importing the Signed Certificate are not applicable for self-signed certificates.
   Note: Uncheck the **Certificate Authority** check box if you are using enterprise CA, or trusted third-party CA certificates.
5. Complete the remaining details such as Country, Organization, and so on. Check with the Certificate Authority (CA) about their requirements for Certificate Attribute formatting and criteria.
6. Click **Generate**.

Note: Ensure that the SSL/TLS service profile is enabled while creating the server certificate.

Exporting the CSR and Importing the Signed Request

Once the CSR is created, you must export the CSR to a third-party CA for signature.

To export the CSR:

1. Click the check box next to the Certificate Name.
2. Click **Export** and save the file.
3. Send the exported CSR to a third-party Certificate Authority. The CA will respond with a signed certificate.

Once the CA responds with the signed certificate, you must import the signed certificate from the certificate authority.

To import the signed certificate:

1. Note the name, including capitalization, of the certificate to import. (This must match the CSR request from above.)
2. Click **Import**.
3. In the Import Certificate dialog, type the name of the pending certificate. It must match exactly.
4. Go to the signed certificate received from the Certificate Authority and click OK.
5. Do not click the **Import Private Key** check box.
6. Depending on the certificate authority used, it may be necessary to chain the intermediate certificate with the server certificate and import it before completing this step.
7. Click **OK**.

Importing the Certificate on PPS

You can use the Trusted Server CAs page to import the trusted root certificate.

To configure device certificate verification:

1. Select **System > Trusted Server CAs > Import Trusted Server CA**.
2. Click **Browse** and select the certificate file.
3. Click **Import Certificate**. The Trusted Server CA page appears.
4. Verify if the certificate is imported successfully and click **Done**.
5. Click **Configuration > Certificates > Trusted Server CAs** and verify that the certificate is from a trusted source.

Adding PAN Device to PPS

For complete information on configuration, See Configuring PAN Infranet Enforcer in PPS.

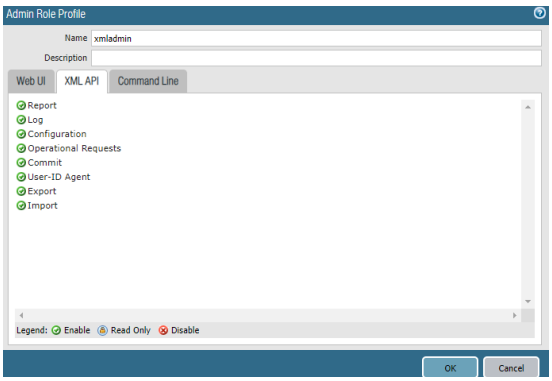
Note: If the server certificate is not valid the user will see the following error message. Error: Failed to Retrieve API Key. Peer Certificate cannot be authenticated with known CA certificates.

Troubleshooting

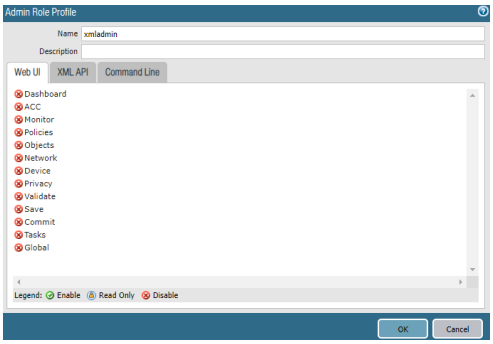
You can use the following CLI commands on the Palo Alto Networks firewall for troubleshooting:

- *show user ip-user-mapping all*— Displays the table of user identities mapped to IP addresses.
- *show object registered-address all* — Displays the table of addresses with user information associated.

For identity management using Palo Alto Networks firewall only minimum Admin role permissions are sufficient. Ensure that the XML API rights on the Palo Alto Networks UI is enabled as shown in the below screenshot.



Admin can choose to disable other options from the Web UI tab of the Palo Alto Networks UI as per the security requirement.



Unsupported Features

The following features are not supported:

- Captive portal
- IPsec Enforcement
- Virtual Systems (VSYS)
- Enforcement for endpoints behind Network Address Translation (NAT)
- Dynamic Auth Table Allocation

Related Documentation

- For federated access across multiple policy servers / firewall enforcers federated single sign-on for Pulse Connect Secure tunneled traffic, see Provisioning PCS sessions to PAN/Check Point Firewall.
- For information on Alert based Admission Control, see Alert Based Admission Control using PAN Next Generation Firewall

Identity Based Enforcement using FortiGate Products

This chapter provides an overview of enforcement using Fortinet firewall. It includes the following information:

Enforcement using Fortinet Firewall

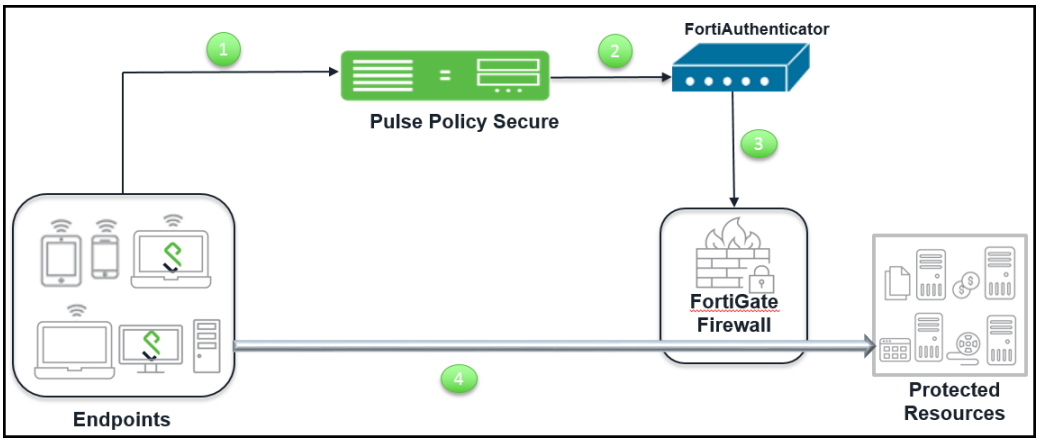
Overview

PPS integration with the FortiGate firewall provides enhanced identity enabled enforcement with backend authentication and comprehensive compliance checks. This section describes the procedure to integrate PPS with FortiGate firewall using FortiAuthenticator, which acts as a syslog server. The FortiAuthenticator receives the syslog messages from PPS and then creates Fortinet Single Sign-on (FSSO) record which is then shared with FortiGate firewall. The firewall uses the FSSO information to either allow or block traffic based on the configured policy.

Deployment of PPS using FortiAuthenticator and FortiGate Firewall

This section describes the integration of PPS with FortiAuthenticator and FortiGate firewall. The PPS and Fortinet solution provides functionality for enforcing security policies on a per user and role basis.

Figure126: Deployment using FortiAuthenticator and FortiGate Firewall



The authentication process is described below:

1. The user is authenticated on PPS after validating the host check policy to ensure that the endpoints meets the corporate policy.
2. The syslog sessions are exported to FortiAuthenticator.
3. Identity information is parsed from the syslog message and is used to create an IP address to username mapping file within FortiAuthenticator. This information is shared with FortiGate firewall in the form of a FSSO record.
4. The FortiGate firewall maps the user to a specific resource access policy and then provides the required access.

Configuring PPS with FortiAuthenticator

The PPS configuration requires defining the FortiAuthenticator as the syslog server on PPS. The Syslog sever uses the filter created in the User Access Log Filters for receiving and parsing the logs.

This section covers the following topics:

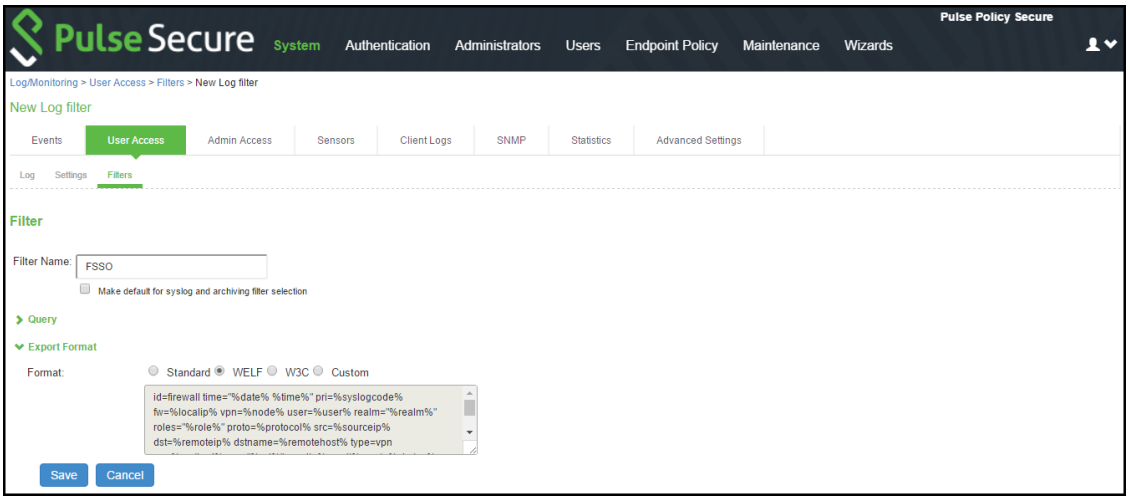
- Creating Custom Filter for User Access Logs
- Editing the Custom Filter
- Configuring Syslog Server

Creating Custom Filter for User Access Logs

To create a custom filter in PPS:

1. Select **System > Log/Monitoring > User Access > Filters**.
2. Click **New Filter**.
3. Enter the filter name.
4. Under Export Format, select **WELF**.
5. Click **Save** to save the filter.

Figure 127: Creating Filter

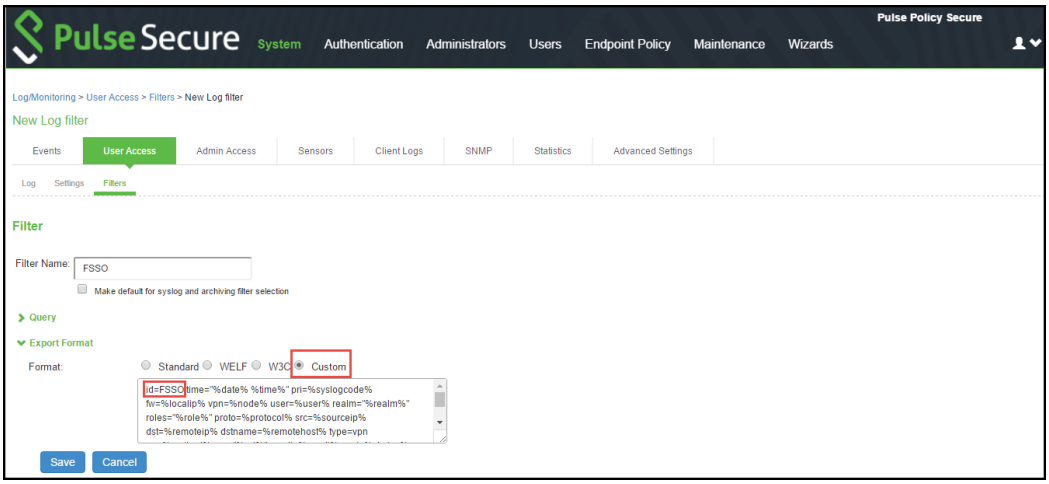


Editing the Custom Filter

To edit the custom created filter:

1. From the Log Filters screen, click the filter name and edit the filter.
2. Under Export Format, select **Custom** format.
3. Edit the ID with the filter name. For example, id=FSSO.
4. Click **Save**.

Figure 128: Editing the Filter



Configuring Syslog Server

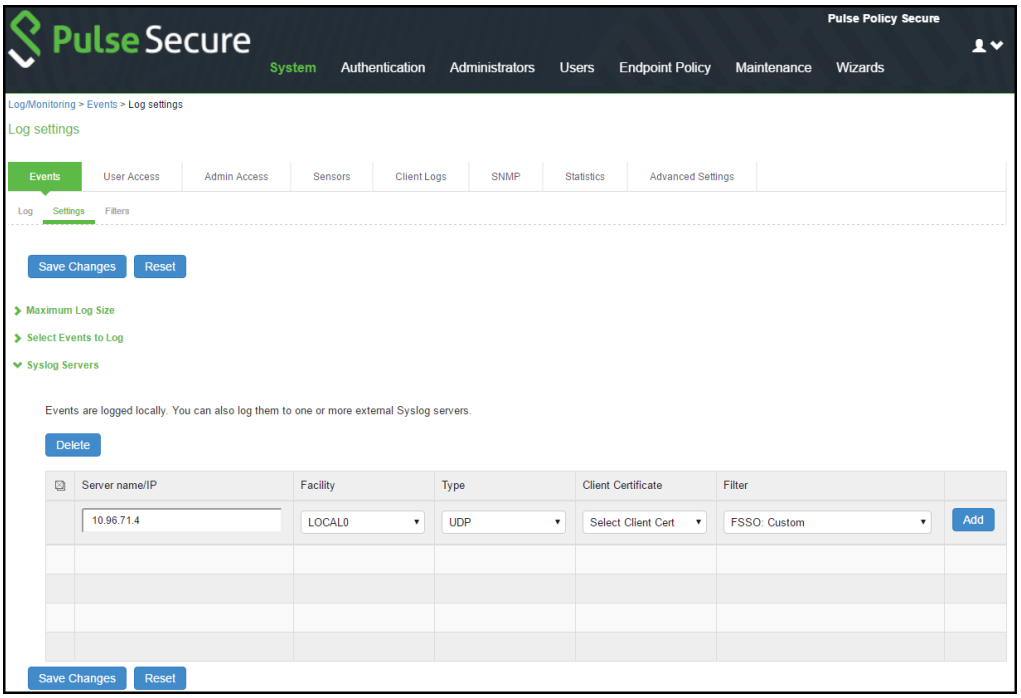
You can configure PPS to send logs to FortiAuthenticator syslog server.

To configure the syslog server:

1. Select **System > Log/Monitoring > User Access > Settings** Policy and click **New Policy**.
2. Under **Select Events to Log**, retain the default settings.
3. Under **Syslog Servers**, create a new Syslog server with the following details:
    a. Server name/IP- Enter the fully qualified domain name or the IP address for the syslog server (FortiAutheticator).
    b. Facility- Select **LOCAL0** as the facility level.
    c. Type- Select **UDP** as the connection type.
    d. Filter- Select the custom created filter format.
4. Click **Add** and then click **Save Changes**.

NOTE: You must add FortiAuthenticator as a syslog server in all the nodes in a clustering environment.

Figure 129: Configuring Syslog Server



Configuring FortiAuthenticator

You must add PPS as a syslog source in FortiAuthenticator to parse the information.

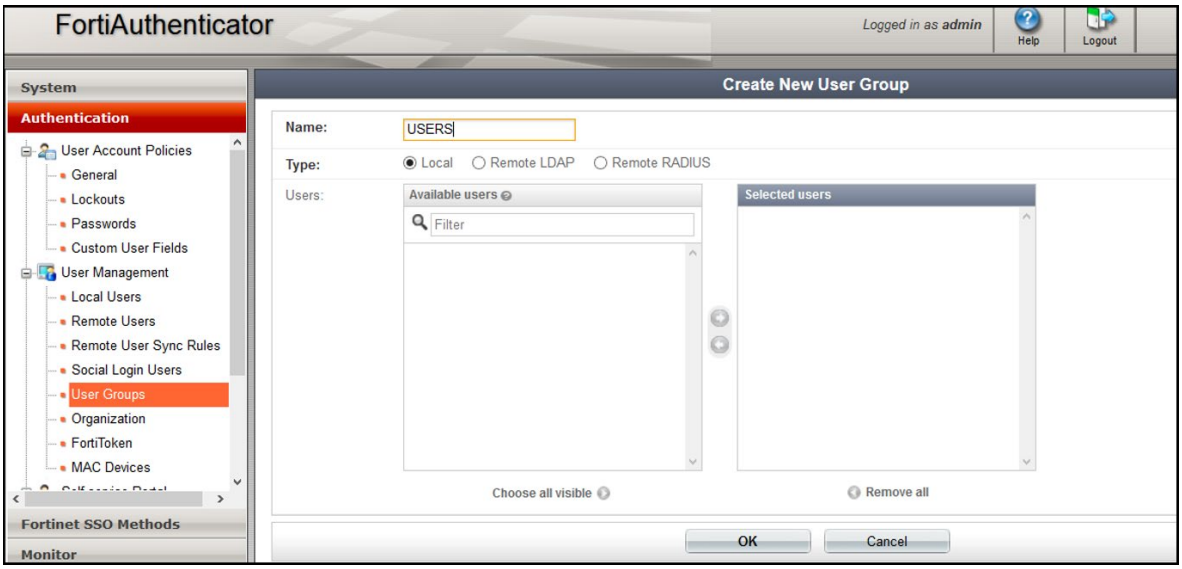
Prerequisite:

- Ensure that the FortiAuthenticator instance is communicating on the network and is reachable from the PPS appliance's management interface.
- Select **System > Network > Interfaces**, select the port and enable the FortiGate FSSO, FortiClient FSSO and Syslog services on FortiAuthenticator interface, which communicates with PPS and FortiGate firewall.

To configure FortiAuthenticator:

1. Create a Local user group with the names which matches the name PPS will send as the 'Group=' value in your Syslog messages. Select **Authentication > User Management > User Groups** and click **Create New**. Create the groups with the following data:
    a. Name- Enter the same names, which is received from PPS, For example, Users.
    b. Type- Select **Local** as type.
    c. Click OK.

Figure 130: Creating a user group



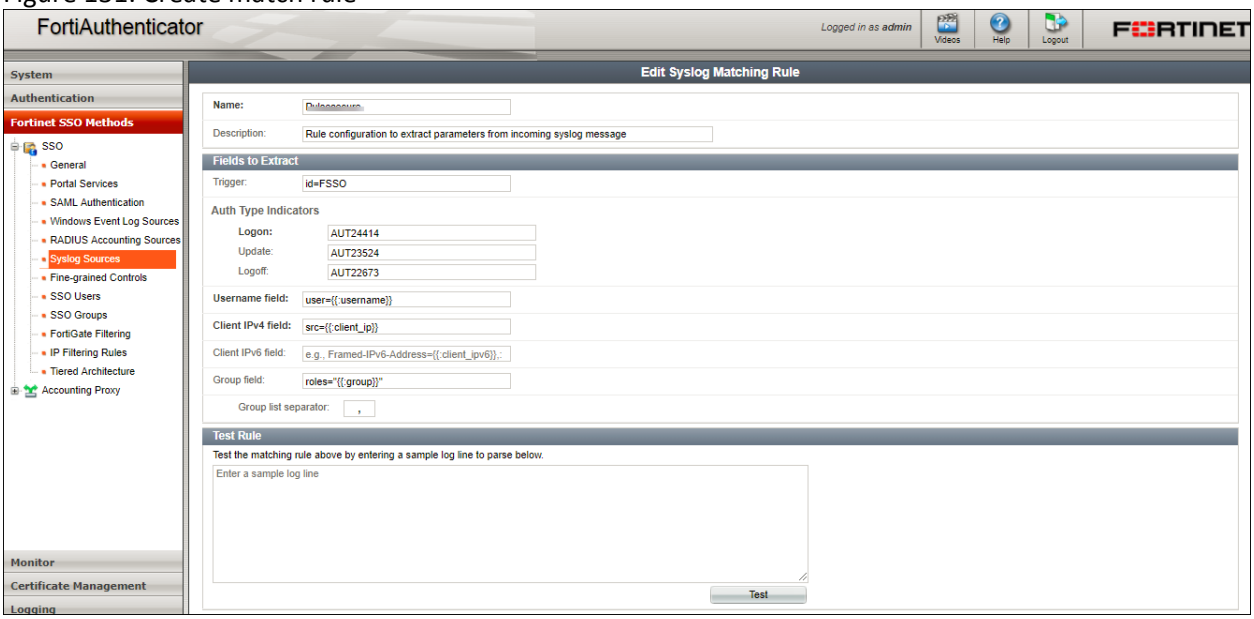
2. Create a syslog matching rule. Select **Fortinet SSO methods > SSO > Syslog Sources**. In the upper right corner, from the 'View' drop down choose matching rules and click Create New and give the following data:
    - Name: Enter the name for the syslog Rule.
    - Trigger: Enter the filter name created in PPS. For example, id=FSSO
    - Auth Type Indicators: Enter strings to differentiate between the types of user activities. For example,
      Logon: AUT24803
      Update: AUT23524
      Logoff: AUT22673
    - Username field: Define the semantics of the username field, where {{user}} indicates where the username is extracted from. For example: user= {{: username}}
    - Client IP field: Define the semantics of the client IP address. For example, src={{:client_ip}}
    - Group field: Define the semantics of the group. For example: roles=" {{: group}}"

NOTE: There is a trailing space after the User, IP, and Group fields. The parser treats the trailing space as an ending character after the variable portion of the field. The parsing fails if the trailing space is omitted.

- Group List Separator: SSO syslog feed can parse multiple groups if the names are separated by a plus (+) symbol or a comma (,). Use the Group list separator to specify the separator.
- Test Rule: Enter a sample log message into the text box, then select **Test** to test that the desired fields are correctly extracted.

3. Click **Ok** to add the new matching rule.

Figure 131: Create match rule

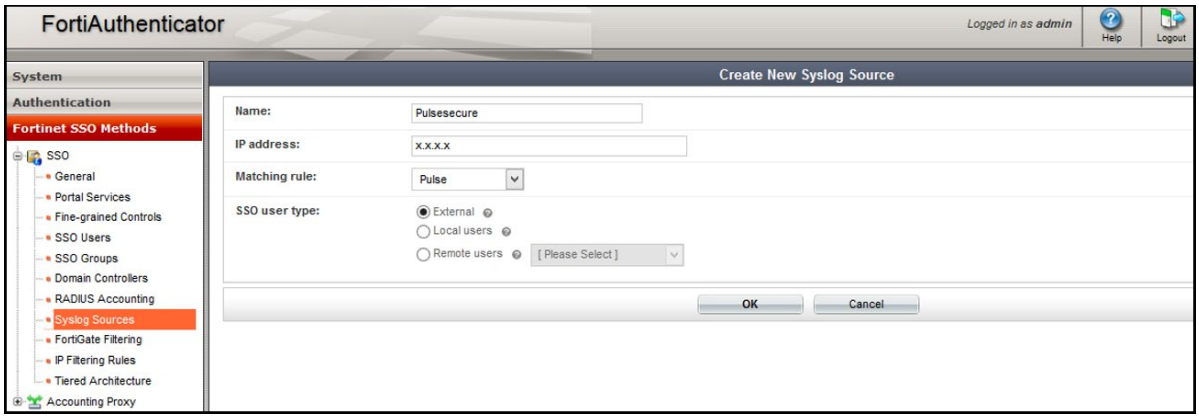


NOTE: For the Logon and Logoff indicators, the data specified will vary depending on the installation and depending on your syslog message contents. In this example, when a user logs in the message ID created is AUT24414 and is considered as a Logon event on FortiAuthenticator. When the role change happens as part of periodic host check updates, the message ID created by PPS is AUT23524. A sign-out event is considered a 'Logoff' event on FortiAuthenticator, and the identity is removed from the user group, thus, failing to match policy.

4. Create a Syslog source, Select **Fortinet SSO methods > SSO > Syslog Sources**. In the upper right corner, from the 'View' drop down choose Syslog Source and click **Create New** and provide the following data:

- Name- Enter a name for the source
- IP address- Enter the IP address of PPS server
- Matching rule- Select the requisite matching rule created above.
- SSO user type- Select **External** as the user type.

Figure 132: Creating a Syslog Source



NOTE: You must add all the cluster node IP's (not cluster VIP's) in the FortiAuthenticator when using a PPS cluster setup.

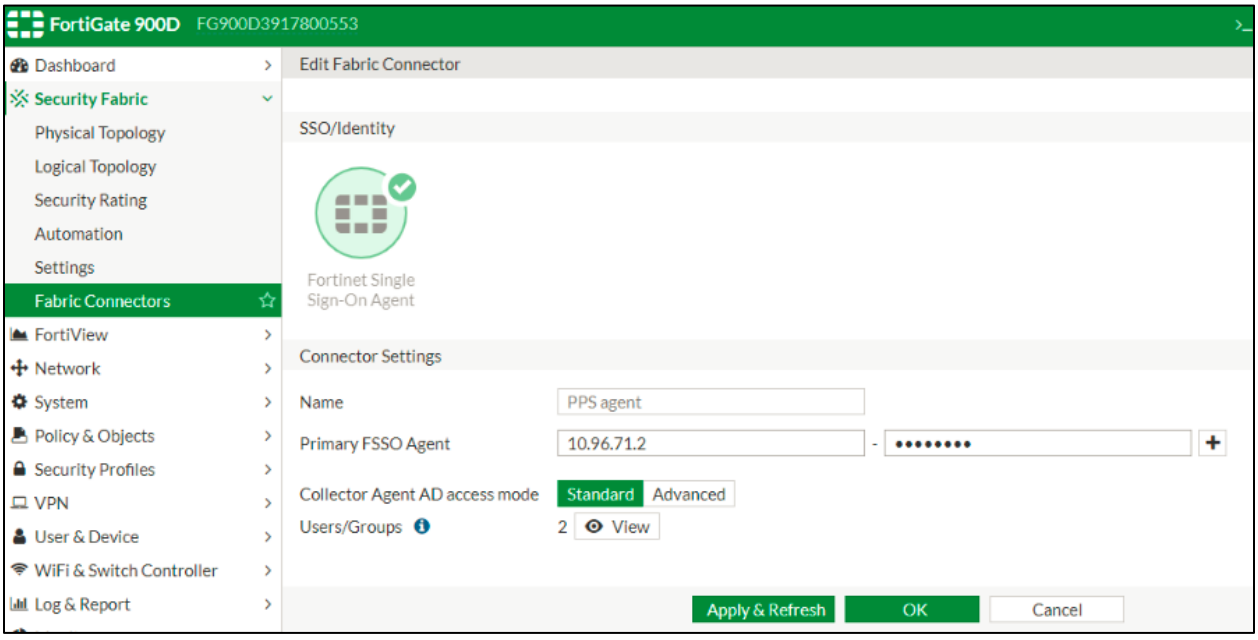
Configuring FortiGate Firewall

The FortiGate firewall detects traffic from an endpoint that matches a configured security policy using the FortiAuthenticator FSSO record. It determines the role(s) associated with that user, and allows or denies the traffic based on the actions configured in the security policy.

To configure FortiGate firewall:

1. (Applies to Release 6.0.*) Create the FortiAuthenticator as an FSSO agent in the FortiGate Firewall. Select **Fabric Connector > Create New**, under **SSO/Identity** select **Fortinet Single Sign-On Agent.**

   - Name: Enter a name for the entry
   - Primary FSSO Agent: Enter the IP address of the FortiAuthenticator appliance, and the password* used to communicate with it.
   - Click **Apply & Refresh** to test your configuration. If correct, the users /groups area will automatically populate

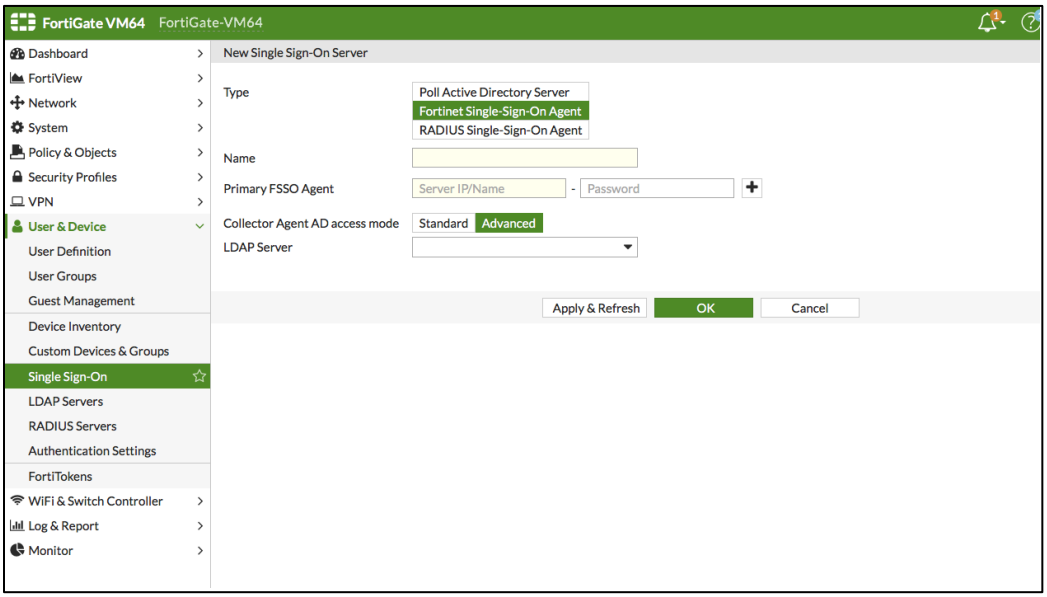


2. (Applies to Release 5.6.*) Create the FortiAuthenticator as an FSSO agent in the FortiGate Firewall. Select **User & Device >Single Sign-On** and click **Create New** and enter the following data.
   - Type: Fortinet Single-Sign-On Agent
   - Name: Enter a name for the entry
   - Primary Agent IP/Name: Enter the IP address of the FortiAuthenticator appliance, and the password* used to communicate with it.

   *This is the same as the secret key configured on FortiAuthenticator in the Fortinet SSO Methods > General section.

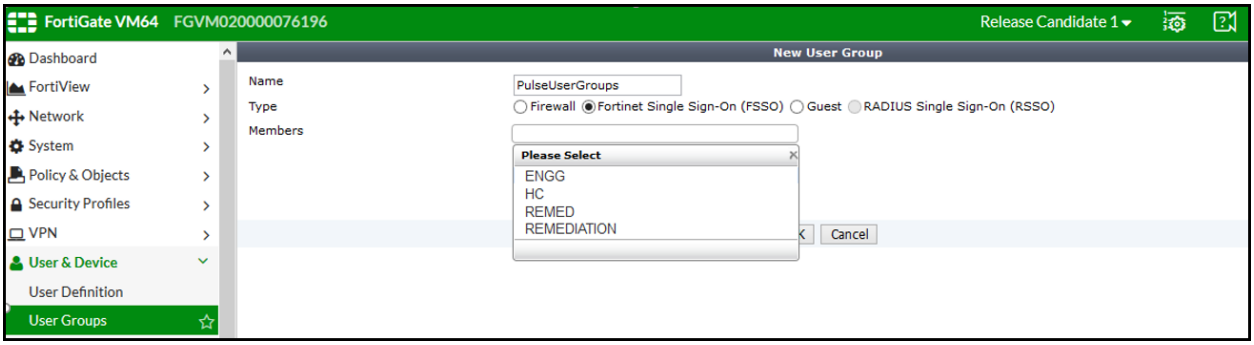
   - Click **Apply & Refresh** to test your configuration. If correct, the users /groups area will automatically populate

Figure 133: Creating Single Sign on Server



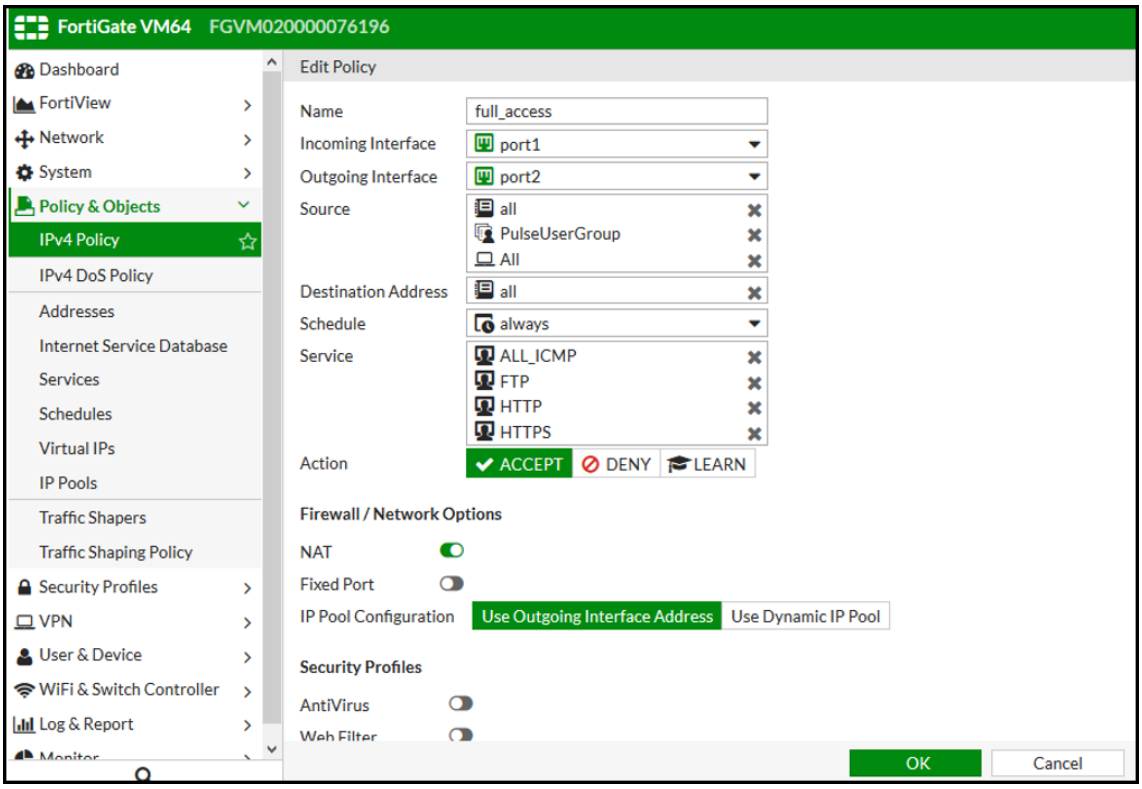
3. Create matching User groups. Select **User & Device > User Groups**. Click **create New** and enter the following data:
   - Name- Enter the name of the group. This name will appear in the firewall policy.
   - Type- Select **Fortinet Single Sign-On** as type.
   - Select the matching User group created on FortiAuthenticator and Click **OK**.

Figure 134: Creating User Groups



4. Create a firewall policy to use the PPS enforcement groups just created. Select **Policy & Objects > IPv4 Policy**. Click **Create New** and create the policy based on the resource access restrictions to be enforced.

Figure 135: Creating Firewall policies



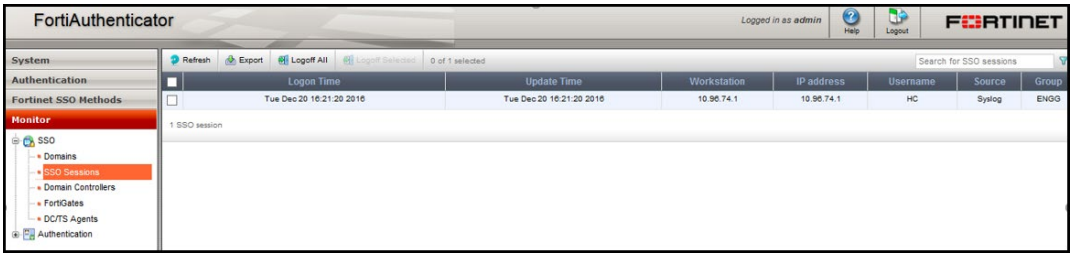
Reports and Logging

You can verify if the syslog messages are reaching the FortiAuthenticator by doing a packet capture on the FortiAuthenticator Interface.

1. Select **System > Network > Packet Capture** and select the interface which is used to communicate with the PPS and click **Start capture** button. Once packet capture is done stop the capture and download the packets and view it using any tool like wireshark.

2. To view identity records from the FortiAuthenticator GUI, Select **Monitor > Sessions**. The list shows the records parsed through syslog.

   Figure 136: Monitor SSO sessions

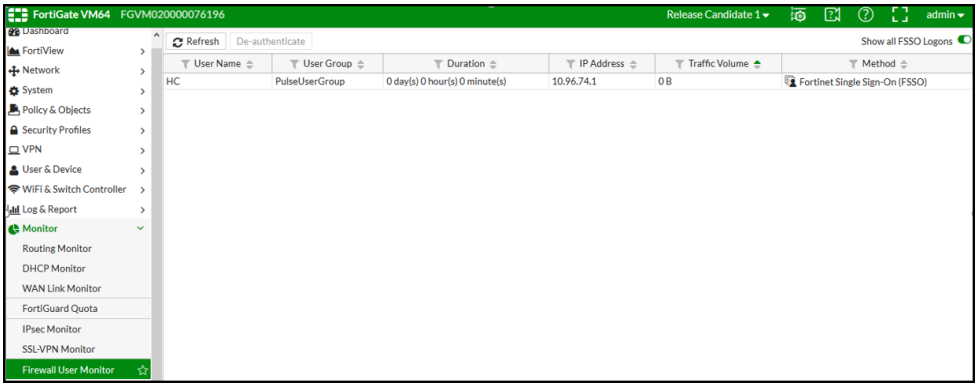


3. You can monitor the FSSO Sessions on FortiGate firewall from CLI or GUI:
   Using the FortiGate CLI, type: *diag debug auth fsso list* .
   The command displays identity records received from FortiAuthenticator.

   Figure 137: Monitor the FSSO Sessions on FortiGate firewall from CLI

4. Select **Monitor > Firewall user Monitor**. The list shows all the identity records.

   Figure 138: Monitor the FSSO Sessions on FortiGate firewall from GUI



Enforcement using SRX Series Firewall

This chapter provides an overview of enforcement using SRX firewall. It includes the following information:

Firewall Enforcement using Juniper SRX

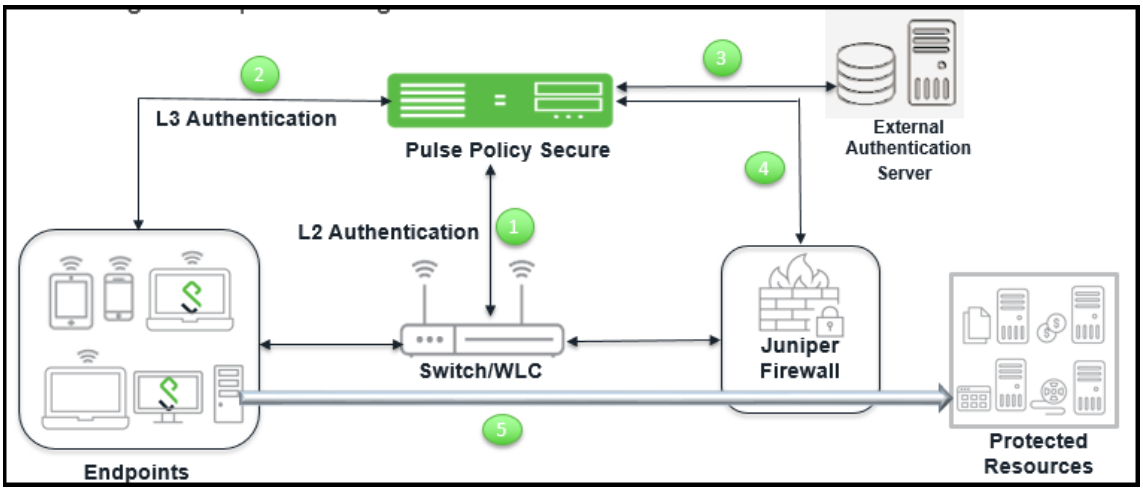
Overview

PPS delivers a layer 3 network access control solution when deployed with Juniper SRX firewall. The PPS is the Layer 2 or Layer 3 policy decision point that determines which users and endpoints can access protected resources. You can use Juniper Networks SRX firewall to serve as the enforcement point to provide the protection to ensure that network assets are secured. PPS authenticates users, ensures that endpoints meet security policies, and serves resource access policy information to Juniper Networks SRX devices.

Deployment of PPS using SRX Firewall

This section describes the integration of PPS with SRX firewall. The PPS and SRX firewall solution provides functionality for enforcing application level security policies on a per user and role basis. It also delivers granular level access control so that it can be easily managed through PPS.

Figure139: Deployment using SRX Firewall



The authentication process is described below:

1. The endpoint connects to switch to perform the layer 2 authentication with PPS.
2. PPS communicates with authentication server and performs the layer 3 authentication along with host check to ensure that the endpoints meets the corporate policy.
3. The external authentication server such as AD/LDAP confirms the role and sends the entries to PPS.
4. PPS provisions the auth table on SRX firewall with changes in role information if any.
5. The SRX series firewall maps the user to a specific resource access policy and then provides the required access.

Configuring PPS with SRX Firewall

The PPS connects with the SRX device over an SSL connection. To enable the connection between the two devices, you must specify the password and serial number of the SRX firewall. The SRX firewall initiates the connection to PPS. PPS presents its SSL server certificate to the SRX device. Optionally, you can configure the SRX device to verify the certificate and to specify constraints with which PPS must comply.

The SRX device and PPS perform mutual authentication with the proprietary JUEP-MAUTH challenge-response authentication based on the password configured. For security reasons, the password is not included in the message sent to PPS. After the SSL handshake, all further communication between the PPS device and the SRX device occurs over the SSL connection. The SRX device acts as a client and the PPS device as server.

This section covers the following topics:

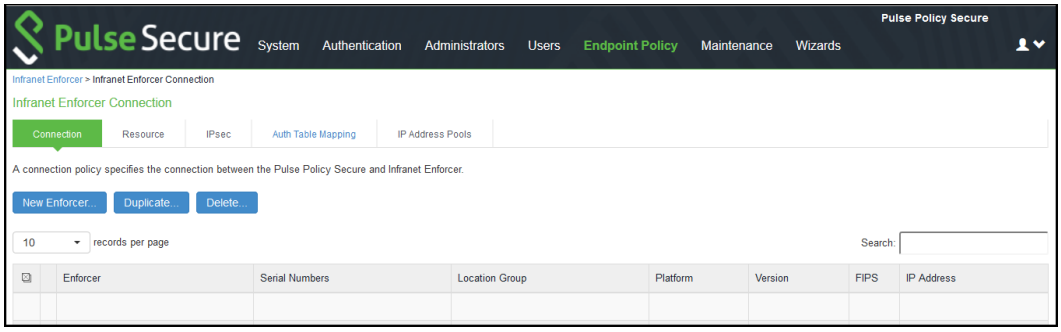
- Configuring SRX Infranet Enforcer in PPS
- Configuring Auth Table Mapping Policies
- Configuring Resource Access Policy

Configuring SRX Infranet Enforcer in PPS

To configure a SRX Firewall Infranet Enforcer in PPS:

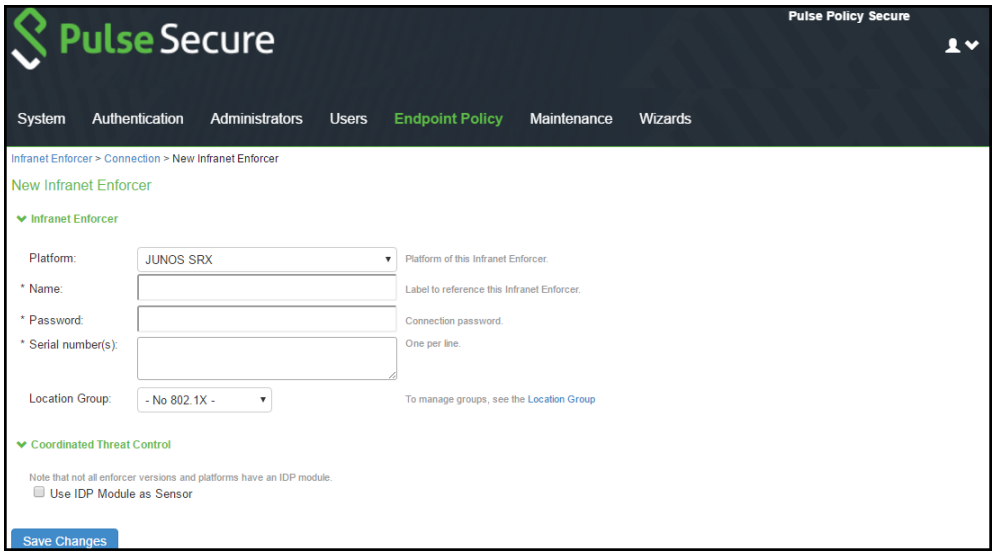
1. Select **Endpoint Policy > Infranet Enforcer**.

Figure 140: Infranet Enforcer



2. Click **New Infranet Enforcer** and select **Junos SRX** Firewall in the **Platform** drop down.

Figure141: SRX Firewall



3. Enter the name of the Infranet Enforcer in the **Name** box.
4. Enter the password for the SRX enforcer.
5. Enter the serial number of the Junos SRX Enforcer. You can view the serial number on the SRX device using the command: *user@host* ***show chassis hardware***
6. Ensure that the server certificate for PPS is configured for the interface to which the SRX device is connecting.
7. Click **Save Changes**. You must create security policies on the SRX device for traffic enforcement.

Configuring Auth Table Mapping Policies

An auth table consists of username, a set of roles, and IP address of the wired adapter, wireless adapter, or virtual adapter of the user device. Using SRX series firewall you can dynamically create auth table entries when a user tries to access the protected resource. An auth table mapping policy specifies which enforcer device can be used for each user role. These policies prevent the PPS from creating unnecessary auth table entries on all connected enforcer devices.

PPS's default configuration includes only one default auth table mapping policy. When the default auth table mapping policy is enabled, PPS pushes one auth table entry for each authenticated user to all SRX firewalls configured as Infranet Enforcers in PPS.

To configure auth table mapping policies:

1. Select **Endpoint Policy > Infranet Enforcer > Auth Table Mapping**.
2. Select the default auth table mapping policy called **Default Policy** and click **Delete**.

On the New Policy page:

1. For Name, enter a name to label this auth table mapping policy.
2. (Optional) For Description, enter a description.
3. In the Enforcer section, specify the Infranet Enforcer device(s) to which you want to apply this auth table mapping policy.
4. In the Roles section, specify:
   - Policy applies to ALL roles—To apply this auth table mapping policy to all users.
   - Policy applies to SELECTED roles—To apply this auth table mapping policy only to users who are mapped to roles in the Selected roles list. Be sure to add roles to this list from the Available roles list.
   - Policy applies to all roles OTHER THAN those selected below—To apply this auth table mapping policy to all users except for those who map to the roles in the Selected roles list. Be sure to add roles to this list from the Available roles list.

5. In the Action section, specify auth table mapping rules for the specified Infranet Enforcer device:
   - Always Provision Auth Table—To automatically provision auth table entries for chosen roles on the specified Infranet Enforcer.
   - Provision Auth Table as Needed—To provision auth table entries only when a user with a chosen role attempts to access a resource behind the specified Infranet Enforcer.
   - Never Provision Auth Table—To prevent chosen roles from accessing resources behind the specified Infranet Enforcer.

   Make sure you delete the Default Policy if you configure any of your own auth table mapping policies. PPS includes this default auth table mapping policy that allows all source IP endpoints to use all Infranet Enforcer devices.
6. If you created a vsys on a ScreenOS Enforcer, enter the name of the vsys in the vsys text box. To view the enforcers or vsys that are associated with each policy, select **Infranet Enforcer > Auth Table Mapping**.
7. Click **Save Changes**.

For more information on dynamic authentication table, see Configuring Dynamic Auth Table Policies.

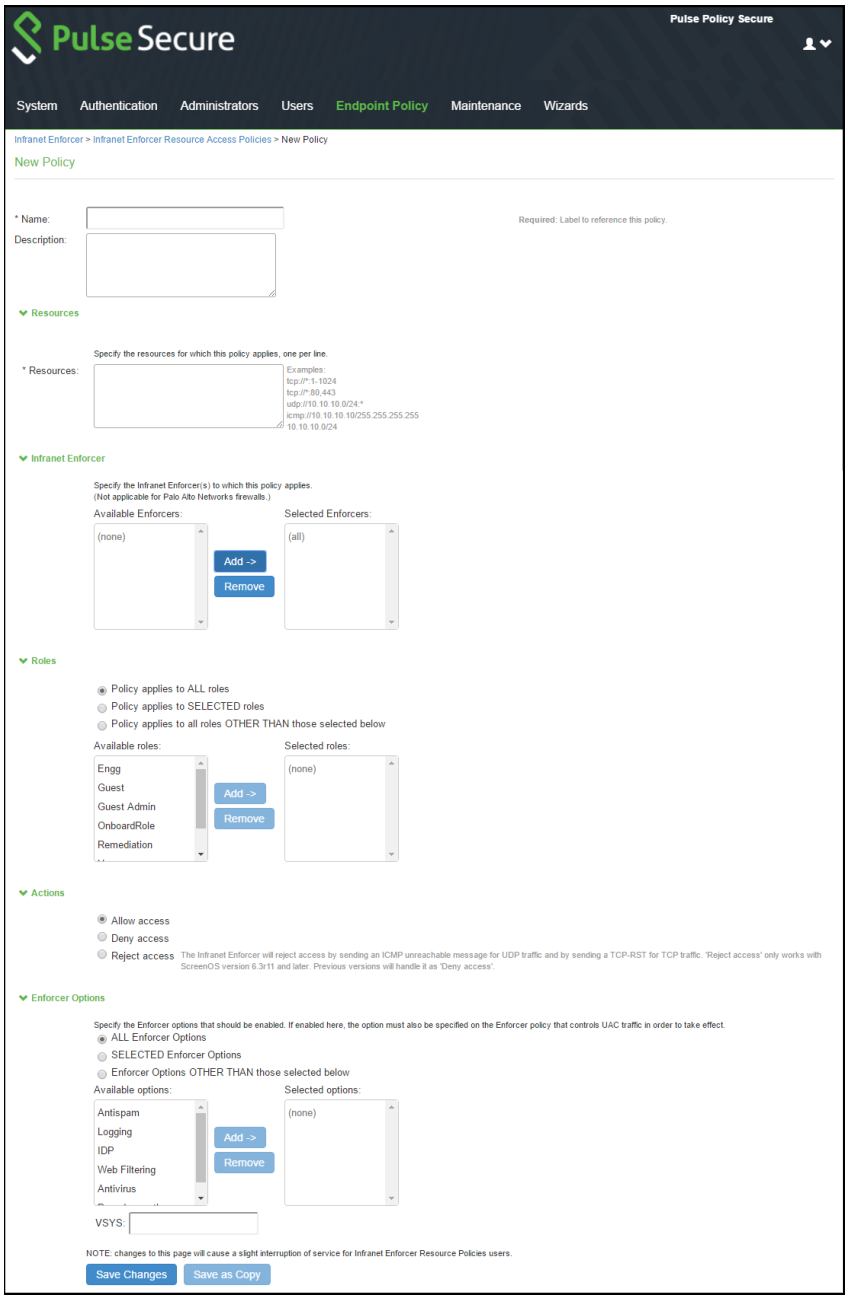
Configuring Resource Access Policy

A resource access policy specifies which users are allowed or denied access to a set of protected resources. You can specify which users you want to allow or deny by choosing the roles for each resource access policy.

To configure Infranet Enforcer resource access policies:

1. Select **Endpoint Policy > Infranet Enforcer > Resource Access** Policy and click **New Policy**.

Figure 142: Infranet Enforcer



On the New Policy page:

2. For Name, enter a name to label this Infranet Enforcer resource access policy.

3. (Optional) For Description, enter a description.

For **Resources**, specify the protocol, IP address, network mask, and port of each resource (or range of addresses) for which this Infranet Enforcer resource access policy applies, one per line. Do not insert any spaces in your entries, or the policy may not be applied correctly.

You cannot specify a host name in a resource access policy. You can specify only an IP address. You can use TCP, UDP, or ICMP.

1. Under Infranet Enforcer, specify the Infranet Enforcer to which this policy applies by using Add.
2. Specify one of the following in the Roles section:
   - **Policy applies to ALL roles**—To apply this Infranet Enforcer resource access policy to all users.
   - **Policy applies to SELECTED roles**—To apply this Infranet Enforcer resource access policy only to users who are mapped to roles in the Selected roles list. You must add roles to this list from the Available roles list.
   - **Policy applies to all roles other than those selected below**— To apply this Infranet Enforcer resource access policy to all users except those who map to the roles in the Selected roles list. You must add roles to this list from the Available roles list.
3. In the Action section, specify whether you want to use this Infranet Enforcer resource access policy to allow or deny access to the specified resources.

If you select deny, a text box is displayed that allows you to customize a deny message for users.

With ScreenOS Enforcer Release 6.3 r13 or later, you can also select Reject Access. The customized deny message is available with the reject action.

The reject action is designed for clients that hang for a long period while waiting for connection initiations that the firewall is blocking. With the deny action, the Enforcer drops traffic in accordance with the PPS policy, but does not send back reject information. The policy action of "reject" denies the traffic and sends a TCP RST to the traffic originator for TCP traffic, or ICMP unreachable for UDP traffic. In earlier versions of ScreenOS and on the Junos Enforcer, the selection of reject results in a deny action.

To record deny actions in the User Access Log, select the **Infranet Enforcer Deny Messages** check box on the **Log/monitoring > User Access > Settings** page. The log records the user, source IP, destination IP, protocol, and destination port.

1. For ScreenOS Enforcers, in the ScreenOS Options section, use the option buttons to select the policy options that you want to apply to selected roles. Use the Add and Remove buttons to specify antispam, logging, IDP, web filtering, antivirus, and deep inspection.
2. By default, all policy options are enabled. To enforce the policies, you must create corresponding policies on the ScreenOS Enforcer. If PPS is upgraded from a previous version, all ScreenOS options are enabled for the resource access policies that were available prior to the upgrade.
3. If you have created a vsys on a ScreenOS Enforcer, enter the name of the vsys in the VSYS text box, if applicable. The Infranet Enforcer > Resource Access Policy page displays the Enforcers and/or vsys that are associated with each policy.

Configuring SRX Firewall

PPS can utilize a SRX device as a policy enforcement point to work as a Layer 3 Enforcer. When the SRX is configured to work as an enforcer with PPS, the following takes place:

- PPS provisions resource access policies.
- SRX gets the user's role membership information from authentication table entries that are sent by PPS when the user authenticates with the PPS or when the user tries to access resources through SRX.
- SRX does a policy lookup in resource access policies, which is sent by PPS and accordingly takes allow/deny decisions.

For the SRX to perform a PPS policy lookup, the *uac-policy application* service needs to be turned on in the SRX firewall rule and the firewall rule's action should be set to permit. The SRX security policies have to be manually configured on SRX.

Configuring SRX as an Enforcer

The SRX enforcer works with the PPS device for Layer 3 connectivity. You can connect with source IP or IPsec. For the initial setup, you must specify the PPS device name, IP address, port number over which the Junos Enforcer and PPS device will connect, the interface, the password (the same password as entered on the PPS device), and, optionally, the CA profile and server certificate subject. Use the Junos CLI to add this information.

You can configure the SRX device in “test only” mode. In test only mode, the SRX device does not enforce PPS policies and allows all traffic to pass. However, all policy decisions are logged. This allows you to set up the devices before actual deployment and determine how the PPS solution works using different configuration options. For example, the PPS device and endpoints can reside on different physical interfaces of the Junos Enforcer or on the same interface.

PPS device policies are role based. Each policy specifies a destination (the resources that are being protected), a set of roles, and an action (allow or deny). To determine the roles for users, an auth table maps source IP addresses to roles. When an endpoint accesses the PPS device, the PPS device populates the Junos Enforcer with an auth table entry mapping the endpoint's IP address to the endpoint's set of roles. When evaluating a flow, the source IP address of the initial packet is used to look up the roles. Then the first policy that matches both the destination (resource) and the roles is used to determine whether to permit or deny the flow.

To use IPsec with the SRX device, you must enable IKE services for the gateway. If you have multiple IPsec tunnels with multiple gateways, the hostname for each gateway must be unique.

NOTE: SRX Series communication to PPS is not supported on an interface that is in a routing instance or VRF instance.

To configure the Junos Enforcer:

2. Set up the trusted interface. The trusted interface connects to the protected resource. The untrusted interface connects to PPS.
3. Ensure that the DHCP server is disabled or enabled as required for the deployment.
4. Create a PPS configuration on the Junos security device, and provide the network information required for connecting using the CLI. This information includes PPS host name, the IP address, and the interface to which the device will connect. The default port for communication with PPS is 11123, you cannot change the port. You must also specify a password, that matches the password configured on PPS.
5. For complete CLI instructions and syntax, see the Junos Software CLI Reference.
   - Specify PPS hostname:
     user@host# **set services unified-access-control infranet-controller hostname**
   - Specify PPS IP address:
     user@host# **set services unified-access-control infranet-controller hostname address ip-address**

- Specify the Junos interface to which PPS should connect:
  user@host# **set services unified-access-control infranet-controller hostname interface interface-name**
- Specify the password that the SRX Series or J Series device should use to initiate secure communications with PPS:
  user@host# **set services unified-access-control infranet-controller hostname password password**

6. Set the appropriate timeout and interval values, and specify a timeout action. The timeout that you set specifies the elapsed time beyond which the Junos Enforcer attempts to reconnect with PPS if no communication is received. The interval specifies how often PPS sends a heartbeat to the Junos Enforcer.
7. (Optional) Verify that the certificate of the CA that signed PPS's server certificate is loaded in the Junos Enforcer and that the path to the certificate is specified.

NOTE: Although certificate verification is optional, there are three different certificate options on the Junos Enforcer that will produce different results.

   - If certificate-verification is set to required, it is required that the device verify any PPS server certificate. If any PPS ca-profile is not configured, the commit check fails.
   - If certificate-verification is set to warning (the default), and PPS ca-profile is not configured, the commit check displays a warning about the security risk with a similar warning in the syslog.
   - If certificate-verification is set to optional, there is no warning.

8. Verify routing from PPS to the untrusted interface.
9. Ensure that both the Junos Enforcer and PPS are set to the correct time. If possible, use a Network Time Protocol (NTP) Server to set the date and time of both appliances.

When you finish configuring PPS instance, the Junos Enforcer can initiate the connection with PPS. The Junos Enforcer optionally validates PPS server certificate if so configured. The device sends the serial number to authenticate with PPS.

For the Junos Enforcer to establish communication, you must configure the Junos Enforcer on PPS.

Enforcement using Screen OS Firewall

This chapter provides an overview of enforcement using ScreenOS. It includes the following information:

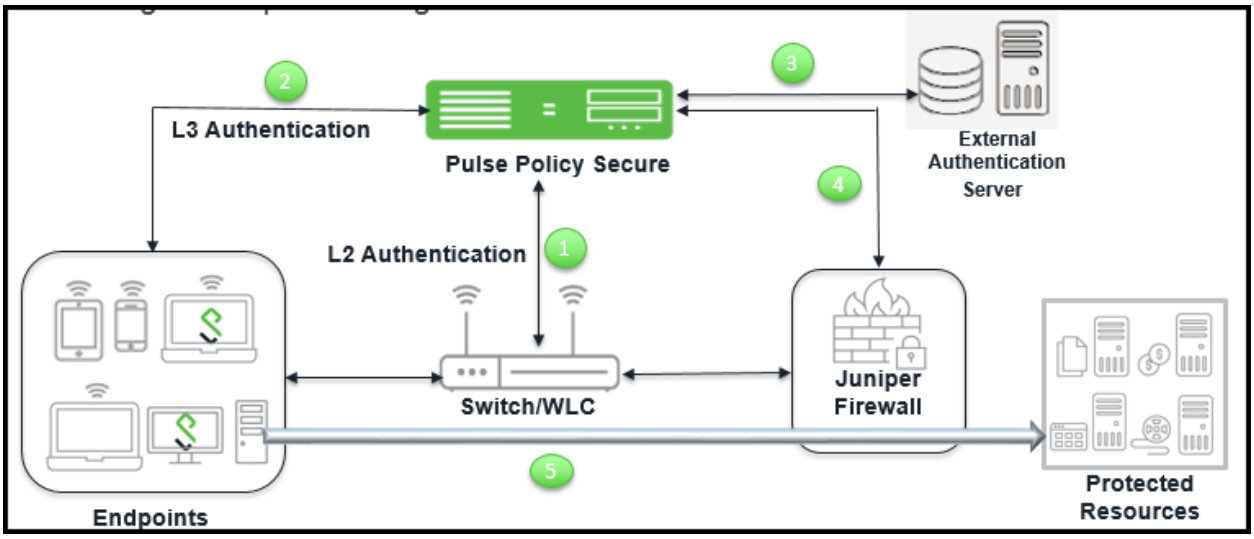
Overview

PPS delivers a layer 3 network access control solution when deployed with Screen OS firewall device. The PPS is the policy decision point that determines which users and endpoints can access protected resources. You can use Screen OS firewalls to serve as the enforcement point to provide the ultimate protection to ensure that network assets are secured.

Deployment of PPS using ScreenOS Firewall

This section describes the integration of PPS with ScreenOS firewall. The PPS and Screen OS firewall solution provides functionality for enforcing security policies on a per user and role basis. It also delivers granular level access control so that it can be easily managed through PPS.

Figure143: Deployment using ScreenOS Firewall



The authentication process is described below:

1. The endpoint connects to switch to perform the layer 2 authentication with PPS.
2. PPS communicates with authentication server and performs the layer 3 authentication along with host check to ensure that the endpoints meets the corporate policy.
3. The external authentication server such as AD/LDAP confirms the role and sends the entries to PPS.
4. PPS provisions the auth table on ScreenOS firewall with changes in role information if any.
5. The ScreenOS firewall maps the user to a specific resource access policy and then provides the required access.

Configuring PPS with ScreenOS Firewall

The ScreenOS Enforcer connects to PPS over an SSH connection that uses the NetScreen Address Change Notification (NACN) protocol. PPS uses the NACN password and serial number for a connection from the ScreenOS Enforcer. When the ScreenOS Enforcer first turns on, it sends an NACN message containing the NACN password and serial number to PPS. PPS uses the serial number to determine which ScreenOS Enforcer is attempting to connect, and PPS uses the NACN password to authenticate the ScreenOS Enforcer. PPS then begins communicating with the ScreenOS Enforcer using SSH.

This section covers the following topics:

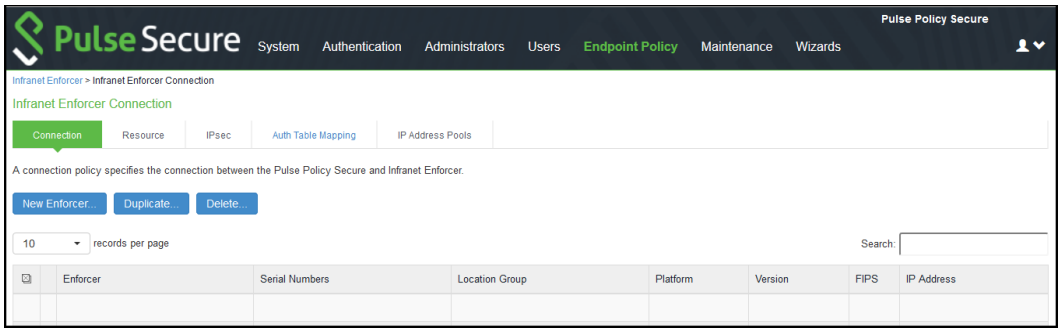
- Configuring ScreenOS Infranet Enforcer in PPS
- Configuring Auth Table Mapping Policies
- Configuring Resource Access Policy

Configuring ScreenOS Infranet Enforcer in PPS

To configure a SRX Firewall Infranet Enforcer in PPS:

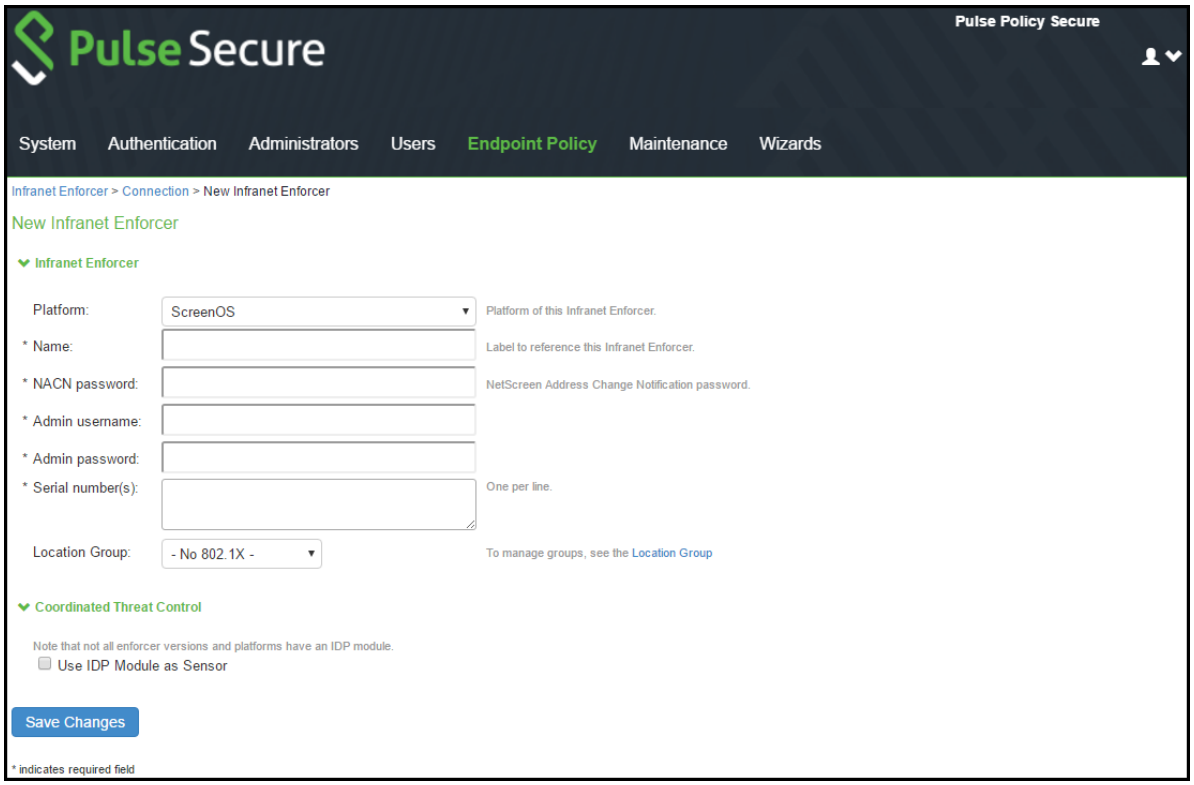
1. Select **Endpoint Policy > Infranet Enforcer**.

Figure 144: Infranet Enforcer



2. Click **New Infranet Enforcer** and select **ScreenOS** Firewall in the **Platform** drop down.

Figure145: ScreenOS Firewall



3. Enter an NACN password for this Infranet Enforcer in the NACN password box. You must enter this same NACN password when configuring the Infranet Enforcer.
4. In the appropriate boxes, enter the administrator name and password for signing into the Infranet Enforcer
5. Enter the name of the Infranet Enforcer in the **Name** box.
6. Enter the password for the ScreenOS enforcer.
7. Enter the serial number of the ScreenOS Enforcer. You can view the serial number on the ScreenOS device using the command: **get system**
8. Select **No 802.1X** from the Location Group list if you are not using an Infranet Enforcer as an 802.1X RADIUS client.
9. Ensure that the server certificate for PPS is configured for the interface to which the SRX device is connecting.
10. Click **Save Changes**.

When you finish configuring the Infranet Enforcer, the Infranet Enforcer attempts to connect to PPS. If the connection is successful, a green dot is displayed next to the Infranet Enforcer icon. Under Enforcer Status select **System > Status > Overview**. The Infranet Enforcer IP address is also displayed in Endpoint Policy > Infranet Enforcer > Connection.

Configuring Auth Table Mapping Policies

An auth table consists of username, a set of roles, and IP address of the wired adapter, wireless adapter, or virtual adapter of the user device. Using SRX series firewall you can dynamically create auth table entries when a user tries to access the protected resource. An auth table mapping policy specifies which enforcer device can be used for each user role. These policies prevent the PPS from creating unnecessary auth table entries on all connected enforcer devices.

For complete configuration information, see Configuring Auth Table Mapping Policies.

Configuring Resource Access Policy

A resource access policy specifies which users are allowed or denied access to a set of protected resources. You can specify which users you want to allow or deny by choosing the roles for each firewall enforcer access policy.

For complete configuration procedure, see Configuring Resource Access Policy.

Configuring ScreenOS Firewall

PPS can utilize a ScreenOS device as a policy enforcement point to work as a Layer 3 Enforcer. When the ScreenOS device is configured to work as an enforcer with PPS, the following takes place:

- PPS provisions resource access policies.
- Screen OS device gets the user's role membership information from authentication table entries that are sent by PPS when the user authenticates with the PPS or when the user tries to access resources through ScreenOS.
- ScreenOS device does a policy lookup in resource access policies, which is sent by PPS and accordingly takes allow/deny decisions.

This section covers the following topics:

Configuring ScreenOS as an Enforcer

You can configure basic Infranet auth Enforcer policies that specify a source zone and a destination zone on the PPS Series device and then push the policies to the ScreenOS Enforcer to add additional policy details, or you can use the ScreenOS Enforcer to configure the policies with the CLI or Web UI. We recommend that you use the PPS Series device to set up the policies for source IP enforcement on the Infranet Enforcer.

Before setting a policy, you must create address book entries for the destination and source addresses unless you use address book entries that already exist, such as Any.

The following example, sets an Infranet auth policy and adds it to the top of the list of policies. The policy allows all traffic of any type from any host to another host. The policy allows traffic according to the Infranet Enforcer resource access policies that you configure on the PPS Series device.

set policy top from untrust to trust any permit Infranet-auth

The following example sets two address book entries and a policy between them for anyone in the 10.64.0.0/16 range can reach the 10.65.0.0/16 range.

set address Trust “10.64 Range” 10.64.0.0 255.255.0.0
set address Untrust “10.65 Range” 10.65.0.0 255.255.0.0
set policy from trust to untrust “10.64 Range” “10.65 Range” any permit Infranet-auth

You can use Route mode or Transparent mode to configure a Juniper Networks ScreenOS Enforcer. By default, the ScreenOS Enforcer operates in Route mode. For more information on ScreenOS, see the *ScreenOS Reference Guide*.

This sections covers the following information:

1. Configuring the ScreenOS Enforcer in Route Mode
2. Configuring the ScreenOS Enforcer in Transparent Mode

Configuring the ScreenOS in Route Mode

The PPS can reside on trust/untrust interface side of the Infranet Enforcer. If PPS resides on the trust interface side, and users come in through the untrust interface, the administrator must configure a policy (untrust to trust) on the Infranet Enforcer that allows traffic to pass between PPS and Pulse Client. By default, Infranet Enforcer traffic from the untrust interface to the trust interface is denied.

The following procedure describes the setup with PPS on the untrust interface side (same side as users).

To configure an Infranet Enforcer in Route mode:

1. Set up the trust interface. The trust interface connects to the protected resource. The untrust interface connects to PPS. Set the following interface (ethernet1/1) settings:
   - Set routing
   - Enable management of the following services:
     - SSL
     - SSH
     - IP (options)
2. Ensure that the DHCP server is disabled or enabled, as appropriate for the deployment.
3. Import the certificate of the CA that signed PPS's server certificate into the Infranet Enforcer.
4. If you set up an NSRP cluster before you import the CA certificate into the Infranet Enforcer, the CA certificate is automatically synchronized to all Infranet Enforcers in the cluster. However, if you set up the NSRP cluster after you import the CA certificate, you must manually synchronize the certificate to the other Infranet Enforcers in the cluster by typing the following CLI command:

   exec nsrp sync pki

   You cannot load the self-signed SSL certificate into the Juniper security device.

   The certificate of the CA that signed PPS's certificate must be imported on the Infranet Enforcer because the Infranet Enforcer must be able to trust PPS during an SSL session. When a user signs into a server by means of SSL, the server displays a dialog box in which the user can manually accept the certificate that is associated with that server. For the Infranet Enforcer to skip that manual step and automatically accept PPS's certificate, the Infranet Enforcer must have the certificate of the CA that signed PPS's certificate.
5. Create an instance of PPS on the Juniper security device.
6. Enable SSH.
7. Verify routing from PPS to the untrust interface.
8. Ensure that both the Infranet Enforcer and PPS have the correct time. If possible, use a Network Time Protocol (NTP) server to set the date and time of both appliances.

Creating a Route based interface with ScreenOS

When an interface is in route mode, the security device routes traffic between different zones without performing source NAT.

To create a PPS instance on ScreenOS, you must configure the following items:

- IP address or hostname of PPS
- Password to use when the Infranet Enforcer uses NACN to contact PPS
- Source interface

- CA index number (ca-idx)

You can set these items using the Web UI or the CLI.

In the following procedure, you first set interface management options and disable the DCHP server option. Then you enable SSHv2 and configure an PPS server named controller1. Next, you set the host IP address, which is the IP address of the server, to 10.64.12.1. The NACN password is 8!JsP37cK9a*_HiEwe. The NACN password must match the NACN password that you entered for PPS server. The source interface is the interface that the Infranet Enforcer uses to communicate with PPS, and the CA index number is 001.

For this example, the source interface is ethernet 1/1. For a descriptive list of CA index numbers by typing the following command at the ScreenOS CLI:

get ssl ca-list

To change SSH versions, delete SSH settings by typing the following CLI command:

delete ssh device all

When you use the Web UI, you do not need to fill in the Full Subject Name of PPS Cert field. If you do fill it in, be sure to enter the entire certificate subject. For example:

CN=ic1.sample.net,CN=14087306185,CN=06990218,OU=Software,O=Comp,S=CA, C=US

To create the instance using the Web UI:

1. Select **Network > Interfaces > Edit > Services** from the left navigation bar to set management options.
2. Select **Network > DHCP > Edit** to disable the DHCP server for both interfaces (Trust and Untrust).
3. Select and load the CA if you have not already done so.
4. Select **Objects > Certificates**.
5. Click **Browse** to find and select the certificate. Then click **Load**.
6. Select **CA** from the show list.
7. Click **Server Settings** and make sure **Check Method** is set correctly for the certificate you are using.
8. Click **OK**.
9. Create PPS instance.
10. Select **Configuration > Infranet Auth > Controllers (List) > New**.
11. Type **controller1** in PPS instance box.
12. Type IP/domain name: **10.64.12.1** in the IP/Domain Name box.
13. For the NACN Parameters, select ethernet1/1 from the **Source Interface** list.
14. Type **8!JsP37cK9a*_HiEwe** in the Password box.
15. Select the CA from the **Selected CA** list.
16. Enable SSH version 2.
17. Select **Configuration > Admin > Management > Enable SSH (v2)**.

To create the instance using the CLI:

Type the following commands:

```
set interface ethernet1/1 manage ssl
set interface ethernet1/1 manage ssh
set interface ethernet1/1 manage ip
set interface ethernet2/1manage ping
set interface ethernet2/1 dhcp server disable
set interface ethernet1/1 dhcp server disable
delete ssh device all
```

```
set ssh version v2
set ssh enable
set infranet controller name controller1 host-name 10.64.12.1
set infranet controller name controller1 password 8!JsP37cK9a*_HiEwe
set infranet controller name controller1 src-interface ethernet1/1
set infranet controller name controller1 ca-idx 001
save
```

Configuring the ScreenOS in Transparent Mode

The ScreenOS device is usually installed between a core router and an access distribution device in a transparent mode. The services are enabled at the zone level, and VLAN1 is used for management.

Transparent mode permits you to implement the following functionality:

- The device can act as a Layer 2 forwarding device, such as a bridge.
- You can control traffic flow between Layer 2 security zones by defining policies.

To configure a ScreenOS Enforcer in Transparent mode:

1. Set up Transparent mode using the predefined security zones, v1-trust and v1- untrust.
2. Assign interfaces to v1-trust and v1-untrust.
3. Configure the IP address for a source interface to establish connectivity with PPS. You can use V1-trust, V1-untrust, or V1-dmz.
4. Configure the broadcast mechanism to flooding (default) or ARP/traceroute. ARP/trace-route is more secure than broadcast.
5. Enable management of the following services for VLAN1:
   - SSL
   - SSH
   - Web (optional)
6. Set up the Juniper Networks security device zones. The protected resources can be in either zone (v1-trust or v1-untrust) as long as the protected resources are in a zone different from the endpoints.

   PPS can also reside in either zone. If PPS resides in a zone different from the endpoints, configure a policy that allows traffic to the endpoints through the ScreenOS Enforcer.
7. Import the certificate of the CA that signed PPS's server certificate into the ScreenOS Enforcer.

   Do not import PPS SSL certificate into the Juniper Networks security device.
8. Create an instance of PPS on the ScreenOS Enforcer.
9. Enable SSH.
10. Verify routing from PPS to the V1-untrust zone.

    To use IPsec enforcement with a ScreenOS Enforcer in Transparent mode, you might need to configure a source interface policy on PPS.
11. Ensure that both the Infranet Enforcer and PPS have the correct time. If possible, use a Network Time Protocol (NTP) server to set the date and time of both appliances.

Creating a Transparent Mode instance on the ScreenOS

To create a PPS instance in transparent mode, use the CLI to perform the following actions:

- Assign all interfaces to Layer 2 zones.
- Assign an IP address to vlan1 and set the route command.
- Set interface management options.
- Configure a PPS instance named controller1.
- Set the host IP address, which is the IP address of PPS, to 10.64.12.1.
- Enter the NACN password. The NACN password is 8!JsP37cK9a*_HiEwe. The NACN password must match the NACN password that you entered for PPS.
- The source interface, vlan1, is the interface that the Infranet Enforcer uses to communicate with PPS. The CA index number is 001. For a descriptive list of CA index numbers type the following CLI command: **get ssl ca-list**

You can use the following sample configuration to create the instance using the CLI.

NOTE: For the firewall to operate in Transparent (Layer 2) mode, all interfaces must be in a Layer 2 zone, such as v1-trust or in the null zone. Interfaces cannot remain in a Layer 3 zone.

```
set interface eth1 zone v1-trust
set interface eth2 zone v1-untrust
set interface vlan1 ip 10.64.12.x
set interface vlan1 route
set interface vlan1 ip manageable
unset interface vlan1 manage ping
unset interface vlan1 manage telnet
unset interface vlan1 manage snmp
unset interface vlan1 manage web
set infranet controller name controller1 host-name 10.64.12.1
set infranet controller name controller1 password 8!JsP37cK9a*_HiEwe
set infranet controller name controller1 src-interface vlan1
set infranet controller name controller1 ca-idx 0001
```

Verifying the PPS Configuration on ScreenOS Enforcer

You can view the configuration of a PPS instance through the Web UI and the CLI. You can view the following information:

- Name of PPS instance
- IP address or domain name of PPS
- Port number (Default 11122)
- Timeout (60 seconds by default)
- Source interface

The Web UI also allows you to view the NACN password.

Web UI

To view configuration information on the Web UI select the following:

1. **Configuration > Infranet Auth > Controllers** from the left navigation bar.
2. **Configuration > Infranet Auth > General Settings** from the left navigation bar.

CLI

To view configuration information at the CLI, type the following command:

get infranet controller name controller1

Appendix

Configuring Dynamic Auth Table Policies

You can use the dynamic auth table allocation feature to push auth table entries to the Infranet Enforcer only when a user attempts to access a protected resource. This is more efficient than the Auth Table Mapping Policies option, which requires administrators to provision auth table entries for authenticated users whether they are accessing resources or not. Dynamic auth table allocation reduces auth table entries to only those that are needed, enabling you to deploy smaller firewalls with a larger user population.

When dynamic auth table allocation is used and a user attempts to access a protected resource, the Infranet Enforcer does not yet have an auth table entry for the user, so it sends a drop notification to PPS to prompt it to send an auth table entry. Unlike captive portal redirect, which only occurs when the user sends HTTP traffic, drop notifications are triggered by any type of traffic for which the destination is a protected resource.

After the user disconnects, the Infranet Enforcer automatically expires the auth table entry.

NOTE: On the SRX device, whenever traffic matches a security policy that includes an **application-services uac-policy** statement, then the firewall sends a drop notification to PPS if there is no auth table entry associated with that traffic. This applies in the captive portal use case, and for all policies that include the **application-services uac-policy** statement.

However, this behavior changes if user role firewall is configured. When a **match source-identity** statement is included in any policy within a zone pair (source zone + destination zone), user and role information must be retrieved before policy lookup can proceed. (If all policies in the zone pair are set to **match source-identity any**, or have no match source-identity state, user and role information is not required and the five standard match criteria are used for policy lookup.) Therefore, for any zone pair in which a security policy is configured that contains a **match source-identity** statement, the firewall sends a drop notification for all traffic matching that source and destination zone, whether or not the traffic matches the specific security policy containing the **match source-identity** statement. This can result in an unexpected number of drop notifications if a single zone contains a mix of protected and unprotected resources.

In most deployments, it is recommended that you use dynamic auth table allocation. The benefits of dynamic auth table allocation are based on many factors within the network deployment: the number of Infranet Enforcers, the anticipated number of sessions, and the persistence of user sessions.

The following requirements and limitations apply:

- Dynamic auth table allocation is supported for all deployments with Junos Enforcer and with ScreenOS Enforcers running ScreenOS 6.1 or later.
- Dynamic auth table allocation does not work with HTTP traffic if the captive portal feature is configured to redirect user traffic to an external web server other than PPS. PPS must be aware of a user log in/session before it can provision an auth table entry.
- If you configure dynamic auth table allocation on PPS, and the DNS server for the network is behind the Infranet Enforcer, endpoints might occasionally experience DNS time-out issues before resources are provisioned.
- Dynamic auth table allocation is required to use IF-MAP Federation.

One scenario in which static auth tables are more practical is a deployment that forces every endpoint to go through a single Infranet Enforcer for all access. In this case, static auth tables can reduce overall traffic between PPS servers and Infranet Enforcers.

For deployments that use static auth table mapping policies, we recommend not more than 100 connected Infranet Enforcers. For deployment scenarios with more than 100 Infranet Enforcers, we recommend a deployment strategy using dynamic auth table allocation. Testing has shown that with 5,000 active sessions, performance is impacted significantly

when dynamic auth table allocation is not configured and 100 connected firewalls are deployed. Performance metrics vary for each PPS release.

To enable dynamic auth table allocation:

1. Select **Infranet Enforcer > Auth Table Mapping** in the admin console. Either delete the Default Policy or specify an Enforcer for which you do not want to configure this feature.
2. Click **Save Changes**.

Binding an Interface to a Security Zone on a Junos Enforcer

Interfaces are the doorways through which traffic enters and exits an Enforcer. Many interfaces share the same security requirements. However, different interfaces can have different security requirements for inbound and outbound data packets. Interfaces with identical security requirements can be grouped together in a single *security zone*.

A security zone is a collection of network segments that require the regulation of inbound and outbound traffic through policies. Security zones are logical entities to which one or more interfaces are bound. Many types of Enforcers let you define multiple security zones based on network requirements.

You can configure multiple security zones by dividing the network into segments to which you can then apply various security options to satisfy the needs of each segment. At a minimum, you must define two security zones, basically to protect one area of the network from the other. On some security platforms, you can define many security zones, bringing finer granularity to the network security design without deploying multiple security appliances to do so.

From the perspective of security policies, traffic enters one security zone and exits through another security zone. This combination of a “from-zone” and a “to-zone” is defined as a *context*. Each context contains an ordered list of policies. On the Junos Enforcer, you must define at least two zones to protect one area of the network from another.

You might need to bind the physical interfaces on a Juniper security device to security zones or you might need to change a binding to accommodate your deployment.

NOTE: Slot numbering varies by platform, and interface numbering varies by module type. For numbering information, see the user guide that accompanied the device for slot and interface numbering information or visit www.pulsesecure.net/techpubs/ to obtain a copy of the user guide specific to your device.

Endpoints must reside in a different security zone from your protected resources. PPS can reside in any security zone. If you place PPS in a different security zone from the one that contains endpoints, you must set a policy allowing traffic from the endpoints to PPS.

Through the policies you define, you can permit traffic between zones to flow in one or both directions. The routes that you define specify the interfaces that traffic from one zone to another must use. Because you can bind multiple interfaces to a zone, the routes you chart are important for directing traffic to the interfaces of your choice.

To view the zones on a Junos Enforcer, type the following command in the CLI:

```
user@host#show security zones
```

To bind the physical interface on the Junos Enforcer:

1. Configure the interface and its IP address for the trust and untrust zones, enter the following statements in Edit mode:
   `user@host#` **set interfaces ge-0/0/1 unit 0 family inet address 192.168.0.1/24**
2. To configure the trust zone and to assign the interface to it, enter the following statement in Edit mode:
   `user@host#` **set security zones security-zone trust interfaces *interface***
3. To configure the interface and its IP address for the untrust zone, enter the following statement in Edit mode:

```
user@host# set interfaces ge-0/0/1 unit 0 family inet address 10.0.0.20/24
```

4. To configure the untrust zone and to assign the interface to it, enter the following statement in Edit mode:
   user@host# **set security zones security-zone untrust interfaces *interface***

NOTE: To use IPsec with the Junos Enforcer, you must enable IKE services for the gateway. If you have multiple IPsec tunnels with multiple gateways, the hostname for each gateway must be unique.

Captive Portal

Captive portal enables an endpoint to be redirected to a specified URL when the user attempts to access a protected resource behind an Infranet Enforcer. The default redirection page is the authentication page of PPS.

The Captive Portal workflow is described below:

1. The user attempts to access a protected resource.
2. The generic source IP policy that matches the destination includes a redirect configuration.
3. The enforcer sends a redirect message to the endpoint browser that includes the URL of PPS.
4. The browser opens a session with PPS and the endpoint completes authentication.
5. PPS sends an authentication table information to Enforcer.
6. PPS redirects the browser back to the original resource.
7. The user tries to access the resource and the enforcer allows the user to access the protected resource.

Configuring Captive Portal

You can configure a captive portal directly on the Infranet enforcer using the CLI. You must create a *captive-portal* application service and then set the traffic that would like to redirect:

- **unauthenticated**—Select this option if your deployment uses source IP only or a combination of source IP and IPsec. The Infranet Enforcer redirects clear-text traffic from unauthenticated users to the currently connected PPS, or to an IP address or domain name that you specify in a redirect URL.
- **all**—Select this option if your deployment uses IPsec only. The Infranet Enforcer redirects all clear-text traffic to the currently connected PPS, or to an IP address or domain name that you specify in a redirect URL.

Note:

- The captive portal feature redirects HTTP traffic only. If the user attempts to access a protected resource using HTTPS or another protocol such as SMTP, the Infranet Enforcer does not redirect the user's traffic. When using HTTPS or another application, the user must manually sign into PPS first before attempting to access protected resources.
- If there is an HTTP proxy between the endpoint and the Infranet Enforcer, the Infranet Enforcer might not redirect the HTTP traffic.

Example: Junos SRX CLI

To use captive portal with the Junos Enforcer, Release 10.2 is required.

To enable captive portal. associate an instance of a captive portal with a security zone use the following command format:

```
user@host# set security policies from-zone zone-name to-zone zone-name policy policy-name
```

To create the captive portal use the following command format:

```
user@host# permit application-services uac-policy captive-portal captive-portal-name
```

You can redirect all traffic, or only unauthenticated traffic on the Junos Enforcer using the following command format:

```
# edit services unified-access-control captive-portal policy redirect-traffic (all | unauthenticated)
```

Example: ScreenOS CLI

To configure a redirect infranet auth policy for deployments that use either source IP only or a combination of source IP and IPsec type the following command:

set policy from source-zone to dest-zone src_addr dst_addr any permit infranet-auth redirect-unauthenticated

To configure a redirect infranet auth policy for deployments that use IPsec only type the following command:

set policy from source-zone to dest-zone src_addr dst_addr any permit infranet-auth redirect-all

Creating a Redirect Policy on the Junos Enforcer

In a Junos Enforcer security policy, specify the redirect URL in the following format:

`user@host#` **set services unified-access-control captive-portal policy redirect-url *url***

By default, after you configure a captive portal policy, the Junos Enforcer redirects HTTP traffic to the currently connected PPS by using HTTPS. To perform the redirection, the Junos Enforcer uses the IP address or domain name that you specified when you configured PPS instance on the Junos Enforcer.

You specify the redirect URL in a Junos Enforcer security policy using the following hierarchy:

`user@host#` **set services unified-access-control captive-portal cap-policy redirect-url "https://%ic-ip%/?target=%dest-url%&enforcer=%enforcer-id%&policy=%policy-id%"**

These are the four available parameters for redirection.

- target
- enforcer
- policy
- dest-ip

Target, enforcer, and policy are required. Dest-ip is optional. For example:

redirect-url "https://acmegizmo.juniper.net/?target=%dest-url%&enforcer=%enforcer-id%&policy=%policy-id%"

If you do not specify the redirect URL, the Junos Enforcer uses the default configuration.

NOTE: To set a redirect URL for the Junos Enforcer, use escape characters instead of dot (.).

For configuration instructions and examples, see the *Junos OS Initial Configuration Guide for Security Devices*.

Creating a Redirect Policy on the ScreenOS Enforcer

From the ScreenOS CLI

1. To specify the redirect URL, enter: **set infranet controller name controller1 url "http://10.64.12.1/?target=%dest-url%"**
2. To specify the redirect URL without the ?target=%dest-url% string, enter: **set infranet controller name controller1 url http://abc.company.com**

IPsec Policy enforcement using SRX and ScreenOS

This chapter provides an overview of IPsec enforcement using SRX and ScreenOS firewall. It includes the following information:

About IPsec Enforcement

Overview

IP Security (IPsec) policy is a firewall policy, which supports IPsec access from endpoints running Pulse Client.
It consists of a suite of related protocols for cryptographically securing communications at the IP Packet Layer.
Odyssey Access Client and Pulse Desktop Client support IPsec using IKEv1 with XAuth. For the client to establish an IPsec tunnel, it must retrieve configuration information from the Junos Enforcer. This information is forwarded to the PPS device by the respective device.

This section details the policies that you configure in association with using IPsec on the Junos Enforcer.

- IPsec Routing Policy—This type of policy specifies which Junos Enforcer an endpoint must use to access a resource. This policy also specifies whether that resource requires an IPsec tunnel for endpoints to access it. Note that an IPsec tunnel does not automatically give the endpoint access. You configure IPsec routing policies on the PPS device.
- IP Address Pools Policy—This type of policy specifies a pool of virtual IP addresses that you want the PPS device to automatically assign to endpoints in NAT environments that use IPsec tunnels to the Junos Enforcer. You configure IP address pools policies on the PPS device.
- Junos Enforcer Security Policy—On the Junos Enforcer, security policies are used to define the source and destination address, the application, and the phase 2 policy. You configure security policies on the Junos Enforcer. You cannot configure security policies on the PPS device.

Configuring IPsec Policy Enforcement

The PPS device is the policy decision point that determines which users and endpoints can access protected resources. The Junos Enforcer is the enforcement point to provide the ultimate protection to ensure that your network assets are secured.

This section covers the following topics:

- Configuring IPsec Routing Policies
- Configuring IP Address Pool Policy
- Example: Configuring Junos Enforcer IPsec Routing Policy

Configuring IPsec Routing Policies

An IPsec routing policy specifies which Junos Enforcer device endpoints must use to access resources when using IPsec. The IPsec routing policy also specifies that endpoints must use an IPsec tunnel to the Junos Enforcer to access resources. For example, you might create an IPsec routing policy that uses IPsec for 0.0.0.0/0 (the entire network). In the same policy, you could specify the resources that are exceptions and do not use IPsec, such as 172.24.80.30 (the PPS device), 172.24.80.31 (the Junos Enforcer), and 172.24.144/21 (a wireless network).

Before you begin:

Topic	Details
IP address exceptions	Do not use IPsec for PPS, the Infranet Enforcer, and networks where your endpoints are located. For example, if you create an IPsec routing policy that uses IPsec on an entire network range (such as 0.0.0.0/0) for your protected resources, be sure to specify exceptions in the same policy for the IP addresses assigned to PPS, Infranet Enforcer, and the endpoints.
UDP encapsulation and virtual adapters	For maximum inter-operability with other third-party IPsec clients, select both Always use UDP encapsulation and Always use a virtual adapter. When both options are selected, Network address translation (NAT) is simulated even if a NAT device is not present. We recommend that you select both options or neither option. For example, if an endpoint contains two network interfaces, such as a wired and a wireless interface, and a NAT device is not present between the endpoint and the Infranet Enforcer. If the endpoint does not access a protected resource by using the interface that is connected to the network where the Infranet Enforcer is installed, then the user cannot access the protected resource through either interface without a virtual adapter. Because PPS does not automatically install a virtual adapter unless a NAT device is detected, enable the Always use a virtual adapter option to simulate NAT and force the use of a virtual adapter for this use case.

To configure an IPsec routing policy:

1. Select **Pulse Policy Secure > Infranet Enforcer > IPsec Routing**.
2. Click **New Policy**.

On the New Policy page:

1. For Name, enter a name to label this IPsec routing policy.
2. For Description, enter an optional description.
3. If you are using ScreenOS Release 6.1 or later, and you want to configure PPS to dynamically provision IPsec routing policies, select the **Dynamic** check box. The Resources and Exceptions text boxes and the Infranet Enforcer check boxes disappear.
4. Go to step 10 to continue configuring this policy for ScreenOS Release 6.1 or later.
5. For Resources, enter the IP address and netmask of each resource that requires endpoints to use IPsec, one per line, in the following format:

   <*ip address*>[*/netmask*]

   You cannot specify a host name in an IPsec routing policy. You must specify an IP address.

6. For Exceptions, use the following format, one per line, to specify the IP address and netmask of each resource that has traffic which you do not want to flow through the Infranet Enforcer:

<*ip address*>[*/netmask*]

Each exception must be a subset of what you specify for Resources.

7. For Destination Zone, enter the zone that is configured on the Infranet Enforcer where the protected resources specified in this IPsec routing policy are located. For example: trust
8. Select these options to configure IPsec interoperability and tunnel persistence:
   - **Always use UDP encapsulation**—Allows the client and the Infranet Enforcer to create an IPsec tunnel inside a third-party IPsec tunnel by using UDP encapsulation even if a NAT device is not present. For example, for inter-operability with third-party IPsec clients running on the endpoint PPS uses port 4500 for UDP encapsulation in compliance with RFC 3948.
   - **Always use a virtual adapter**—Forces the use of a virtual adapter on the endpoint. If you select this option, you must also set up IP address pools even if a NAT device is not present.
   - **Persistent Tunnel Mode**—Allows you to determine whether or not a tunnel is established when a user first connects to PPS. If the check box is selected, an IPsec tunnel is established, and users can access protected resources behind the Infranet Enforcer. If the check box is not selected, the tunnel is not automatically set up: a tunnel will not be initiated until there is a request for traffic.
9. From the Enforcer list, choose the Infranet Enforcer to which endpoints connect to access the resources specified in this IPsec routing policy.
10. In the Roles section, specify:
    - **Policy applies to ALL roles**—To apply this IPsec routing policy to all users.
    - **Policy applies to SELECTED roles**—To apply this IPsec routing policy only to users who are mapped to roles in the Selected roles list. Be sure to add roles to this list from the Available roles list.
    - **Policy applies to all roles OTHER THAN those selected below**—To apply this IPsec routing policy to all users except for those who map to the roles in the Selected roles list. Be sure to add roles to this list from the Available roles list.
11. Click **Save Changes**.

Configuring IP Address Pool Policy

The PPS device supports the use of IPsec tunnels through NAT devices to allow users secure access to protected resources. In a NAT environment, a virtual IP address must be used for the IPsec tunnel's inner address.
You can configure a pool of virtual IP addresses that the PPS device can automatically assign to endpoints by creating IP address pool policies. An IP address pool is a contiguous range of IP addresses which you configure by specifying the starting address and the number of addresses in the pool. You can associate an IP address pool with one or more Junos Enforcers.

To configure an IP address pool policy:

1. Select Pulse Policy Secure > Infranet Enforcer > IP Address Pools.
2. Click **New Policy**.

On the New Policy page:

1. For Name, enter a name to label this IP address pool policy.
2. (Optional) For Description, enter a description.

For IP address pool, specify IP addresses or a range of IP addresses to assign to endpoints. The IP address range can be specified as shown in Table 13 lists the syntax for IP address pools, where the last component of the IP address is a range delimited by a hyphen (-). Note that no special characters are allowed.

Table 13: Syntax for IP Address Pools

IP Address Range	Description
a.b.c.d	A single IP address
a.b.c.d-e.f.g.h	All IP addresses from the first address to the last address, inclusive
a.b.c.d-f.g.h	An abbreviated form that specifies the range a.b.c.d through a.f.g.h
a.b.c.d-g.h	An abbreviated form that specifies the range a.b.c.d through a.b.g.h
a.b.c.d-h	An abbreviated form that specifies the range a.b.c.d through a.b.c.h
a.b.c.d/mask	All addresses in a network

For example, to allocate all addresses in the range 172.20.0.0 through 172.20.3.255, specify 172.20.0.0-3.255. To allocate all addresses in a class C network, specify 10.20.30.0/24.

Under Infranet Enforcer, select the Infranet Enforcer to which you want to apply this IP address pool policy and click **Add**. To apply the policy to all Infranet Enforcers, do not add any Infranet Enforcers, and leave the default setting (all) listed in the Selected Enforcers list.

1. In the Roles section, specify:
   - **Policy applies to ALL roles**—To apply this IP address pool policy to all users.
   - **Policy applies to SELECTED roles**—To apply this IP address pool policy only to users who are mapped to roles in the Selected roles list. Be sure to add roles to this list from the Available roles list.
   - **Policy applies to all roles OTHER THAN those selected below**—To apply this IP address pool policy to all users except for those who map to the roles in the Selected roles list. Be sure to add roles to this list from the Available roles list.

3. Click **Save Changes**.

   If the IP addresses you specify in the IP address pool policies (that is, the virtual IP addresses) are not routable from the network where your protected resources are located, make sure you enable Source Network Address Translation (NAT-src) on the infranet auth tunnel policies that configure IPsec on the Infranet Enforcer.

To enable NAT-src using the Infranet Enforcer Web UI:

1. Click **Policies**.
2. Click **Edit** on the infranet auth tunnel policy.
3. Click **Advanced**.
4. Select **Source Translation** and click **OK**.

For information about enabling NAT-src on the infranet auth tunnel policy, see http://www.juniper.net/techpubs/en_US/release-independent/screenos/information-products/pathway-pages/screenos/product/index.html .

Example: Configuring Junos Enforcer IPsec Routing Policy

This topic describes how to configure Junos Enforcer IPsec routing policies. You use the Junos OS CLI to configure IPsec routing policies on the Junos Enforcer. Unlike the ScreenOS Enforcer, you cannot create policies on the PPS device and push the policies to the Junos Enforcer.

The source interface is specified in the IKE gateway configuration on the Junos Enforcer. In security policies you specify a VPN, and you specify the IKE gateway in the VPN. For more information, see Juniper's Junos OS Initial Configuration Guide for Security Devices.

NOTE:

- IPsec on the Junos Enforcer can handle up to 5,000 concurrent IKE gateways.
- Dynamic IPsec is not supported on the Junos Enforcer.

To configure IPsec on the Junos Enforcer, you must perform three primary tasks:

- Configure the PPS device as a RADIUS server for the Junos Enforcer RADIUS client to enable XAUTH. You must use the internal interface on the PPS device, the external interface does not support XAUTH.
- Configure IKE and IPsec parameters to specify security restrictions.
- Configure security policies to route traffic between the security gateway and the interface for endpoints.

The following example describes a sample configuration for setting up IPsec on the Junos Enforcer.

To use IPsec with the ScreenOS Enforcer, you can configure basic IPsec security policies on the PPS device and then push the policies to the firewall. On the Junos Enforcer, this functionality does not exist. For the Junos Enforcer, you use the CLI to configure settings on the Junos Enforcer that are negotiated with Pulse Desktop Client.

Before you begin, ensure that security zones and interfaces are set up, and that IPsec routing policies and optional IP address pool policies have been configured on the PPS device.

Junos Enforcer devices support up to four proposals for Phase 2 negotiations, allowing you to define the range of tunnel parameter restrictions that endpoints will accept.

For a complete description of IPsec on the Junos Enforcer see the Junos OS Initial Configuration Guide for Security Devices.

To configure IPsec on the Junos Enforcer:

1. Configure the PPS device as a RADIUS server for the Junos Enforcer RADIUS client.

In this example, you create an instance of the PPS device hostname dev1086 as the RADIUS server. The IP address is 192.168.100.5. You need to provide a shared secret, which is used to permit the PPS device to accept RADIUS packets from the device.
Enter the following commands:

```
user@host# set access profile dev1086 authentication-order radius
user@host# set access profile dev1086 radius-server 192.168.100.5 secret some-shared-secret
```

2. If you are configuring PPS devices in an active/active cluster, you must configure all IP addresses for individual PPS devices.
   The shared secret must be the same, as in the following example:

```
user@host# set access profile dev1086 authentication-order radius
user@host# set access profile dev1086 radius-server 192.168.100.5 secret some-shared-secret
user@host# set access profile dev1086 radius-server 192.168.100.6 secret some-shared-secret
```

   If you are configuring an active/passive cluster, configure the Pulse Policy Secure device's VIP as the RADIUS server IP address.

3. Configure IKE and IPsec security parameters. The IPsec with Junos Enforcer is supported only with aggressive mode and Encapsulation Security Payload (ESP).

   You define the security proposals, including all of the IKE parameters that determine the strength of the IPsec tunnels.

   - Set up a phase 1 IKE proposal named prop, Enter the following series of commands.

```
user@host# set security ike proposal prop1 authentication-method pre-shared-keys
The client supports only the preshared key authentication method.
user@host# set security ike proposal prop1 dh-group group2
The client supports group1, group2, and group5.
user@host# set security ike proposal prop1 authentication-algorithm sha1
The client supports md5 and sha1.
user@host# set security ike proposal prop1 encryption-algorithm 3des-cbc
The client supports des-cbc, 3des-dbc, aes-128-cbc, aes-192-cbc, and aes-256-cbc
```

   - Set up an IKE policy named pol1 with aggressive mode, the pre-shared key and the proposal configured above.

```
user@host# set security ike policy pol1 mode aggressive
The client supports only aggressive mode.
user@host# set security ike policy pol1 proposals prop1
user@host# set security ike policy pol1 pre-shared-key ascii-text some-preshared-key
```

     Only ascii-text is supported. Do not use a hexadecimal pre-shared key.

   - Configure an IKE gateway named gateway1 with 5000 connection-limits, host.company.com identity, group IKE ID, IKE policy pol1 configured above, and XAUTH dev1086 as configured above.

```
user@host# set security ike gateway gateway1 ike-policy pol1
user@host# set security ike gateway gateway1 dynamic hostname host.company.com
user@host# set security ike gateway gateway1 dynamic ike-user-type group-ike-id
user@host# set security ike gateway gateway1 dynamic connections-limit (maximum 5,000)
```

```
user@host# set security ike gateway gateway1 external-interface ge-0/0/2.0
user@host# set security ike gateway gateway1 xauth access-profile dev1086
```

PPS and the client support only group-ike-id.

- Configure an IPsec phase 2 proposal named prop1 with ESP protocol, HMAC-SHA1-96 authentication algorithm, and 3DES-CBC encryption algorithm.

```
user@host# set security ipsec proposal prop1 protocol esp
```

The client supports only esp.

```
user@host# set security ipsec proposal prop1 authentication-algorithm hmac-sha1-96
```

The client supports hmac-md5-96, and hmac-sha1-96.

```
user@host# set security ipsec proposal prop1 encryption-algorithm 3des-cbc
```

The client supports des-cbc, 3des-cbc, aes-128-cbc, aes-192-cbc, aes-256-cbc, and no encryption-algorithm.

- Configure an IPsec phase 2 policy name pol1 with proposal prop1 as configured above.

```
user@host# set security ipsec policy pol1 proposals prop1
```

In this section, you configure an IPsec VPN named vpn1 with IKE gateway gateway1 as configured in the above example, and IPsec policy pol1 as configured above.

```
user@host# set security ipsec vpn vpn1 ike gateway gateway1
user@host# set security ipsec vpn vpn1 ike ipsec-policy pol1
user@host# set security ipsec vpn vpn1 establish-tunnels immediately
user@host# set security ike gateway gateway1 external-interface ge-0/0/0.0
```

NOTE: The external interface refers to the interface that faces the client.

```
user@host# set security ike gateway gateway1 xauth access-profile name
```

4. Create the security policy.

   Enable the VPN vpn1 configured above and add Pulse Policy Security enforcement in a security policy named pol1, from the zone named untrust to the zone named trust.

```
user@host# set security policies from-zone untrust to-zone trust policy pol1 match source-address any
user@host# set security policies from-zone untrust to-zone trust policy pol1 match destination-address any
user@host# set security policies from-zone untrust to-zone trust policy pol1 match application any
user@host# set security policies from-zone untrust to-zone trust policy pol1 then permit tunnel ipsec-vpn vpn1
user@host# set security policies from-zone untrust to-zone trust policy pol1 then permit application-services uac-policy
```

Enforcement using EX Series Ethernet Switches

This chapter provides an overview of enforcement using Juniper EX switch. It includes the following information:

Enforcement using Juniper EX switch

Overview

You can use the EX Series switch as an Infranet Enforcer with PPS. With this solution, PPS is the policy decision point, while the switch is the policy enforcement point. In prior releases, Layer 3 firewalls were the only option for policy enforcement points. This scenario allows enforcement with 802.1X deployments.
To employ the switch as an Infranet Enforcer, you configure a connection between the EX Series switch and the PPS, establish communication, set up 802.1X, configure PPS parameters for admission to the network, and configure resource access policies.

Upon successful configuration, the following occurs:

- The EX Series switch sends a connection request to PPS.
- The EX Series switch shares its RADIUS configuration with PPS from the CLI configuration on the switch.
- PPS creates the RADIUS client for the EX Series switch using the information provided.
- When a user successfully authenticates, PPS provides an auth table entry to the connected EX Series switch. The auth table includes the MAC address of the user, the assigned roles and the port index.
- PPS must receive the attributes Calling Station ID and Network Access Server (NAS) Port from the switch to successfully make the connection.

Configuring EX switch with PPS

The EX Series switch serves as a policy enforcement point. PPS sends auth table entries and resource access policies when an endpoint successfully completes 802.1X authentication or MAC authentication (unmanaged devices). Access for any endpoint is governed by the resource access policies that you configure on PPS. Because resource access policies are employed, firewall filters are not required for the EX Series switch configuration.

This section covers the following topics:

- Configuring EX switch as an Infranet Enforcer
- Configuring an Authentication Table
- Configuring Resource Access Policy

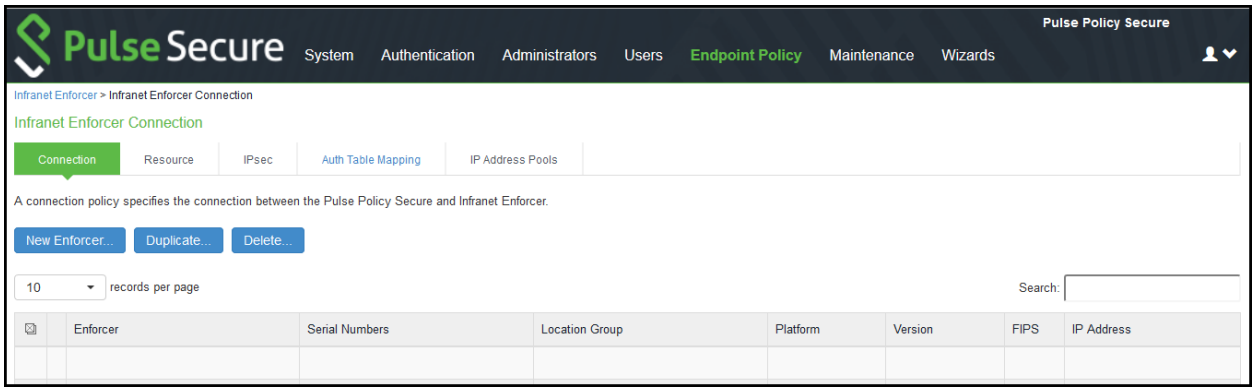
Configuring EX switch as an Infranet Enforcer

The EX-series switches will permit or deny network access based on policies developed and distributed by PPS, including those policies based on user authentication status, endpoint posture compliance, user/device role and other policies. The EX-series switches provide standards-based 802.1X port-level access control.

To configure a Juniper EX switch as an Infranet Enforcer in PPS:

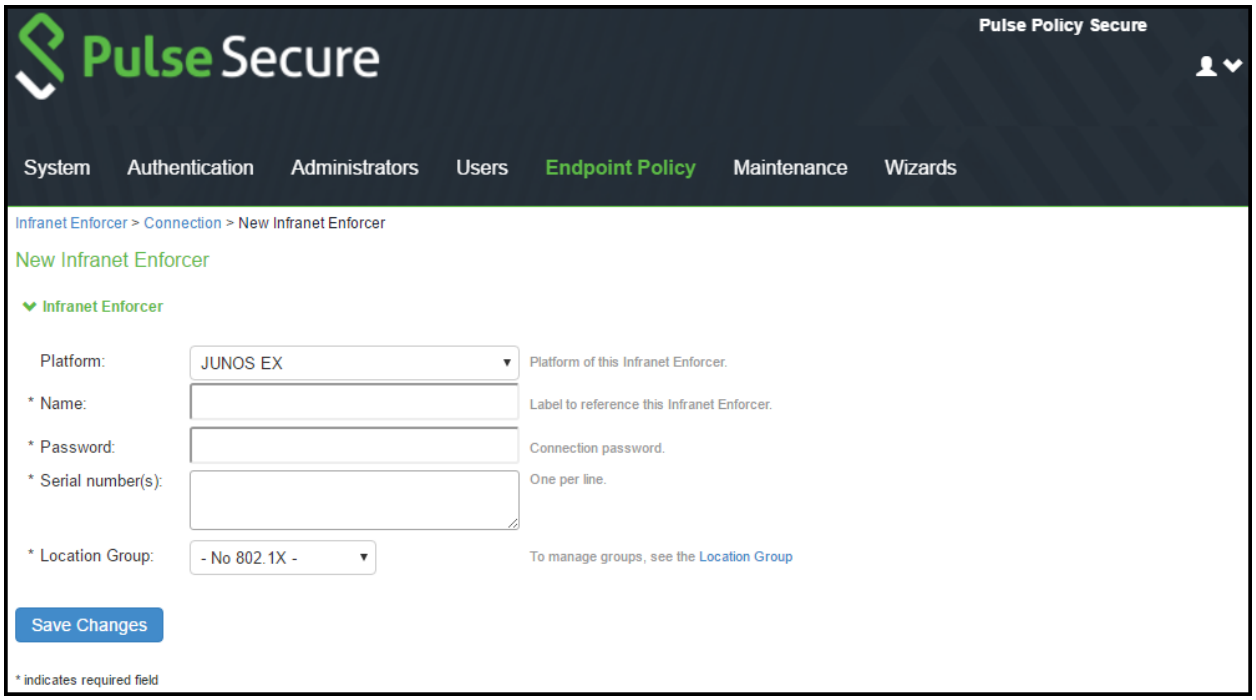
1. Select **Endpoint Policy > Infranet Enforcer**.

Figure 146: Infranet Enforcer



2. Click **New Infranet Enforcer** and select **Junos EX** in the **Platform** drop down.

Figure147: Juniper EX Enforcer



3. Enter the name of the EX Series switch in the Name box.
4. Enter the password for the EX Series switch. This password is a shared secret that administrators of both the switch and PPS can use for connectivity between the two devices.
5. Enter the serial number of the EX Series switch.
6. Select the location group.
7. Click **Save Changes**.

On the EX Series switch, you use the CLI to configure the connection with PPS.

Configuring an Authentication Table

The EX Series switch receives and maintains auth tables for valid user sessions with PPS. An auth tables consist of a unique identification number, the MAC address of the endpoint that initiated the session, and a list of roles that the user has been assigned.

Auth tables are sent from PPS to the EX Series switch when a user is authenticated on the network.

NOTE: Always Provision and Never Provision Auth table mapping policies are supported for the EX Series switch.

For complete configuration information, see Configuring Auth Table Mapping Policies.

Configuring Resource Access Policy

Using resource access policies with an EX Series switch you can configure authorization for protected resources. If you have configured the EX Series switch as an Infranet Enforcer, select the switch in the resource access policy.

A resource is a single entry in the resource field of the resource access policy. This could be a MAC address, or it could be a combination of IP address ranges, ports, and protocol. A filter term is the access/deny detail for a single resource. The

number of terms you can configure per firewall filter will vary, depending on which EX Series switch you are configuring. The below table shows the number of terms allowed per firewall filter for different EX Series switches.

Table 14: EX Series Switches and Filter Term Limitations

EX Switch	Number of Terms Allowed
EX2200 switch	512
EX3200 and 4200 switches	7,042
EX4500 switch	1,536
EX8200 switch	32,768
EX3300 switch	1,436
EX6200 switch	1,400

If you create resource access policies with the number of resources greater than the maximum number of filter terms allowed, the filter is not installed, and 802.1X authentication fails.

For complete information on configuring resource access policy, see Configuring Resource Access Policy.

IF-MAP Federation

This chapter provides an overview of the IF-MAP. It includes the following information:

About IF-MAP

Overview

The federation allows users to connect to a PPS or PCS appliance and then access resources that are protected by the firewall connected to different PPS without re-authentication. For example, users in large campus sites and in branch offices connect to the corporate network from campus, branch, or private home offices and access the resources distributed across locations. The federation eliminates redundant log ins and host checks and provides seamless access to protected resources. The federation uses IF-MAP protocol to share information about user sessions between PCS and PPS over the distributed network.

For more information about IF-MAP, see http://www.trustedcomputinggroup.org/wp-content/uploads/TNC_IFMAP_v1_1_r5.pdf

IF-MAP Federation Use Cases

This section describes the various IF-MAP use cases. Using IF-MAP federation the users can seamlessly access with a single log in to corporate resources protected by the firewall. It provisions seamless access between the user sessions of PCS and PPS.

This section describes the following uses cases:

- Access Control in the Federated Enterprise
- Session Migration across PCS and PPS using IF-MAP

Access Control in the Federated Enterprise

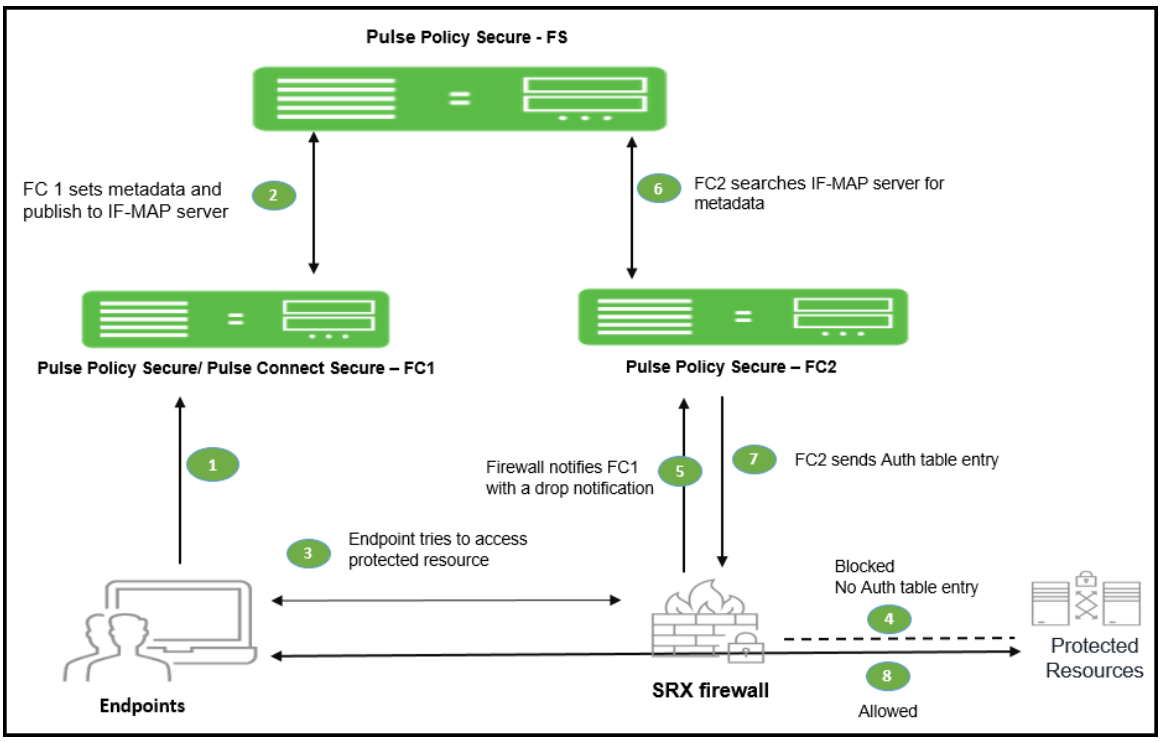
In a federated enterprise, a user can log in to a PPS or PCS device for authentication or remote access and access the resource protected by the firewall connected to another PPS. The session information is shared across PPS or PCS device using IF-MAP protocol through IF-MAP server.

The federation requires dynamic auth table provisioning on the SRX firewall and allows access to the protected resource based on the resource access policies that are configured on PPS.

The access solution serves the following objectives:

- Ensures that the employees can access the corporate network and can access resources and data in both local and remote locations without having to specify their authentication credentials at each security policy enforcement point.
- Enhances security by enforcing role or policy based access control.

Figure148: Access Control in the federated enterprise using IF-MAP



The session federation work flow is described below:

1. The user connects to network and authenticates with PPS/PCS (FC1).
2. Authentication information such as IP address, MAC address, username, and roles are published to the IF-MAP server.
3. The user tries to access protected resource from the branch office.
4. The firewall blocks the access.
5. The firewall requests PPS (FC2) for session details such as user roles. PPS device subscribes to session information and other endpoint data based on the originating IP address.
6. The federation server sends the search result based on the search request from PPS (FC2).
7. PPS (FC2) send roles and policy information to the firewall.
8. The firewall allows or denies traffic based on the resource access policies received from FC2.

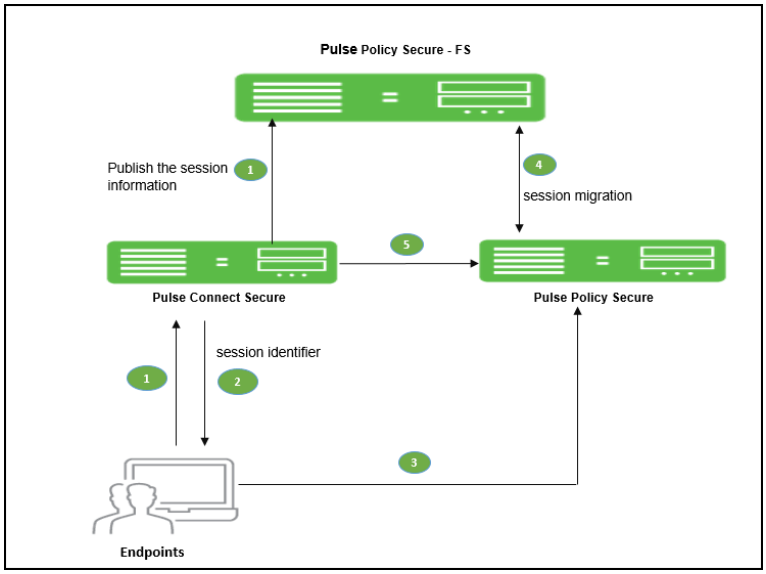
Session Migration across PCS and PPS using IF-MAP

IF-MAP federation allows seamless access to the users connected through remote access and on premise network without re-authenticating. For example, a user can connect from home through PCS and then arrive at work and connect through PPS without logging in again. The session migration also enables users to access different resources within the network that are protected by Pulse Secure devices without repeatedly providing credentials.

When a session is migrated, realm role-mapping rules determine user access capabilities. You can import user attributes when a session is migrated, or you can configure a dedicated directory server to look up attributes for migrated user sessions. To ensure that session migration retains user sessions, configure a limited access remediation role that does not require a Host Checker policy. This role is necessary because the Host Checker timeout can be exceeded if an endpoint is in hibernation or asleep. With the new remediation role, the user's session is maintained. The session migration works only with same authentication group.

If additional Host Checker policies are configured on a role or realm to which a migrated session applies, the policies are performed before allowing the user to access the role or realm. Administrators of different Pulse servers should ensure that Host Checker policies are appropriately configured for endpoint compatibility.

Figure 149: Session Migration across PCS and PPS



The session migration workflow is as follows:

1. User connects to PCS and the information is published to the federation server, which includes session identifier.
2. The session identifier information is also communicated to Pulse client.
3. When user connect to PPS in the same authentication group after arriving at office network using Pulse client. The Pulse client sends session identifier to PPS.
4. PPS appliance uses the session identifier to look up the session information in the IF-MAP server and request to migrate the session from PCS to PPS.
5. PPS create a local session for the endpoint.

To permit session migration for users with the Pulse client, perform the following tasks:

1. Configure location awareness rules within a client connection set to specify locations included in the scope of session migration for users. For example, configure location awareness rules for a corporate PPS server connection and a PCS server connection.

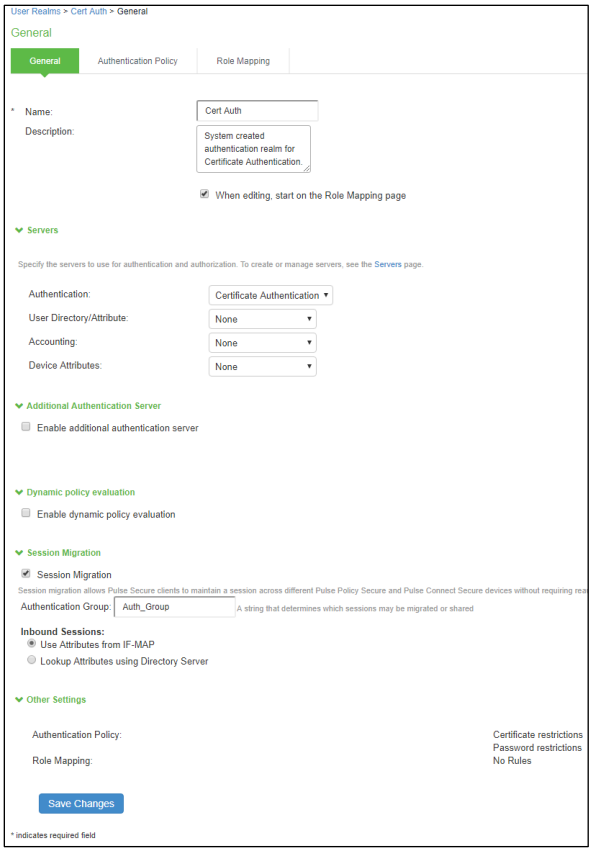
2. Configure an IF-MAP federated network, with the applicable Pulse servers as IF-MAP Federation clients of the same IF-MAP Federation server.
3. Ensure that user entries are configured on the authentication server for each gateway.
4. Ensure that user roles are configured for all users on each gateway.
5. Define a remediation role with no Host Checker policies to allow user sessions to be maintained when an endpoint is sleeping or hibernating.
6. Configure role-mapping rules that permit users to access resources on each gateway.
7. Enable and configure session migration from the User Realms page of the admin console.
8. Distribute the Pulse client to users.

Configuring Session Migration for Pulse Client

Note: Ensure that all of the PPS and PCS servers for which you want to enable session migration are IF-MAP Federation clients of the same IF-MAP Federation server. Additionally, make sure that each gateway is configured according to the procedures outlined in this section.

To configure session migration:
1. In the admin console, select **Users > User Realms**.
2. Select an existing realm, or create a new realm.
3. On the General page, select the **Session Migration** check box. Additional options appear.
4. In the Authentication Group box, enter a string that is common to all of the gateways that provision session migration for users. The authentication group is used as an identifier.
5. Select for either the **Use Attributes from IF-MAP** option button or the **Lookup Attributes using Directory Server** option.

Note:Select Lookup Attributes using Directory Server only if you are using an LDAP server. Attributes are served faster with an LDAP server.



Authentication Server Support

The behavior of session migration depends to some extent on the authentication server on the inbound side.

The following list provides a summary of authentication server support:

- Local authentication server—Migration succeeds if the username is valid on the local authentication server.
- LDAP server—Migration succeeds if the LDAP authentication server can resolve the username to a distinguished name (DN).
- NIS server—Migration succeeds if the NIS authentication server can find the username on the NIS server.
- ACE server—Migration always succeeds.
- RADIUS server—Migration always succeeds. If you select Lookup Attributes using Directory Server, no attributes are present in the user context data.
- Active Directory—Migration always succeeds. The Lookup Attributes using Directory Server option may not work, depending on your configuration.
- Certificate—Migration succeeds if the certificate is valid.
- SAML—Migration always succeeds because Identity provider is external server.
- Anonymous—No support for migrating sessions because sessions are not authenticated.
- Siteminder—No support for migrating sessions because Siteminder SSO is used instead.

IF-MAP Configuration

The IF-MAP configuration involves configuring the PPS device as an IF-MAP client or an IF-MAP server. You can configure the PCS device as an IF-MAP client for an IF-MAP server. A device configured as an IF-MAP server is automatically a client of itself. An IF-MAP server can function as a fully functional PPS device and any endpoint sessions with an IP address created on an IF-MAP server are automatically published to that IF-MAP server.

This section covers the following information:

- Configuring IF-MAP Server
- Configuring IF-MAP Client
- Configuring IF MAP Policies

Configuring IF-MAP Server

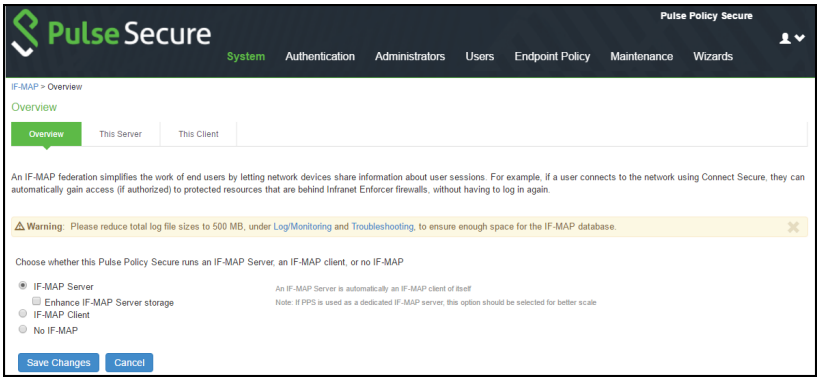
An IF-MAP server is a repository for IF-MAP clients, which is used for publishing information regarding an activity on the network. To deploy PPS as an IF-MAP server, you must configure PPS as an IF-MAP server and then add PPS/PCS as IF-MAP clients. A PPS device can be deployed as a dedicated IF-MAP server for better scale and performance. If you opt for this configuration it consumes most of the virtual memory available on appliance, which results in performance degradation of other PPS services.

NOTE: Currently we support only the Active/Passive cluster mode for IF-MAP server.

To configure IF-MAP server on the PPS:

1. Select **System > IF-MAP Federation > Overview**.

   Figure 150: IF-MAP Federation Overview



2. Select **IF-MAP Server** option
   (Optional) Select **Enhance IF-MAP server storage** for using the appliance as a dedicated federation server for high scalability.
3. Click **Save Changes**.

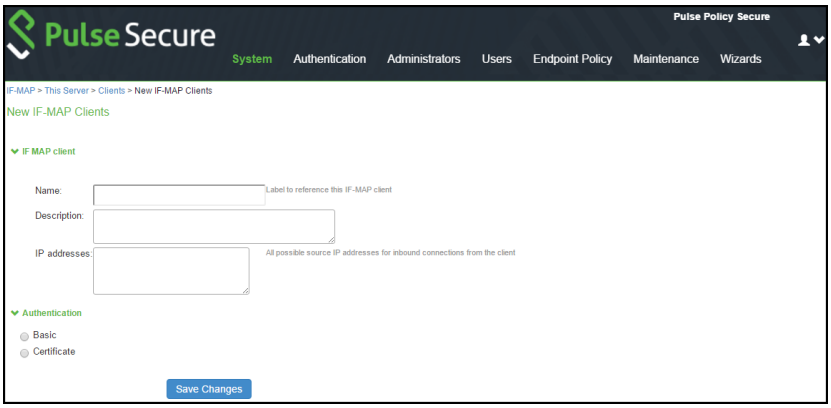
Adding IF-MAP Clients

The IF-MAP client must be added for subscribing the session information on an IF-MAP server. You configure an entry for each IF-MAP client on the IF-MAP server.

To add IF-MAP client:

1. Select **System > IF-MAP Federation > This Server > Clients**.
2. Click **New IF-MAP Client**.

Figure 151: IF-MAP Client



3. Under IF-MAP Client,
    a. Enter name and optionally a description for client.
    b. Enter one or more IP addresses of the client.

    NOTE:

    - If the client is connected to multiple data links on the same network or different network, then list all of its physical network interfaces.
    - If the client is a PPS cluster, then list the internal and external network interfaces of all nodes. You must enter all of the IP addresses for all of the interfaces because equipment failures may cause traffic between the IF-MAP client and the IF-MAP server to be re-routed through a different network interface. Listing all of the IP addresses maximizes the probability that IF-MAP Federation still works in the event of a failure.
4. Under Authentication, select the Client Authentication Method: **Basic or Certificate**.
    a. If you select **Basic**, enter a Username and Password. The same information should be added to the IF-MAP server.
    b. If you select **Certificate**, choose which Certificate Authority (CA) to use to verify the certificate for this client. Optionally, specify certificate attributes or restrictions to require values for certain client certificate attributes
5. Click **Save Changes**.

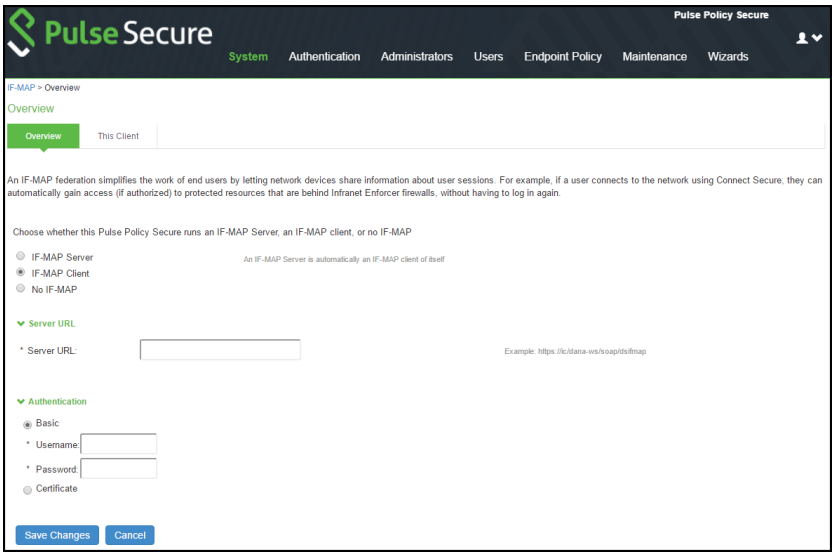
Configuring IF-MAP Client

The IF-MAP client publishes the basic session information, which includes IP address, usernames, and roles. The IF-MAP server stores the information as metadata. Other IF-MAP clients in the network can poll the server for metadata information when the endpoint tries to access the protected resource. A PCS or PPS device can be deployed as an IF-MAP client. The PPS device connected to firewall is always added as an IF-MAP client. You must import the trusted root CA certificate of the federation sever device certificate issuing cert store in to IF-MAP client for secure connection. You can trust the certificate issued by CA of server's device certificate by importing the root certificate of the issuing authority.

To configure the IF-MAP client:

1. Select **System > IF-MAP Federation > Overview**.
2. Select **IF-MAP Client**.

Figure 152: IF-MAP Federation



3. Enter IF-MAP server IP address or complete IF-MAP server URL. For IF-MAP server in cluster mode use the virtual IP address (VIP).
4. Select the Client Authentication Method: Basic or Certificate.
    a. Select Basic authentication, and enter the username and password. This is the same as the information that you entered on the IF-MAP server.
    b. Select Certificate, select the Device Certificate to use.
        i. Ensure that the certificate of the CA that signed the IF-MAP server certificate is added from the System > Configuration > Certificates > Trusted Server CA page.
        ii. Ensure that the hostname in the IF-MAP URL on the client machine matches the hostname of the server certificate on the IF-MAP server and that the CA that signed the server certificate is configured as trusted server CA on the IF-MAP client.
5. Click **Save Changes**.

NOTE: The status light on the server's IF-MAP Federation > This Server > Clients page is green when the client and server are successfully connected.

Configuring IF MAP Policies

The IF-MAP policies allows you to perform the data synchronization operations between the IF-MAP server and IF-MAP clients. This section covers the following information:

- Session Export Policies
- Session Import Policies

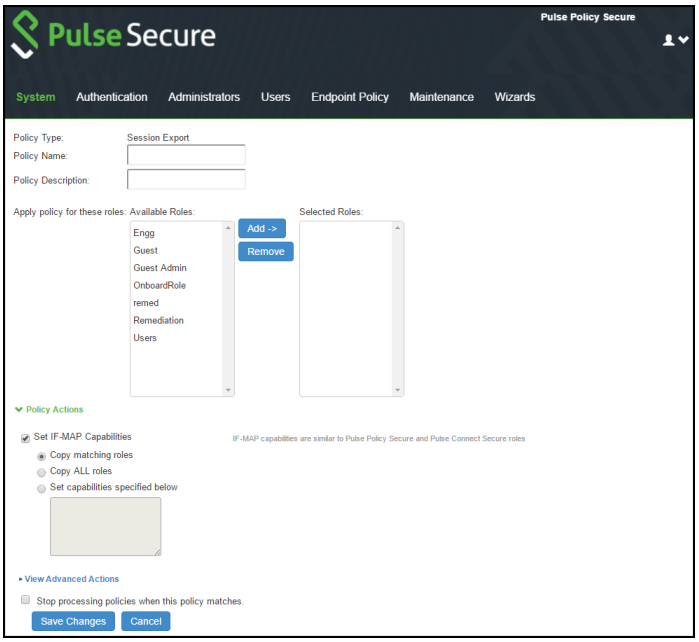
Session Export Policies

The session export policy specifies how to transform Pulse Secure client session data into IF-MAP standard data. It allows IF-MAP clients to translate outgoing session information into IF-MAP data and incoming IF-MAP data into session information. These translations enable sessions to be shared between PCS and PPS even if the devices sharing sessions have different role configurations.

To configure a session export policy:

1. Select **System > IF-MAP Federation > Session-Export Policies**.
2. Click **New** to create a new policy.

Figure 153: IF-MAP Session Export Policies



3. Enter a policy name and, optionally, a description.
4. Select role and add if the policy needs to be applied to selected roles only, otherwise by default is to apply policy for all roles.
5. Under Policy Actions, select **Set IF-MAP Capabilities** and select the applicable option:
   - **Copy Matching Roles**—Copies all of the user roles that match the roles specified in the Roles section of this policy into the IF-MAP capabilities data.
   - **Copy all Roles**—Copies all of the roles from the user session to the IF-MAP capabilities data.
   - **Set capabilities specified below**—Enter capabilities, one per line.

   To configure advanced options:

   1. Select the **View Advanced Actions** link to display additional options.
   2. Select **Set IF-MAP Identity** and configure identity settings:
      - **Identity Type** —Select an element used to specify identity. Options include aik-name, distinguished-name, dns-name, email-address, kerberos-principal, trusted-platform-model, username, sip-uri, tel-uri, and other. For example, for a regular employee named Bob Smith you can select username as the Identity Type and enter the Identity as username bsmith.
      - **Identity**—Identity is normally specified as <NAME>, which assigns the user's log in name. Any combination of literal text and context variables may be specified. If you select other for Identity Type, enter a unique Identity Type in the text box.
      - **Administrative Domain**—This optional information is applied to identity and MAC address data. One example for using this field is in a large network environment with several domains in which a username could be duplicated. By supplying the domain, you ensure that the correct user is identified.
      - **Other**—This field is provided for advanced use cases when none of the predefined options are applicable.
   3. Select **Set IF-MAP Roles** and select the applicable option:

- **Copy Matching Roles**—Copies all of the user roles that match the roles specified in the Roles section of this policy into the IF-MAP capabilities data.
- **Copy all Roles**—Copies all of the roles from the user session to the IF-MAP capabilities data.
- **Set capabilities specified below**—Enter capabilities, one per line.

4. Select **Set IF-MAP Device Attributes**. Device attributes represent a passed Host Checker policy on PPS or PCS. Select the applicable option:
   - **Copy Host Checker policy names**—The name of each Host Checker policy that passed for the session is copied to a device attribute.
   - **Set Device Attributes**—Enter device attributes, one per line.

6. Select **Stop processing policies when this policy matches** to specify that when this policy is matched, no more Session-Export policies should be applied.
7. Select **Save Changes** or continue to configure advanced actions.

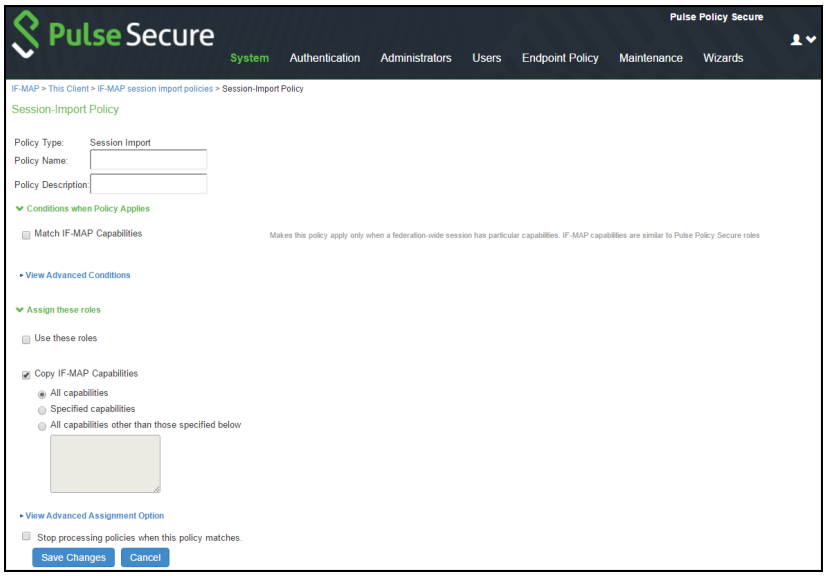
Session Import Policies

The session import policies specify how the device derives a username and a set of roles based on IF-MAP data that it receives from the IF-MAP server. The import policies are similar to role mapping rules on a realm. You must be precise when you configure Import policies, otherwise roles cannot be assigned properly.

To configure session-import policies:

1. Select **System > IF-MAP > Session-Import Policies**.
2. Click **New** to create a new policy.

Figure 154: IF-MAP Session Import Policies



3. Type a policy name and, optionally, a description.
4. Under Conditions when Policy Applies, select **Match IF-MAP Capabilities**.

   NOTE: You can use the wildcard characters * and % to match IF-MAP capabilities.

5. Enter IF-MAP capabilities exactly as they appear in the corresponding session-export policy. For example, if you assigned the value “engineering” to an IF-MAP capability in the session-export policy, enter “engineering” here.
6. Under “Assign these roles,” select **Use these roles** and select the roles for which the policy applies.
7. Alternatively, select **Copy IF-MAP Capabilities**. If you select this check box, IF-MAP session capabilities on the IF-MAP server are converted to PPS roles with the same name. You can use this option if PPS roles and IF-MAP capabilities have the same name. This option is typically not required for PPS deployments.
8. Select **Stop processing policies when this policy matches** to specify that when this policy is matched, no more Session-Export policies should be applied.
9. Select **Save Changes**, or continue to configure Advanced Conditions.

   You can configure advanced options that would further require that Identity, Role, or Device Attributes in the IF-MAP data for a session must match before applying the role matching. The advanced options are not required for most PPS IF-MAP deployments.

To configure advanced options:

10. Select the **View Advanced Conditions** link to additional options.
11. Select one or more of the following check boxes to specify which IF-MAP criteria to use for assigning roles:

    NOTE: You can use the wildcard characters * and % to match IF-MAP capabilities.

    - If you select **Match IF-MAP Identity**, complete the following settings:
        - **Identity Type**—Select an element used to specify identity. Options include aik-name, distinguished-name, dns-name, email-address, kerberos-principal, trusted-platform-model, username, sip-uri, tel-uri, and other. For example, for a regular employee named Bob Smith you can select username as the Identity Type and enter the Identity as username bsmith.
        - **Identity—**Identity is normally specified as <NAME>, which assigns the user's log in name. Any combination of literal text and context variables may be specified. If you select other for Identity Type, enter a unique Identity Type in the text box.
        - **Administrative Domain**—This optional information is applied to identity and MAC address data. One example for using this field is in a large network environment with several domains in which a username could be duplicated. By supplying the domain, you ensure that the correct user is identified.
        - **Other**—This field is provided for advanced use cases when none of the predefined options are applicable.
    - **Match IF-MAP Roles**—Enter individual roles in the provided text box.
    - **Match IF–MAP Device Attributes**—Enter individual device attributes in the provided text box.
12. Click **Save Changes**.

Active Federated Session Details

The federated session details of all the active users can be viewed on both the IF-MAP client and the IF-MAP server. This section covers the following information:

- Imported Session Details
- Exported Session Details
- Federated Session Details

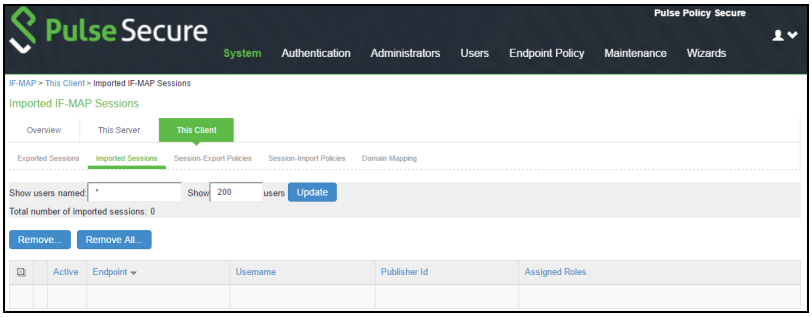
Imported Session Details

The session details from PPS, which are provisioned to SRX firewall can be viewed on an IF-MAP client.

To view, remove, or remove all the current sessions on an IF-MAP client:

1. Select **System > IF-MAP Federation > This Client**.
2. Select **Imported Sessions**.

Figure 155: Imported Sessions



3. Select **Remove** or **Remove All** to remove the imported federated session(s) from the device and the associated authentication table entries.

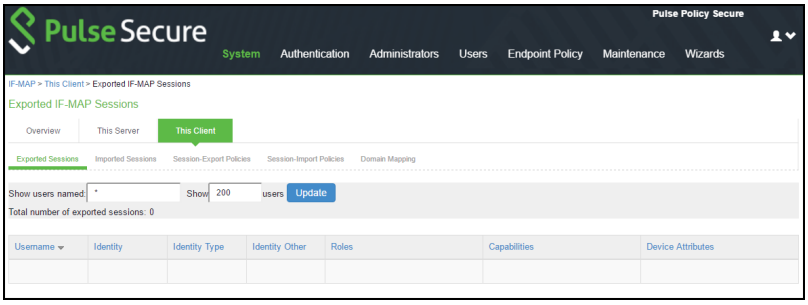
Exported Session Details

On an IF-MAP client, you can view all sessions from other PPS appliances that are currently published to firewall.

To view the exported sessions:

1. Select **System > IF-MAP Federation > This Client**.
2. Select **Exported Sessions**.

Figure 156: Exported Sessions



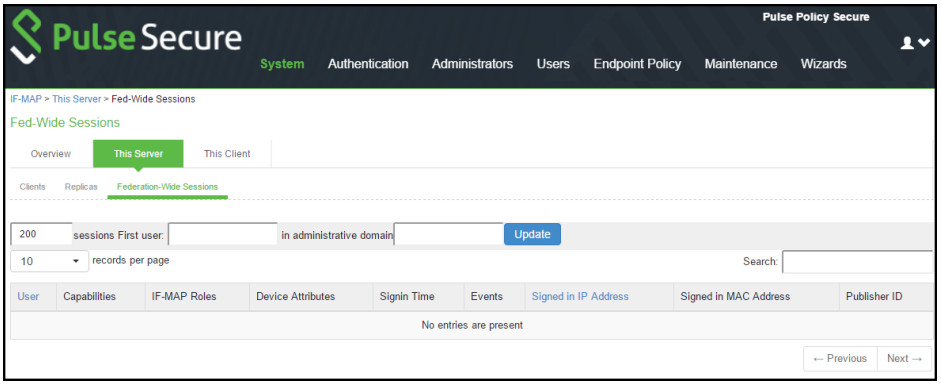
Federated Session Details

The federated sessions published to the server can be viewed on an IF-MAP server. The IF-MAP server purges sessions about 3.5 minutes after the client disconnects. The exceptions are if the server is currently involved in a purge or immediately after the server starts. It takes several minutes to scan the database before a purge can begin.

To view details about users and their sessions, and perform detailed searches:

1. Select **System > IF-MAP Federation > This Server > Federation-Wide Sessions**.

Figure 157: IF-MAP Fed Wise Sessions



2. Enter users and administrative domain and click **Update** to search for specific session information.
3. Sort users on the page by selecting **User** or **Signed in IP Address**.

NOTE: The maximum number of session entries displayed in the Federation-Wide Sessions table or returned by the query to the table is 5,000 entries.

TIP: You can also view IF-MAP session-export details by selecting the IF-MAP check box at Troubleshooting > User Sessions > Policy Tracing in the admin console.

Troubleshooting

The following diagnostic tools on PPS can assist you in troubleshooting the federated network:

- **IF-MAP Client User Messages**—On the IF-MAP client, logs information that is published to and removed from the IF-MAP server. Enable IF-MAP Client User Messages by selecting **Log/Monitoring > User Access > Settings** on the PPS IF-MAP client.
- **IF-MAP Server Trace**—On the IF-MAP server, logs the XML for all IF-MAP requests and responses. Enable the IF-MAP Server Trace by selecting **Log/Monitoring > Events > Settings** on the IF-MAP server. IF-MAP Server Trace should only be enabled for troubleshooting purposes, because running this diagnostic incurs a large performance impact.
- **Debuglog** – Select **Troubleshooting > Monitoring > Debug Log,** use event code dsfederate for debugging logs.

NOTE:

- The admin logs help to debug the configuration issues. Ensure that the server root CA certificate is imported to avoid configuration issues.
- If the IF-MAP server loses the connectivity due to hard failures and reconnects back within 3 minutes, then the access to protected resources is not affected. If the connection is lost for more than 3 minutes the access to protected resource is suspended till the users tries to access the resource.

Appendix

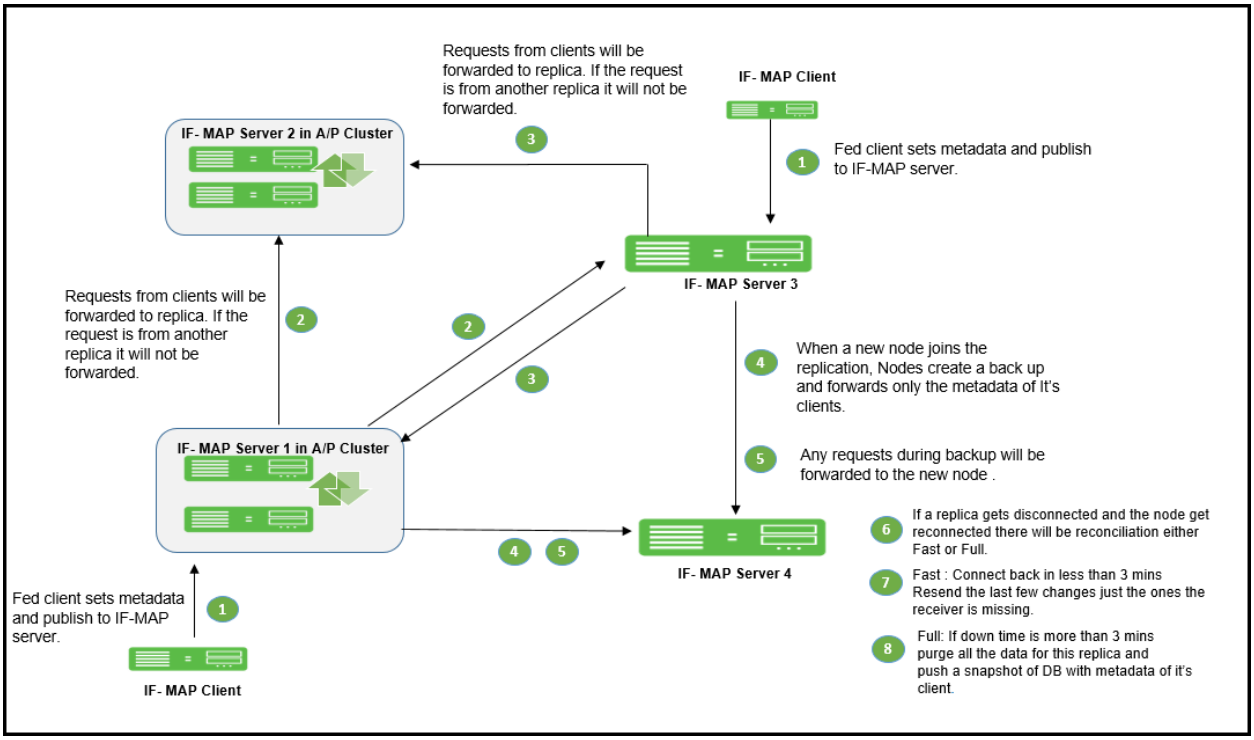
Clustering in a Federated Deployment

You can deploy clustered PPS appliance as IF-MAP servers or IF-MAP clients. You can configure IF-MAP servers in an Active Passive cluster. IF-MAP clients must be configured with the cluster's virtual IP (VIP) and must communicate with only the active node.

The session changes in federation cluster networks are propagated rapidly. The clients can access resources without experiencing delays, and there is no single point of failure. If any single device fails, the passive node recovers in seconds. You can configure IF-MAP client in Active/Active or Active/Passive cluster.

You can also use clustered PPS appliances as server replicas. The below figure illustrates a complex network of clustered and standalone PPS appliance.

Figure 158: IF-MAP Server Clustering



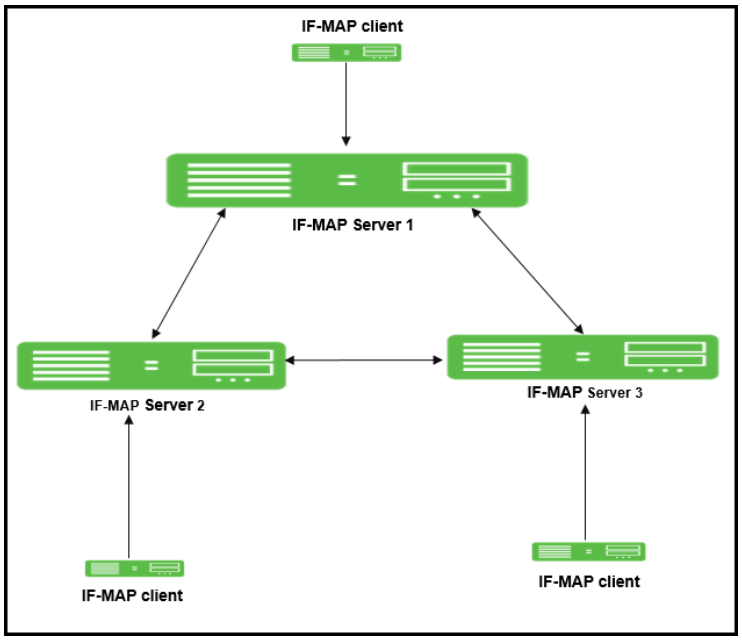
Replica IF-MAP Server

The IF-MAP server has the capability to replicate all of its IF-MAP data to other IF-MAP servers. For example, if you have a network in Boston and a network in London, you can run IF-MAP servers in both places and configure the IF-MAP servers in both locations to replicate data to one another. An endpoint that accesses PPS or PCS can access protected resources behind any of the PPS devices connected to local or replica IF-MAP server.

Each replica IF-MAP server communicates in a bidirectional way with all the connected IF-MAP server replicas. The data on each IF-MAP server is available on every server and enhances the system performance. A 3-way replica in mesh topology in which all the servers are connected to each other is supported.

The below figure depicts one possible deployment replica scenario.

Figure 159: IF-MAP Server Replica

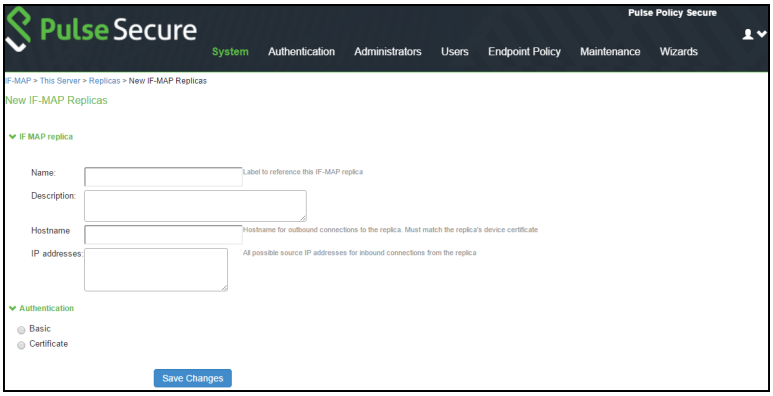


Bandwidth issues determine the effectiveness of the entire IF-MAP Federation's operation. A key to timeliness is that IF-MAP servers should generally be placed geographically close to IF-MAP clients to ensure the most efficient operation. Replicas in an IF-MAP federated network allow user session data to be shared over greater distance. For example, the user in Boston can connect with servers in London through the replicated IF-MAP server in London.

To configure IF-MAP server replicas to communicate:

1. Select **System > IF-MAP Federation > This Server**.
2. Click the **Replicas** tab and then select **New IF-MAP replica** to configure Replica settings.

Figure 160: IF-MAP Server Replica



3. Type a Name for the replica IF-MAP server.
4. (Optional) Enter a Description for the replica or replica network.
5. For **Hostname**, enter the hostname that exactly matches the replica's device certificate. This is used when this IF-MAP server initiates a connection to the replica Use the fully qualified domain name (FQDN) of the replica's internal or external interface should be used; for a cluster, use the FQDN of the internal or external VIP.
6. After **IP addresses**, provide one or more IP addresses from which the replica can initiate connections to this server. If the replica is standalone, for survivability list both the internal and external network interfaces. If the replica is a cluster, for survivability list the internal and external network interfaces of both cluster nodes.
7. Select the Authentication method: **Basic** or **Certificate**.
8. For **Basic**, enter a username and password.
9. For **Certificate**, select the CA that issued the IF-MAP replica's certificate. Enter restrictions, one per line. If any restrictions match, (for example CN=ic.example.com), the certificate is accepted.
10. Click **Save Changes** to create the connection for the replica.

Coordinated Threat Control in a Federated Environment

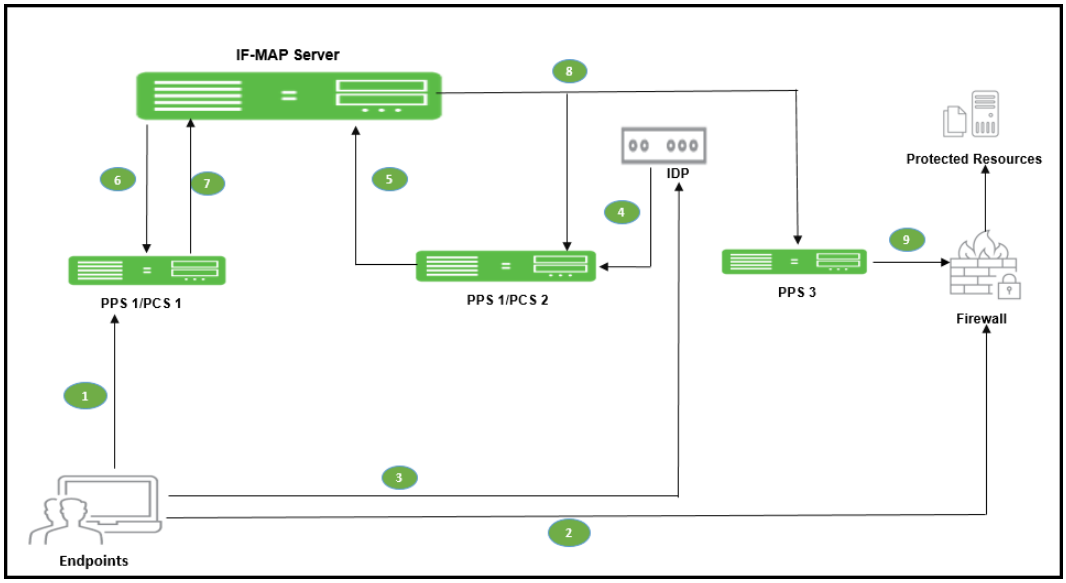
You can use Juniper Networks IDP Series Intrusion Detection and Prevention Appliance with Federation to detect attacks from within the network. Any endpoint that is on any connected PPS device or PCS can be monitored for suspicious activity. IF-MAP clients can work together to provide coordinated threat control across all attached enforcement points.

Endpoints that access PCS can be monitored by standalone IDP. Endpoints that access PPS device can be monitored by either standalone IDP, Integrated Security Gateway Intrusion Detection and Prevention ISG-IDP, or SRX Series Services Gateway IDP.

The IDP device reports attacks to the PPS or PCS to which it is connected. The PPS or PCS configured as an IF-MAP client reports the user's activity to the IF-MAP server using IF-MAP. The IF-MAP server notifies the authenticating PPS or PCS about the attack, and the authenticating device applies its IDP sensor policies. If new roles or restrictions are imposed on the endpoint based on policies configured on the device, the PPS or PCS publishes the new session information for the endpoint to the IF-MAP server.

When any other PPS or PCS polls the IF-MAP server, the newly published session information for the user determines the protected resources that the user can access. The below figure shows a deployment with IDP.

Figure 161: IF-MAP with IDP



The following steps summarize the interaction with IDP in an IF-MAP federated network.

1. The endpoint successfully accesses PPS or PCS 1 and publishes session data to the IF-MAP server through Session-Export policies.
2. The endpoint attempts to access protected resources behind the SRX firewall, which is connected to PPS 3. PPS 3 uses IF-MAP to query the IF-MAP server for session information about the endpoint. After receiving session information, PPS 3 uses Session-Import policies to determine roles and then provisions an auth table entry on the SRX firewall. PPS 3 subscribes to updates about the endpoint's session data.
3. After the endpoint is successfully connected to resources behind the SRX firewall, IDP detects an attack originating from the endpoint.
4. IDP notifies PPS 2 of the attack. (If IDP is standalone IDP, PPS 2 could also be an PCS. If IDP is an SRX firewall with the ISG-IDP security module, PPS 2 cannot be a PCS, because the PCS does not communicate with the SRX firewall.)
5. PPS 2 updates the endpoint session data on the IF-MAP server with information about the attack.

6. The IF-MAP server notifies PPS or PCS 1 (the original authenticating device) about the attack. The authenticating PPS or PCS is responsible for consuming the attack.
7. The authenticating PPS or PCS applies its sensor policies to the endpoint and updates the endpoint's session according to actions specified in the sensor policies. For example, the endpoint must be assigned a more restrictive role. The PPS or PCS publishes the new session information to the IF-MAP server, and the new information replaces the old data.
8. The IF-MAP server notifies any PPS that subscribe to updates about the endpoint. This includes PPS 3, which is connected to the SRX firewall.
9. PPS 3 applies Session-Import policies to the new session data for the endpoint and pushes the resulting roles to the SRX firewall.
10. If the new set of roles denies access to the protected resources, access is denied.

Performance and Scalability

The IF-MAP server is supported on both hardware and virtual platforms.

The scalability of the IF-MAP server depends on:

- Type of platform- Hardware or VM image
- If the IF-MAP server is used as a dedicated IF-MAP server and the virtual memory available. You must configure PPS as dedicated only when you want it to be fully used as an IF-MAP server and not for other processes such as authentication.
- Number of roles and attributes
- For example, PSA 7000 has no impact of dedicated IF-MAP server setting option due to kernel memory limit of process. With single role for session, scale limit is up to 300K fed-wide sessions.
- PSA5000/SM360/PSA3000, the scale limit is 150K fed-wide session on dedicated IF-MAP appliance.
- For virtual platform (VM image), scalability is limited and based on the size of virtual memory.

The performance on IF-MAP server is described below:

- The IF-MAP server supports 24 export/import requests together per second.
- The time interval required to access the resource protected by the firewall after the user log in is 20 seconds.
- Latency and bandwidth between IF-MAP replicas affect the amount of time taken to replicate large amounts of data during heavy IF-MAP server utilization.
- The IF-MAP federation replica is supported over transatlantic link, however we might face issues due to WAN connection and latency between the devices.
- For clustering or replication, there is no impact on the scalability.

Provisioning PCS sessions to PAN/Check Point Firewall

This chapter provides an overview of provisioning PCS/PPS user sessions to PAN/Check Point firewall through IF-MAP server. It includes the following information:

- Overview
- Deployment of PPS/PCS using PAN/Check Point Next Generation Firewall
- IF-MAP Configuration

Overview

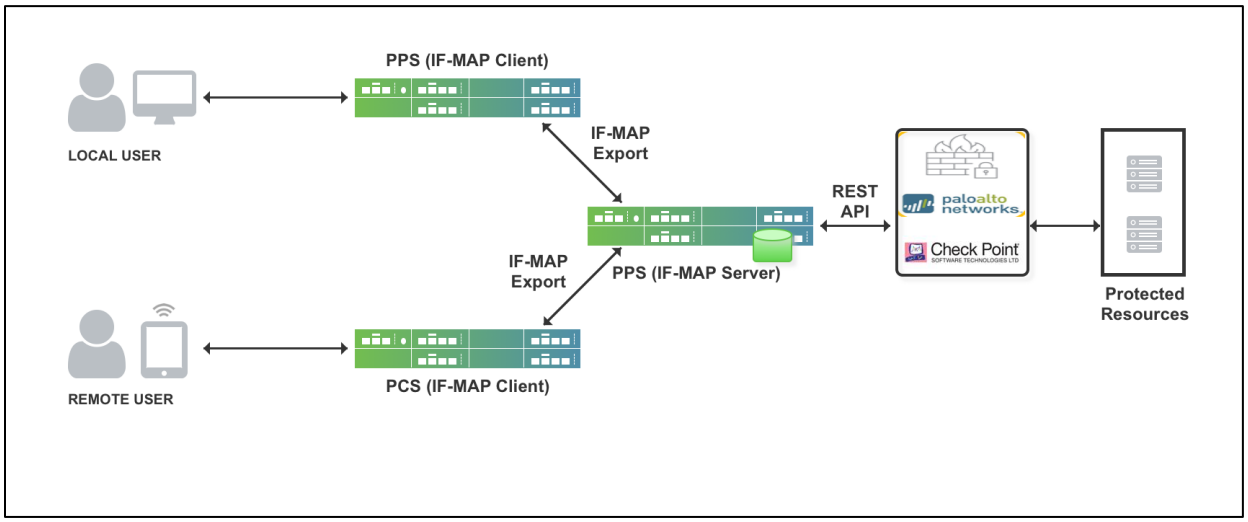
Pulse Policy Secure (PPS) integrates with Palo Alto Network's (PAN)/Check Point Next Generation Firewall to provision user's identity information (user name, roles and IP address) to PAN/Check Point firewall.

This section focuses on provisioning Pulse Connect Secure (PCS) /PPS user's identity information to PAN/Check Point firewall using IF-MAP server. Using this solution access control can be provided for PCS/PPS users for accessing resources protected by Firewall.

Deployment of PPS/PCS using PAN/Check Point Next Generation Firewall

In a federated enterprise, a user can log in to a PPS or PCS device (remote access) for authentication and access the resource protected by the PAN/Check Point Firewall. The session information is shared across PPS or PCS device using IF-MAP protocol through IF-MAP server.

The PAN/Check Point Firewall controls the PPS and PCS user's access to protected resources based on the policy settings. The IF-MAP server receives the session information of multiple PPS and PCS and provisions user identity information to Firewall. The federation requires provisioning of user's information on the PAN/Check Point Firewall and allows access to the protected resource based on the resource access policies that are configured on PPS.



The authentication process is described below:

1. The remote user establishes VPN tunnel using Pulse Client and the role is granted to the user based on policy configured on PCS.
    a. PCS session is exported to IF-MAP server.
    b. IF-MAP server provisions user identity details to PAN/Check Point Firewall.
2. The remote user tries to access PAN firewall protected resource. PAN/Check Point Firewall allows access to protected resource if the user is authorized.
3. User's role changes while logged in (for example, when Host Check compliance change causes role(s) to change). In this case, user's new role(s) are sent to PAN/Check Point Firewall.
4. User logs out of PCS. In this case, all information associated with the user from that endpoint is removed from the Firewall. User is denied access to protected resources by Firewall.

Note: The same workflow applies to local users connecting through PPS.

IF-MAP Configuration

A high-level overview of the configuration steps needed to set up and run the integration:

- The Administrator configures IF-MAP clients (PPS, PCS) on IF-MAP server admin UI from System > IF-MAP Federation.
- Install the Device certificates and Trusted Server CA from System > Configuration > certificates on both IF-MAP Server and IF-MAP client.
- From IF-MAP Server admin UI, admin configures PAN Firewall device by entering the following:
    - Name for the PAN/Check Point Firewall.
    - IP address of the PAN/Check Point Firewall.
    - API Key for PAN/ Shared Secret for Check Point
- Administrator configures the Infranet Enforcer Auth Table Mapping Policies.

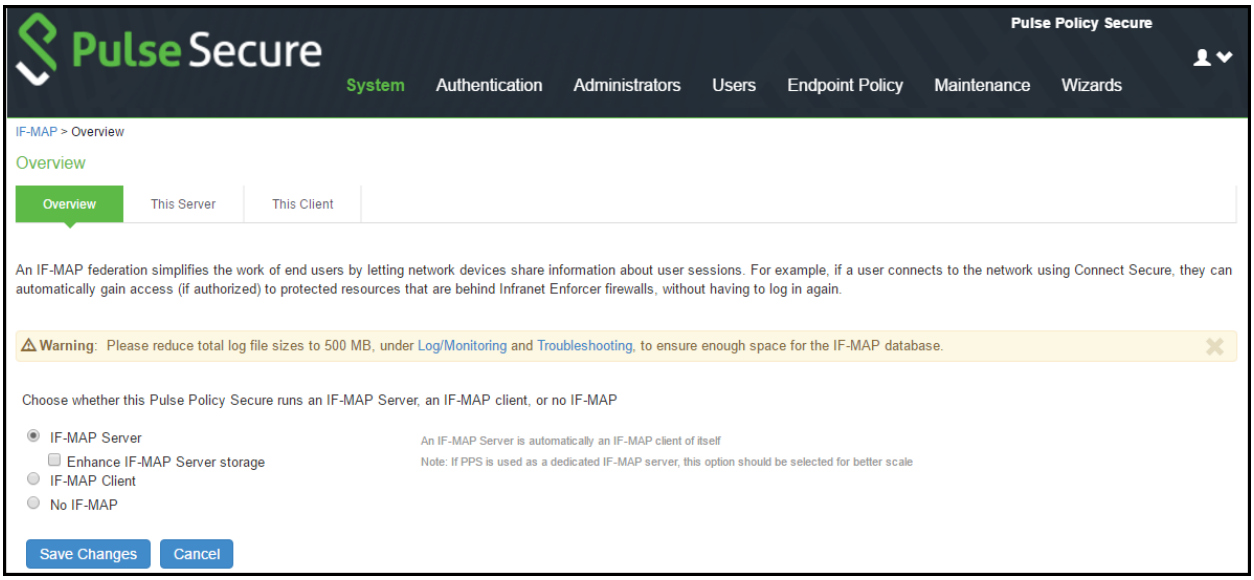
When the PPS or PCS session is exported to IF-MAP server, IF-MAP server provisions user identity details to configured PAN/Check Point Firewall based on the configured Auth Table Mapping Policies.

This section covers the following topics:

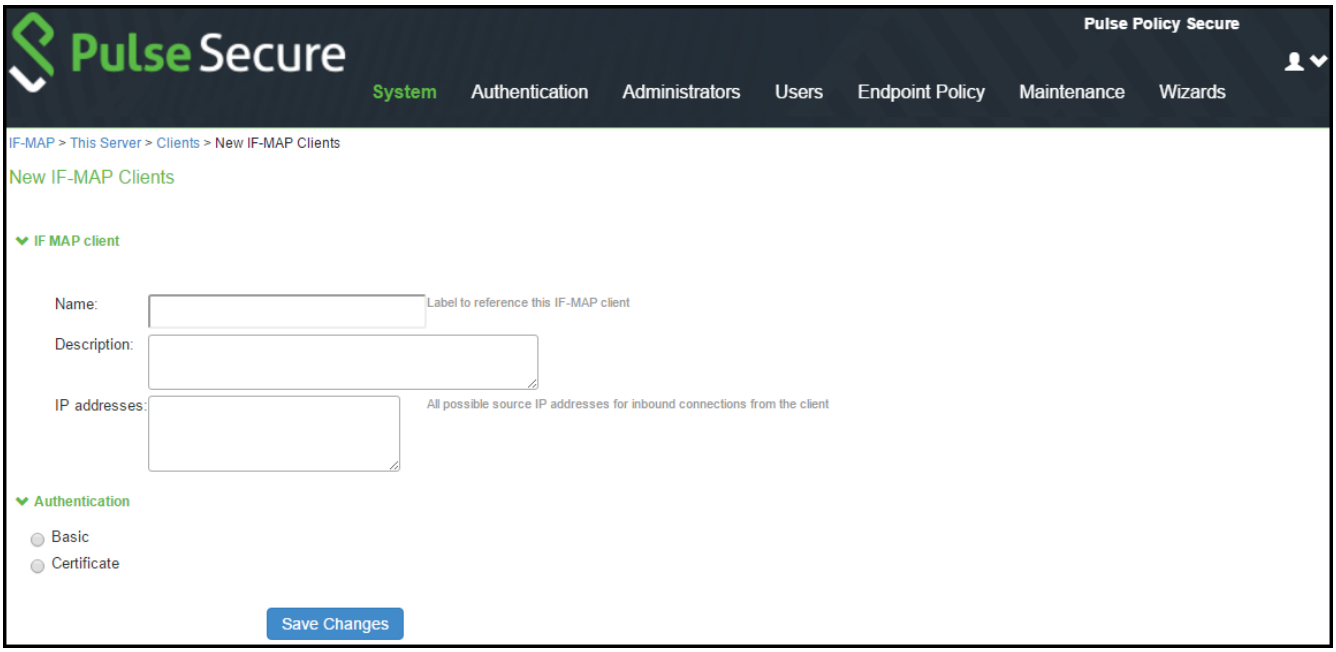
Step1: Configuring IF-MAP Server

To configure IF-MAP server on the PPS:

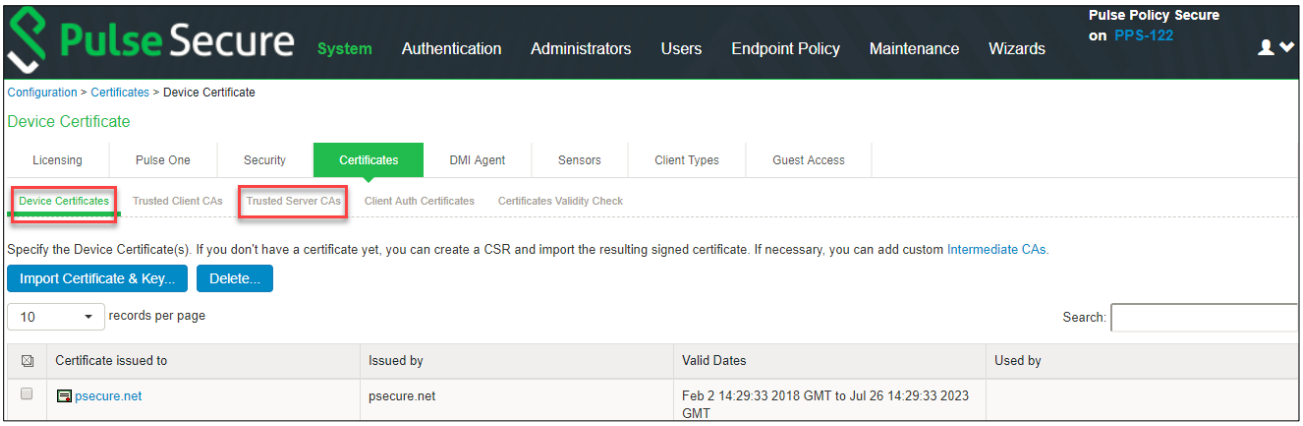
1. Select **System > IF-MAP Federation > Overview**.
2. Select IF-MAP Server.
3. Click Save Changes.



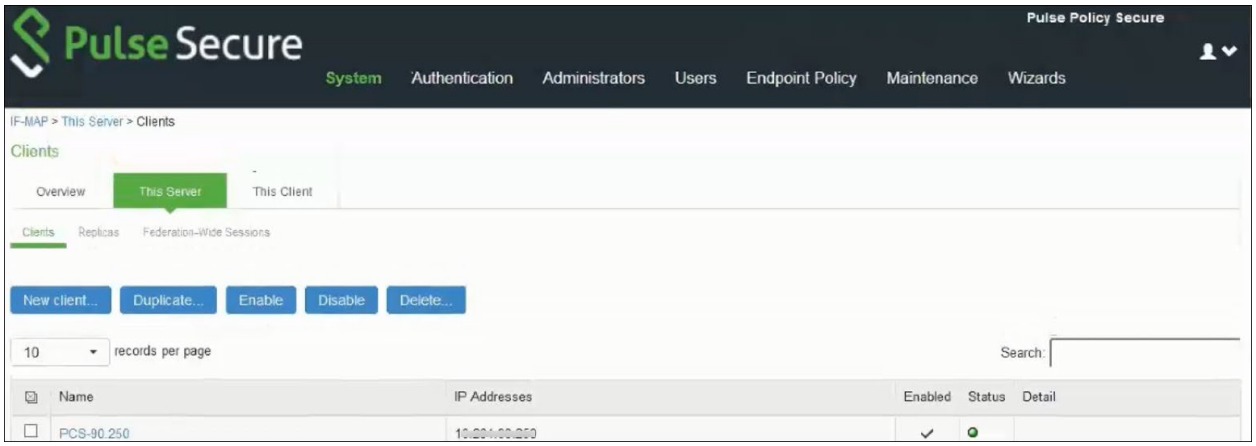
4. Select **IF-MAP > This Server > Clients > New Client** and add PPS/PCS as IF-MAP client.



5. Install the Device certificates and Trusted Server CA from System > Configuration > certificates on both IF-MAP Server.



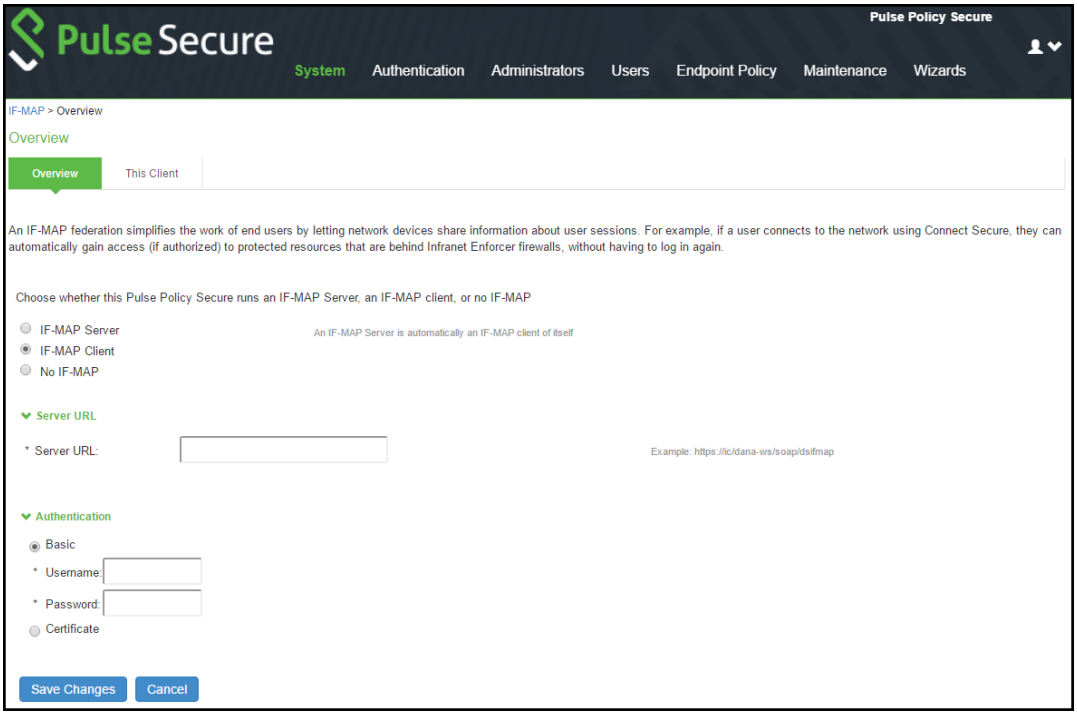
6. If the client is added successfully the status turns to green colour.



Step 2: Configuring IF-MAP Client

To configure the IF-MAP client:

1. Select **System > IF-MAP Federation > Overview**.
2. Select **IF-MAP Client**.
3. Enter the IF-MAP server IP address or the complete server URL.

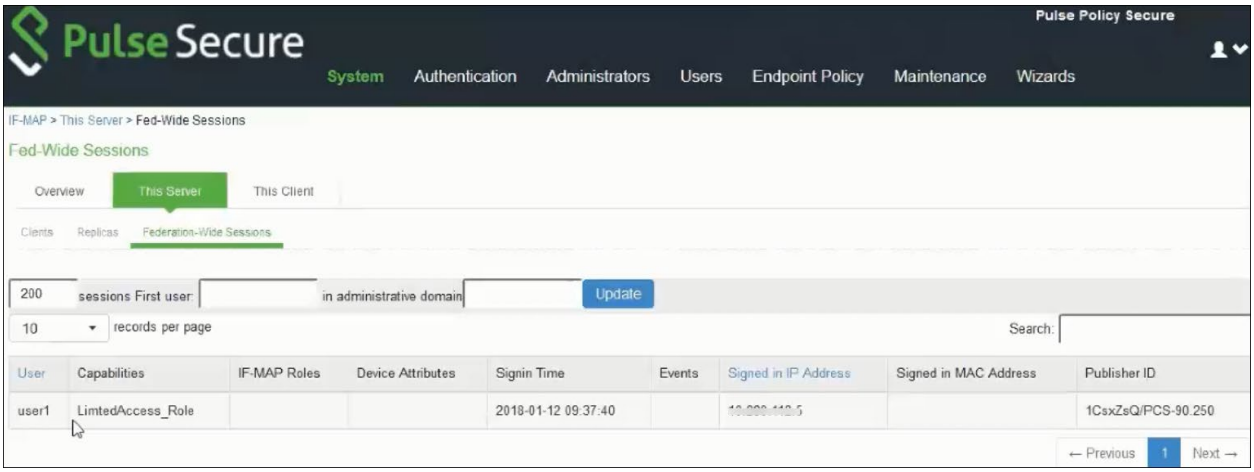


After completing the IF-MAP server and IF-client configurations, configure the IF-MAP Policies. For more information, see **Configuring Session Export Policies**.

Note: This use case supports configuring only Session-Export policies.

Step 3: Viewing the Federated Session Details

To view the federated session details, select **System > IF-MAP > This Server > Federation-wide Sessions**.



Deployments with Juniper IDP

About IDP Technology

Securing intranet work application and resource traffic is vital to protecting the network. You can add levels of application security to detect internal threats coming from users who are authenticated through the system by integrating PPS with a Juniper Networks IDP Series sensor.

PPS supports standalone IDP and IDP through the Juniper Networks ISG Series Integrated Security Gateways Infranet Enforcer with the IDP Security Module (supported in ScreenOS Release 6.2 or greater).

The IDP sensor monitors the network on which the IDP system is installed. The sensor's primary task is to detect suspicious and anomalous network traffic based on specific rules defined in IDP rulebases.

The IDP device provides the following types of protection (some of which depend upon the specific configuration):

- Protects against attacks from user to application.
- Detects and blocks most network worms based on software vulnerabilities.
- Detects and blocks non-file-based Trojan Horses.
- Detects and blocks effects of spyware. adware, and key loggers.
- Detects and blocks many types of malware.
- Detects and blocks zero day attacks through the use of anomaly detection.

NOTE: An IDP Sensor can send logs to one PPS only. However, a PPS device can receive logs from more than one IDP Sensor.

Using the admin console, you can configure and manage interaction attributes between PPS and an IDP, including the following:

- (With standalone IDP) Global configuration parameters such as the IDP hostname or IP address, the TCP port over which the sensor communicates with PPS, and the one-time password PPS and IDP use to authenticate with one another.
- Various levels of attack severity warnings and the action that PPS takes.

The IDP sits within the network and monitors traffic from endpoints that are connected through PPS. You can position the IDP in-line, or you can configure the IDP in sniffer mode.

After PPS connects with the IDP sensor, PPS registers all of the IP addresses to be monitored for potential threats. With standalone IDP, you enter the IP addresses to monitor.

Any abnormal events detected by the IDP Sensor are reported to PPS, which you configure to take appropriate action based on the severity level of the reported events. The IDP Sensor performs reporting functions to allow you to determine what IP address within the network has launched the attacks in addition to any normal logging the IDP has been configured to undertake.

With a large number of connected users IDP can overwhelm PPS with more alert logs than it can process. In this situation, the number of logs sent by the IDP to PPS can be controlled by decreasing the severity level setting in the IDP connection settings.

With IDP deployments using the Infranet Enforcer and the IDP Security Module, the Infranet Enforcer can send messages to Pulse debug log.

IDP Deployment Scenarios Overview

Three possible deployment scenarios are shown in the following figures.The standalone IDP is located within the internal network. All network traffic originating from endpoints that are registered with the IDP is monitored. You can deploy IDP in sniffer mode, or inline mode. You can use transparent mode or route mode with an inline mode configuration. In the first deployment example, the IDP does not monitor IPsec traffic from the user to protected resources.

To monitor all IPsec traffic from users to protected resources, deploy the IDP behind the Infranet Enforcer, as shown in figure.

You can deploy up to ten IDP devices in a network with PPS. Performance is based on how rapidly sessions are created or changed, the number of events that IDP sends to PPS, and the efficiency of the network links that connect the devices. IDP devices must be connected over a high-speed LAN link.

In a clustering environment, only one member of an PPS cluster exchanges information with an IDP sensor. If the connected PPS fails or is shut down, another cluster member will assume the load.

Understanding PPS Deployments with IDP Devices

This topic provides and overview of deployments with IDP devices. It includes the following content:

- About IDP Devices
- Coordinated Threat Control Overview
- Deployments with IDP Series Devices
- Deployments with IDP-Enabled Infranet Enforcers
- Monitoring IDP-Reported Events

About IDP Devices

The IDP Sensor is a powerful tool to counteract users who initiate attacks. The IDP sensor monitors the network on which the IDP system is installed. The IDP sits within the network and monitors traffic from endpoints that are connected through PPS. You can position the IDP in-line, or you can configure the IDP in sniffer mode. The sensor’s primary task is to detect suspicious and anomalous network traffic based on specific rules defined in IDP rulebases.

The IDP device provides the following types of protection (some of which depend upon the specific configuration):

- Protects against attacks from user to application.
- Detects and blocks most network worms based on software vulnerabilities.

- Detects and blocks non-file-based Trojan Horses.
- Detects and blocks effects of spyware, adware, and key loggers.
- Detects and blocks many types of malware.
- Detects and blocks zero day attacks through the use of anomaly detection.

Coordinated Threat Control Overview

In a coordinated threat control deployment, the IDP device reports abnormal events to PPS. The attack logs sent by the IDP device include the source and destination IP addresses and port numbers of the attacking host, and the resource against which the attack was launched, along with the attack identifier, severity of the attack, and the time at which the attack was launched.

PPS displays the attack information received from the IDP sensor on the Active Users page. Based on the attackers IP address and port number, PPS can uniquely identify the user's session.

When you learn that an attack has been launched by an active user, you can disable the user's account, end the user's session, or remediate to a different role. You can choose automatic or manual actions for attacks detected by the IDP sensor. For manual action, you look up the information available on the Active Users page and decide on an action. For automatic action, you configure the action in advance when you define IDP policies.

PPS displays an error message to the user whose account has been disabled indicating the reason.

Deployments with IDP Series Devices

You can deploy PPS with IDP Series devices in coordinated threat control deployments and user-role-based IDP policy deployments. User-role-based IDP policy deployments require IDP Series 5.0 or later. To display the version of an associated IDP device in PPS admin console, select **System > Configuration > Sensors**.

NOTE: An IDP Sensor can send logs to one PPS only. However, PPS can receive logs from more than one IDP Sensor.

Using the admin console, you can configure and manage interaction attributes between PPS and an IDP Series device, including the following:

- Global configuration parameters such as the IDP hostname or IP address, the TCP port over which the sensor communicates with PPS, and the one-time password PPS and IDP use to authenticate with one another.
- Various levels of attack severity warnings and the action that PPS takes
- IP addresses to monitor.

With a large number of connected users IDP can overwhelm PPS with more alert logs than it can process. In this situation, the number of logs sent by the IDP to PPS can be controlled by decreasing the severity level setting in the IDP connection settings.

Deployments with IDP-Enabled Infranet Enforcers

PPS also supports IDP through the Juniper Networks ISG Series Integrated Security Gateways Infranet Enforcer with the IDP Security Module (supported in ScreenOS Release 6.2 or later).

Unlike a standalone IDP which requires manual configuration on the IDP to allow communication with the PPS, the ScreenOS Enforcer or the Junos Enforcer use the existing communication channel with PPS.
If you are using integrated IDP with the ISG-1000 or ISG-2000, see http://www.juniper.net/techpubs/en_US/release-independent/screenos/information-products/pathway-pages/screenos/product/index.html. If you are using Junos IDP with Junos

OS Release 10.0, see *Junos OS Initial Configuration Guide for Security Devices*. ISG-IDP and CTC are configured the same on PPS.

When ISG-IDP or Junos IDP are activated, ScreenOS or Junos notifies PPS when an attack event is detected from any endpoint. To avoid overwhelming the SSH connection between PPS and the Infranet Enforcer, the number of attack notifications is limited to ten per second. If additional attacks are detected, the Infranet Enforcer holds an additional ten notifications in a queue.

ISG-IDP or Junos devices attached to any node in a cluster may send messages regarding sessions attached to any node in the cluster.

There is a Use IDP module as Sensor check box on the Infranet Enforcer admin console page. If you select the check box and there is no IDP module or if the Enforcer is not running a compatible version, PPS logs an appropriate message.

With IDP deployments using the Infranet Enforcer and the IDP Security Module, the Infranet Enforcer can send messages to Pulse debug log.

Monitoring IDP-Reported Events

After the IDP Sensor has been set up, you can specify the events you want the IDP to watch for and the actions that PPS takes once a particular event has been noted and reported.

In two locations on PPS, you can specify actions to be taken in response to users that perform attacks:

- **Sensor Event policies page**—Define the policy on this page to generate an automatic response to users who perform attacks.
- **Users page**—Manually identify and quarantine or disable users on the Active Users page, which lists users who have performed attacks.

Activating IDP for the ScreenOS or Junos Enforcer

To activate ISG-IDP or Junos IDP on PPS:

1. Select **PPS > Infranet Enforcer**.
2. Select the name of the Enforcer on which you want to activate IDP.
3. Select the **Use IDP Module as Sensor** check box. Additional options are presented.
4. Select **For sessions provisioned for this Enforcer only** to limit monitored sessions to this device. This is applicable in an IF-MAP Federation network.
5. Select **1 - INFO through 5 - Critical** from the Severity menu. The severity filter allows you to specify the level of attacks that the Infranet Enforcer reports to PPS. For example, if you select 3, only level 3 attacks or higher are reported.

Managing Interoperation with IDP Devices

The Sensors tab allows you to specify the system settings PPS uses to establish a connection to an IDP device. Select **System > Configuration > Sensors > Sensors**. The main Sensor page displays the sensor, the network address, the state (enabled), the version, and the status of any configured sensors. The following sections describe tasks related to configuring and managing interaction between PPS and an IDP Sensor:

- Configuring Communication with an IDP Device
- Enabling or Disabling IDP Sensors
- Reconnecting to an IDP Sensor
- Refreshing and Displaying the Connection Status
- Deleting an IDP Sensor Entry

Configuring Communication with an IDP Device

To configure communication with an IDP device and a IDP log monitoring policy:

NOTE: To use the IDP sensor with PPS you must enable logging for the applicable policies.

1. Select **System > Configuration > Sensors**
2. Click **New Sensor**. The admin console displays the New Sensor page.
3. Under Sensor Properties, specify the following information:
   - **Name**—A name PPS uses to identify the new connection entry.
   - **Hostname**—The hostname or IP address of the IDP Sensor to which PPS connects in order to receive application and resource attack alert messages.
   - **Port**—The TCP port on the IDP Sensor to which PPS listens when receiving application and resource attack alert messages.
   - **One-time password**—The encrypted password PPS uses when conducting the initial Transport Layer Security (TLS) handshake with the IDP Sensor. You must enter the encrypted PPS OTP password as displayed on the IDP ACM configuration summary screen.

NOTE: The hostname, TCP port, and one-time password must already be configured on the IDP Sensor before this configuration can be successful.

4. Under **Monitoring Options**, specify IP addresses to monitor and the minimum alert severity level the IDP Sensor records and submits to PPS:
   - In the Addresses to Monitor field, specify individual IP addresses and address ranges, one entry per line. IDP reports attack information only for the IP addresses that you specify. For IDP to report all events to PPS, enter 0.0.0.0/0. For IDP to report only selected events, enter <default> to permit IDP to report events for events with source IPs that have an active user session on PPS, and /or enter one or more addresses or address ranges for any endpoint that you want the IDP sensor to report.

     NOTE: With ISG-IDP or Junos IDP, you do not need to specify which IP addresses to monitor. The Infranet Enforcer monitors all IP address for which auth tables exist.

   - Select one of the severity options available in the Severity filter drop down list. The severity level is a number on a scale from 1 to 5, where 1 is informational and 5 is critical. This option represents the severity of messages the IDP should send to PPS.
5. Click **Save Changes**.

Enabling or Disabling IDP Sensors

To enable or disable existing IDP Sensor entries on PPS:

1. Select **System > Configuration > Sensors**.
2. Select the check box for one or more IDP Sensor entries to enable or disable.
3. Click **Enable** or **Disable** to enable or disable the specified IDP Sensor entries, respectively.

Reconnecting to an IDP Sensor

When the connection to an IDP Sensor is down, you can use the admin console on PPS to re-establish the connection. You can also use the admin console to refresh the status of existing connections between PPS and the IDP Sensor.

To re-establish communication with an IDP Sensor, you must generate a new One-time Password.

To reconnect to an associated IDP Sensor:

1. Select the check box next to the IDP Sensor to which you want to reconnect.
2. Click **Reconnect**.

   The admin console displays a message indicating that PPS is currently attempting to re-establish connection to the specified IDP Sensor. This page automatically refreshes each second during the reconnection process. Otherwise, the connection status page automatically refreshes once every 30 seconds.

Refreshing and Displaying the Connection Status

To refresh and display the connection status for the specified IDP Sensor:

1. Select the check box for one or more IDP Sensor entries to display current connection status
2. Click **Refresh**.

Deleting an IDP Sensor Entry

You can delete existing IDP Sensor entries that define a connection between PPS and an IDP Sensor.

To delete one or more existing IDP Sensor entries from PPS:

1. Select the check box for the IDP Sensor entry or entries to delete.

2. Click **Delete**, then confirm that you want to delete the sensor entry or entries.

Identifying and Managing Quarantined Users Manually

When PPS quarantines a user based on an attack, you can display and manage the states by locating the user link in the **Active Users** page.

- A small warning icon is displayed in front of the username.
- The linked username.
- An enabled Quarantined option button on the specific user's page. If the user is not quarantined, the option button is disabled.

To manage quarantined users:

1. Locate Identify quarantined users at **System > Status > Active Users**.
2. the quarantined user and click on the username link. The user page opens, showing a number of options.
3. Click **Disabled** to disallow a user from authenticating.
4. Click **Quarantined** to leave a user in a quarantined state. The Quarantined option is enabled only if the user is already quarantined.

    NOTE: PPS assigns quarantined users to the quarantined role, regardless of their log in realm.
5. Click **Save Changes**.
6. To re-enable previously quarantined or disabled users, select **Authentication > Auth. Servers >** *Select Server* **> Users** and click the link for the given user.

    NOTE: You can also disable users from this location.
7. Click **Enabled** to release the user from quarantine.
8. Click **Save Changes**.

   All Sensor events are logged at System > Log/Monitoring > Sensors > Log.

Using Role-Based Policies to Monitor User Activity

If you are using IDP Release 5.0 or later or ScreenOS ISG-IDP Release 6.3 or later, you can add enhanced user management capabilities to your PPS IDP deployment. This feature is supported for endpoints using Pulse Client and users who connect with agentless access.

When a user session is established on PPS, PPS pushes session information including IP address, username and the roles to which the user is assigned to the IDP. The session information allows IDP to apply policies based on user roles, or on the username which is added to the IDP log.

Since role selection for a user can be based on the results of Host Checker policies, you can set policies that are based on Host Checker results. For example, if a user is assigned to a restrictive role based on the results of a Host Checker policy requiring a instant messaging software patch, you can restrict instant messenger traffic for that role.

PPS keeps the IDP device updated when a user's role changes or when a session is deleted. IDP's application policy enforcement reflects the most currently available information about a user.

If role-based policies are less restrictive than IP address based policies, some users could be inadvertently blocked during this period. Once session information is obtained about the endpoint IDP re-evaluates the endpoint and applies the less restrictive policies.

If role-based policies are more restrictive than IP address based policies, IDP cannot apply the more restrictive policies, and an endpoint could engage in potentially damaging behavior prior to session information being sent.

If you are using PPS and IDP in a network that employs IF-MAP client and server Federation, and IDP detects an attack that is attributed to a session, IDP informs PPS about the attack. Upon notification, PPS publishes the information to any attached IF-MAP servers. The IF-MAP server notifies PPS that originally published the session and PPS takes the appropriate action based on the applicable Sensor Event Policies.

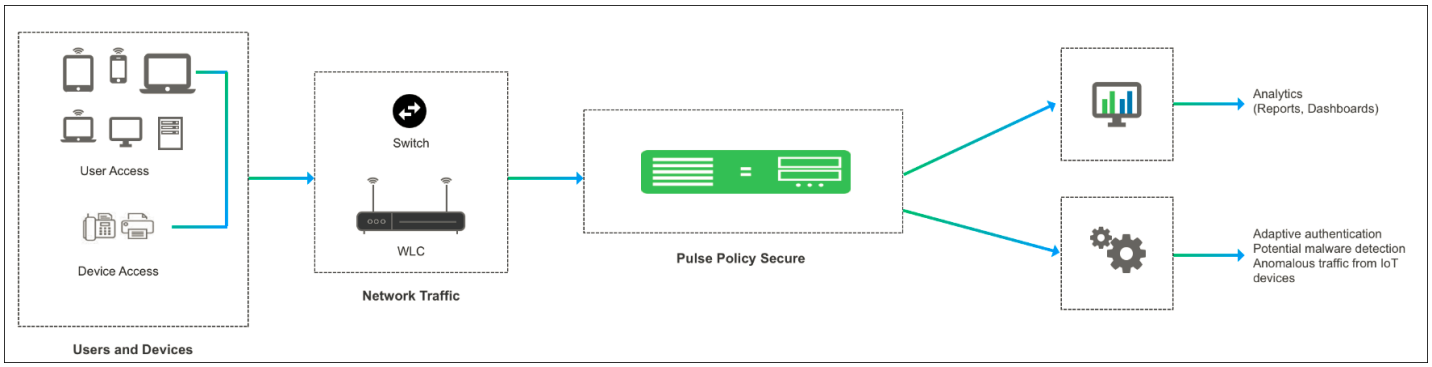
Behavioral Analytics

Overview

Enterprises deal with constant and ever-increasing magnitude of threat vectors, which includes Data Loss Prevention (DLP), malware and Domain Generation Algorithms (DGA) attacks. With changing business requirements and new types of threats, Administrators must understand how users and devices are accessing company's data and services to ensure that the access control policies are up to date. Even after successful authentication the user's activity should be monitored fully to ensure device compliance. Policy rules for protecting resources need to be configured and should be resistant to new attacks. Policy rules are configured manually, and the process is not scalable with new attacks. Hence, it is very important for Administrators to have insights into any anomalous behavior and act accordingly.

Behavioral Analytics feature analyzes user's action along with other context data to derive conclusions about any anomalous activities. It provides information/visibility based on real time user or device context thus helping in advanced attack detection and helps in proactive policy-based enforcement.

Figure: Behavioral Analytics



The Behavioral Analytics feature analyzes user or device behavior using the following methods:

- Adaptive Authentication- User/device is prompted for second level of authentication based on the threat profile determined for the corresponding user/device.

  Below are some of the scenarios where second level of authentication is required:

  - User authenticating from new device: This is detected by using the device MAC address.
  - User authenticating from new location: Location details are obtained by using the subnet and location configurations.
- Anomalous Traffic from IoT devices: The unmanaged and IoT devices are profiled during the learning period configured in PPS. Any Anomolous traffic from these devices is detected as an anomoly based on the known profile of the device. PPS uses both Netflow and SPAN configuration on switches for detecting anomalous traffic from IoT devices.
- Potential Malware Detection: Malware on client devices have become more intelligent and in generating domain names by using dynamic generation algoritms. Hence, using rule-based policies might not detect these anomalies. PPS uses SPAN data collection method for monitoring DNS traffic and detects these potential malware on the endpoint.

Adaptive authentication user flow

1. Users connect to PPS.
2. PPS performs the primary authentication.
3. PPS checks for any anomalies.
4. PPS prompts for secondary authentication for the first login or if the user location changes.
5. User enters the credentials required for secondary authentication.
6. PPS performs the secondary authentication and allows/rejects access to the user/device.

Anomalous traffic from IoT devices user flow

1. Users/Device establishes a connection with PPS.
2. Switch and DNS Server forwards the network traffic of the device to PPS.
3. PPS analyzes the network traffic and takes the action based on the detected anomaly.

Potential malware detection user flow

1. Users/Device establishes a connection with PPS.
2. DNS server forwards all the domain resolutions to PPS.
3. PPS analyzes the DNS traffic and detects potential malware on the endpoint.

Licensing

- Adaptive Authentication feature is part of the PPS license.
- Anomalous Traffic detection from IoT devices and Potential Malware detection feature requires Behavioral Analytics license to be installed on PPS.

Benefits

- Monitors the traffic from user/devices and helps in determining the possible anomalous activities such as:
  - User is authenticating from a new device/new location.
  - Device traffic is different from previous instances.
  - Potential malware on the endpoint.
- Data collected as part of Behavioral Analytics is stored so that it can be used later for determining the anomalies.

Configurations

- Pre-Requisites
- Summary of Configuration
- Configuring PPS for enabling Behavioral Analytics

Pre-Requisites

PPS determines the network anomalies based on the NetFlow and Switch Port Analyzer (SPAN) configurations on the switch.

- Enable NetFlow (v5 or v9) and port mirroring/SPAN on switches. For sample configurations, see Appendix.
- NetFlow traffic is currently qualified only with Cisco switches.

Summary of Configuration

1. Administrator enables the Behavioral Analytics feature and configures PPS based on the use case (Adaptive Authentication, anomaly traffic detection, potential malware detection). The Admin configures the list of switches in the network from where the network traffic can be received/forwarded to analytics engine on PPS.
2. Administrator configures the role mapping rules to consume these flags and control the access to the corresponding users and devices.
3. Administrator enables the secondary authentication for the users in case they are tagged with anomalies activities to ensure additional level of authentication for security purpose.
4. View the Dashboard and Reports for any detected anomalies.
5. From the Reports page, Administrator has options to clear the detected anomalies, export the available anomaly data to a CSV file.

Note:

- Behavioral Analytics configuration is synched across the nodes in the cluster (including config-only clusters). However, data collected and analyzed is synched across the nodes but not in case of config-only clusters.
- RSPAN is the recommended configuration for cluster deployments especially for the Active/Passive cluster for seamless VIP failover.
- Adaptive authentication is not supported for 802.1.x connections using native supplicant.

Configuring PPS for enabling Behavioral Analytics

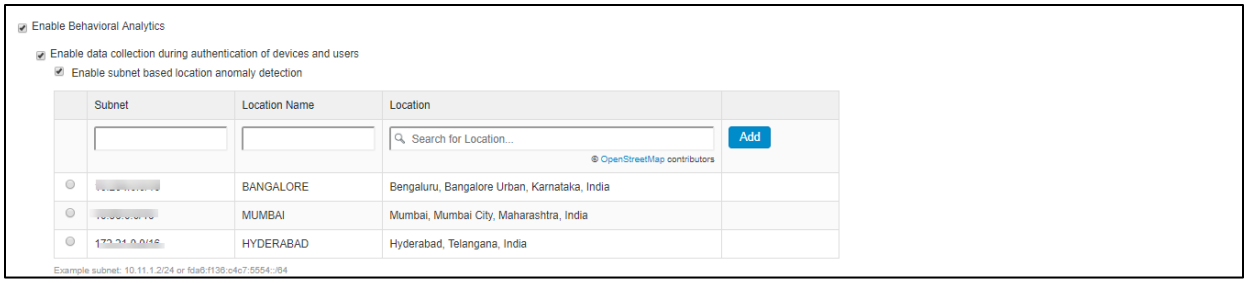
The UEBA package is available by default for detecting the anomalies. If you plan to upgrade to the latest package, it can be downloaded from the Pulse Secure Portal. Click **Upload and Activate** after uploading the package.

- Configuring PPS for Adaptive Authentication
- Configuring PPS to detect Anomaly Traffic from IoT devices
- Configuring PPS to detect Potential Malware

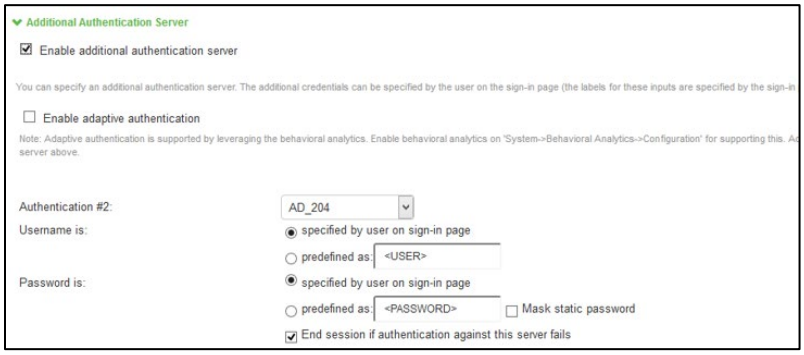
Configuring PPS for Adaptive Authentication

To enable adaptive authentication:

1. Select **System > Behavioral Analytics > Configuration.**
2. Under Configurations, select **Enable Behavioral Analytics**.
3. For enabling Adaptive Authentication, select **Enable data collection during authentication of devices and users**.
    a. For location-based anomaly detection, select **Enable subnet based location anomaly detection**.
        i. Enter the Subnet details. For example, 10.11.1.2/24.
        ii. Enter the location name.
        iii. Type the location to search and press **Enter**.
        iv. Click **Add** to add the location.



4. Select **User > User Realms > General**.
5. Under Additional Authentication Server, **Enable Additional Authentication Server**.
    a. Select **Enable Adaptive authentication**.
    b. Under Authentication #2, select the desired secondary authentication server from the drop-down list.



6. Click **Save Changes**.

Configuring PPS to detect Anomaly Traffic from IoT devices

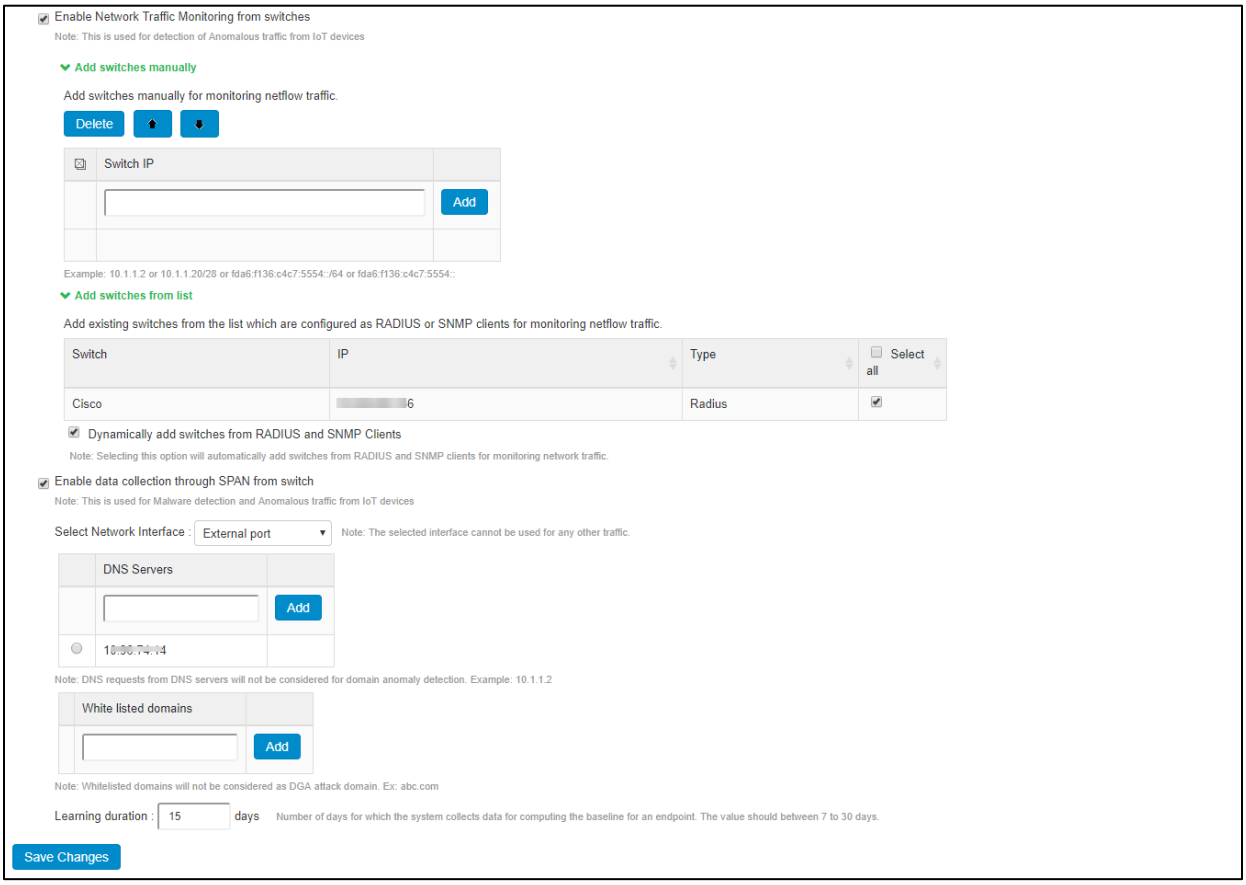
As a pre-requisite Profiler should have been configured for detecting the anomaly traffic from IoT devices. For more information, see Profiler Deployment Guide.

To determine anomaly traffic from IoT devices:

1. Select **System > Behavioral Analytics > Configuration.**
2. Under Configurations, select **Enable Behavioral Analytics**.
3. Select **Enable Network Traffic from switches**.

    - Configure the list of switches in the network from where the required data can be received/forwarded to analytics engine on PPS.
    - Add the switches manually by adding (Switch IP address/mac address) or add the existing switches under **Add Switch from list** table. Select **Dynamically add switches from RADIUS and SNMP clients** to automatically add switches from RADIUS and SNMP clients.

4. Select **Enable Data Collection through SPAN from switch** to enable SPAN configuration for determining unknown domain anomaly for unmanaged devices.
    a. Select the network interface (External port/Internal port).
    b. (Optional) Enter the IP address of the DNS server and click Add. DNS requests from these servers will not be considered for anomaly detection.
5. Enter the learning duration in days (7-30 days). Learning duration is learning period for unmanaged devices to build the device profile.

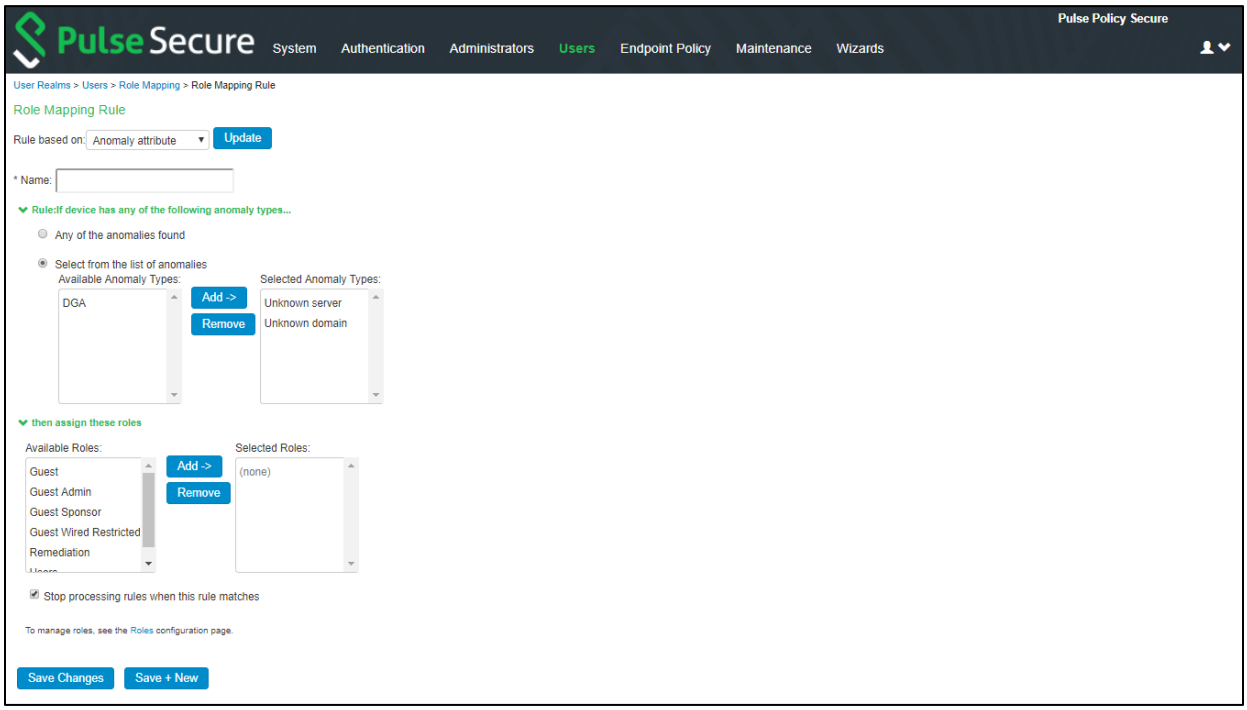


6. Click **Save Changes**.
7. Configure the role mapping rules for user realm and/or MAC authentication realm.
    a. Create new role mapping rule, select **Anomaly attribute** under **Rule based on** and click **Update**.
    b. Enter the rule name.

c. Under Rule: If device has any of the following anomaly types:
   i. **Any of the anomalies found**- Select this option to detect the device with any anomaly type.
   ii. **Select from list of anomalies**- Select this option to configure the specific anomaly type from the available list. To detect anomaly traffic from IoT devices configure **Unknown server/Unknown domain** as anomaly from the list of **Available Anomaly Types**.

d. Select **Stop processing more rules** option to stop evaluating role mapping rules if the user meets the conditions specified for this rule. Ensure that the rule is at the top of the list.

8. Configure the required roles and click **Save Changes**.



Configuring PPS to detect Potential Malware

PPS relies on DNS traffic collected through SPAN to determine the potential malware on the endpoint.

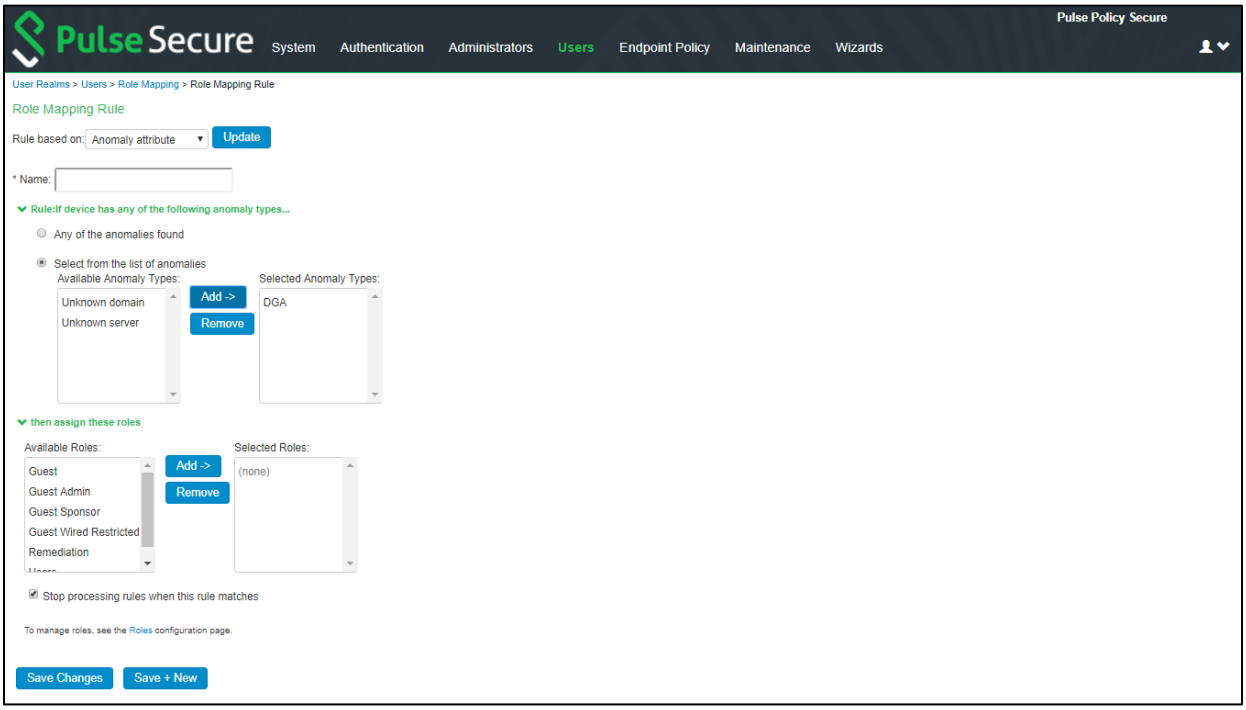
To configure PPS for detecting potential malware:

1. Select **System > Behavioral Analytics > Configuration.**
2. Under Configurations, select **Enable Behavioral Analytics**.
3. Select **Enable Data Collection through SPAN from switch** to enable SPAN configuration for determining DGA based potential malware attacks. This anomaly detection mechanism is supported for both managed and unmanged/IoT devices.
   a. Select the network interface (External port/Internal port).
   b. (Optional) Enter the IP address of the DNS server and click Add. DNS requests from these servers will not be considered for anomaly detection.
   c. (Optional) Enter the white listed domains to exempt the domains from anomaly detection.

4. Configure the role mapping rules for user realm and/or MAC authentication realm.

    a. Create new role mapping rule, select **Anomaly attribute** under **Rule based on** and click **Update**.
    b. Enter the rule name.
    c. Under Rule: If device has any of the following anomaly types:
        i. **Any of the anomalies found**- Select this option to detect the device with any anomaly type.
        ii. **Select from list of anomalies**- Select this option to configure the specific anomaly type from the available list. To detect potential malware from IoT devices configure **DGA** as anomaly from the list of **Available Anomaly Types**.
    d. Select **Stop processing more rules** option to stop evaluating role mapping rules if the user meets the conditions specified for this rule. Ensure that the rule is at the top of the list.

    Note: The Administrator can also create Anomaly rules based on Custom Expressions.



5. Click **Save Changes**.

Dashboard and Reports

The Behavioral Analytics dashboard provides visibility to many anomalies in the network. It provides visibility of any known, active anomalies, devices with potential malware, IoT devices with anomalous traffic, anomalies location, trend and so on.

To view the Behavioral analytics dashboard:

1. Select **System > Status > Behavioral Analytics.**
2. Select the desired timeframe from available options.
3. Click **Save Changes**.

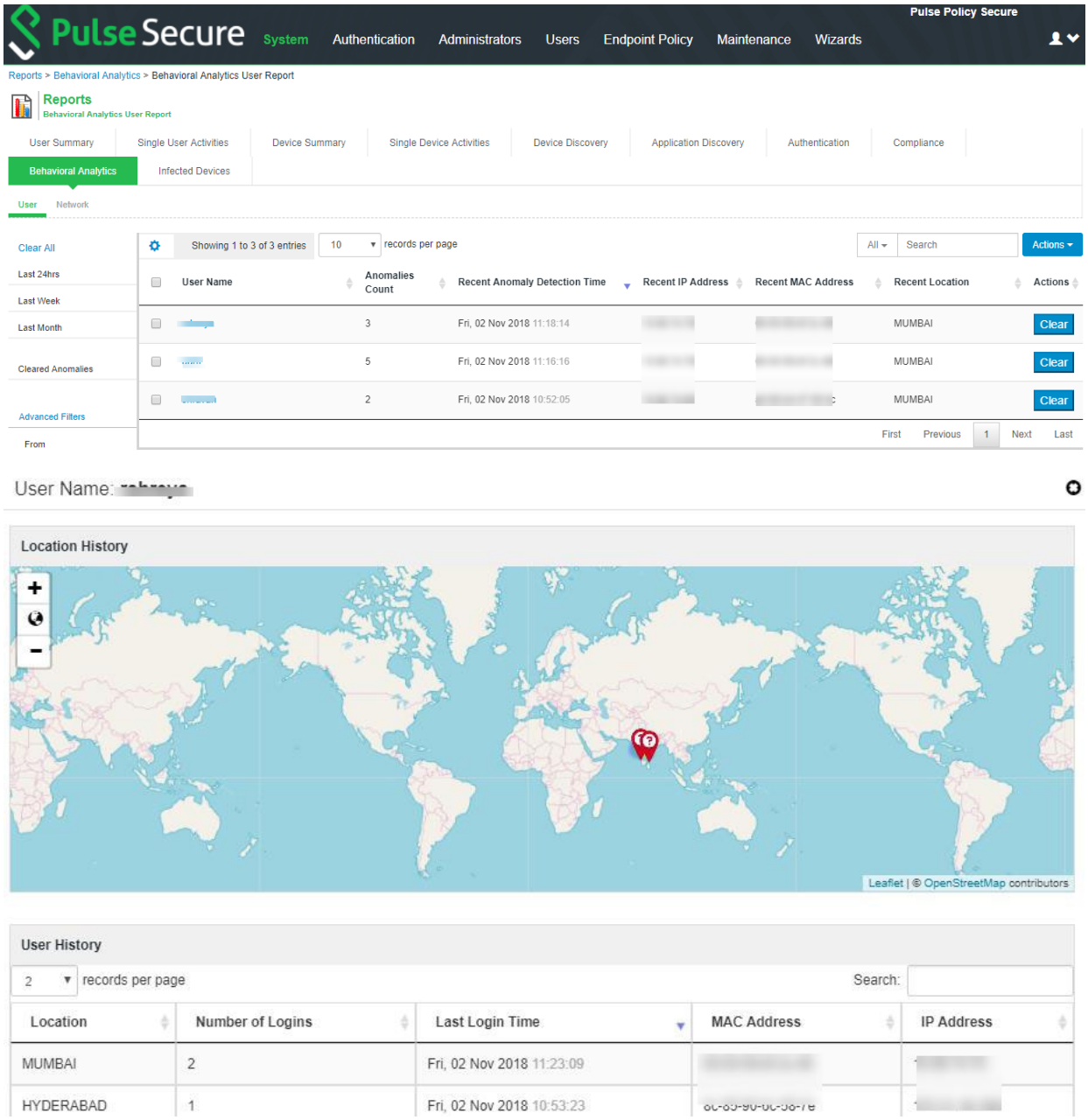
You can also view the drill down reports such as:

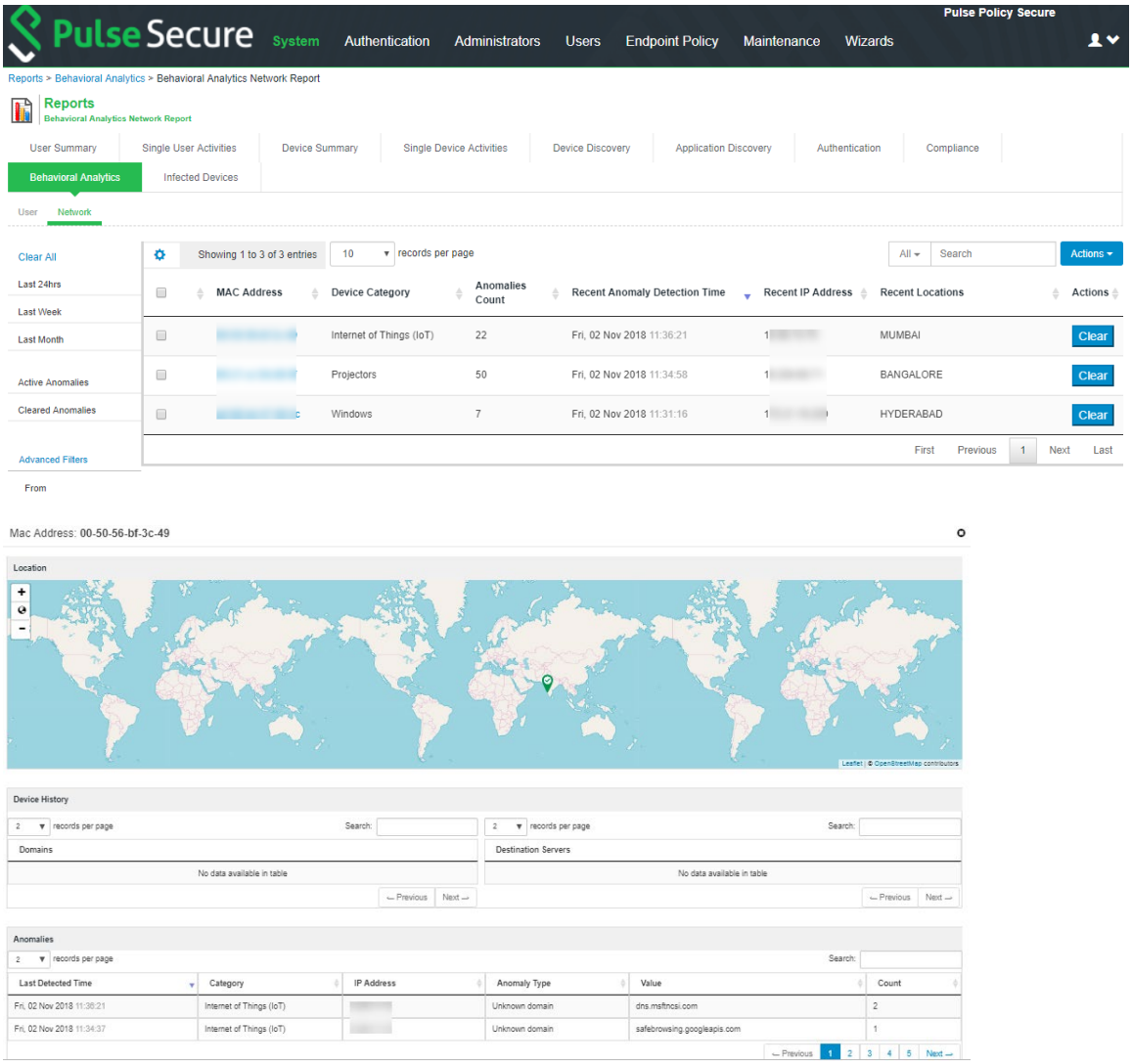
- Top 5 Users with Adaptive Authentication
- Top 5 Devices with Potential Malware
- Top 5 Devices with Anomalous Traffic

Figure: Behavioral Analytics Dashboard Page

To view the Behavioural Analytics reports, select **System > Reports > Behavioral Analytics**.

Figure: Behavioral Analytics Reports Page





Troubleshooting

The event and debug logs can be used for troubleshooting:

The Event logs are generated for the device related anomalies:

- Anomalous traffic from IoT devices
- Potential malware

You can use the User Access and Admin Logs in case of any issues. The user access logs are generated whenever there are any user related anomalies such as user logging from new location/device/new user. The Admin Logs are generated whenever there is a change with Behavioral Analytics options and if there are any changes with respect to application policies.

You can also use **Maintenance > Troubleshooting > Monitoring > Debug Log** for debugging issues. Enable debug log with events *ueba*.

Appendix

SPAN

Switched Port Analyzer (SPAN) allows you to send a copy of traffic passing through ports to another port on the switch. SPAN is important to mirror received or transmitted (or both) traffic on one or more source ports to a destination port for analysis.

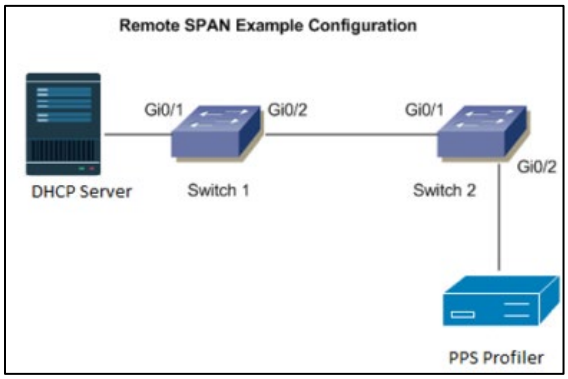
SPAN is mirroring ports in the same switch, RSPAN (Remote SPAN) is mirroring ports in one switch to a port in different switch.

This example describes how to configure RSPAN on Cisco Catalyst switches (Cisco 2960).

RSPAN

A sample topology to monitor traffic on port Gi0/1 in Switch1 using a PPS Profiler connected to port Gi0/2 in Switch2 is shown below.

Create a VLAN that will be used as an RSPAN-VLAN on both switches. In this example vlan ID 999 is used as the RSPAN-VLAN. Allow the RSPAN-VLAN on the trunk port between Switch1 and Switch2.



Switch1 (Source switch)

```
Switch1#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch1(config)#vlan 999
Switch1(config-vlan)#name RSPAN-Vlan
Switch1(config-vlan)#remote-span
Switch1(config-vlan)#exit
Switch1(config)#monitor session 1 source interface Gi0/1
Switch1(config)#monitor session 1 destination remote vlan 999
Switch1(config)#end
```

Allow VLAN ID 999 on the trunk port Gi0/2

```
Switch1#sh run int g0/2
Building configuration...
Current configuration : 175 bytes
!
interface GigabitEthernet0/2
description To-Switch2-port-Gi0/1
switchport trunk allowed vlan 74,999
switchport mode trunk
end
```

Switch2 (destination switch)

```
Switch2#conf t
Enter configuration commands, one per line.  End with CNTL/Z.
Switch2(config)#vlan 999
Switch2(config-vlan)#name RSPAN-Vlan
Switch2(config-vlan)#remote-span
Switch2(config-vlan)#exit
Switch2(config)#monitor session 1 source remote vlan 999
Switch2(config)#end
```

Allow vlan id 999 on the trunk port Gi0/1

```
Switch2#sh run int g0/1
Building configuration...
Current configuration : 175 bytes
!
interface GigabitEthernet0/1
description To-Switch1-port-Gi0/2
switchport trunk allowed vlan 10,20,30,999,60
switchport mode trunk
end
```

Allow VLAN id 999 on trunk port Gi0/2.

```
Switch1#sh run int g0/2
Building configuration...
Current configuration : 175 bytes
!
interface GigabitEthernet0/2
description To-Switch2-port-Gi0/2
switchport trunk allowed vlan 60,999
switchport mode trunk
end
```

NetFlow

NetFlow is a network protocol developed by Cisco for collecting IP traffic information and monitoring network traffic. Using a NetFlow collector and analyzer, you can see where network traffic is coming from and going to and how much traffic is being generated.

NetFlow V5 or V9 has to be configured on Cisco switch.

Commands on Cisco Switch

```
ueba-switch(config)#flow exporter UEBA
ueba-switch(config-flow-exporter)# destination <PPS IP>
ueba-switch(config-flow-exporter)#transport udp 2055
ueba-switch(config-flow-exporter)#export-protocol netflow-v9 (or netflow-v5)
```

Note: Cisco 3850 Catalyst switches support only v9 whereas Cisco 2960 supports both v5 and v9

```
ueba-switch(config)#flow record UEBA
```

```
 ueba-switch(config-flow-record)# match ipv4 protocol
 ueba-switch(config-flow-record)#match ipv4 source address
 ueba-switch(config-flow-record)#match ipv4 destination address
 ueba-switch(config-flow-record)# match transport source-port
 ueba-switch(config-flow-record)#match transport destination-port
 ueba-switch(config-flow-record)#match interface input
 ueba-switch(config-flow-record)#collect interface output
ueba-switch(config)#flow monitor UEBA
 ueba-switch(config-flow-monitor)#exporter UEBA
 ueba-switch(config-flow-monitor)#cache timeout active 60
 ueba-switch(config-flow-monitor)#record UEBA
 ueba-switch(config)#interface GigabitEthernet1/0/3    ---(interface to which client endpoint is connected)
 ueba-switch(config-if)#ip flow monitor UEBA input
```

IoT Access

IoT Policy Provisioning

This chapter provides an overview of IoT device enforcement using SRX/PAN firewall. It includes the following information:

Overview

As we increasingly connect devices to the Internet, new opportunities to exploit potential security vulnerabilities grow. Any unknown devices including IoT devices could serve as entry points for cyberattack by allowing malicious individuals to re-program a device or cause it to malfunction. The IoT devices are being added to corporate networks with or without the knowledge of IT administrator and they may communicate using the corporate IP network. These devices may have limited security controls leaving them open to be used as an attack vector. To improve security posture of IoT devices in corporate network, visibility and Role Based Access Control play a key role. Hence, it’s extremely important to detect and classify what’s there on the network.

PPS along with Profiler enables you to secure and manage access to IoT devices. It allows you to configure IoT Access Policy based on discovered or profiled device category. It also allows you to dynamically configure resource access policies for newly discovered devices and map user's role-based access to specific category and manufacturer or profile group of IoT devices.

Benefits

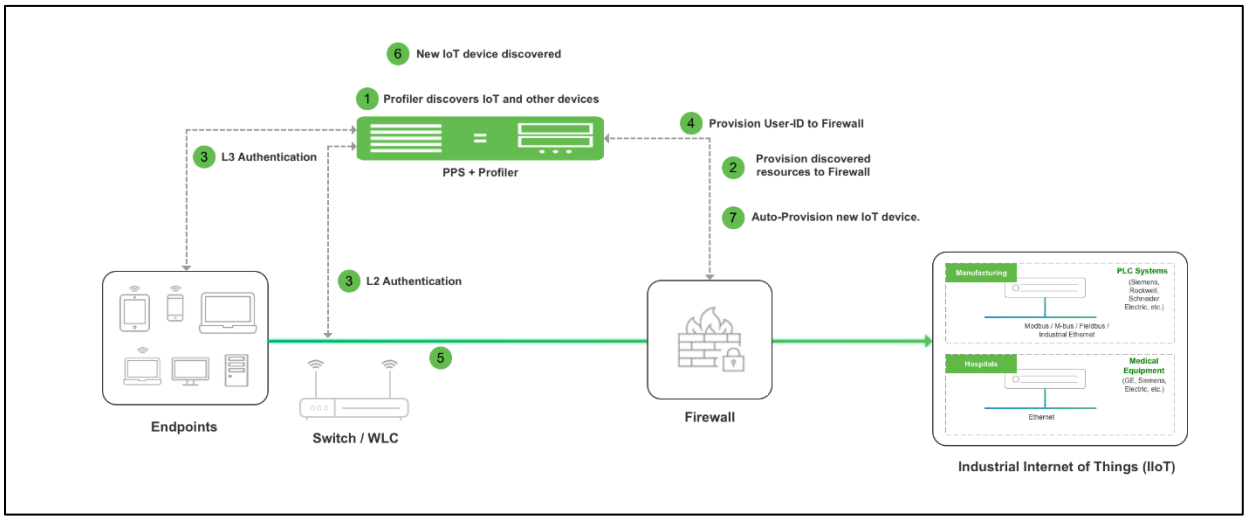
The IoT Policy Provisioning Page enables you to quickly configure IoT policy provisioning and provides the following benefits:

- Discover and profile IoT devices using Profiler. Profiler enables you to continuously monitor the network and discover new devices such as security cameras, sensors, Industrial IoT devices (IIoT), medical sensors, and so on.
- PPS provides IoT access control using the IoT Access Policies, which are created automatically based on profiled or newly discovered device information from Profiler.
- Reduce IoT/IIoT machine downtime by allowing authorised users to get a role-based access to specific IoT/IIoT device for troubleshooting/maintenance.
- Automatic access control for the newly discovered IoT devices.

Deployments

The below network diagram depicts how PPS, Profiler, and SRX/PAN Firewall can be deployed to protect access to IoT devices. For example, the manufacturing domain consists of different IoT devices to monitor and control the manufacturing process. The industrial IoT devices are separated and controlled behind the firewall. PPS enables you to define IoT Access Policy using the Profiler attributes (category and manufacturer or profile group) and provides secure and seamless access to IoT devices for authorized users.

Figure: IoT Device Deployment



The workflow is described below:

1. A local Profiler configured on PPS discovers devices including IoT devices connected to corporate network.
2. PPS leverages the list of IoT devices discovered using Profiler and based on device category and manufacturer or profile group and it enforces or controls the access to IoT devices protected by the firewall.
3. User authenticates to PPS and endpoint compliance is evaluated. The user session is created on PPS and appropriate role is assigned based on the compliance check and user ID.
4. User Identity details (AuthTable) are provisioned to firewall.
5. User tries to access IoT devices protected by firewall. Authorised users (based on roles) are allowed to access IoT devices. Access to IoT devices by unauthorised users is blocked.
6. A new IoT device is added to the corporate network and same is discovered by Profiler.
7. IoT Access Policy for the newly discovered IoT device is automatically pushed to SRX/PAN firewall.

Note:

- Only Local Profiler is currently supported.
- The Administrator can group the discovered devices based on any Profiler attributes. For more information see, Configuring Profiler Groups.

Configuring IoT Policy Provisioning

This section covers the procedure for configuring IoT Policy Provisioning on PPS.

- Basic Configurations
- Configuring IoT Access Policy
- Configuring Additional Device Category/Profile Groups

Pre-Requisite

IoT Policy Provisioning requires Profiler feature. You must install the Profiler license on PPS to enable it.

Summary of Configuration

A high-level overview of the configuration steps needed to set up IoT Policy Provisioning is shown below.

Step 1: Configure Profiler

Step 2: Configure SRX/PAN Enforcer

Step 3: Configuring IoT Access Policy

Step 3.1: Viewing Devices in Enforcer Policy Report

Step 3.2: Configuring IoT Access Policy

Step 4: Configuring Additional Device Category/Profile Groups

Basic Configurations

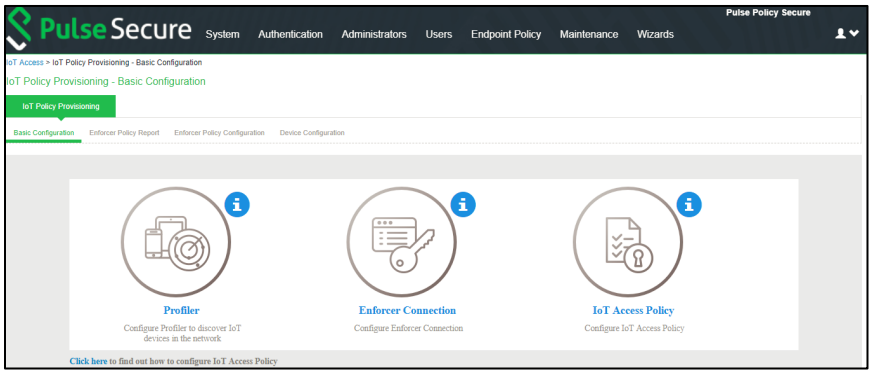
The basic configuration page enables you to configure Profiler to discover IoT devices in the network,

Enforcer to push the user identity information to PPS, and IoT Access Policy for IoT devices.

To launch the configuration page:

1. Select **Endpoint Policy > IoT Access > IoT Policy Provisioning**.
2. Click **Basic Configuration.**

Figure: Policy Provisoning- Basic Configurations



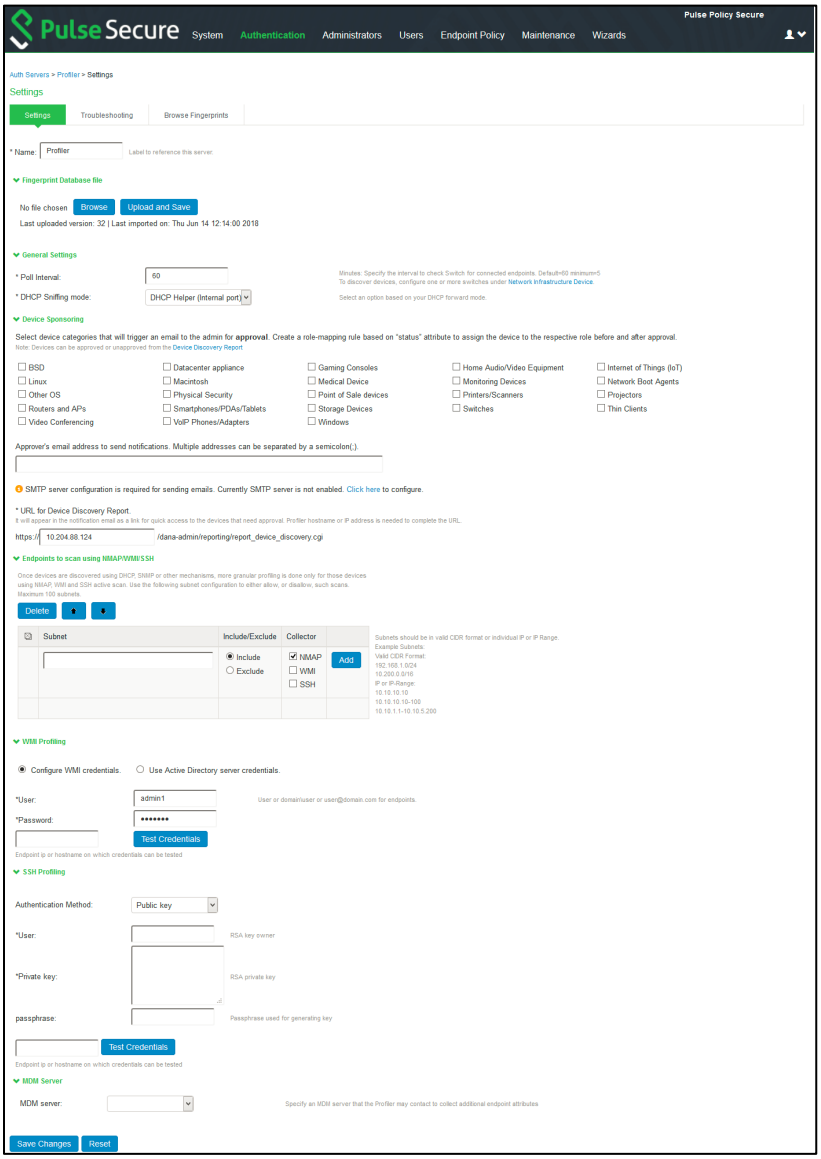
Note: If PPS is already configured with Profiler and Enforcer. The configurations will be reused.

3. Configure the Profiler used to discover the IoT devices in the network. Click **Profiler** and configure the local Profiler. See Profiler Deployment Guide for complete configuration.

The icons in the configuration page indicate the status of configuration.

- Green Tick mark refers that this section is configured correctly.
- If the configuration section is in grey color, it indicates that the section is not configured.
- Information icon refers that this section has to be configured.

Figure: Profiler Settings



4. Configure the SRX/PAN Enforcer. Click **Enforcer Connection** and add SRX/PAN as a New Enforcer.

Figure: SRX Enforcer

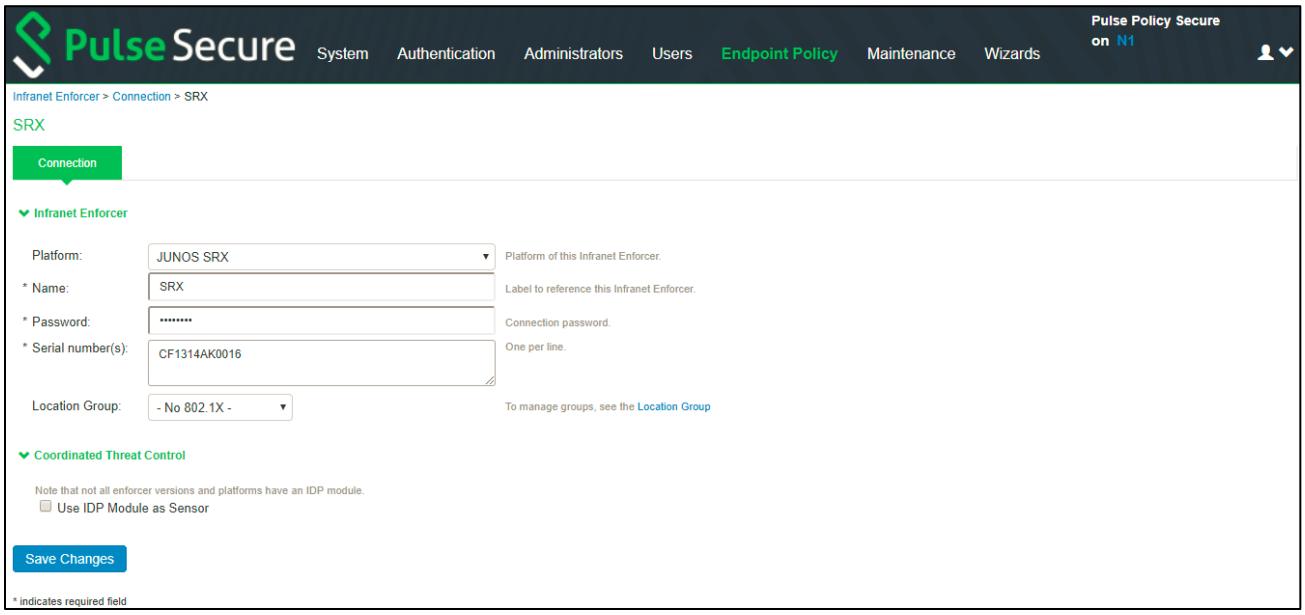
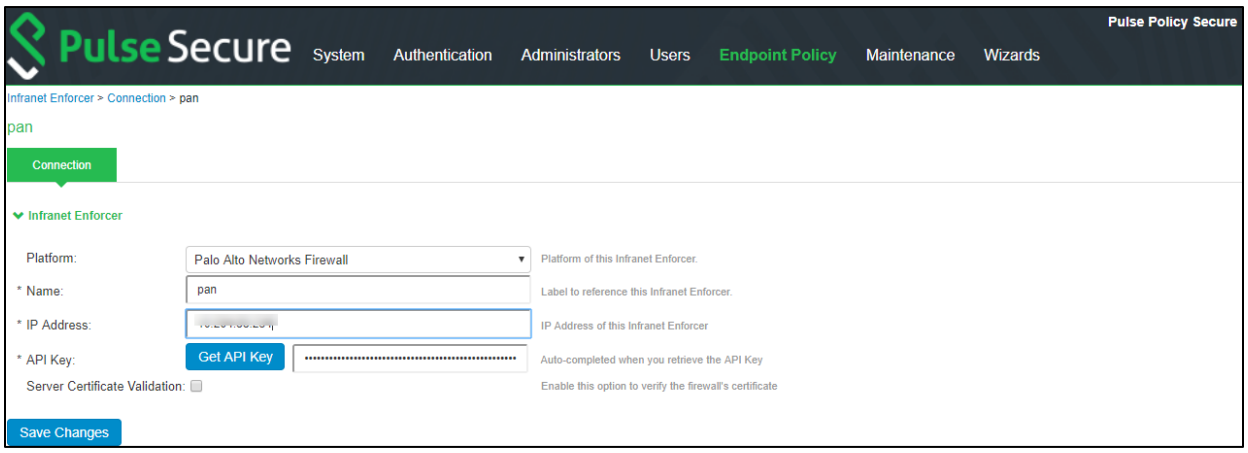
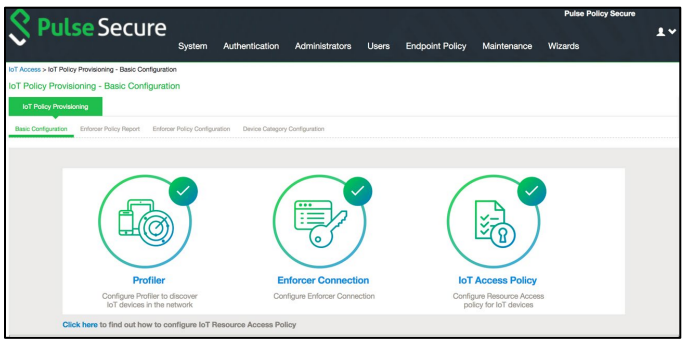


Figure: PAN Enforcer



Once the configuration is complete and successful, the Administrator can see the configuration status as shown below.



Configuring IoT Access Policy

- Viewing Devices in Enforcer Policy Report
- Configuring IoT Access Policy using Juniper SRX Firewall
- Configuring IoT Access Policy using Palo Alto Networks Firewall

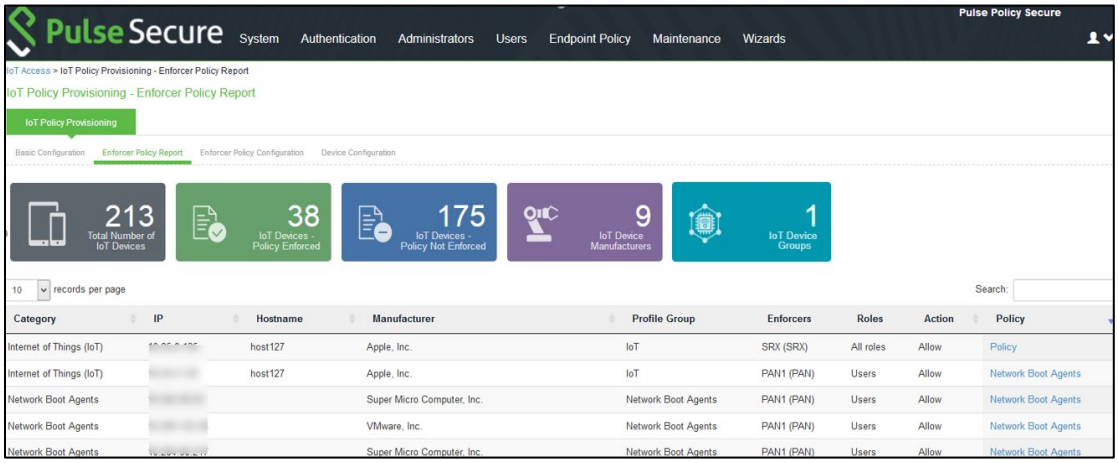
Viewing Devices in Enforcer Policy Report

This page provides details of discovered and connected IoT device's and firewall policies applied for IoT devices. You can view details such as total number of IoT devices, number of IoT devices enforced, number of IoT devices not enforced, and IoT device manufacturers.

To view the enforcer policy report:

1. Select **Endpoint Policy > IoT Access > IoT Policy Provisioning**.
2. Click **Enforcer Policy Report**.

Figure: Enforcer Policy Report



Configuring IoT Access Policy using Juniper SRX Firewall

The IoT access policy specifies which users are allowed or denied access to a set of protected resources. You can specify which users you want to allow or deny by choosing the roles for each IoT Access Policy. The IoT Access Policy page enables you to configure the policy based on device details using Profiler device attributes, such as device category and manufacturer or profile group.

When the network Administrator selects category and manufacturer or profile group information under device details the IP addresses of the corresponding discovered devices get automatically updated under Resources. Hence the Administrator can seamlessly create IoT Access Policy of profiled devices based on device category, device manufacturer attributes, or Profiler group. If the Administrator wants to have granular control over the IoT devices, further control can be achieved by providing specific port and protocol. The specified port and protocol configuration is applied to all the discovered devices of the selected category and manufacturers.

To configure IoT access policy:

1. Select **Endpoint Policy > IoT Access > IoT Policy Provisioning > Enforcer Policy Configuration**.
2. Click **New Policy**.
3. Enter the Policy name.
4. Enter a description.
5. Under Infranet Enforcer, select the Platform as **Junos SRX**.
6. Under **Device Details**, specify whether the policy should be applied based on device category and manufacturer or Profile group.
    a. Category and manufacturer
        i. Specify the category from the drop-down list. The values in the drop-down list is populated based on the Device category configuration (IoT Access > IoT Policy Provisioning - Device Configuration).
        ii. Select the Device manufacturer from the Available Device Manufacturers.
        iii. Specify the protocol (TCP/UDP/ICMP) and Port/Range to be applied to the discovered devices.
    b. Profile Group
        i. Configure the Profiler Group (IoT Access > IoT Policy Provisioning - Device Configuration). To configure Profiler Groups, Configuring Profiler Groups.
        ii. Select the Profile Group from the Available Profile Groups.
        iii. Specify the protocol (TCP/UDP/ICMP) and Port/Range to be applied to the discovered devices.

Note: Port ranges must be configured in dash-separated, comma-delimited, ascending, and non-overlapping order. Multiple port ranges must be separated by a comma. For example, the following examples show the delimiters that are used to enter port ranges:(80, 443, 1-1024, 1-100, 500-600).

The Port/Range entered will be applied to all the discovered devices. If you want to enter different port values, you can edit the port value under Resources table.

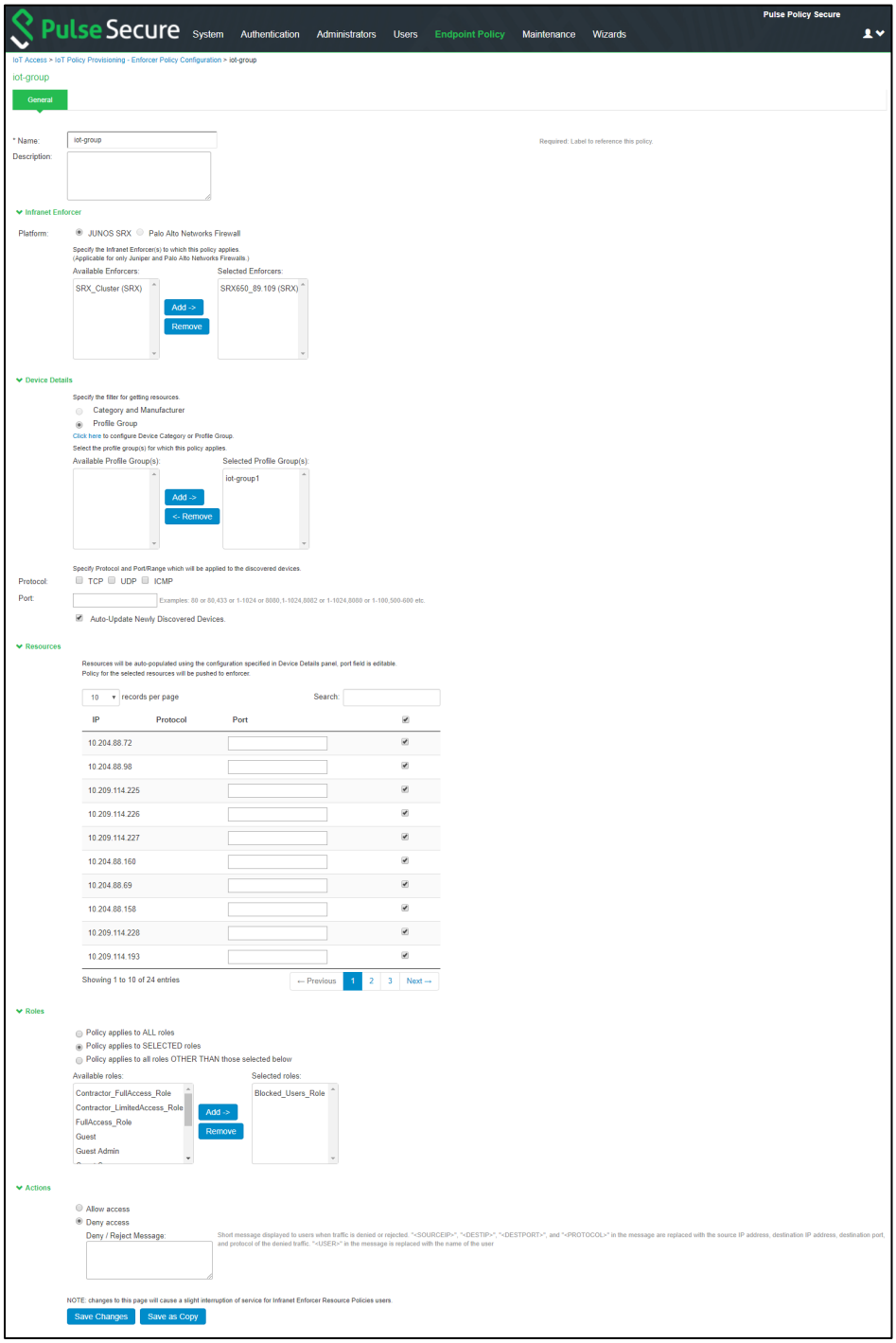
    c. Select **Auto-Update Newly Discovered Devices** to automatically add IoT Access Policy for the newly discovered devices from the selected category and manufacturer or Profile Group.

For example, If a policy is created for IoT device category with manufacturer or Profile Group with **Auto-Update Newly Discovered Devices** enabled then for any new IoT device discovered with the selected manufacturer, a IoT Access Policy is automatically added to firewall. If port and protocol are specified in the "Device Details" panel, the policy for the newly discovered devices is applied for specified port and protocol.

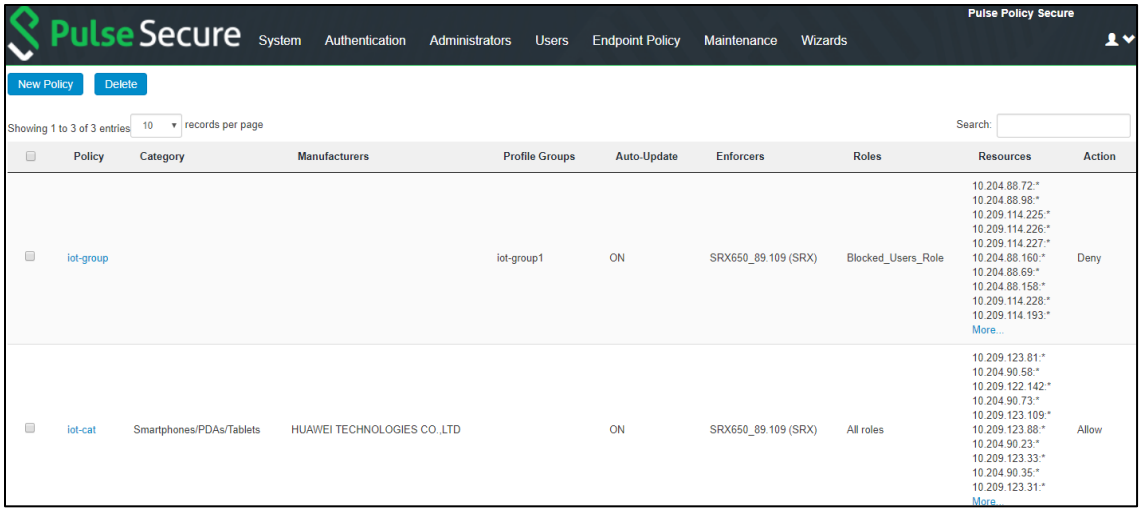
7. Under Resources, the IoT devices will be auto populated using the Device details configuration described earlier. If the administrator wants to apply policies on different ports for different discovered devices, the port configuration can be edited. If the Admin selects multiple protocol (for example, TCP and UDP) then the device entries appear twice with protocol information in the Resources table. The Admin can choose whether to push the policies for the selected resource based on the IP address, Protocol, and Port information to enforcer by enabling/disabling the checkbox in the resources table.
8. Select the desired Roles for which the policy applies. For example, IoT Administrator.

9. Under Actions, select whether to allow access or deny access.
10. Click **Save Changes**.

Figure: Junos SRX Enforcer Policy Configuration



Once the policy is successfully added, it can be viewed as shown below.



Note: The Device Details panel is only available when IoT Access Policy is created using IoT Policy Provisioning > Enforcer Policy Configuration.

Configuring IoT Access Policy using Palo Alto Networks Firewall

The IoT access policy specifies which users are allowed or denied access to a set of protected resources. You can specify which users you want to allow or deny by choosing the roles for each IoT Access Policy. The IoT Access Policy page enables you to configure the policy based on device details using Profiler device attributes, such as device category and device manufacturer or Profile Group.

When the network Administrator selects category and manufacturer or Profile Group information under device details the IP addresses of the corresponding discovered devices get automatically updated under Resources. Hence the Administrator can seamlessly create IoT Access Policy of profiled devices based on device category, device manufacturer attributes, or Profiler group. If the Administrator wants to have granular control over the IoT devices, further control can be achieved by providing specific port and protocol. The specified port and protocol configuration is applied to all the discovered devices of the selected category and manufacturers.

To configure IoT access policy:

1. Select **Endpoint Policy > IoT Access > IoT Policy Provisioning > Enforcer Policy Configuration**.
2. Click **New Policy**.
3. Enter the Policy name.
4. Enter a description.
5. Under Infranet Enforcer, select the Platform as **Palo Alto Networks Firewall**.
6. Under Security Zones, specify the firewall security zones (source zone/destination zone) for the policy. Multiple zones can be specified with comma separated values. If zones are not specified, then it applies to all zones.
7. Under Service, select any to allow all TCP and UDP ports (default) or select the service to specify the TCP or UDP port or port range. The policy port and protocol configuration remains same for all the resources.
8. Under **Device Details**, specify whether the policy should be applied based on device category and manufacturer or Profile group.
    a. Category and manufacturer
        i. Specify the category from the drop-down list. The values in the drop-down list is populated based on the Device category configuration (IoT Access > IoT Policy Provisioning - Device Configuration).
        ii. Select the Device manufacturer from the Available Device Manufacturers.
        iii. Specify the protocol (TCP/UDP) and Port/Range to be applied to the discovered devices.
    b. Profile Group
        i. Configure the Profiler Group (IoT Access > IoT Policy Provisioning - Device Configuration). To configure Profiler Groups, see Configuring Profiler Groups.
        ii. Select the Profile Group from the Available Profile Groups.
        iii. Specify the protocol (TCP/UDP) and Port/Range to be applied to the discovered devices.

Note: Port ranges must be configured in dash-separated, comma-delimited, ascending, and non-overlapping order. Multiple port ranges must be separated by a comma. For example, the following examples show the delimiters that are used to enter port ranges:(80, 443, 1-1024, 1-100, 500-600).

The Port/Range entered will be applied to all the discovered devices.

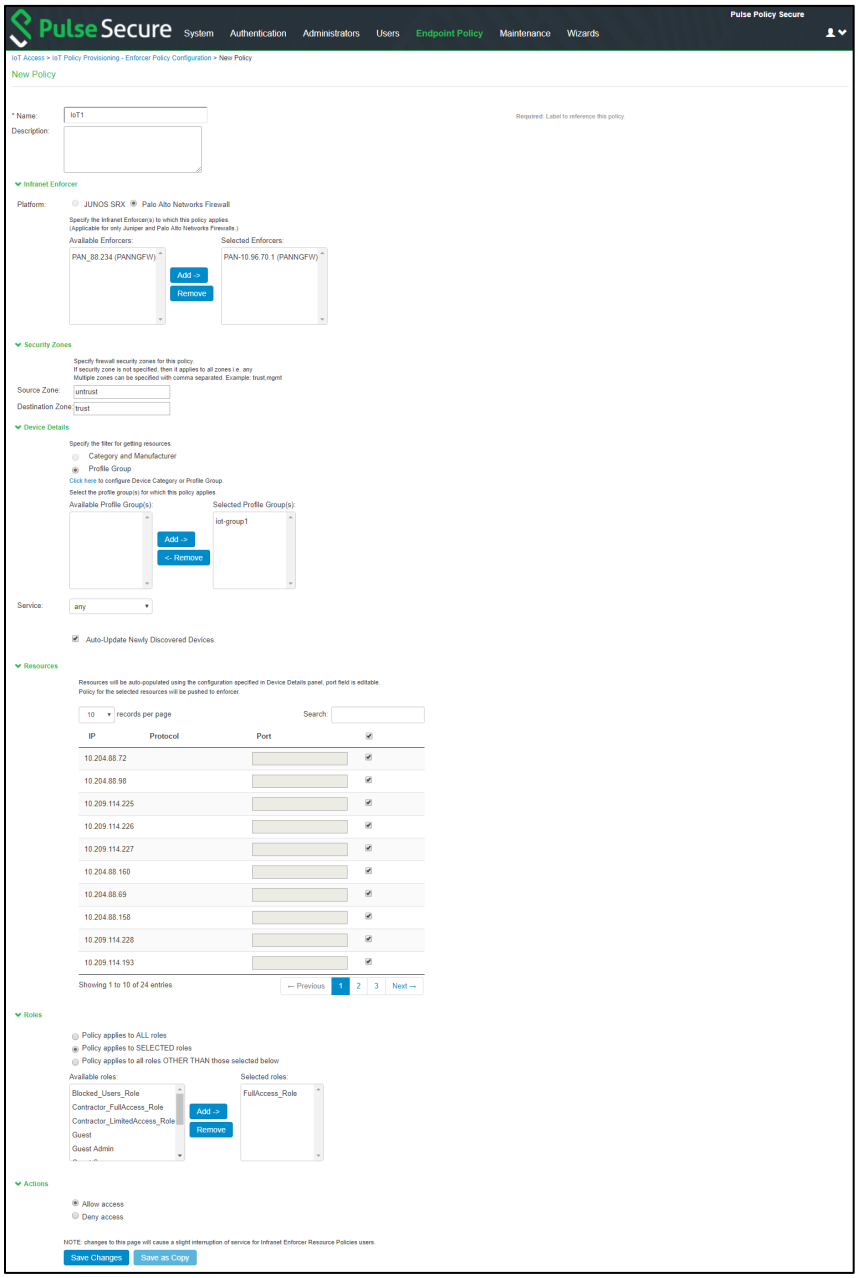
    c. Select **Auto-Update Newly Discovered Devices** to automatically add IoT Access Policy for the newly discovered devices from the selected category and manufacturer or Profile Group.

For example, If a policy is created for IoT device category with manufacturer or Profile Group with **Auto-Update Newly Discovered Devices** enabled then for any new IoT device discovered with the selected manufacturer, a IoT Access Policy is automatically added to firewall. If port and protocol are specified in the "Device Details" panel, the policy for the

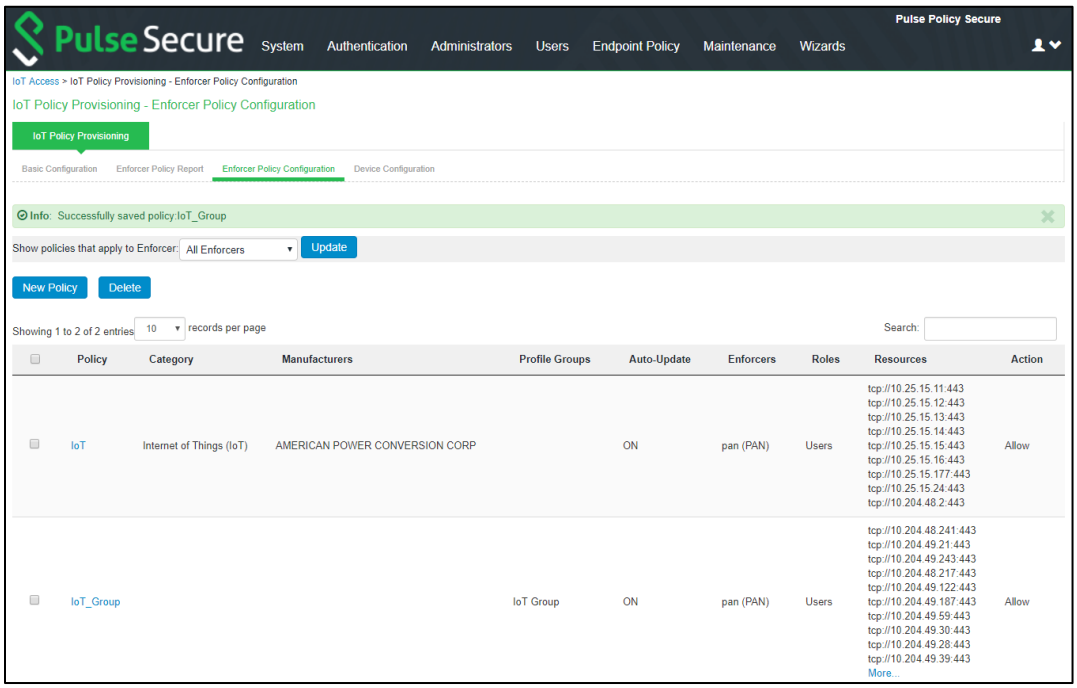
newly discovered devices is applied for specified port and protocol.

9. Under **Resources**, the IoT devices will be auto populated using the Device details configuration described earlier. If the administrator wants to apply policies on different ports and protocols for different discovered devices, the port configuration can be edited. If the Admin selects multiple protocol (for example, TCP and UDP) then the device entries appear twice with protocol information in the Resources table. The Admin can choose whether to push the policies for the selected resource based on the IP address, Protocol, and Port information to enforcer by enabling/disabling the checkbox in the resources table.
10. Select the desired Roles for which the policy applies. For example, IoT Administrator.
11. Under **Actions**, select whether to allow access or deny access.
12. Click **Save Changes**.

Figure: Palo Alto Networks Firewall Enforcer Policy Configuration



Once the policy is successfully added, it can be viewed as shown below.



Note:

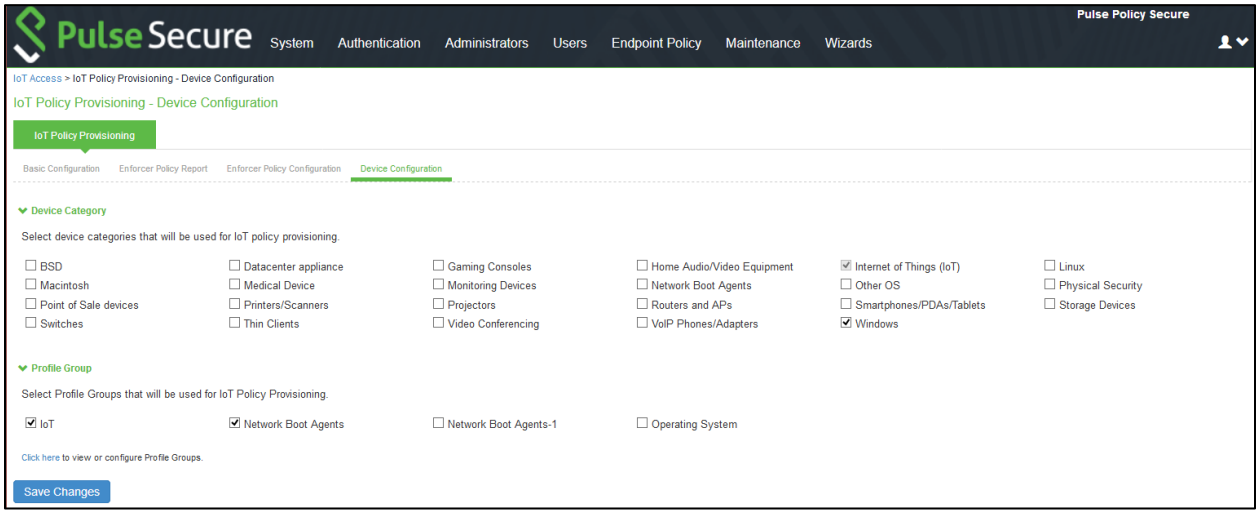
Resource Access Policy and IoT Policy Provisioning with Palo Alto Network's Firewall works only with default Virtual System "vsys1" and default device name "localhost.localdomain" configuration.

Configuring Additional Device Category/Profile Groups

The Internet Of Things (IoT) device category is selected by default and hence it is visible by default on IoT policy enforcer report and Policy Configuration page. However, If the Administrator wants to use IoT Policy Provisioning feature for other Profiler supported categories such as Video Conferencing Devices, Printers/Scanners, Medical device, Storage device and so on additional categories can be configured on this page.

Under Profile Groups, Admin can select the groups that should be used with IoT Policy Provisioning feature. Only the selected Profile Groups are shown while creating IoT access policy using Profile Groups. If none of the Profile Groups are selected in Device Configuration tab then no groups are shown in IoT access policy. To create IoT access policy using Profile Groups, the same needs to be selected in the Device Configuration tab.

Figure: Device Category Configuration

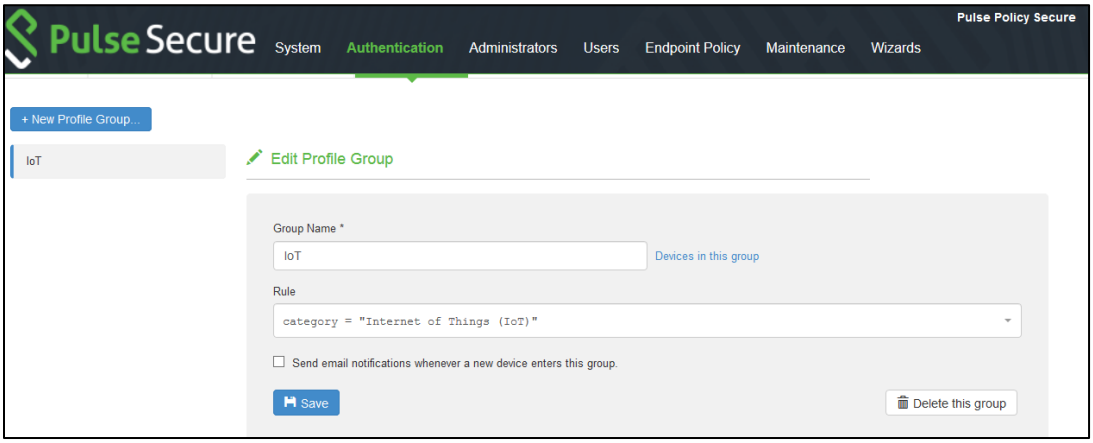


Configuring Profiler Groups

Administrator can create different Profile Groups by using different Profiler attributes (for example, group all IoT devices with manufacturer Schneider Electric and Operating System Linux) and combine discovered devices in a group. If an Admin wants to provision IoT Access policy using attributes other than Category and Manufacturer, a Profile Group can be created to group discovered devices and then IoT Policy Provisioning feature can be used for the resources belonging to Profile Group.

To configure Profiler Groups:

1. Select the Profiler server under **Authentication > Auth. Servers**.
2. Select Profile Groups tab, select the **New Profile Group**.
3. Enter the Group Name and Rule. The rules can be written with device attributes and suggested operators can be chosen from the list.
4. As an optional step, emails also can be configured which results in notifications for any group related changes.



5. Click **Save Changes**.

Troubleshooting

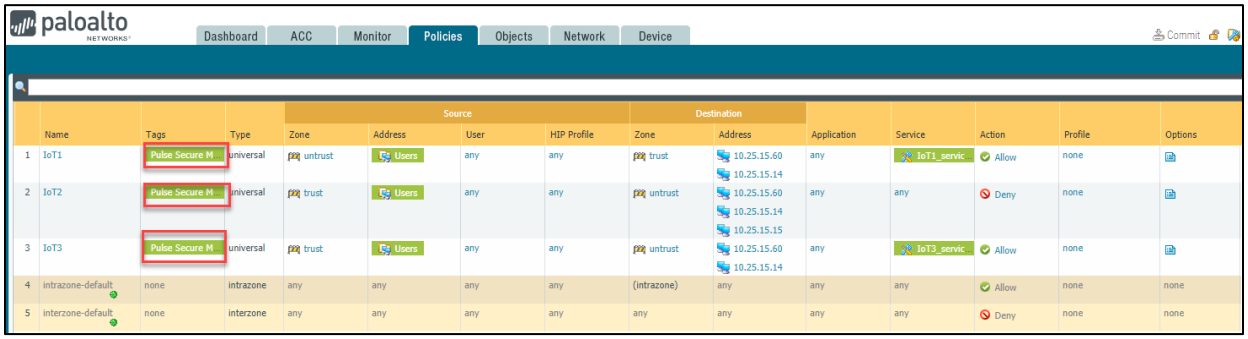
The event and debug logs can be used for troubleshooting:

- The Event logs are generated whenever the policies are pushed to firewall.
- The Admin Logs are generated upon policy provisioning and auto updation of newly discovered devices.

You can also use **Maintenance > Troubleshooting > Monitoring > Debug Log** for debugging issues.

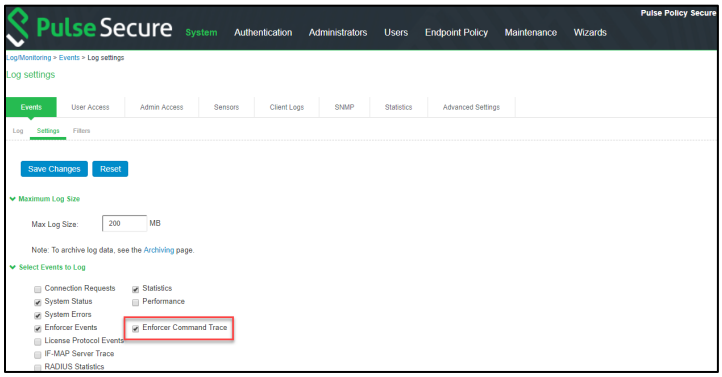
If the device is not discovered properly in the IoT Policy Provisioning > Enforcer Policy Report page check the Device Discovery Report page for the device category.

The PPS created policies on PAN firewall should not be modified by the PAN admin. The PPS created policies on Palo Alto Networks firewall are tagged as *Pulse Secure Managed*.

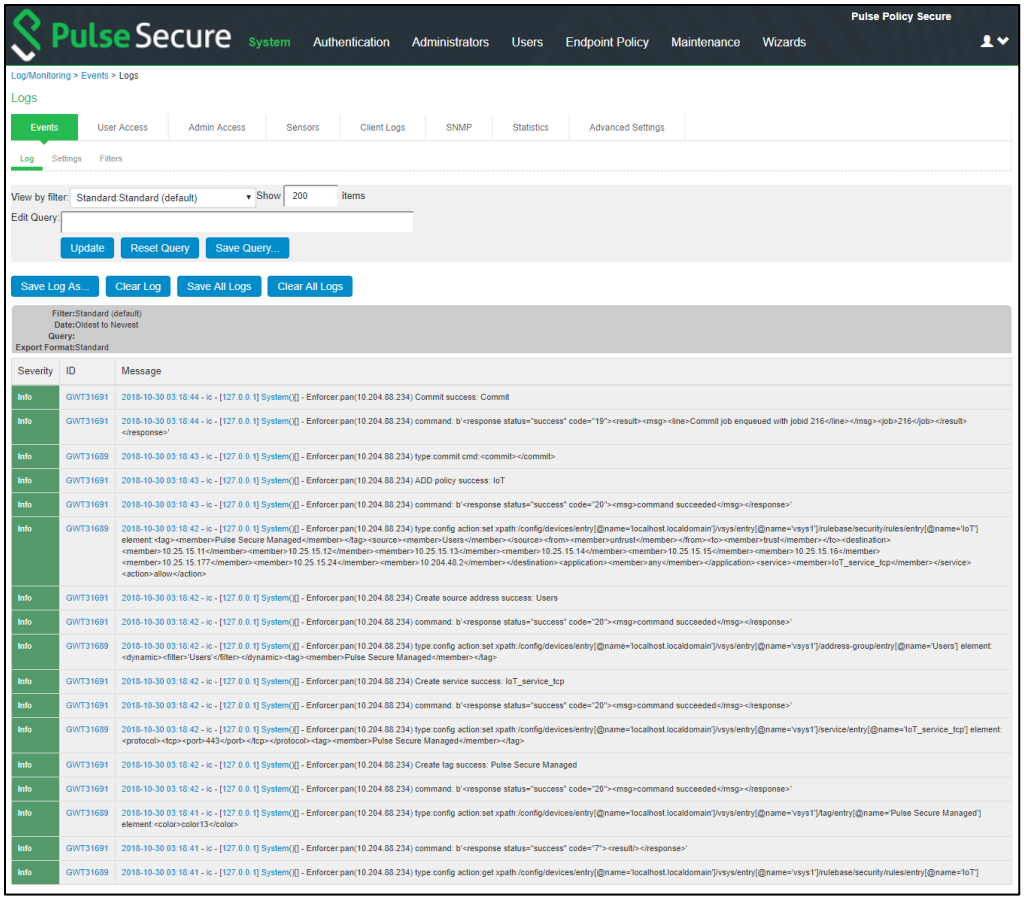


Event Logs

To view the communication between PPS and Infranet Enforcer enable **Enforcer Command Trace** under Events > Settings.



A sample event logs is shown below.



Admission Control Using Network Security Devices

This part covers the following chapter:

- Alert Based Admission Control using Fortinet Products
- Alert Based Admission Control using PAN Next Generation Firewall
- Alert Based Admission Control using Juniper SDSN

Alert Based Admission Control using Fortinet Products

This chapter provides an overview of enforcement using Fortinet firewall. It includes the following information:

- Overview
- Configuring PPS with Fortinet Products
- Configuring Fortinet Products
  - Configuring FortiGate Firewall
  - Configuring FortiGate Analyser
- Troubleshooting

Overview

PPS integration with network security devices provide user access control based on the threats identified by the network security devices. The network security device provides intelligence driven detection of threats based on the intrusion prevention system. This helps in detecting the unknown threats and also reduces the false alarms. The network security device uses the syslog events or REST API mechanism to notify the other devices regarding the network threats. PPS also supports dynamically changing the access to the user based on the information received from the network security device.

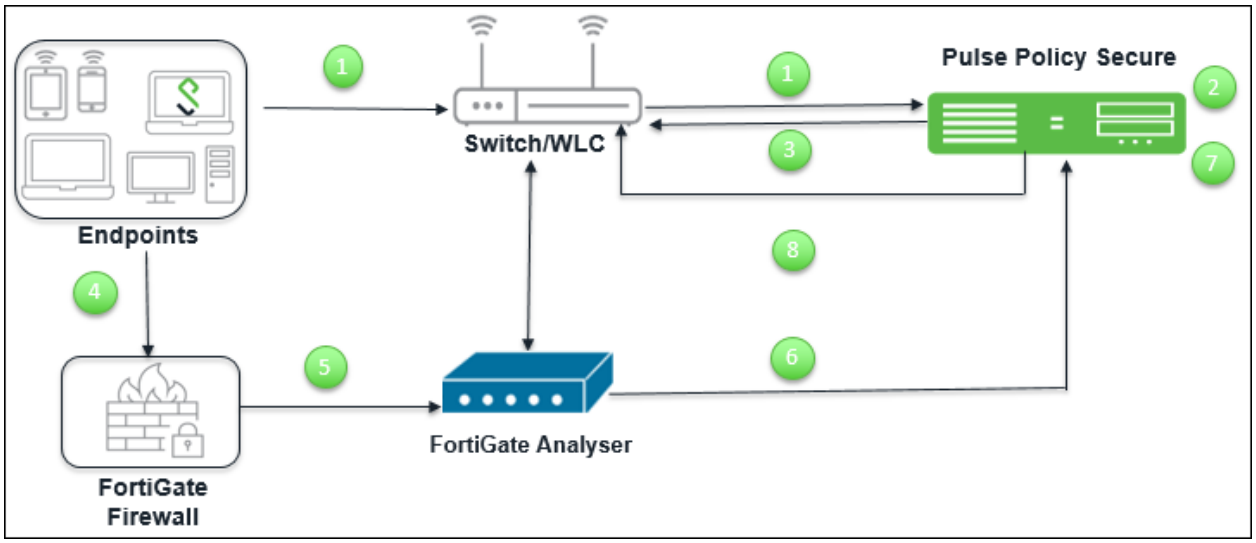
The admission control user flow is as follows:

1. The user logs into the PPS and a corresponding session is created on PPS.
2. The user starts accessing the resources and tries to access a restricted website or application.
3. The network security device identifies it as threat and generates a corresponding syslog event and sent to PPS.
4. PPS receives the threat information and based on the policies configured it modifies the user access. For example, changing user access, terminating user access and so on.

Deployment of PPS using Fortigate Products

This section describes the integration of PPS with Network Security Devices (For example, FortiAnalyser and FortiGate firewall). PPS integrates with Fortinet's syslog notification mechanism to receive the threat alert information from Fortinet and takes an action based on the admin configured policies.

Figure162: Deployment using FortiAnalyser and FortiGate Firewall



The authentication process is described below:

1. The user connects to PPS through Switch/WLC.
2. The user session is created on the PPS.
3. The user details are pushed to Switch for enforcing access to user.
4. The FortiGate firewall monitors the user traffic.
5. The FortiGate Analyser/Manager generates the syslog messages for the user.
6. The syslog message is sent to PPS if any suspicious traffic or activity is detected from the user.
7. PPS processes the received syslog message and based on the configured policies actions are taken.
8. New/Updated details are pushed to Switch for updating the enforcement of the user.

Note: The enforcement of the user is also updated on the Firewall.

Configuring PPS with Fortinet Products

The network security devices are configured with PPS for admission access control. A high-level overview of the configuration steps needed to set up and run the integration is described below:

- The Administrator configures the required syslog clients on PPS Admin UI.
  The network security device acts as a syslog client on which syslog forwarding is enabled and PPS receives the forwarded syslog messages.
- The Administrator then configures a set of policies that define what actions are to be taken on user sessions, based on the data in the threat events.
- The user defined templates are used to map the data and the predefined variables. The predefined variables in the template are Rule Name, Source IP Address, Source User, and Severity.
- The templates for parsing the syslog messages from Fortinet Firewall/Analyser are available by default. The administrators can also add customised templates for integrating with other network security devices.

This section covers the following topics:

Admission Control Template

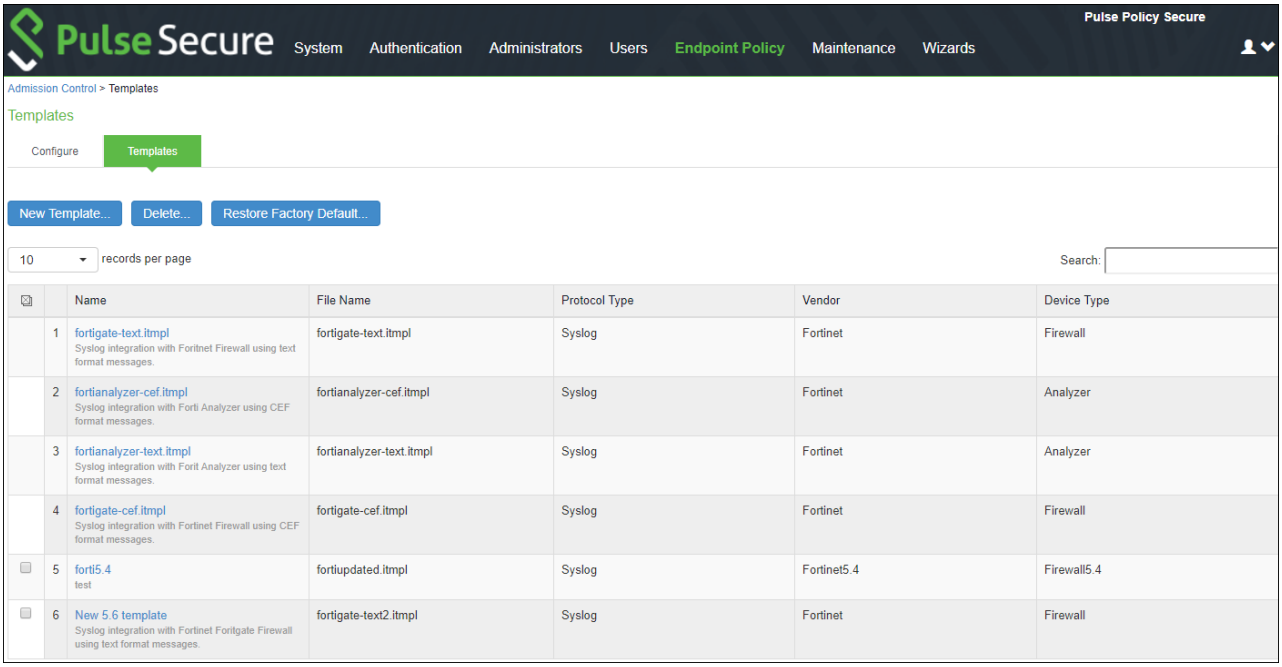
The admission control template parses the events based on the variables such as source IP, source user, rule name, and severity. The corresponding action such as terminating the session, disabling the user, changing the user role is taken based on the template configuration.

You can view the list of configured integration templates that provides the list of network security devices and the supported protocol type using Endpoint Policy > Admission Control > Templates.

To view and add the admission control templates:

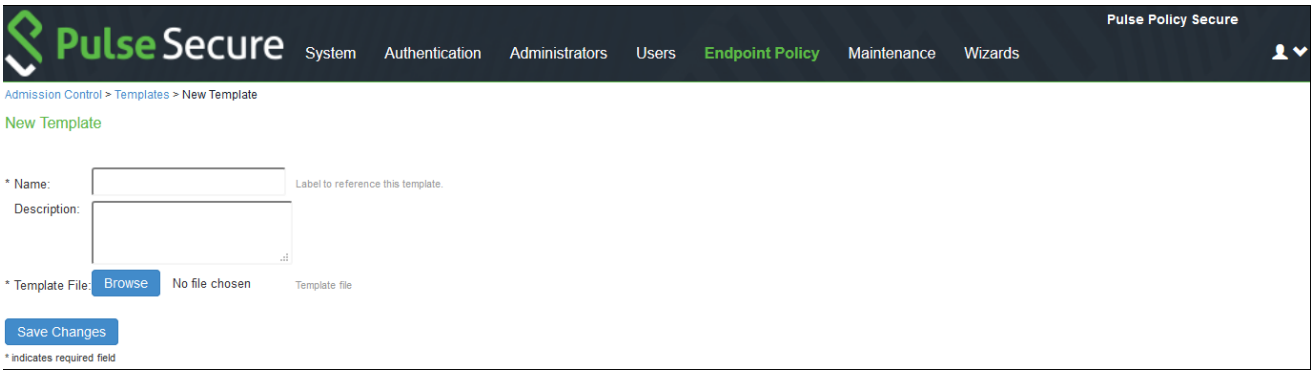
7. Select **Endpoint Policy > Admission Control > Templates**.

Figure 163: Existing Template



8. Click **New Template**.

Figure 164: Adding New Configuration Template



9. Enter the template name.

10. Enter the description.
11. Click **Browse** and select the template file.
12. Click **Save Changes**.

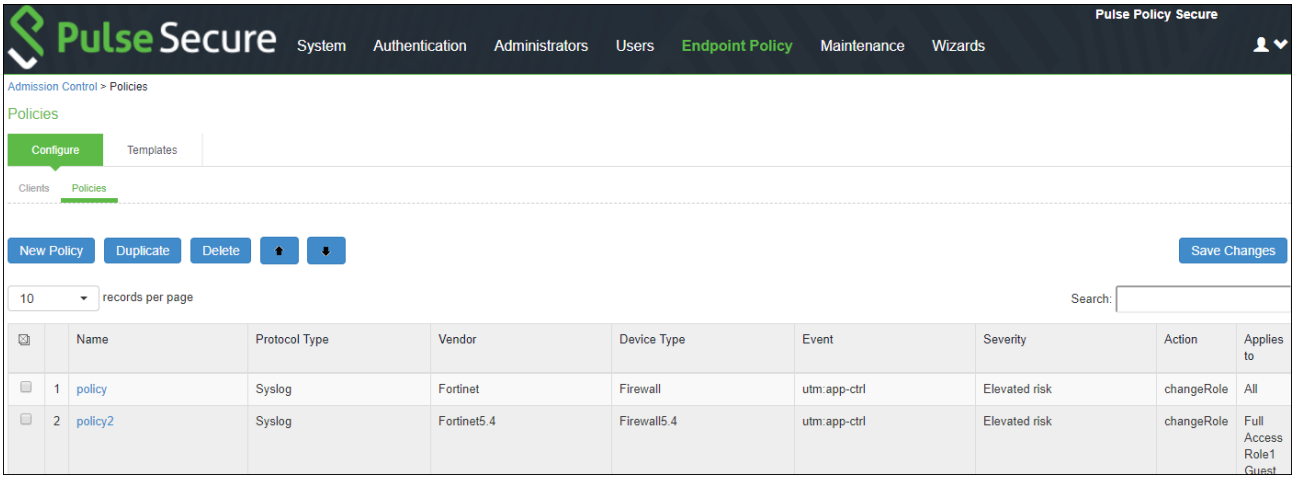
Admission Control Policies

The admission control policies define the list of actions to be performed on PPS for the user sessions. The actions are based on the specific threat event information received from the network security device.

To view and add the new integration policy:

10. Select **Endpoint Policy > Admission Control > Policies**.

Figure 165: Configuration Policies



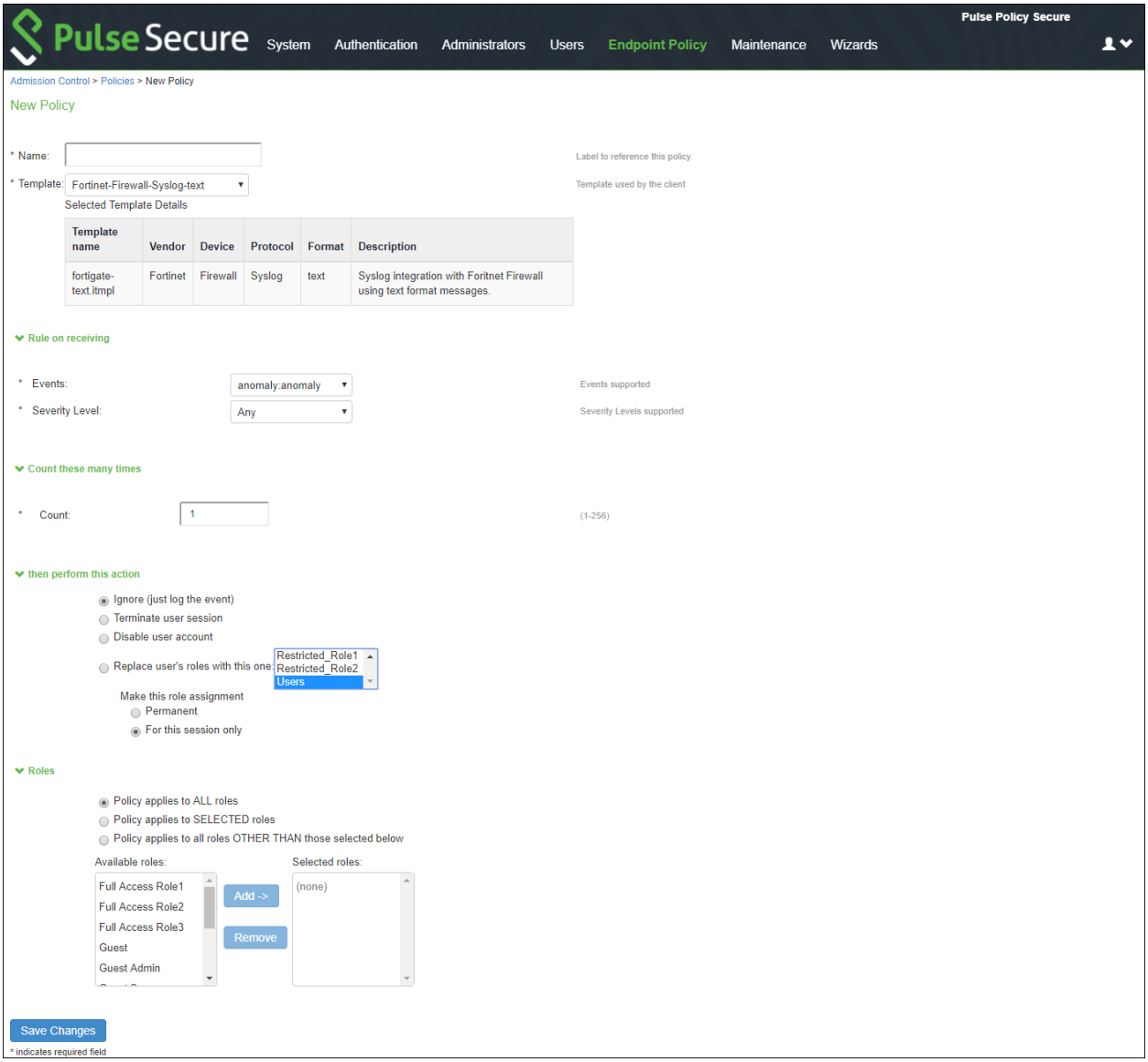
11. Click **New Policy**.
12. Enter the policy name.
13. Select the template used by the client. The following templates are available by default for Fortinet:
    - Fortinet-Firewall-Syslog-text
    - Fortinet-Analyzer-Syslog-CEF
    - Fortinet-Analyzer-Syslog-text
    - Fortinet-Firewall-Syslog-CEF
14. Under **Rule on Receiving**, select the event type and the severity level. The event types and the severity level are based on the selected template.
15. Under **Count these many times**, enter the number between 1-256.
16. Under **then perform this action**, select the desired action.
    - Ignore (log the event) —Received syslog event details are logged on the PPS and no specific action is taken.
    - Terminate user session— Terminates the user session on the PPS for the received messages.
    - Disable user account— Terminates the user session and disables the user on the PPS for the received messages.
    - Replace user role with this role— Changes the roles assigned to the user on PPS so that restriction/privileges for the user can be changed.
        - Specify whether to apply the role assignment permanently or only for the session.

17. Under **Roles**, specify:
    - Policy applies to ALL roles—To apply the policy to all users.
    - Policy applies to SELECTED roles—To apply this policy only to users who are mapped to roles in the Selected roles list. You must add roles to this list from the Available roles list.

- Policy applies to all roles OTHER THAN those selected below—To apply this policy to all users except for those who map to the roles in the Selected roles list. You must add roles to this list from the Available roles list.

18. Click **Save changes**.

Figure 166: Adding New Configuration Policy



Admission Control Client

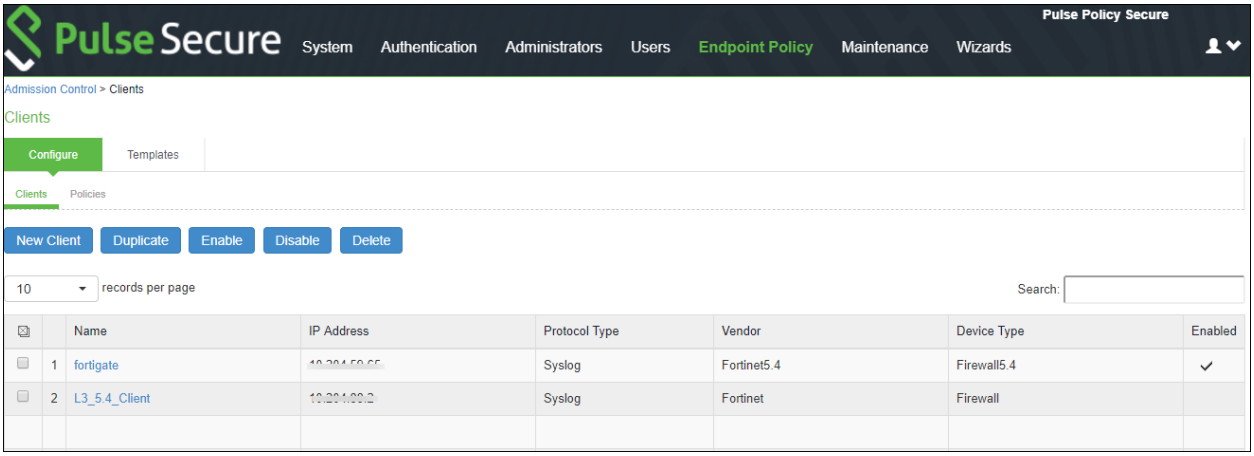
The admission control clients are the network security devices on which the syslog forwarding is enabled. The messages are received by the syslog server module running on PPS.

For example, you can add Fortigate Firewall/Analyzer as a client on PPS to receive the required threat information through syslogs.

To add a client:

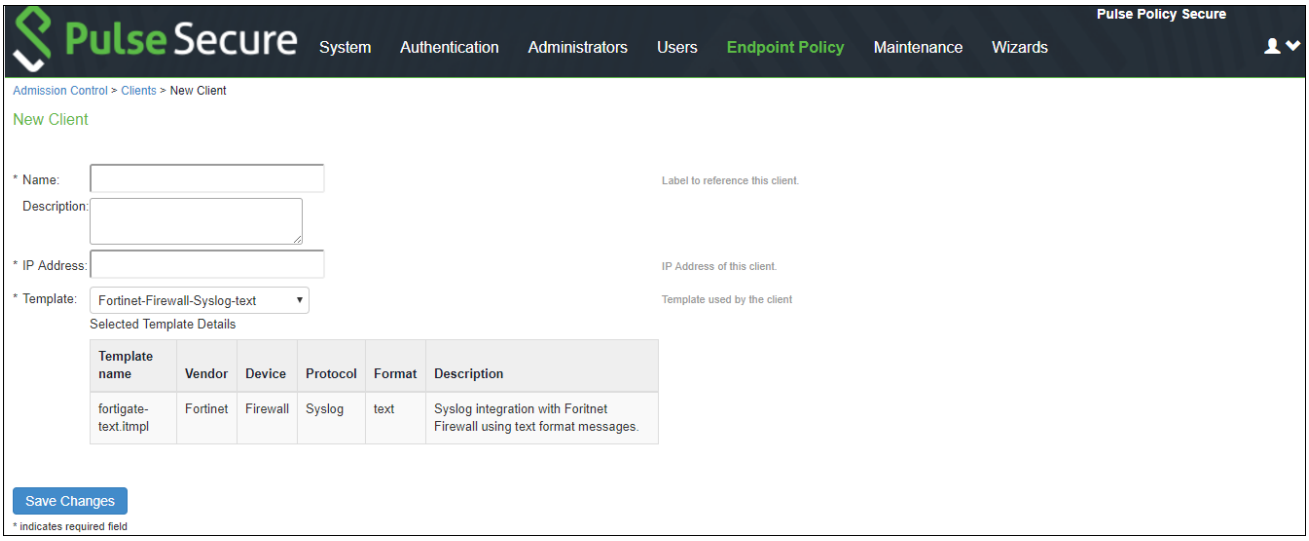
14. Select **Endpoint Policy > Admission Control > Clients**.

Figure 167: Admission Control Client



15. Click **New Client**.
16. Enter the name of the client that will be added in the PPS.
17. Enter the description.
18. Enter the IP address of the client.
19. Select the template used by the client.
    - Fortinet-Firewall-Syslog-text
    - Fortinet-Analyzer-Syslog-CEF
    - Fortinet-Analyzer-Syslog-text
    - Fortinet-Firewall-Syslog-CEF
20. Click **Save Changes**.

Figure 168: Adding Clients



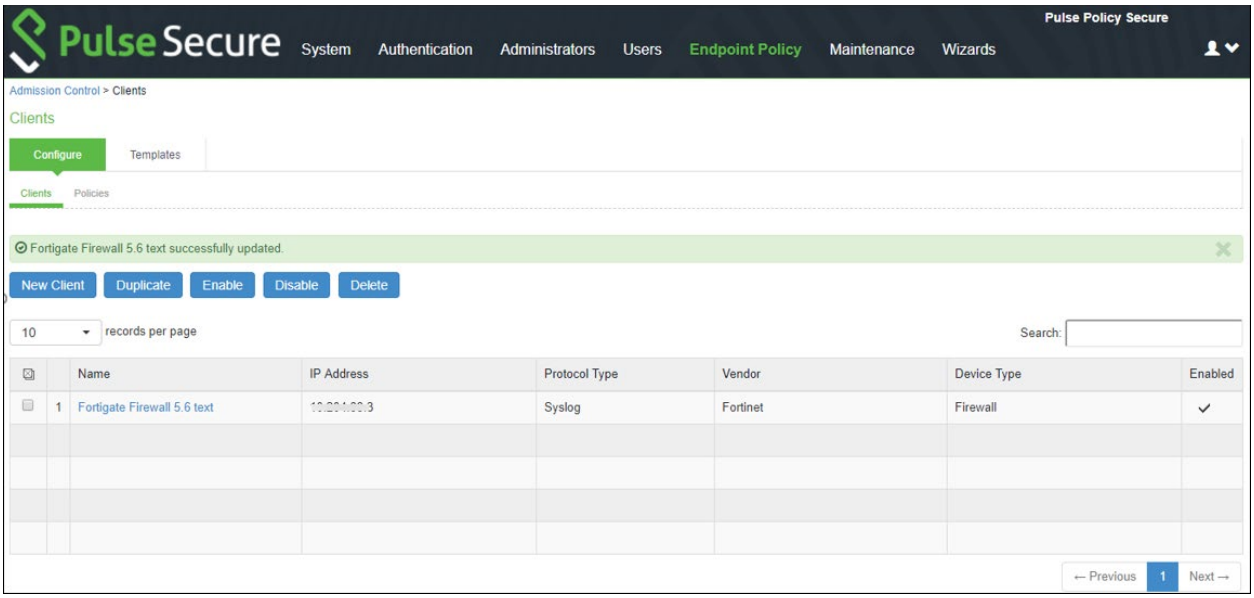
Configuring FortiGate Firewall

The PPS device must be added as a syslog server while configuring the Fortigate firewall for sending the logging information. You must add Fortigate firewall as syslog client on PPS.

To configure FortiGate firewall:

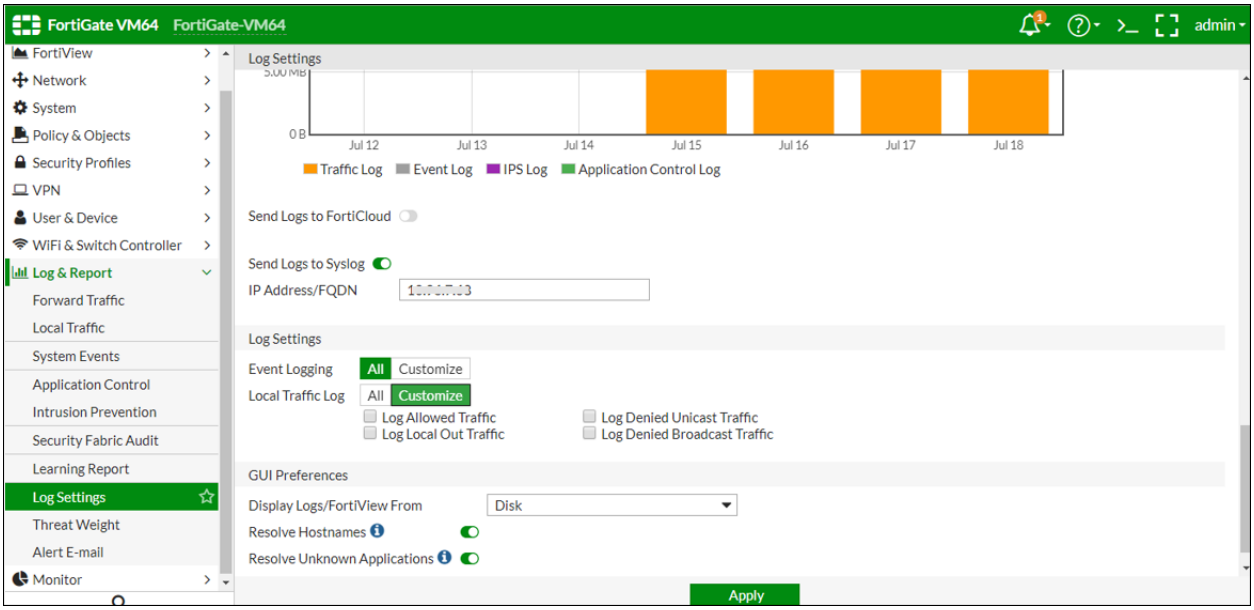
1. Select **Endpoint Policy > Admission Control > Clients**. Add the Fortigate Firewall as a Syslog Client on PPS.

Figure 169: Syslog Client



2. Under Log Settings, enable **Send Logs to Syslog**.
3. Enter the IP address of the PPS device and click **Apply** to add it as a syslog server.

Figure 170: Log Settings



4. The default syslog format is text. You must use the following command to change the format to CEF.

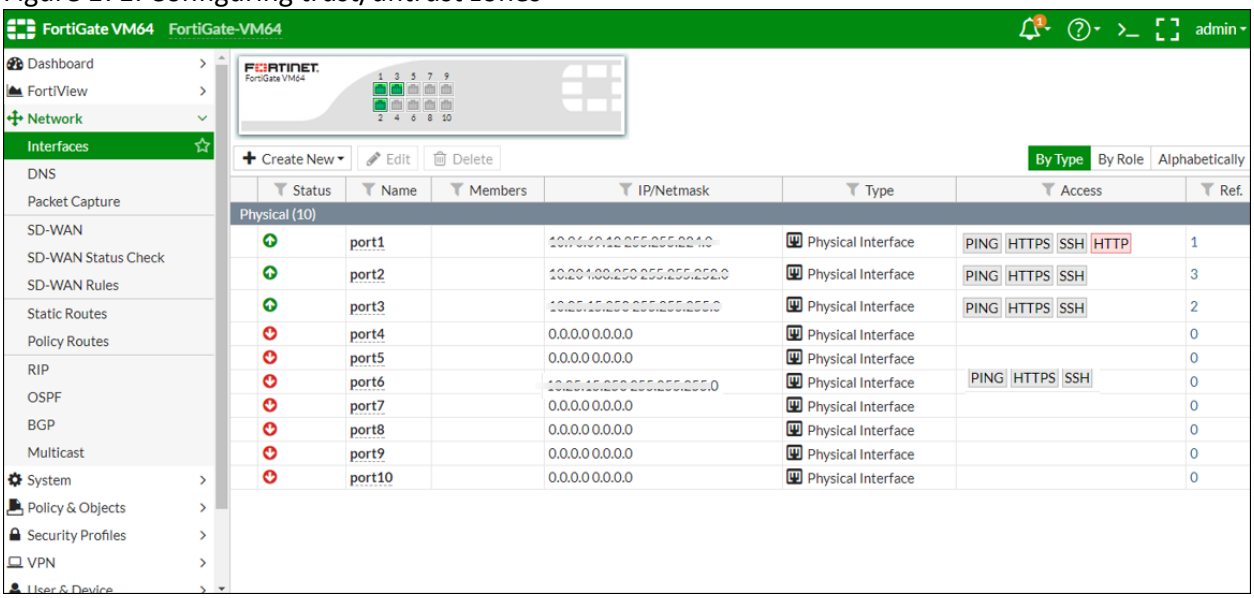
```
FortiGate-VM64 # config log syslogd setting

FortiGate-VM64 (setting) # show
config log syslogd setting
    set status enable
    set server "10.96.7.68"
    set format cef
end
```

5. To access the firewall, you must configure Firewall management interface settings.

```
FGVM020000076196 # config system interface

FGVM020000076196 (interface) # edit port6

FGVM020000076196 (port6) # set ip 192.168.0.1 255.255.255.0

FGVM020000076196 (port6) # set allowaccess ping https http ssh fgfm

FGVM020000076196 (port6) # set type physical

FGVM020000076196 (port6) # set status up

FGVM020000076196 (port6) #
FGVM020000076196 (port6) #
FGVM020000076196 (port6) # show
config system interface
    edit "port6"
        set vdom "root"
        set ip 192.168.0.1 255.255.255.0
        set allowaccess ping https ssh http fgfm
        set type physical
        set snmp-index 6
    next
end
```

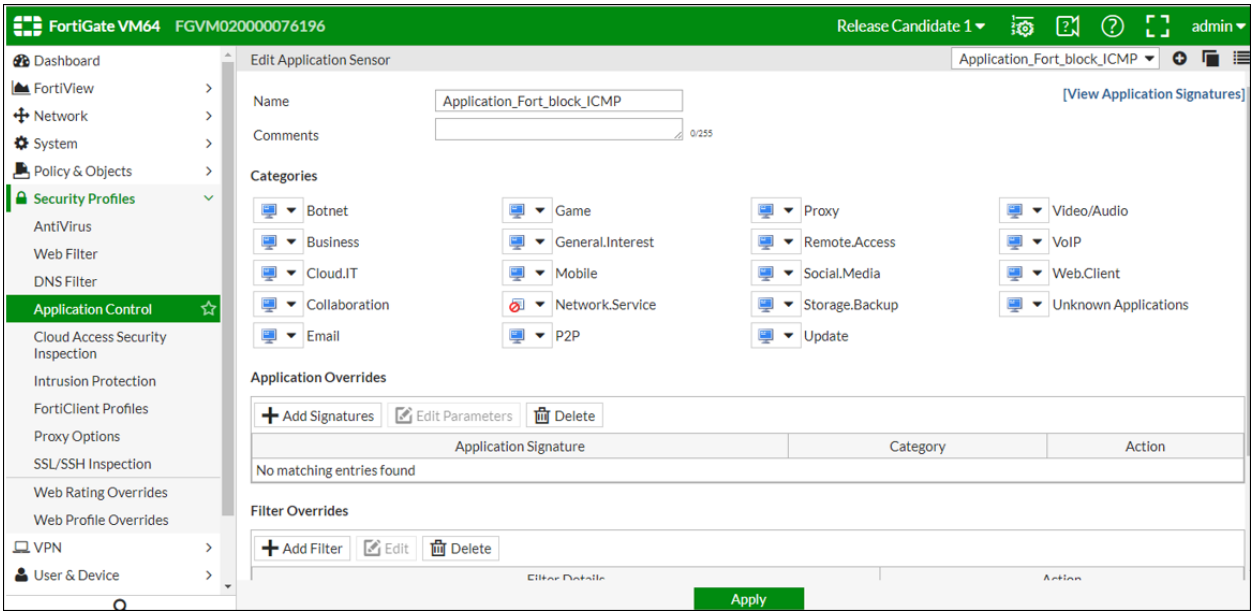
6. Under **Interfaces**, configure the trust and untrust zones.

Figure 171: Configuring trust/untrust zones



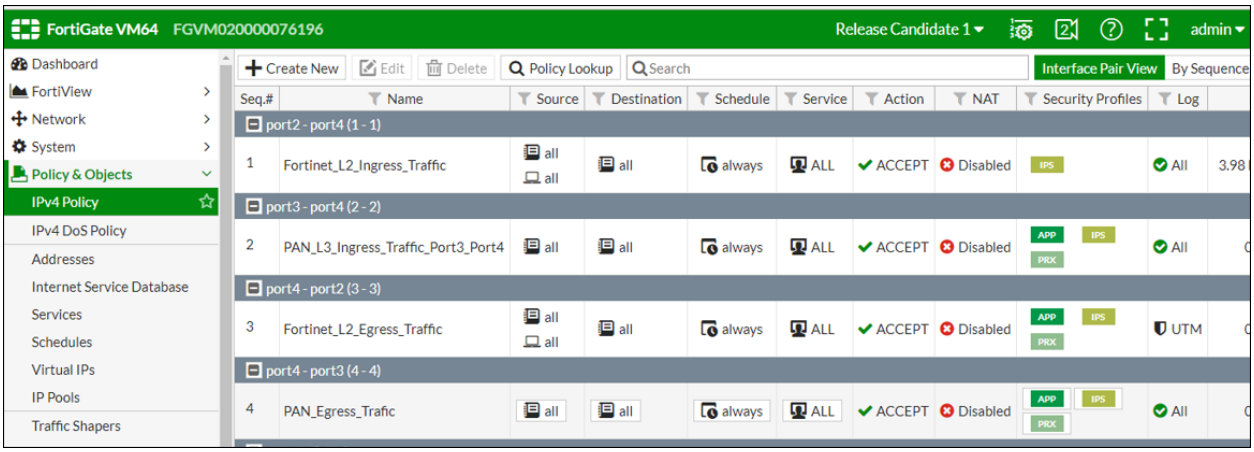
7. Under **Security Profiles > Application Control**. Create a security profile.

Figure 172: Creating Security Profile



8. Under **Policy & Objects**, apply policies to desired port.

Figure 173: Policy

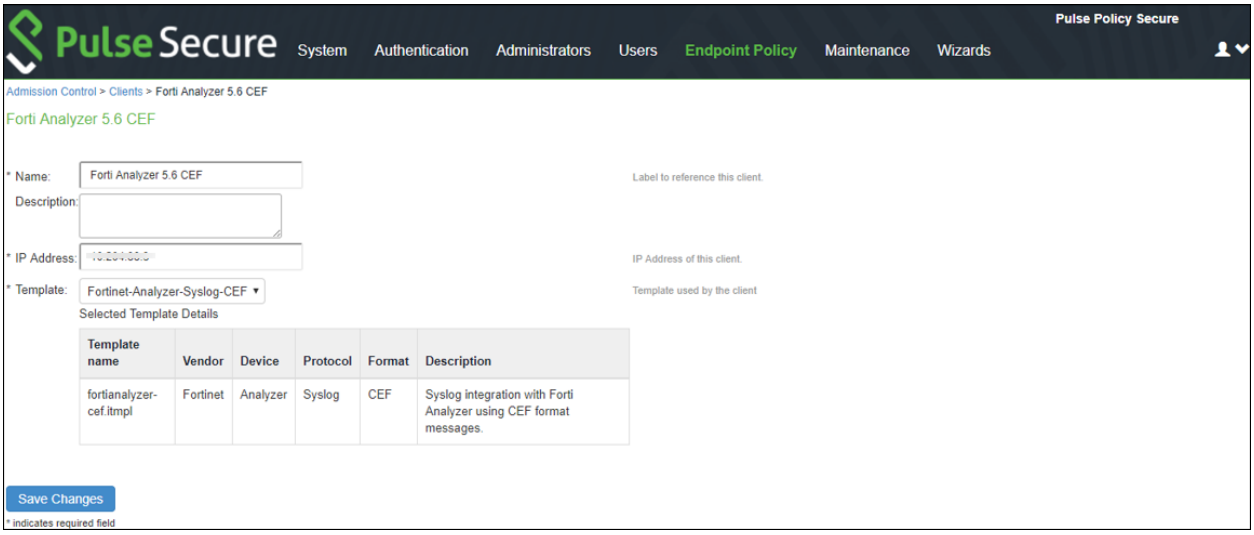


Configuring FortiGate Analyser

To configure FortiGate firewall:

1. Add the FortiAnalyzer as a Syslog Client on PPS.

Figure 174: FortiAnalyzer



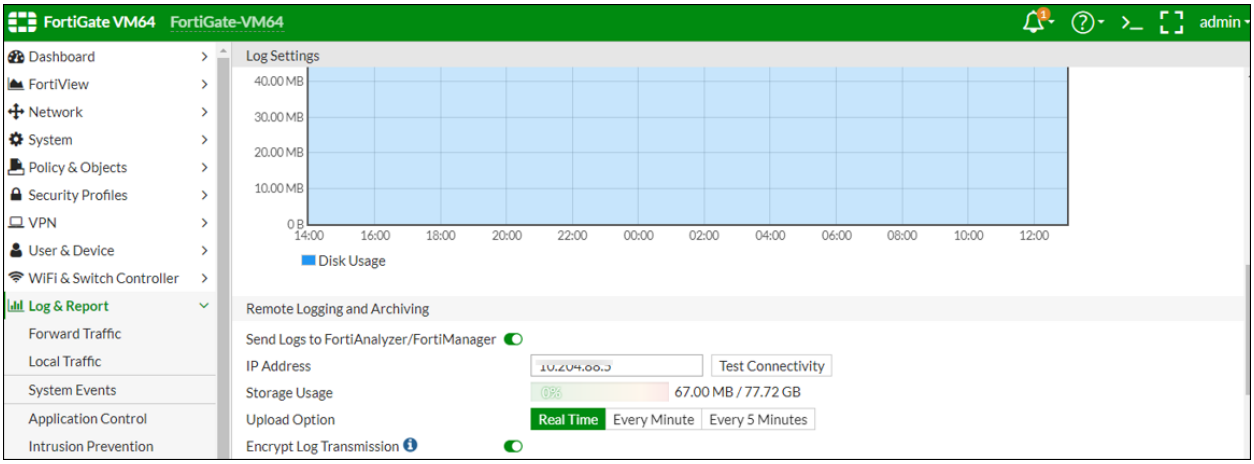
2. Configure the FortiAnalyser management interface through CLI.

```
FAZVM64 # config system interface

(interface)# show
config system interface
    edit "port1"
        set ip 10.204.88.5 255.255.252.0
        set allowaccess ping https ssh telnet http
    next
    edit "port2"
        set ip 10.96.71.6 255.255.224.0
        set allowaccess ping https ssh snmp telnet http fgfm
    next
    edit "port3"
    next
    edit "port4"
    next
end
```

```
FAZVM64 # config system route

(route)# show
config system route
    edit 1
        set device "port1"
        set gateway 10.204.63.254
    next
    edit 2
        set device "port3"
        set gateway 10.96.64.1
    next
end
```

3. Enable **Send Logs to FortiAnalyzer/FortiManager** to forward the syslog message. Enter the IP address of the FortiAnalyser.

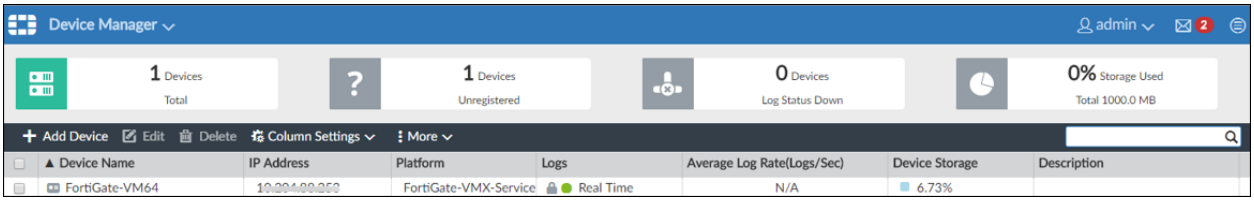
Figure 175: Forwarding



Note: On Fortigate Firewall, configure the security policy – network trust, untrust zone and apply the policy to desired ports.

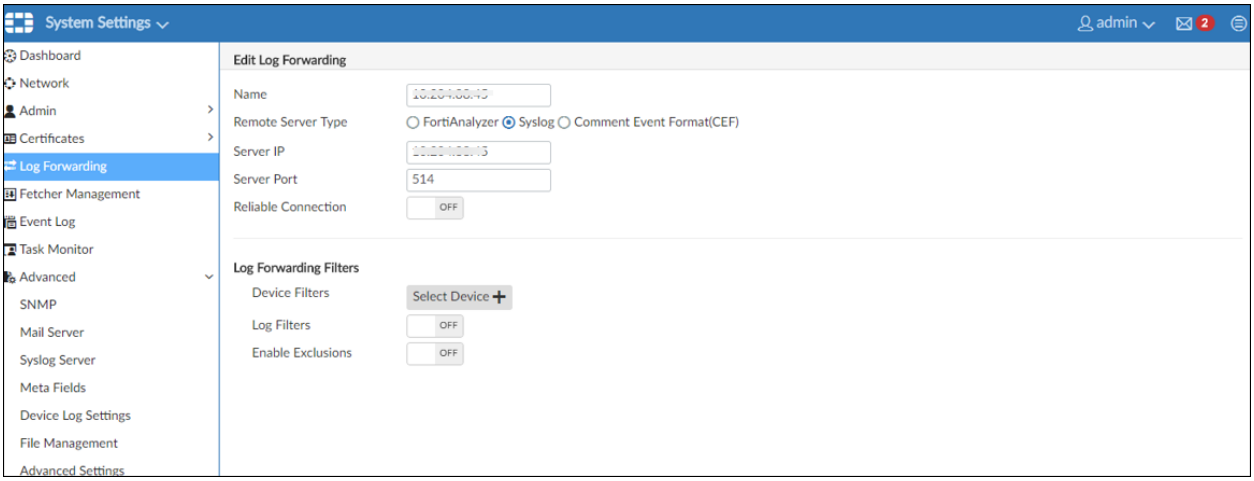
4. Under **FortiAnalyser** > **Device Manager**, Click **+ Add Device** to add Fortigate firewall.

Figure 176: Adding Device

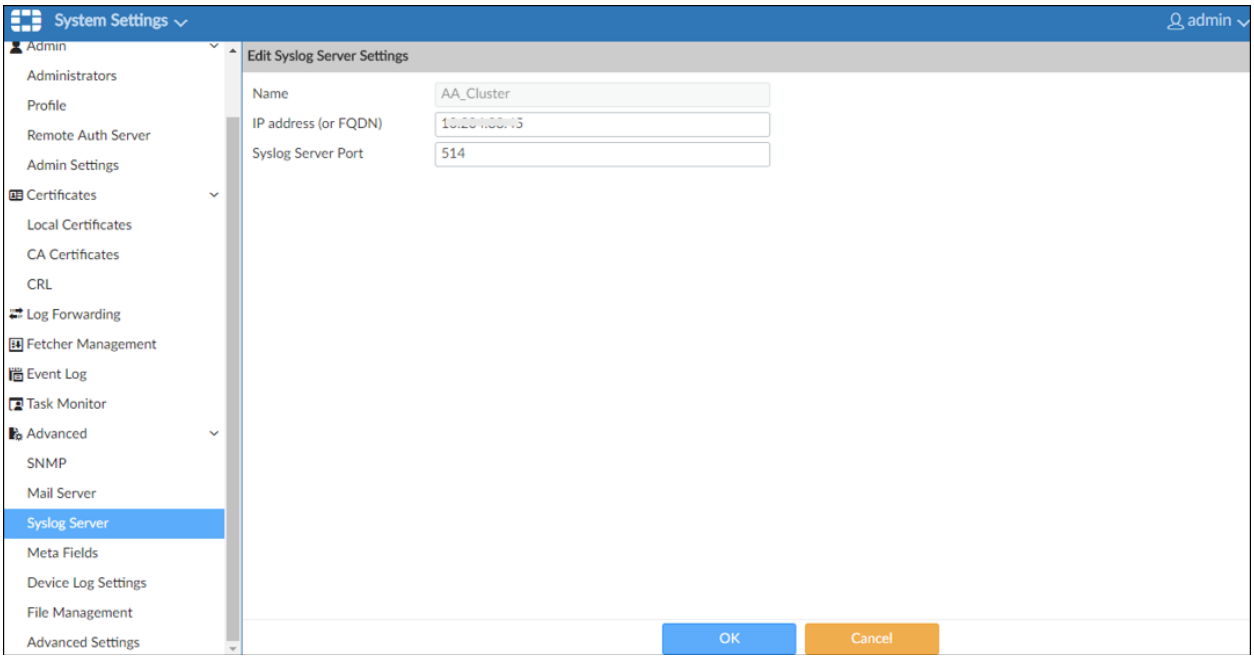


5. Under **System Settings > Log Forwarding**, enter the IP address of the PPS device for log forwarding.

Figure 177: Log Forwarding



6. Under **System Settings > Advanced > Syslog Server**, enter the IP address of PPS device.

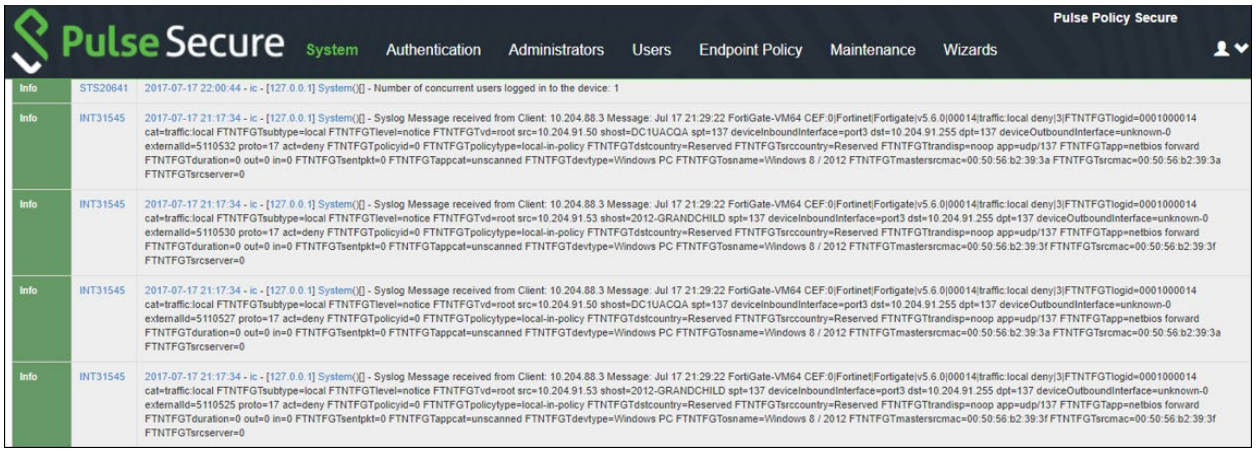


Troubleshooting

When the network security device detects threats, the syslogs are forwarded to PPS.

To verify the event logs, select **System > Network > Status > Active Users.**

Figure 178: Event Logs



Alert Based Admission Control using PAN Next Generation Firewall

This chapter provides an overview of enforcement using PAN Next Generation Firewall. It includes the following information:

Overview

PPS integration with PAN next generation firewall provide user access control based on the threats identified by the network security devices. The network security device provides intelligence driven detection of threats based on the intrusion prevention system. This helps in detecting the unknown threats and also reduces the false alarms. The PAN Next Generation Firewall uses the syslog events to notify the other devices regarding the network threats. PPS also supports dynamically changing the access to the user based on the information received from the PAN Next Generation Firewall.

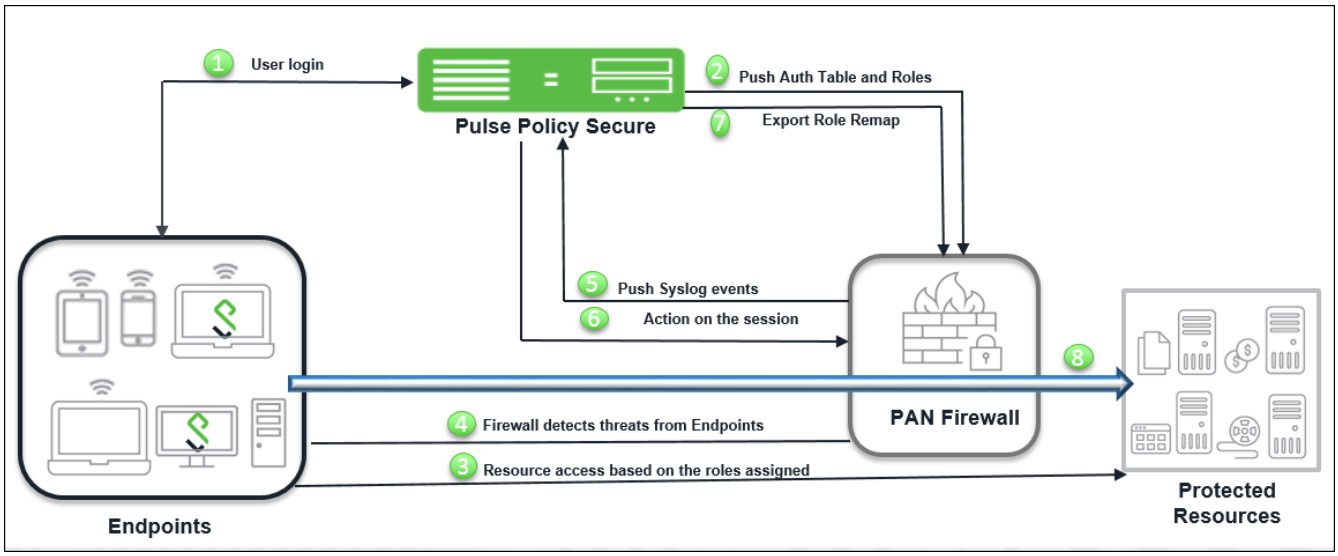
The admission control user flow is as follows:

1. The user logs into the PPS and a corresponding session is created on PPS.
2. The user starts accessing the resources and tries to access a restricted website or application.
3. The PAN Next Generation Firewall identifies it as threat and generates a corresponding syslog event and sent to PPS.
4. PPS receives the threat information and based on the policies configured it modifies the user access. For example, changing user access, terminating user access and so on.

Deployment of PPS using PAN Next Generation Firewall

This section describes the integration of PPS with PAN Next Generation Firewall. PPS integrates with PAN Next Generation Firewall syslog notification mechanism to receive the threat alert information from Palo Alto Networks and takes an action based on the admin configured policies.

Figure179: Deployment using PAN Next Generation Firewall



The authentication process is described below:

1. User is authenticated on PPS after validating the Host Checker policy
2. The user sessions are exported to PAN through enforcement configuration, which uses REST APIs for updating the session details.
3. The PAN Next Generation firewall obtains session information from REST APIs and creates an IP to username mapping. The firewall can use this information to either allow or block traffic based on the configured policy.
4. PAN Next Generation Firewall Monitors the end user flow and activity and detects attacks/malicious activity at the end user session
5. PAN Next Generation Firewall sends a syslog message to PPS if any suspicious traffic or activity is detected from end user.
6. PPS will process the received syslog message and based on the configured policies, actions will be taken for the end user session.
7. PPS will update PAN Next Generation firewall with updated session information.
8. The PAN Next Generation Firewall changes access to the user based on the updated session information obtained from PPS.

Note: The enforcement of the user is also updated on the firewall.

Configuring PPS with PAN Next Generation Firewall

The network security devices are configured with PPS for admission access control. A high-level overview of the configuration steps needed to set up and run the integration is described below:

- The Administrator configures the PAN syslog client on PPS Admin UI.
  The network security device acts as a syslog client on which syslog forwarding is enabled and PPS receives the forwarded syslog messages.
- The Administrator then configures a set of policies that define what actions are to be taken on user sessions, based on the data in the threat events.
  The actions on sessions supported are
  - Ignore - Logs and ignores the syslog message.
  - Terminate session - Removes the user session.
  - Disable - Removes the user session and disables the user.
  - Change role - Update the user session with limited role specified. The role change can also be marked as permanent or only for that session.
- The user templates are used to identify events supported by the security device. It also provides the pattern match for collecting values for predefined variables which are used for acting on a session. The predefined variable used are source IP, source user, event and severity.

This section covers the following topics:

Admission Control Template

The admission control template provides the list of possible events that can be received from the network security device along with regular expression to parse the message. The template also provides possible actions that can be taken for an event.

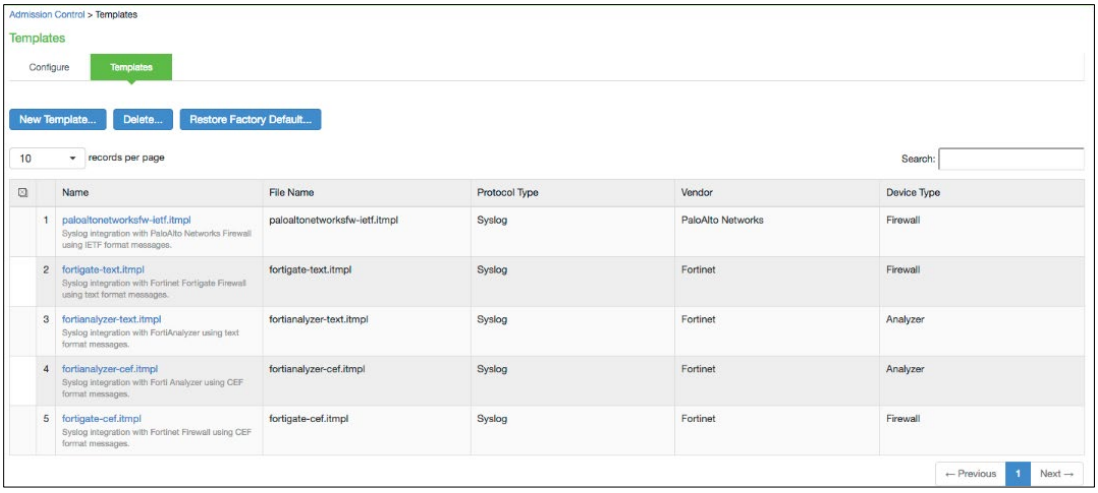
PPS is loaded with default templates for Fortigate, Fortianalyzer and PAN next generation firewall. Admin can create templates for other security devices and can upload to templates.

You can view the list of configured integration templates that provides the list of network security devices and the supported protocol type using Endpoint Policy > Admission Control > Templates.

To view the admission control templates:

Select **Endpoint Policy > Admission Control > Templates**.

Figure 180: Existing Template



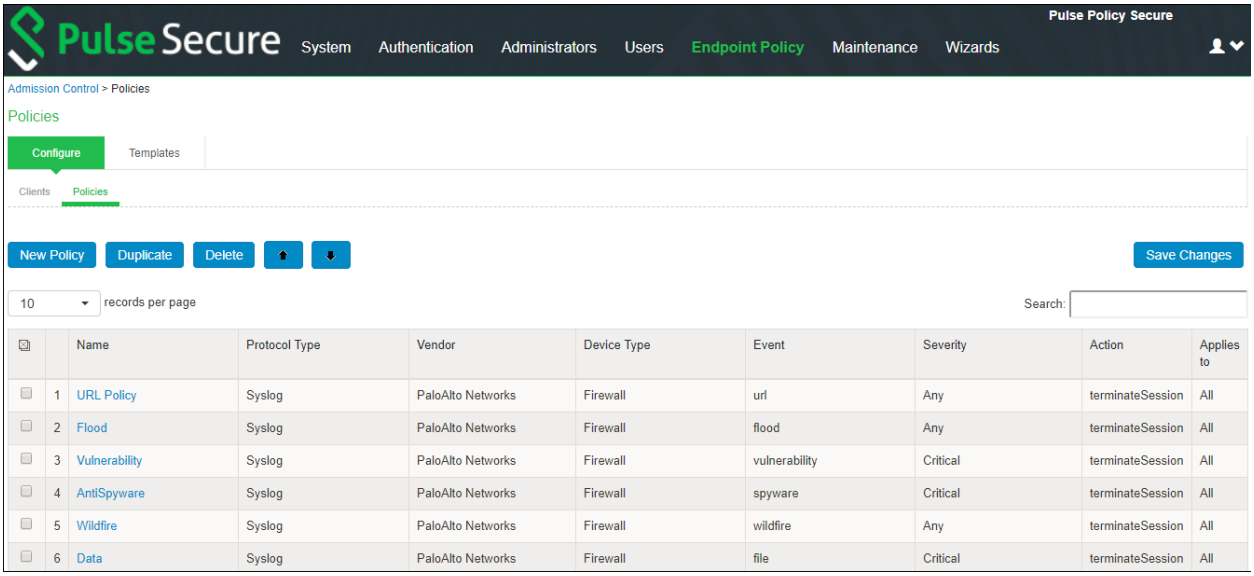
Admission Control Policies

The admission control policies define the list of actions to be performed on PPS for the user sessions. The actions are based on the event and the severity information received from the network security device.

To view and add the new integration policy:

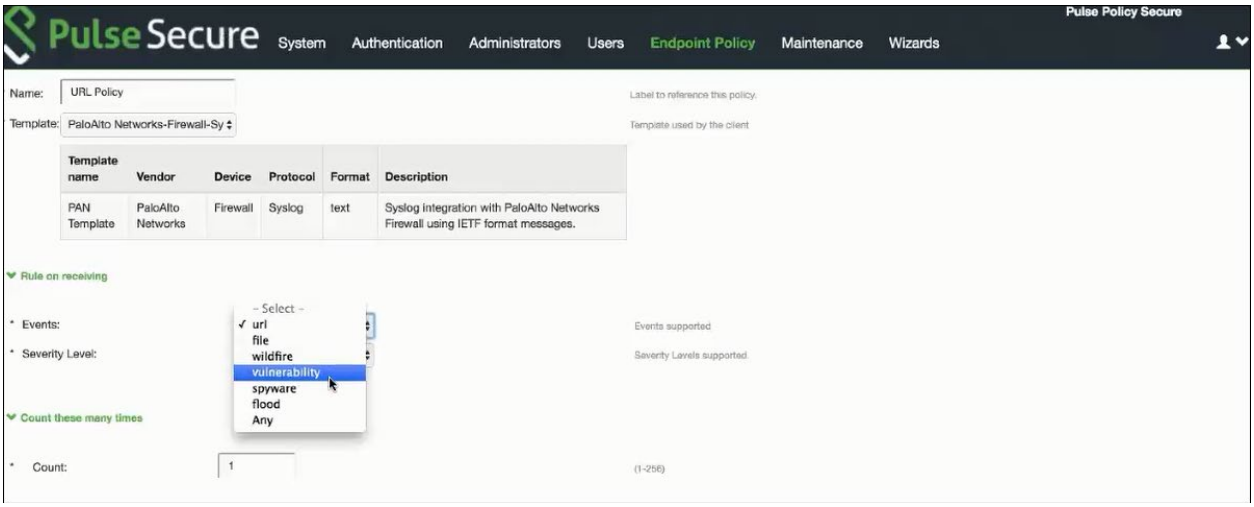
1. Select **Endpoint Policy > Admission Control > Policies**.

Figure 181: Configuration Policies



2. Click **New Policy**.
3. Enter the policy name.
4. Select **PaloAlto Networks-Firewall-Syslog-text** as a template.
5. Under **Rule on Receiving**, select the event type and the severity level. The event types and the severity level are based on the selected template.

Figure 182: Adding New Configuration Policy



6. Under **Count these many times**, enter the number between 1-256.
7. Under **then perform this action**, select the desired action.
    - Ignore (log the event) —Received syslog event details are logged on the PPS and no specific action is taken.
    - Terminate user session— Terminates the user session on the PPS for the received messages.
    - Disable user account— Terminates the user session and disables the user on the PPS for the received messages.
    - Replace user role with this role— Changes the roles assigned to the user on PPS so that restriction/privileges for the user can be changed.
        - Specify whether to apply the role assignment permanently or only for the session.

8. Under **Roles**, specify:
    - Policy applies to ALL roles—To apply the policy to all users.
    - Policy applies to SELECTED roles—To apply this policy only to users who are mapped to roles in the Selected roles list. You must add roles to this list from the Available roles list.
    - Policy applies to all roles OTHER THAN those selected below—To apply this policy to all users except for those who map to the roles in the Selected roles list. You must add roles to this list from the Available roles list.
9. Click **Save changes**.

Admission Control Client

The admission control clients are the network security devices on which the syslog forwarding is enabled. The messages are received by the syslog server module running on PPS.

To add a client:

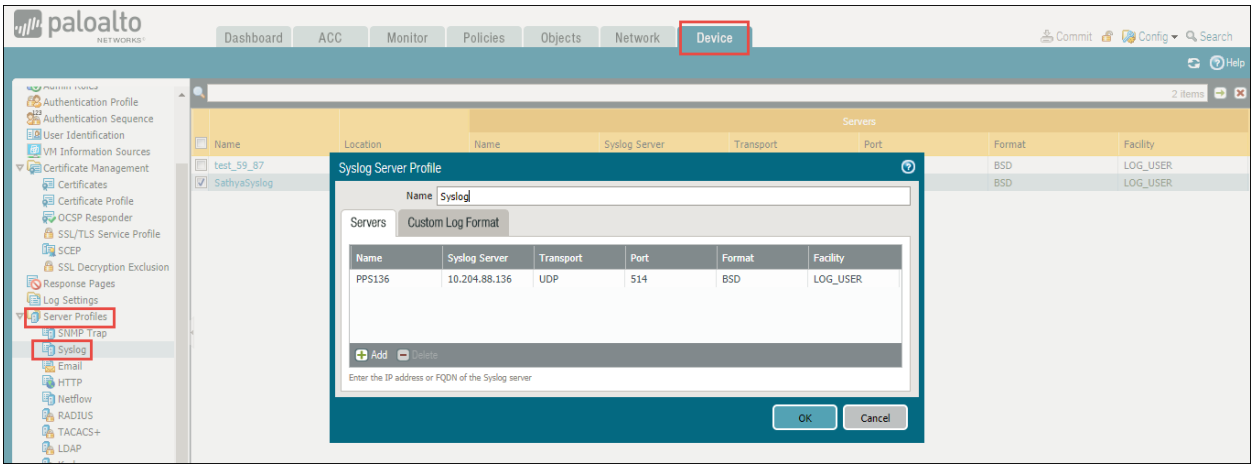
1. Select **Endpoint Policy > Admission Control > Clients**.
2. Click **New Client**.
3. Enter the name of the client that will be added in the PPS.
4. Enter the description.
5. Enter the IP address of the client.
6. Select the template used by the client.
    - PaloAlto Networks-Firewall-Syslog-text
7. Click **Save Changes**.

Configuring PAN Next Generation Firewall

The PPS device must be added as a syslog server while configuring the PAN Next Generation Firewall for sending the logging information. You must add PAN Next Generation Firewall as syslog client on PPS.

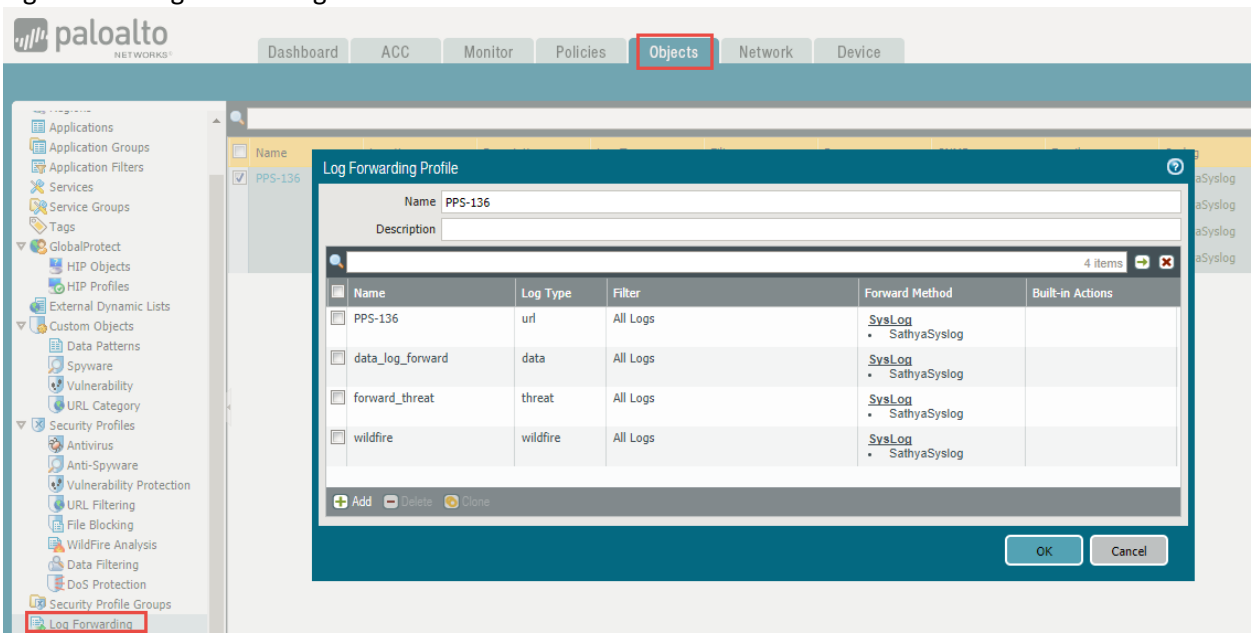
To configure PAN firewall:

1. Select **Device > Service Profiles > Syslog** and create a syslog server. Enter the IP address of PPS.



2. Create a log forwarding profile. Select **Objects > Log Forwarding.** Enable **PAN** to forward the syslog message.

Figure 183: Log Forwarding

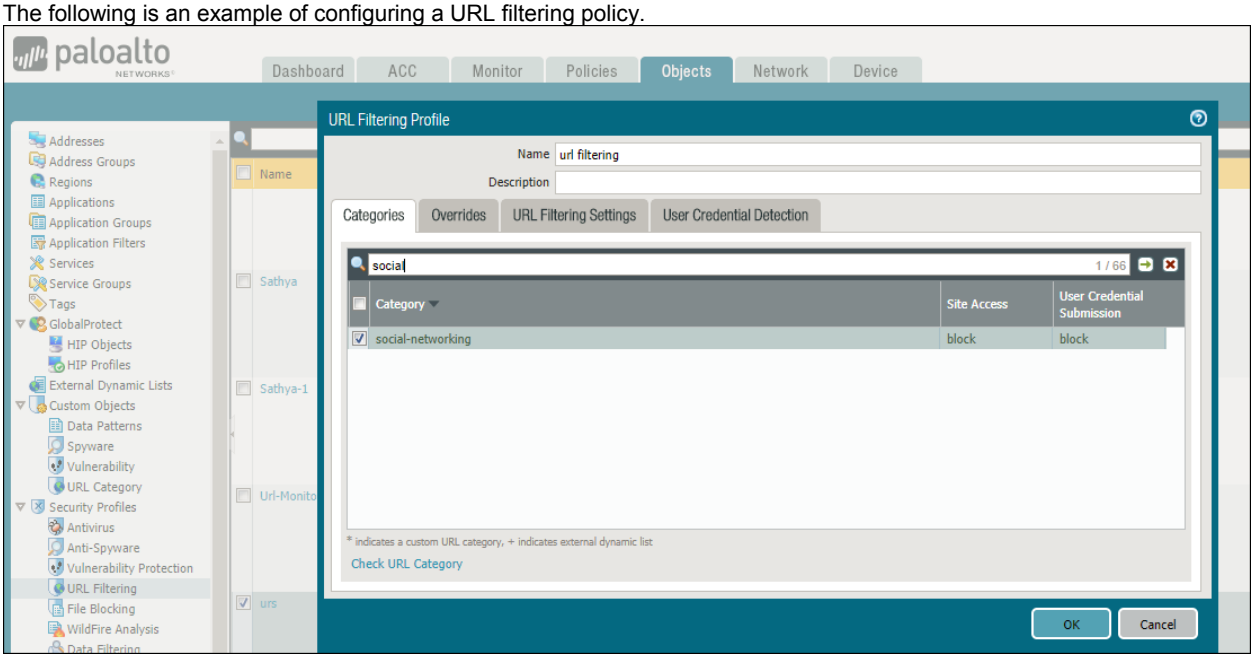


Note: On PAN Next Generation Firewall, configure the security policy – network trust, untrust zone and apply the policy to desired ports.

3. Select **Objects > Security Profiles** and create a security profile. The following security profiles are available:
   - URL Filtering
   - Anti Spyware
   - Vulnerability Protection

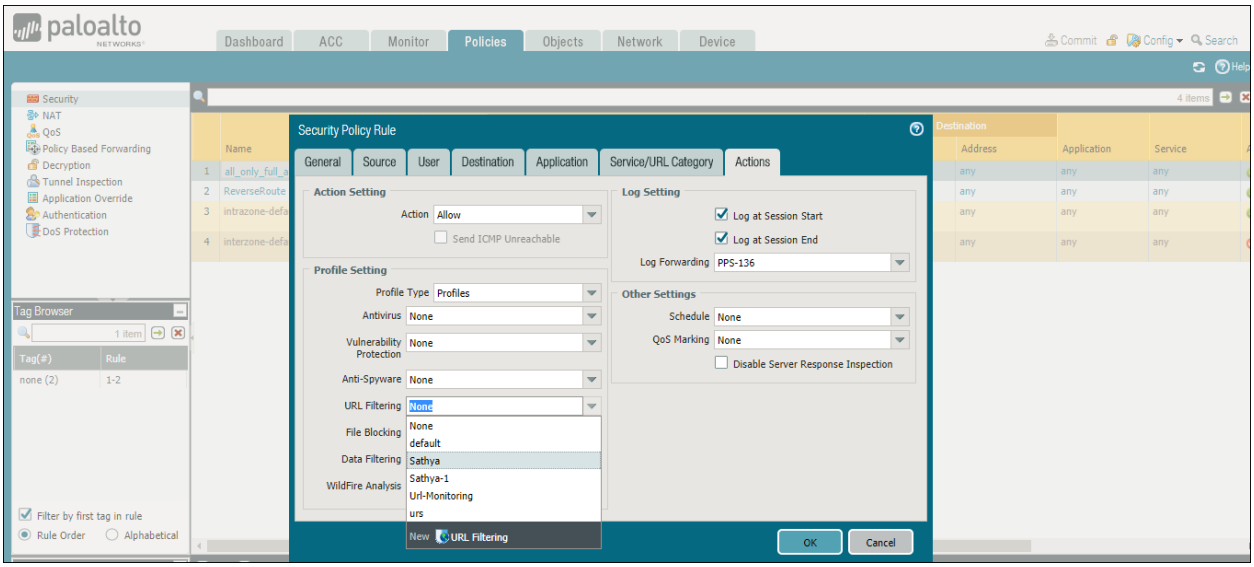
- File Blocking
- Wildfire Analysis
- DoS Protection

4. The following is an example of configuring a URL filtering policy.



5. Select **Policies > Security,** click the policy add the created objects to Security Policy Rule.

Figure 184: Security Policy Rule

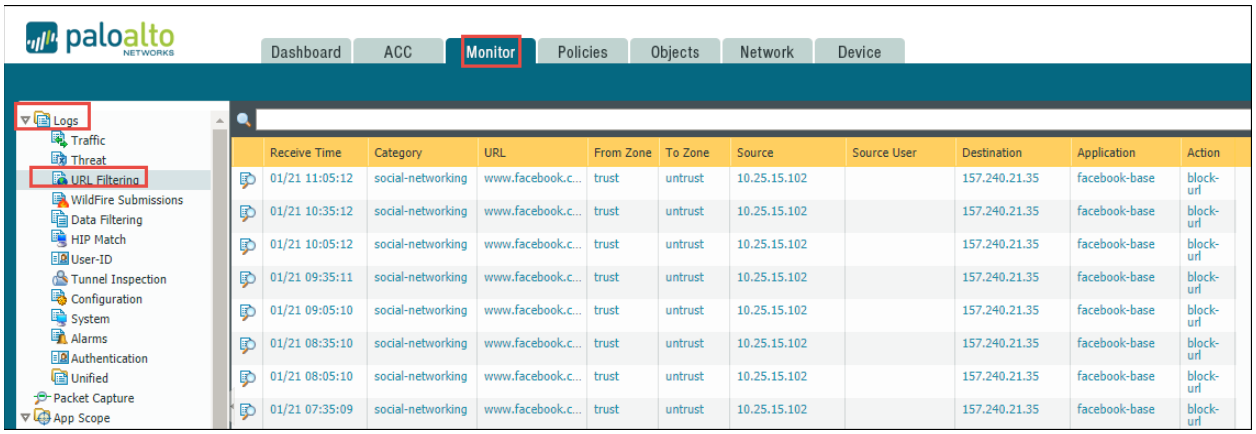


Troubleshooting

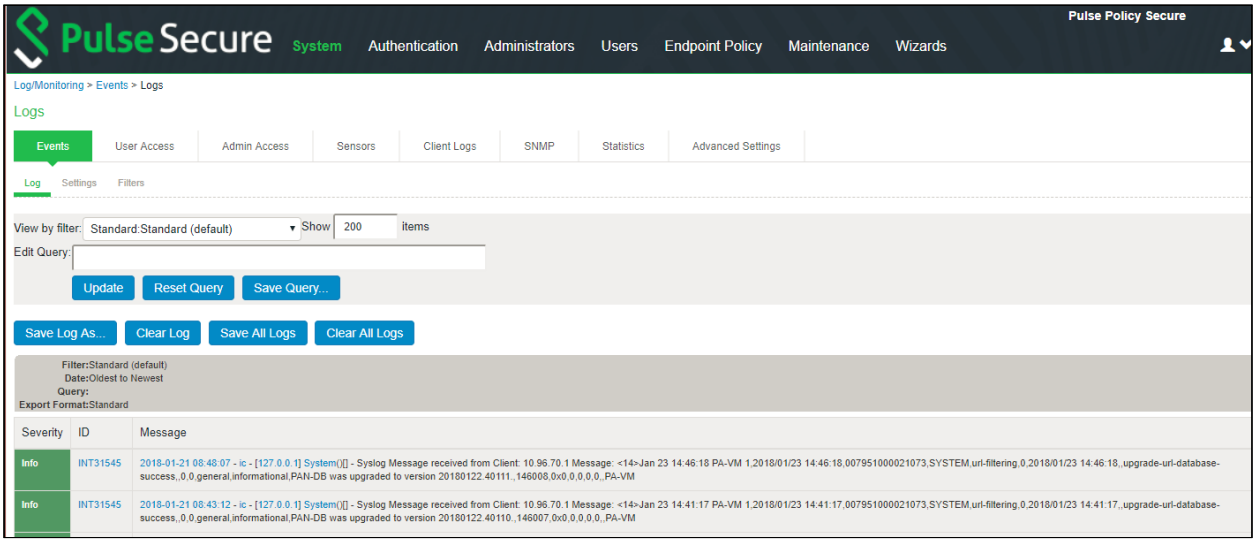
When the network security device detects threats, the syslogs are forwarded to PPS.

For example, to monitor the URL filtering logs on PAN Next Generation Firewall, select Monitor > URL Filtering and view the logs.

Figure 185: Event Logs



To verify the event logs on PPS, select **System > Log/Monitoring > Events.**



Alert Based Admission Control using Juniper SDSN

This chapter provides an overview of PPS enforcement using Juniper Networks Software-Defined Secure Network (SDSN). It includes the following information:

- Overview
- Deployment of PPS in Juniper SDSN
- Configuring PPS with Juniper SDSN
- Configuring Juniper SDSN
- Troubleshooting

Overview

The SDSN solution provides end-to-end network visibility, allowing enterprises to secure their entire network, both physical and virtual. Using threat detection and policy enforcement, PPS and SDSN solution automates and centrally manages security in a multi-vendor environment.

PPS integrates with Juniper SDSN solution through REST API mechanism and takes appropriate action based on the admission control policies. The PPS integration with SDSN solution detects and enforces threat prevention policies and provides a collaborative and comprehensive approach toward complete network security. It enables users to leverage existing, trusted threat feed sources to provide consistent, automated defense across diverse environments.

Benefits

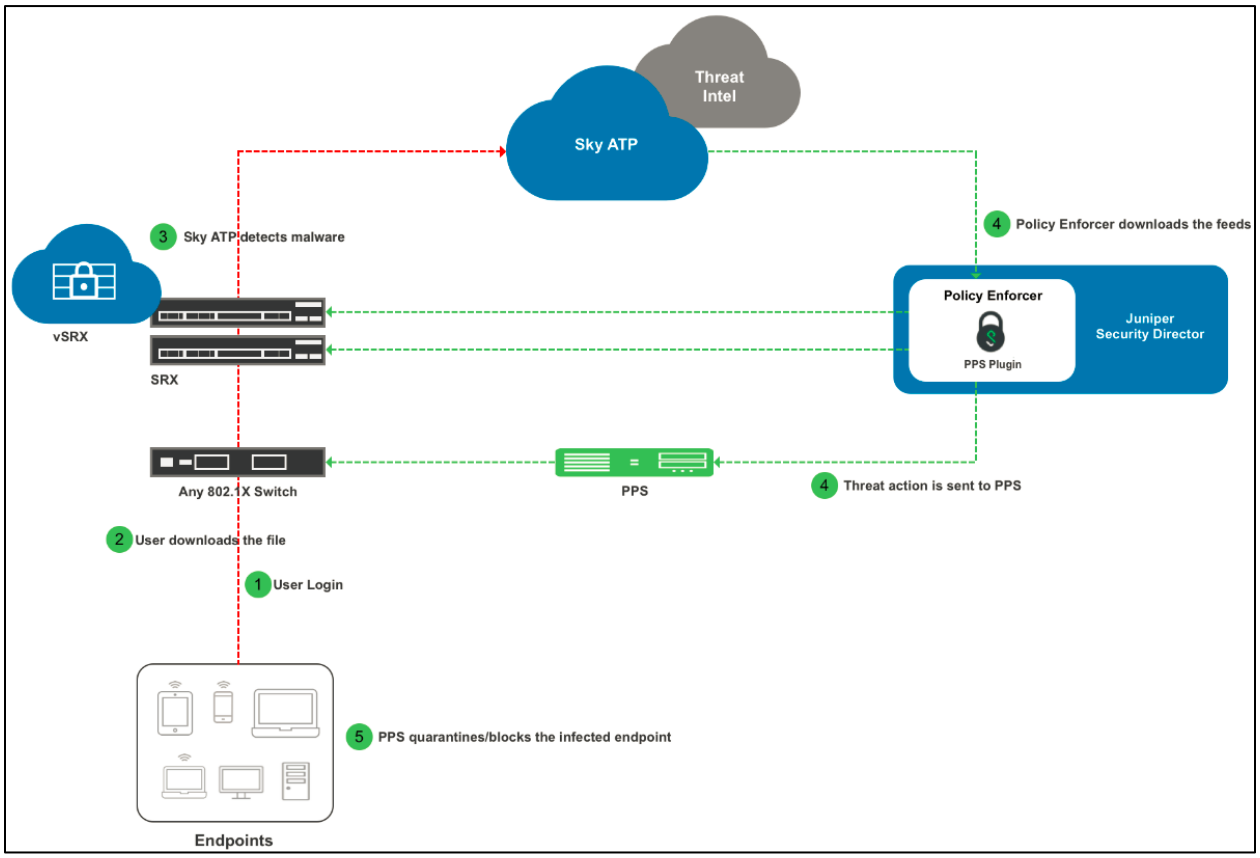
As PPS has more visibility of the endpoint connected to the network. PPS integration with SDSN enhances the security by isolating or acting at the endpoint level based on threat alerts received from Juniper SDSN.


Note: PPS connector is supported by Junos Space from version 18.3 onwards.

Deployment of PPS in Juniper SDSN Environment

This section describes the integration of PPS in Juniper SDSN environment. PPS receives the threat alert information from Juniper SDSN solution and takes an action at the endpoint based on the admission control policies.

Figure: Deployment of PPS in Juniper SDSN Environment



In this example, the endpoint is connected to a third-party switch. The switch has 802.1X authentication enabled. The switch authenticates 802.1X requests through a PPS server.

1. The endpoint authenticates to the network through 802.1X or through MAC-based authentication.
2. User downloads a file from the Internet. The perimeter firewall (SRX Series device) scans the file and, based on user-defined policies, sends the file to Sky ATP for analysis.
3. Sky ATP detects that the file contains malware, identifies the endpoint as an infected host, and notifies the SRX Series device and Policy Enforcer.
4. Policy Enforcer downloads the infected host feed and sends a threat action to PPS.
5. The PPS server quarantines/blocks the endpoint.
   PPS keeps track of the infected host and won't allow an infected host to acquire full access until the endpoint gets disinfected. When the host is disinfected and cleared from Sky ATP or Juniper PE, PPS receives 'clear' event from Juniper PE (Connector), PPS also removes from its infected host list, and host will now be authenticated and gets assigned an appropriate role.

   Note: The enforcement of the user is also updated on the firewall.

Configuring PPS with Juniper SDSN

The network security devices are configured with PPS for admission access control. A high-level overview of the configuration steps needed to set up and run the integration is described below:

- The Administrator configures the basic PPS configurations such as creating an authentication server, authentication realm, user roles, and role mapping rules.
- Configure Juniper Policy Enforcer as a client in PPS. PPS acts as a REST API Server for Juniper Policy Enforcer. The REST API access for the admin user needs to be enabled by accessing the serial console or alternatively from the PPS admin UI (Authentication > Auth Server > Administrators > Users > click “admin”, enable Allow access to REST APIs).
- Configure PPS to block/quarantine the endpoint based on the threat prevention policy.
- Configure the Switches/WLC as RADIUS Client in PPS (Endpoint Policy > Network Access > Radius Clients > New Radius Client). Switch should be configured with PPS as a RADIUS server.
- Configure RADIUS return attribute policies to define the action upon receiving the event.

 Note:

- Ensure that PPS has the endpoint IP Address for the enforcement to work correctly.
- As the endpoint IP Address is mandatory, deployments where the user is behind a NAT might not work well as PPS might have actual IP address whereas SDSN may send NAT'ed IP address.

This section covers the following topics:

- Admission Control Template
- Admission Control Policies
- Admission Control Client

Admission Control Template

The admission control template provides the list of possible events that can be received from the network security device along with regular expression to parse the message. The template also provides possible actions that can be taken for an event.

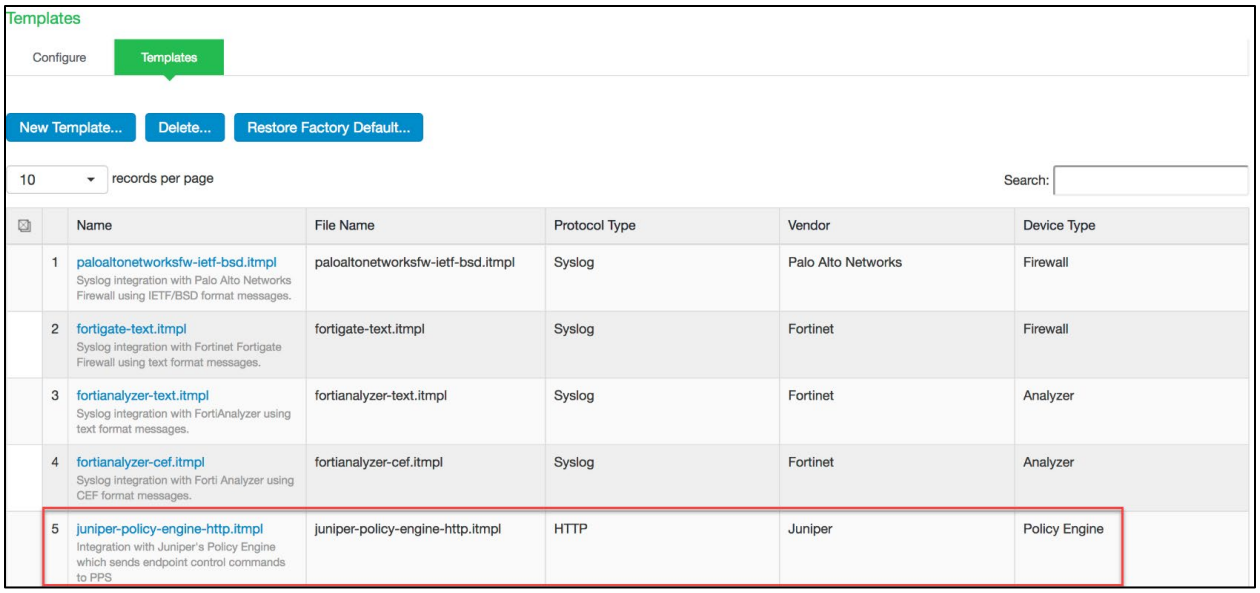
PPS is loaded with default templates for Juniper Policy Enforcer. Admin can create templates for other security devices and can upload to templates.

You can view the list of configured integration templates that provides the list of network security devices and the supported protocol type using Endpoint Policy > Admission Control > Templates.

To view the admission control templates:

Select **Endpoint Policy > Admission Control > Templates**.

Figure 186: Existing Template



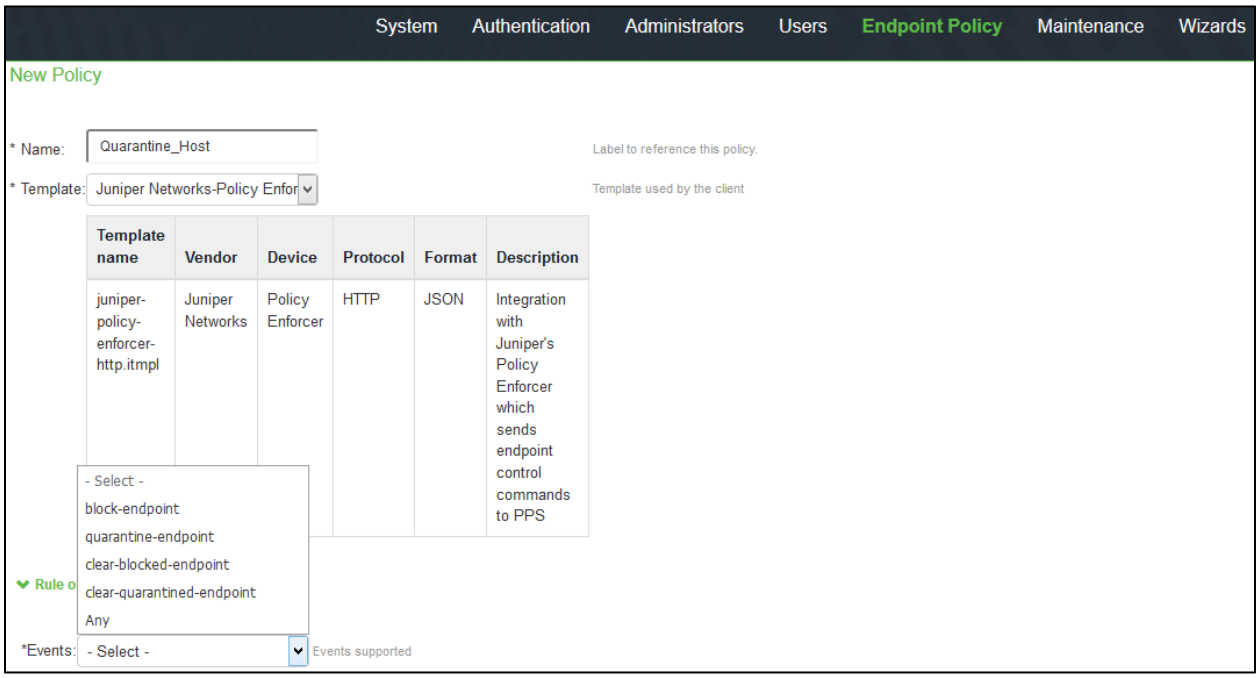
Admission Control Policies

The admission control policies define the list of actions to be performed on PPS for the user sessions. The actions are based on the event and the severity information received from the network security device.

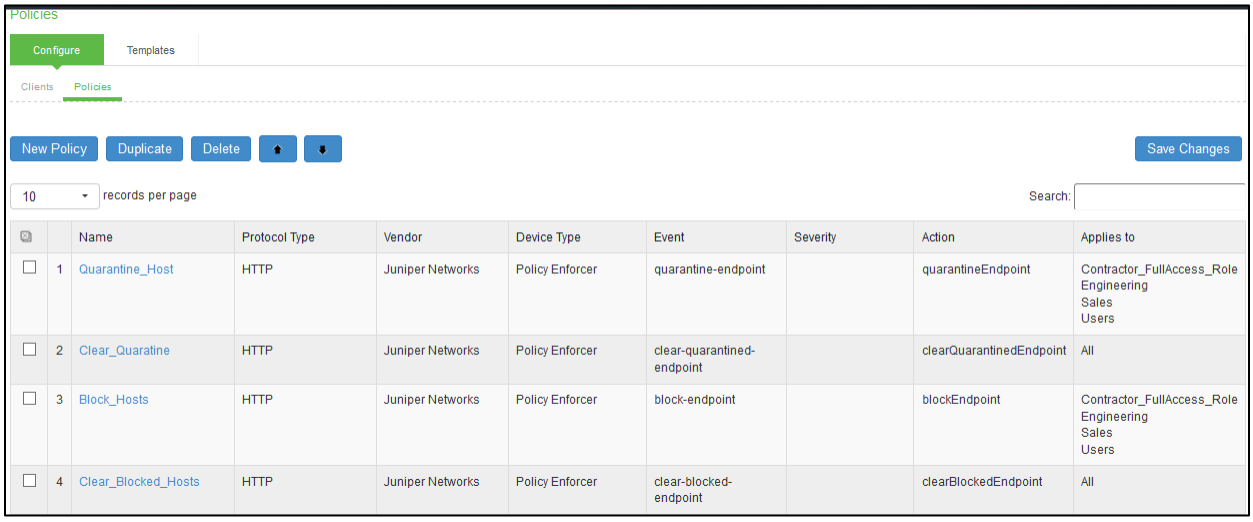
To view and add the new integration policy:

1. Select **Endpoint Policy > Admission Control > Policies**.
2. Click **New Policy**.
3. Enter the policy name.
4. Select **Juniper Networks Policy Enforcer** as a template.
5. Under **Rule on Receiving**, select the event type (block-endpoint, quarantine-endpoint, clear-blocked-endpoint, clear-quarantined-endpoint) and the severity level. The event types and the severity level are based on the selected template.
   The actions on sessions supported are:
   - **Block Endpoint**: Blocks the host MAC Address on the PPS permanently. If admin choose to clear this, it can be cleared either by using Juniper Security Director application or by using the PPS Admin UI.
   - **Quarantine Endpoint** (Change user roles): Changes the roles assigned to the user on PPS so that restriction/privileges for the user can be changed. The Administrator can choose to apply these roles permanently or temporarily. If it is permanent, host will be added to infected host list and will be tracked for subsequent login attempts. Whereas quarantining temporarily is specific to that particular user session (Not tracked in Infected host list and subsequent login attempts will succeed).
   - **Clear Blocked Endpoint** - Clears a previously blocked MAC Address.
   - **Clear Quarantined Endpoint** - Clears a previously quarantined MAC Address.
6. Under **then perform this action**, select the desired action.
   - Ignore (log the event) —Received syslog event details are logged on the PPS and no specific action is taken.
   - Terminate user session— Terminates the user session on the PPS for the received messages.
   - Disable user account— Terminates the user session and disables the user on the PPS for the received messages.
   - Replace user role with this role— Changes the roles assigned to the user on PPS so that restriction/privileges for the user can be changed.
     - Specify whether to apply the role assignment permanently or only for the session.
7. Under **Roles**, specify:
   - Policy applies to ALL roles—To apply the policy to all users.
   - Policy applies to SELECTED roles—To apply this policy only to users who are mapped to roles in the Selected roles list. You must add roles to this list from the Available roles list.
   - Policy applies to all roles OTHER THAN those selected below—To apply this policy to all users except for those who map to the roles in the Selected roles list. You must add roles to this list from the Available roles list.
8. Click **Save changes**.

Figure 187: Configuration Policies



Once the policy is created. You can see the summary page as shown below. The following page shows the different policies created for different events with different user roles.



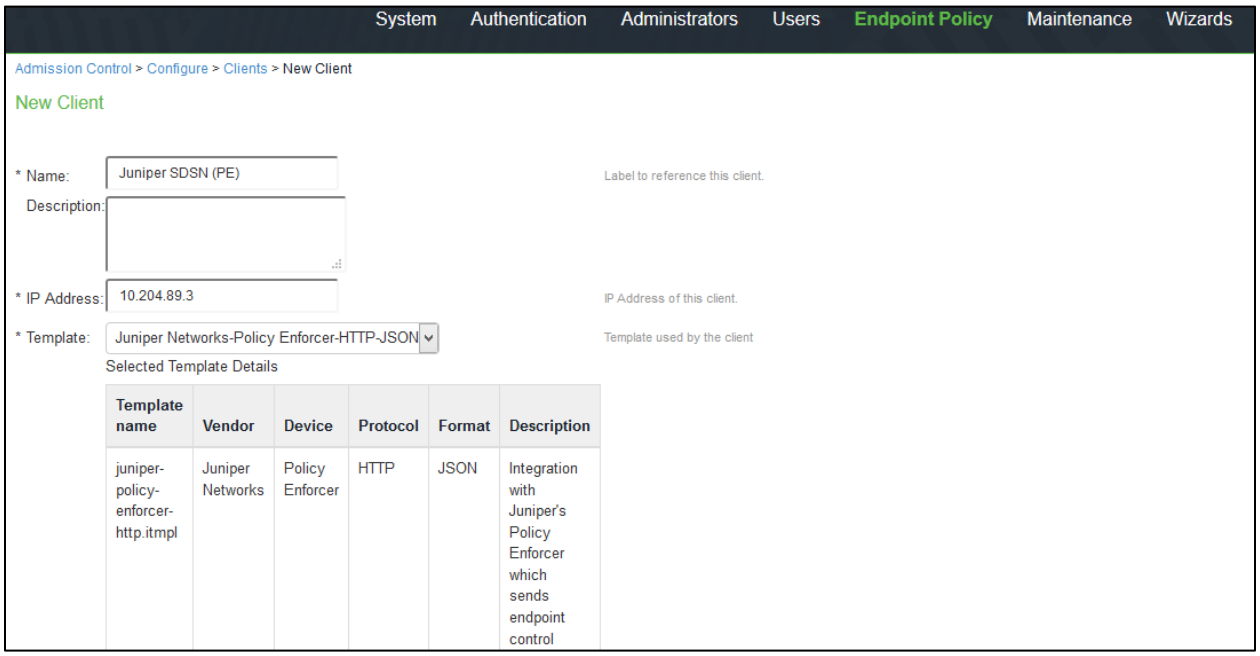
		Name	Protocol Type	Vendor	Device Type	Event	Severity	Action	Applies to
☐	1	Quarantine_Host	HTTP	Juniper Networks	Policy Enforcer	quarantine-endpoint		quarantineEndpoint	Contractor_FullAccess_Role Engineering Sales Users
☐	2	Clear_Quaratine	HTTP	Juniper Networks	Policy Enforcer	clear-quarantined-endpoint		clearQuarantinedEndpoint	All
☐	3	Block_Hosts	HTTP	Juniper Networks	Policy Enforcer	block-endpoint		blockEndpoint	Contractor_FullAccess_Role Engineering Sales Users
☐	4	Clear_Blocked_Hosts	HTTP	Juniper Networks	Policy Enforcer	clear-blocked-endpoint		clearBlockedEndpoint	All

Admission Control Client

The admission control clients are the network security devices on which the syslog forwarding is enabled. The messages are received by the syslog server module running on PPS.

To add a client:

1. Select **Endpoint Policy > Admission Control > Clients**.
2. Click **New Client**.
3. Enter the name of the Juniper Policy Enforcer that will be added as a client in the PPS.
4. Enter the description.
5. Enter the IP address of the client.
6. Select the template used by the client.
    - Juniper-Policy Engine-HTTP
7. Click **Save Changes**.



Configuring Juniper SDSN

- Configuring PPS with Juniper SD
- Configuring Juniper Policy Enforcer with SKY ATP

Configuring PPS with Juniper SD

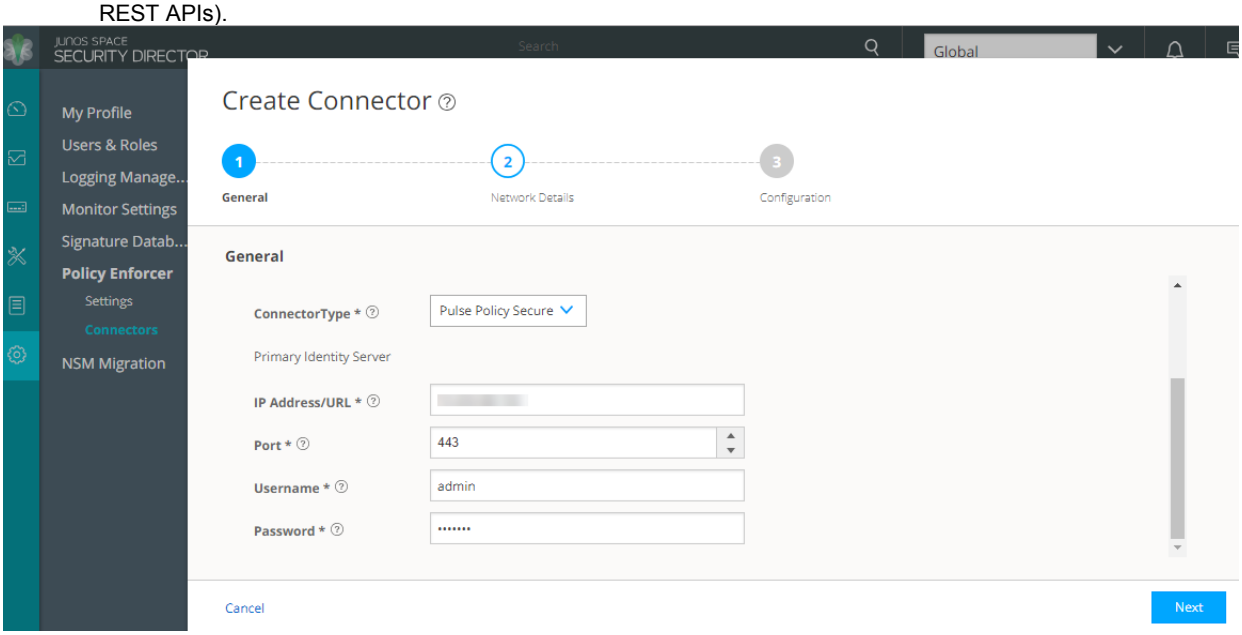
The PPS connector must be added as a connector while configuring the Juniper SDSN for sending the event information. You must add Juniper Policy Enforcer as a client on PPS.

Pre-requisite

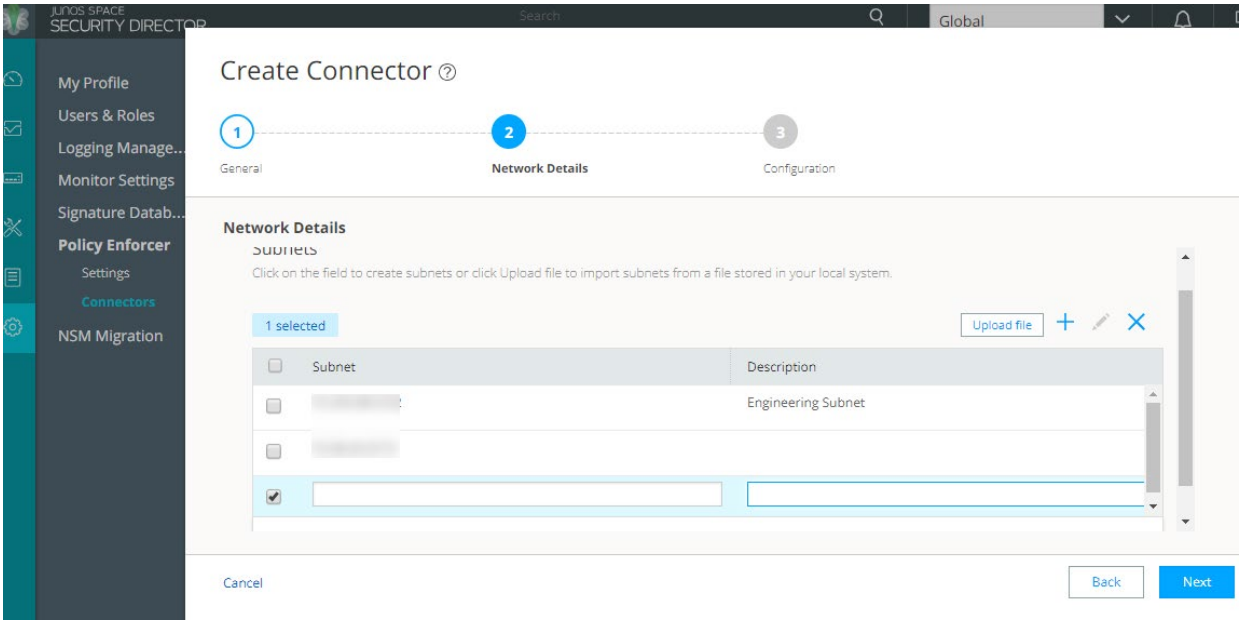
PPS Connector is supported beginning with Junos Space release version 18.3.

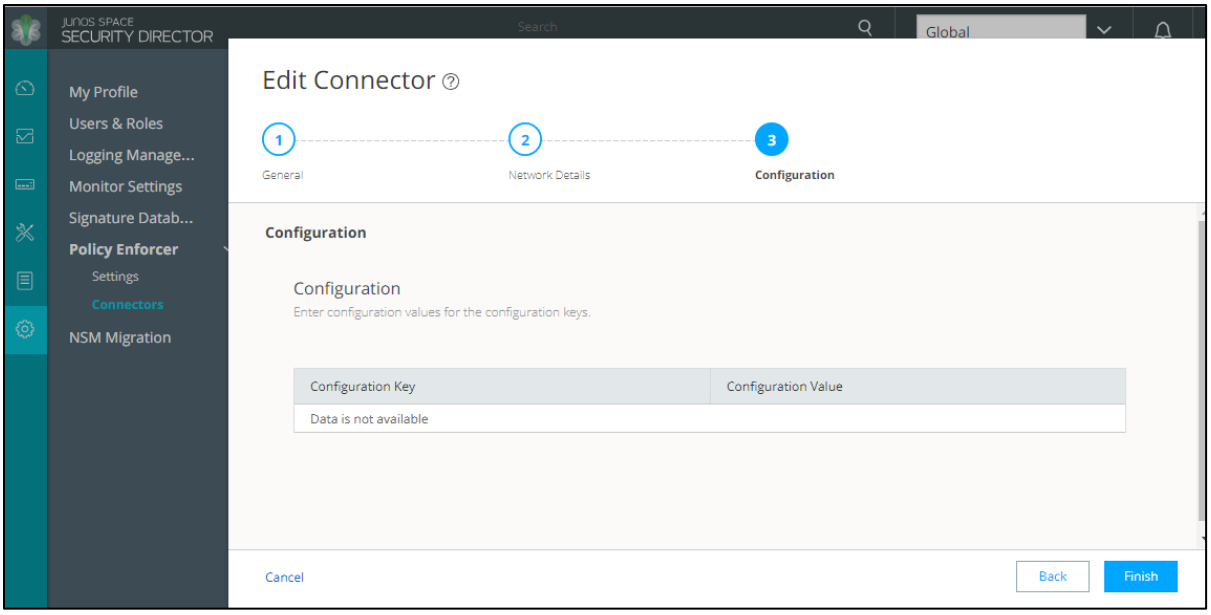
To configure Juniper SDSN using Junos Space Security Director:

1. Select **Policy Enforcer > Connectors** and create a connector.
   a. Select the Collector type as **Pulse Policy Secure**
   b. Enter the IP address of PPS.
   c. Retain the default port number as 443.
   d. Enter the username and password of PPS. Note that you must have enabled the REST API access on PPS (Authentication > Auth Server > Administrators > Users > click “admin”, enable Allow access to REST APIs).

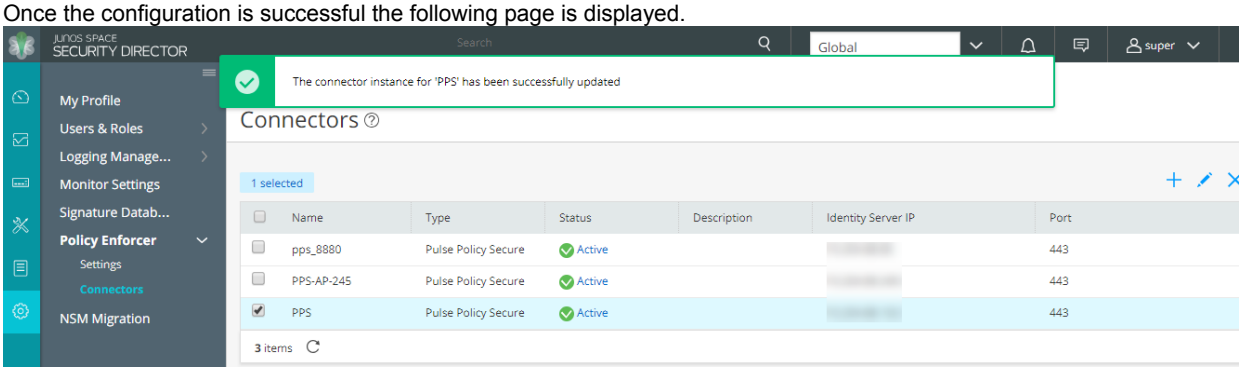


2. Enter the subnet details of the network.

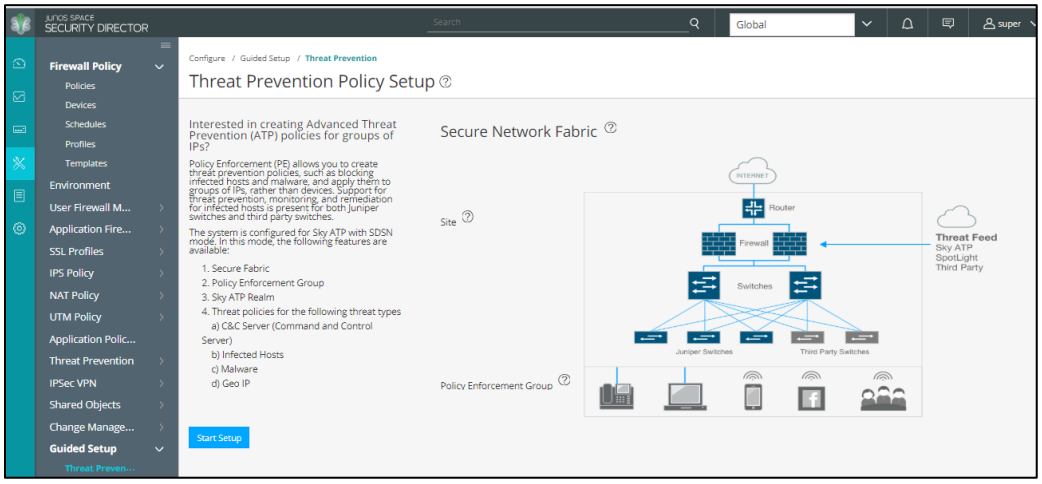




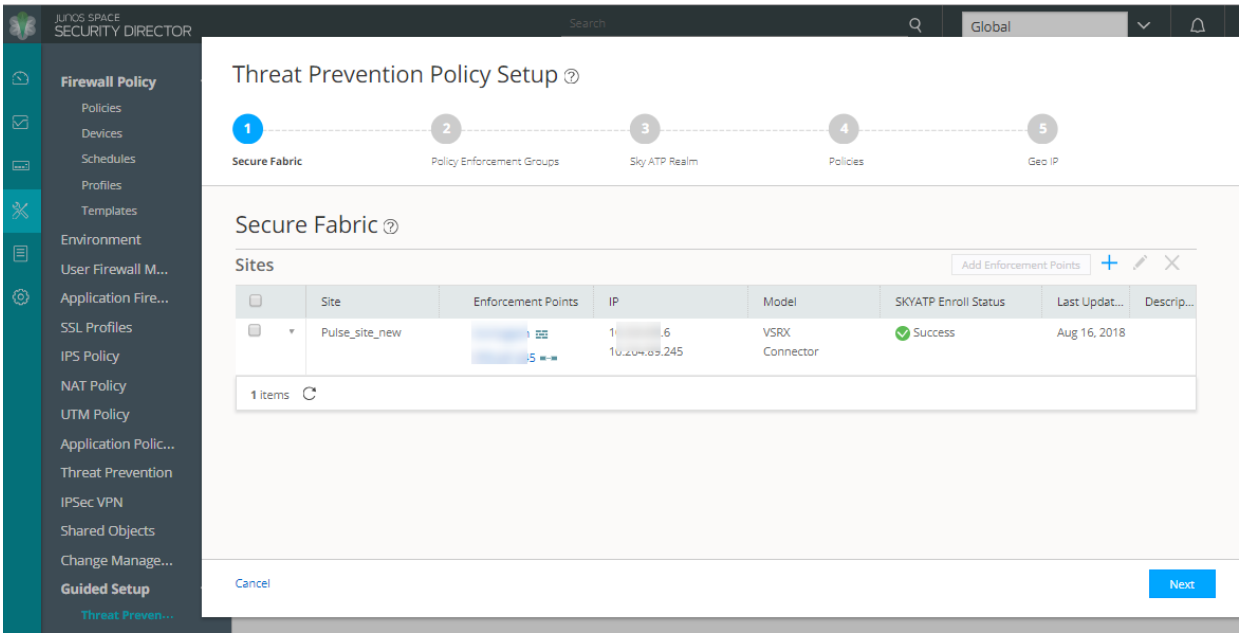
3. Once the configuration is successful the following page is displayed.



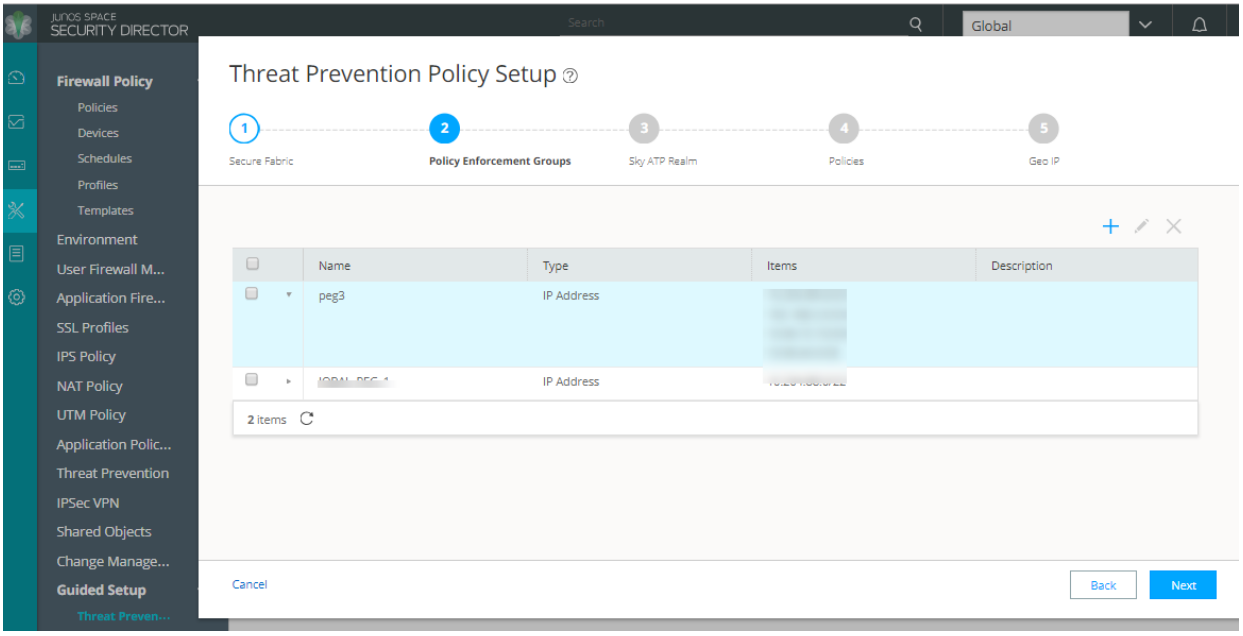
4. Create an advanced threat prevention policy, such as blocking infected hosts and malware, monitoring and remediation of infected hosts and apply them on group of devices. Select **Configure > Guided Setup > Threat Prevention.**



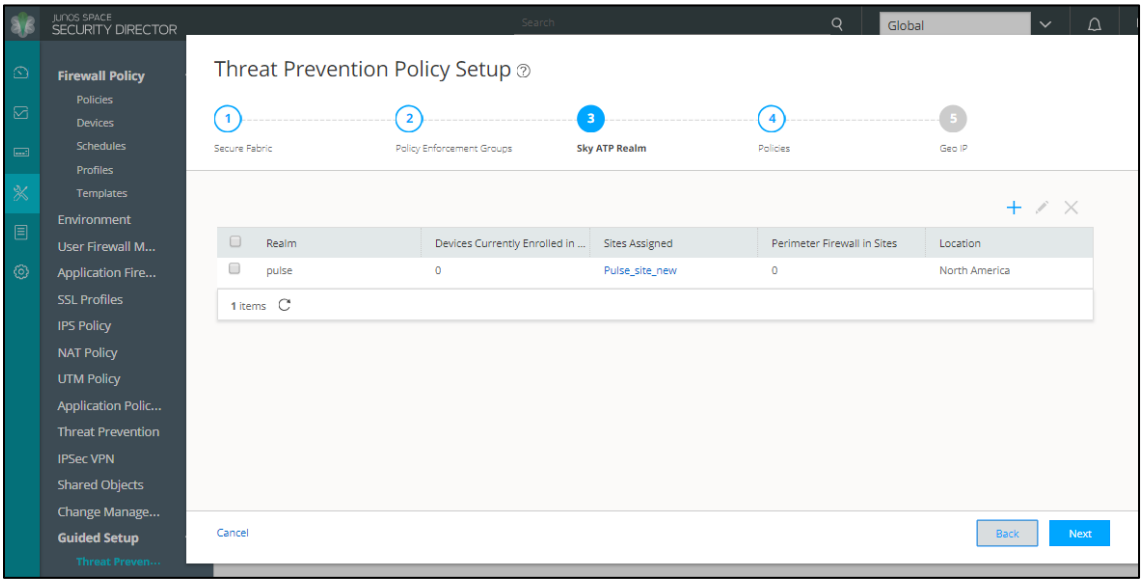
5. Add the SRX device and the PPS device as enforcement points. As a pre-requisite, you must have configured the SRX device and the PPS device as Enforcement points.



6. Create a policy enforcement group by adding endpoints (firewalls and switches) under one common group name and later applying a security policy to that group. Once configured, policy enforcement groups are located under Configure > Shared Objects.

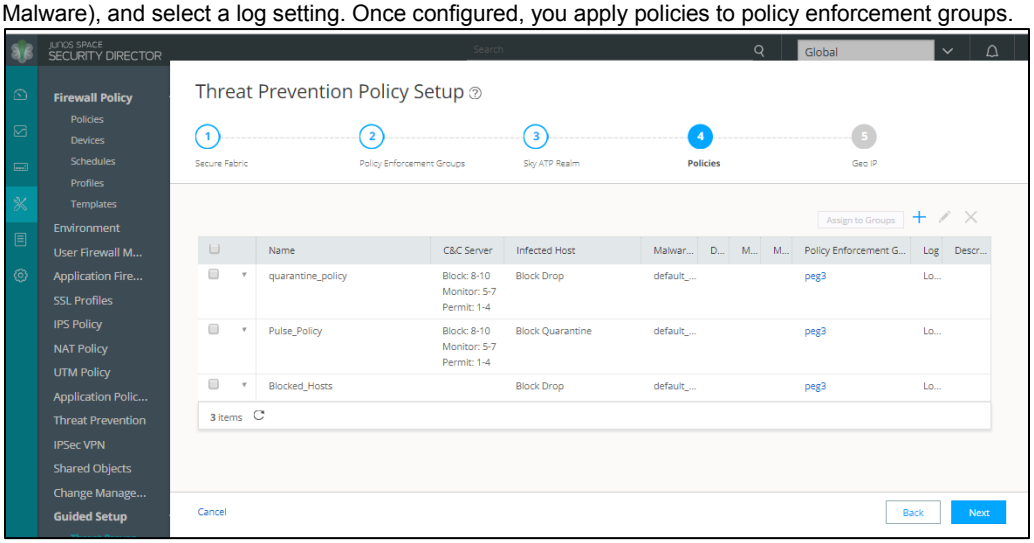


7. Add the Sky ATP realm. If you have not created a realm from within your Sky ATP account, you can create and register it here by clicking the + sign. Once you register a realm, you can enroll SRX Series devices into the realm.

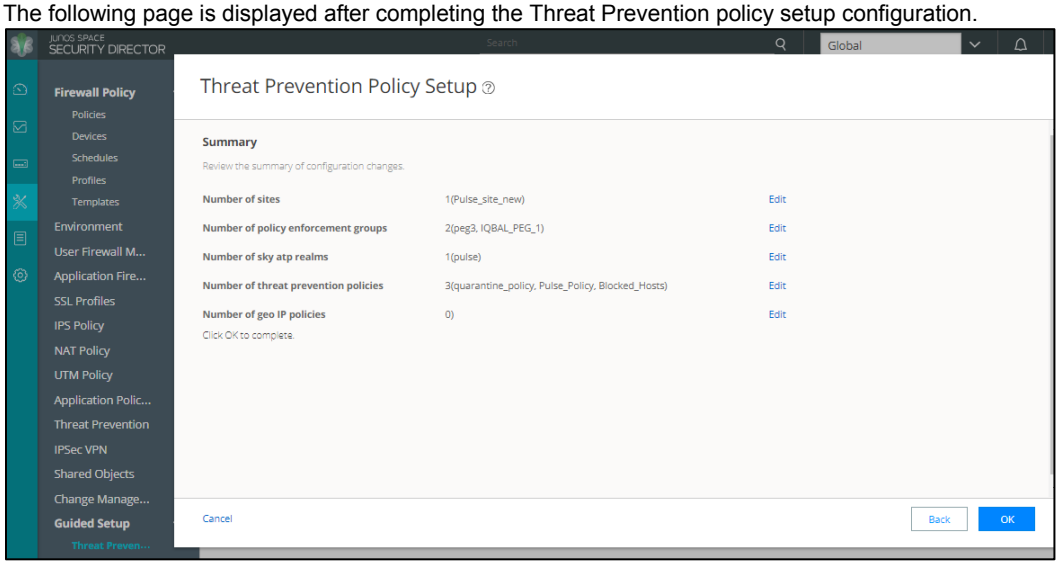


8. Assign the policies to groups. A threat prevention policy requires you to create a name for the policy, choose one or more profile types depending on the type of threat prevention this policy provides (C&C Server, Infected Host,

Malware), and select a log setting. Once configured, you apply policies to policy enforcement groups.

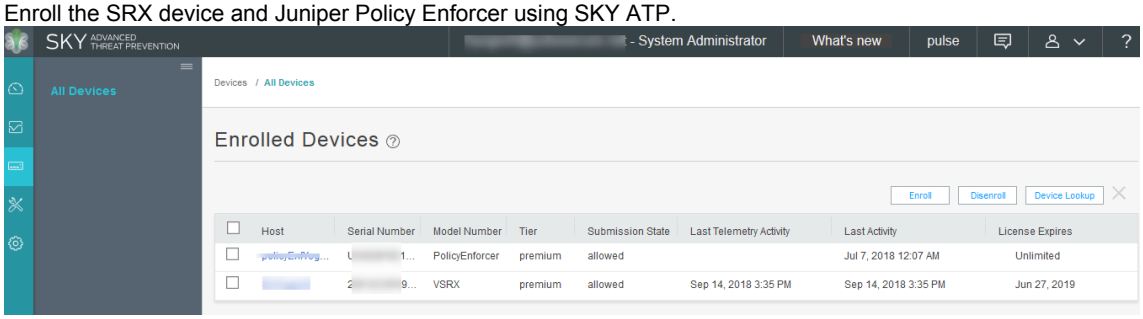


The following page is displayed after completing the Threat Prevention policy setup configuration.



Configuring Juniper Policy Enforcer with SKY ATP

Enroll the SRX device and Juniper Policy Enforcer using SKY ATP.

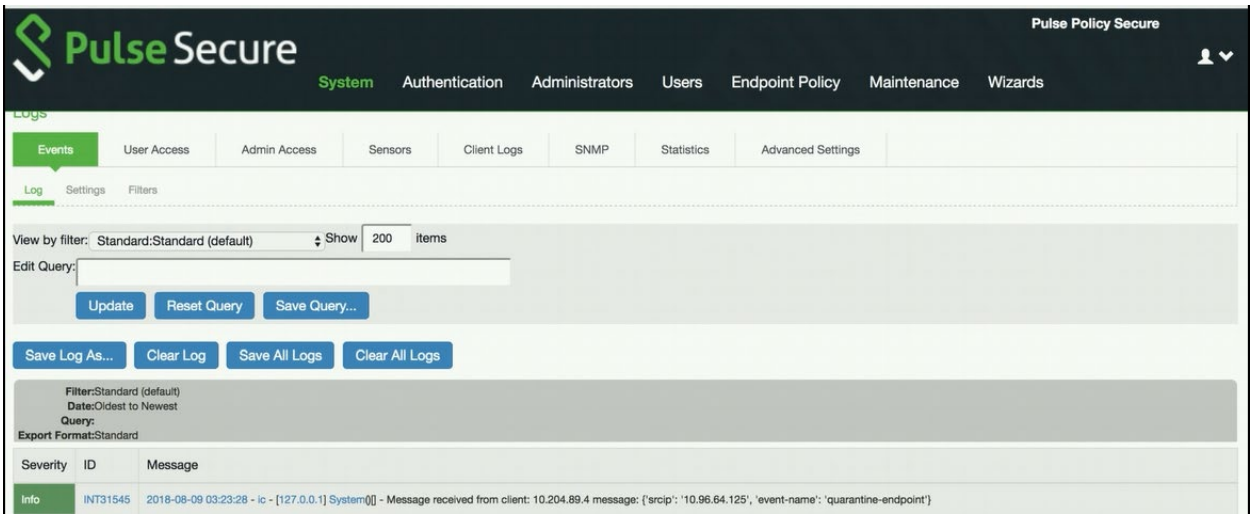


For more information on Juniper SDSN configuration, see Juniper Documentation.

Troubleshooting

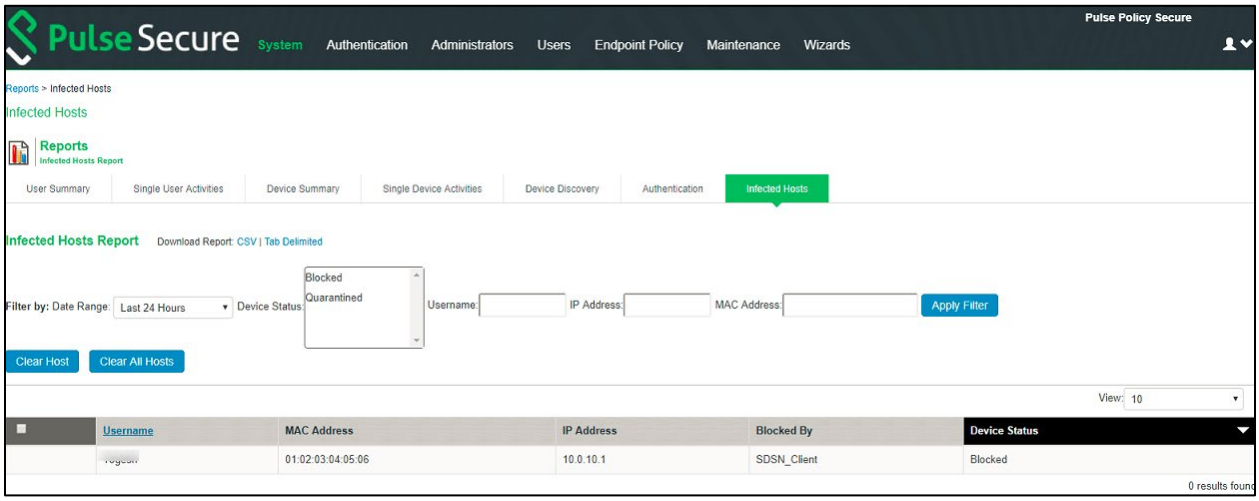
To verify the event logs on PPS, select **System > Log/Monitoring > Events.**

You can verify that the event logs are generated every time when an event is received from Juniper Policy Enforcer.

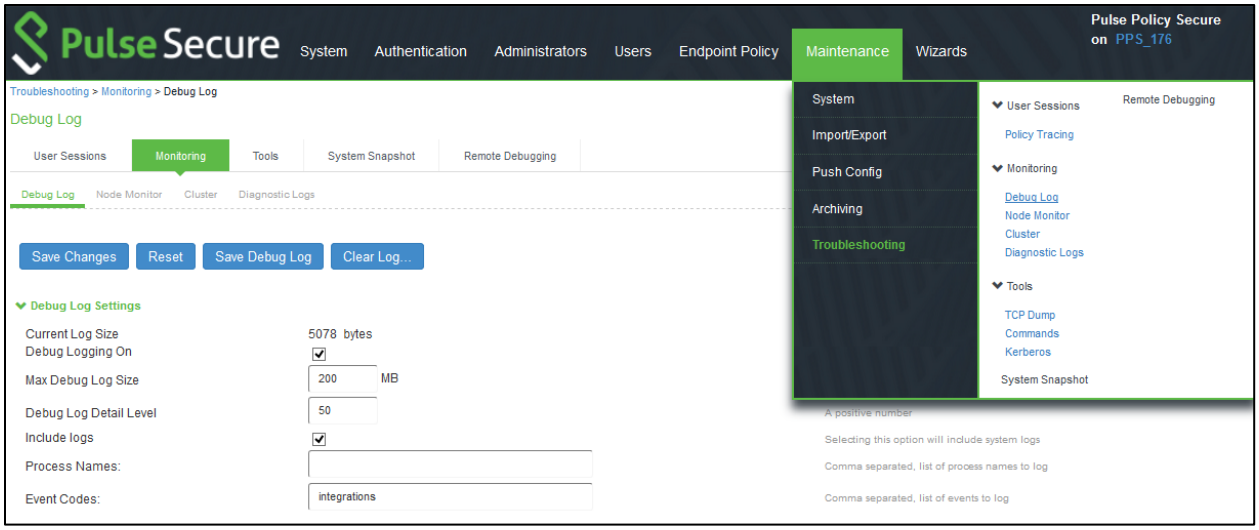


To verify the user access logs, select **System >Logs & Monitoring > User Access** to verify the user login related logs like realm, roles, username and IP address.

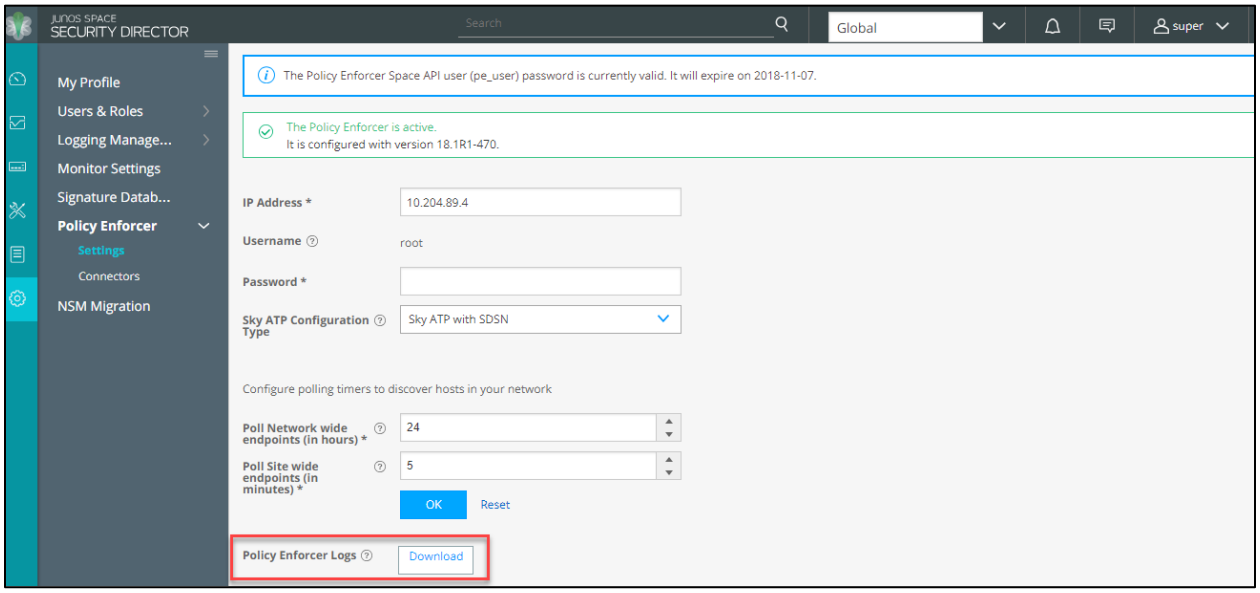
You can also verify whether the quarantined/blocked host is listed in the Infected Devices report, which lists the mac address, IP address, and the device status. To verify the reports, select **System > Reports > Infected Hosts.**



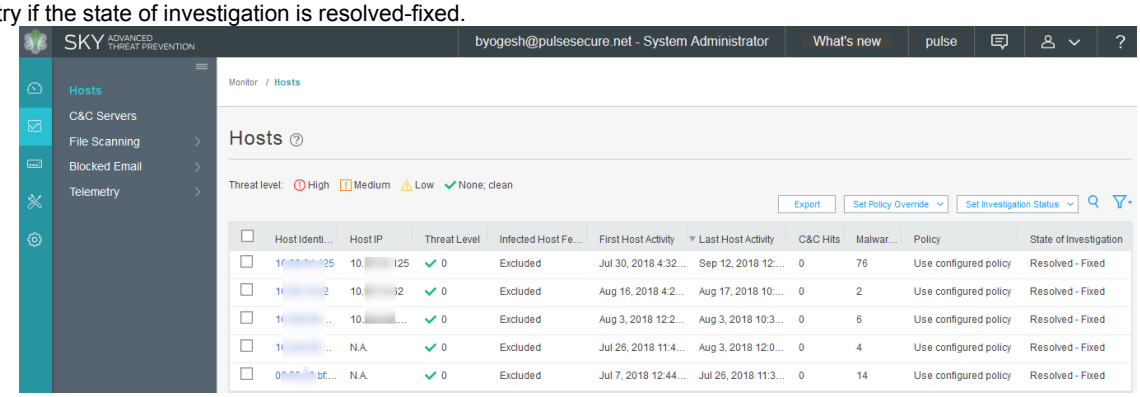
You can also enable debug logs to troubleshoot any issues. Select **Maintenance > Troubleshooting > Monitoring > Debug Log** to enable debug logs.



For any issues on the Policy Enforcer, you can download and verify the Policy Enforcer logs from Junos Space Security Director, Policy Enforcer > Settings page.



The Administrators can also verify the Hosts table from Sky ATP to check the status of the host. You can clear the host entry if the state of investigation is resolved-fixed.



Alert Based Admission Control using Nozomi Networks

This chapter provides an overview of PPS enforcement using Nozomi Networks. It includes the following information:

- Overview
- Deployment of PPS with Nozomi Networks
- Configuring PPS with Nozomi Networks
- Configuring Nozomi Networks
- Troubleshooting

Overview

Nozomi Networks provides industry leading solution for real-time cyber security and visibility for Industrial Control Networks. It provides superior network and operational visibility and advanced threat detection for ICS (Industrial Control System). Nozomi Networks SCADAguardian uses behavior based anomaly detection and multiple types of signature and rule based detection. SCADAguardian also generates different kinds of alerts when potentially dangerous conditions are met. These alerts are originated from different engines (Protocol Validation, Learned Behaviour, Built-in checks, Custom checks) in SCADAguardian.

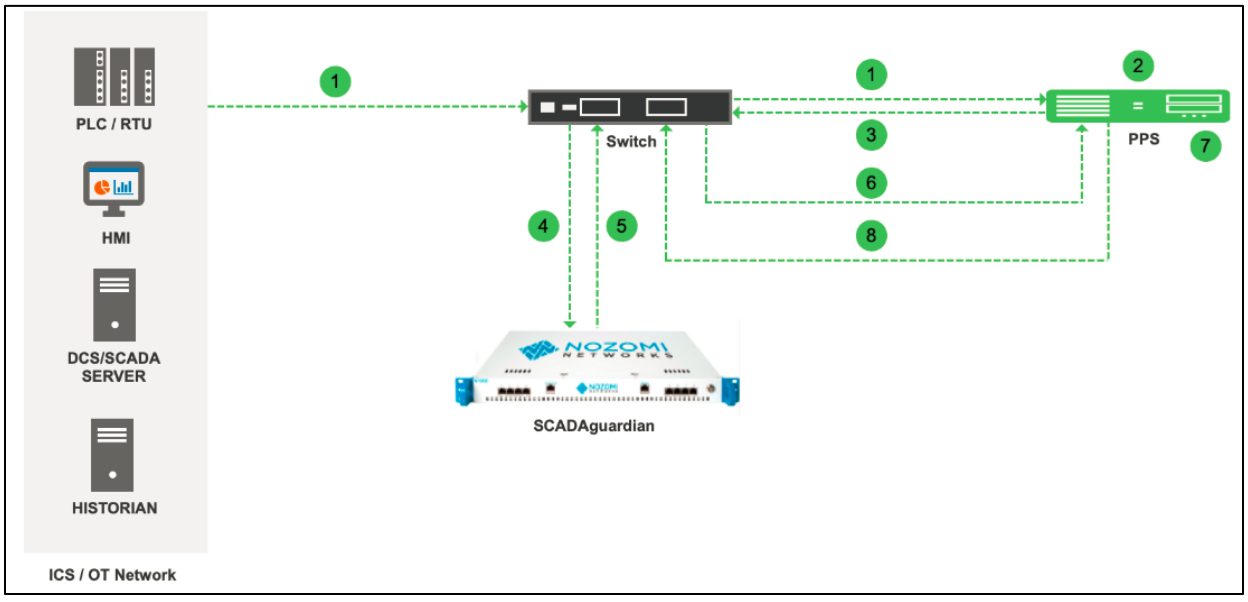
PPS can be deployed in ICS/OT network to provide authentication and access control. PPS can consume alerts generated by Nozomi Networks SCADAguardian and takes appropriate action to restrict access of anomalous device \ endpoint.

PPS and Nozomi Networks together can provide threat detection and threat response in ICS/OT environment.

Deployment of PPS with Nozomi Networks SCADAguardian

This section describes the integration of PPS with Nozomi Networks. PPS receives the threat alert information from Nozomi networks solution and takes an action at the endpoint based on the admission control policies.

Figure: Deployment of PPS with Nozomi Networks



ICS security vendors such as Nozomi Networks are deployed to passively analyse industrial protocol communication for automatic assert discovery and threat detection.

1. The device connects to PPS through Switch.
2. The device session is created on the PPS.
3. The device access details are pushed to Switch using ACL.
4. The Nozomi Networks SCADAguardian monitors the device traffic.
5. The Nozomi Networks SCADAguardian generates the syslog messages for the device.
6. The syslog message is sent to PPS if any suspicious traffic or activity is detected from the device.
7. PPS processes the received syslog message and actions are taken based on the configured policies.
8. New/Updated ACL details are pushed to Switch for updating the enforcement of the device.

Configuring PPS with Nozomi Networks

The network security devices are configured with PPS for admission access control. A high-level overview of the configuration steps needed to set up and run the integration is described below:

- The Administrator configures the basic PPS configurations such as creating an authentication server, authentication realm, user roles, and role mapping rules.
- Configure Nozomi Networks SCADAguardian as a client in PPS.
- Configure PPS details in SCADAguardian
- Configure PPS to block/quarantine the endpoint based on the SCADAguardian admission control template.

This section covers the following topics:

Admission Control Template

The admission control template provides the list of possible events that can be received from the network security device along with regular expression to parse the message. The template also provides possible actions that can be taken for an event.

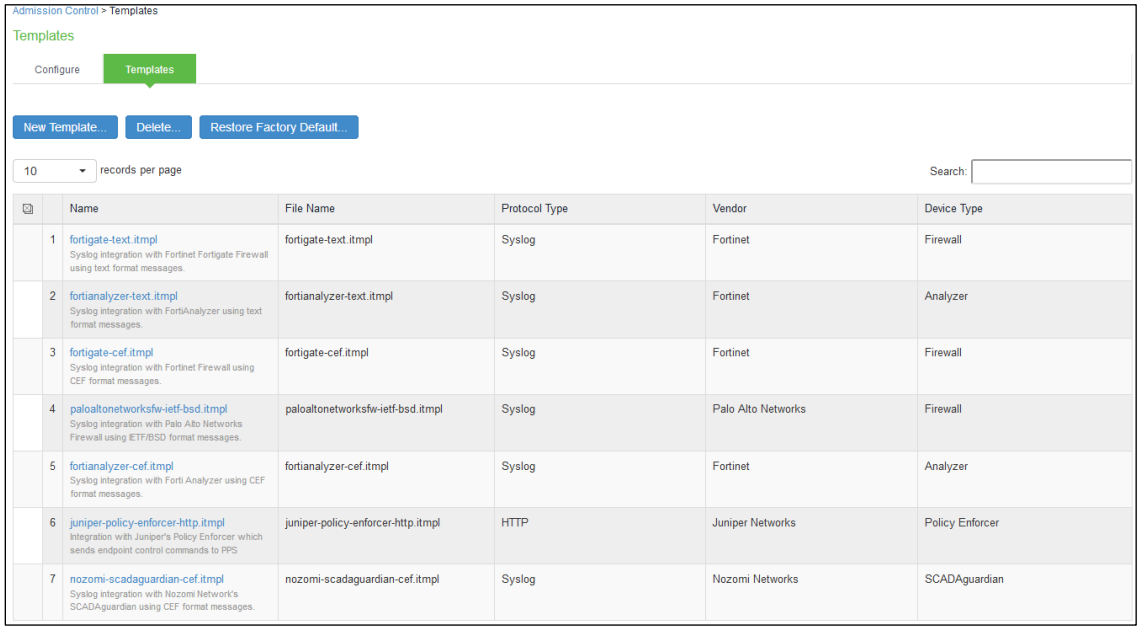
PPS is loaded with default templates for SCADAguardian (nozomi-scadaguardian-cef.itmpl).

You can view the list of configured integration templates that provides the list of network security devices and the supported protocol type using Endpoint Policy > Admission Control > Templates.

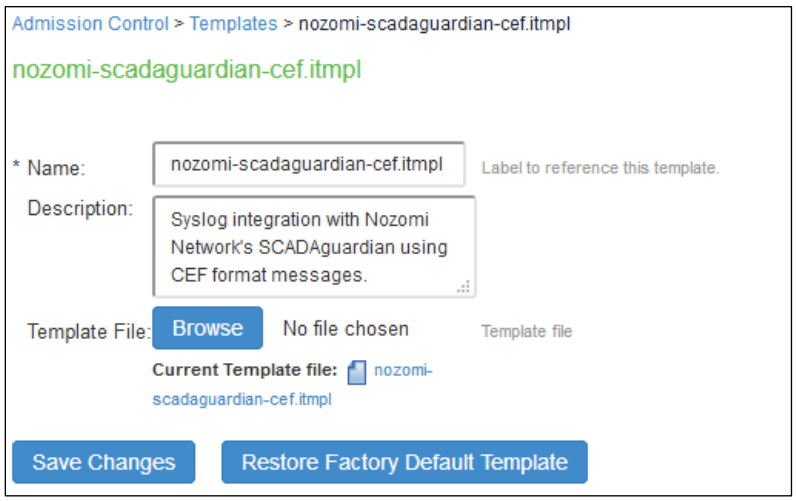
To view the admission control templates:

Select **Endpoint Policy > Admission Control > Templates**.

Figure: Existing Template



Admin can also create templates and can upload it to PPS.



Admission Control Policies

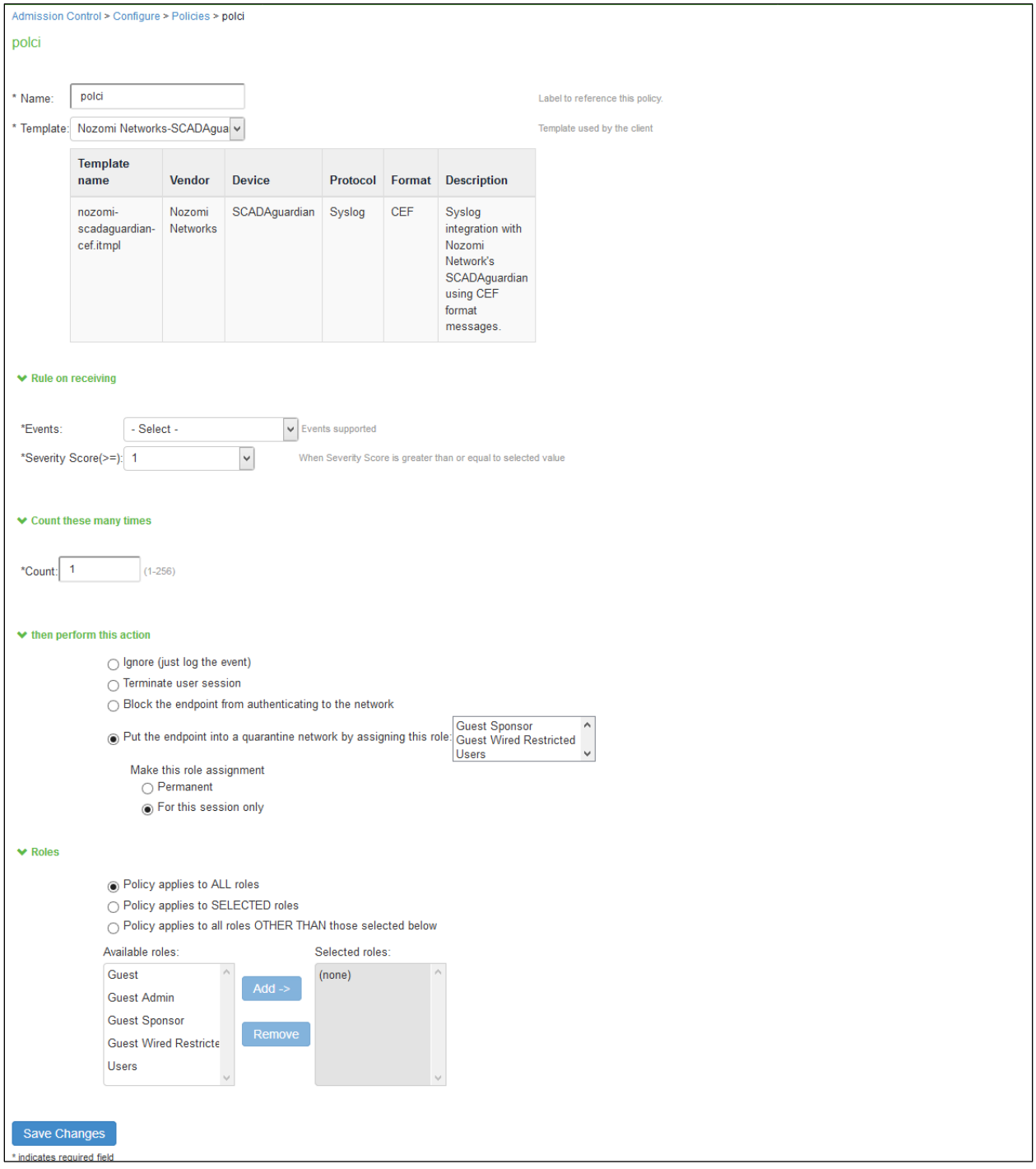
The admission control policies define the list of actions to be performed on PPS for the user sessions. The actions are based on the event and the severity information received from the network security device.

To view and add the new integration policy:

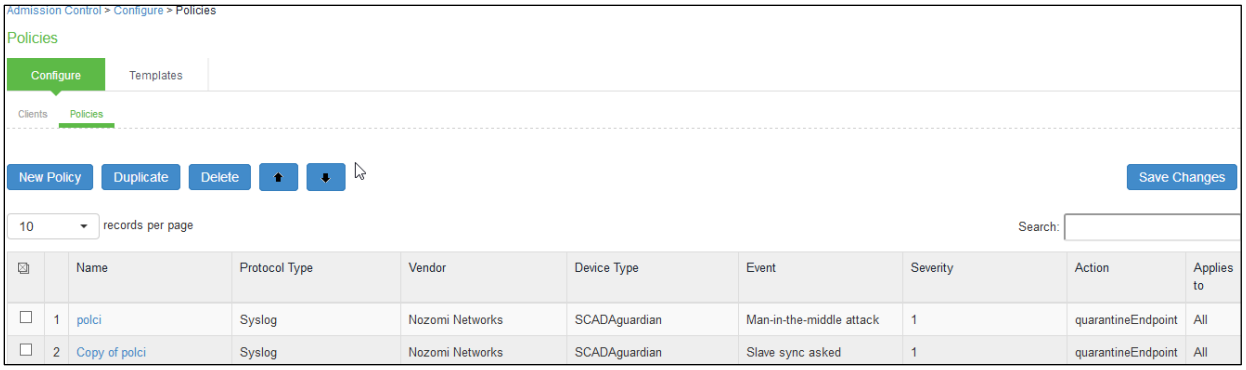
1. Select **Endpoint Policy > Admission Control > Policies**.
2. Click **New Policy**.
3. Enter the policy name.
4. Select **Nozomi Networks-SCADAguardian-Syslog-CEF** as a template.

5. Under **Rule on Receiving**, select the event type severity score. Refer to Event Types supported by Nozomi Networks for more information on supported event types. The event types and the severity score are based on the selected template.
6. Under **then perform this action**, select the desired action.
    - Ignore (log the event) —Received syslog event details are logged on the PPS and no specific action is taken.
    - Terminate user session— Terminates the user session on the PPS for the received messages.
    - Block the endpoint from authenticating to the network — Blocks the endpoint from authenticating to the network.
    - Put the endpoint into a quarantine network by assigning this role — choose the role to put endpoint in quarantine role. Specify whether to apply the role assignment permanently or only for the session.
7. Under **Roles**, specify:
    - Policy applies to ALL roles—To apply the policy to all users.
    - Policy applies to SELECTED roles—To apply this policy only to users who are mapped to roles in the Selected roles list. You must add roles to this list from the Available roles list.
    - Policy applies to all roles OTHER THAN those selected below—To apply this policy to all users except for those who map to the roles in the Selected roles list. You must add roles to this list from the Available roles list.
8. Click **Save changes**.

Figure: Configuration Policies



Once the policy is created. You can see the summary page as shown below. The following page shows the different policies created for different events with different user roles.

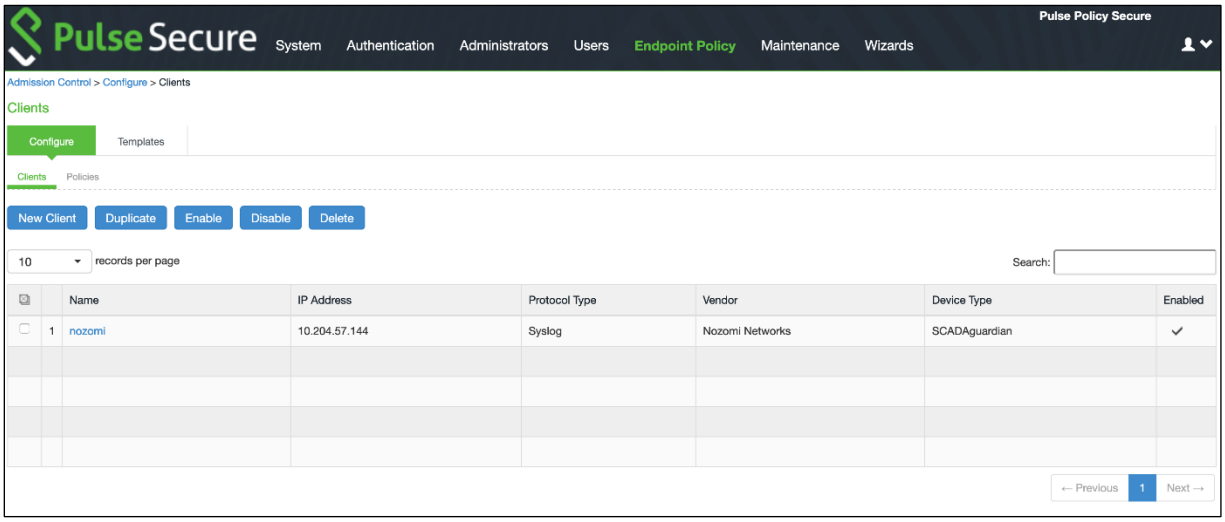


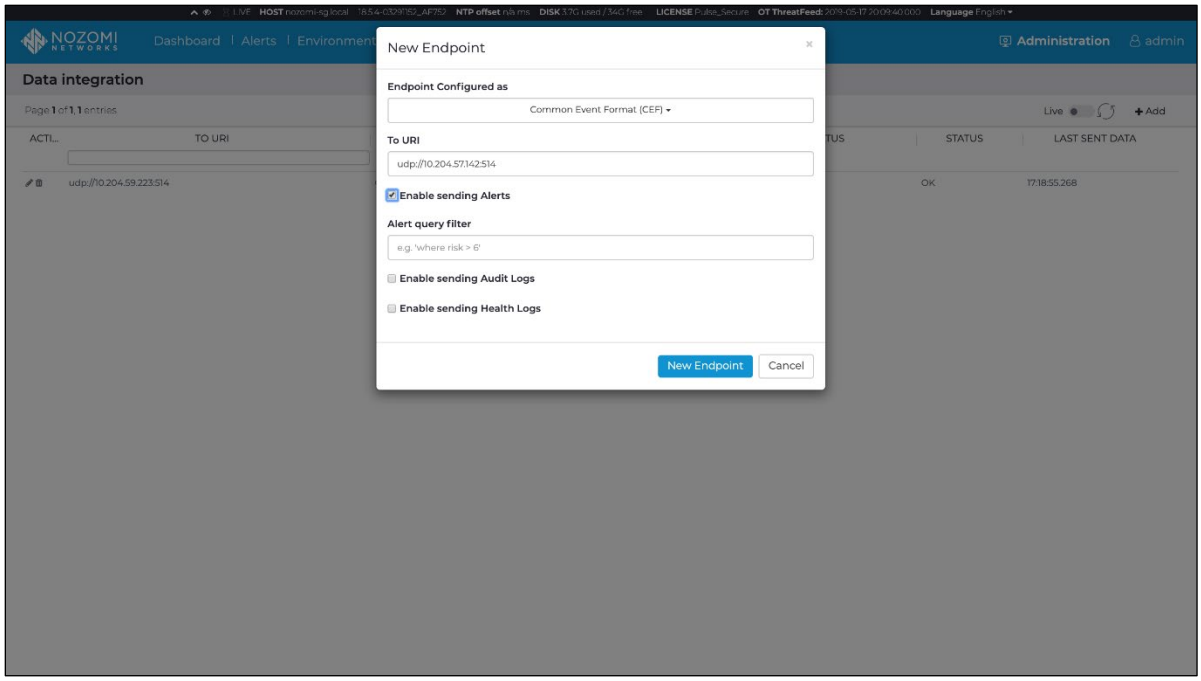
Admission Control Client

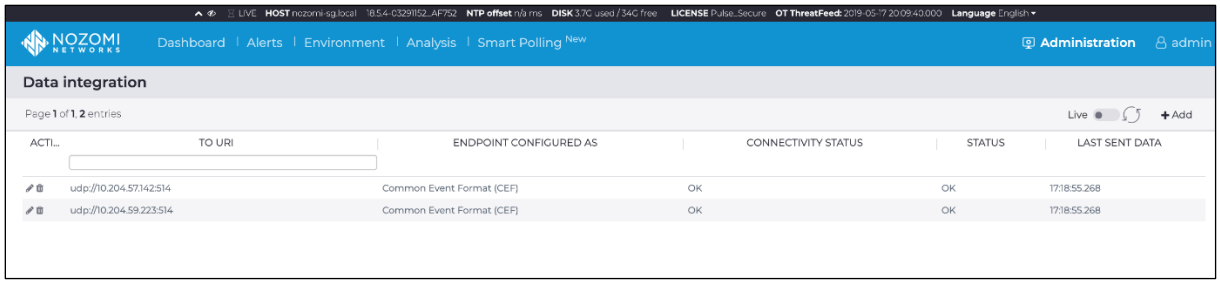
The admission control clients are the network security devices on which the syslog forwarding is enabled. The messages are received by the syslog server module running on PPS.

To add a client:

1. Select **Endpoint Policy > Admission Control > Clients**.
2. Click **New Client**.
3. Enter the name of the client.
4. Enter the description.
5. Enter the IP address of the Nozomi client.
6. Select the Protocol Type as Syslog.
7. Select the Vendor as Nozomi Networks.
8. Select Device Type as SCADAguardian.
9. Click **Save Changes**.







Configuring Nozomi Networks SCADAguardian

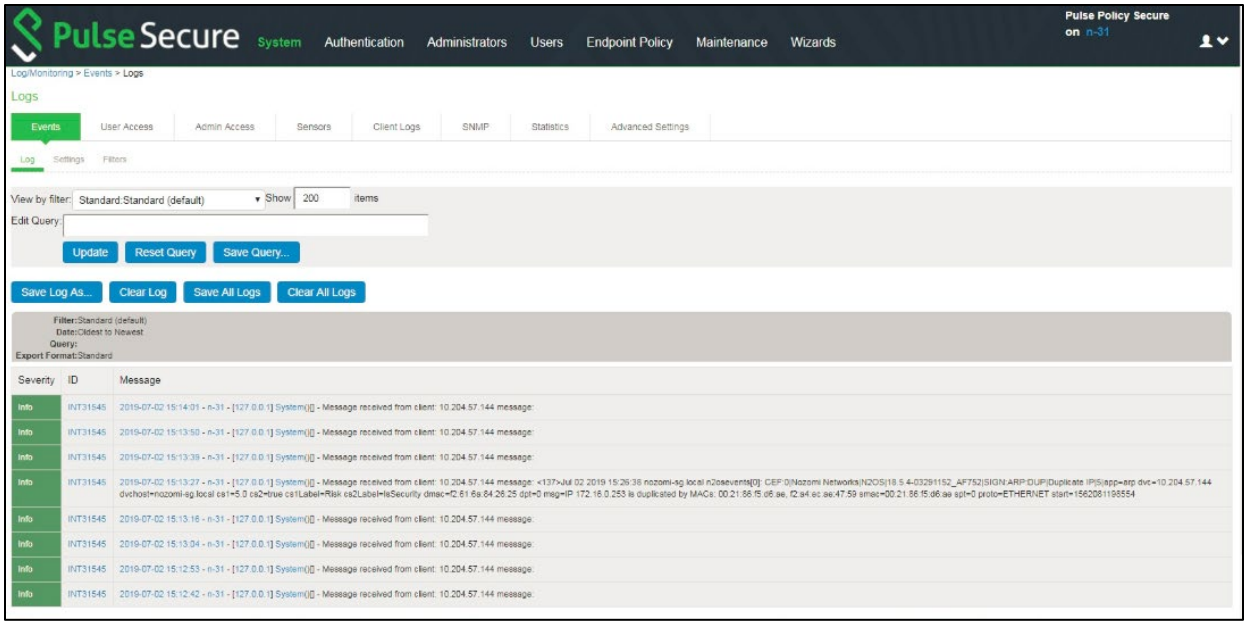
To receive the alert information, PPS details are added in SCADguardian admin interface.

1. Select **Administration > Data Integration**.
    a. Click **+Add** to add new Endpoint.
    b. Under Endpoint Configured as, select **Common Event Format (CEF)**.
    c. Under **To URL**, enter the Protocol (TCP or UDP), IP address of PPS, and port number.
    d. Select the checkbox **Enable sending Alerts**.
    e. Enter the filter query if only specific alert information should be sent to PPS.
    For example, if administrator wants to send information to PPS for alerts with risk score of more than 6, specify "where risk > 6" in query filter.

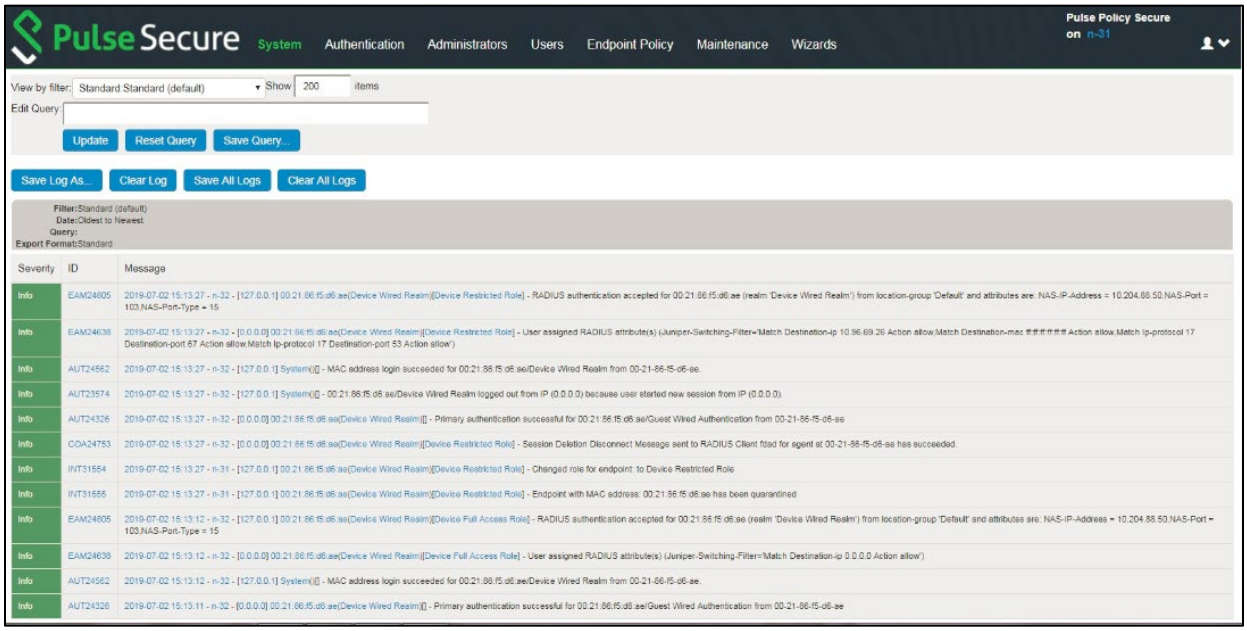
Troubleshooting

To verify the event logs on PPS, select **System > Log/Monitoring > Events.**

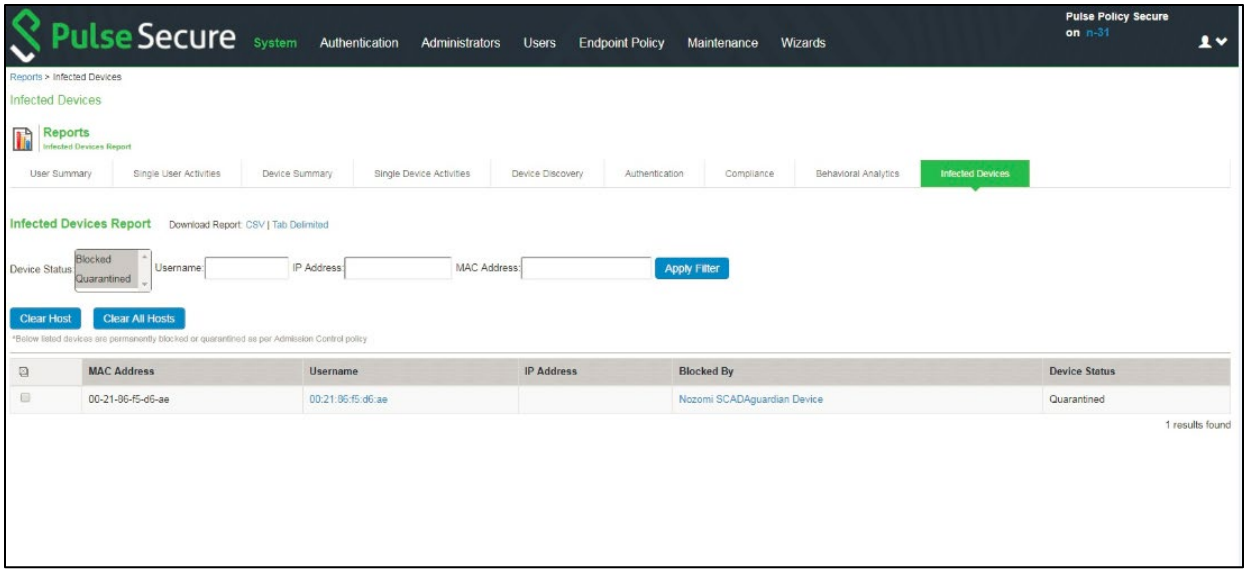
You can verify that the event logs are generated every time when an event is received from SCADAguardian.



To verify the user access logs, select **System >Logs & Monitoring > User Access** to verify the user login related logs like realm, roles, username and IP address.



You can also verify whether the quarantined/blocked host is listed in the Infected Devices report, which lists the mac address, IP address, and the device status. To verify the reports, select **System > Reports > Infected Hosts.**



You can also enable debug logs to troubleshoot any issues. Select **Maintenance > Troubleshooting > Monitoring > Debug Log** to enable debug logs.

Host Checker

This chapter covers the following topics:

- Host Checker Overview
- Policies
- Host Checker Installation Options
- Endpoint Security Assessment Plug-In (ESAP)
- Configuring Host Checker Policy
- Store and Reuse Host Checker Policy Results

Host Checker Overview

Host Checker is a software component that performs endpoint compliance checks on hosts that connect to the PPS. It supports two types of rules within a policy; predefined and custom. The pre-defined inspection capabilities consist of health and security checks including antivirus versions, antispyware, OS versions, hard disk encryption status and patch checks. The pre-defined rules are provided by OPSWAT and it uses the ESAP plug-in for pre-defined checks. For more information, see Endpoint Security Assessment Plug-In (ESAP).

Custom rules allows admin to define checks to collect system health using Integrity message collector (IMC) and evaluate using Integrity message verifier (IMV) of TNC framework. The custom rules are created by the admin to include inspection checks such as absence or presence of specific file, certificate checks, TCP ports, processes, registry key settings, NetBIOS name, MAC addresses or certificate of the client machine and third party inspection methods (custom DLLs).

Host Checker evaluation is done at 2 stages:

1. Initial check or evaluation of the user machine as the user browses to the sign-in page.
2. Enforcement of the policy during the user sign-in process, which happens at realm or role level.

- **Realm-level policies/Pre-Authentication**— The realm level policy is also called as Pre-Authentication requirement as it occurs before the user is prompted for authentication.
- **Role-level policies/Post-Authentication**—The role level policy is also called as Post-Authentication requirement as it occurs after the user is authenticated and during the role-mapping phase.

If the endpoint does not meet HC policy requirement, administrator can define a customized remediation page with specific instructions and links to resource to ensure that the end user's computer is compliant with the HC policy.

Host checking for layer 2 session is supported only for Pulse initiated 802.1x session. Note that it's not supported for session initiated by native supplicant. For layer 3 sessions host checking is supported for Pulse initiated and browser based sessions.

Trusted Network Connect

Host Checker is compliant with the Trusted Network Connect (TNC) model developed by Trusted Computing Group (TCG). TCG created an architecture and set of standards for verifying endpoint integrity and policy compliance during or after a network access request. For more information about TNC, see www.trustedcomputinggroup.org.

Policies

PPS Host checker component supports many different type of product policy evaluation on endpoint along with continues monitoring of system health. The below table lists the description of various policies and features, which can be defined as part of device compliance check.

Table 15: Supported Policies

Policy	Description
Predefined	
Antivirus Policy	Policy to detect whether the Antivirus is installed and up-to-date with latest virus signatures. It also includes other options to check the last scan time, virus signature download, and remediation options.
Firewall Policy	Policy to detect the firewall installed on endpoint and the remediation option to turn on the firewall if it's turned off.
Anti-Spyware Policy	Policy to detect the installed spyware on endpoints.
Hard disk Encryption	Policy to detect and check the encryption status of the specified or all drives using installed encryption software.
Patch Management	Policy to check whether the required operating system patches are installed properly.
OS Checks	Policy to check the version of the windows operating systems and minimum service packs.
Common Vulnerability and Exposure (CVE)	Policy to check any vulnerable attacks such as ransomware attack.
System Integrity Protection (SIP)	Policy to check the status (enabled/disabled) of System Integrity Protection (SIP) on the Mac OS endpoints.
Custom	
3rd Party NHC Check	Policy to specify the location of custom DLL files.
Ports policy	Policy to check if a particular port is either opened or closed to allow or reject the user authentication.
Process policy	Policy to control the software or processes that runs on the client machine.
File Policy	Policy to check if a particular file with specific version or checksum, or last modified file is present on endpoint to allow or reject the user authentication.
Registry Settings policy	Policy to check the registry and its value to allow or reject the user authentication, with a remediation option to set the registry value if not configured.

Policy	Description
NetBIOS policy	Policy to check the NetBIOS name from list of NetBIOS names provided to control user access.
MAC Address policy	Policy to check if the endpoint MAC address is in the provided regex or white listing of mac addresses to control user access.
Machine Certificate Policy	Policy to check for the required machine certificate on the endpoint to control user access. This policy evaluates both public and private keys of the installed machine certificate on endpoint for users using Pulse Client. For agentless users, only public key is evaluated.
Advanced Host Checking	Policy to dynamically check the compliance status of the endpoints. It includes combining 2 policy types for obtaining the expected values of the check type. The expected values are fetched from registry location on the client machine for evaluating the policies. The advanced support for checking the expected values against another policy is supported on Ports, Process, File, Registry, NETBIOS, MAC Address, and Machine certificate.
Statement of Health	Policy to perform the health state validation to determine which roles or realms can be accessed by endpoints. It checks the system health indicators such as antivirus is enabled and up to date, antispyware is enabled and up to date, firewall is enabled and so on.
Command	Policy to check the versions of the installed applications on the Mac OS endpoints.
Host Checker General Settings	PPS provides following admin configuration options while performing host checking.
General Options	
Continuous Policy Evaluation	Option to configure periodic and continuous policy evaluation so that the endpoint is compliant with the Host Checker policy.
Virus Signature Version Monitoring	Option to monitor and verify the virus signatures, operating systems, and patches installed are up to date.
Pre-Authentication Host Checking	Pre-Authentication host checking are policies that are enforced at the realm level before authentication.
Post-Authentication Host Checking	Post-Authentication host checking are policies that are enforced when role assignment happens after authentication.

Support Platform Matrix

A Host Checker policy contains one or more rules. Each rule can apply to different host checks and for different device types (Windows, Mac, Linux, Solaris, iOS, Android). The below table lists the Host Checker policies that are supported on Windows, Mac, Linux, and Solaris.

Table 16: Supported Policies for Desktop

Policy	Windows	Mac	Linux	Solaris
Antivirus	Yes	Yes	No	No
Firewall	Yes	Yes	No	No
AntiSpyware	Yes	Yes	No	No
Hard Disk Encryption	Yes	Yes	No	No
Patch Assessment	Yes	Yes	No	No
OS Checks	Yes	Yes	No	No
Common Vulnerability and Exposure (CVE) Check	Yes	No	No	No
3rd Party NHC Checks	Yes	No	No	No
Ports	Yes	Yes	Yes	Yes
Process	Yes	Yes	Yes	Yes
Files	Yes	Yes	Yes	Yes
Registry Setting	Yes	No	No	No
NetBIOS	Yes	Yes	No	No
MAC Address	Yes	Yes	No	No
Machine Certificates	Yes	Yes	No	No
Statement of Health	Yes	No	No	No
System Integrity Protection (SIP)	No	Yes	No	No
Command	No	Yes	No	No
Advanced Host Checking	Yes	No	No	No

Note:
Agentless mode with Profiler is supported only with Windows platforms. The supported policies are Antivirus, Firewall, Antispyware, OS checks, Ports, Process, NetBIOS, and MAC Address. For more information, see Profiler documentation.

Host Checker Installation Options

Host Checker is supported for agent and agentless clients. The installation options are listed below:

- Browser based Host Checking (Agentless) — This is used for browser-based logins and requires PSAL to be present on the endpoint. If PSAL is not available on the endpoint, it gets installed as part of the connection.

It is recommended not to keep a very low value for **login inactivity timeout** (For example,1 or 2 minutes). This might result in connection timeouts on fresh endpoints where PSAL also need to be installed as part of compliance evaluation.

- Pulse Client (Agent)—You can use Pulse client, which contains the Host Checker component for compliance check. To manually install the Host Checker, Select **Maintenance > System > Installers** and download the Pulse installer.

Using the downloaded executable file, you can:

- Distribute the file to client machines using software distribution tools. This option enables you to install an application or service on client machines.
- Post the executable in a secure repository so that users with the proper administrator right may download and install the appropriate version.

Auto-upgrading Host Checker

To automatically upgrade Host Checker:

1. Select **Authentication > Endpoint Security > Host Checker**.
2. Under Options, select **Auto-upgrade Host Checker** if you want the system to automatically download the Host Checker application to a client computer when the version of Host Checker on the system is newer than the version installed on the client.
3. Click **Save Changes**.

Endpoint Security Assessment Plug-In (ESAP)

The Endpoint Security Assessment Plug-in (ESAP) is a plug-in in PPS using which you can upload the latest SDK from Opswat independently.

Pulse Secure frequently adds enhancements, bug fixes, and support for new third-party applications to the plug-in. New plug-in releases are available independently and more frequently than new releases of the system software package. If necessary, you can upgrade the plug-in independently of a system upgrade.

You can upload up to four versions of the plug-in, but the system uses only one version at a time (called the active version). If necessary, you can rollback to a previously active version of the plug-in.

If the endpoints in your deployment connect to multiple servers simultaneously, all of those connected servers must use the same version of the ESAP plug-in.

Upgrading the ESAP

To upgrade the ESAP plug-in:

1. Download the Endpoint Security Assessment Plug-in from the Pulse Secure Support Portal.
   - To access the Customer Support Center, enter a username and password for a Pulse Secure Support Center account.
   - Click the ESAP Download Page link.
   - Navigate to the ESAP release you want.
   - Download the plug-in zip file to your computer.
2. Select **Authentication > Endpoint Security > Host Checker**.
3. On the Host Checker page, under Manage Endpoint Security Assessment Plug-In Versions:
   - If you want PPS to actively begin using the new component software immediately after you upload it, select the Set as active after upload option.

- Click **Browse**, select the plug-in file to upload and click **OK**.
- Click **Upload**. After the plug-in is installed, the date and time of the plug-in installation is displayed in the plug-in list.
- If you did not select the Set as active after upload option, activate the plug-in to use by selecting the version in the plug-in, list and click **Activate**.

NOTE:

- You can rollback to an older plug-in version after you upgrade to a later version by selecting the older version as the active version.
- If you upgrade the system software to a newer version, or if you import a user configuration file, active plug-in version can change based on the supportability of ESAP version. If you want to use a different plug-in version after you upgrade or importing a user configuration file, you must manually activate that plug-in version.

OPSWAT SDK V3 to V4 Migration

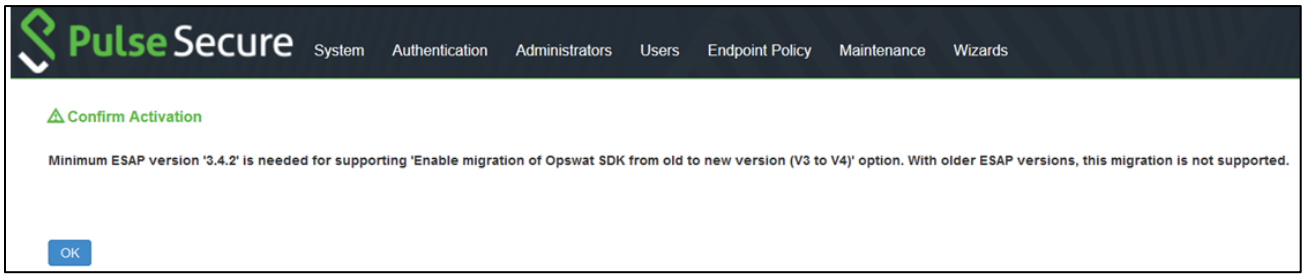
Pulse Secure supports Opswat version 3 and version 4 for endpoint compliance evaluation. The migration option helps the administrators to migrate their servers and clients with Opswat v4 to take advantage of latest updates.

Software Support- Starting with Release 9.1R2 and later releases.

OS support: Windows 7 and later releases and macOS 10.12 and later releases

Prerequisites - ESAP 3.4.2 is the minimum version. A warning message is displayed if the minimum version is not present.

Figure 188: Warning Message

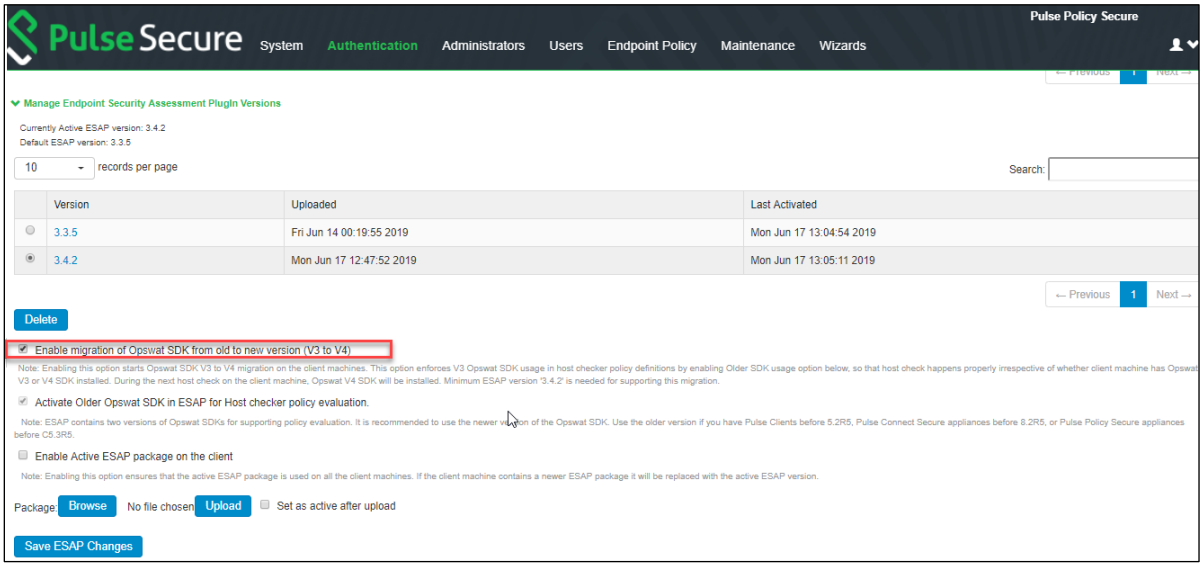


Procedure to migrate from Opswat V3 to V4

To migrate follow the below procedure:

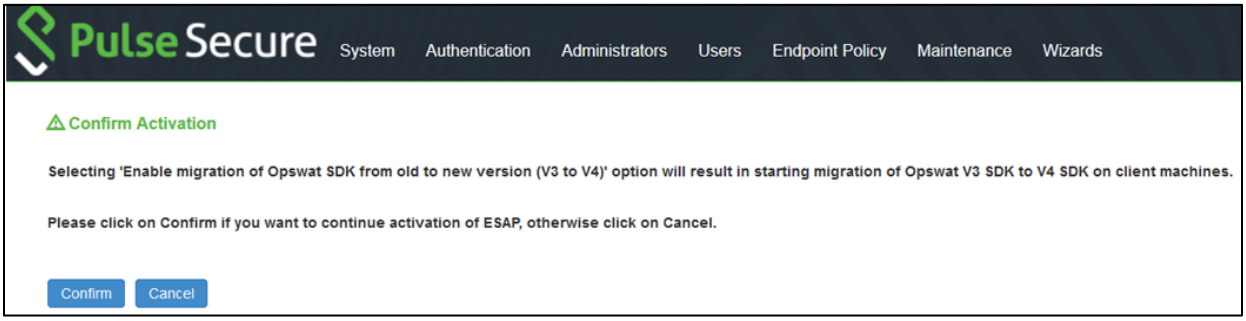
1. Navigate to “Manage Endpoint Security Assessment PlugIn Versions” section on **Authentication > Endpoint Security > Host Checker page**.
2. Enable the option for **Enable migration of Opswat SDK from old to new version (V3 to V4)**.
   On enabling this option, the clients start downloading the V4 SDK and migrate to newer SDK.

Figure 189: Migration Opswat SDK V3 to V4



3. **Uncheck/Disable Enable migration of OPSWAT SDK from old to new version (V3 to V4)** option once the migration is complete. Verify the migration status.
4. A confirmation message display. Click **Confirm**.

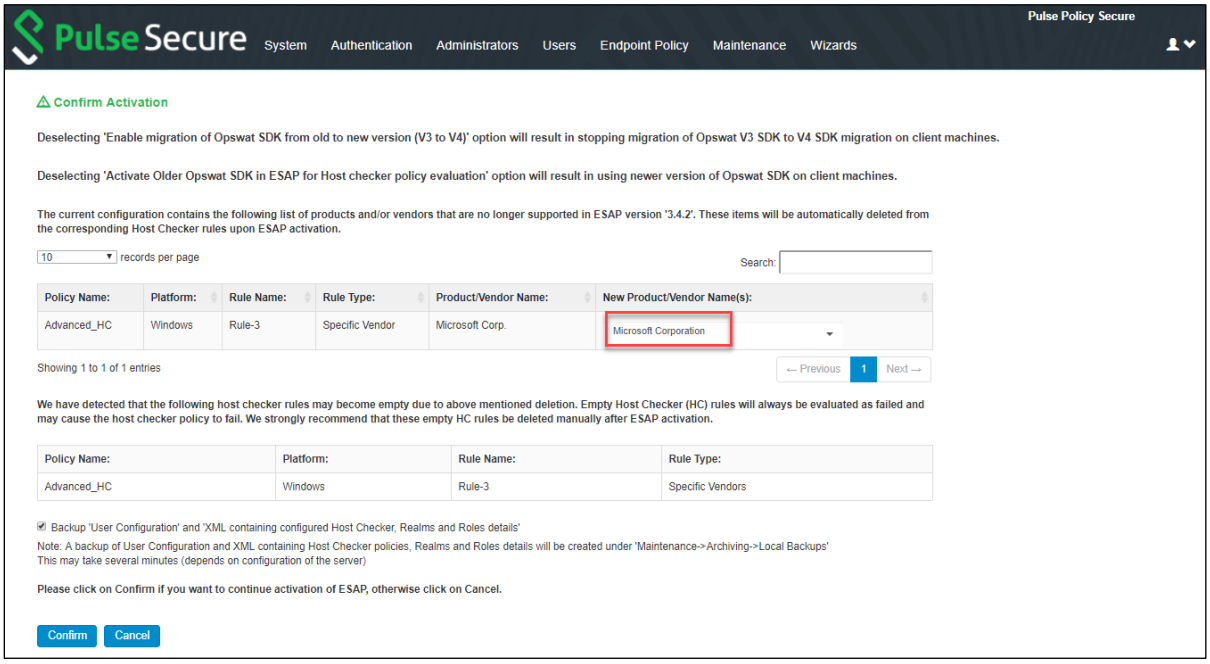
Figure 190: Confirmation Message



Post migration, Admin can remap the configured products in the policies to map to the newer SDK using the post migration window.

For example, in the below screenshot the Product /Vendor Name for the policy has been changed from Microsoft Corp. to Microsoft Corporation for successful migration.

Figure 191: Post Migration Product Mapping



5. Enable **Backup User Configuration and XML containing Host Checker, Realms and Role details** for performing configuration backup. This option helps to revert to the previous version of PPS/PCS configuration, if required.
6. Click **Confirm**.

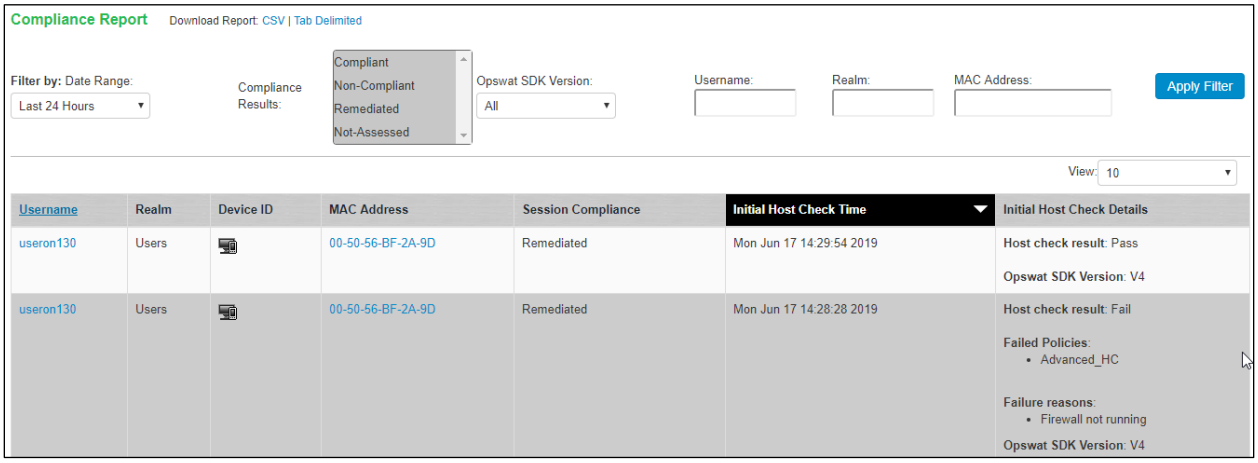
Compliance Report

The Compliance Report displays the compliance details of the users connected to the server. The report also includes the Opswat SDK Version used for these connections. **Opswat SDK Version** is used to filter the users using a specific Opswat SDK version.

The compliance report page displays the Opswat SDK version details only when "Enable migration of OPSWAT SDK from old to new version (V3 to V4)" option is enabled.

To check the SDK version for each connection, view the report under **System > Reports > Compliance Report**.

Figure 192: Compliance Report

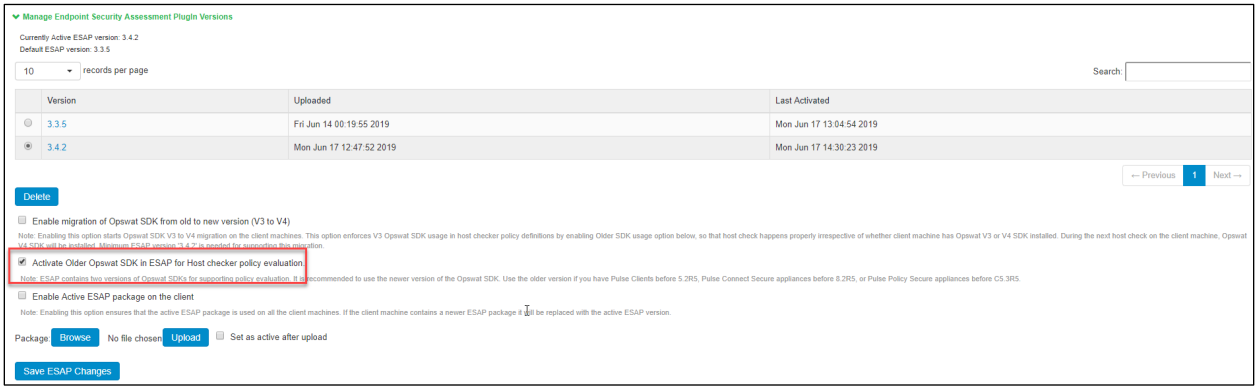


Roll back procedure

To roll back to previous version of Opswat SDK:

1. Navigate to “Manage Endpoint Security Assessment PlugIn Versions” section on Authentication > Endpoint Security > Host Checker page.
2. Uncheck **Enable migration of Opswat SDK from old to new version (V3 to V4).**
3. Enable **Activate Older Opswat SDK in ESAP for Host Checker policy evaluation**.
4. Click **Save ESAP changes**.

Figure 193: Activate Older SDK



End User Flow

User logging in from browser or User logging in from Pulse client for L3 connection

- Client machine has Opswat V3 SDK installed.
- Host Check starts on the client machine as part of connection establishment.
- Server sends the required information to client for upgrading V3 to V4 SDK.
- Client downloads V4 SDK and collects the installed security products details using newly installed V4 SDK and sends the detected product details to server.
- Server evaluates configured Opswat based rules by consuming the details received from client machine.
- Host Checker continues to use the installed V4 SDK on client machine for subsequent host checks and connections.

User logging in from Pulse client for L2 connections

- Client machine has Opswat V3 SDK installed.
- Host Check starts on the client machine as part of connection establishment.
- Server sends the required information to client for upgrading V3 to V4 SDK.
- During L2 connection, client fails to download V4 SDK.
- Host Checker collects the installed security products details using existing V3 SDK and sends the detected product details to server.
- Server evaluates configured Opswat based rules by consuming the details received from client machine.
- L2 connection is established followed with an L3 connection.
- Server detects L2 followed by L3 connection attempt and remembers that ESAP upgrade is needed on the client machine.
- Host Check is triggered again on client machine during L3 connection.
- Server sends the required information to client for upgrading V3 to V4 SDK.
- Client downloads V4 SDK (because L2 connection is complete already) and collects the installed security products details using newly installed V4 SDK and sends the detected product details to server.
- Server evaluates configured Opswat based rules by consuming the details received from client machine.
- Host Checker continues to use the installed V4 SDK on client machine for subsequent host checks and connections.

Note: Host checking is done twice for the same client machine (once during L2 connection and once during L3 connection) for the first time. However, Host Checking is done only once for the subsequent connections as the client machines has the Opswat V4 SDK installed.

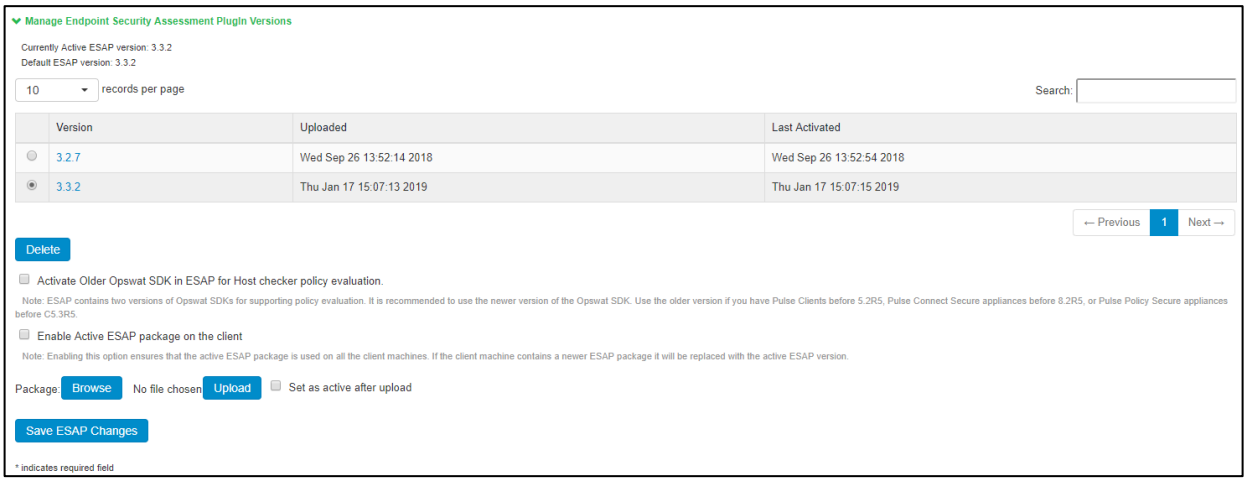
Activating the Opswat SDK Version

Beginning with Release 5.3R5, PPS supports both v3 and v4 SDKs provided by OPSWAT. The default SDK version used is v4, but it can be reconfigured based on your requirement. The product/vendor names used by v3 and v4 SDK might differ. Due to the product/vendor names mismatch, there is a possibility that the rules become empty while creating Host Checker rule with v3 SDK activated and upon enabling v4 SDK. To avoid this, a migration page is added to help the administrators in migrating the policies from v3 to v4 SDK.

To use v3 or v4 SDK:

1. Select **Authentication > Endpoint Security > Host Checker**.
2. Enable the **Activate Older SDK in ESAP for Host Checker policy evaluation** check box for v3 SDK.
3. Disable the **Activate Older SDK in ESAP for Host Checker policy evaluation** check box for v4 SDK.

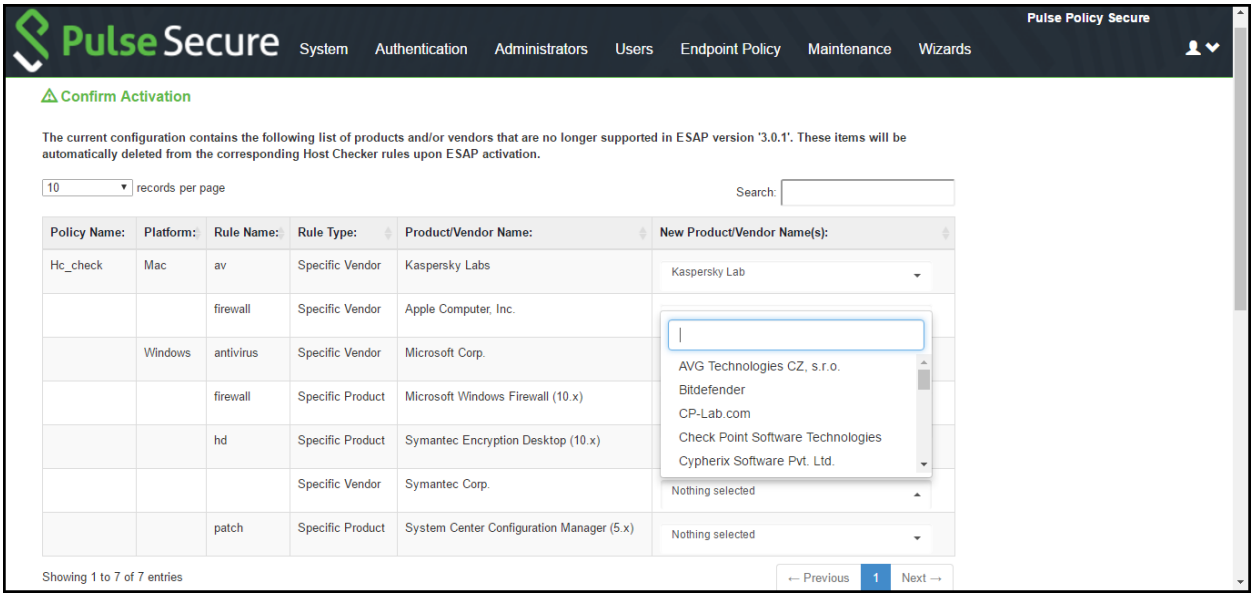
Figure 194: Activating Opswat SDK



NOTE: It is recommended to disable this option for using newer version of OPSWAT SDK, after all the Pulse Clients are upgraded to 5.2R5 or above and servers are upgraded to PPS 5.3R5 or above.

4. Click **Save ESAP Changes**. A confirm Activation page appears which lists the products and/or vendors, which are no longer supported in that particular ESAP SDK version. From the drop downlist, admin can select one or many new products /vendors instead of the existing product/vendor.

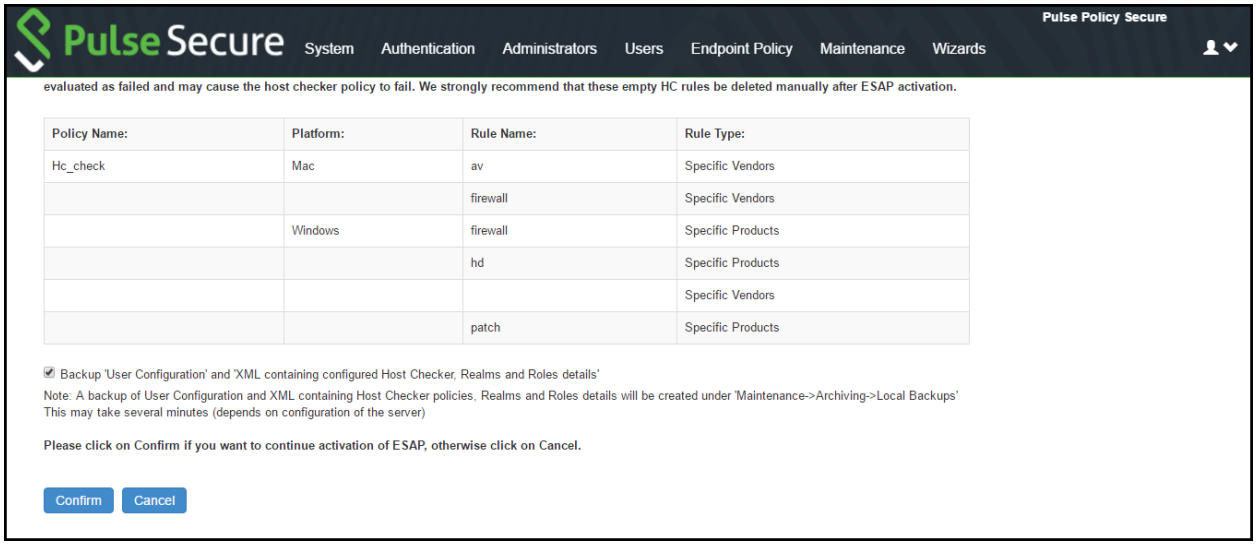
Figure 195: ESAP Activation



NOTE: Only the products/vendors, which get changed are listed. If some rules have some products/vendors whose names are not changed, those products/vendors will be automatically migrated and will not be listed.

5. Enable **Backup 'User Configuration' and 'XML containing configured Host Checker, Realms and Roles details** check box to create a local backup of user configurations under Maintenance > Archiving > Local Backups.

Figure 196: Backup User Configuration



NOTE: Server maintains a maximum of 5 backups. To capture a new backup, older backup will be automatically deleted.

6. Click **Confirm**.

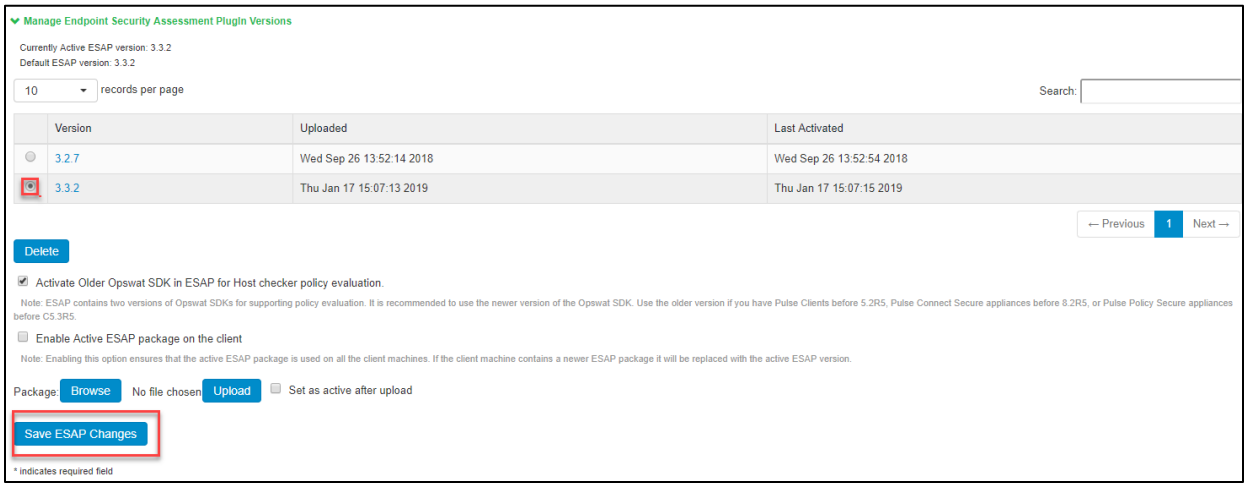
Changing the Active ESAP Package

Administrator can activate any of the already uploaded ESAP packages by selecting the corresponding radio button under “Manage Endpoint Security Assessment Plugin Versions” table and then clicking on “Save ESAP Changes” button.

To change the active ESAP packages:

1. Select **Authentication > Endpoint Security > Host Checker**.
2. Under Manage Endpoint Security Assessment Plugin Versions, select the required ESAP version.
3. Click **Save ESAP Changes**.

Figure 197: Changing Active ESAP package



Note: If the client machine has newer ESAP package and if it has to be replaced, then select “Enable the Active ESAP package”. See Enabling the Active ESAP Package to know about the procedure.

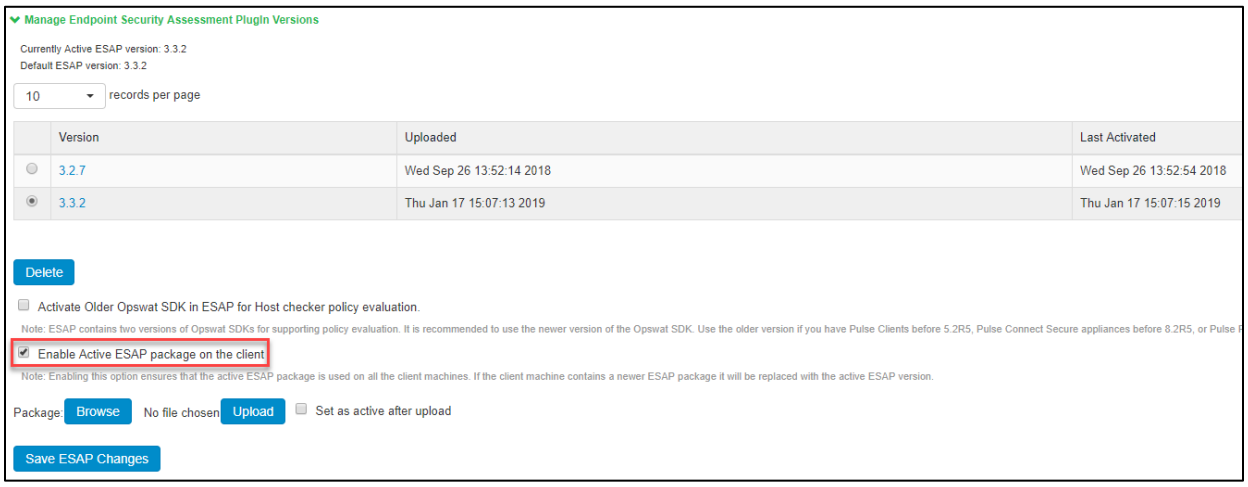
Enabling the Active ESAP Package

Administrator can enable “Enable Active ESAP package on the client” checkbox to ensure that client machine always uses the active ESAP package, even if the active ESAP package is older than the version installed on the client system. In case client machine has newer ESAP package installed, it will be replaced with the older Active ESAP version with this option enabled.

To enable the active ESAP package:

1. Select **Authentication > Endpoint Security > Host Checker**.
2. Under Manage Endpoint Security Assessment Plugin Versions, enable **Enable Active ESAP package on the client** checkbox.

Figure 198: Enabling Active ESAP package



3. Click **Save ESAP Changes**.

Updating Virus Signature Database

You can automatically import the current virus-signature version-monitoring from the Pulse Secure staging site at a specified interval, or you can download the files from Pulse Secure and use your own staging server. You can also configure a proxy server as a staging site between PPS and the Pulse Secure site. To use a proxy server, you enter the server network address, port, and authentication credentials, if applicable.

To access the Pulse Secure staging site for updates, you must enter the credentials for your Pulse Secure Support account.

For patch assessment remediation with Pulse Secure you can use OPSWAT (a third-party vendor) to automatically download patches from trusted sources to the endpoint.

To configure PPS to automatically import the current virus signature version-monitoring from the Pulse Secure staging site:

1. Select **Authentication > Endpoint Security > Host Checker**.
2. Select **Virus signature version monitoring**.
3. Select **Auto-update virus signatures list**.
4. For Download path, leave the existing URLs of the staging sites where the current lists are stored. The default URLs are the paths to the Pulse Secure staging site:
5. For Download interval, specify how often you want PPS to automatically import the current list(s).
6. For Username and Password, enter your **Pulse Secure Global Support Center** (PSGSC) credentials.
7. Click **Save Changes**.

To manually import the current virus signature version-monitoring lists:

1. Select **Authentication > Endpoint Security > Host Checker**.
2. Click **Virus signature version monitoring**.
3. Download the list(s) from the Pulse Secure staging site to a network server or local drive on your computer by entering the Pulse Secure URLs in a browser window:
4. https://download.pulsesecure.net/software/av/uac/epupdate_hist.xml
5. https://download.pulsesecure.net/software/hc/patchdata/patchupdate.dat
6. Under Manually import virus signatures list, click Browse, select the list, and then click OK.
7. Click **Save Changes**.


NOTE: If you use your own staging site for storing the current list(s), you must upload the trusted root certificate of the CA that signed the staging's server certificate to PPS.

To use a proxy server as the auto-update server:

1. Select **Authentication > Endpoint Security > Host Checker**.
2. Select **Virus signature version monitoring**.
3. Select **Auto-update virus signatures list**.
4. For Download path, leave the existing URLs of the staging sites where the current lists are stored. The default URLs are the paths to the Pulse Secure staging site:

https://download.pulsesecure.net/software/av/uac/epupdate_hist.xml

(for auto update virus signatures list)

https://download.pulsesecure.net/software/hc/patchdata/patchupdate.dat

(for auto update patch management)

1. For Download interval, specify how often you want PPS to automatically import the current lists.
2. For Username and Password, enter your Pulse Secure Global Support Center(PSGSC) credentials.
3. Select the **Use Proxy Server** check box.
4. For IP Address, enter the IP address of your proxy server.
5. For Port, enter the port that the **Pulse Secure Global Support Center** (PSGSC) will use to communicate with your proxy server.
6. If your proxy server is password protected, type the Username and Password of the proxy server.
7. Click **Save Changes**.

Understanding Host Checker Policy Remediation

This topic describes Host Checker policy remediation. It includes the following information:

- Remediation Options
- Remediation User Experience

Remediation Options

You can specify general remediation actions for Host Checker to take if an endpoint does not meet the requirements of a policy. For example, you can display a remediation page to the user that contains specific instructions and links to resources to help the user bring their endpoint into compliance with Host Checker policy requirements.

You can also include a message to users (called a reason string) that is returned by Host Checker or an IMV and that explains why the client machine does not meet the Host Checker policy requirements.

For example, the user might see a remediation page that contains custom instructions, a link to resources, and reason strings:

For each Host Checker policy, you can configure two types of remediation actions:

- **User-driven**—Using custom instructions and reason strings, you can inform the user about the failed policy and how to make his computer conform. The user must take action to successfully re-evaluate the failed policy unless you configure an IMV to automatically remediate his computer. For instance, you can create a custom page that is linked to a policy server or Web page and enables the user to bring his computer into compliance.
- **Automatic (system-driven)**—You can configure Host Checker to automatically remediate the user's computer. For example, when the initial policy fails, you can kill processes, delete files, or allow automatic remediation by an antivirus rule, a firewall rule, or a registry setting rule. Host Checker does not inform users when performing automatic actions. (You could, however, include information in your custom instructions about the automatic actions.)

Remediation User Experience

Users might see a remediation page in the following situations:

- Before the user signs in:
  - If you enable custom instructions or reason strings for a policy that fails, the system displays the remediation page. The user has two choices:
    - Take the appropriate actions to make the endpoint conform to the policy and then click **Try Again** on the remediation page. Host Checker checks the user's computer again for compliance with the policy.

- Leave the endpoint in its current state and click **Continue** to sign in. The user cannot access the realm, role, or resource that requires compliance with the failed policy.

  If you do not configure the system with at least one realm that allows access without enforcing a Host Checker policy, the user must bring the endpoint into compliance before signing in.

- If you do not enable custom instructions or reason strings for a policy that fails, Host Checker does not display the remediation page. Instead, a message displays telling the user that no additional information has been provided and to contact the system administrator. The system does not assign the user a role that allows access to protected resources.

- After the user signs in:

  - **Pulse**—During a session, if a user's computer becomes noncompliant with the Host Checker policy, a message is displayed briefly in the system tray that informs the user of the noncompliance. The remediation page is displayed on the client.
  - **Agentless**—During a session, if a user's agentless computer becomes noncompliant with the Host Checker policy, the system displays the remediation page to inform the user of the noncompliance. On Windows agentless computers, Host Checker displays a bubble and tray icon if the endpoint becomes noncompliant. The user must click the bubble or tray icon to open a browser window that contains the remediation instructions. On Macintosh, Linux or Solaris agentless computers, Host Checker automatically opens a browser window that contains the remediation instructions as soon as the endpoint is noncompliant.

Configuring Host Checker Policy

To configure a Host Checker policy:

1. Select **Authentication > Endpoint Security > Host Checker**.
2. Under Policies, click New.
3. Enter a name in the Policy Name field then click Continue. (Users see this name on the Host Checker remediation page if you enable custom instructions for this policy.)
4. Create one or more rules to associate with the policy.
5. Configure additional system-level options on **Authentication > Endpoint Security > Host Checker** page.
6. Determine the level at which you want to enforce Host Checker policies:
   - To enforce Host Checker policies when the user initially signs in, implement the policy at the realm level select **Users > User Realms >** *Select Realm* **> Authentication Policy > Host Checker**.
   - To allow or deny users access to specific roles based on compliance with Host Checker policies, implement the policies at the role level by using the **Users > User Roles >** *Select Role* **> General > Restrictions > Host Checker** page of the admin console.
   - To map users to roles based on their compliance with Host Checker policies, select **Users > User Realms >** *Select Realm* **> Role Mapping** and use custom expressions.
7. To create client-side logs. Select **System > Log/Monitoring > Client Logs/Settings** and enable Host Checker and Pulse Desktop Client option.
8. If more than one valid session exists from the same system, and Host Checker is used in those sessions, all valid sessions are terminated if a user signs out from any of the sessions. To prevent this, turn off Host Checker for those sessions that do not need Host Checker.

Note: Enable **Agentless Mode with Profiler** for using Agentless Host Checker policy evaluation. As a pre-requisite the Admin must configure the Profiler server to collect the endpoint attributes. Note that the Agentless Mode with Profiler functionality is also supported on the MAC Authentication Realm. Refer the Profiler documentation for configuration and other details.

Configuring Antivirus Rule with Remediation Options

Use this rule type to configure antivirus rule along with remediation actions. You can also monitor policies to ensure that logged-in endpoints maintain compliance status, and remediate the endpoint to another role or realm depending on the current status.

To configure a predefined antivirus rule:

1. Select **Authentication > Endpoint Security > Host Checker**.
2. Create a policy or click on existing policy in the Policies section of the page.
3. Select the tab for Windows or Mac, depending on the platform for which this rule is intended.
4. Under Rule Settings, select **Predefined: Antivirus** and click **Add**.

Figure 199: Antivirus Rule with Remediation Options

5. Enter the name of the antivirus rule.
6. To determine if your software vendor's product is supported for the System Scan check, click **these Antivirus products**. A new window opens with a list of the products that support the feature.
7. Select or clear the check box next to **Successful System Scan must have been performed in the last _ days**, and enter the number of days in the box. If you select this check box, a new option is displayed. If the remediation action to start an antivirus scan successfully begun, you can override the previous check.
8. Select or clear **Consider this rule as passed if 'Full System Scan' was started successfully as remediation** check box.
9. Select or clear the **Check for Virus Definition files** check box. If you select this check box, then choose either **Virus Definition files should not be older than n Updates** (the range for this value is 1 - 20) or **Virus Definition files should not be older than n Days** (the range for this value is 1 – 30).
10. Select one of the following options:
    - **Require any supported product** allows you to check for any product (rather than requiring you to select every product separately). This option button reveals a list of products in the remediation section to allow you to enable remediation options which are product specific.
    - **Require specific products/vendors** allows you to define compliance by allowing any product by a specific vendor or provides functionality that allows you to select individual products to define compliance.

After you select your vendors and products, remediation options appear on the page.

For each of the following remediation actions:

- **Download latest virus definition files**—Obtains the latest available file for the specified vendor from the vendor's website.
- **Turn on Real Time Protection**—Launches the virus-scanning mechanism for the specified vendor.
- **Start Antivirus Scan**—Performs a real-time virus scan for the specified vendor.

The check box is active if the action is supported for your product.

If your antivirus product is not supported, you can click the remediation column headers to determine what vendors and products are supported.

1. If your product is supported, select the check box for the remediation action that you want to apply.
2. Under Optional, select **Monitor this rule for change in result** to continuously monitor the policy compliance of endpoints. If this check box is selected, the compliance status of an endpoint that has successfully logged in changes, PPS initiates a new handshake to reevaluate realm or role assignments.
3. Click **Save Changes** to save the antivirus rule and enforce antivirus remediation.
4. (Optional) Add more rules to the policy, specify how Host Checker should evaluate multiple rules within the policy, and define remediation options.

Configuring Firewall Rule with Remediation Options

Use this rule type to create a Host Checker firewall rule that requires the endpoint to have a specific firewall installed and running before it connects to the network.

To configure a Host Checker predefined firewall rule:

1. Select **Authentication > Endpoint Security > Host Checker**.
2. Create a policy or click an existing policy in the Policies section of the page.
3. Select the tab for Windows or Mac, depending on the platform for which this rule is intended.
4. Under Rule Settings, select **Predefined: Firewall** and click **Add**.

Figure 200: Firewall Rule with Remediation Option

5. Enter a name for the firewall rule.
6. Select one of the following options:
7. **Require any supported product** allows you to check for any product (rather than requiring you to select every product separately). This option button provides a list of products in the remediation section to allow you to enable remediation options which are product specific.

8. • **Require specific products/vendors** allows you to define compliance by allowing any product by a specific vendor or provides functionality that allows you to select individual products to define compliance.
9. After you select your vendors and products, remediation options appear on the page.
10. If your firewall is supported, select the **Turn on Firewall** check box.
11. Under Optional, select **Monitor this rule for change in result** to continuously monitor the policy compliance of endpoints. If this check box is selected, and a change in compliance status on an endpoint that has successfully logged in occurs, PPS initiates a new handshake to reevaluate realm or role assignments.
12. Click **Save Changes** to save the firewall rule and enforce firewall remediation.
13. (Optional) Add more rules to the policy, specify how Host Checker should evaluate multiple rules within the policy, and define remediation options.

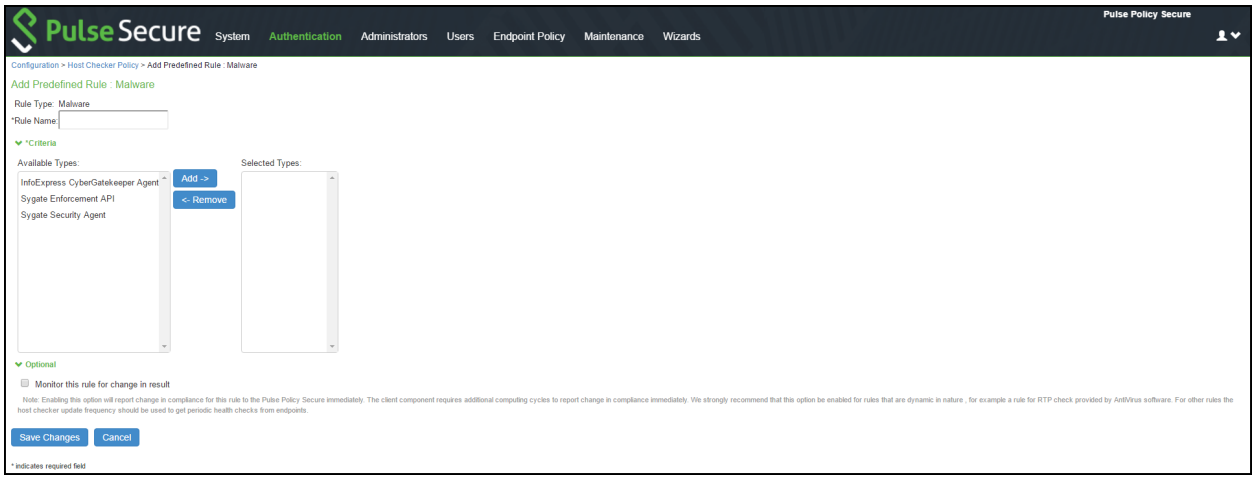
Configuring Malware Rule

Use this rule type to check for installed malware on endpoints.

To configure a Host Checker Predefined malware rule:

1. Select **Authentication > Endpoint Security > Host Checker**.
2. Create a new or click an existing policy in the Policies section of the page.
3. Select the tab for Windows.
4. Under Rule Settings, select **Predefined: Malware** and click **Add**.

Figure 201: Malware Rule



5. From the Criteria, select the Malware Software to be installed on the endpoint**.**
6. Click **Save Changes**

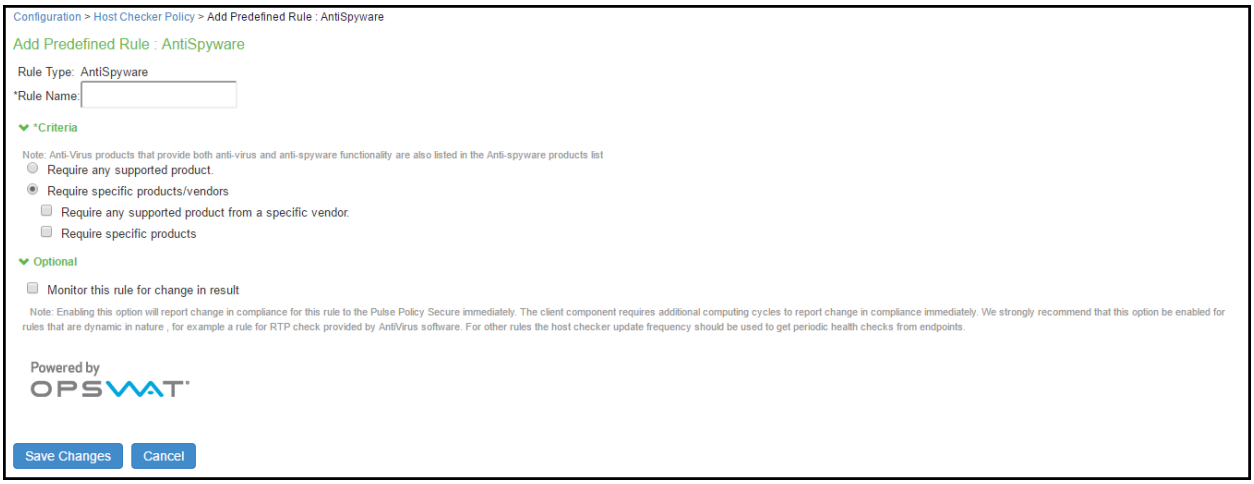
Configuring AntiSpyware Rule

Use this rule type to check for installed antispyware on endpoints.

To configure a Host Checker Predefined Spyware rule:

1. Select **Authentication > Endpoint Security > Host Checker**.
2. Create a new or click an existing policy in the Policies section of the page.
3. Select the tab for Windows or Mac, depending on the platform for which this rule is intended.
4. Under Rule Settings, select **Predefined: AntiSpyware** and click **Add**.

Figure 202: AntiSpyware Rule



5. Enter a name for the firewall rule.
6. Select one of the following options:
   - **Require any supported product** allows you to check for any product (rather than requiring you to select every product separately). This option button provides a list of products in the remediation section to allow you to enable remediation options which are product specific.
   - **Require specific products/vendors** allows you to define compliance by allowing any product by a specific vendor or provides functionality that allows you to select individual products to define compliance.
7. Under Optional, select **Monitor this rule for change in result** to continuously monitor the policy compliance of endpoints. If this check box is selected, and a change in compliance status on an endpoint that has successfully logged in occurs, PPS initiates a new handshake to re-evaluate realm or role assignments.
8. Click **Save Changes**.
9. (Optional) Add more rules to the policy, specify how Host Checker should evaluate multiple rules within the policy, and define remediation options.

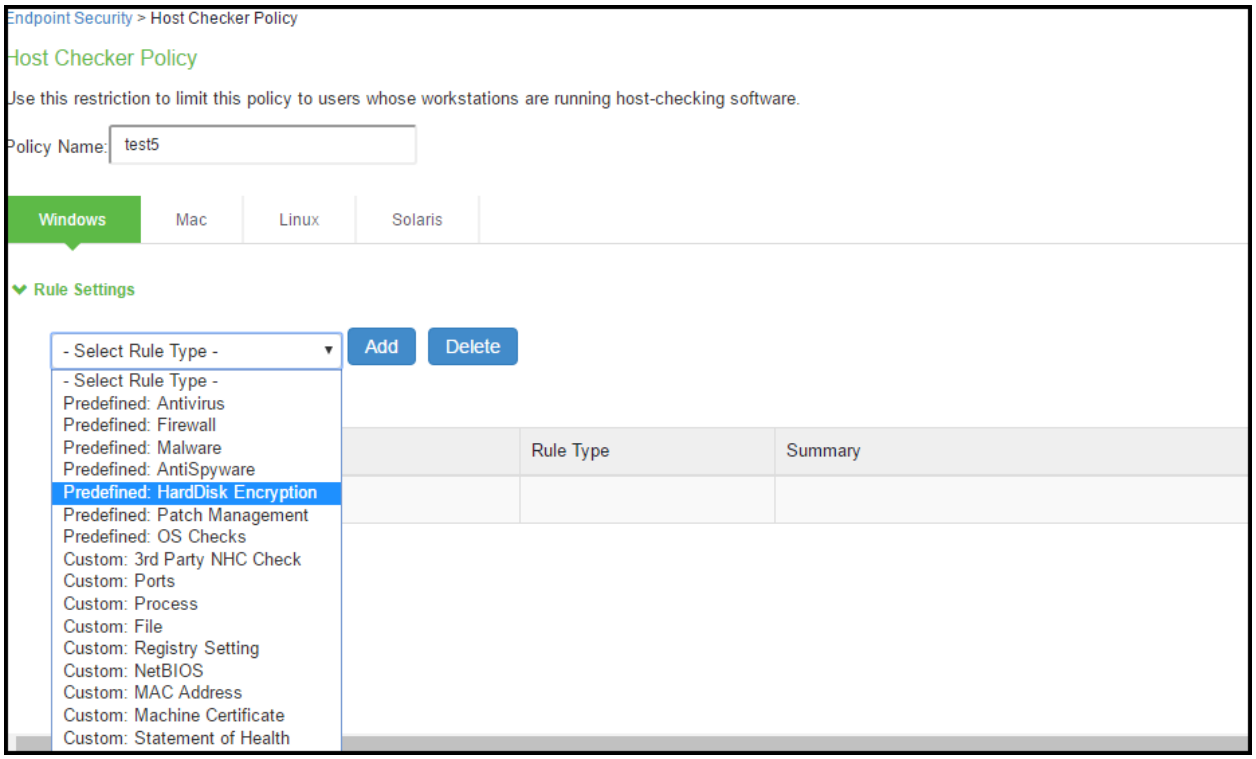
Configuring Hard Disk Encryption Rule

Use this rule type to check for installed Hard Disk Encryption software on endpoints and specify the drives which needs to be encrypted.

To configure a predefined hard disk encryption rule:

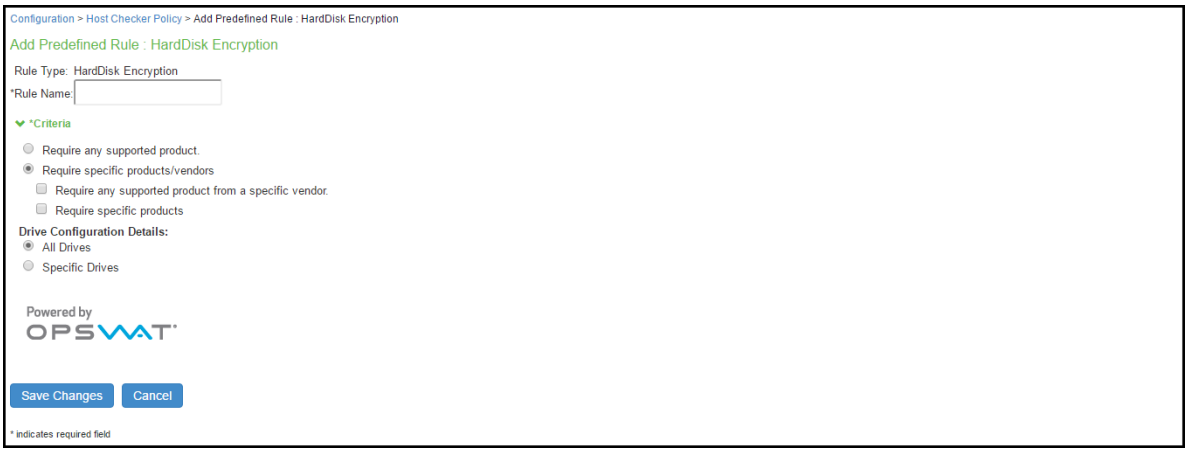
1. Select **Authentication > Endpoint Security > Host Checker**.
2. Create a new policy, or click an existing policy in the Policies section of the page.
3. Select the tab for Windows or Mac, depending on the platform for which this rule is intended.
4. Under Rule Settings, select **Predefined: HardDisk Encryption** and click **Add**.

Figure 203: Hard Disk Encryption Rule



5. Under Rule Settings, select **Predefined: HardDisk Encryption** and then click **Add**.

Figure 204: HardDisk Encryption



6. Enter a Rule Name for the HardDisk Encryption rule.
7. Select one of the following options:
   - **Require any supported product** allows you to check for any product (rather than requiring you to select every product separately). This option button provides a list of products in the remediation section to allow you to enable remediation options which are product specific.
   - **Require specific products/vendors** allows you to define compliance by allowing any product by a specific vendor or provides functionality that allows you to select individual products to define compliance.
8. Under Drive Configuration, select the required option.
   - All Drives--(Default) Select this option to check if all the drives on the client machine are encrypted.
   - Specific Drives-Select this option to check if only specific drives on the client machine are encrypted.
     - Drive Letters– Enter the drive name. For example, C, D, E.
     - Consider policy as passed if the drives are not detected– Select this option to consider policy as passed if the drives are not detected
9. Click **Save Changes**.

Configuring Common Vulnerability and Exposure (CVE) Check Rules

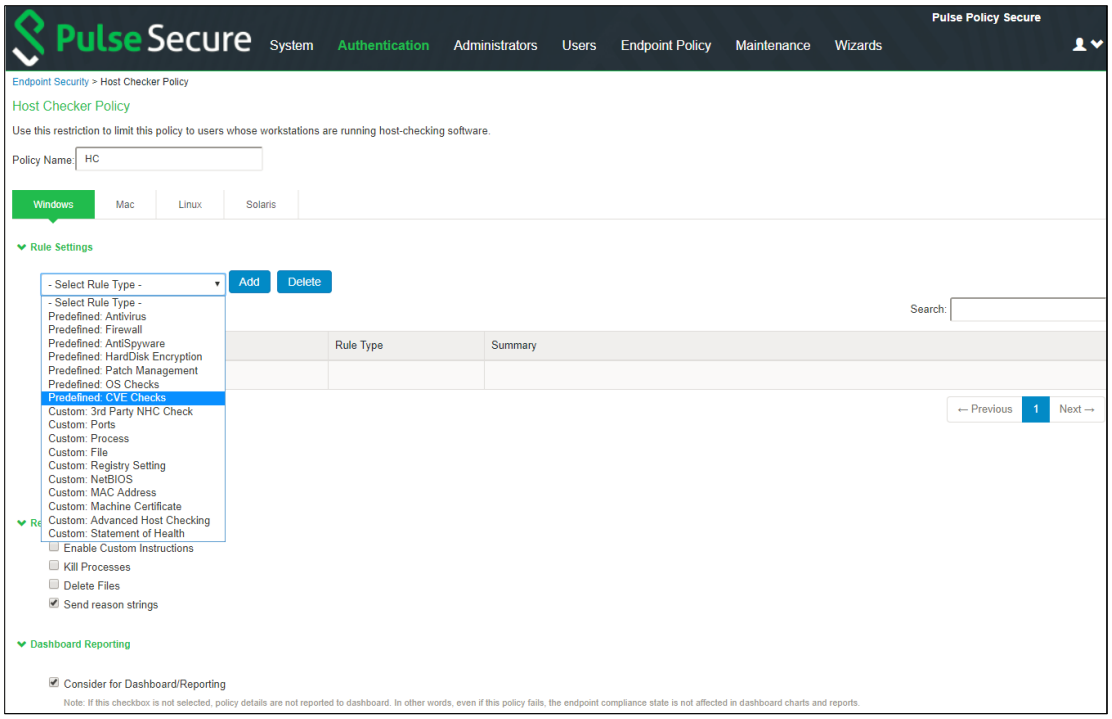
Host Checker is used for analyzing the health of the endpoint before providing access to the network. As endpoints are vulnerable to many types of new attacks such as Ransomware attack. It becomes extremely important to identify such endpoints, which are vulnerable to any attacks. The CVE lists some of these attacks along with the required software patches to prevent from such attacks. PPS provides the CVE check rule, which helps in identifying the endpoints which are vulnerable using the OPSWAT library. If the endpoint is vulnerable appropriate action is taken based on the rule configuration. For example, the user can be denied from accessing the network.

Note:

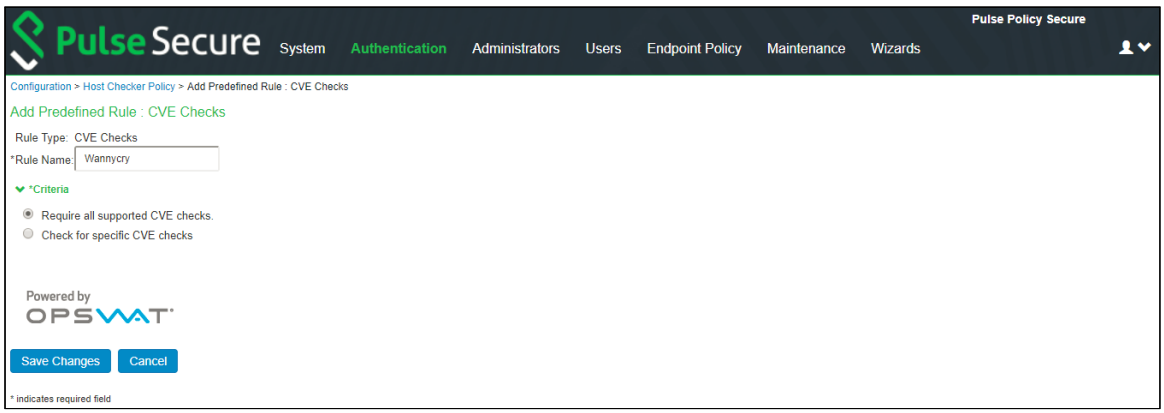
- CVE check rule is supported from ESAP 3.2.3 onwards.
- OPSWAT version 3 does not support CVE rules. These rules will always be evaluated as failed and may cause the host checker policy to fail. It is recommended to delete CVE rules if you are using OPSWAT V3 SDK for evaulation.

To configure a predefined CVE check rule:

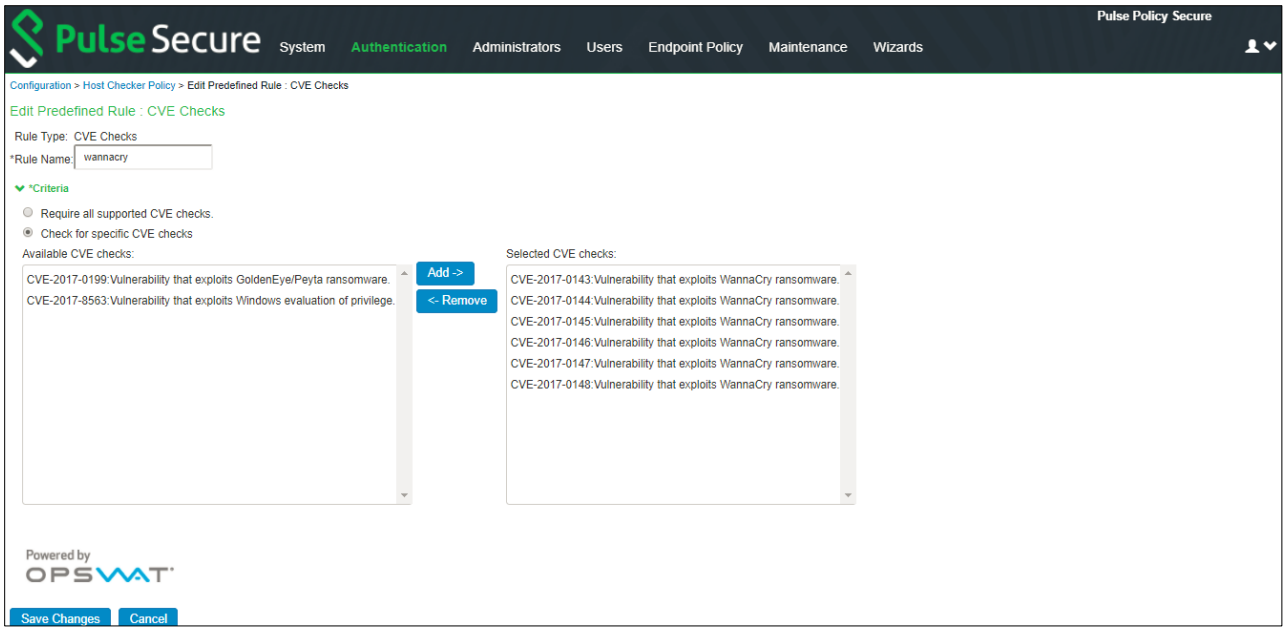
1. Select **Authentication > Endpoint Security > Host Checker**.
2. Create a new policy, or click an existing policy in the Policies section of the page.
3. Click the **Windows** tab.
4. Under Rule Settings, select **Predefined: CVE Checks** and click **Add**.



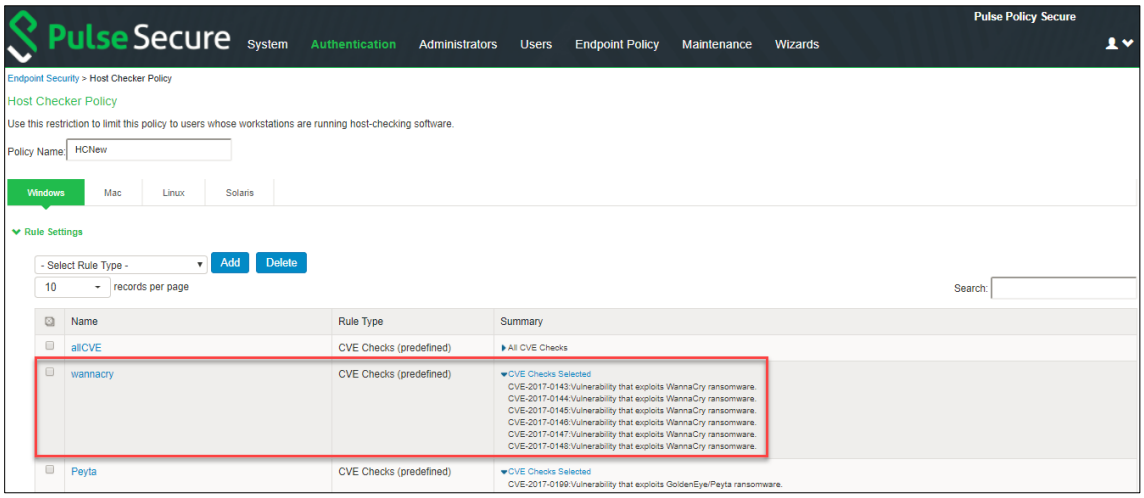
5. Enter a Rule Name for the CVE Check rule. For example, you can configure a check for WannyCry vulnerability.



6. From the Criteria, select if you require all the CVE checks from OPSWAT or choose the specific CVE checks from the available CVE checks list.



7. Click Save Changes.



Configuring Patch Management Rules

You can configure Host Checker to check for installed Patch Management Software on endpoints.

Patch management software detects patch status based on the configured rules on corresponding patch management server. Detection of patches status on the client machine depends on the support provided by the 3rd party patch management solution that is used. Hence different patch management software on the same client can report the status differently. To avoid conflicts, administrator is allowed to configure only one patch management software product on policy configuration page.

It provides options to configure various Severity and Category options that administrator is interested in. These additional details are used during policy evaluation such that only the missing patches that belongs to configured "Severity" and "Category" are considered. Any other patches that does not belong to configured "Severity" and "Category" are not considered during policy evaluation.

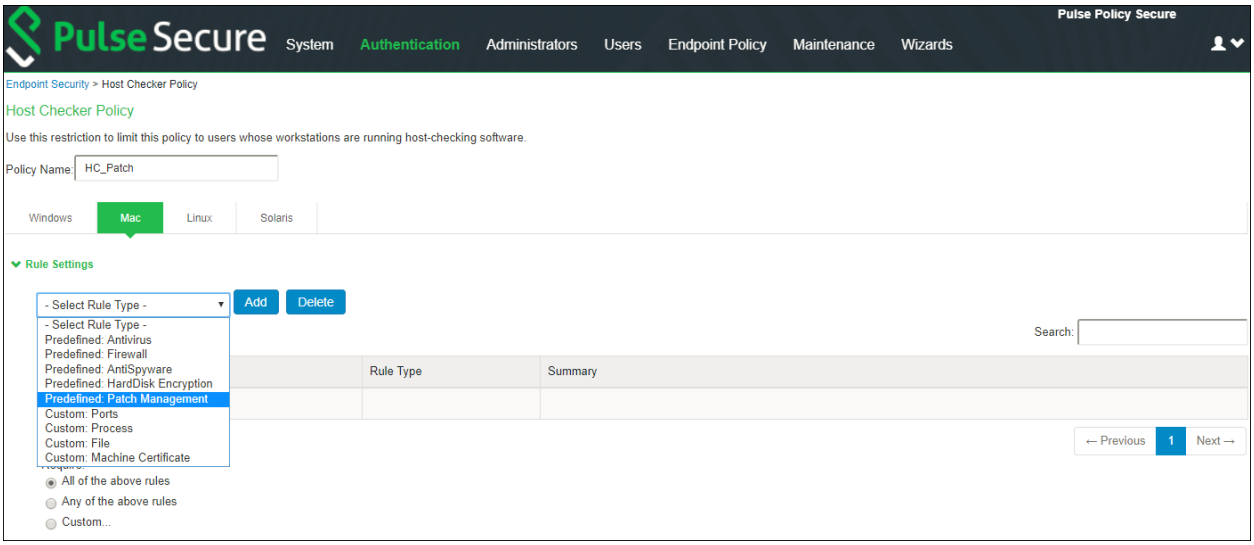
The default "Severity" options selected in policy are Critical, Important. The default "Category" options selected in policy are Security Update, Critical Update, Regular Update, Driver Update.

Note:

- The remediation support for patch management rule is available only for Windows platform using SCCM client.
- Patch Management on Mac is not supported with OPSWAT SDK V3 and pre-9.0R1 Pulse clients.

To configure a predefined patch management rule:

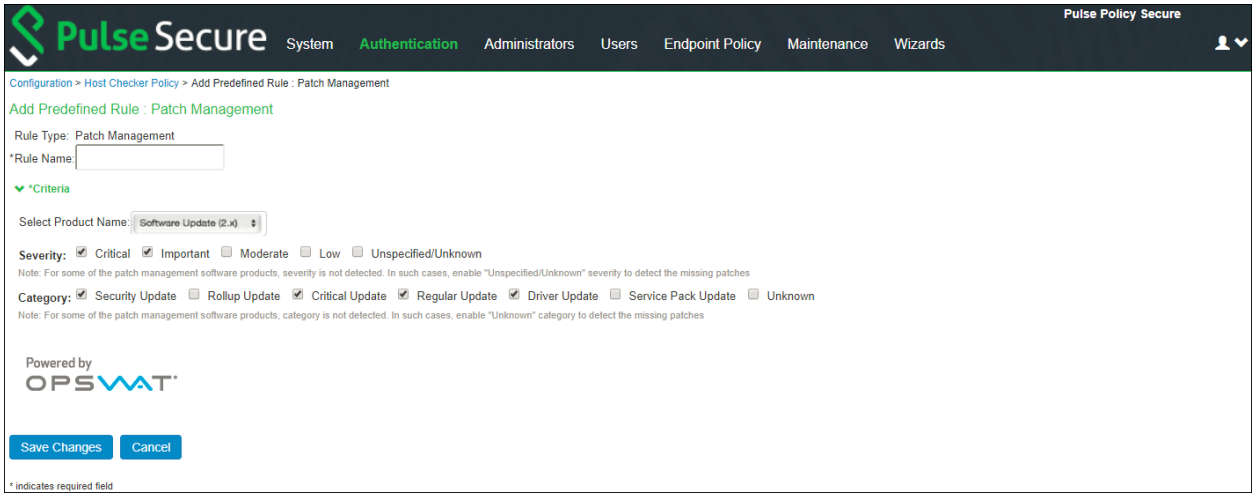
1. Select **Authentication > Endpoint Security > Host Checker**.
2. Create a new policy, or click an existing policy in the Policies section of the page.
3. Click the **Windows/Mac** tab.
4. Enter a Rule Name for the Patch Management rule.



5. Under Rule Settings, select **Predefined: Patch Management** and click **Add**.
6. From the Criteria, select the **Patch Management Software** to be installed on the endpoint.
7. Select the Severity and Category details of the patches to be evaluated.

NOTE: For patch management products that do not provide "Severity" and "Category" details, administrator can choose the "Unknown" options so that all the reported missing patches are considered in policy evaluation.

8. (Windows Only) If you want to do remediation, Under the Remediation section, select **Enable Automatic Patch Deployment**.
9. Click **Save Changes**.



Configuring OS Checks Rule

You can configure Host Checker to check for the Windows/MAC operating systems and minimum service pack versions that you specify. Any service pack whose version is greater than or equal to the version you specify satisfies the policy.

Note: OS Check rule is supported starting from MAC OS X El Captain (10.11) and above.

To configure a rule for OS checks:

1. Select **Authentication > Endpoint Security > Host Checker**.
2. Create a new policy, or click an existing policy in the Policies section of the page.
3. Click the **Windows/Mac** tab.
4. Enter a Rule Name for the OS checks rule.
5. Under Rule Settings, select **Predefined: OS checks** and click **Add**.

Figure 205: Configuring OS Checks Rule for Windows

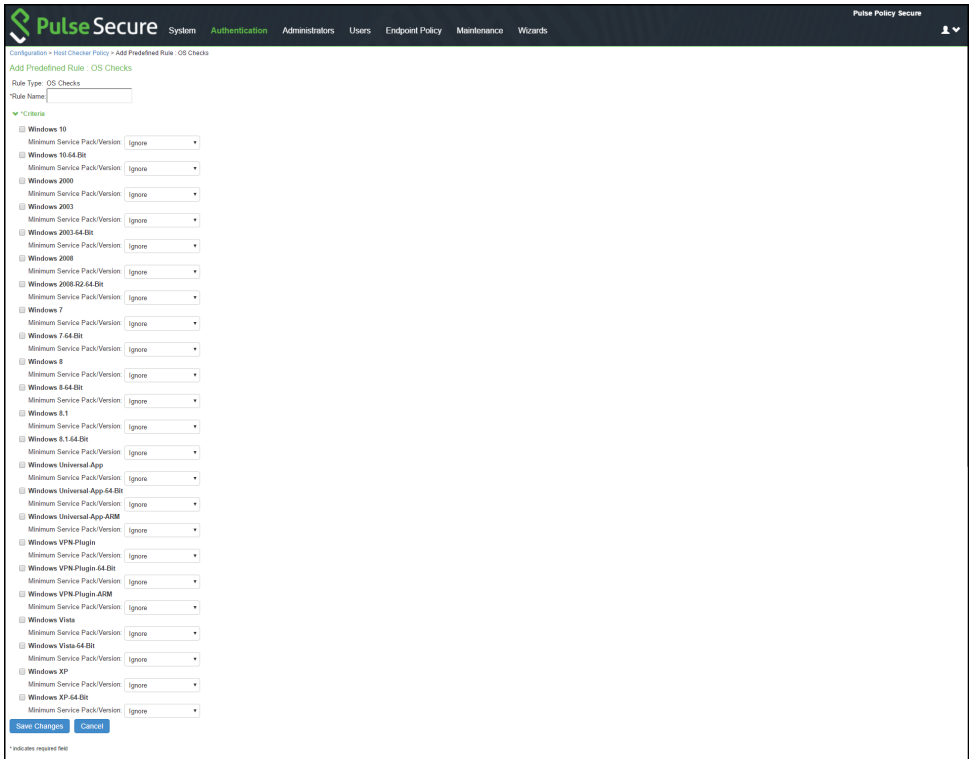
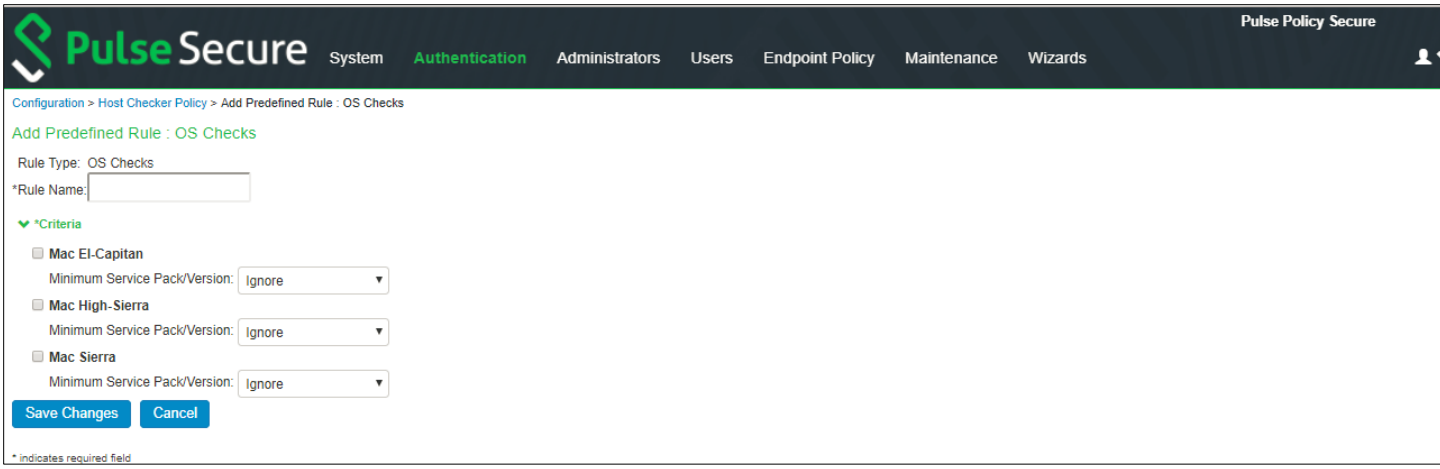


Figure 206: Configuring OS Checks Rule for MAC



6. From the Criteria, select the Windows/Mac operating systems and minimum service pack/version to be there on the endpoint.

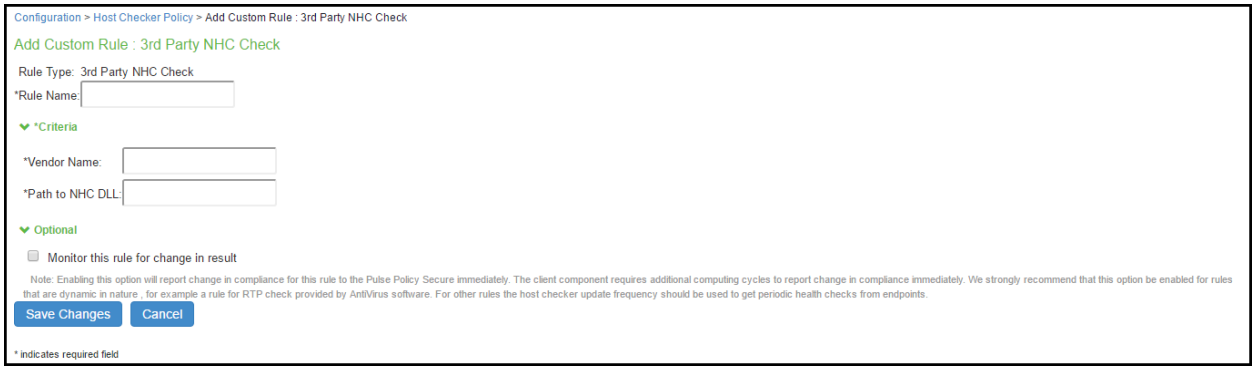
7. Click **Save Changes.**

Configuring Third-Party NHC Rule

Use this rule type to specify the location of a custom DLL. Host Checker calls the DLL to perform customized client-side checks.
To configure a rule for third-party NHC:

1. Select **Authentication > Endpoint Security > Host Checker**.
2. Under Rule Settings, select **Custom: 3rd Party NHC Check** and then click **Add**.

Figure 207: 3rd Party NHC Rule



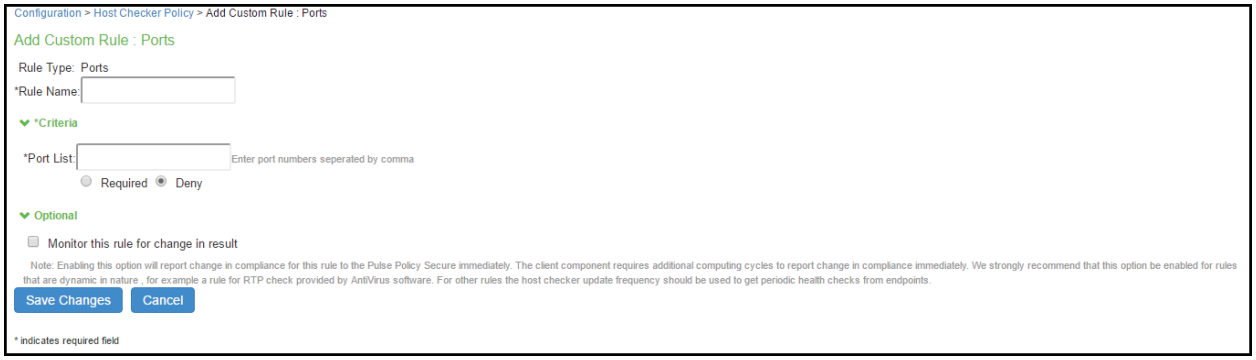
3. Enter a name for the NHC Check rule.
4. Under Criteria, enter the Vendor name and Path to NHC DLL.
5. Under Optional, select **Monitor this rule for change in result** to continuously monitor the policy compliance of endpoints. If this check box is selected, and a change in compliance status on an endpoint that has successfully logged in occurs, the PPS initiates a new handshake to re-evaluate realm or role assignments.
6. Click **Save Changes**.

Configuring Ports Rule

Use this rule type to control the network connections that a client can generate during a session. This rule type ensures that certain ports are open or closed on the client machine before the user can access the system.
To configure a custom port rule:

1. Select **Authentication > Endpoint Security > Host Checker**.
2. Create a new policy, or click an existing policy in the Policies section of the page.
3. Under Rule Settings, select **Custom: ports** and then click **Add**.

Figure 208: Ports Rule



4. Enter a name for the port rule.

5. Under Criteria, enter a comma delimited list (without spaces) of ports or port ranges, such as: 1234,11000-11999,1235. Select Required if you want these ports to be open on the client machine or Deny if you want them to be closed.
   (Windows only) Under Optional, select Monitor this rule for change in result to continuously monitor the policy compliance of endpoints. If this check box is selected, and a change in compliance status on an endpoint that has successfully logged in occurs, the PPS initiates a new handshake to re-evaluate realm or role assignments.
6. Click **Save changes**.

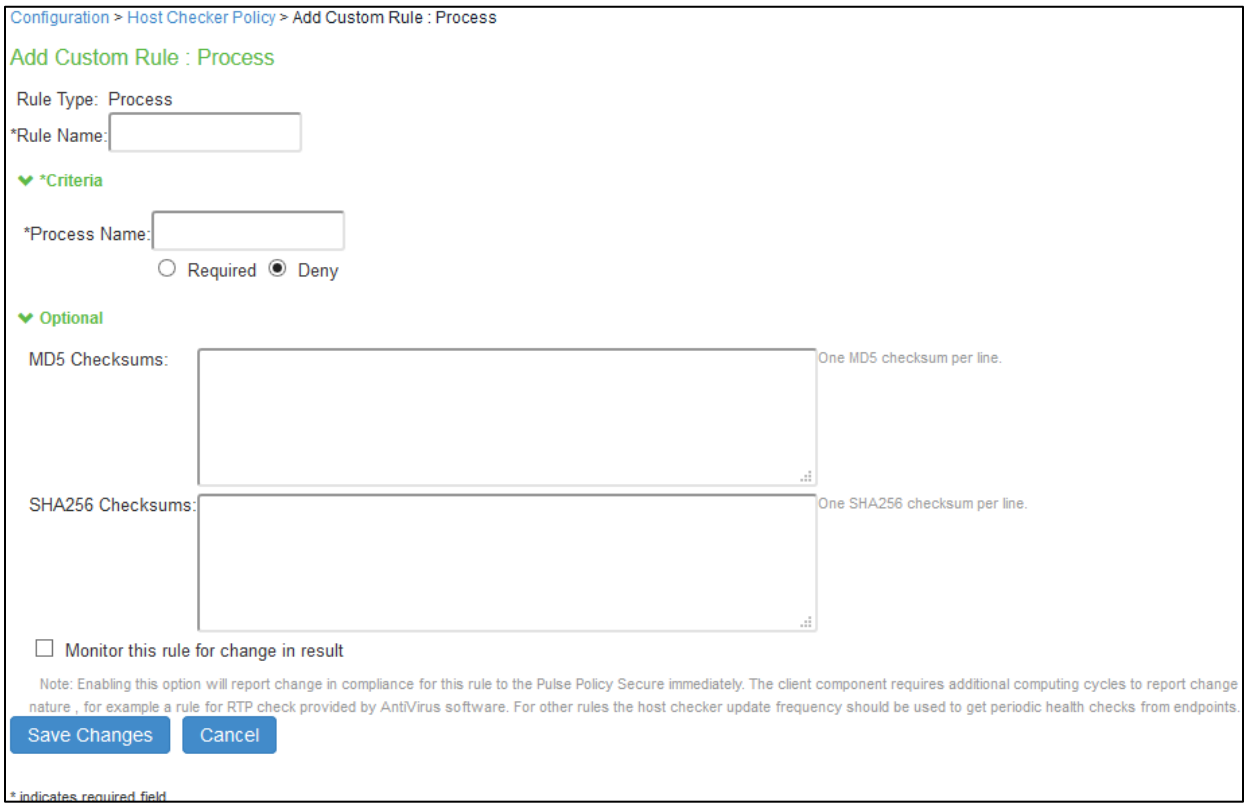
Configuring Process Rule

Use this rule type to control the software that a client may run during a session. This rule type ensures that certain processes are running or not running on the client machine before the user can access protected resources.

To configure a custom process rule:

1. Select **Authentication > Endpoint Security > Host Checker**.
2. Create a new policy, or click an existing policy in the Policies section of the page.
3. Under Rule Settings, select **Custom: Process** and then click **Add**.

Figure 209: Process Rule



4. Enter a name for the process rule.
5. Under Criteria, enter the name of a process (executable file), such as: *good-app.exe*. You can use a wildcard character to specify the process name. For example: *good*.exe*. Select Required to require that this process is running or Deny to require that this process is not running.
6. Under Optional, enable the checks required from the following:
   - Specify the MD5 checksum value of each executable file to which you want the policy to apply. For example, an executable may have different MD5 checksum values on a desktop, laptop, or different operating systems. On a system with OpenSSL installed—Macintosh, Linux and Solaris systems have OpenSSL installed by default—you can determine the MD5 checksum by using this command: openssl md5 <processFilePath>.

- Specify the SHA256 checksum value of each file.
- Select or clear the check box next to Monitor this rule for change in result. With the checkbox enabled, it continuously monitors the policy compliance of endpoints. If this check box is selected, and a change in compliance status on an endpoint that has successfully logged in occurs, the PPS initiates a new handshake to re-evaluate realm or role assignments.

7. Click Save Changes.

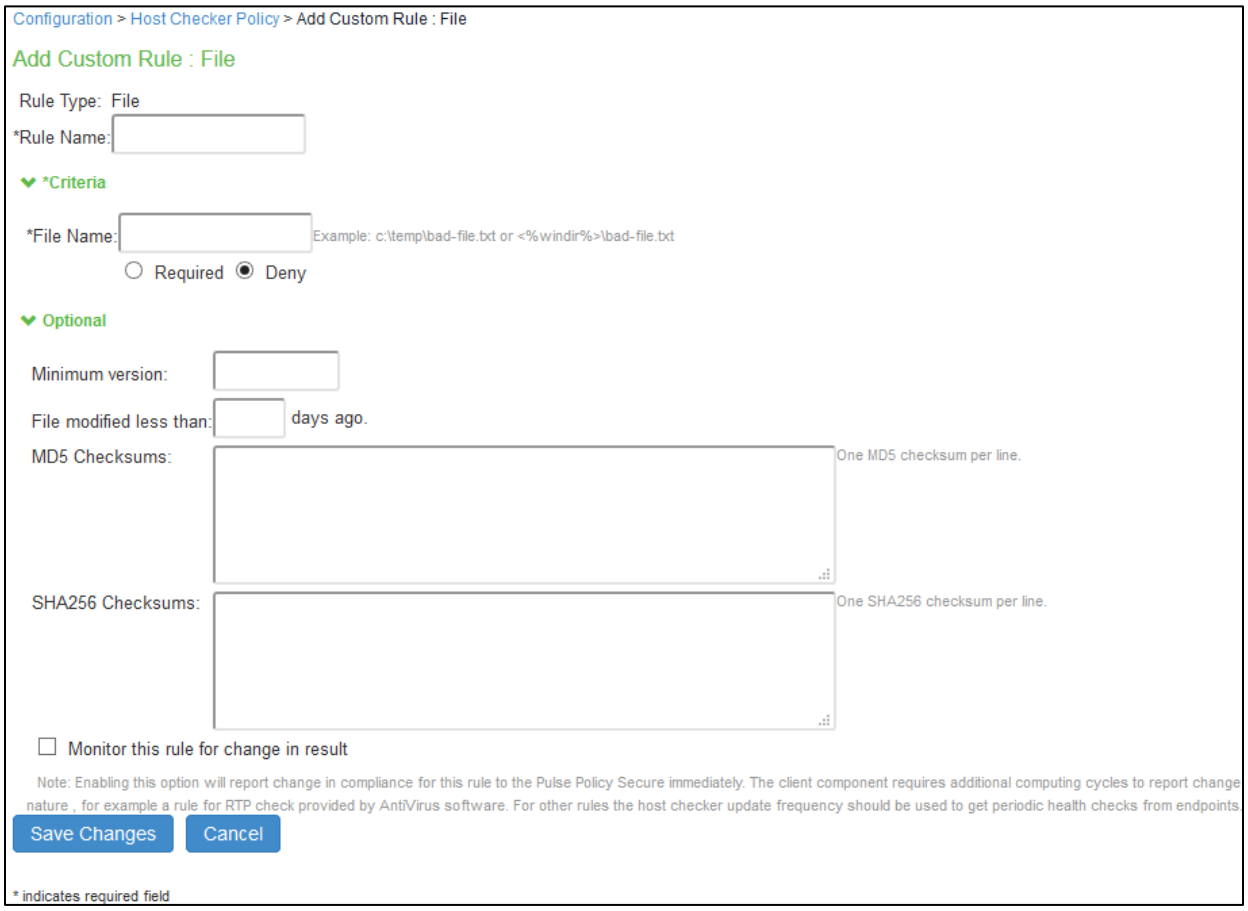
Configuring File Rule

Use this rule type to ensure that certain files are present or not present on the client machine before the user can access. You may also use file checks to evaluate the age and content (through MD5 checksums) of required files and allow or deny access accordingly.

To configure a custom file rule:

1. Select **Authentication > Endpoint Security > Host Checker**.
2. Create a new policy, or click an existing policy in the Policies section of the page.
3. Under Rule Settings, select **Custom: File** and then click **Add**.
4. Enter a name for the file rule.

Figure 210: File Rule



5. Under Criteria, enter the name of a file (any file type), For example, ***c:\temp\bad-file.txt*** or ***/temp/bad-file.txt***. You can use a wildcard character to specify the file name. For example: *.txt.You can also use an environment variable to specify the directory path to the file. (You cannot use a wildcard character in the directory path.) Enclose the variable between the <% and %> characters. For example***:<%windir%>\bad-file.txt***.
6. Select Required to require that this file is present on the client machine or Deny to require that this file is not present.
7. (Windows only) Under Optional, enable the checks required from the following:
   - Specify the minimum version of the file (optional). For example, if you require notepad.exe to be present on the client, you can enter 5.0 in the field. Host Checker accepts version 5.0 and above, of notepad.exe.
   - Specify the maximum age (File modified less than n days) (in days) for a file (optional). If the

file is older than the specified number of days, then the client does not meet the attribute check requirement.

- Specify the MD5 checksum value of each file to which you want the policy to apply (optional). On Macintosh, Linux and Solaris, you can determine the MD5 checksum by using this command: ***openssl md5 <filePath>***
- Specify the SHA256 checksum value of each file.
- Select Monitor this rule for change in result to continuously monitor the policy compliance of endpoints. If this check box is selected, and a change in compliance status on an endpoint that has successfully logged in occurs, the PPS initiates a new handshake to re-evaluate realm or role assignments.

8. Click Save Changes.

Configuring Registry Settings Rule

Use this rule type to control the corporate PC images, system configurations, and software settings that a client must have to access the PPS. This rule type ensures that certain registry keys are set on the client machine before the user can access the PPS. You may also use registry checks to evaluate the age of required files and to allow or deny access accordingly.

1. Select Authentication > Endpoint Security > Host Checker.
2. Create a new policy, or click an existing policy in the Policies section of the page.
3. Under Rule Settings, select **Custom: Registry Setting** and then click **Add**.

Figure 211: Registry Settings Rule

4. Enter a name for the registry setting rule.
5. Under the criteria:
   - Select a root key from the drop-down list.
   - Enter the path to the application folder for the registry subkey.
   - Enter the name of the key's value that you want to require (optional). This name appears in the **Name** column of the Registry Editor.
   - Select the key value's type (**String, Binary**, or **DWORD**) from the drop-down list (optional). This type appears in the Type column of the Registry Editor.
   - Specify the required registry key value (optional). This information appears in the **Data** column of the Registry Editor.
   - If the key value represents an application version, select **Minimum version** to allow the specified version or newer
6. Under Optional, select **Monitor this rule for change in result to continuously monitor the policy compliance of endpoints**. If this check box is selected, and a change in compliance status on an endpoint that has successfully logged in occurs, the system initiates a new handshake to re-evaluate realm or role assignments.
7. Under Remediation, Select the check box for Set Registry value specified in criteria.
8. Click Save Changes.

Configuring NetBIOS Rule

Use this rule type to check the NetBIOS name of the client machine before the user can access PPS.

To configure a custom NetBIOS rule:

1. Select **Authentication > Endpoint Security > Host Checker**.
2. Create a new policy, or click an existing policy in the Policies section of the page.
3. Under Rule Settings, select **Custom: File** and then click **Add.**
4. Enter a name for the NetBIOS rule.

Figure: NetBIOS Rule Windows

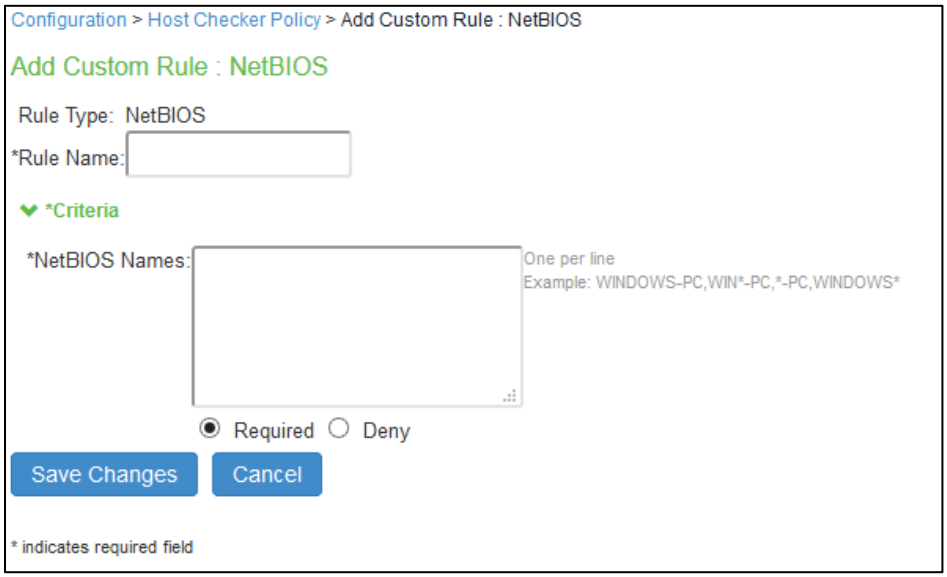
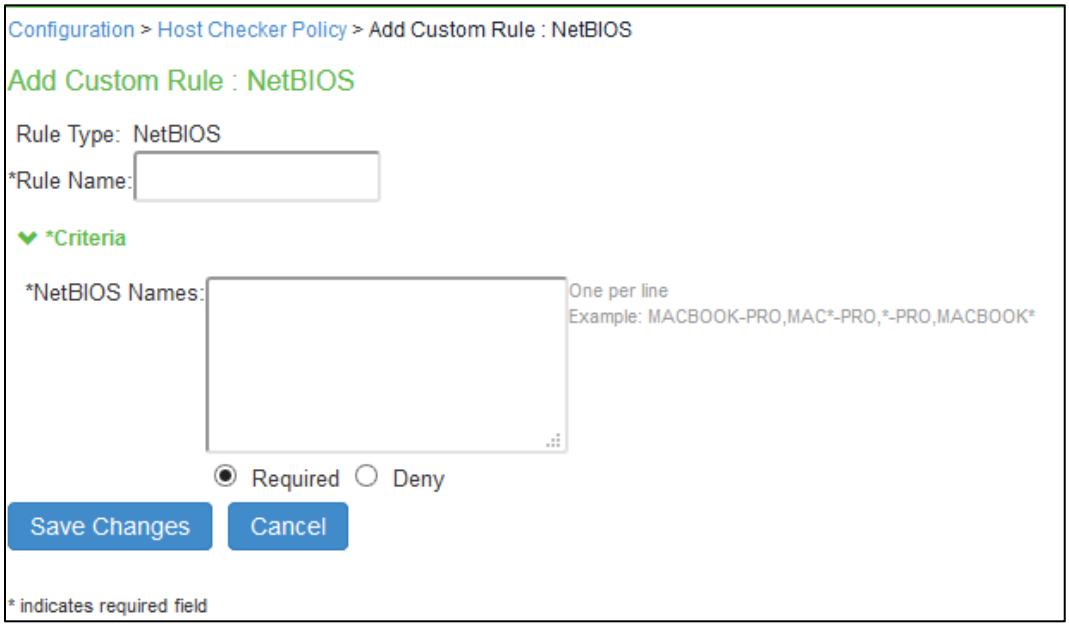


Figure: NetBIOS Rule for Mac



5. Under Criteria, enter a comma-delimited list (without spaces) of NetBIOS names. The name can be up

to 15 characters in length. You can use wildcard characters in the name and it is not case-sensitive. For example, md*, m*xp and *xp all match MDXP. Select **Required** to require that this file is present on the client machine or **Deny** to require that this file is not present.

Note: For Mac OS, you can enter special characters “[!"\#$%&'()*+,\-./:;<=>?@\[\\\]^_`{|}~]” and space is allowed between NetBIOS names.

6. Select Required to require that NETBIOS name of the client machine match one of the names you specify, or Deny to require that the name does not match any name.
7. Click Save Changes.

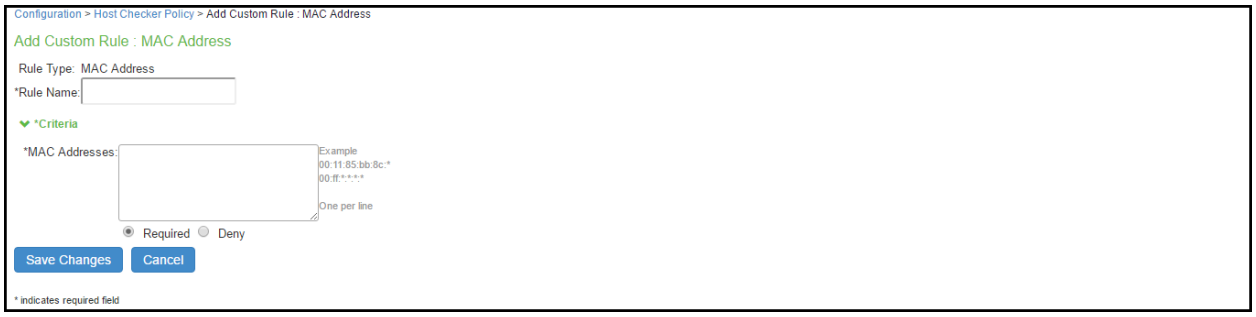
Configuring MAC Address Rule

Use this rule type to check the MAC addresses of the client machine before the user can access the PPS.

To configure a custom MAC Address Rule:

1. Select Authentication > Endpoint Security > Host Checker.
2. Create a new policy or click an existing policy in the Policies section of the page.
3. Under Rule Settings, select **Custom: MAC Address** and then click **Add**.
4. Enter a name for the MAC address rule.

Figure 212: MAC Address Rule



5. Under Criteria,enter a comma-delimited list (without spaces) of MAC addresses in the form XX:XX:XX:XX:XX:XX where the X's are hexadecimal numbers. For example: 00:0e:1b:04:40:29.You can use a * wildcard character to represent a two-character section of the address. For example, you can use a * to represent the "04", "40", and "29" sections of the previous example address:00:0e:1b:*:*:*But you cannot use a * to represent a single character. For example, the * in the following address is not allowed:00:0e:1b:04:40:*9
6. Select **Required** to require that a MAC address of the client machine matches any of the addresses you specify, or **Deny** to require that the all addresses do not match. A client machine will have at least one MAC address for each network connection, such as Ethernet, wireless, and VPN.
7. This rules requirement is met if there is a match between any of the addresses you specify and any MAC address on the client machine.
8. Click Save Changes.

Configuring Machine Certificate Rule

Use this rule type to check that the client machine is permitted access by validating the machine certificate stored on the client machine.

To configure a machine certificate rule:

1. Select **Authentication > Endpoint Security > Host Checker**.
2. Create a new policy, or click an existing policy in the Policies section of the page.
3. Under Rule Settings, select **Custom: Machine certificate** and then click **Add**.
4. Enter a name for the machine certificate rule.

Figure 213: Machine Certificate Rule

5. Under Criteria, **Select Issuer Certificate** list, select the certificate that you want to retrieve from the user's machine and validate. Or, select **Any Certificate** to skip the issuer check and only validate the machine certificate based on the optional criteria that you specify below.
6. From the **Optional** fields (**Certificate field and Expected value**), specify any additional criteria that Host Checker should use when verifying the machine certificate.

Note:

- If more than one certificate is installed on the client machine that matches the specified criteria, The Host Checker client passes the first certificate it finds to PPS for validation.
- Admin must perform some additional configurations on the Client machine for installing machine certificate on MAC OS due to some restrictions from Apple. For more information, see KB44148.

7. Click **Save Changes**.

Configuring Advanced Host Checking Rule

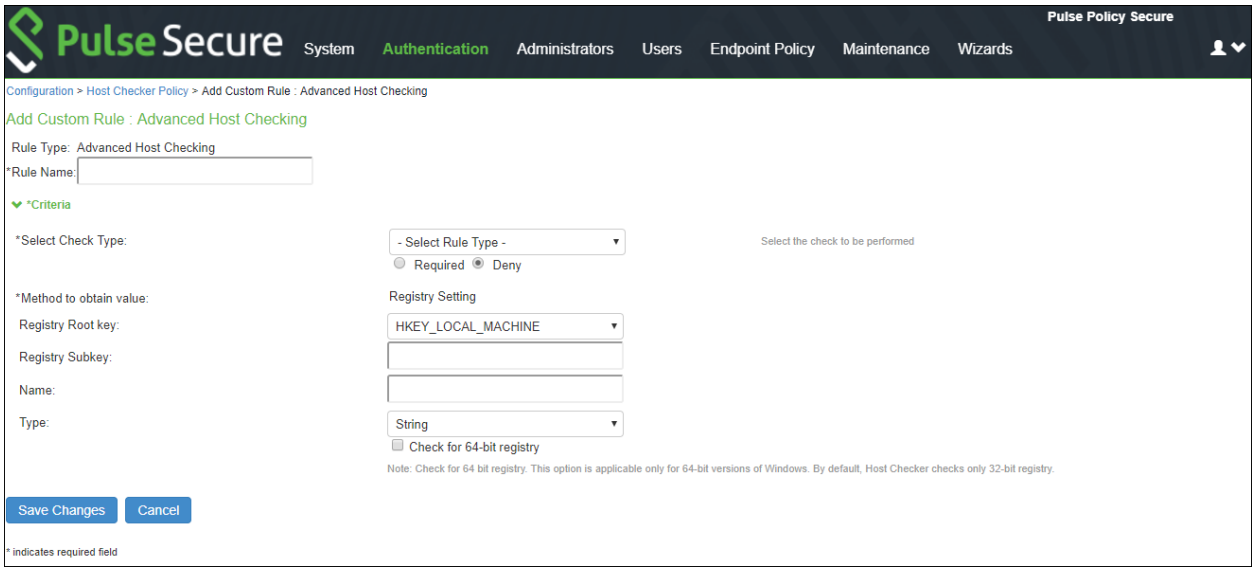
Use this rule type to combine multiple policies for performing advanced host checking. The supported policy types are ports, process, file, registry setting, NETBIOS, MAC address and machine certificate. It allows Administrator to dynamically configure the expected values from registry locations on the endpoint for evaluating the policies.

NOTE: This feature is supported only on Windows platform.

To configure an advanced host checking rule:

1. Select Authentication > Endpoint Security > Host Checker.
2. Create a new policy, or click an existing policy in the Policies section of the page.
3. Under Rule Settings, select **Custom: Advanced Host Checking** and then click **Add**.
4. Enter a name for the rule.
5. Select the check to be performed from the Rule Type list.

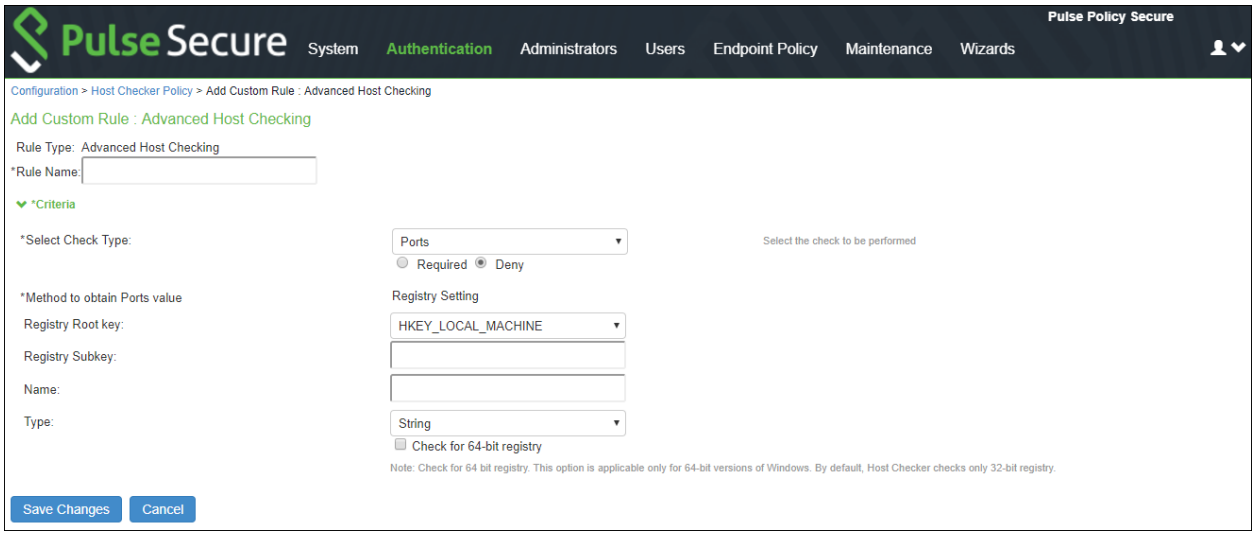
Figure 214: Advanced HC Rule



6. Under Criteria, **Select Rule Type** list.
    a. Select **Ports** to check whether a specific port number is opened or closed on the endpoint.
        i. Enable **Required/Deny** to check if the specified port is open/closed.
        ii. Select the registry root key- HKEY_LOCAL_MACHINE, HKEY_USERS, HKEY_CURRENT_USER, HKEY_CURRENT_CONFIG, or HKEY_CLASSES_ROOT.
        iii. Enter the registry subkey.
        iv. Enter the name of the registry.
        v. Select the type of the registry- String, Binary, or DWORD.
        vi. Select **Check for 64-bit registry** to check the 64 bit registry on Windows. The default is 32 bit registry.

NOTE: You can similarly add the check type for Process/File/NETBIOS/MAC Address. The port number/process name/file path/NETBIOS name/MAC address is obtained from the Registry setting.

Figure 215: Advanced Host Check- Ports



b. Select **Registry Setting** to verify the specific registry values on the endpoint. You can define only the registry location in the policy and define another registry location, which provides the expected registry value.

i. Select the registry root key- HKEY_LOCAL_MACHINE, HKEY_USERS, HKEY_CURRENT_USER, HKEY_CURRENT_CONFIG, or HKEY_CLASSES_ROOT.

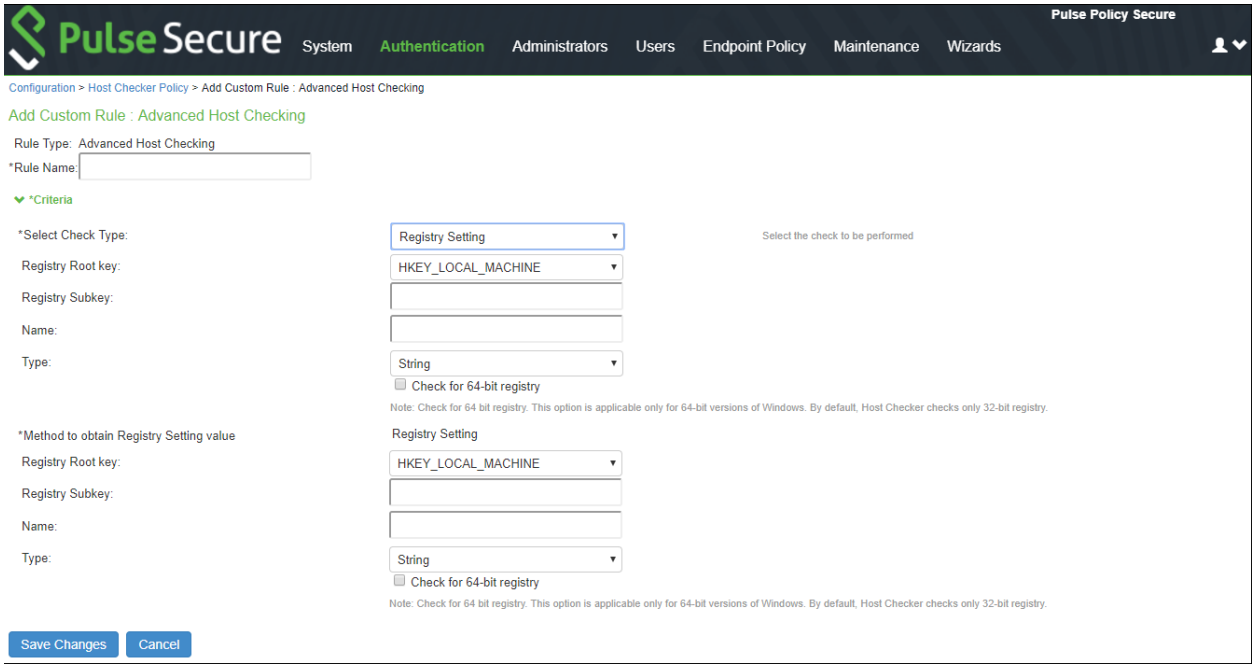
ii. Enter the registry subkey.

iii. Enter the name.

iv. Select the type of the registry- String, Binary, or DWORD.

v. Configure another registry setting to fetch the expected registry value. Select the registry subkey, name, and type.

Figure 216: Advanced Host Check- Registry Setting



c. Select **Machine Certificate** to verify the required certificate is installed on the client machine

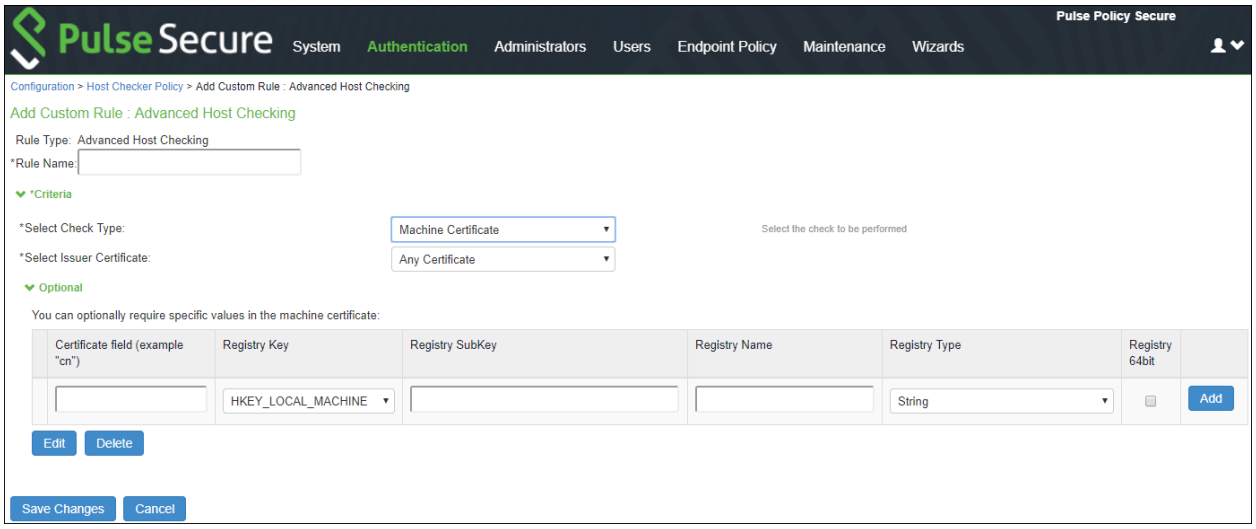
certificate store.

i. Select the issuer certificate from the list.

ii. Specify any additional criteria that Host Checker must use while verifying the certificate.

1. Enter the certificate field name. For example, cn.
2. Select the registry key.
3. Enter the registry subkey.
4. Enter the registry name.
5. Select the registry type.
6. Click **Add**.

Figure 217: Advanced Host Check- Machine Certificate



7. Click Save Changes.

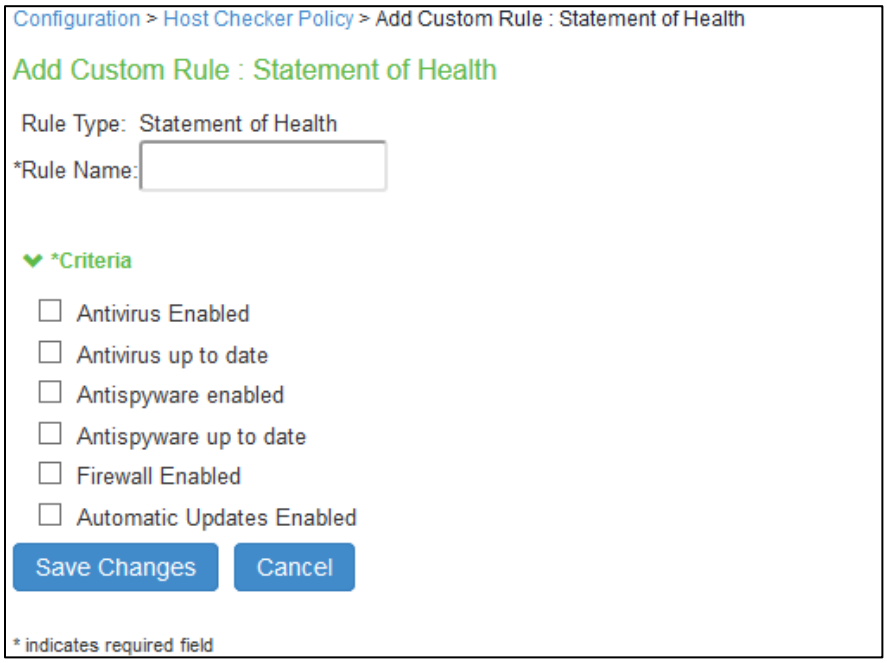
Configuring Statement of Health Rule

Use this rule type to evaluate endpoint's health status and make policy decisions for network access based on the result.

To configure a custom state of health rule:

1. Select **Authentication > Endpoint Security > Host Checker**.
2. Create a new policy, or click an existing policy in the Policies section of the page.
3. For a new policy, specify a name for the policy and then click Continue.
4. Under Rule Settings, select **Custom: Statement of Health** and then click **Add**.

Figure 218: Statement of Health Rule



5. Enter a Name for the SOH rule.
6. Under Criteria, enter a Label for a SOH parameter. Select an SOH policy option from the Parameter menu then click Add for the following types:
   - Antivirus Enabled
   - Antivirus up to date
   - Antispyware enabled
   - Antispyware up to date
   - Firewall Enabled
   - Automatic Updates Enabled
7. Select additional options from the Parameter list to add additional SOH parameters.
8. (Optional) For each rule, select the Enable automatic remediation check box. If you select this option for a rule, the user receives a remediation message from the SoH agent, and appropriate remediation is performed, if possible. If the box is not selected, the user receives a remediation message, but no remediation action is performed.
9. Click **Save Changes**.

Configuring System Integrity Protection Rule

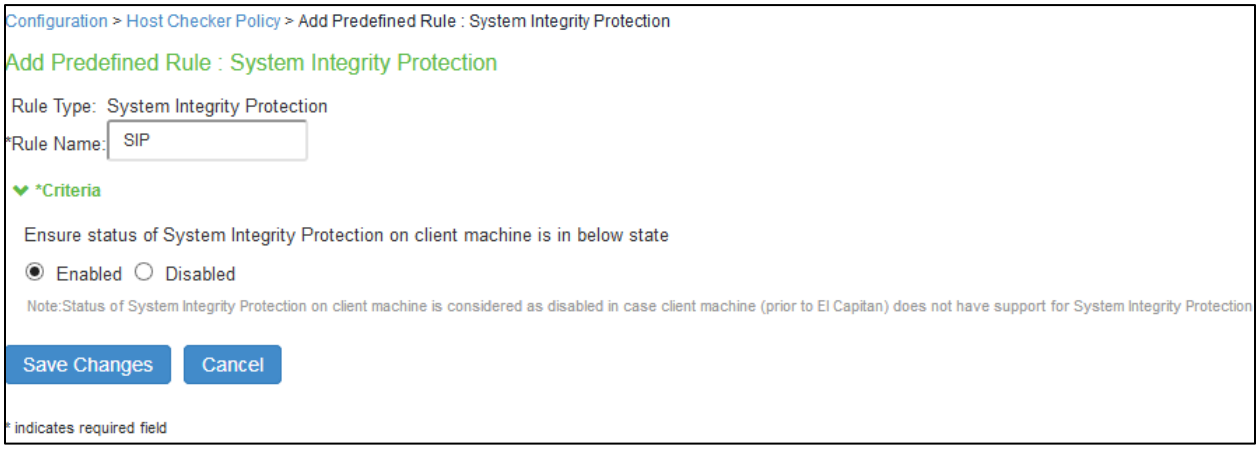
System Integrity Protection (SIP) is a security feature introduced in Mac OS X El Capitan. This security feature from Apple provides security on the endpoint machine by restricting various actions that root user can perform on the client machine. System Integrity Protection is enabled by default but can be disabled.

PPS supports System Integrity Protection policy to check the status of System Integrity Protection (SIP) on the Mac OS endpoints. Using this, the administrators can provide different access level to the end points based on the status of "System Integrity Protection" on the client machines.

To configure a Host Checker Predefined SIP rule:

1. Select **Authentication > Endpoint Security > Host Checker**.
2. Create a new or click an existing policy in the Policies section of the page.
3. Select the tab for **Mac**.
4. Under Rule Settings, select **Predefined: System Integrity Protection Rule** and click **Add**.

Figure 219: ***System Integrity Protection Rule***



5. Enter the rule name.
6. Under Criteria, select **Enabled** to ensure that the System Integrity Protection on the client machine is enabled.
7. Click **Save Changes.**

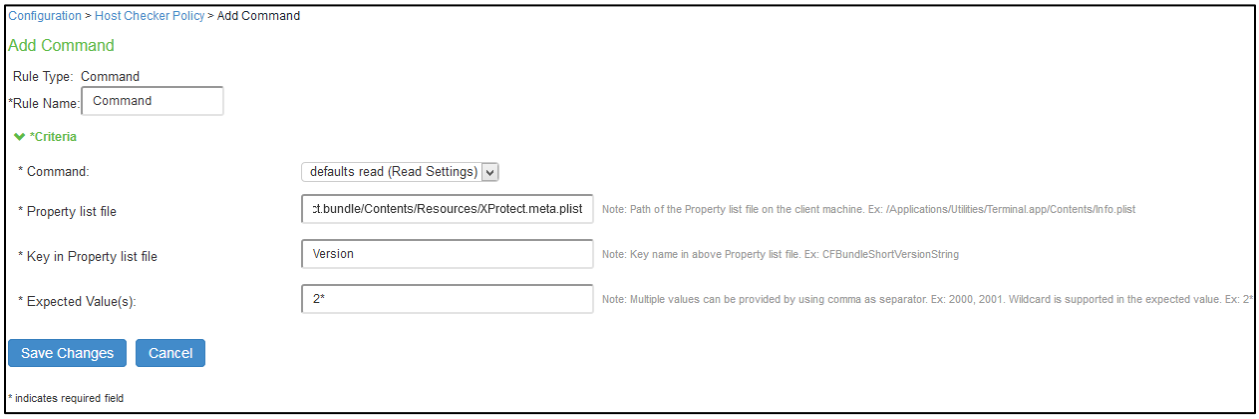
Configuring Command Rule

Command Rule enables administrators to check the versions of the installed applications on the Mac OS endpoints.

To configure a Host Checker: Custom command rule:

1. Select **Authentication > Endpoint Security > Host Checker**.
2. Create a new or click an existing policy in the Policies section of the page.
3. Select the tab for **Mac**.
4. Under Rule Settings, select **Custom: Command** and click **Add**.

Figure 220: Command Rule



5. Enter the rule name.
6. Under Criteria, complete the following configuration:
   - Select the command type as **default read (Read Settings)**
   - Specify the path of the property list file of the required application on the client machine.
   - Enter the key name used in the property list file for obtaining the version of the application.
   - Enter the expected version that needs to be present on the client machine
7. Click **Save Changes.**

Note: Ensure that the required ESAP package (which has support for Command Rule) is installed and activated on the server.

Using a Wildcard or Environment Variable in a Host Checker Rule

The following table lists the wildcards you can use to specify a file name in a File rule or a process name in a **Process** rule.

Table 17: Wildcard Characters for Specifying a File Name or Process Name

Wildcard Character	Description	Example
*	Matches any character	*.txt
?	Matches exactly one character	app-?.exe

In a **Custom File** rule for Windows, you can use the following environment variables to specify the directory path to a file:

Table 18: Environment Variables for Specifying a Directory Path on Windows

Environment variable	Example Windows Value
<%APPDATA%>	C:\Documents and Settings\jdoe\Application Data
<%windir%>	C:\WINDOWS
<%ProgramFiles%>	C:\Program Files
<%CommonProgramFiles%>	C:\Program Files\Common Files
<%USERPROFILE%>	C:\Documents and Settings\jdoe
<%HOMEDRIVE%>	C:
<%Temp%>	C:\Documents and Settings \<username>\Local Settings\Temp

The following table lists File rules for Macintosh, Linux and Solaris.

Table 19: Environment Variables for Specifying a Directory Path on Macintosh, Linux and Solaris

Environment variable	Example Macintosh Value	Example Linux and Solaris Values
<%Java.home%>	/System/Library/Frameworks/JavaVM.framework/Versions/1.4.2/Home	/local/local/Java/j2sdk1.4.1_02/jre
<%Java.io.tmpdir%>	/tmp	/tmp
<%user.dir%>	/Users/admin	/home-shared/cknouse
<%user.home%>	/Users/admin	/home/cknouse

Configuring Third-Party Integrity Measurement Verifiers (IMV)

The TNC standard enables the enforcement of security requirements for endpoints connecting to networks. You can configure Host Checker to monitor third-party TNC-compliant IMCs installed on client computers. To do so, you must:

1. Run the Third-party Integrity Measurement Verifier (IMV) Server installer on the system designated as the remote IMV server. Install the third-party IMVs and create the server certificates. You can download this installer from Maintenance > system > Installers.
2. Specify the remote IMV server so that PPS can communicate with it.
3. Implement the Host Checker policy. Once you configure the remote IMV server, PPS adds the policy type Custom: remote IMV.

Configuring a Remote IMV Server

The third-party IMVs are installed on the remote IMV server and not on PPS and then obtain a server certificate for the remote IMV server. Import the trusted root CA certificate of the CA that generated the server certificate to PPS. PPS then authenticates with the remote IMV server through the certificate. If you do not have a CA, install and use OpenSSL to generate a CA certificate.

To configure the remote IMV server:

1. Select **Maintenace > System > Installers** and download the third-party Measurement Verifier (IMV) server installer.
2. Run the installer on the system designated as the remote IMV server.
3. Install the third-party IMVs on the remote IMV server and the corresponding IMCs on the client systems.
4. Generate a server certificate from a certificate authority for the remote IMV server. The server's certificate Subject CN value must contain the actual host name or IP address of the remote IMV server.

The server certificate and the private key must be combined into a single PKCS#12 file and must be encrypted with a password. If you do not have a CA, you can use OpenSSL to create one, and then create a server certificate for the remote IMV server.

Configuring a Third-Party IMV Policy

To use Host Checker as a policy enforcement tool for managing endpoints, you must create global Host Checker policies at the system level and then implement the policies at the realm and role levels.

NOTE: The **Custom: Remote IMV** option does not appear until you add the Remote IMV New Server and New IMV on the main Host Checker page.

To configure a third-party IMV policy:

1. Select **Authentication > Endpoint Security > Host Checker**.
2. Under Policies, click **New**.
3. Enter a name in the Policy Name field and click Continue. (Users see this name on the Host Checker remediation page if you enable custom instructions for this policy.)
4. Under Rule Settings, select Custom: Remote IMV and click Add.
5. In the Add Custom Rule: Remote IMV page:
   - In the **Rule Name** field, enter an identifier for the rule.
   - Under **Criteria**, select the third-party IMV to associate with this rule.
   - Click **Save Changes**.
6. Specify how Host Checker must evaluate multiple rules within the policy.
7. (Recommended) Specify remediation options for users whose computers do not meet the requirements specified in the policy.
8. Click **Save Changes**.

9. Implement the policy at the realm or role level.

Configuring General Host Checker Remediation

To specify remediation actions for a Host Checker policy:

1. Select **Authentication > Endpoint Security > Host Checker**.
2. Create or enable Host Checker policies.
3. Specify the remediation actions for Host Checker to perform if a computer does not meet the requirements of the current policy:

   - **Enable Custom Instructions**—Enter the instructions to display to the user on the Host Checker remediation page. You can use the following HTML tags to format text and to add links to resources such as policy servers or web sites: <i>, <b>, <br>, <font>, and <a href>. For example:

     You do not have the latest signature files.

     Click here to download the latest signature files.

   - **Kill Processes**—On each line, enter the name of one or more processes to kill if the computer does not meet the policy requirements. You can include an optional MD5 checksum for the process. (You cannot use wildcards in the process name.) For example:

     keylogger.exe

     MD5: 6A7DFAF12C3183B56C44E89B12DBEF56

   - **Delete Files**—Enter the names of files to delete if the user’s computer does not meet the policy requirements. (You cannot use wildcards in the file name.) Enter one filename per line. For example:

     c:\temp\bad-file.txt

     /temp/bad-file.txt

   - **Send reason strings**—Select this option to display a message to users (called a reason string) that is returned by Host Checker or IMV and that explains why the client machine does not meet the Host Checker policy requirements. This option applies to predefined rules, to custom rules, and to third-party IMVs that use extensions in the Pulse Secure TNC SDK. For example, an antivirus IMV might display the following reason string:

     The AntiVirus Product Version is too low. The age of the Virus Definitions is not acceptable.

4. Click **Save Changes**.

Store and Reuse Host Checker Policy Results

The Host Checker configuration page enables you to store and reuse the host checker evaluation results. The admin can configure the time interval in days for not performing the host check on the endpoint. When the user connects for the first time the Host Checker runs and the results are saved in PPS. However, for the subsequent logins from the same endpoint, the host checking is not performed and the saved host check result is reused till the expiration of the admin defined time interval.

The first connection from the endpoint never reuses the cached results. The subsequent logins from the same endpoint uses the cached host checker results.

This feature saves the Host Check results for clients connecting from Windows and Mac desktop operating systems. This feature helps in providing faster connection or access to the network.

The Host Checker saved/cached results will be cleared in the following scenarios:

- Change in HC policy configuration such as addition, deletion and modifications.
- Change in Active ESAP version.
- Change in HC configuration such as periodic interval, disabling the caching feature and role configuration under caching feature.
- Server reboot

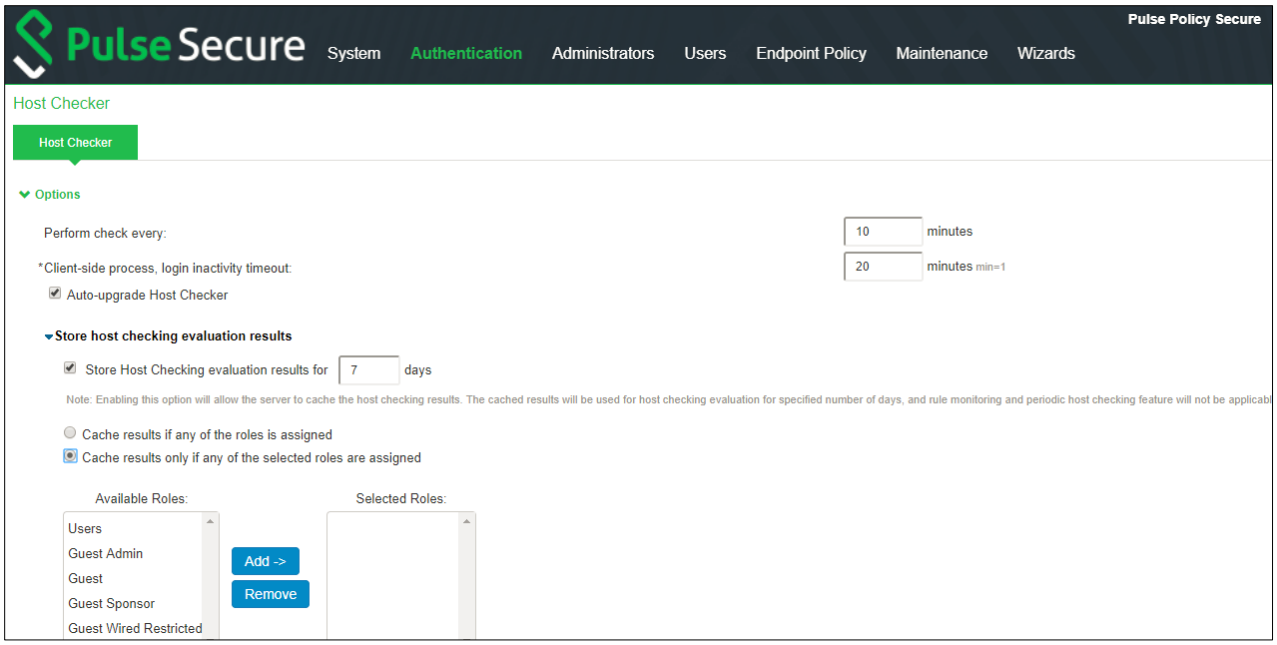
Limitations

- Periodic host checking, rule monitoring, and remediation are supported only for the first connection when the results are not cached.
- Change in Compliance status of the device is not detected if cached results are used for the connection.

To configure caching on Host Checker:

1. Select **Authentication > Endpoint Security > Host Checker**.
2. Under Options, Store host checking evaluation results enable **Store Host Checking evaluation results** and enter the number of days for not performing the Host Check. The default number of days for storing HC results is 7 days. The supported range is between 1- 30 days.
3. The Admin can also choose to cache results based on the roles assigned:
    - **Any role is assigned**- If you select this option, the HC results are cached irresepective of the role assigned.
    - **Any of the selected roles is assigned-** If you select this option, the HC results are cached only when the selected role is assigned.

Note: It is recommended to not enable caching for remediation roles because the subsequent logins will be in the remediation role as cached results are used.



4. Click **Save Changes**.

MDM Interoperability with PPS

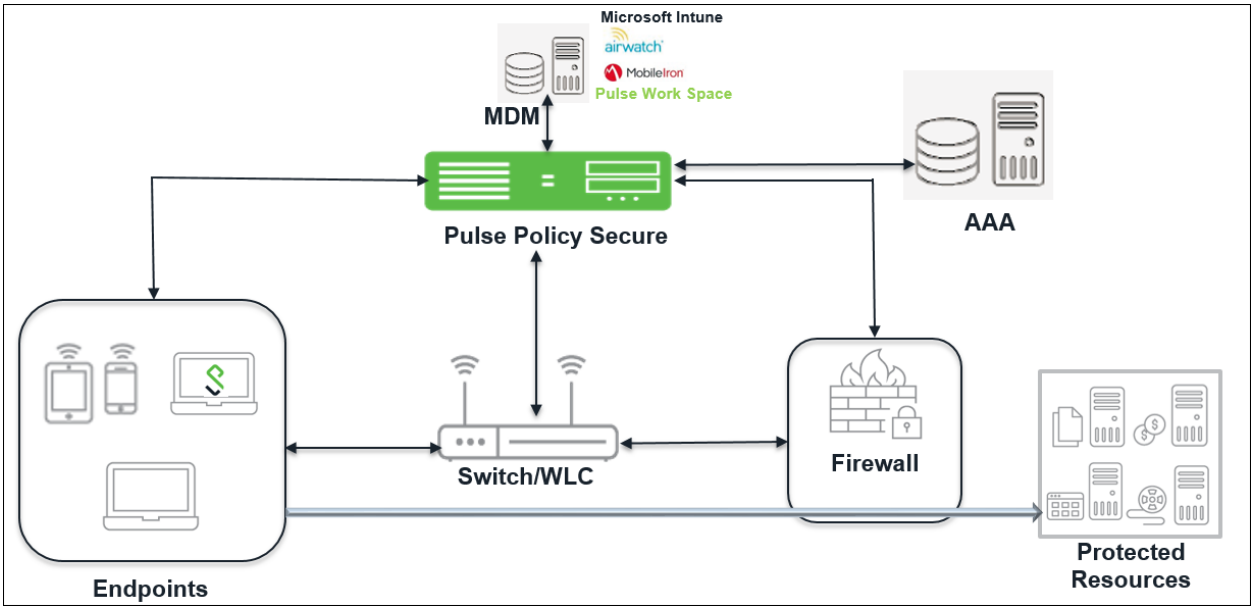
This chapter covers the following topics:

Overview

Mobile Device Management (MDM) servers secure, monitor, manage, and support mobile devices deployed across mobile operators, service providers, and enterprises. MDM servers consist of a device authorization server that controls the use of some applications on a mobile device (for example, an e-mail application) in the deployed environment. The PPS queries the MDM servers for the necessary device attributes and evaluates them while assigning roles before giving access to the network.

For example, the MDM might detect that a device is out of compliance with PPS role mapping rules. At the next device check interval, PPS queries the MDM for updated attribute data. The compliance check is done periodically and if a formerly compliant device is now non-compliant, it assigns the device the non-compliant role and enforces the same on switch or firewall based on the PPS configuration.

Figure 221: MDM interoperability with PPS



Supported MDM Servers

PPS supports the following MDM servers:

- Pulse Workspace (PWS)
- Airwatch
- Mobile Iron
- Microsoft Intune

PPS determines the device identifiers using the following methods:

- Device Certificate
- MAC Address

NOTE: The dynamic policy evaluation feature is not used in the device access management framework.

The device-attribute-based roles are specified for the following policies:

- 802.1x network access control RADIUS return attribute policies (Layer 2)
- Infranet Enforcer resource policies (Layer 3)

MDM Integration Work Flow

The MDM integration work flow is described below:

1. The user associates a device to SSID.
2. (Optional) If the device is not registered, the user goes through the device on-boarding process.
3. PPS queries the MDM server with device details through MAC address or device attributes.
4. The MDM server returns device attributes with which PPS uses one or more attributes to determine device access.
5. PPS allows or denies access based on the attributes.

MDM Dictionary Attributes

This section focuses on the following elements of the MDM configuration that are important to this solution:

- Device identifier—The primary key for device records. Your MDM configuration determines whether a universal unique identifier (UUID), unique device identifier (UDID), or serial number is used as the device identifier. For AirWatch, UDID is supported and recommended. For MobileIron, UUID is supported and recommended.
- Device attributes—A standard set of data maintained for each device. The device attributes for AirWatch, MobileIron, PWS, and Microsoft Intune are described below.

When the user installs the MDM application on the device and completes enrollment, the MDM pushes the device certificate to the device. After enrollment, the MDM maintains a database record that includes information about the enrollee—attributes related to device identity, user identity, and posture assessment against MDM policies.

Table20 describes these attributes. In this solution, these attributes are used in PPS role mapping that is the basis for network access and resource access policies. When you configure role-mapping rules, you specify the normalized attribute name.

Table20: AirWatch Device Attributes

AirWatch Attribute	Normalized Name	Description	Data Type
BlockLevelEncryption	BlockLevelEncryption	True if block-level encryption is enabled; false otherwise.	Boolean
ComplianceStatus	complianceReason	Values: Compliant, Non-Compliant.	String
ComplianceStatus	isCompliant	True if the status is compliant with MDM policies; false otherwise.	Boolean
CompromisedStatus	CompromisedStatus	True if the status is compromised; false otherwise.	Boolean
CompromisedStatus	isCompromised	True if the device is compromised; false otherwise.	Boolean
DataProtectionEnabled	DataProtectionEnabled	True if data protection is enabled; false otherwise.	Boolean
DeviceFriendlyName	deviceName	The concatenated name used to identify the device/user combination.	String
EnrollmentStatus	isEnrolled	True if MDM value is Enrolled; false otherwise.	Boolean
FileLevelEncryption	FileLevelEncryption	True if file-level encryption is enabled; false otherwise.	Boolean
Id.Value	deviceId	Device identifier.	String
Imei	IMEI	IMEI number of the device.	String
IsPasscodeCompliant	IsPasscodeCompliant	True if the passcode is compliant with the MDM policy; false otherwise	Boolean
IsPasscodePresent	IsPasscodePresent	True if a passcode has been configured; false otherwise.	Boolean
LastComplianceCheckOn	LastComplianceCheckOn	The refresh date and timestamp of the last status reported.	Timestamp
LastCompromisedCheckOn	LastCompromisedCheckOn	The refresh date and timestamp of the last status reported.	Timestamp
LastSeen	lastSeen	Date and time the device last made successful contact with the MDM.	Timestamp
LocationGroupName	LocationGroupName	MDM location group configuration value.	String
MacAddress	macAdress	The Wi-Fi MAC address.	String
Model	model	Model is automatically reported by the device during registration.	String
OperatingSystem	osVersion	OS version.	String
Ownership	ownership	Values: C, E, or S (Corporate, Employee, or Shared).	String
PhoneNumber	phoneNumber	Phone number entered during registration.	String
Platform	platform	Platform specified during registration.	String
SerialNumber	serialNumber	Serial number.	String
Udid	UDID	Unique device identifier.	String
UserEmailAddress	userEmail	E-mail address of device user.	String
UserName	userName	Name of device user.	String
Uuid	UUID	Universal unique identifier.	String

Table21: MobileIron Device Attributes

MobileIron Attribute	Normalized Name	Description	Data Type
@id	deviceId	Device identifier.	String
blockedReason	blockedReason	Reason MDM has blocked the device. Can be a multivalued string. Values are: • AllowedAppControlPolicyOutOfCompliance • AppControlPolicyOutOfCompliance • DataProtectionNotEnabled • DeviceAdminDeactivated • DeviceComplianceStatusUnknown • DeviceCompliant • DeviceCompromised • DeviceExceedsPerMailboxLimit • DeviceManuallyBlocked • DeviceNotRegistered • DisallowedAppControlPolicyOutOfCompliance • ExchangeReported • HardwareVersionNotAllowed • OsVersionLessThanSupportedOsVersion • PolicyOutOfDate • RequiredAppControlPolicyOutOfCompliance	String
compliance	complianceReason	MDM policy compliance status. Can be a multivalued string. Values are: • AllowedAppControlPolicyOutOfCompliance • AppControlPolicyOutOfCompliance • DataProtectionNotEnabled • DeviceAdminDeactivated • DeviceComplianceStatusUnknown • DeviceCompliant • DeviceCompromised • DeviceExceedsPerMailboxLimit • DeviceManuallyBlocked • DeviceNotRegistered • DisallowedAppControlPolicyOutOfCompliance • ExchangeReported • HardwareVersionNotAllowed • OsVersionLessThanSupportedOsVersion • PolicyOutOfDate • RequiredAppControlPolicyOutOfCompliance	String
compliance	isCompliant	True if the device is in compliance with its MDM security policies; false otherwise.	Boolean
compliance	isCompromised	True if the device is compromised; false otherwise.	Boolean
countryName	countryName	Country name corresponding with the country code of the device.	String
currentPhoneNumber	phoneNumber	Phone number entered during registration.	String

MobileIron Attribute	Normalized Name	Description	Data Type
emailAddress	userEmail	E-mail address of device user.	String
employeeOwned	Ownership	Values: Employee or Corporate.	String
homeOperator	homeOperator	The service operator for the device when it is not roaming.	String
iPhone IMEI (iOS), imei (Android)	Imei	IMEI number of the device.	String
iPhone UDID	UDID	Unique device identifier.	String
isBlocked	isBlocked	True if the device is blocked from accessing the ActiveSync server; false otherwise.	Boolean
isQuarantined	isQuarantined	True if the device is quarantined by the MDN; false otherwise.	Boolean
lastConnectAt	lastSeen	Date and time the device last made successful contact with the MDM.	Timestamp
manufacturer	manufacturer	Manufacturer is automatically reported by the device during registration.	String
mdmManaged	mdmManaged	True if the MDM profile is enabled on the device; false otherwise. This field applies only to iOS devices. For other devices, the value is always false.	Boolean
ModelName, model, device_model	Model	Model is automatically reported by the device during registration.	String
name	deviceName	The concatenated name used to identify the device/user combination.	String
operator	Operator	Service provider. The value PDA indicates no operator is associated with the device.	String
OSVersion (iOS), os_version (Android)	osVersion	OS version.	String
platform	Platform	Platform specified during registration.	String
principal	userId	User ID.	String
quarantinedReason	quarantinedReason	MDM policy compliance status. Can be a multivalued string. Values are: • AllowedAppControlPolicyOutOfCompliance • AppControlPolicyOutOfCompliance • DataProtectionNotEnabled • DeviceAdminDeactivated • DeviceComplianceStatusUnknown • DeviceCompliant • DeviceCompromised • DeviceExceedsPerMailboxLimit • DeviceManuallyBlocked • DeviceNotRegistered • DisallowedAppControlPolicyOutOfCompliance • ExchangeReported • HardwareVersionNotAllowed • OsVersionLessThanSupportedOsVersion • PolicyOutOfDate • RequiredAppControlPolicyOutOfCompliance	
SerialNumber	serialNumber	Serial number.	String

MobileIron Attribute	Normalized Name	Description	Data Type
statusCode	isEnrolled	True if the device has completed enrollment or registration; false otherwise.	Boolean
uuid	UUID	Universal unique device identifier.	String
userDisplayName	userName	Name of device user.	String
wifi_mac (iOS), wifi_mac_addr (Android)	macAdress	The Wi-Fi MAC address.	String

Table22: Microsoft Intune Device Attributes

Intune Attribute	Normalized Name	Description	Data Type
complianceState	isCompliant	True or false (string) based on whether device is compliant or non-compliant.	Boolean
isManaged	isEnrolled	True or false (indicating whether the client is managed by Intune or not).	Boolean
macAddress	macAddress	MAC address of the device.	String
serialNumber	serialNumber	Serial number of the device. Applies to iOS Devices only.	String
imei	IMEI	The device unique identifier. IMEI (15 decimal digits: 14 digits plus a check digit) or IMEISV (16 digits) includes information on the origin, model, and serial number of the device.	String
udid	UDID	The device unique identifier. Unique Device Identifier (UDID), which is a sequence of 40 letters and numbers that is specific to iOS devices.	String
meid	MEID	MEID is 56 bits long (14 hex digits). It consists of three fields, including an 8-bit regional code (RR), a 24-bit manufacturer code, and a 24-bit manufacturer-assigned serial number.	String
osVersion	osVersion	OS Version of the device.	String
model	Model	Model of the device.	String
manufacturer	manufacturer	Device Manufacturer.	String
azureDeviceId	deviceId	The device Id of the device after it has work place joined with Azure Active Directory.	String
lastContactTimeUtc	lastSeen	The date time when the device last checked in with the Intune management service endpoint.	String The format is MM/DD/YYYY HH:MM:SS

Refer to third-party documentation for complete information and configuration details.

Configuring PPS with MDM Servers

This section describes the basic steps for configuring the device access management framework:

- Configuring an Authentication Protocol Set
- Configuring the MDM Authentication Server
- Configuring the Certificate Server
- Adding the MDM Certificate to the Trusted Client CA Configuration
- Configuring User Roles
- Configuring a Realm and Role Mapping Rules
- Configuring a Sign-In Policy

Configuring an Authentication Protocol Set

The authentication protocol set associated with the sign-in page must include the EAP method selected in the MDM Wi-Fi profile. The predefined authentication protocol set named **802.1x** can be used as-is because it includes all the EAP methods currently configurable on MDMs.

To configure the authentication protocol set:

1. Select **Signing In > Authentication Protocols** to display the configuration page.
2. Click **New Authentication Protocol** or select the predefined 802.1x set. If anything other than MAC address is used as a device identifier then you must use cert auth and the protocol set has to be used for cert auth.
3. Click **Save**.

Configuring the MDM Authentication Server

The MDM authentication server configuration is used by PPS to communicate with the MDM. In the device access management framework, the MDM server is used as the device authorization server.

To configure the authentication server:

1. Select **Authentication > Auth Servers** to navigate to the authentication server configuration pages.
2. Select **MDM Server** and click **New Server** to display the configuration page.
3. Complete the configuration as described in Table23.
4. Save the configuration.

Figure222: Authentication Server Configuration Page

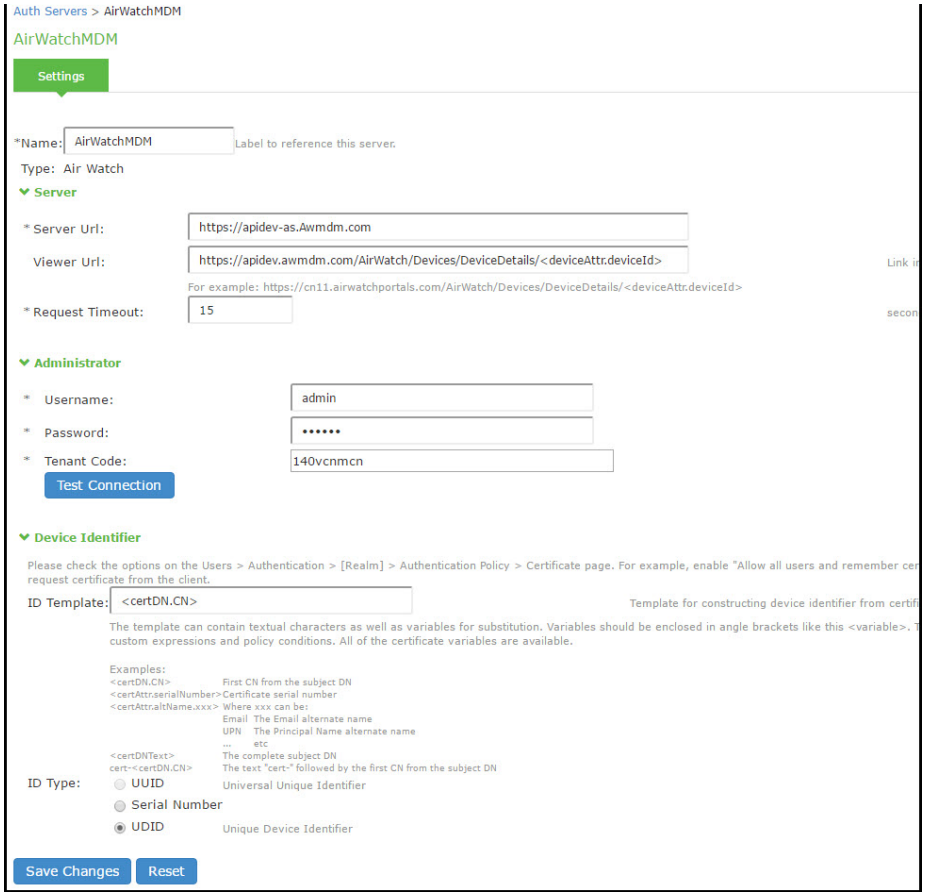


Table23: Authentication Server Configuration Guidelines

Settings	Guidelines
Name	Specify a name for the configuration.
Type	Select the MDM server.
Server	
Server Url	Specify the URL for your AirWatch server. This is the URL AirWatch has instructed you to use to access its RESTful Web API (also called a RESTful Web service). The URL for the AirWatch MDM server used in this example has the following form: **https://apidev-as.Awmdm.com** **https://m.mobileiron.net/pulsesecuretest** NOTE: You must configure your firewalls to allow communication between these two nodes over port 443.
Viewer Url	Specify the URL for the AirWatch report viewer. This URL is used for links from the Active Users page to the AirWatch report viewer. The URL for the AirWatch MDM viewer for this example has the following form: **https://apidev.awmdm.com/AirWatch/Devices/DeviceDetails/<deviceAttr.deviceId>** **https://m.mobileiron.net/pulsesecuretest/admin/admin.html#smartphones:all**

Settings	Guidelines
Request Timeout	Specify a timeout period (0-60 seconds) for queries to the MDM server. The default is 15 seconds. Calibrate this value based on your observations on how long a query to the MDM server takes over your network. If your network experiences latency when querying the MDM cloud service, increase the timeout to account for the latency. The system queries the MDM when a user attempts to sign in. If a timeout occurs, role mapping proceeds without attributes.
Administrator	
Username	Specify the username for an account that has privileges to access the MDM RESTful Web API.
Password	Specify the corresponding password.
Tenant Code	Copy and paste the AirWatch API tenant code.
Device Identifier	
Device identity	Select an option on whether to require that the MDM certificate is presented by the endpoint when signing in: • **Require**—Require that the device certificate pushed to client devices during enrollment be used at sign-in. If this option is selected, and the client device does not have a certificate, authorization fails. Use this option when you require endpoints to adhere to your certificate security requirements. • **Use Certificate if present**—Use the certificate to derive the device ID if the certificate is presented at sign-in, but do not reject authentication if the certificate is not present. You can use this option in conjunction with a role mapping rule and a remediation VLAN to identify devices that have not perfected MDM enrollment. • **Always Use MAC address**—In some cases, the MDM certificate might be configured without a device identifier. When the endpoint uses an 802.1x framework to authenticate, PPS can obtain the MAC address from the RADIUS return attribute callingStationID. The system can then use the MAC address as the device identifier.
ID Template	Construct a template to derive the device identifier from the certificate attributes. The template can contain textual characters as well as variables for substitution. The variables are the same as those used in role mapping custom expressions and policy conditions. Enclose variables in angle brackets like this <variable>. For example, suppose the certificate DN is: CN=<EnrollmentUser>, serialNumber=<DeviceUid>, o=Company. With this configuration, the certificate could identify both the user and the device. In this example, the device ID template is <certDN.serialNumber>.
ID Type	Select the device identifier type that matches the selection in the MDM certificate configuration: • **UUID**— The device universal unique identifier. This is the key device identifier supported by MobileIron MDM. • **Serial Number**—The device serial number. • **UDID**—The device unique device identifier. This is supported by the AirWatch MDM.

Configuring the Certificate Server

The certificate server configuration enables device users to authenticate using the certificate pushed to the device by the MDM. The certificates are used for user authentication, and the users do not have to enter user credentials.

To configure authentication with the certificate server:

1. Select **Authentication** > **Auth. Servers**.
2. Select **Certificate Server** and click **New Server** to display the configuration page.
3. Complete the configuration as described in table below.
4. Save the configuration.

Figure223: Certificate Server Configuration Page

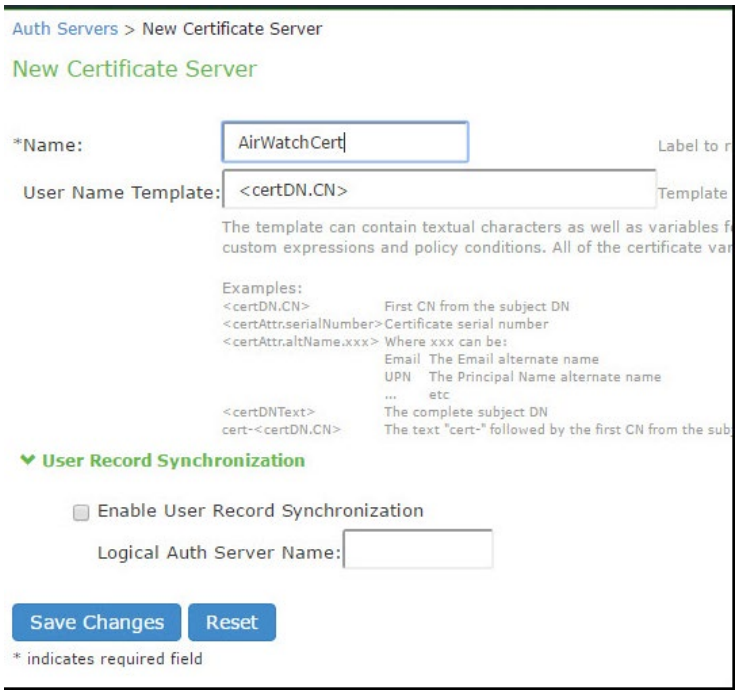


Table24: Certificate Server Settings

Settings	Guidelines
Name	Specify a name to identify the server within the system.
User Name Template	Specify a username template. Specify how the system should construct a username. You may use any combination of certificate variables contained in angle brackets and plain text. The username template you configure must be consistent with the MDM certificate template configuration. Your goal is to identify the values specified in the MDM certificate that are to be used as the username in PPS system. This value populates the <USER> and <USERNAME> session variables for use throughout the rest of the system configuration. For example, suppose the certificate DN is: CN=<EnrollmentUser>, serialNumber=<DeviceUid>, o=Company. With this configuration, the certificate could identify both the user and the device. In this example, the username template is <certDN.CN>.

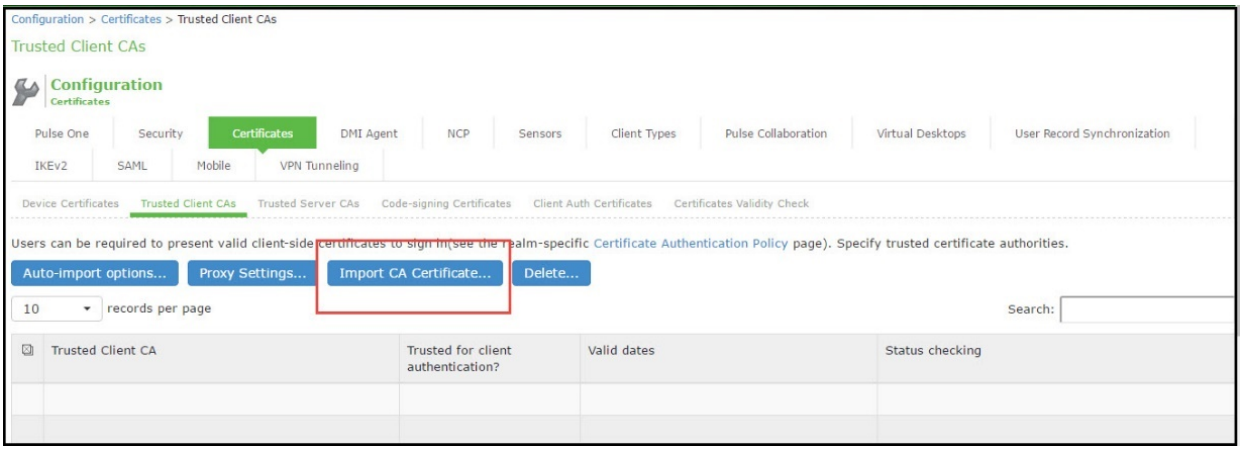
Adding the MDM Certificate to the Trusted Client CA Configuration

The system uses the uploaded certificate to verify that the browser-submitted certificate is valid. You must upload the MDM certificate that signed the client certificate that was pushed to the mobile devices. Typically, you obtain this certificate from the MDM when your company establishes its account with them.

To import a trusted client CA certificate:

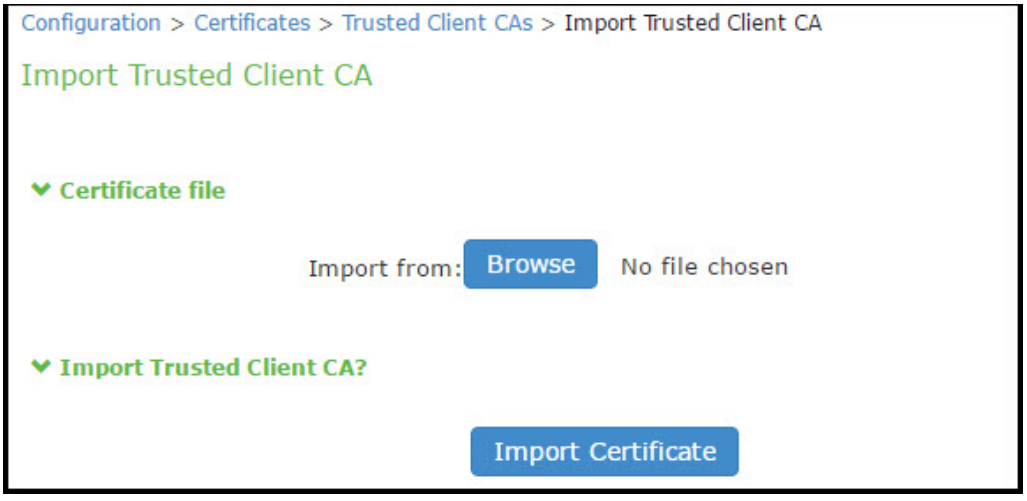
1. Select **System > Configuration > Certificates > Trusted Client CAs**.

Figure224: Trusted Client CA Management Page



2. Click **Import Trusted Client CA Certificate**.

Figure225: Import Trusted Client CA Page



3. Browse to the certificate file, select it, and click **Import Certificate** to complete the import operation.
4. Click the link for the Trusted Client CA to display its details.

Configuring User Roles

User roles are classifiers for network access control policies. You create a set of roles to use in your classification scheme: device status is MDM enrollment complete or incomplete; device status is MDM-policy compliant or noncompliant; device is employee owned or company owned; device platform is iOS, Android, or neither; and so forth.

The user role configuration also includes options to customize user interface features that are appropriate for a particular role. For MDM deployments, you can use the Personalized Greeting UI option to send a notification message to the device when the role has been applied.

To configure user roles:

1. Select **Users > User Role** to navigate to the role configuration page.
2. Click **New Role** to display the configuration page.
3. Complete the configuration for general options as described in below table.
4. Save the configuration.
5. Click **UI options** to display the configuration page.
6. Complete the configuration for UI options as described in below table.
7. Save the configuration.
8. Click **Session Options** to display the configuration page.
9. Complete the configuration for session options as described in below table.
10. Save the configuration.
11. Click **Agentless** to display the configuration page.
12. Complete the configuration for agentless options as described in below table.
13. Save the configuration.

Figure226: User Role Configuration Page – General Settings

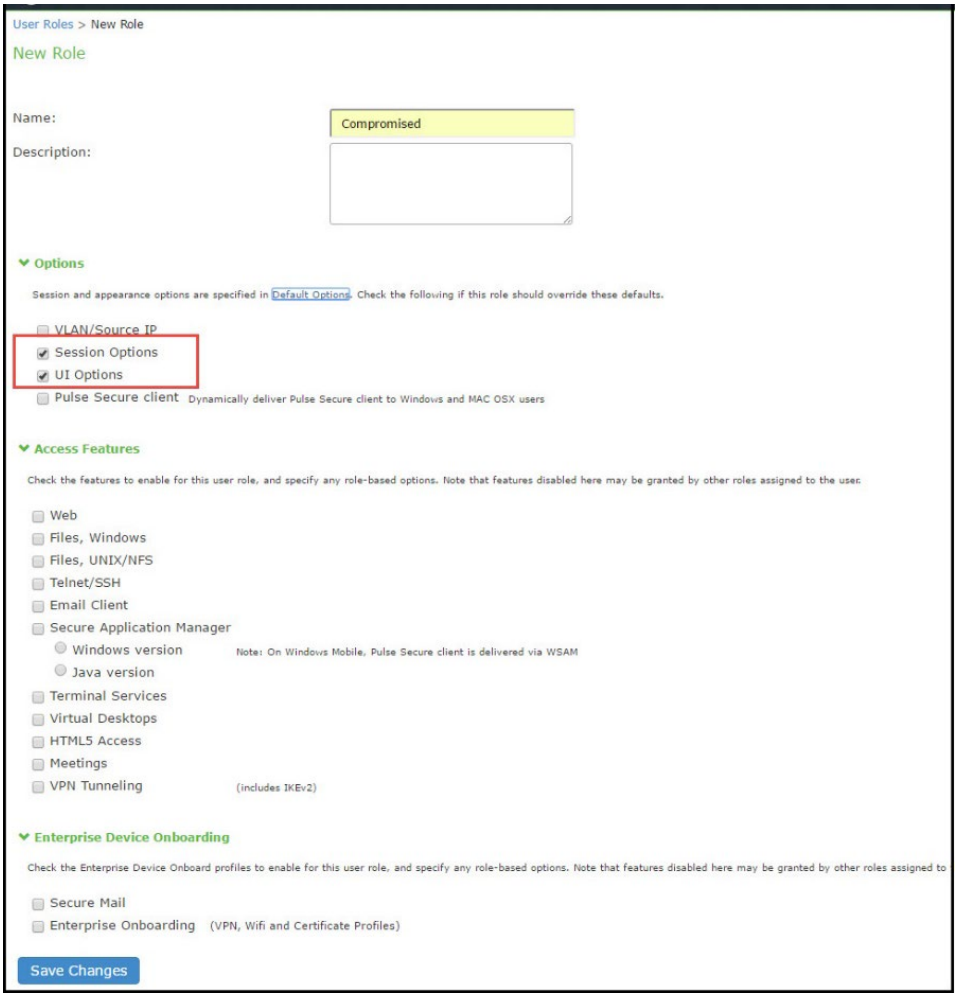


Figure227: User Role Configuration Page – UI Options

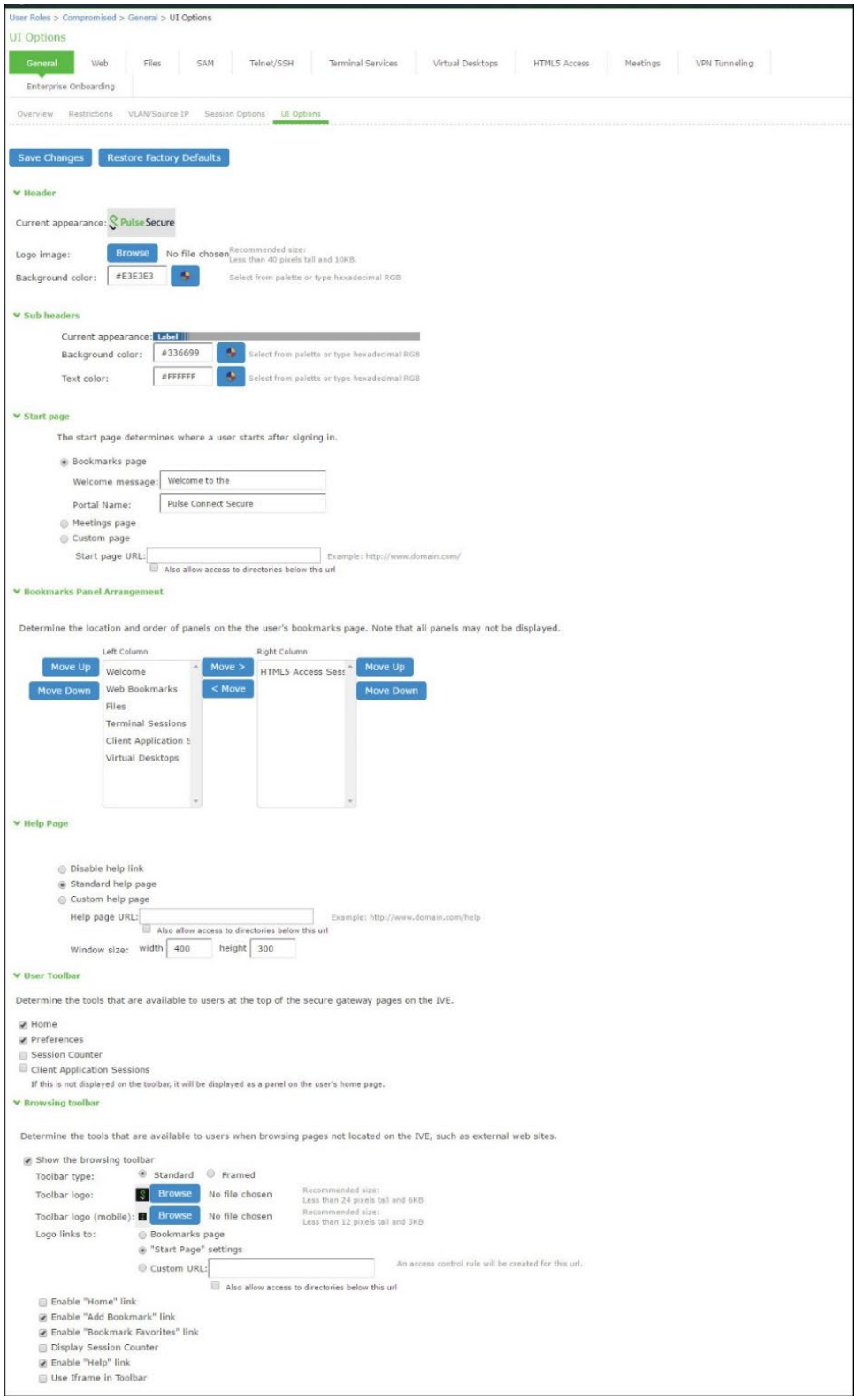


Figure228: User Role Configuration Page – Session Options

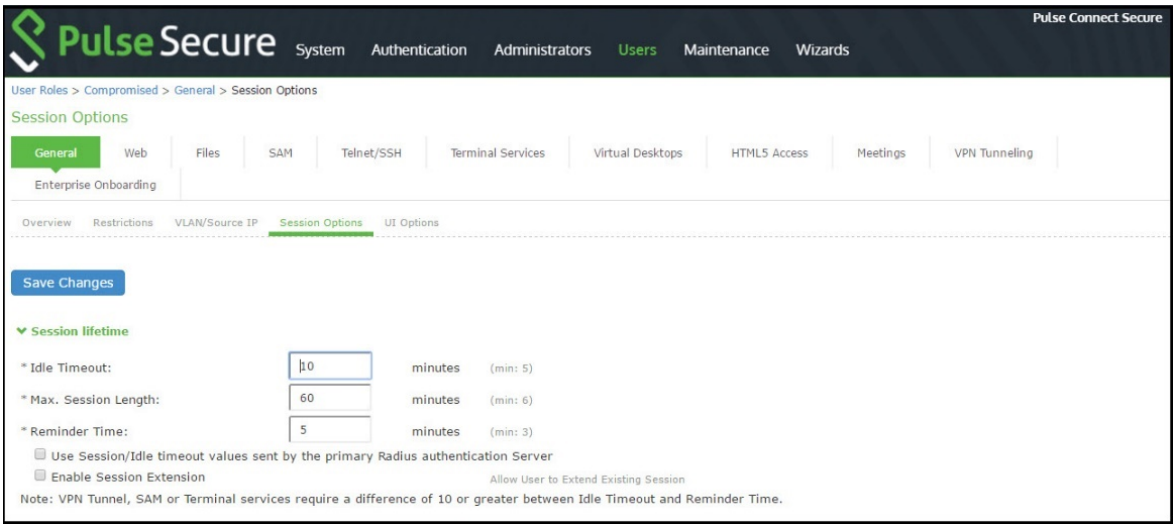


Table25: User Role Configuration Guidelines

Settings	Guidelines
Overview tab	
Name	Specify a name for the configuration.
Description	Describe the purpose of the role so that other administrators are aware of it.
Options	Select **UI Options** so that you can customize a message to be sent to the device when the role is applied.
UI Options tab	
Personalized greeting	Select the **Show notification message** option and enter a message to be sent to the device (through the MDM API) after sign-in and this role has been applied, or after role reevaluation if it results in a role change to this role. In this example, we are using the system to enforce MDM enrollment by flagging compromised devices. The message, therefore, is: Your device is compromised. Network access may be limited. The message is forwarded to the device using the MDM server Push Notification feature. The content of your notification message can vary depending on whether the switch or access point supports change of authorization (CoA). If the CoA is supported, reauthentication is automatic, so your message might simply state that “your level of access has changed.” If CoA is not supported, reauthentication needs to be done manually by the user in which case the message might state that “your level of access has changed, please reconnect.” NOTE: When multiple roles are assigned, UI options are not merged. The UI options for the first role that matches are applied.
Session Options	
Allow VPN Through Firewall	Enable this option to allow Infranet Enforcer traffic to act as a heartbeat and keep the session alive. This option is useful for iOS devices.
Agentless	
Enable agentless access	Select this option for roles that you provision to access the network from BYOD devices. The solution that integrates with MDMs depends on the native supplicant, not a Pulse Secure agent.

Configuring a Realm and Role Mapping Rules

The user realm configuration associates the authentication server data and MDM server data with user roles.

To configure the realm and role mapping rules:

1. Select **Users > User Realms > New User Realm** to display the configuration page.
2. Upon saving the new realm, the system displays the role mapping rules page.
3. Click **New Rule** to display the configuration page.
4. Complete the configuration as described in table.
5. Click the **Authentication Policy** tab and then click the **Certificate** subtab to display the certificate restriction configuration page.

Table26: Realm Configuration Guidelines

Settings	Guidelines
Name	Specify a name for the realm. If you enable sign-in using a realm suffix in the sign-in policy configuration, the realm name must match the username realm suffix configured in the MDN Wi-Fi profile.
Description	Describe the purpose of the realm so that other administrators are aware of it.
Servers	
Authentication	Select the user authentication server for this realm's users. This example uses the certificate server configured in the earlier step. When you use a certificate server, users are not prompted for their credentials. You can also select the authentication server used for employees. In that case, users are prompted by the sign-in page to provide their username and password.
User Directory/Attribute	This option is not used.
Accounting	This option is not used.
Device Attributes	Select the MDM server configured for device authorization.
Device Check Interval	Select this feature to leverage the MDM posture assessment checks and enforce compliance. For example, the MDM might detect that a device is out of compliance with its security policies, such as a password policy. At the next device check interval, PPS queries the MDM for updated attribute data. In this example, it learns that a formerly compliant device is now noncompliant. It assigns the device the noncompliant role and sends the 802.1x authenticator the corresponding RADIUS attribute to place it in a remediation VLAN. Specify the interval at which to query the MDM for updated attribute data. Specify 0 to disable periodic queries. The minimum is 10 minutes and the maximum is 10080 minutes (7 days). Specify an interval that is appropriate for the MDM. Some MDMs, for example, update records every 4 hours, so a 10-minute interval would not be productive.
Dynamic Policy Evaluation	
Dynamic Policy Evaluation	This option is not used.

Figure229: Role Mapping Configuration Page

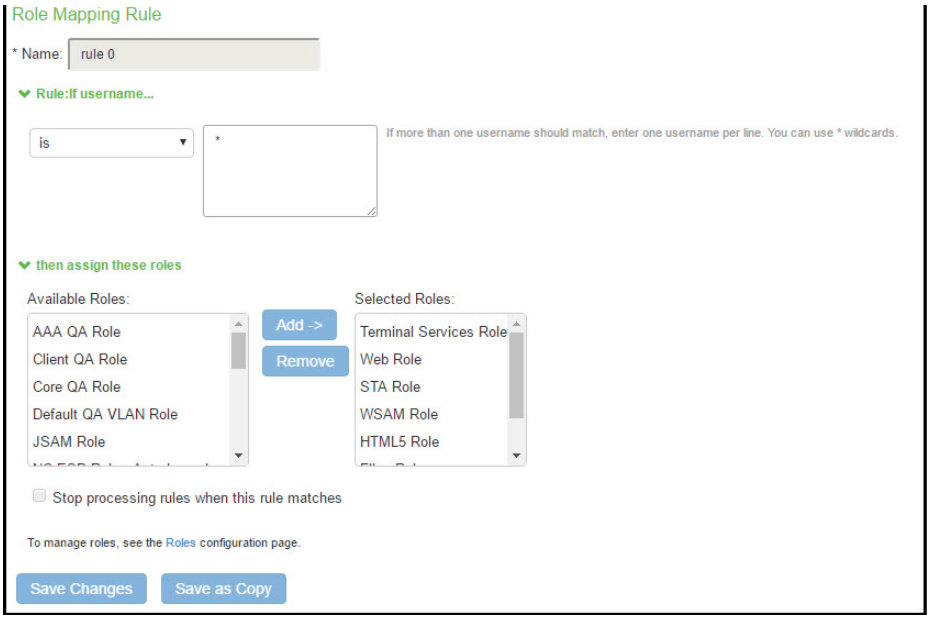


Table27: Role Mapping Configuration Guidelines

Settings	Guidelines
Rule based on	Select **Device Attribute** and click **Update** to update the configuration page so that it displays settings for role mapping using device attributes.
Name	Specify a name for the configuration.
Rule	Select a device attribute and a logical operator (is or is not), and type a matching value or value pattern. In this example, select **isCompromised** and the logical operator **is**, and enter the value **1** (true). This means that devices with a compromised status match the rule.
Role assignment	Select the roles to apply if the data matches the rule.

The below table describes the AirWatch record attributes that can be used in role mapping rules.

Table28: AirWatch Device Attributes

Role Mapping Attribute Name	AirWatch Attribute Name	Description	Data Type
BlockLevelEncryption	BlockLevelEncryption	True if block-level encryption is enabled; false otherwise.	Boolean
complianceReason	ComplianceStatus	Values: Compliant, Non-Compliant.	String
CompromisedStatus	CompromisedStatus	True if the status is compromised; false otherwise.	Boolean
DataProtectionEnabled	DataProtectionEnabled	True if data protection is enabled; false otherwise.	Boolean
deviceId	Id.Value	Device identifier.	String
deviceName	DeviceFriendlyName	The concatenated name used to identify the device/user combination.	String
FileLevelEncryption	FileLevelEncryption	True if file-level encryption is enabled; false otherwise.	Boolean
IMEI	Imei	IMEI number of the device.	String
isCompliant	ComplianceStatus	Values: Compliant.	String
isCompromised	CompromisedStatus	True if the device is compromised; false otherwise.	Boolean
isEnrolled	EnrollmentStatus	True if MDM value is Enrolled; false otherwise.	Boolean
IsPasscodeCompliant	IsPasscodeCompliant	True if the passcode is compliant with the MDM policy; false otherwise	Boolean
IsPasscodePresent	IsPasscodePresent	True if a passcode has been configured; false otherwise.	Boolean
LastComplianceCheckOn	LastComplianceCheckOn	The refresh date and timestamp of the last status reported.	Timestamp
LastCompromisedCheckOn	LastCompromisedCheckOn	The refresh date and timestamp of the last status reported.	Timestamp
lastSeen	LastSeen	Date and time the device last made successful contact with the MDM.	Timestamp
LocationGroupName	LocationGroupName	MDM location group configuration value.	String
macAdress	MacAddress	The Wi-Fi MAC address.	String
model	Model	Model is automatically reported by the device during registration.	String
osVersion	OperatingSystem	OS version.	String
ownership	Ownership	Values: C, E, or S (Corporate, Employee, or Shared).	String
phoneNumber	PhoneNumber	Phone number entered during registration.	String
platform	Platform	Platform specified during registration.	String
serialNumber	SerialNumber	Serial number.	String
UDID	Udid	Unique device identifier.	String
userEmail	UserEmailAddress	E-mail address of device user.	String
userName	UserName	Name of device user.	String
UUID	Uuid	Universal unique identifier.	String

The below table describes the MobileIron record attributes that can be used in role mapping rules.

Table29: MobileIron Device Attributes

Role Mapping Attribute Name	MobileIron Attribute Name	Description	Data Type
blockedReason	blockedReason	Reason MDM has blocked the device. Can be a multivalued string. Values are: • AllowedAppControlPolicyOutOfCompliance • AppControlPolicyOutOfCompliance • DataProtectionNotEnabled • DeviceAdminDeactivated • DeviceComplianceStatusUnknown • DeviceCompliant • DeviceCompromised • DeviceExceedsPerMailboxLimit • DeviceManuallyBlocked • DeviceNotRegistered • DisallowedAppControlPolicyOutOfCompliance • ExchangeReported • HardwareVersionNotAllowed • OsVersionLessThanSupportedOsVersion • PolicyOutOfDate • RequiredAppControlPolicyOutOfCompliance	String
complianceReason	compliance	MDM policy compliance status. Can be a multivalued string. Values are: • AllowedAppControlPolicyOutOfCompliance • AppControlPolicyOutOfCompliance • DataProtectionNotEnabled • DeviceAdminDeactivated • DeviceComplianceStatusUnknown • DeviceCompliant • DeviceCompromised • DeviceExceedsPerMailboxLimit • DeviceManuallyBlocked • DeviceNotRegistered • DisallowedAppControlPolicyOutOfCompliance • ExchangeReported • HardwareVersionNotAllowed • OsVersionLessThanSupportedOsVersion • PolicyOutOfDate • RequiredAppControlPolicyOutOfCompliance	String
countryName	countryName	Country name corresponding with the country code of the device.	String
deviceId	@id	Device identifier.	String
deviceName	name	The concatenated name used to identify the device/user combination.	String
homeOperator	homeOperator	The service operator for the device when it is not roaming.	String

Role Mapping Attribute Name	MobileIron Attribute Name	Description	Data Type
Imei	iPhone IMEI (iOS), imei (Android)	IMEI number of the device.	String
isBlocked	isBlocked	True if the device is blocked from accessing the ActiveSync server; false otherwise.	Boolean
isCompliant	compliance	True if the device is in compliance with its MDM security policies; false otherwise.	Boolean
isCompromised	compliance	True if the device is compromised; false otherwise.	Boolean
isEnrolled	statusCode	True if the device has completed enrollment or registration; false otherwise.	Boolean
isQuarantined	isQuarantined	True if the device is quarantined by the MDN; false otherwise.	Boolean
lastSeen	lastConnectAt	Date and time the device last made successful contact with the MDM.	Timestamp
manufacturer	manufacturer	Manufacturer is automatically reported by the device during registration.	String
macAdress	wifi_mac (iOS), wifi_mac_addr (Android)	The Wi-Fi MAC address.	String
mdmManaged	mdmManaged	True if the MDM profile is enabled on the device; false otherwise. This field applies only to iOS devices. For other devices, the value is always false.	Boolean
model	ModelName, model, device_model	Model is automatically reported by the device during registration.	String
operator	operator	Service provider. The value PDA indicates no operator is associated with the device.	String
osVersion	OSVersion (iOS), os_version (Android)	OS version.	String
ownership	employeeOwned	Values: Employee or Corporate.	String
phoneNumber	currentPhoneNumber	Phone number entered during registration.	String
platform	platform	Platform specified during registration.	String

Role Mapping Attribute Name	MobileIron Attribute Name	Description	Data Type
quarantinedReason	quarantinedReason	MDM policy compliance status. Can be a multivalued string. Values are: • AllowedAppControlPolicyOutOfCompliance • AppControlPolicyOutOfCompliance • DataProtectionNotEnabled • DeviceAdminDeactivated • DeviceComplianceStatusUnknown • DeviceCompliant • DeviceCompromised • DeviceExceedsPerMailboxLimit • DeviceManuallyBlocked • DeviceNotRegistered • DisallowedAppControlPolicyOutOfCompliance • ExchangeReported • HardwareVersionNotAllowed • OsVersionLessThanSupportedOsVersion • PolicyOutOfDate • RequiredAppControlPolicyOutOfCompliance	
serialNumber	SerialNumber	Serial number.	String
UDID	iPhone UDID	Unique device identifier.	String
userEmail	emailAddress	E-mail address of device user.	String
userId	principal	User ID.	String
userName	userDisplayName	Name of device user.	String
UUID	uuid	Universal unique device identifier.	String

Table30: PWS Device Attributes

Role Mapping Attribute Name	PWS Attribute Name	Description	Data Type
osVersion	os_version	OS version	String
UUID	uuid	Unique device identifier	String
IMEI	imei	IMEI number of the device.	String
macAddress	wifi_mac	The Wi-Fi MAC address.	String
serialNumber	serial_number	Serial number of the device.	String
lastSeen	last_seen	Date and time the device last made successful contact with the MDM.	Time Stamp

Role Mapping Attribute Name	PWS Attribute Name	Description	Data Type
isCompliant isCompromised complianceReason	is_compliant	True if the device is in compliance with its MDM security policies; false otherwise.	Boolean
isEnrolled	state	True or false (indicating whether the client is managed by PWS or not).	Boolean
UDID	ios_udid	The device unique identifier. Unique Device Identifier (UDID), which is a sequence of 40 letters and numbers that is specific to iOS devices.	String
model	model	Model of the device.	String
phonenumber	PhoneNumber	Phone number entered during registration.	String
userName	username	Name of device user.	String
carrier	carrier	User ID.	String
manufacturer	manufacturer	Device manufacturer name.	String
deviceName	devicename	Name of the device.	String

Table31: Microsoft Intune Device Attributes

Role Mapping Attribute Name	Microsoft Intune Attribute Name	Description	Data Type
deviceid	azureDeviceId	The device Id of the device after it has work place joined with Azure Active Directory.	String
IMEI	imei	The device unique identifier. IMEI (15 decimal digits: 14 digits plus a check digit) or IMEISV (16 digits) includes information on the origin, model, and serial number of the device.	String
isCompliant	complianceState	True or false (string) based on whether device is compliant or non-compliant.	Boolean
isEnrolled	isManaged	True or false (indicating whether the client is managed by Intune or not).	Boolean

Role Mapping Attribute Name	Microsoft Intune Attribute Name	Description	Data Type
lastSeen	lastContactTimeutc	The date time when the device last checked in with the Intune management service endpoint.	String The format is MM/DD/YYYY HH:MM:SS
macAddress	macAddress	MAC address of the device.	String
manufacturer	manufacturer	Device Manufacturer.	String
meid	meid	MEID is 56 bits long (14 hex digits). It consists of three fields, including an 8-bit regional code (RR), a 24-bit manufacturer code, and a 24-bit manufacturer-assigned serial number.	String
model	model	Model of the device.	String
osVersion	osVersion	OS Version of the device.	String
serialNumber	serialNumber	Serial number of the device. Applies to iOS Devices only.	String
UDID	udid	The device unique identifier. Unique Device Identifier (UDID), which is a sequence of 40 letters and numbers that is specific to iOS devices.	String
UUID	uuid	Universal unique device identifier.	String

Figure230: Realm Configuration Page – Certificate Restrictions

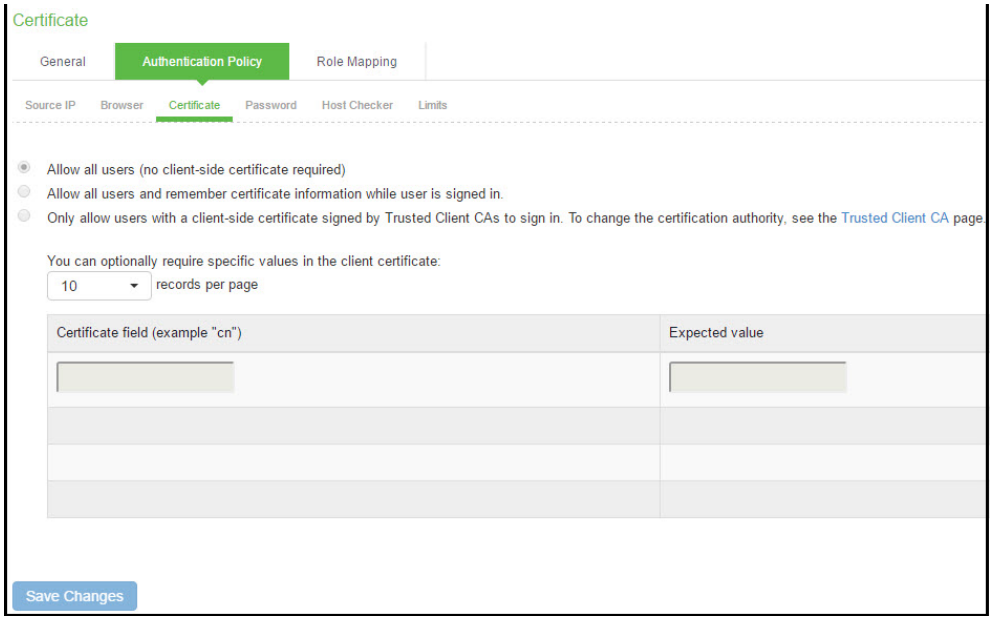


Table32: Realm Configuration Certificate Restriction Guidelines

Settings	Guidelines
Allow all users	Do not select this option. If you select this option, the system does not request a client certificate during the TLS handshake.
Allow all users and remember certificate	If you select this option, the system requests a client certificate during the TLS handshake. It does allow endpoints to authenticate without a client certificate. For those with a client certificate, the certificate attributes are placed in the session context.
Only allow users with a client-side certificate	If you select this option, the system requests a client certificate during the TLS handshake. It does not allow endpoints to authenticate without a valid client certificate. If the realm is configured with a certificate server, like this example, this option is the only option that can be selected.

Configuring a Sign-In Policy

A sign-in policy associates devices with a realm.

To configure a sign-in policy:

1. Select **Authentication > Signing In > Sign-In Policies** to navigate to the sign-in policies configuration page.
2. Click **New URL** to display the configuration page.
3. Complete the configuration as described below.
4. Save the configuration.

Table33: Sign-In Policy Configuration Guidelines

Settings	Guidelines
User type	Select **Users**.
Sign-in URL	Enter a URL.
Description	Describe the purpose of the sign-in policy so that other administrators are aware of it.
Sign-In Page	Select a sign-in page.
Authentication Realm	
Realm	Select the realm you configured in the earlier step.
Authentication Protocol Set	Select the protocol you configured in the earlier step.
Realm name as a username suffix	Select this option if the username sent during sign-in includes a realm suffix. To use this option, the realm name must match the username realm suffix configured in the MDN Wi-Fi profile. This configuration enables you to dedicate the realm to the MDM traffic. Non-MDM traffic passing through the same switch then belongs to a different realm. NOTE: In some cases, you can use authentication protocol sets to segregate traffic into a particular realm. For example, assuming only mobile endpoints use TLS and other endpoints do not, an authentication protocol set containing only TLS can be created and associated with a particular realm through a sign-in policy.
Remove realm suffix	Remove the realm suffix within system processes, such as rule processing and logs.

Configuring PPS with Pulse Workspace

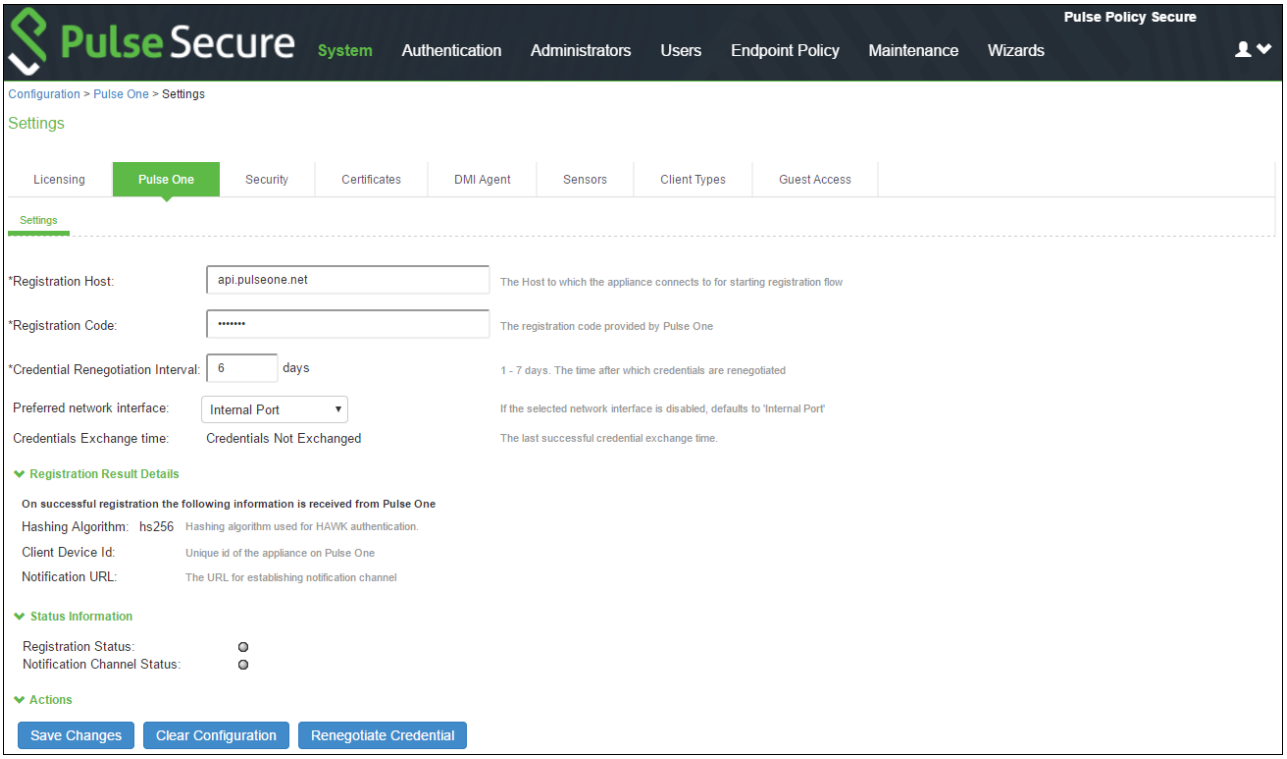
Pulse Workspace is the Pulse Secure MDM server which provides the device compliance status for the mobile devices. PPS retrieves the device attributes from PWS and uses it for compliance assessments and role assignment.

To configure PWS MDM:

1. Select **System > Configuration > Pulse One > Settings** to register PPS with Pulse One.
   - Enter the PWS registration URL and registration code details and register PPS to PWS.
   - Click Save Changes.

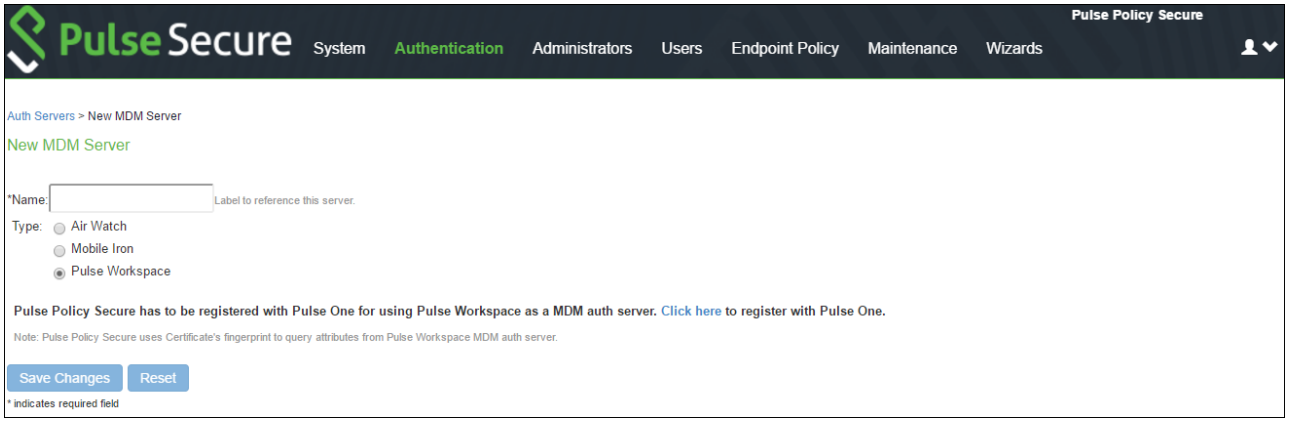
   The registration status and the notification channel status turns green if the connection is successful.

   Figure231: PWS MDM Configuration



2. Select **Authentication > Auth. Servers > New MDM Server**. Enter the name, select Pulse Workspace as MDM and click **Save changes**.

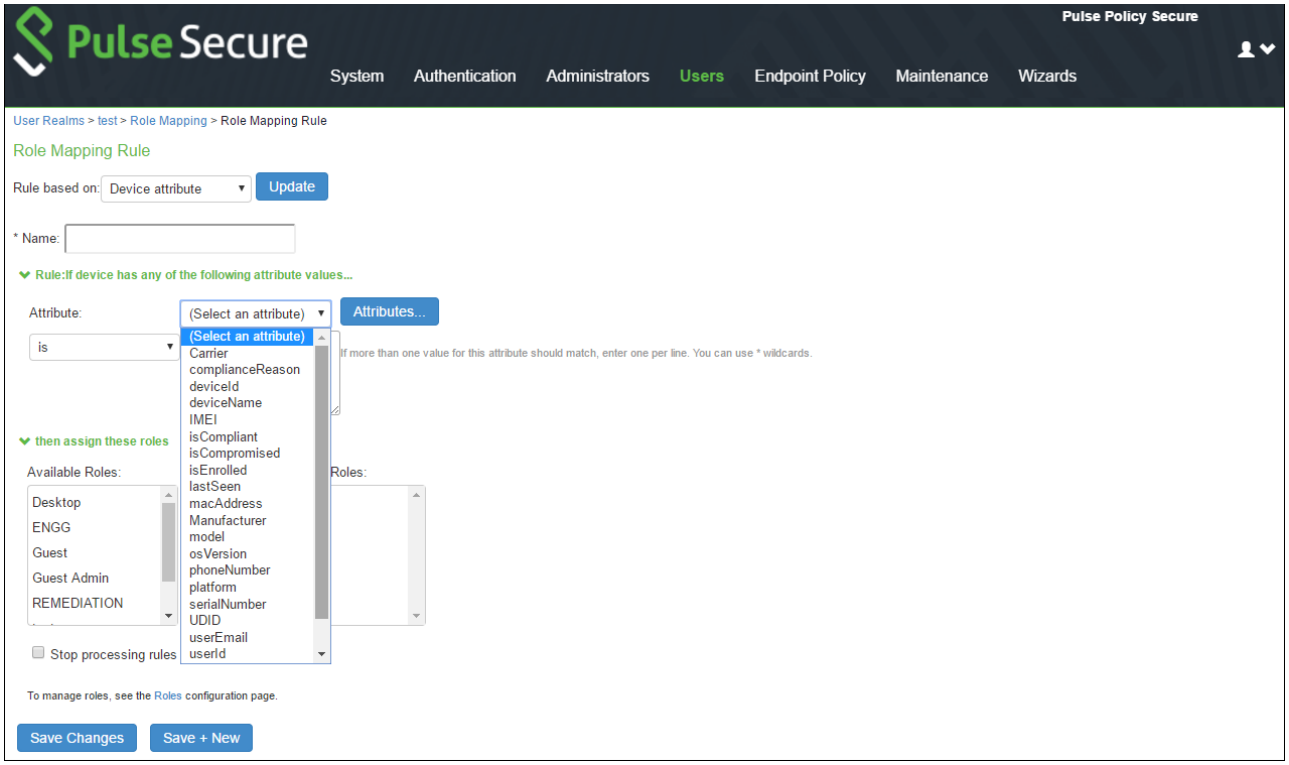
Figure232: PWS MDM Server



3. Select **Users > User Realms** and select the Device Attribute server for PWS.

4. Select Role Mapping tab of the user realm to create role mapping rules. Configure the role mapping rules based on the PWS supported device attributes.

Figure233: Role Mapping PWS MDM Server



Configuring PPS with Microsoft Intune

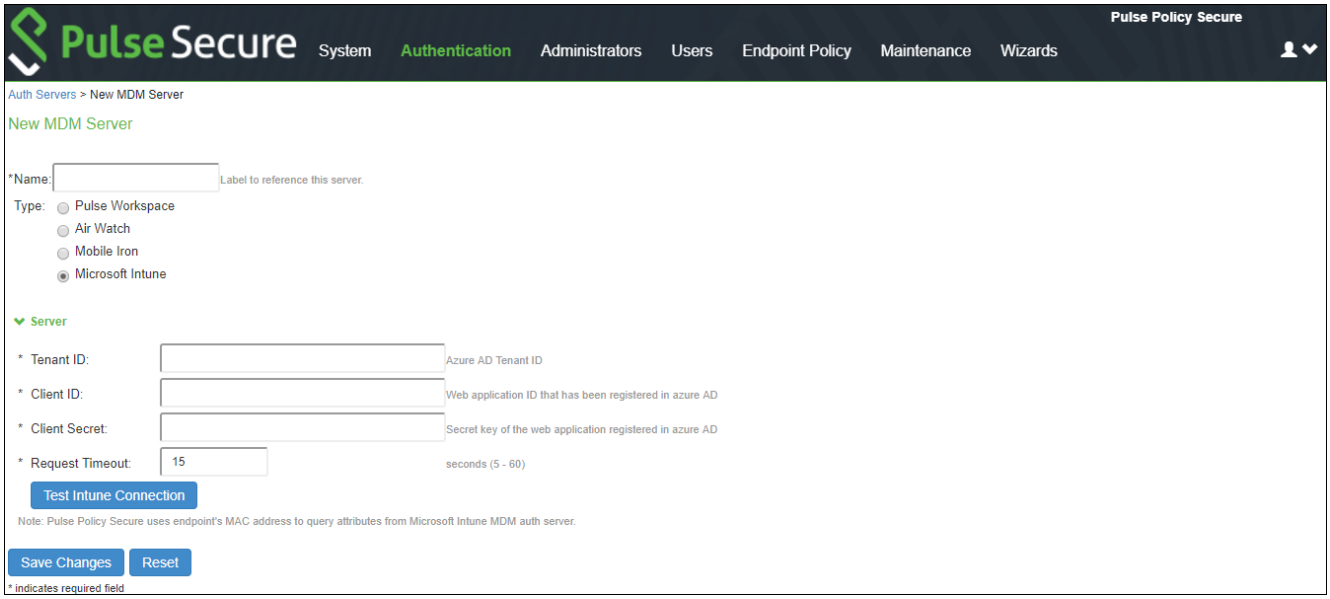
Microsoft Intune is an MDM server which provides the device compliance status for the mobile devices. PPS retrieves the device attributes from Microsoft Intune and uses it for compliance assessments and role assignment. This feature integrates Microsoft Intune and PPS for providing compliance check and onboarding of devices.

To configure Microsoft Intune MDM server:

1. Select **Authentication > Auth. Servers > New MDM Server**.
2. Enter the server name, select **Microsoft Intune** as MDM.
   - Enter the Azure AD Tenant ID.
   - Enter the Web application ID or Client ID that is registered in Azure AD.
   - Enter the Client Secret key registered in the Azure AD.
   - Enter the Timeout duration in seconds. Default is 15 seconds.

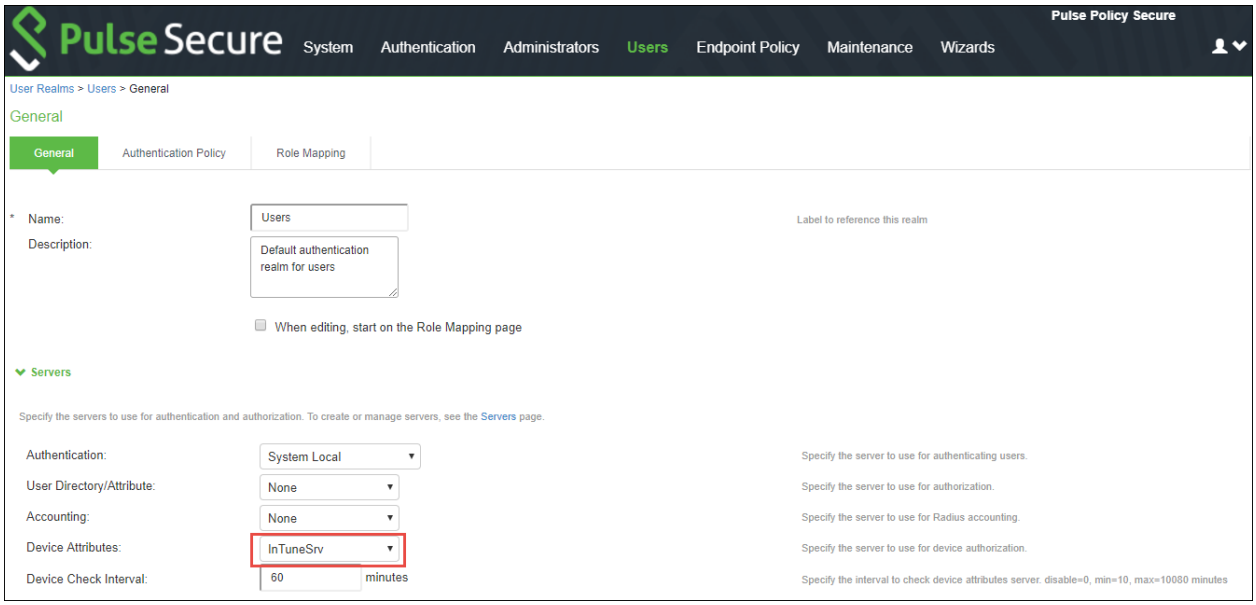
   To obtain Tenant ID, Client ID, Client Secret Key, see Viewing Client ID, Tenant ID, and Client Secret.
3. Click **Save changes**.

Figure234: Intune MDM Server



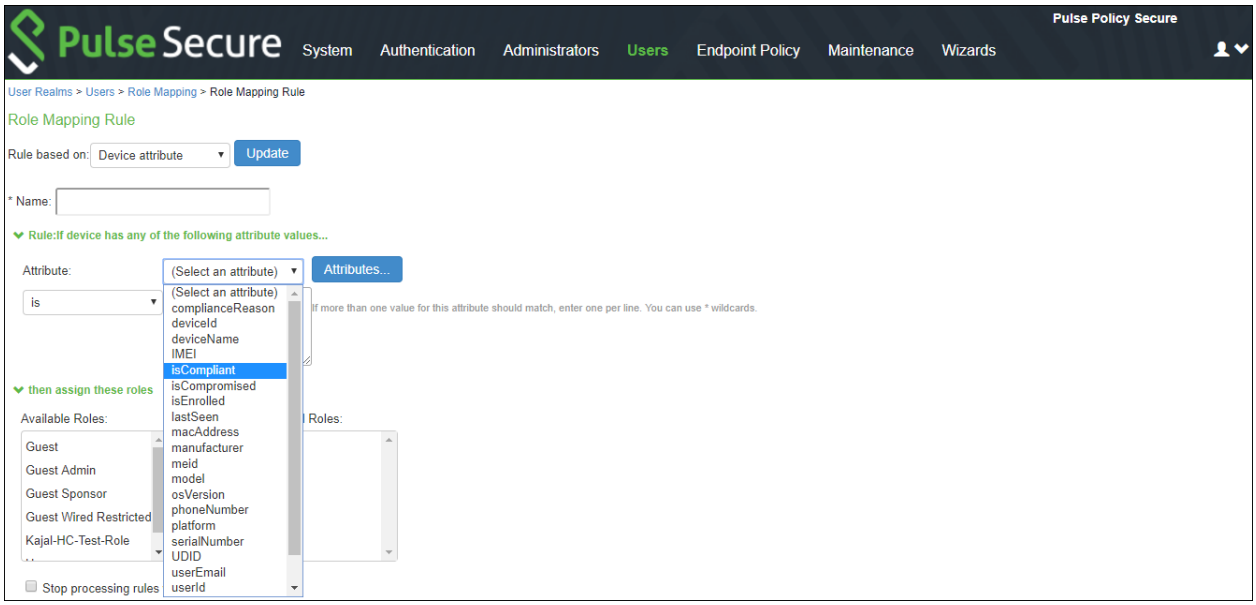
4. Select **Users > User Realms** and select the Device Attribute server for Microsoft Intune.

Figure235: Realm



5. Select **Role Mapping** tab of the user realm to create role mapping rules. Configure the role mapping rules based on the Microsoft Intune supported device attributes.

Figure236: Role Mapping Intune MDM Server



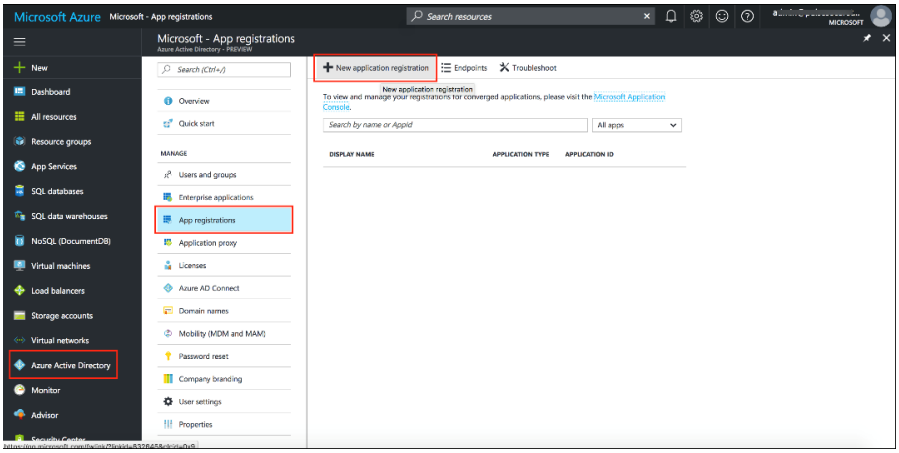
Configuring the Microsoft Intune MDM

Microsoft Intune acts as the Mobile Device Management (MDM) Server for PPS solution. PPS users have to register their mobile devices with Microsoft Intune. As part of registration, the relevant Profiles get automatically provisioned to mobile device.

To configure the Microsoft Intune MDM:

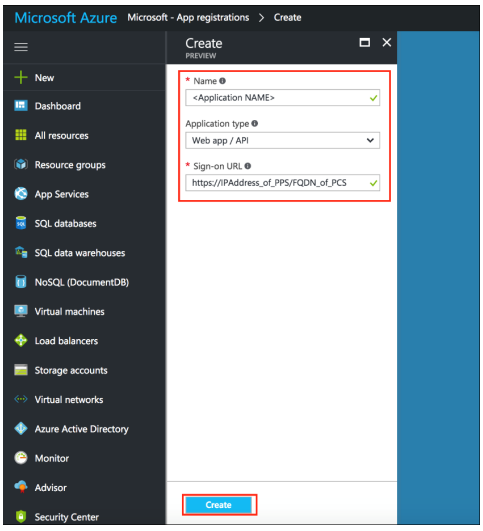
1. Enroll the devices with the MDM server.
2. Create an enterprise WiFi profile.
3. Configure PPS with a role and realm for the user. Microsoft Intune provides the user with a link to provision the created policy and then pushes the profile information. PPS does the role assignment and either allows or denies based on the device assessment. For more information, see Configuring PPS.
4. Create Azure Active Directory (AAD) web application.
5. Go to portal.azure.com, click on the Azure Active Directory on the left of the screen, click on to App registrations and click on New application registration.

Figure237: Creating New Application



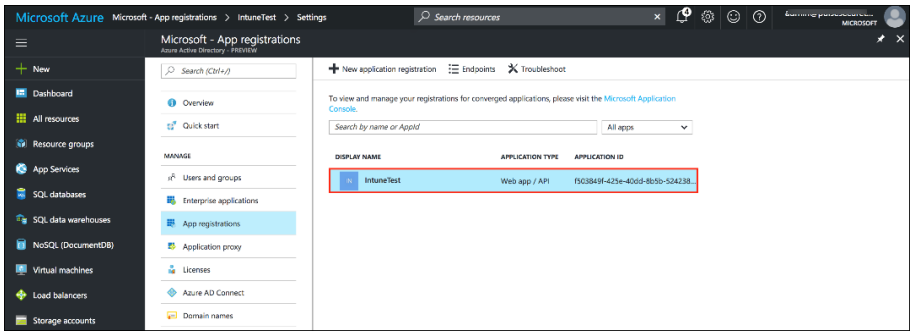
6. Enter the application name, select Web app/API as application type, and enter the IP address/FQDN for sign-on-URL and Click **Create**.

Figure238: Setting up the New Application



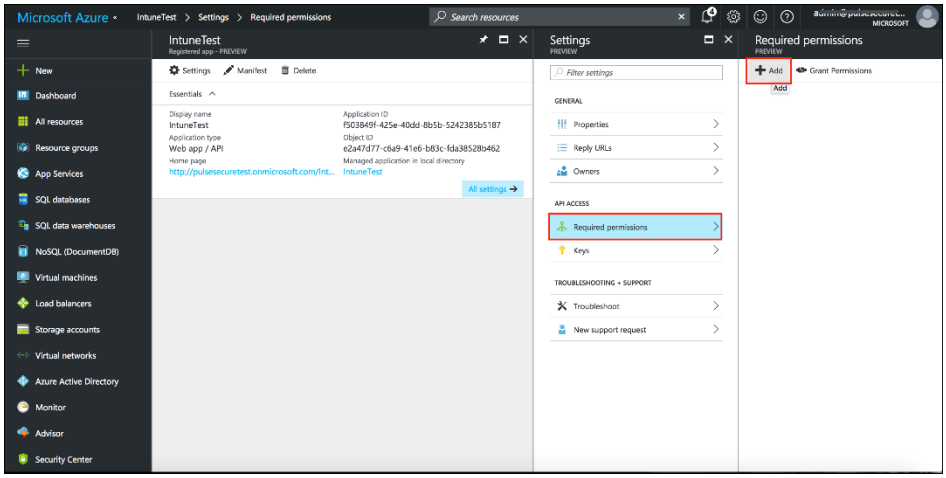
7. The Application Registration page appears if the registration is successful.

Figure239: Application Created



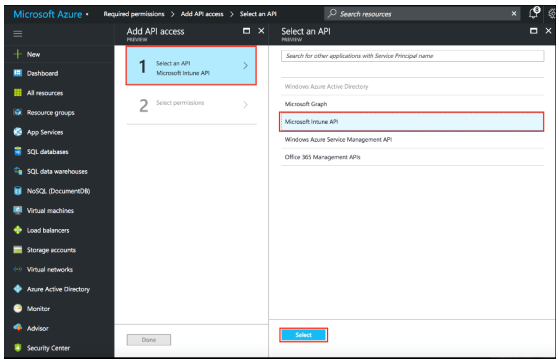
8. Click the application and select the required permissions and click **Add**.

Figure240: Adding Permissions



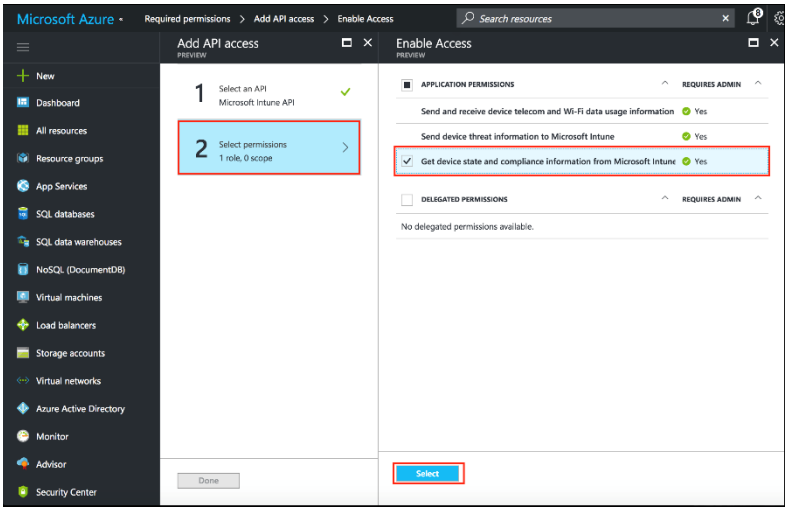
9. Click **Grant Permission**.
10. Select Microsoft Intune API.

Figure241: Setting Intune Permissions



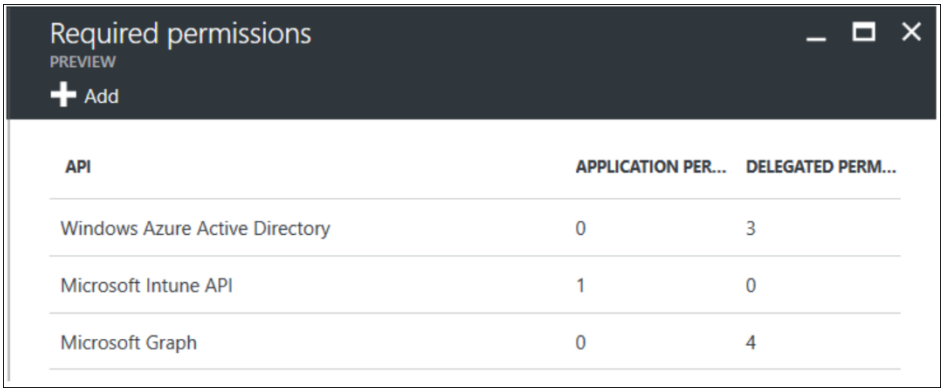
11. Under Application Permissions, select **Get device and compliance information from Microsoft Intune**.

Figure242: Setting Intune Permissions



12. (Optional) You must add the following delegated permissions for Microsoft Graph API.
    - Sign in and read user profile
    - Sign Users in
    - View users' email address
    - View users' basic profile
13. (Optional) Add the following delegated permissions for Azure Active Directory.
    - Sign in and read user profile
    - Read all users' basic profiles
    - Access the directory as the signed-in user.

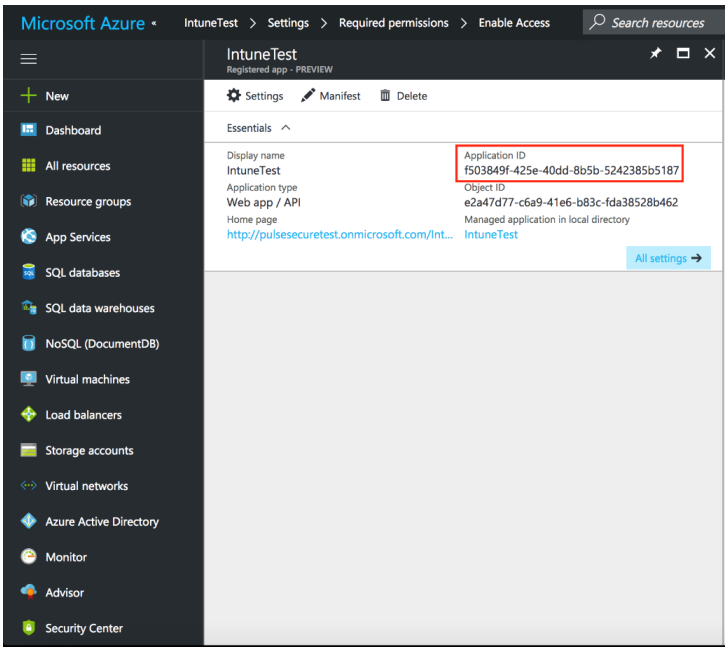
Figure243: Permissions



Viewing Client ID, Tenant ID, and Client Secret

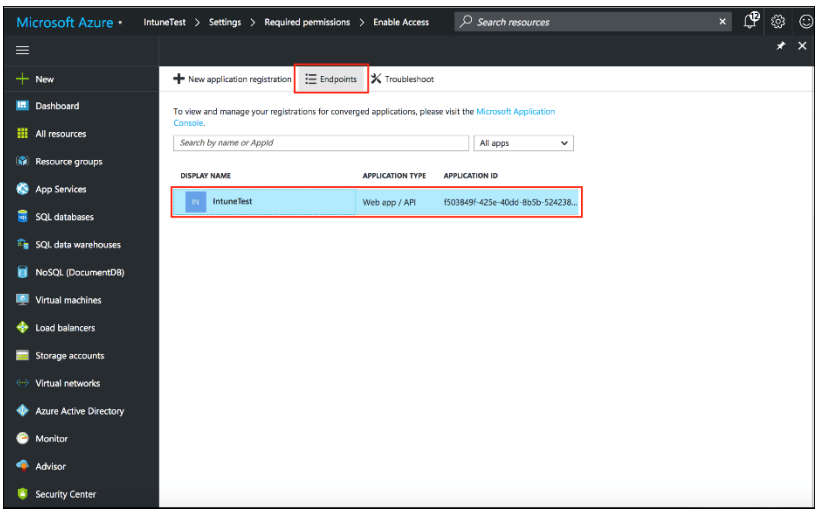
The Client ID/Application ID is created automatically once the AAD web application/API is created. You can view the client ID/application ID from the application properties page.

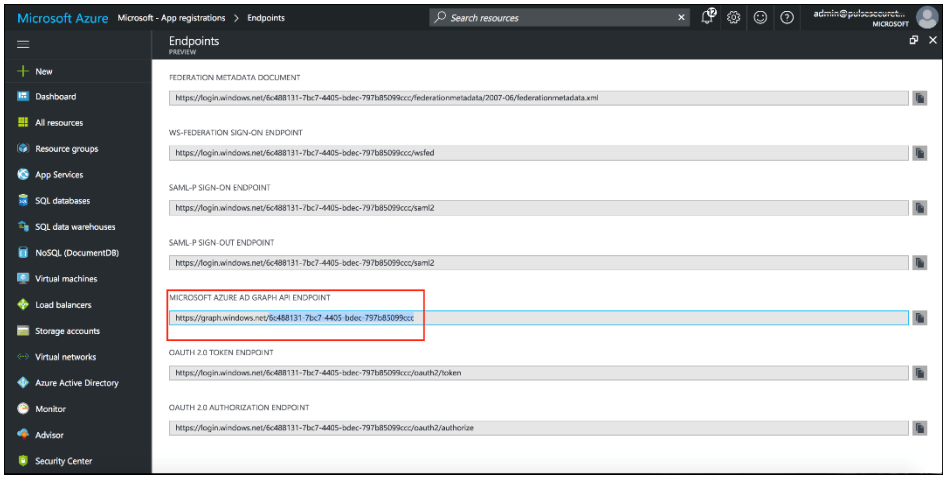
Figure244: Client ID/Application ID



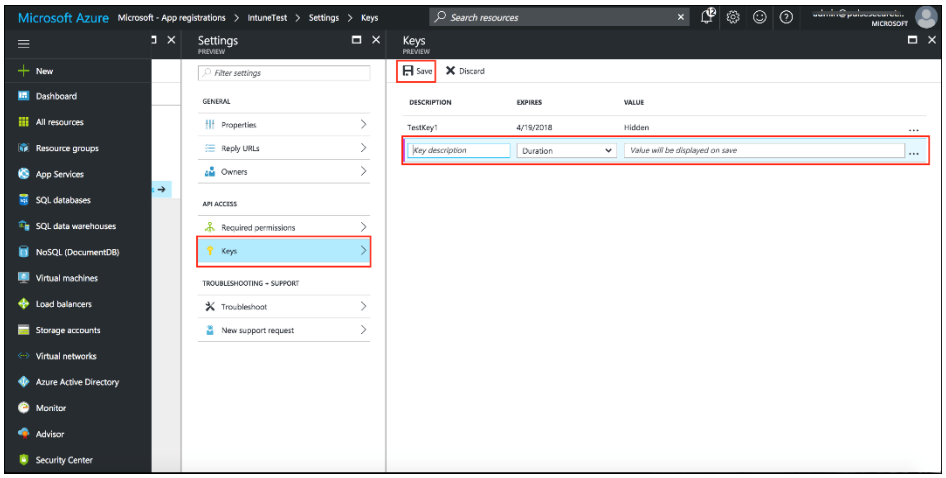
Every organization in Microsoft cloud is called tenant and it is organization specific. Each Tenant will be having a unique Tenant ID. Select the web application/API and click Endpoints tab and then you can copy the tenant ID.

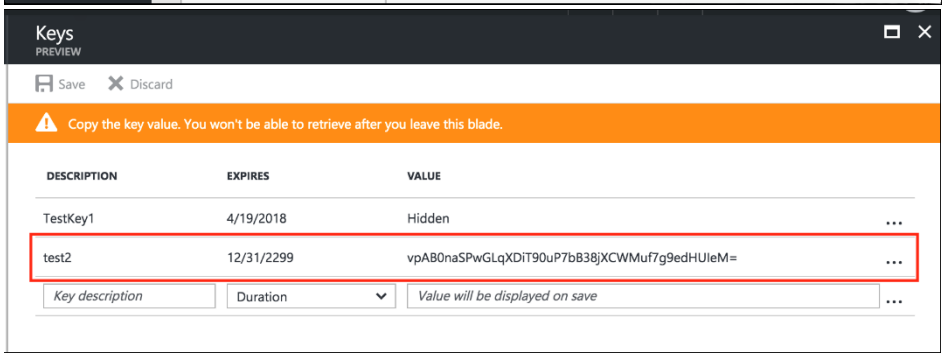
Figure245: Client ID/Application ID





To create the secret key, click the Web Application/API and then click Keys.





Configuring the PWS MDM

Pulse Workspace acts as the Mobile Device Management (MDM) Server for PPS solution. PPS users have to register their mobile devices with Pulse Workspace. As part of registration, the relevant Profiles get automatically provisioned to mobile device.

To configure the PWS MDM:

1. Enroll the devices in the MDM.
2. Create an enterprise WiFi profile. For more information, see Enterprise WiFi configuration.
3. Configure PPS with a role and realm for the user using the Certificate authentication server. PWS provides the user with a link to provision the created policy and then pushes the profile information. PPS does the role assignment and either allows or denies based on the device assessment. For more information, see Configuring PPS.

Configuring the AirWatch MDM

To configure the AirWatch MDM:

1. Enroll devices in the MDM using the methods supported by the MDM.
2. Create a profile with the following MDM management options:
    - Certificate template- Create a configuration that specifies the field and type of identifier for client device certificates.

      The MDM configuration templates provide flexibility in how the device identifier can be placed in the device certificate's subject or alternative subject. We recommend you include the user ID in the certificate, so the certificate can identify both the user and the device. For example:
        - CN=<EnrollmentUser>, serialNumber=<DeviceUid>, o=Company
    - Credential profile- Create a configuration that specifies the certificate authority and certificate template configuration.
    - Wi-Fi profile- Create a configuration that specifies the SSID, security options, and the credential configuration.
3. Save and deploy the profile to devices registered with your organization.
4. Enable API access and generate the AirWatch API key (tenant code).

The tenant code is part of the REST API configuration. The tenant code must be included in PPS MDM server configuration.

Figure246: AirWatch Certificate Template Configuration

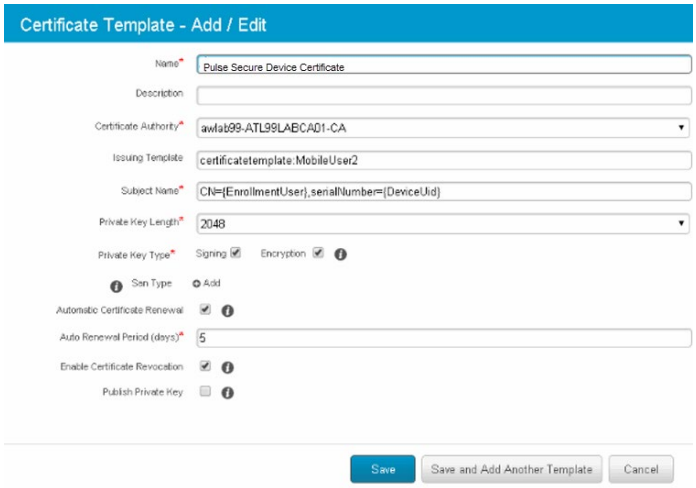


Figure247: AirWatch Credential Configuration

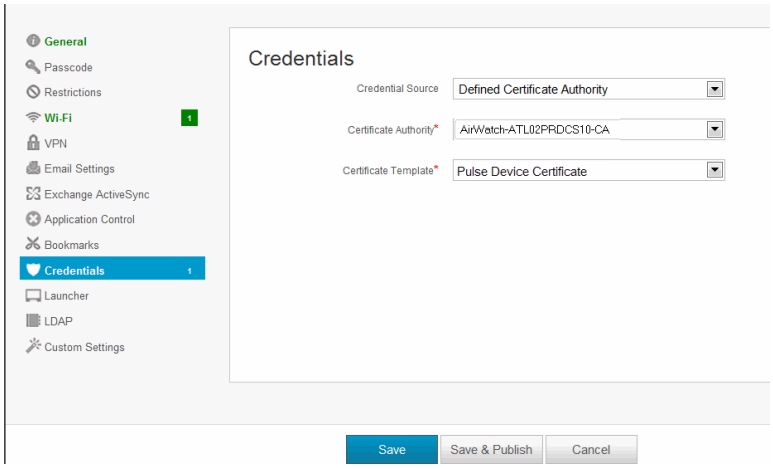


Figure248: AirWatch Wi-FI Configuration

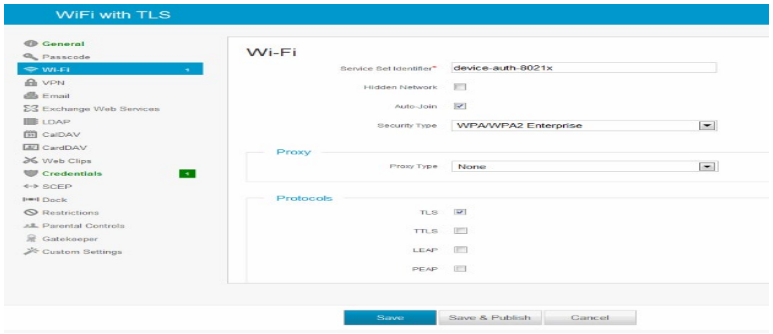


Figure249: Deploying a Profile to Your Organization's Managed Devices

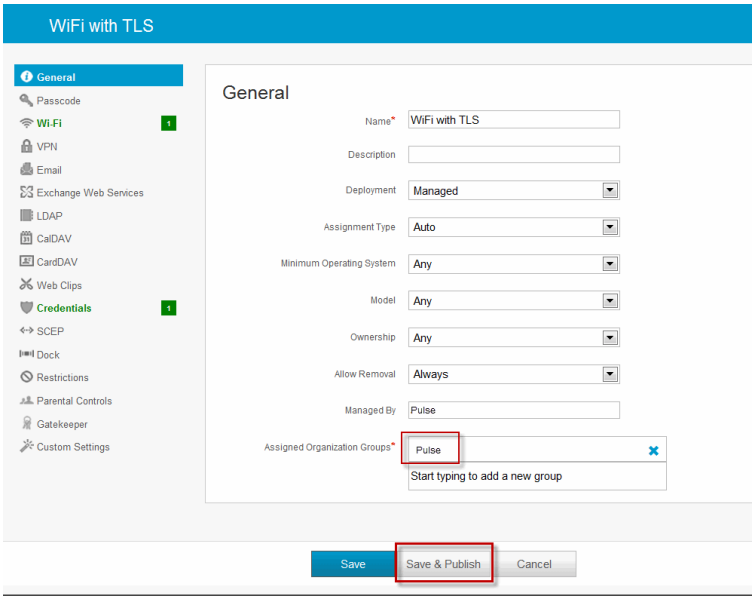
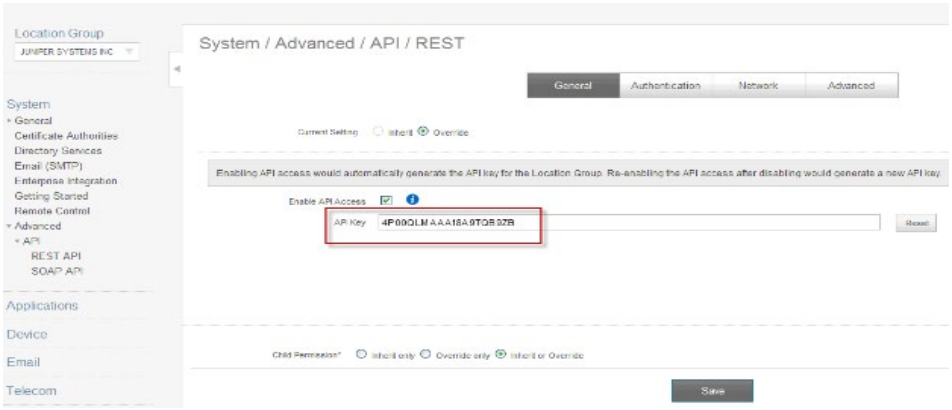


Figure250: AirWatch API Tenant Code Configuration



Configuring the MobileIron MDM

To configure the MobileIron MDM:

1. Enroll devices in the MDM using the methods supported by the MDM.
2. Create a Simple Certificate Enrollment Protocol (SCEP) configuration that specifies the field and type of identifier for client device certificates.

   The MDM configuration templates provide flexibility in how the device identifier can be placed in the device certificate's subject or alternative subject. We recommend you include the user ID in the certificate, so the certificate can identify both the user and the device. For example:

   CN=<DEVICE_UUID>, uid=<USER_ID>, o=Company
3. Create a Wi-Fi configuration that specifies the SSID and security options. During the enrollment process, this profile is provisioned to the device. Select the SCEP configuration completed in Step 2.
4. Select the Wi-Fi Profile configuration and apply it to a group label you have provisioned to manage this group of devices.

NOTE: Wi-Fi connect fails if it is configured to use a device certificate that is signed by an intermediate CA and selects this in Wi-Fi profile trusted CA. Root CA has to be selected to properly work.

5. Apply the group label to the devices when you add them to the MDM. If they have already been added to the MDM, use the edit configuration utilities in the device inventory page to apply the group label.

Figure251: MobileIron Wi-FI Configuration

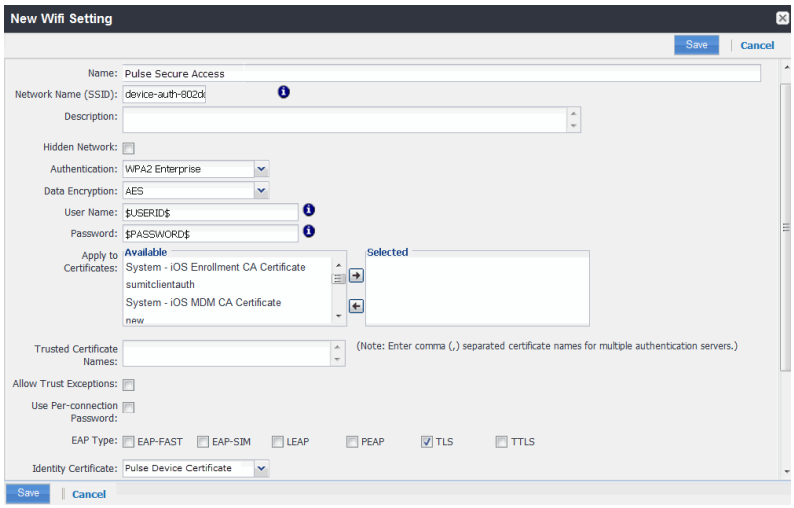


Figure252: Applying the Wi-Fi Configuration to a Label

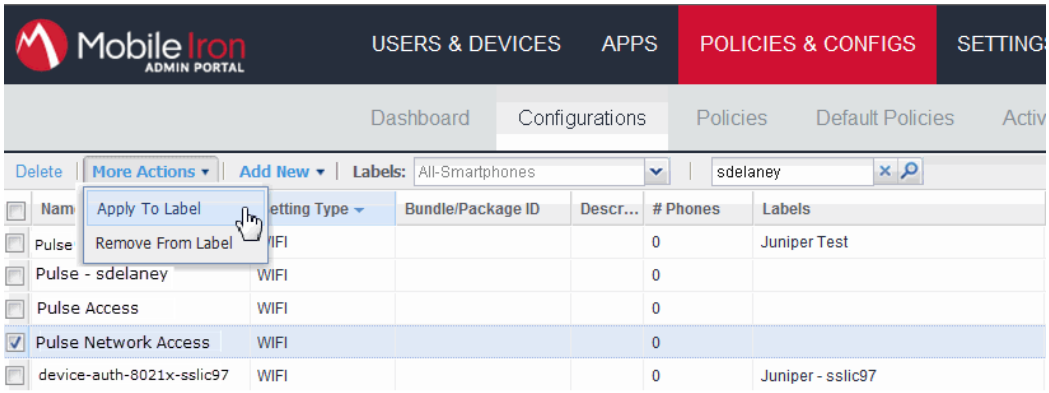
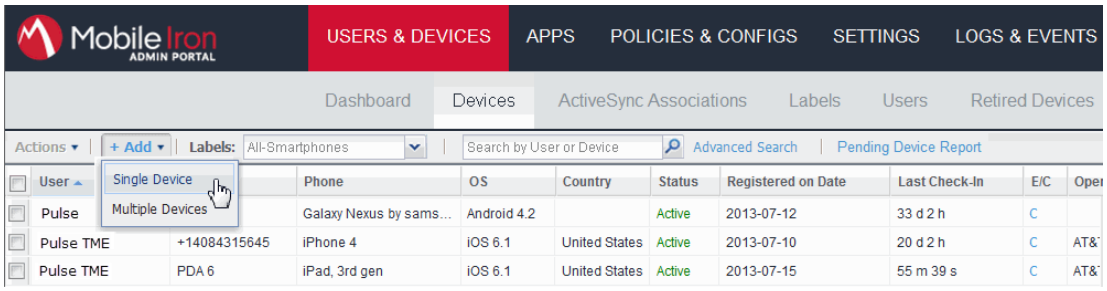


Figure253: Adding a Device to the MDM



Troubleshooting

During initial configuration, enable event logs for MDM API calls. You can use these logs to verify proper configuration. After you have verified proper configuration, you can disable logging for these events. Then, enable only for troubleshooting.

To enable logging for MDM API calls:

1. Select **System Log/Monitoring**.
2. Click the **Events** tab.
3. Click the **Settings** tab to display the configuration page.

After you have completed the MDM server configuration, you can view system event logs to verify that the polling is occurring.

To display the Events log:

1. Select **System Log/Monitoring**.
2. Click the **Events** tab.
3. Click the **Log** tab.

Next, to verify user access, you can attempt to connect to a wireless access point with your smart phone, and then view the user access logs.

To display the User Access log:

1. Select **System Log/Monitoring**.
2. Click the **User Access** tab.
3. Click the **Log** tab.

After you have verified proper configuration, you are not likely to need to tune the authentication server configuration, the 802.1x framework, or the enforcement points. However, based on user experience, MDM capabilities, and security threats, there are a few configuration elements you might want to tune from time to time.

The below table describes these configuration elements.

Table34: Tuning the Configuration

Configuration Element	Tuning
Remediation	In a network access control solution, noncompliant endpoints are typically placed in a remediation VLAN that serves a Web page. The Web page explains the steps users can take to make their endpoints compliant so that they can access the network. Your reasons for denying access might change from time to time. For example, your initial policy might be based on compliance with an MDM policy, and you can give steps on how to bring a device into compliance. You want to set an expectation on how long it takes for the MDM to reassess compliance. You might want to factor in PPS device check interval to estimate how long until the device can access the network. When there are new threats that exploit vulnerabilities in specific mobile platforms, you might create rules on the fly that deny access from specific platforms. If events like this occur, you might want to update your remediation message so that users can understand why access is denied.
Realm – Device Check Interval	You might want to tune this setting as you learn how frequently the MDM updates device records, or if the standard practice of the MDM changes. If the MDM records are updated every four hours, it does not make sense to poll every 10 minutes. If the MDM records are updated in real time, it might make sense to poll every 10 minutes.

Configuration Element	Tuning
Roles and role mapping rules	As you learn about mobile security threats and vulnerabilities, you might make changes to roles and role mapping rules or create new classifications. In general, you list restrictive rules first and set the stop flag. For example, if a device is noncompliant and maps to a noncompliant role, you would list it near the top of the rules for the realm and set the stop flag. Classification based on device type or platform can be more complicated. When you initially role out your BYOD solution, you might want to use roles to merely classify the devices, and so the rule classifying it would not need to be near the top of the list and would not need to have a stop flag. In response to a threat, however, you might want to use the role and role mapping configuration to deny access from a specific device platform. If events like this occur, you can edit your rules to map the vulnerable platform to an appropriate role and set the stop flag so that permissive roles are not assigned.
RADIUS return attribute policy	Likewise, in response to threats and vulnerabilities, you can edit your rules to place formerly trusted device types into a remediation or guest VLAN instead of an employee VLAN; and then allow access again when you are no longer concerned with the threat.
Infranet Enforcer resource access policy	Likewise, in response to threats and vulnerabilities, you can edit your rules to deny access from formerly trusted device types; and then allow access again when you are no longer concerned with the threat.

Using the Debug Logs

The Pulse Secure Global Support Center (PSGSC) might direct you to create a debug log to assist them in helping you debug an issue with the system. The debug log is used only by PSGSC.

To use debug logging:

1. Select **Troubleshooting > Monitoring > Debug Log** to display the configuration page. Complete the configuration as described in table below.
2. Click **Save Changes**. When you save changes with Debug Logging On selected, the system begins generating debug log entries.
3. Initiate the action you want to debug, such as a user sign in. You can reset the debug log file to restart debug logging if it takes you too long to initiate the action.
4. Click **Save Debug Log** to save the debug log to a file that you can send to PSGSC. You can clear the log after you have saved it to a file.
5. Clear the **Debug Logging On** check box and click **Save Changes** to turn off debug logging.

Table35: Debug Log Configuration Guidelines

Settings	Guidelines
Current Log Size	Displays the size of the current log file. If it is large, use the controls to save, reset, or clear the log file.
Debug Logging On	Select to turn on debug logging.
Debug Log Size	Specify a maximum debug logfile size. The default is 2 MB. The maximum is 250 MB.
Debug Log Detail Level	Specify the debug log detail level. Obtain this from PSGSC.
Include logs	Select this option to include system logs in the debug log file. Recommended.
Process Names	Specify the process name. Obtain this from PSGSC.
Event Codes	Specify the event code. Obtain this from PSGSC. For MDM integration issues, PSGSC typically likes to collect debugging information for codes **MDM**, **Auth**, **agentman**, and **Realm**. The text is not case sensitive.

AAA Servers

AAA Server Overview

This topic includes the following information:

Overview

AAA stands for authentication, authorization, and accounting. A AAA server is a database that stores user credentials—username and password—and, in some cases, group information or other user attributes. The authentication results and group or user attribute information are used Pulse Secure access management framework policy decisions.

In the Pulse Secure access management framework, the sign-in page, realm, and AAA server configurations are associated. They determine user access and user role. A user submits credentials through a sign-in page, which specifies a realm, which is associated with a AAA server. If the access request meets the realm's authentication policy, the system forwards the user's credentials to the associated authentication server. The authentication server's job is to verify the user's identity. After verifying the user, the authentication server sends approval. If the realm also uses the server as a directory/attribute server, the AAA server sends the user's group information or other user attribute information. The access

management framework then evaluates the realm's role-mapping rules to determine the user roles that apply to the session.

The Pulse Secure access management framework supports the following types of AAA servers:

- Local—You can create special purpose local databases to manually create user accounts, manage guest user access, permit anonymous access, or manage access based on digital certificates or MAC addresses.
- External (standards-based)—You can integrate standards-based LDAP and RADIUS servers with the access management framework. In addition to using the backend server for authentication, you can use LDAP group and RADIUS attribute information in role-mapping rules.
- External (other)—You can integrate compatible versions of popular third-party AAA servers with the access management framework. In addition to using the backend server for authentication, you can use Active Directory group information and SiteMinder attributes in role-mapping rules. In addition, you can use MDM device attributes in role mapping rules.

Table36 is a reference of the AAA servers supported in PPS deployments.

Table36: Supported AAA Servers

	PPS
Local	"Local Authentication Server"*, "Anonymous Server", "Certificate Server", "MAC Address Authentication Server" *Special features to manage guest users.
External (standards-based)	"LDAP Server", "RADIUS Server"
External (other)	"Active Directory", *MDM Server*, "NIS Server", "RSA ACE Server", "SiteMinder Server", "SQL Auth Server"

Authentication Protocols Used by AAA Servers

Policy Secure supports multiple authentication protocols. The following authentication servers require the protocols listed:

- Local authentication servers—If the passwords are stored as hashed values, the protocols available are PAP and MS-CHAP v1 with or without EAP. If the passwords are stored as clear text, CHAP and MD5-Challenge are also available.
- Active directory—The protocols available for inner authentication are PAP, MSCHAP and MS-CHAP v2, with or without EAP.
- LDAP—CHAP, EAP-MD5-Challenge, MS-CHAP v1, and MS-CHAP v2 protocols can be used with an LDAP authentication server only if the administration password is in clear text. By default, challenge response protocols are disabled for LDAP servers. Use these protocols only with noninteractive devices (for example, phones), as password management is not possible if these protocols are used for authentication.
- Anonymous authentication server—The anonymous authentication server is not supported with the open protocols.

AAA Traffic Management

From 9.0R3 release, the PPS Virtual appliances and the Pulse Secure Appliances allow the administrator to choose the communicating interface or the network for each authentication server.
This feature allows the AAA traffic across the following interfaces:

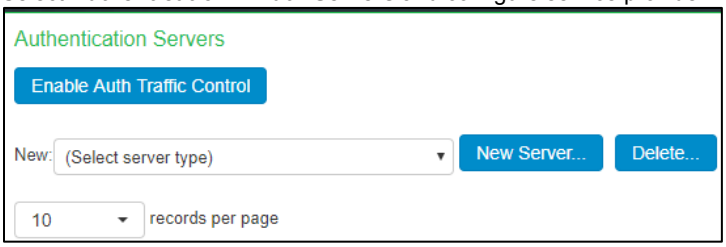
- Physical Internal
- Physical External
- Physical Management
- Virtual ports for Physical Interfaces
- VLAN ports
- Virtual Ports on VLAN Interfaces

This feature allows to connect to remote supported authentication servers through any interfaces based on the network Topology.
The following Authentication server types are supported:

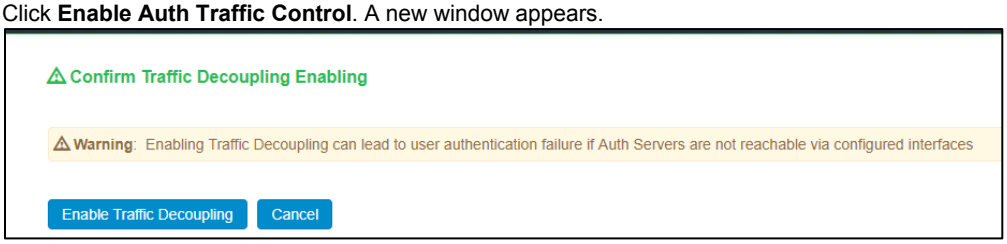
- LDAP
- Active Directory
- RADIUS
- SiteMinder

Configuring AAA Traffic Management Across Interfaces

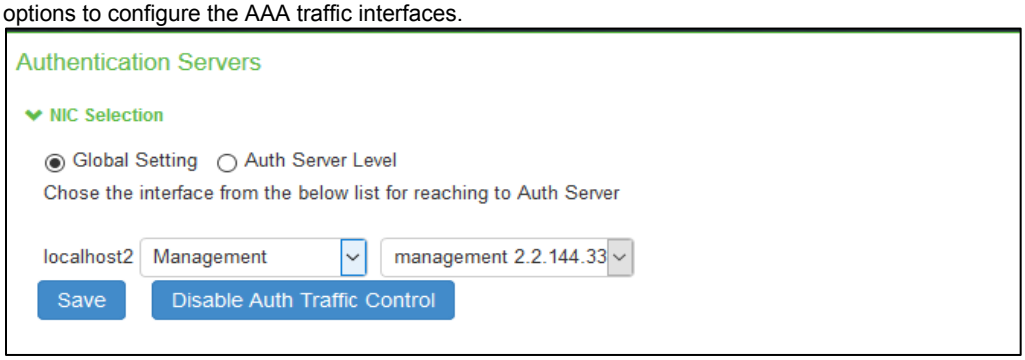
1. Select **Authentication** > **Auth Servers** and configure service provider AAA configurations as needed.



2. Click **Enable Auth Traffic Control**. A new window appears.



3. Click **Enable Traffic Decoupling** to confirm. The page navigates to the Auth server page that displays the options to configure the AAA traffic interfaces.



4. Select **Global setting** to use same interface across all supported authentication servers or select **Auth Server Level** to select the interface for a specific authentication server for the AAA traffic.

Figure: Global Setting

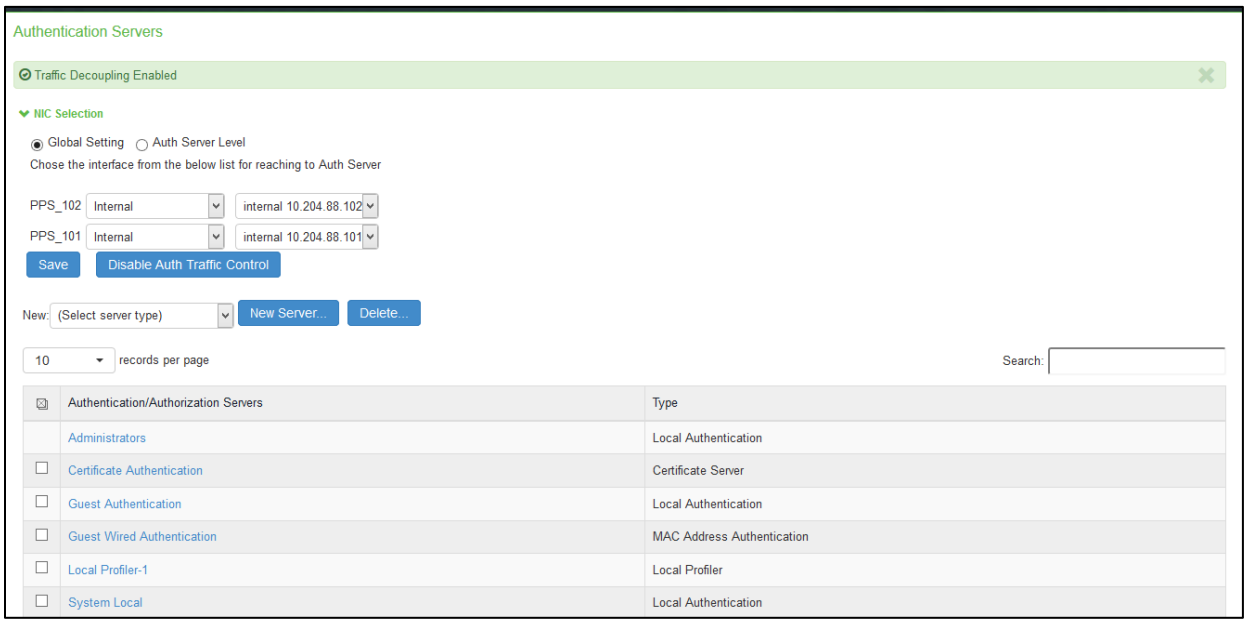
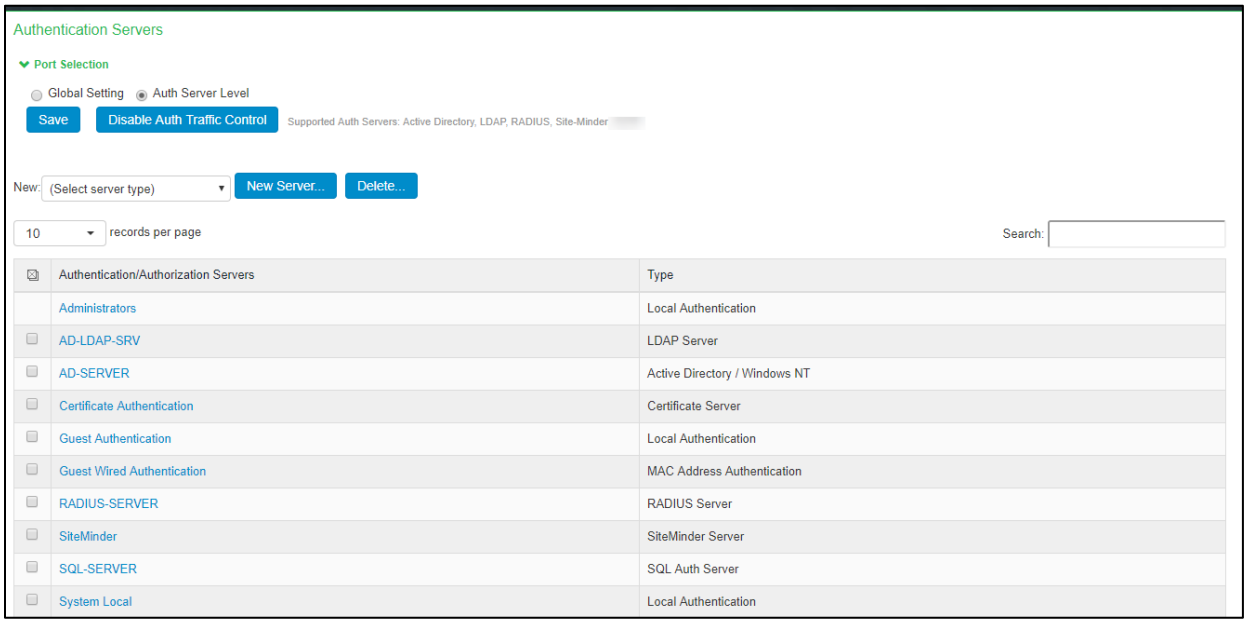
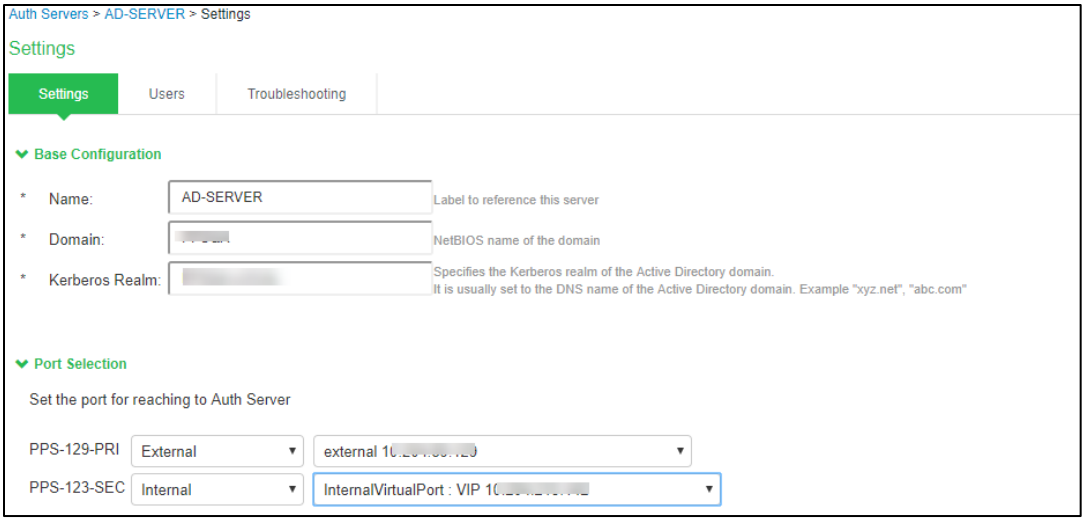


Figure: Auth Server Level Setting



5. Select the required interface and port from the list.
   For Clusters, select applicable interfaces and associated ports.



6. Click **Save**.

AAA Server Configuration Task Summary

To integrate an authentication server:

1. Configure the authentication server. Select Authentication > Auth. Servers page and complete the authentication server configuration.
2. Create an authentication realm. Select Users > User Realms or Administrators > Admin Realms and select the authentication server when you complete the authentication realm configuration.

Using the Local Authentication Server

This topic describes the local authentication server. It includes the following information:

- Local Authentication Server Overview
- Configuring the Local Authentication Server
- Creating User Accounts
- Managing User Accounts
- Creating Administrator User Accounts

Local Authentication Server Overview

The local authentication server is an authentication database that is built in to PPS. Therefore, it is considered a “local” server in contrast to a third-party enterprise AAA server that is connected over the network.

Typically, you create local user accounts for temporary users who do not have accounts on your enterprise AAA servers. Temporary users include lab users or guests, but you might find the local authentication server useful to create temporary accounts for users who are normally verified by an enterprise AAA server that you plan to disable.

You also use the local authentication server to create accounts for administrator users, such as system administrators and guest user access managers (GUAM).

NOTE: Although it is common practice to use the local authentication server for administrator accounts, it does not preclude you from using any of the supported third-party enterprise AAA servers in your administrator access management framework.

The following authentication protocol sets can be used with the local authentication server:

- By default, the system uses hashing to store passwords. When using the default, the protocols available are PAP and MS-CHAP v1 with or without EAP.
- You can enable an option to store passwords as clear text. If you enable this option, CHAP and MD5-Challenge are also available.

Configuring the Local Authentication Server

You can create multiple local authentication server instances. When you define a new local authentication server, you must give the server a unique name and configure options for passwords and guest users.

To create a local authentication server:

1. Select **Authentication > Auth. Servers**.
2. Select **Local Authentication** and click **New Server** to display the configuration page.

   The Local Authentication Server configuration page.
3. Complete the configuration as described below.
4. Save the configuration.

Figure254: Local Authentication Server Configuration Page

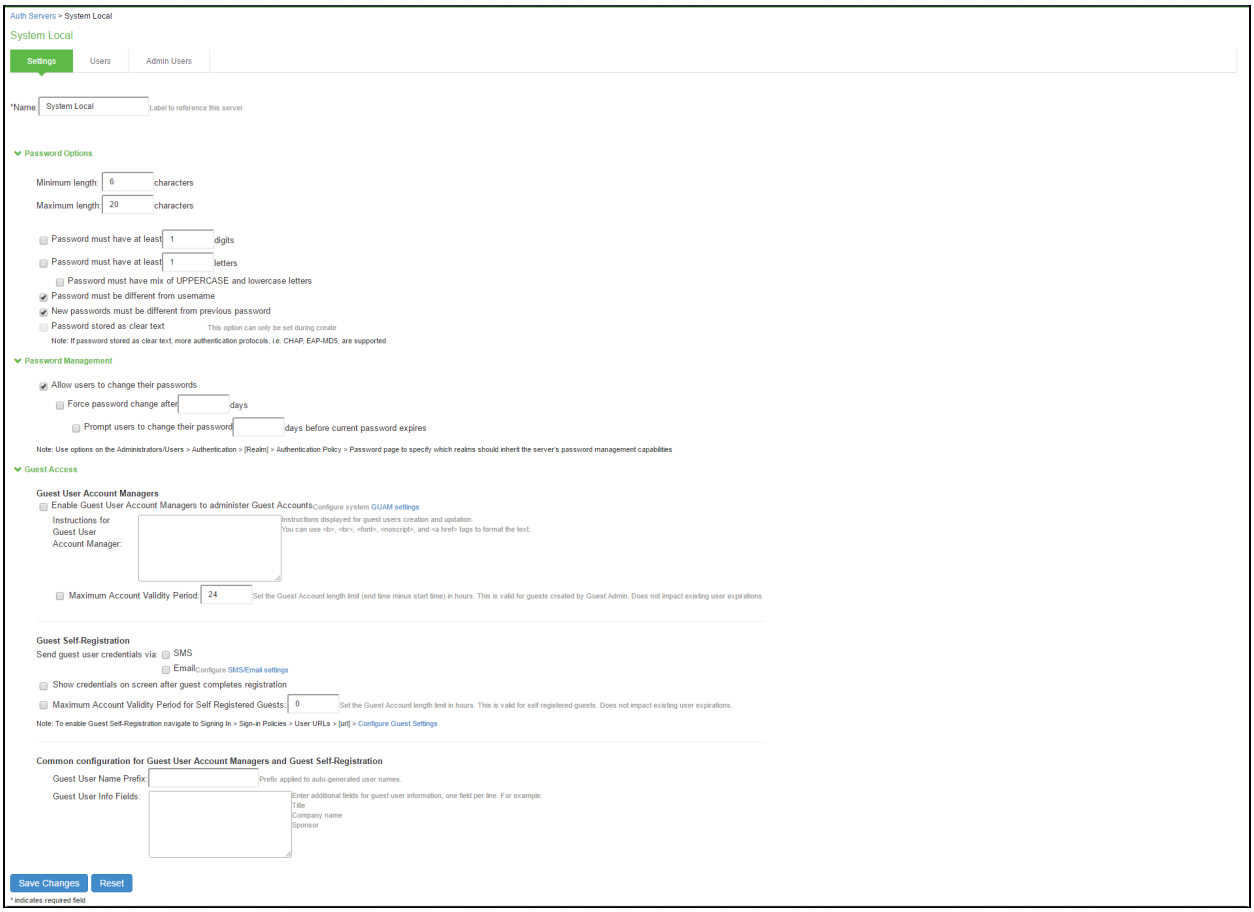


Table37: Local Authentication Server Settings

Settings	Guidelines
Name	Specify a name that is useful to you.
Password Options	
Minimum length	Specify a number of characters. The valid range is 0-99. 6 is the default.
Maximum length	Specify a number of characters. The valid range is 0-99. 8 is the default. The maximum length cannot be less than the minimum length.
Minimum digits	Specify the number of digits required in a password. Do not require more digits than the value of the maximum length option.
Minimum letters	Specify the number of letters required in a password. Do not require more letters than the value of the maximum length option. If you enable the previous option, the combined total of the two options cannot exceed that of the value specified in the maximum length option.
Uppercase and lowercase required	Select this option if you want all passwords to contain a mixture of uppercase and lowercase letters. NOTE: Require passwords to contain at least two letters if you also require a mix of uppercase and lowercase letters.
Different from username	Select this option if the password cannot equal the username.
Different from previous password	Select this option if a new password cannot equal the previous password.

Settings	Guidelines
Stored as clear text	Select this option if you are using open authentication protocol sets. CHAP and EAP-MD5-Challenge work with local authentication servers only if you select this option. NOTE: Be aware of the security implications of storing passwords as clear text.
Password Management	
Allow users to change passwords	Select this option if you want users to be able to change their passwords. NOTE: In addition to selecting local authentication password management options, you must select the **Enable Password Management** option for the associated realm authentication policy.
Force password change	Select this option to specify the number of days after which a password expires. The default is 64 days.
Prompt users to change password	Select this option to specify when to prompt the user to change passwords.
Guest Access Configurations	
Enable Guest User Account Managers	Select this option to allow guest user account managers to create guest user accounts on the local authentication server. In some businesses, you might want to delegate responsibility for temporary or guest users to a guest user access manager (GUAM) who can use the local authentication server to provision accounts for guests.
Guest User Name Prefix	Specify the prefix to be used in auto generated guest usernames. We recommend you retain the default **guest_** so that you can rely on the naming convention in your role mapping rules.
Guest User Info Fields	(Optional) Add line items to represent fields that you want to appear on the configuration page for creating guest user accounts. For example, you can create fields for Company Name, Host Person, Meal Preference, and so on.
Instructions for Guest User Account Manager	(Optional) Add instructions to the GUAM that appear on the GUAM sign-in page. You can use the following HTML tags to format the text: <b>, , <font>, <noscript>, and <a href>.
Maximum Account Validity Period	Specify the number of hours the account is valid. The default is 12 hours.

Creating User Accounts

You use the Users page to create local authentication server user accounts. A user account includes a username and password to be used for authentication, as well as other information used for records and account management.

To create a local user account:

1. Select Authentication > Auth. Servers.
2. Select the local authentication server to which you want to add a user account.
3. Click the Users tab.
4. Click New to display the configuration page.
5. Complete the configuration as described below.
6. Save the configuration.

Figure255: User Account Configuration Page

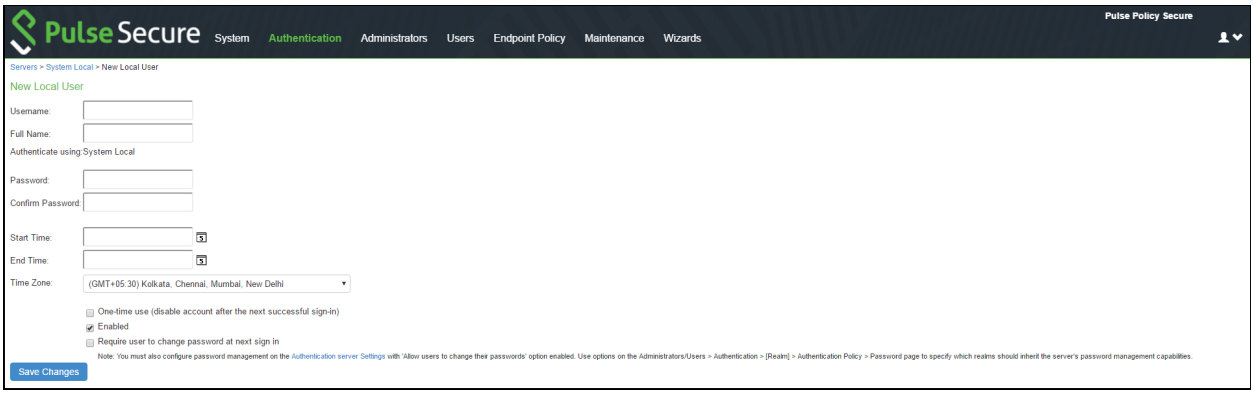


Table38: User Account Configuration Settings

Settings	Guidelines
Username	Do not include "~~" in a username. NOTE: You cannot change a username after you create the account.
Full Name	Specify the user's full name.
Password	Specify a password. Make sure that the password you enter conforms to the password options specified on the local authentication server configuration page.
Confirm password	Confirm the password.
Start Time End Time	(Optional) Specify a start and end time for the account. The system process that deletes expired user accounts runs every 10 minutes. There might be a delay of some minutes before the account is purged. Even if the system time or date is moved ahead past the expiration time, the account could still be valid until the purge process runs. One-time user accounts are not deleted by the purge process; they are deleted immediately after the user exits.
Company Name	(Optional) Specify the company with which the user is associated.
Host or Sponsor	(Optional) Specify the host or sponsor—for example, the person at your company who requested that you create the account.
One-time use	Select this option to limit the user to one log in. After one successful log in, the user's log in state is set to disabled, and the user receives an error message when attempting subsequent sign-ins. However, you can manually reset this option to allow the same user to log in again. If you do not select this option, the user account is subject to the specified start and end time for the account.
Enabled	Select this check box if it is not already selected. If the one-time use option has been implemented, this option is listed as **Disabled** after the user has logged in successfully. If a permanent or one-time user is logged in and you disable this option, the user is immediately logged out of the system and receives an error message.
Require user to change password	Select this option to force users to change their passwords at the next log in. NOTE: If you force the user to change passwords, you must also enable the local authentication password management options.

Managing User Accounts

You use the Users page to list, modify, and delete local authentication server user accounts.

To manage a user account:

1. Select Authentication > Auth. Servers.
2. Click the link for the authentication server you want to manage.
3. Click the **Users** tab to display the user accounts table.

The user accounts table includes entries for the accounts that have been created. The Last Sign-in Statistic column shows the last successful sign-in date and time for each user, the user's IP address, and the agent or browser type and version.

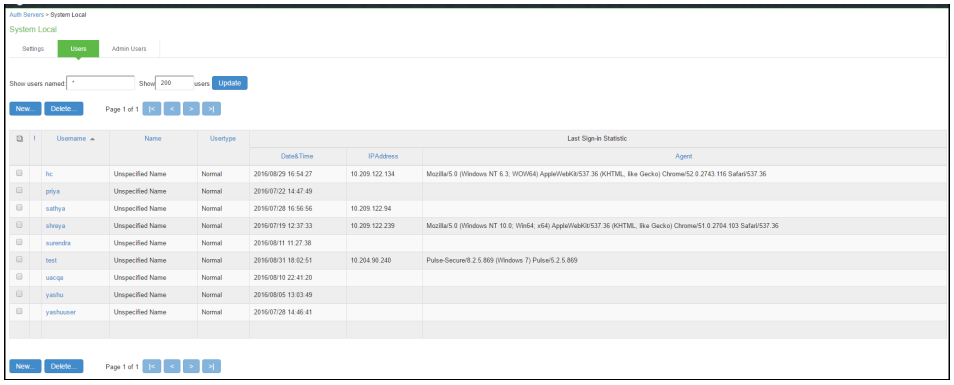
4. Use the controls to search for users and manage user accounts:

- To search for a specific user, enter a username in the Show users named box and click **Update**.

TIP: You can use an asterisk (*) as a wildcard, where * represents any number of zero or more characters. For example, to search for all usernames that contain the letters jo, enter ***jo***. The search is case-sensitive. To display the entire list of accounts again, type * or delete the field's contents and click **Update**.

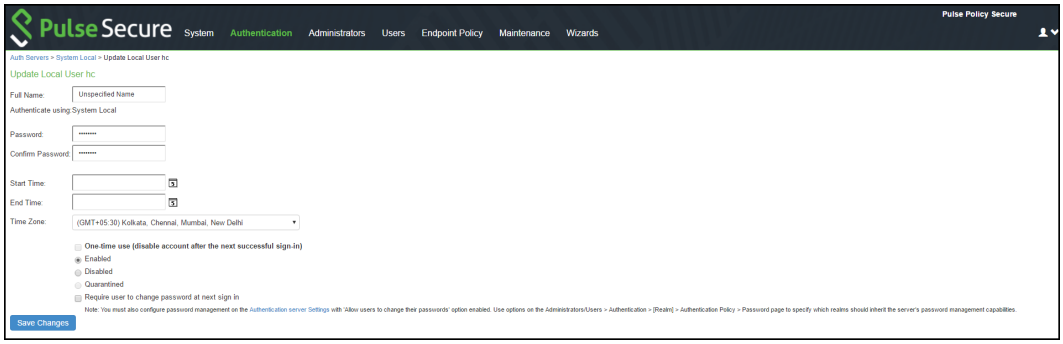
- To limit the number of users displayed on the page, enter a number in the Show *N* users box and click **Update**.
- To edit the user account configuration, click the link in the Username column to display the Update Local User Account page.
- To terminate the user session and delete the account, select the box next to the user account record and click **Delete**.

Figure256: User Accounts Table



The below figure shows the user account configuration page. You can use this page to modify the account settings, or to disable or quarantine the account.

Figure257: Update User Account Configuration Page



Creating Administrator User Accounts

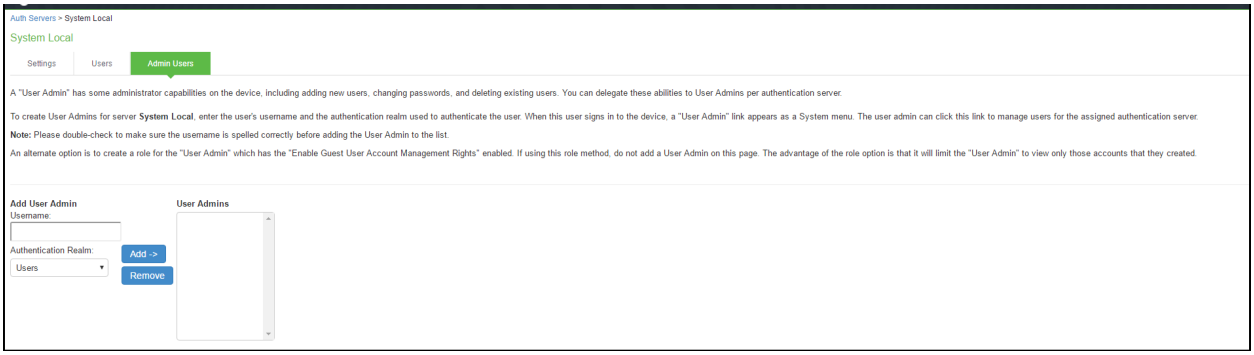
You use the Admin Users page to create accounts for local authentication server administrators. An administrator user can create, modify, and delete user accounts.

The admin users you create on the Admin Users page can view and manage all users that have been added to the local authentication server. In contrast, admin users you create by assigning the GUAM role capability can view and manage only the user accounts they created.

To create an administrator user account:

1. Select **Authentication > Auth. Servers**.
2. Click the link for the Guest Authentication Server you want to manage.
3. Click the Admin Users tab to display the configuration page.
4. Specify a username, select an authentication realm, and click Add to create the administrator user.
5. Save the configuration.

Figure258: Admin Users Configuration Page



Using Active Directory

This topic describes integration with the Microsoft® Windows® platform Active Directory™ service. It includes the following information:

- Microsoft Windows Platform Active Directory Service Overview
- Configuring Authentication and Authorization with Active Directory Service (Standard Mode)
- Displaying the User Accounts Table

Microsoft Windows Platform Active Directory Service Overview

This section describes support for using PPS with the Active Directory AAA service. It includes the following sections:

- Understanding Active Directory
- Active Directory Feature Support
- Interoperability Requirements and Limitations

Understanding Active Directory

Active Directory is a directory service used in Windows domain networks. It is included in most Windows server operating systems. Enterprise servers that run Active Directory are called domain controllers. An Active Directory domain controller authenticates and authorizes users and computers in a Windows domain network.

When you use Active Directory as the authentication and authorization service for your Pulse Secure access management framework, users can sign in to PPS using the same username and password they use to access their Windows desktops. You can also use Active Directory group information in role mapping rules.

NOTE:

From 9.1R1 onwards, Active Directory Legacy Mode configuration will not be supported. If you have an existing Active Directory authentication server using Legacy Mode, first migrate to Standard Mode and then upgrade PPS. For the detailed migration procedure, refer KB40430.

Active Directory Feature Support

Pulse Secure access management framework supports the following Active Directory features:

- Honors trust relationships in Active Directory and Windows NT environments.
- Supports Domain Local Groups, Domain Global Groups, and Universal Groups defined in the Active Directory forest.
- Supports use of Kerberos, NTLMv2, and NTMLv1 authentication protocols.
- Supports user principal name (UPN) format for usernames. This support is available for Web log in, PPS at Layer 3, and EAP-MS-CHAP v2.

Interoperability Requirements and Limitations

The following limitations apply to interoperability with Active Directory:

- The Pulse Secure access management framework uses Active Directory security groups, not distribution groups. Security groups allow you to use one type of group for not only assigning rights and permissions, but also as a distribution list for e-mail.
- Each Active Directory configuration you create for the Pulse Secure access management framework should use a different and unique machine account name.
- If the current Active Directory domain controller is not reachable, the user or machine authentication requests fail for a few seconds (less than 2 minutes) before attempting to authenticate users with another domain controller in the Active Directory domain.
- We do not support interoperation with Active Directory implementations that use the equal sign operator (=) in a group name, such as: "\=THIRD FLOOR GROUP". The Pulse Secure access management framework authentication process involves search operations that use the equal sign operator (=) when parsing server catalogs to retrieve group names, usernames and domain names, as well as user_SID and domain_SID values. You might encounter unexpected behavior that can affect normal processing of authentication services if a group name configured on your Active Directory server includes an equal sign operator (=).
- Active Directory versions Windows 2008, Windows 2018 R2 and later use a dynamic port range. The default start port is 49152 and the default end port is 65535. Therefore, if there is a firewall between the Pulse Secure service and the Active Directory Service, you must increase the remote procedure call (RPC) port range on the firewall. See .Microsoft Knowledge Base article 929851.
- The Pulse Secure password management feature, which enables users to change their Active Directory passwords through the Pulse Secure service Web server, is not supported for users of trusted domains that do not trust the domain specified in the Pulse Secure Active Directory configuration.
- UPN format for user log in is not supported for MS-CHAP v2.

Understanding the Active Directory Standard Configuration

Active Directory standard configuration supports interoperability with any version of Active Directory, and is the required configuration mode to support authentication using MS-CHAP v2 with Windows 2008 R2 Active Directory Service. Machine authentication, for example, uses MS-CHAP v2.

Configuring Authentication and Authorization with Active Directory Service (Standard Mode)

To configure integration with Active Directory Service (standard mode):

1. Select **Authentication > Auth. Servers**
2. Select **Active Directory / Windows NT** and click **New Server** to display the configuration page.
3. Select **Active Directory** mode and complete the configuration as described in Table39.
4. Save the configuration.

Table39: Active Directory Mode Settings

Settings	Guidelines
Mode	
	Select one of the following modes: **Active Directory**—For recent versions of Windows Server. This table describes Active Directory mode.
Base Configuration	
Name	Specify a name to identify the server within the system.
Domain	Specify the NetBIOS domain name for the Active Directory domain. The system uses DNS to discover domain controllers in the Active Directory forest. It sends authentication requests to the domain controller at the closest site. Ensure that your DNS servers are configured to resolve the Active Directory domain controller fully qualified domain name (FQDN) and service (SRV) records.
Kerberos Realm	Specify the FQDN of the Active Directory domain. For example, if “pulsesecure” is the domain name (NetBIOS name), then pulsesecure.net is the Kerberos realm name.
Domain Join Configuration	
Username	Specify a username that has permission to join computers to the Active Directory domain. Use the “Delegate Control” workflow in Active Directory to assign the following user account permissions to the username or to a group to which the user belongs: • Write • Write All Properties • Change Password • Reset Password • Validate Write to DNS hostname • Read and write DNS host attributes • Delete Computer Objects • Create Computer Objects
Password	Specify the password for the special user.
Save Credentials	If this setting is not enabled, the credentials entered will be destroyed after successfully joining the domain. This option is useful when managing clusters. For example, you might want to save the credentials for a cluster node you have yet to add. If you do not enable this option, you must manually enter the credentials when you add the new cluster node.

Settings	Guidelines
Container Name	Specify the container path in Active Directory in which to create the machine account. Changing this field triggers a domain rejoin action. The default is **Computers**, which is a standard container created during installation of the AD server. The AD Computers container is the default location for new computer accounts created in the domain. If desired, you may specify a different container or OU. To specify nested containers, use a forward slash (**/**) as the container separator. For example: **outer OU/inner OU**. NOTE: Do not use backslashes in the path. Using backslashes causes an Invalid DN Syntax error.
Computer Name	Specify the machine account name. The default computer name is derived from the license hardware in the following format: 0161MT2L00K2C0. We recommend the Computer Name string contain no more than 14 characters to avoid potential issues with the AD/NT server. Do not include the '$' character.
Update Join Status / Reset Join	The following colors are used to indicate status: Gray. The Domain Join action has not been attempted. This is the default status that appears when you are using the page to create a new Active Directory configuration. Yellow. Attempting to join the Active Directory domain. This is the default status that appears after saving configuration settings or when any domain join settings are changed in an existing configuration. Green. The attempt was successful. This status indicates that this server can now be used to authenticate users. Red. The attempt to join the Active Directory domain was not successful. Click **Update Join** to get the latest join status of nodes. If the status appears persistently red, click **Reset Join** to reinitiate the domain join process. The Reset Join action requires Active Directory administrator credentials. NOTE: For cluster nodes, you might need to click Update Join multiple times to obtain the latest join status of nodes. Transient network issues might also cause the join status indicator to appear red. Before reinitiating the join process, ensure that it is not caused by network issues. Make sure your DNS servers can resolve queries to the Active Directory domain controller and that the Active Directory credentials are valid and have the appropriate permissions.
Additional Options	
Authentication Protocol	The system attempts authentication using the protocols you have enabled in the order shown on the configuration page. For example, if you have selected the check boxes for Kerberos and NTLMv2, the system sends the credentials to Kerberos. If Kerberos succeeds, the system does not send the credentials to NTLMv2. If Kerberos is not supported or fails, the system uses NTLMv2 as the next protocol in order.
	Kerberos. Select this option to enable the Kerberos authentication protocol. Kerberos is the most secure method and is required for Kerberos single sign-on authentication. Kerberos must be enabled if you plan to use Pulse Secure single sign-on or browser-based agentless single sign-on (SPNEGO).
	Enable NTLM protocol. Select this option to enable NTLM if you plan to use any of the following features: Machine authentication using Pulse Secure client, or Windows native 802.1x supplicants. MS-CHAP-based authentication protocols for any 802.1x supplicants. User password management. Role mapping rules based on group membership. If you enable NTLM, select one of the following versions: **NTLMv2**. This protocol is moderately secure. It is required for machine authentication and MS-CHAP v2 based 802.1x authentication protocols. **NTLMv1**. This protocol is comparatively less secure. It might be required for compatibility with existing legacy servers, MS-CHAP based servers, and MS-CHAP based 802.1x authentication protocols.

Settings	Guidelines
Trusts	**Contact trusted domains**. Select this option to contact domain controllers of trusted domains directly without proxying authentication requests and group membership checks through the domain controller. If this option is not selected: Network contact with trusted domains is not permitted, but pass-through authentication using the primary domain is still permitted. Trusted domain user's group lookup for Kerberos SSO and SPNEGO authentication does not work even though user authentication succeeds. Trusted domain user's password-based authentication does not work. Only groups from the domain in which this system is a member are available for use in role mapping when a group search is performed in the server catalog window. NOTE: If you want to restrict trusted domain users and computers (machine authentication) from logging in when this option is not selected, you can define a custom expression based on the ntdomain variable and use it in role mapping rules. For example, if PPS belongs to the domain named Corporate, you can define a custom expression as **ntdomain=Corporate** and use the custom expression in the role mapping rule of the realm.
SPNEGO Single Sign On	**Enable SPNEGO**. Select this option to support SPNEGO SSO. **Keytab Upload**. Select this option to use the controls to upload the SPNEGO keytab. The keytab must be generated on the Active Directory Service for the SPN. It must match the FQDN used to access this device.
Machine account password change	**Enable periodic password change of machine account**. Select this option to change the domain machine account password for this configuration. **Change machine password** frequency. Specify a frequency in days. For example, every 30 days.
Logical Auth Server Name	Specify a logical authentication server name.

NOTE:

You can troubleshoot the configurations using the Troubleshooting Tab for the respective server. You will be able to view this option on configuring the respective server. Using the troubleshooting option, you can validate:

- Domian Joint Status
- Authentication sucess status
- DNS Look-up for the respective servers
- Authentication Statistics

Using Kerberos SSO

This topic includes the following information:

- Kerberos SSO Support Overview
- Requirements and Limitations
- Enabling Kerberos SSO

Kerberos SSO Support Overview

Kerberos single sign-on (SSO) is a method of access control that allows a user to log in once to the client desktop without being prompted again for credentials.

The Kerberos SSO feature uses Kerberos authentication to automatically sign in users with the same credentials they used to access their Windows desktops. After you configure Kerberos SSO, the sign-in dialog box does not appear to users.

Requirements and Limitations

The following requirements and limitations apply to the Kerberos SSO implementation:

- The SSO feature requires a Windows NT Primary Domain Controller (PDC) or Active Directory for user authentication.
- The Kerberos SSO feature is not supported on Windows NT Server 4.0 or earlier.
- The clocks on PPS and the Windows Active Directory authentication server must be synchronized to within 2 minutes of each other.
- The Active Directory controller must be deployed in front of PPS.
- The Windows endpoint computers must be joined to the same domain that PPS uses for authentication. Alternatively, make sure the Windows endpoint computers are joined to a domain that has a trust relationship with the domain that PPS uses for authentication.
- Users must sign into their endpoint computers in the domain of the Windows Active Directory authentication server or in a trusted domain.
- The realm Enable SSO option is visible only if the Windows Active Directory authentication server is used for authenticating users of the selected realm.

Enabling Kerberos SSO

To enable Kerberos SSO:

1. Select **Authentication > Auth. Servers**.
2. Select **New Active Directory / Windows NT** and click **New**.
3. Complete the configuration. Enable the Kerberos authentication protocol option.
4. Configure the realm:
    - Select Administrators > Admin Realms or Users > User Realms. Specify the realm that must use the Active Directory server to authenticate and authorize administrators and users.
    - Select **Administrators > Admin Realms > Select Realm > Authentication Policy > SSO** to ensure that the **Enable SSO** option is enabled (the default).

Understanding Multidomain User Authentication

This topic provides an overview of multi domain user authentication with Active Directory and Windows NT. It includes the following information:

- Multi-Domain User Authentication Overview
- Windows NT User Normalization
- Kerberos Support
- Windows NT4 Support

Multi-Domain User Authentication Overview

The Pulse Secure access management framework allows for multidomain Active Directory and Windows NT authentication. The system authenticates users in the domain that you configure, users in child domains, and users in all domains trusted by the configured domain.

Users in the default domain can sign into the system using just their username, or the default domain and the username in the format default-domain\username.

When you enable trusted domain authentication, users in trusted or child domains can sign in using the name of the trusted or child domain and the username in the format trusted-domain\username. Note that enabling trusted domain authentication adds to the server response time.

Windows NT User Normalization

To support multidomain authentication, the Pulse Secure access management framework uses “normalized” Windows NT credentials when it contacts an Active Directory or Windows NT4 domain controller for authentication. Normalized Windows NT credentials include both the domain name and the username: domain\username. Regardless of how the user signs in (either using just a username or using the domain\username format), the access management framework always processes the username in domain\username format.

When a user signs in using only their username, the access management framework normalizes their Windows NT credentials as default-domain\username. Authentication succeeds only if the user is a member of the default domain.

When a user signs in using the domain\username format, the access management framework attempts to authenticate the user as a member of the domain the user specifies. Authentication succeeds only if the user-specified domain is a trusted or child domain of the default domain. If the user specifies an invalid or untrusted domain, authentication fails.

Two variables, <NTUser> and <NTDomain>, allow you to individually refer to Windows NT domain and username values. The system populates these two variables with the Windows NT domain and username information.

In role mapping rules, when you specify **USER = someusername**, the system treats this rule semantically as **NTUser = someusername AND NTDomain = defaultdomain**.

Kerberos Support

We recommend you configure the Pulse Secure access management framework to use the Kerberos authentication protocol with Windows domain controllers. When a user logs in to the system, the system performs Kerberos authentication and attempts to fetch the Kerberos realm name for the domain controller, as well as all child and trusted realms, using LDAP calls.

You can use Kerberos differently. You can specify the Kerberos realm name when configuring an Active Directory authentication server. We do not recommend this method for two reasons:

- You cannot specify more than one realm name. The system cannot then authenticate against child or trusted realms of the realm you specify.
- If you misspell the realm name, the system cannot authenticate users against the proper realm.

Windows NT4 Support

The Pulse Secure access management framework does not support Kerberos-based authentication in Windows NT4 domain controllers. The system uses NTLM with a backend Windows NT4 domain controller.

Understanding Active Directory and Windows NT Group Information Support

This topic describes support for polling group information from Active Directory and Windows NT servers. It includes the following information:

- Active Directory Group Information Overview
- Windows NT4 Group Information Overview

Active Directory Group Information Overview

The Pulse Secure access management framework supports user group lookup in Domain Local, Domain Global, and Universal groups in the default domain, child domains, and all trusted domains. The system obtains group membership using one of three methods that have different capabilities:

- Group information in User's Security Context—Returns information about the user's Domain Global groups.
- Group information obtained using LDAP search calls—Returns information about the user's Domain Global groups and about the user's Universal groups if the access management framework queries the Global Catalog Server.
- Group information using native RPC calls—Returns information about the user's Domain Local Group.

  With respect to role-mapping rules, the system attempts group lookup in the following order:

- Checks for all Domain Global groups using the user's security context.
- Performs an LDAP query to determine the user's group membership.
- Performs an RPC lookup to determine the user's Domain Local group membership.

Windows NT4 Group Information Overview

The Pulse Secure access management framework supports group lookup in the Domain Local and Domain Global groups created in the default domain, as well as all child and other trusted domains. The system obtains group membership using:

- Domain Global group information from the user's security context.
- Domain Local information using RPC calls.

In the Windows NT4 environment, the system does not use LDAP-based search calls.

Importing and Exporting an Active Directory Mode Configuration

You can use the Maintenance > Import/Export > Import/Export users page to copy an Active Directory mode configuration from one system to another. If Active Directory credentials for joining a domain are not stored in the exported configuration, you must update the configuration to specify them.

NOTE: Push configuration is not supported for Active Directory mode configurations.

XML Import/Export for the Active Directory mode configuration has limitations. An XML exported Active Directory configuration (standalone/cluster) can be imported to the same system from which it is exported. However, an XML exported Active Directory configuration from a standalone configuration cannot be imported into a cluster configuration. Similarly, an XML exported Active Directory configuration from a cluster cannot be imported into a standalone configuration.

It is not recommended that you import a configuration into a different system than the one from which the configuration was exported. Although the import operation will be successful, the importing system will join the AD domain with the same computer name as the exporting system. When this occurs, the Active Directory disconnects the earlier join from the exporting system.

To work around this, modify the value of the **computer-name** parameter in the XML file to be unique and then import it to another system. In cluster configurations, in addition to modifying the **computer-name** parameter, also modify the **node** parameter for each cluster member to match with the importing cluster node names.

Here are the parameters you must change before importing the XML configuration file of Active Directory:

<nodenames>

```
<node>clusternode1</node>
<computer-name>computer1</computer-name>
</nodenames>
<nodenames>
<node>clusternode2</node>
<computer-name>computer2</computer-name>
</nodenames>
```

NOTE: You must specify the clear text password within <password-cleartext> </password-cleartext> tags, in place of <user-password-encrypted> </user-password-encrypted> tags, before you perform an XML Import of an Active Directory mode configuration.

Using the Anonymous Server

This topic describes integration with the anonymous server. It includes the following information:

- Anonymous Server Overview
- Configuring Authentication with the Anonymous Server
- Monitoring Anonymous User Sessions

Anonymous Server Overview

This section describes support for using PPS with the anonymous server. It includes the following sections:

- Understanding the Anonymous Server
- Anonymous Server Feature Support
- Interoperability Requirements and Limitations

Understanding the Anonymous Server

The anonymous server is a local authentication server that allows any user to access the system without providing a username and password.

Instead, when a user enters the URL of a sign-in page that is configured to authenticate against an anonymous server, the PPS access management framework bypasses the standard sign-in page and immediately displays the welcome page to the user.

Anonymous Server Feature Support

PPS access management framework supports the following anonymous server features:

- Enables guest access without username or password
- Supports Host Checker scans before allowing a guest device to connect to the network
- Supports firewall enforcement roles and policies to limit the resources available to the guest user

Interoperability Requirements and Limitations

The following limitations apply to the anonymous server configuration and logging:

- You can add only one anonymous server configuration.
- You cannot create an administrator realm that uses the anonymous server. Anonymous administration is not allowed.
- During configuration, you must choose the anonymous server as both the authentication server and the directory or attribute server in the Users > User Realms > General tab.

- For security reasons, you might want to limit the number of users who sign in through an anonymous server at any given time. To do this, use the option on the Users > User Realms > [Realm] > Authentication Policy > Limits tab (where [Realm] is the realm that is configured to use the anonymous server to authenticate users).

Configuring Authentication with the Anonymous Server

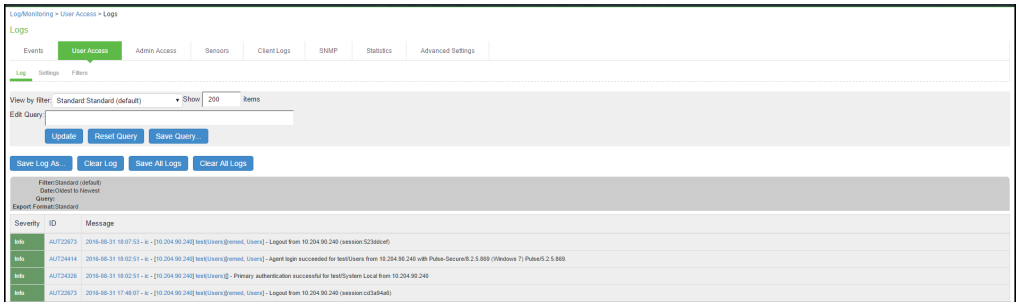
To configure authentication with the anonymous server:

1. Select Authentication > Auth. Servers.
2. Select Anonymous Server and click New Server to display the configuration page.
3. Save the configuration.

Monitoring Anonymous User Sessions

The purpose of the anonymous server is to enable unauthenticated access. Therefore, the system does not maintain session tables, and the Anonymous Server configuration page does not have a corresponding Users tab. The system does maintain user access logs for anonymous access. The username is recorded in the user access log as “AnonUser1234”. If the user is logging in using the agentless access method, the user access log records the host’s IP address. You can view the User Access Log file by navigating to **System > Log/Monitoring**.

Figure259: User Access Log



Using the Certificate Server

This topic describes integration with the certificate server. It includes the following information:

- Certificate Server Overview
- Configuring Authentication with the Certificate Server
- Displaying the User Accounts Table

Certificate Server Overview

This section describes support for using PPS with the certificate server. It includes the following sections:

- Understanding the Certificate Server
- Feature Support
- Interoperability Requirements and Limitations

Understanding the Certificate Server

The certificate server is a local server that allows user authentication based on the digital certificate presented by the user without any other user credentials.

When you use a certificate server, the user experience is similar to anonymous authentication. If the certificate is secured through a hardware or a software token or through a password, the certificate server authentication is very useful. The certificate contains the full distinguished name (DN) and the system extracts the values from the DN and uses it for role mapping rules, authentication policies, and role restrictions.

Feature Support

The PPS access management framework supports the following certificate server features:

- Certificate directory services to retrieve user attributes in role mapping rules, authentication policies, and role restrictions.
- Load CA-created certificates on the system.
- Load multiple certificates from different CAs for use with different authentication realms.

Interoperability Requirements and Limitations

If you choose a certificate attribute with more than one value, the system uses the first matched value. For example, if you enter <certDN.OU> and the user has two values for the attribute (ou=management, ou=sales), the system uses the “management” value.

To use all values, add the SEP attribute to the variable. For example, if you enter <certDN.OUT SEP=”:”> the system uses “management:sales”.

Configuring Authentication with the Certificate Server

1. To configure authentication with the certificate server:
2. Select **Authentication > Auth. Servers**.
3. Select Certificate Server and click New Server to display the configuration page.
4. Complete the configuration as described below.
5. Save the configuration.

Figure260: Certificate Server Configuration Page

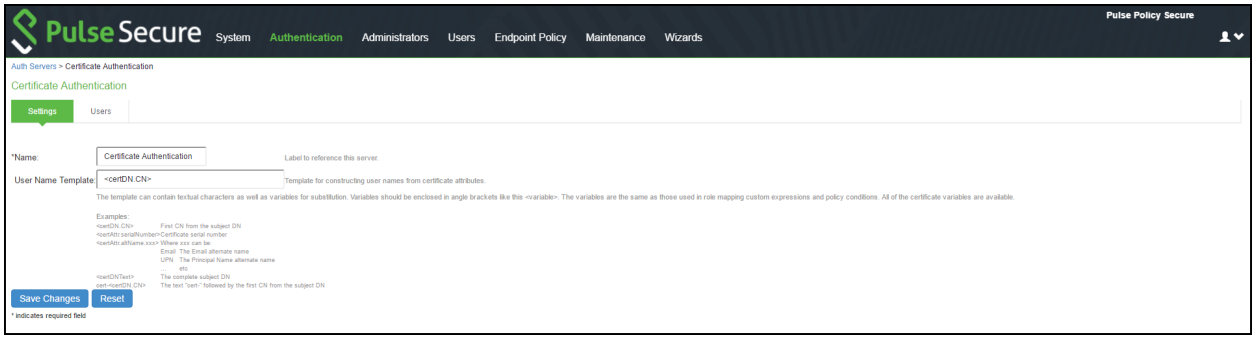


Table40: Certificate Server Settings

Settings	Guidelines
Name	Specify a name to identify the server within the system.
User Name Template	Specify a username template. Specify how the system should construct a username. You may use any combination of certificate variables contained in angle brackets and plain text. NOTE: This value populates the <USER> and <USERNAME> session variables for use throughout the rest of the system configuration.
Logical Auth Server Name	Specify a logical authentication server name.

Displaying the User Accounts Table

To display user accounts:

1. Select Authentication > Auth. Servers.
2. Click the link for the authentication server you want to manage.
3. Click the Users tab to display the user accounts table.

   The user accounts table includes entries for the accounts that have been created. The Last Sign-in Statistic column shows the last successful sign-in date and time for each user, the user's IP address, and the agent or browser type and version.

4. Use the controls to search for users and manage user accounts:

   - To search for a specific user, enter a username in the Show users named box and click **Update**.

     TIP: You can use an asterisk (*) as a wildcard, where * represents any number of zero or more characters. For example, to search for all usernames that contain the letters jo, enter ***jo***. The search is case-sensitive. To display the entire list of accounts again, type ***** or delete the field's contents and click **Update**.

   - To limit the number of users displayed on the page, enter a number in the Show *N* users box and click **Update**.
   - To terminate the user session and delete the account, select the check box next to the user account record and click **Delete**.

Using an LDAP Server

This topic describes integration with the LDAP server. It includes the following information:

- LDAP Server Overview
- Configuring Authentication with an LDAP Server
- Displaying the User Accounts Table

LDAP Server Overview

This section describes support for using PPS with the LDAP server. It includes the following sections:

- Understanding LDAP Server
- LDAP Feature Support
- Interoperability Requirements and Limitations

Understanding LDAP Server

Lightweight Directory Access Protocol (LDAP) facilitates the access of online directory services. The Internet Engineering Task Force (IETF) designed and specified LDAP as a better way to make use of X.500 directories, having found the original Directory Access Protocol (DAP) too complex for average Internet clients to use. LDAP is a relatively simple protocol for updating and searching directories running over TCP/IP.

LDAP directory consists of a collection of attributes with a name, known as a distinguished name (DN). Each of the entry's attributes, known as a relative distinguished name (RDN), has a type and one or more values. The types are typically mnemonic strings, such as CN for common name. The valid values for each field depend on the types.

The full DN is constructed by stringing together RDNs from most specific to least specific, separated by commas, as shown in the following example:

cn=Bob_Employee, ou= account_mgr, o=sales, dc=Acme,dc=com.

LDAP Feature Support

Pulse Secure access management framework supports the following LDAP features:

- LDAP directory services to retrieve user attributes and group membership in role mapping rules
- Encrypted connections to the LDAP server using LDAP over SSL (LDAPS) or Start Transport Layer Security (TLS)
- Password management feature enabling users who access an LDAP server to manage their passwords using the policies defined on the LDAP server
- Fine-grained password policy (FGP) for Active Directory 2008

Interoperability Requirements and Limitations

The following limitations apply to interoperability with LDAP:

- By default, challenge response protocols are disabled for LDAP servers. Use these protocols only with noninteractive devices (for example, phones), as password management is not possible if these protocols are used for authentication.
- To use the CHAP, EAP-MD5-Challenge, MS-CHAP-V1, and MS-CHAP-V2 protocols, the LDAP server must store the user's password in clear text.

- Backup LDAP servers must be the same version as the primary LDAP server. Also, we recommend that you specify the IP address of a backup LDAP server instead of its hostname, which might accelerate failover processing by eliminating the need to resolve the hostname to an IP address.

Configuring Authentication with an LDAP Server

To configure authentication with an LDAP server:

1. Select Authentication > Auth. Servers.
2. Select LDAP Server and click New Server to display the configuration page.
3. Complete the configuration as described below.
4. Save the configuration.

Figure261: LDAP Server Configuration Page

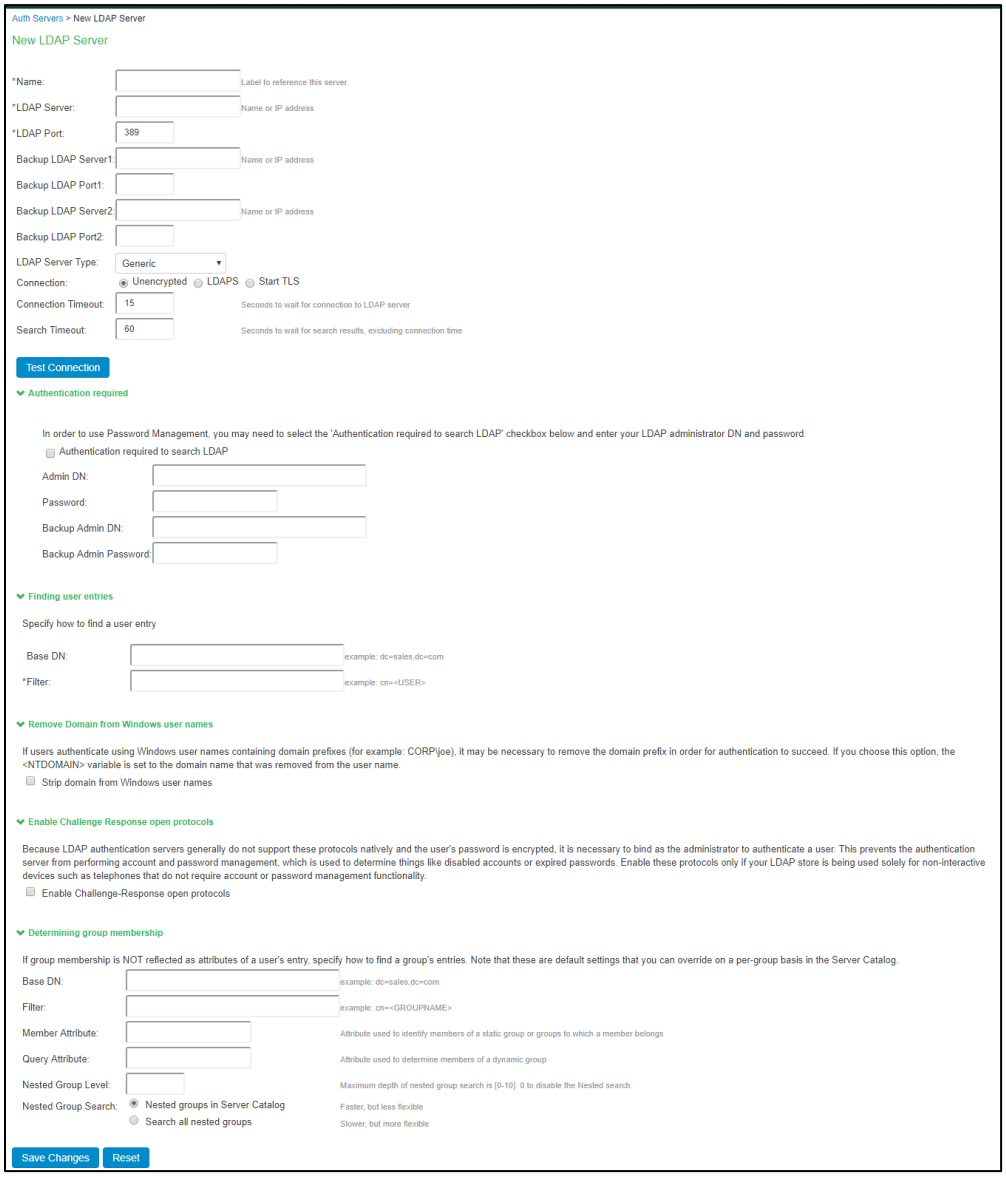


Table41: LDAP Server Settings

Settings	Guidelines
Name	Specify a name to identify the server within the system.
LDAP Server	Specify the LDAP server name or the IP address.
LDAP Port	Specify the LDAP port for the LDAP server. Default port number: 389 (unencrypted connection) Default port number: 636 (SSL connection)
Backup LDAP Server1	(Optional) Specify the parameters for backup LDAP server1. The specified backup LDAP server is used for failover processing. The authentication request is first routed to the primary LDAP server, and then to the specified backup servers if the primary server is unreachable.
Backup LDAP Port1	Specify the parameters for backup LDAP port1.
Backup LDAP Server2	(Optional) Specify the parameters for backup LDAP server2.
Backup LDAP Port2	Specify the parameters for backup LDAP port2.
LDAP Server Type	Select the backend LDAP server type from the following choices: **Generic** **Active Directory** **iPlanet** **Novell eDirectory** **Profiler** (*Policy Secure only*)
Connection	Select one of the following options for the connection to the LDAP server: **Unencrypted**– The device sends the username and password to the LDAP Directory Service in clear text. **LDAPS**– The device encrypts the data in the LDAP authentication session using the Secure Socket Layer (SSL) protocol before sending it to the LDAP Directory Service. **Start TLS**– The device allows both secure and plain requests against an LDAP server on a single connection. NOTE: If you select **LDAPS** or **Start TLS**, the Validate Certificate option is displayed for the configured LDAP server(s) and its referral servers. Select this option if the SSL connection uses digital certificate security. If you enable validation for the referral servers, make sure your network DNS supports reverse lookup zone. If you want to verify the server certificates, the root CA and Intermediate CAs must be imported as trusted CAs.
Connection Timeout (seconds)	Specify the time to wait for connection to the primary LDAP server, and then to each backup LDAP server. Default: 15 seconds
Search Timeout (seconds)	Specify the time to wait for search results from a connected LDAP server.
Test Connection	(Optional) To verify the connection between Pulse Secure client and LDAP servers, click the **Test Connection** button. NOTE: We recommend using the Test Connection function only after saving changes on the LDAP Server Configuration page.
Authentication required?	

Settings	Guidelines
Authentication required to search LDAP	Select this option to require authentication when performing search or password management operations. NOTE: If you use Active Directory, you must select the **Authentication required to search LDAP** check box and provide the full DN and password of an account that can reach Active Directory. You can enable password management on any LDAP server. This feature enables users who authenticate through an LDAP server to manage their passwords through the system using the policies defined on the LDAP server. To enable password management on any LDAP server,you must provide primary and backup administrator accounts (with write privileges to the directory) for the administrator DN and backup administrator DN.
Admin DN	Specify the administrator DN for queries to the LDAP directory.
Password	Specify the password for the LDAP server.
Backup Admin DN	Specify the backup administrator DN for queries to the LDAP directory, as a fallback when primary Admin DN fails (due to account expiration). The interaction with LDAP directory stops when both primary and backup administrator accounts fail.
Backup Admin Password	Specify the backup administrator password for the LDAP server.
Finding user entries	
Base DN	Specify the base DN under which the users are located. For example, dc=sales,dc=acme, dc=com.
Filter	Specify a unique variable that can be used to do a fine search in the tree. For example, samAccountname=<username> or cn=<username>. NOTE: Include <username> in the filter to use the username entered on the sign-in page for the search. Specify a filter that returns 0 or 1 user DNs per user; the device uses the first DN returned if more than 1 DN is returned.
Remove Domain from Windows users names?	
Strip domain from Windows username	Select this option to pass the username without the domain name to the LDAP server.
Enable Challenge-Response open protocols?	
Enable Challenge-Response open protocols	Select this option if you want to use a challenge-response protocol for authentication. NOTE: By default, these protocols are disabled for LDAP servers because account management is not possible.
Determining group membership	
Base DN	Specify the base DN to search for user groups.
Filter	Specify a unique variable which can be used to do a fine search in the tree. For example, samAccountname=<username> or cn=<GROUPNAME>.
Member Attribute	Specify all the members of a static group. For example, member or uniquemember (iPlanet specific).
Reverse group search	Select this option to start the search from the member instead of the group. This option is available only for Active Directory server types.
Query Attribute	Specify an LDAP query that returns the members of a dynamic group. For example, memberURL.
Nested Group Level	Specify how many levels within a group to search for the user. NOTE: The higher the number, the longer the query time, so we recommend that you specify to perform the search no more than two levels deep.

Settings	Guidelines
Nested Group Search	Select one of the following options: **Nested groups in Server Catalog**–This option is faster because it can search within the implicit boundaries of the nested group. **Search all nested groups**–With this option, the device searches the Server Catalog first. If the device finds no match in the catalog, then it queries LDAP to determine if a group member is a subgroup.

Displaying the User Accounts Table

To display user accounts:

1. Select Authentication > Auth. Servers.
2. Click the link for the authentication server you want to manage.
3. Click the Users tab to display the user accounts table.

   The user accounts table includes entries for the accounts that have been created. The Last Sign-in Statistic column shows the last successful sign-in date and time for each user, the user's IP address, and the agent or browser type and version.

4. Use the controls to search for users and manage user accounts:

   - To search for a specific user, enter a username in the Show users named box and click **Update**.

     TIP: You can use an asterisk (*) as a wildcard, where * represents any number of zero or more characters. For example, to search for all usernames that contain the letters jo, enter ***jo***. The search is case-sensitive. To display the entire list of accounts again, type * or delete the field's contents and click **Update**.

   - To limit the number of users displayed on the page, enter a number in the Show *N* users box and click **Update**.
   - To terminate the user session and delete the account, select the check box next to the user account record and click **Delete**.

Using the LDAP Password Management Feature

This topic describes support and limitations for LDAP password management. It includes the following information:

LDAP Password Management Feature Overview

The password management feature enables users who access an LDAP server to manage their passwords through the Pulse Secure access management framework using the policies defined on the LDAP server. For example, if a user tries to sign in to the system with an LDAP password that is about to expire, the system notices the user through the interface, and then passes the user's response back to the LDAP server without requiring the user to sign in to the LDAP server separately.

Users, administrators, and help desk administrators who work in environments where passwords have set expiration times may find the password management feature very helpful. If users are not informed that their passwords are about to expire, they can change them themselves through the system rather than call the help desk.

Once this feature is enabled, the system performs a series of queries to determine user account information, such as when the user's password was last set, whether the account is expired, and so on. The Pulse Secure access management framework does this by using its internal LDAP or Samba client. Many servers, such as Microsoft Active Directory or Sun iPlanet, offer an Administrative Console to configure account and password options.

LDAP-based password management works with only three types of LDAP servers:

- Microsoft Active Directory. For Active Directory, password policy attributes can be configured in the user entry container level or any organization level above the user container. If these attributes are configured at multiple levels, the level closest to the user node takes precedence. The password management feature is not supported on the Active Directory Global Catalog because password policy attributes are not fully populated in the Active Directory Global Catalog.
- For Active Directory 2008, the Pulse Secure access management framework supports the Fine Grained Password Policy (FGP) configured in the AD user container.
- Sun Microsystems iPlanet
- Novell eDirectory

  LDAP-based password management does not work on generic LDAP servers such as OpenLDAP.

The system relies on the back-end server to pinpoint the cause of error when a password change operation fails. However, although LDAP servers may report errors accurately to human operators, they do not always do so when communicating programmatically to systems. Therefore, reported errors might be generic or cryptic.

The system does not support customized password policies.

Enabling LDAP Password Management

To enable password management, you must first create an instance of the LDAP server. Next, you associate the LDAP server with the applicable realms. Finally, you select the enable password management feature at the realm level.

LDAP Password Management Support

The Pulse Secure access management framework supports password management with the following LDAP directories:

- Microsoft Active Directory/Windows NT
- Sun iPlanet
- Novell eDirectory
- Generic LDAP directories, such as IBM Secure Directory and OpenLDAP

The below table describes supported password management functions, their corresponding function names in the individual LDAP directories, and any additional relevant details. These functions must be set through the LDAP server itself before the system can pass the corresponding messages, functions, and restrictions to end users.

The Active Directory attribute names shown are specific to the Domain Security Policy object. Similar attributes for the corresponding functions are used for the Active Directory 2008 Fine-Grained Password Policy. Refer to Microsoft documentation for details.

When authenticating against a generic LDAP server, such as IBM Secure Directory, the system supports only authentication and allowing users to change their passwords. Password management functions are not supported when the CHAP family protocols are used for authentication. All functions are available when the JUAC protocol is used for authentication.

Table42: Supported Password Management Functions

Function	Active Directory	iPlanet	eDirectory	Generic
Authenticate user	unicodePwd	userPassword	userPassword	userPassword
Allow user to change password if enabled	Server tells us in bind response (uses ntSecurityDescriptor)	If passwordChange == ON	If passwordAllowChange == TRUE	Yes
Log out user after password change	Yes	Yes	Yes	Yes
Force password change at next log in	If pwdLastSet == 0	If passwordMustChange == ON	If pwdMustChange == TRUE	-
Expired password notification	userAccountControl== 0x80000	If Bind Response includes OID 2.16.840.1.113730.3.4.4 == 0	Check date/time value	-
Password expiration notification (in X days/hours)	if pwdLastSet - now() < maxPwdAge - 14 days (Read from domain attributes) (The system displays warning if less than 14 days)	If Bind Response includes control OID 2.16.840.1.113730.3.4.5 (contains date/time) (The system displays warning if less than 14 days)	If now() - passwordExpirationTime< 14 days (The system displays warning if less than 14 days)	
Disallow authentication if "account disabled/locked	userAccountControl== 0x2 (Disabled) accountExpires userAccountControl == 0x10 (Locked) lockoutTime	Bind ErrorCode: 53 "Account Inactivated" Bind Error Code: 19 "Exceed Password Retry Limit"	Bind ErrorCode: 53 "Account Expired" Bind ErrorCode: 53 "Login Lockout"	

Function	Active Directory	iPlanet	eDirectory	Generic
Honor "password history"	Server tells us in bind response	Server tells us in bind response	Server tells us in bind response	
Enforce "minimum password length"	If set, the system displays message telling user minPwdLength	If set, the system displays message telling user passwordMinLength	If set, the system displays message telling user passwordMinimumLength	
Disallow user from changing password too soon	If pwdLastSet - now() < minPwdAge, then we disallow	If passwordMinAge > 0, then if now() is earlier than passwordAllowChangeTime, then we disallow	Server tells us in bind response	
Honor "password complexity"	If pwdProperties == 0x1, then enabled. Complexity means the new password does not contain username, first or last name, and must contain characters from 3 of the following 4 categories: English uppercase, English lowercase, Digits, and Non-alphabetic characters (ex. !, $, %)	Server tells us in bind response	Server tells us in bind response	

Note the following expected behavior:

- When you select the User must change password after reset option on the iPlanet server, you must also reset the user password before this function takes effect. This issue is a limitation of iPlanet.
- The system displays a warning about password expiration only if the password is scheduled to expire in 14 days or less. The system displays the message during each sign-in attempt. The warning message contains the remaining number of days, hours, and minutes that the user has to change the password before it expires on the server. The default value is 14 days, but you can change it on the password configuration page of the admin console.

LDAP Password Management for Windows AD Versions

The Pulse Secure access management framework supports password management with the following Windows servers:

- Microsoft Active Directory 2008
- Microsoft Active Directory 2003
- Windows NT 4.0

The below table describes supported password management functions. These functions are not supported for a layer 2 connection when CHAP, MS-CHAP, or PAP are used as authentication protocols.

Table43: AD/NT Password Management Matrix

Function	Active Directory	Active Directory 2003	Active Directory 2008 FGP	Windows NT
Authenticate user	Yes	Yes	Yes	Yes
Allow user to change password if licensed and if enabled	Yes	Yes	Yes	Yes
Log out user after password change	Yes	Yes	Yes	Yes

Function	Active Directory	Active Directory 2003	Active Directory 2008 FGP	Windows NT
Force password change at next log in	Yes	Yes	Yes	Yes
Password expired notification	Yes	Yes	Yes	Yes
Account disabled	Yes	Yes	Yes	Yes
Account expired	Yes	Yes	Yes	Yes

Note the following expected behavior:

- Changes on the Active Directory domain security policy can take 5 minutes or longer to propagate among Active Directory domain controllers. Additionally, this information does not propagate to the domain controller on which it was originally configured for the same time period. This issue is a limitation of Active Directory.
- When changing passwords in Active Directory using LDAP, the system automatically switches to LDAPS, even if LDAPS is not the configured LDAP method. To support LDAPS on the Active Directory server, you must install a valid SSL certificate into the server's personal certificate store. The certificate must be signed by a trusted CA, and the CN in the certificate's Subject field must contain the exact hostname of the Active Directory server, (for example: adsrv1.company.com). To install the certificate, select the Certificates Snap-In in the Microsoft Management Console (MMC).
- The Account Expires option in the User Account Properties tab only changes when the account expires, not when the password expires. Microsoft Active Directory calculates the password expiration using the Maximum Password Age and Password Last Set values retrieved from the User object and Fine-Grained Password Policy objects or the Domain Security Policy LDAP objects.
- The system displays a warning about password expiration only if the password is scheduled to expire in 14 days or less. The system displays the message during each sign-in attempt. The warning message contains the remaining number of days, hours, and minutes that the user has to change the password before it expires on the server. The default value is 14 days, but you can change it on the password configuration page of the admin console.

Troubleshooting LDAP Password Management

When you troubleshoot, provide any pertinent system logs, server logs, configuration information, and a TCP trace from the system. If you are using LDAPS, switch to the "Unencrypted" LDAP option LDAP server configuration while taking the LDAP TCP traces.

Using the MAC Address Authentication Server

This topic describes how to use the MAC address authentication server. It includes the following information:

- MAC Address Authentication Server Overview
- Configuring the MAC Address Authentication Server
- Displaying the User Accounts Table

MAC Address Authentication Server Overview

This section describes PPS MAC address authentication solution. It includes the following sections:

- Understanding MAC Address Authentication
- MAC Address Authentication Server Feature Support

- Interoperability Requirements and Limitations
- MAC Address Authentication Framework Configuration Overview
- 802.1x Framework Configuration Overview
- Ethernet Switch MAC Address Authentication Configuration Overview

Understanding MAC Address Authentication

MAC address authentication is port-based security typically deployed at the edge of the network to enable secure access for non-user devices, such as IP phones, printers, and network attached storage devices. The Pulse Secure MAC address authentication solution uses PPS 802.1x framework. When a device connects to a switch, the switch forwards the MAC address as the log in credential to PPS RADIUS server. With MAC-based authentication, the MAC address serves as both the username and the password. The RADIUS server consults the authentication server and sends back a RADIUS return attribute based on authentication results.

BEST PRACTICE: MAC-based authentication is not as secure as agent access or agentless access authentication. MAC addresses are not generally guarded as secrets, so an attacker can spoof a MAC address and impersonate a device to gain network access. To reduce risk of an exploit, create a special VLAN for each device type.

MAC Address Authentication Server Feature Support

The MAC address authentication server is a local authentication server that supports both a local database of records and integration with LDAP servers. You can add entries manually or by reference to LDAP servers. The address table for each local MAC address authentication server is limited to 500 entries. We recommend you use LDAP for large-scale projects.

Interoperability Requirements and Limitations

Integration with an LDAP server requires the LDAP server to communicate with PPS internal interface.

MAC Address Authentication Framework Configuration Overview

The MAC address authentication framework is similar to the user access management framework. It involves configuration of a MAC address authentication server, MAC address realm, and roles.

To implement the MAC address authentication framework:

1. If necessary, use the Authentication Protocols Sets page to add the protocols that your Ethernet switches use for MAC authentication to PPS 802.1x protocol set. Select Authentication > Signing In > Authentication Protocols Sets.

   The HP and Cisco switches can use CHAP and EAP-MD5-Challenge protocols for MAC address authentication with the username (the MAC address) as the clear text password. By default, the Nortel switch uses PAP, with a password in the format .<MAC Address>. We recommend using PAP with the Nortel switch.

2. Create LDAP server configurations for the external LDAP servers used to maintain MAC address records.

3. Create a MAC address authentication server.

4. Create roles for agentless access.

5. Create a MAC address authentication realm that uses the MAC address authentication server and role mapping rules that sort MAC address authentication requests into roles according to your security policy design.

802.1x Framework Configuration Overview

The MAC address authentication solution uses PPS 802.1x framework.

To implement the 802.1x framework:

1. Complete the Location Group configuration.
2. Complete the RADIUS Client configuration.
3. Complete the RADIUS Return Attributes Policy configuration.

Ethernet Switch MAC Address Authentication Configuration Overview

The MAC address solution depends on the Ethernet switch configuration.

To configure MAC address authentication on the Ethernet switch:

1. Configure the switch as an 802.1x authenticator and enable MAC RADIUS protocols.
2. Configure RADIUS client communication with PPS RADIUS server.
3. Configure Ethernet switching options and VLANs to provision VLANs for non-user devices.

Configuring the EX Series Switch

The nonsupplicant devices, such as VoIP phones, connect to the network through an EX Series switch using MAC RADIUS authentication. You configure the following EX Series features to support this solution:

- Configure the switch as an 802.1x authenticator and enable MAC RADIUS protocols.
- Configure RADIUS client communication with PPS RADIUS server.
- Configure Ethernet switching options and VLANs to provision a VLAN for VoIP phones.

The following example shows commands that configure the ge-0/1/0.0 and ge-0/1/1.0 interfaces as 802.1x authenticators, enable MAC RADIUS protocols, and create a reference to the authentication profile used for integration with PPS RADIUS server:

```
set protocols dot1x authenticator authentication-profile-name pulsesecure-access-profile
set protocols dot1x authenticator interface ge-0/1/0.0 supplicant multiple
set protocols dot1x authenticator interface ge-0/1/0.0 transmit-period 15
set protocols dot1x authenticator interface ge-0/1/0.0 mac-radius
set protocols dot1x authenticator interface ge-0/1/0.0 maximum-requests 2
set protocols dot1x authenticator interface ge-0/1/0.0 server-fail vlan-name enterprise
set protocols dot1x authenticator interface ge-0/1/1.0 supplicant multiple
set protocols dot1x authenticator interface ge-0/1/1.0 quiet-period 5
set protocols dot1x authenticator interface ge-0/1/1.0 transmit-period 15
set protocols dot1x authenticator interface ge-0/1/1.0 mac-radius
set protocols dot1x authenticator interface ge-0/1/1.0 supplicant-timeout 15
set protocols dot1x authenticator interface ge-0/1/1.0 maximum-requests 2
set protocols dot1x authenticator interface ge-0/1/1.0 guest-vlan guest
set protocols dot1x authenticator interface ge-0/1/1.0 server-reject-vlan vlan-name guest
set protocols dot1x authenticator interface ge-0/1/1.0 server-fail vlan-name enterprise
```

The following example shows commands that configure the access profile for PPS RADIUS server and the RADIUS client connection to it:

```
set access radius-server 10.0.1.5 port 1812

set access radius-server 10.0.1.5 secret "$9$JLZHmzF/t0I69Icrv7N24aZikmfT3/C"

set access radius-server 10.0.1.5 timeout 5

set access radius-server 10.0.1.5 retry 3

set access profile pulsesecure-access-profile authentication-order radius

set access profile pulsesecure-access-profile radius authentication-server 10.0.1.5

set access profile pulsesecure-access-profile radius accounting-server 10.0.1.5

set access profile pulsesecure-access-profile accounting order radius
```

The following example shows commands that configure the Ethernet switching options and VLAN used for VoIP phones:

```
set ethernet-switching-options voip interface ge-0/0/10.0 vlan VoIP_Phone

set ethernet-switching-options voip interface ge-0/0/11.0 vlan VoIP_Phone

set ethernet-switching-options voip interface ge-0/0/8.0 vlan VoIP_Phone

set ethernet-switching-options voip interface ge-0/0/9.0 vlan VoIP_Phone

set ethernet-switching-options voip interface ge-0/0/6.0 vlan VoIP_Phone

set ethernet-switching-options voip interface ge-0/0/7.0 vlan VoIP_Phone

set ethernet-switching-options voip interface ge-0/0/4.0 vlan VoIP_Phone

set ethernet-switching-options voip interface ge-0/0/5.0 vlan VoIP_Phone

set ethernet-switching-options voip interface ge-0/1/0.0 vlan VoIP_Phone

set ethernet-switching-options voip interface ge-0/1/1.0 vlan VoIP_Phone

set vlans VoIP_Phone description "VoIP Phones"

set vlans VoIP_Phone vlan-id 5
```

The following example shows the complete configuration hierarchy for the Ethernet switch configuration:

```
system {
    host-name Demo_EX;
    root-authentication {
        encrypted-password "$1$OOuTCh1K$/Z6JTJ/l9BnjTsKAoefLS."; ## SECRET-DATA
    }
    log in {
        user admin {
            full-name Administrator;
            uid 2000;
            class super-user;
            authentication {
                encrypted-password "$1$RKLp.iDP$m//eueOcF.rExsnQXuZNb/"; ## SECRET-DATA
            }
        }
    }
    services {
        ssh;
        telnet;
        web-management {
```

```
            http;
        }
    }
    syslog {
        user * {
            any emergency;
        }
        file messages {
            any notice;
            authorization info;
        }
    }
}
    chassis {
        alarm {
            management-ethernet {
                link-down ignore;
            }
        }
    }
    interfaces {
        ge-0/0/0 {
            unit 0 {
                family ethernet-switching {
                    port-mode trunk;
                    vlan {
                        members [ enterprise guest remediation VoIP_Phone ];
                    }
                    native-vlan-id default;
                }
            }
        }
        ge-0/0/1 {
            unit 0 {
                family ethernet-switching {
                    port-mode trunk;
                    vlan {
                        members [ enterprise guest remediation VoIP_Phone ];
                    }
                    native-vlan-id default;
                }
            }
        }
        ge-0/0/2 {
            unit 0 {
                family ethernet-switching {
                    port-mode trunk;
                    vlan {
                        members [ enterprise guest remediation VoIP_Phone ];
                    }
                    native-vlan-id default;
                }
            }
        }
        ge-0/0/3 {
            unit 0 {
                family ethernet-switching {
                    port-mode trunk;
```

```
            vlan {
                members [ enterprise guest remediation VoIP_Phone ];
            }
            native-vlan-id default;
        }
    }
}
ge-0/0/4 {
    unit 0 {
        family ethernet-switching {
            port-mode access;
        }
    }
}
ge-0/0/5 {
    unit 0 {
        family ethernet-switching {
            port-mode access;
        }
    }
}
ge-0/0/6 {
    unit 0 {
        family ethernet-switching {
            port-mode access;
        }
    }
}
ge-0/0/7 {
    unit 0 {
        family ethernet-switching {
            port-mode access;
        }
    }
}
ge-0/0/8 {
    unit 0 {
        family ethernet-switching {
            port-mode access;
        }
    }
}
ge-0/0/9 {
    unit 0 {
        family ethernet-switching {
            port-mode access;
        }
    }
}
ge-0/0/10 {
    unit 0 {
        family ethernet-switching {
            port-mode access;
        }
    }
}
ge-0/0/11 {
    unit 0 {
```

```
            family ethernet-switching {
               port-mode access;
            }
         }
      }
      ge-0/1/0 {
         unit 0 {
            family ethernet-switching {
               port-mode access;
            }
         }
      }
      ge-0/1/1 {
         unit 0 {
            family ethernet-switching {
               port-mode access;
            }
         }
      }
      vlan {
         unit 0 {
            family inet {
               address 10.0.1.10/24;
            }
         }
      }
   }
   routing-options {
      static {
         route 0.0.0.0/0 next-hop 10.0.1.1;
      }
   }
   protocols {
      dot1x {
         authenticator {
            authentication-profile-name pulsesecure-access-profile;
            interface {
               ge-0/1/0.0 {
                  supplicant multiple;
                  transmit-period 15;
                  mac-radius;
                  maximum-requests 2;
                  server-fail vlan-name enterprise;
               }
               ge-0/1/1.0 {
                  supplicant multiple;
                  quiet-period 5;
                  transmit-period 15;
                  mac-radius;
                  supplicant-timeout 15;
                  maximum-requests 2;
                  guest-vlan guest;
                  server-reject-vlan guest;
                  server-fail vlan-name enterprise;
               }
            }
         }
      }
```

```
}
access {
    radius-server {
        10.0.1.5 {
            port 1812;
            secret "$9$JLZHmzF/t0I69Icrv7N24aZikmfT3/C"; ## SECRET-DATA
            timeout 5;
            retry 3;
        }
    }
    profile pulsesecure-access-profile {
        authentication-order radius;
        radius {
            authentication-server 10.0.1.5;
            accounting-server 10.0.1.5;
        }
        accounting {
            order radius;
        }
    }
}
ethernet-switching-options {
    voip {
        interface ge-0/0/10.0 {
            vlan VoIP_Phone;
        }
        interface ge-0/0/11.0 {
            vlan VoIP_Phone;
        }
        interface ge-0/0/8.0 {
            vlan VoIP_Phone;
        }
        interface ge-0/0/9.0 {
            vlan VoIP_Phone;
        }
        interface ge-0/0/6.0 {
            vlan VoIP_Phone;
        }
        interface ge-0/0/7.0 {
            vlan VoIP_Phone;
        }
        interface ge-0/0/4.0 {
            vlan VoIP_Phone;
        }
        interface ge-0/0/5.0 {
            vlan VoIP_Phone;
        }
        interface ge-0/1/0.0 {
            vlan VoIP_Phone;
        }
        interface ge-0/1/1.0 {
            vlan VoIP_Phone;
        }
    }
}
vlans {
    VoIP_Phone {
        vlan-id 5;
```

```
    }
    default {
      vlan-id 1;
      interface {
        ge-0/0/4.0;
        ge-0/0/5.0;
      }
      l3-interface vlan.0;
    }
    enterprise {
      vlan-id 2;
      interface {
        inactive: ge-0/0/5.0;
        ge-0/0/6.0;
        ge-0/0/7.0;
        ge-0/1/0.0;
        ge-0/1/1.0;
      }
    }
    guest {
      vlan-id 3;
      interface {
        ge-0/0/8.0;
        ge-0/0/9.0;
      }
    }
    remediation {
      vlan-id 4;
      interface {
        ge-0/0/10.0;
        ge-0/0/11.0;
      }
    }
  }
  poe {
    interface all;
  }
```

In addition to the configuration for the MAC authentication solution shown above, you can also configure the switch to send data (SNMP traps) to the Beacon Endpoint Profiler for use in profiling. The following example commands configure SNMP traps to the Beacon Endpoint Profiler. The Beacon Endpoint Profiler can use the traps to build profile entries:

```
set snmp description EX4200-VOIP-Switch

set snmp contact ex-admin@company.com

set snmp view jweb-view-all oid .1 include

set snmp community public view jweb-view-all

set snmp community public authorization read-only

set snmp community public clients <BeaconEndpointProfilerIPaddressOrSubnet>

set snmp trap-group Beacon version v2

set snmp trap-group Beacon categories link

set snmp trap-group Beacon targets <BeaconEndpointProfilerIPaddress>
```

TIP: To verify that the Beacon Endpoint Profiler can read the EX Series MIB, run the following command from the Beacon Endpoint Profiler command line:

```
snmpwalk -v 2c -c public <EXseriesIPaddress>
```

Related Documentation

- *Great Bay Software Beacon Endpoint Profiler Configuration Guide*

Using an NIS Server

This topic describes integration with the NIS server. It includes the following information:

- NIS Server Overview
- Configuring Authentication with an NIS Server
- Displaying the User Accounts Table

NIS Server Overview

This section describes support for using PPS PPS with the NIS server. It includes the following sections:

- Understanding NIS Server
- Feature Support
- Interoperability Requirements and Limitations

Understanding NIS Server

Network Information Service (NIS) is an authentication server that allows a central server to manage password authentication, hosts, services, and so on.

When you use an NIS server as the authentication and authorization service for your Pulse Secure access management framework, users can sign in to PPS using the same username and password that is used for the NIS server.

Feature Support

Pulse Secure access management framework supports the following NIS server features:

- Password management feature enables users who access an NIS server to manage their policies defined on the NIS server.
- Integrates NIS map data for passwords, groups, and hosts with corresponding objects in Active Directory.
- Allows migration of NIS domains to Active Directory.

Interoperability Requirements and Limitations

The following limitations apply when defining and monitoring an NIS server instance:

- You can only use NIS authentication with the system if your passwords are stored on the NIS server using Crypt or MD5 formats.
- You can only add one NIS server configuration to the system, but you can use that configuration to authenticate any number of realms.
- The username submitted to the system cannot contain two consecutive tilde symbols (~~).

Configuring Authentication with an NIS Server

To configure authentication with the NIS server:

1. Select **Authentication > Auth.Servers**
2. Select **NIS Server** and click **New Server** to display the configuration page.
3. Complete the configuration as described below.
4. Save the configuration.

Figure262: NIS Server Configuration Page

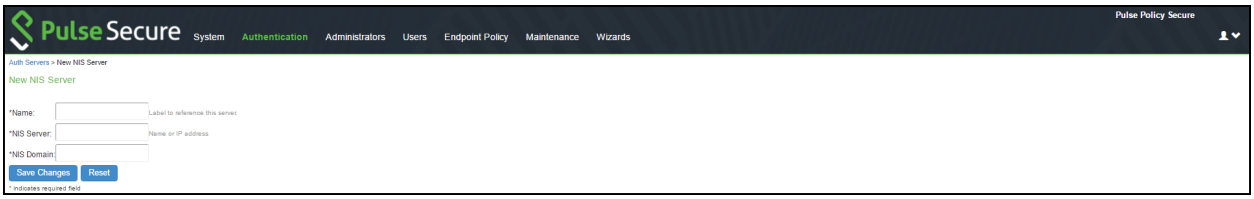


Table44: NIS Server Settings

Settings	Guidelines
Name	Specify a name to identify the server within the system.
NIS Server	Specify the name or IP address of the NIS server.
NIS Domain	Specify the domain name for the NIS server.

Using a RADIUS Server

This topic describes integration with the RADIUS server. It includes the following information:

- RADIUS Server Overview
- Configuring Authentication with a RADIUS Server

RADIUS Server Overview

This section describes support for using an external RADIUS server. It includes the following sections:

- Understanding RADIUS Server
- Feature Support
- Using Challenge Expressions
- Using RADIUS Attributes
- Understanding RADIUS Accounting
- Interoperability Requirements and Limitations

Understanding RADIUS Server

A Remote Authentication Dial-In User Service (RADIUS) server is a type of server that allows you to centralize authentication and accounting for users.

The following authentication schemes are supported:

- Access-Request–The user enters the username and password to request access to RADIUS server.
- Access-Accept–The user is authenticated.
- Access-Reject–The user is not authenticated and is prompted to reenter the username and password, or access is denied.
- Access-Challenge–A challenge is issued by the RADIUS server. The challenge collects additional data from the user.

Feature Support

Pulse Secure access management framework supports the following RADIUS features:

- RADIUS authentication.
- RADIUS attributes that can be used in role mapping.
- RADIUS directory services to retrieve user attributes in role-mapping rules.
- RADIUS accounting to track the services and the network resources used.
- RADIUS proxy to configure your external RADIUS server as an inner or outer proxy target. When you specify RADIUS proxy, some fields in the RADIUS server configuration page are not applicable. This feature is supported only on PPS.
- RADIUS Disconnect messages.

Using Challenge Expressions

The Pulse Secure access management framework supports the RSA Authentication Manager using the RADIUS protocol and a SecurID token (available from Security Dynamics). If you use SecurID to authenticate users, they must supply a user ID and the concatenation of a PIN and a token value.

When you define a RADIUS server, the Pulse Secure access management framework allows administrators to use hard-coded (default) challenge expressions that support Defender 4.0 and some RADIUS server implementations (such as Steel-Belted RADIUS and RSA RADIUS) or to enter custom challenge expressions that allow the system to work with many different RADIUS implementations and new versions of the RADIUS server, such as Defender 5.0. The system looks for the response in the Access-Challenge packet from the server and issues an appropriate Next Token, New PIN, or Generic Passcode challenge to the user.

Using CASQUE Authentication

CASQUE authentication uses a token-based challenge/response authentication mechanism employing a CASQUE player installed on the client system. Once configured with CASQUE authentication, the RADIUS server issues a challenge with a response matching the custom challenge expression (:([0-9a-zA-Z/+=]+):). The system then generates an intermediate page that automatically launches the CASQUE player installed on the user's system.

PassGo Defender

If you are using a PassGo Defender RADIUS server, the user sign-in process is as follows:

1. The user is prompted for and enters a username and password.
2. The username and encrypted password are sent over the network to the RADIUS server.
3. The RADIUS server sends a unique challenge string to the system. The system displays this challenge string to the user.

4. The user enters the challenge string in a Defender token and the token generates a response string.
5. The user enters the response string on the system and clicks **Sign In**.

Using RADIUS Attributes

The below table describes the RADIUS attributes that are supported in RADIUS role-mapping.

Table45: RADIUS Attributes

Attribute	Description
ARAP-Challenge-Response	Contains the response to the challenge of a dial-in client. Sent in an Access-Accept packet with Framed-Protocol of ARAP.
ARAP-Features	Includes password information that the network access server (NAS) must send to the user in an ARAP feature flags packet. Sent in an Access-Accept packet with Framed- Protocol of ARAP.
ARAP-Password	Appears in an Access-Request packet containing a Framed-Protocol of ARAP. Only one of User-Password, CHAP-Password, or ARAP-Password must be included in an Access-Request, or one or more EAP-Messages.
ARAP-Security	Identifies the ARAP security module to be used in an Access-Challenge packet.
ARAP-Security-Data	Contains the actual security module challenge or response, and is in Access-Challenge and Access-Request packets.
ARAP-Zone-Access	Indicates how to use the ARAP zone list for the user.
Access-Accept	Provides specific configuration information necessary to begin delivery of service to the user.
Access-Challenge	Sends the user a challenge requiring a response, and the RADIUS server must respond to the Access-Request by transmitting a packet with the Code field set to 11 (Access-Challenge).
Access-Reject	Transmits a packet with the Code field set to 3 (Access-Reject) if any value of the received Attributes is not acceptable.
Access-Request	Conveys information specifying user access to a specific NAS, and any special services requested for that user.
Accounting-Request	Conveys information used to provide accounting for a service provided to a user.
Accounting-Response	Acknowledges that the Accounting-Request has been received and recorded successfully.
Acct-Authentic	Indicates how the user was authenticated, whether by RADIUS, the NAS itself, or another remote authentication protocol.
Acct-Delay-Time	Indicates how many seconds the client has been trying to send this record.
Acct-Input-Gigawords	Indicates how many times the Acct-Input-Octets counter has wrapped around 2^32 over the course of this service being provided.
Acct-Input-Octets	Indicates how many octets have been received from the port during the current session.
Acct-Input-Packets	Indicates how many packets have been received from the port during the session provided to a Framed User.
Acct-Interim-Interval	Indicates the number of seconds between each interim update in seconds for this specific session.
Acct-Link-Count	Indicates the count of links known to have been in each multilink session at the time the accounting record is generated.
Acct-Multi-Session-Id	Indicates a unique Accounting ID to make it easy to link together multiple related sessions in a log file.
Acct-Output-Gigawords	Indicates how many times the Acct-Output-Octets counter has wrapped around 2^32 during the current session.
Acct-Output-Octets	Indicates how many octets have been sent to the port during this session.
Acct-Output-Packets	Indicates how many packets have been sent to the port during this session to a Framed User.

Attribute	Description
Acct-Session-Id	Indicates a unique Accounting ID to make it easy to match start and stop records in a log file.
Acct-Session-Time	Indicates how many seconds the user has received service.
Acct-Status-Type	Indicates whether this Accounting-Request marks the beginning of the user service (Start) or the end (Stop).
Acct-Terminate-Cause	Indicates how the session was terminated.
Acct-Tunnel-Connection	Indicates the identifier assigned to the tunnel session.
Acct-Tunnel-Packets-Lost	Indicates the number of packets lost on a given link.
CHAP-Challenge	Contains the Challenge Handshake Authentication Protocol (CHAP) challenge sent by the NAS to a PPP CHAP user.
CHAP-Password	Indicates the response value provided by a PPP CHAP user in response to the challenge.
Callback-Id	Indicates the name of a location to be called, to be interpreted by the NAS.
Callback-Number	The dialing string to be used for callback.
Called-Station-Id	Allows the NAS to send the phone number that the user called, using Dialed Number Identification Service (DNIS) or similar technology.
Calling-Station-Id	Allows the NAS to send the phone number that the call came from, using Automatic Number Identification (ANI) or similar technology.
Class	Sent by the server to the client in an Access-Accept and then sent unmodified by the client to the accounting server as part of the Accounting-Request packet, if accounting is supported.
Configuration-Token	Used in large distributed authentication networks based on proxy.
Connect-Info	Sent from the NAS to indicate the nature of the user's connection.
EAP-Message	Encapsulates Extended Access Protocol [3] packets to allow the NAS to authenticate dial-in users by means of EAP without having to understand the EAP protocol.
Event-Timestamp	Records the time that this event occurred on the NAS, in seconds since January 1, 1970 00:00 UTC.
Egress -VLAN-ID	The Egress-VLANID attribute represents an allowed Egress VLANID for this port, indicating if the VLANID is allowed for tagged or untagged frames as well as the VLANID.
Egress-VLAN-Name	The Egress-VLAN-Name attribute represents an allowed VLAN for this port. It is similar to the Egress-VLANID attribute, except that the VLAN-ID itself is not specified or known; rather, the VLAN name is used to identify the VLAN within the system.
Filter-Id	Indicates the name of the filter list for this user.
Framed-AppleTalk-Link	Indicates the AppleTalk network number used for the serial link to the user, which is another AppleTalk router.
Framed-AppleTalk-Network	Indicates the AppleTalk Network number which the NAS can probe to allocate an AppleTalk node for the user.
Framed-AppleTalk-Zone	Indicates the AppleTalk Default Zone to be used for this user.
Framed-Compression	Indicates the compression protocol to be used for the link.
Framed-IP-Address	Indicates the address to be configured for the user.
Framed-IP-Netmask	Indicates the IP netmask to be configured for the user when the user is a router to a network.
Framed-IPv6-Pool	Contains the name of an assigned pool used to assign an IPv6 prefix for the user.
Framed-IPv6-Prefix	Indicates an IPv6 prefix (and corresponding route) to be configured for the user.
Framed-IPv6-Route	Indicates the routing information to be configured for the user on the NAS.

Attribute	Description
Framed-IPv6 Address	Indicates an IPv6 address assigned to NAS interface of the host.
Framed-Interface-Id	Indicates the IPv6 interface identifier to be configured for the user.
Framed-IPX-Network	Indicates the IPX Network number to be configured for the user.
Framed-MTU	Indicates the maximum transmission unit to be configured for the user, when it is not negotiated by some other means (such as PPP).
Framed-Pool	Indicates the name of an assigned address pool used to assign an address for the user.
Framed-Protocol	Indicates the framing to be used for framed access.
Framed-Route	Indicates the routing information to be configured for the user on the NAS.
Framed-Routing	Indicates the routing method for the user, when the user is a router to a network.
Idle-Timeout	Sets the maximum number of consecutive seconds of idle connection allowed to the user before termination of the session or prompt.
Ingress-Filters	The Ingress-Filters attribute corresponds to the Ingress Filter per-port variable. Supports the following values: Disabled=2 Enabled= 1 When the attribute has the value "Enabled", the set of VLANs that are allowed to ingress a port must match the set of VLANs that are allowed to egress a port.
Keep-Alives	Uses SNMP instead of keepalives.
Login-IP-Host	Indicates the system with which to connect the user when the Login-Service Attribute is included.
Login-IPv6-Host	Indicates the system with which to connect the user when the Login-Service Attribute is included.
Login-LAT-Group	Contains a string identifying the LAT group codes that this user is authorized to use.
Login-LAT-Node	Indicates the node with which the user is to be automatically connected by LAT.
Login-LAT-Port	Indicates the port with which the user is to be connected by LAT.
Login-LAT-Service	Indicates the system with which the user is to be connected by LAT.
Login-Service	Indicates the service to use to connect the user to the log in host.
Login-TCP-Port	Indicates the TCP port with which the user is to be connected when the Login-Service Attribute is also present.
MS-ARAP-Challenge	Only present in an Access-Request packet containing a Framed-Protocol Attribute with the value 3 (ARAP).
MS-ARAP-Password-Change-Reason	Indicates the reason for a server-initiated password change.
MS-Acct-Auth-Type	Represents the method used to authenticate the dial-up user.
MS-Acct-EAP-Type	Represents the Extensible Authentication Protocol (EAP) type used to authenticate the dial-up user.
MS-BAP-Usage	Describes whether the use of BAP is allowed, disallowed, or required on new multilink calls.
MS-CHAP-CPW-1	Allows the user to change password if it has expired.
MS-CHAP-CPW-2	Allows the user to change password if it has expired.
MS-CHAP-Challenge	Contains the challenge sent by a NAS to a MS-CHAP user.
MS-CHAP-Domain	Indicates the Windows NT domain in which the user was authenticated.
MS-CHAP-Error	Contains error data related to the preceding MS-CHAP exchange.
MS-CHAP-LM-Enc-PW	Contains the new Windows NT password encrypted with the old LAN Manager password hash.
MS-CHAP-MPPE-Keys	Contains two session keys for use by the Microsoft Point-to-Point Encryption (MPPE).

Attribute	Description
MS-CHAP-NT-Enc-PW	Contains the new Windows NT password encrypted with the old Windows NT password hash.
MS-CHAP-Response	Contains the response value provided by a PPP MS-CHAP user in response to the challenge.
MS-CHAP2-CPW	Allows the user to change password if it has expired.
MS-CHAP2-Response	Contains the response value provided by an MS- CHAP-V2 peer in response to the challenge.
MS-CHAP2-Success	Contains a 42-octet authenticator response string.
MS-Filter	Transmits traffic filters.
MS-Link-Drop-Time-Limit	Indicates the length of time (in seconds) that a link must be underutilized before it is dropped.
MS-Link-Utilization-Threshold	Represents the percentage of available bandwidth utilization below which the link must fall before the link is eligible for termination.
MS-MPPE-Encryption-Policy	Signifies whether the use of encryption is allowed or required.
MS-MPPE-Encryption-Types	Signifies the types of encryption available for use with MPPE.
MS-MPPE-Recv-Key	Contains a session key for use by the MPPE.
MS-MPPE-Send-Key	Contains a session key for use by the MPPE.
MS-New-ARAP-Password	Transmits the new ARAP password during an ARAP password change operation.
MS-Old-ARAP-Password	Transmits the old ARAP password during an ARAP password change operation.
MS-Primary-DNS-Server	Indicates the address of the primary domain name server (DNS) server to be used by the PPP peer.
MS-Primary-NBNS-Server	Indicates the address of the primary NetBIOS name server (NBNS) server to be used by the PPP peer.
MS-RAS-Vendor	Indicates the manufacturer of the RADIUS client machine.
MS-RAS-Version	Indicates the version of the RADIUS client software.
MS-Secondary-DNS-Server	Indicates the address of the secondary DNS server to be used by the PPP peer.
MS-Secondary-NBNS-Server	Indicates the address of the secondary DNS server to be used by the PPP peer.
Message-Authenticator	Signs Access-Requests to prevent spoofing Access-Requests using CHAP, ARAP, or EAP authentication methods.
NAS-IP-Address	Indicates the identifying IP address of the NAS that is requesting authentication of the user, and must be unique to the NAS within the scope of the RADIUS server.
NAS-IPv6-Address	Indicates the identifying IPv6 Address of the NAS that is requesting authentication of the user, and must be unique to the NAS within the scope of the RADIUS server.
NAS-Identifier	Contains a string identifying the NAS originating the Access-Request.
NAS-Port	Indicates the physical port number of the NAS that is authenticating the user.
NAS-Port-Id	Contains a text string that identifies the port of the NAS that is authenticating the user.
NAS-Port-Type	Indicates the type of the physical port of the NAS that is authenticating the user.
Password-Retry	Indicates how many authentication attempts a user is allowed to attempt before being disconnected.
Port-Limit	Sets the maximum number of ports to be provided to the user by the NAS.

Attribute	Description
Prompt	Indicates to the NAS whether it should echo the user's response as it is entered, or not echo it.
Proxy-State	Indicates that a proxy server can send this attribute to another server when forwarding an Access-Request. The attribute must be returned unmodified in the Access-Accept, Access-Reject or Access-Challenge.
Reply-Message	Indicates that the text that can be displayed to the user.
Service-Type	Indicates the type of service the user has requested, or the type of service to be provided.
Session-Timeout	Sets the maximum number of seconds of service to be provided to the user before termination of the session or prompt.
State	Indicates that the packet must have only zero or one State Attribute. Usage of the State Attribute is implementation dependent.
Telephone-number	Using the Calling-Station-Id and Called-Station-Id RADIUS attributes, authorization and subsequent tunnel attributes can be based on the phone number originating the call, or the number being called.
Termination-Action	Indicates the action the NAS should take when the specified service is completed.
Tunnel-Assignment-ID	Indicates to the tunnel initiator the particular tunnel to which a session is to be assigned.
Tunnel-Client-Auth-ID	Specifies the name used by the tunnel initiator during the authentication phase of tunnel establishment.
Tunnel-Client-Endpoint	Contains the address of the initiator end of the tunnel.
Tunnel-Link-Reject	Indicates the rejection of the establishment of a new link in an existing tunnel.
Tunnel-Link-Start	Marks the creation of a tunnel link.
Tunnel-Link-Stop	Marks the destruction of a tunnel link.
Tunnel-Medium-Type	Indicates the transport medium to use when creating a tunnel for those protocols (such as L2TP) that can operate over multiple transports.
Tunnel-Medium-Type	Indicates the transport medium to use when creating a tunnel for those protocols (such as L2TP) that can operate over multiple transports.
Tunnel-Password	Specifies a password used to access a remote server.
Tunnel-Preference	Indicates that if RADIUS server returns more than one set of tunneling attributes to the tunnel initiator, you should include this attribute in each set to indicate the relative preference assigned to each tunnel.
Tunnel-Private-Group-ID	Indicates the group ID for a particular tunneled session.
Tunnel-Reject	Marks the rejection of the establishment of a tunnel with another node.
Tunnel-Server-Auth-ID	Specifies the name used by the tunnel terminator during the authentication phase of tunnel establishment.
Tunnel-Server-Endpoint	Indicates the address of the server end of the tunnel.
Tunnel-Start	Marks the establishment of a tunnel with another node.
Tunnel-Stop	Marks the destruction of a tunnel to or from another node.
Tunnel-Type	Indicates the tunneling protocol(s) to be used (in the case of a tunnel initiator) or the tunneling protocol in use (in the case of a tunnel terminator).
User-Name	Indicates the name of the user to be authenticated.
User-Password	Indicates the password of the user to be authenticated, or the user's input following an Access-Challenge.

Understanding RADIUS Accounting

You can configure the device to send session start and stop messages to a RADIUS accounting server. The device sends a user-session start message after the user successfully signs in and the device maps to a role.

Whenever a user session is terminated, the device sends a user-session stop message to the accounting server. A user session is terminated whenever the user:

- Manually signs out
- Times out because of either inactivity or exceeding the maximum session length
- Is denied access because of Host Checker role-level restrictions
- Is manually forced out by an administrator as a result of dynamic policy evaluation

NOTE: If users are signed into a device cluster, the RADIUS accounting messages might show the users signing in to one node and signing out of another.

Table46 table describes the attributes that are common to start and stop messages.

Table46: Attributes Common to Start and Stop Messages

Attribute	Description
User-Name (1)	Specifies the string that the device administrator specifies during RADIUS server configuration.
NAS-IP-Address (4)	Specifies the device's IP address.
NAS-Port (5)	The device sets this attribute to 0 if the user signed in using an internal port, or 1 if an external port is used.
Framed-IP-Address (8)	Specifies the user's source IP address.
NAS-Identifier (32)	Specifies the configured name for the device client under the RADIUS server configuration.
Acct-Status-Type (40)	The device sets this attribute to 1 for a start message, or 2 for a stop message in a user-session or a subsession.
Acct-Session-Id (44)	Specifies the unique accounting ID that matches start and stop messages corresponding to a user-session or to a subsession.
Acct-Multi-Session-Id (50)	Specifies the unique accounting ID that you can use to link together multiple related sessions. Each linked session must have a unique Acct-Session-Id and the same Acct-Multi-Session-Id.
Acct-Link-Count (51)	Specifies the count of links in a multilink session at the time the system generates the accounting record.

Table47: Start Attributes

Attribute	Description
Acct-Authentic (45)	The device sets this attribute to: • RADIUS—if the user is authenticated to a RADIUS server. • Local—if the user is authenticated to a local authentication server. • Remote—if the user is authenticated through any other RADIUS server.

Table48: Stop Attributes

Attribute	Description
Acct-Session-Time (46)	Specifies the duration of the user-session or the subsession.
Acct-Terminate-Cause (49)	The device uses one of the following values to specify the event that caused the termination of a user session or a subsession: • User Request (1) – User manually signs out. • Idle Timeout (4) – User is Idle and times out. • Session Timeout (5) – User's maximum session times out. • Admin Reset (6) – User is forced out from active user's page.

Interoperability Requirements and Limitations

You must configure the third-party RADIUS server to communicate with the Pulse Secure access management framework.

On the RADIUS server, configure the following settings:

- Hostname.
- Network IP address.
- Client type, if applicable. If this option is available, select **Single Transaction Server** or its equivalent.
- Type of encryption for authenticating client communication. This choice should correspond to the client type.
- Shared secret.

The following are the requirements and limitations for Interim update feature:

- If you want a server to receive interim accounting messages, you can statically configure an interim value on the client, in which case, the locally configured value overrides any value that might be included in the RADIUS Access-Accept message.
- The octet count reported in the accounting messages is the cumulative total since the beginning of the user session.
- The interim update byte count is only supported based on a user session, not on SAM or NC sessions.

Configuring Authentication with a RADIUS Server

To configure authentication with the RADIUS server:

1. Select **Authentication** > **Auth. Servers**.
2. Select **RADIUS Server** and click **New Server** to display the configuration page.
3. Complete the configuration as described below.
4. Save the configuration.

Figure263: RADIUS Server Configuration Page

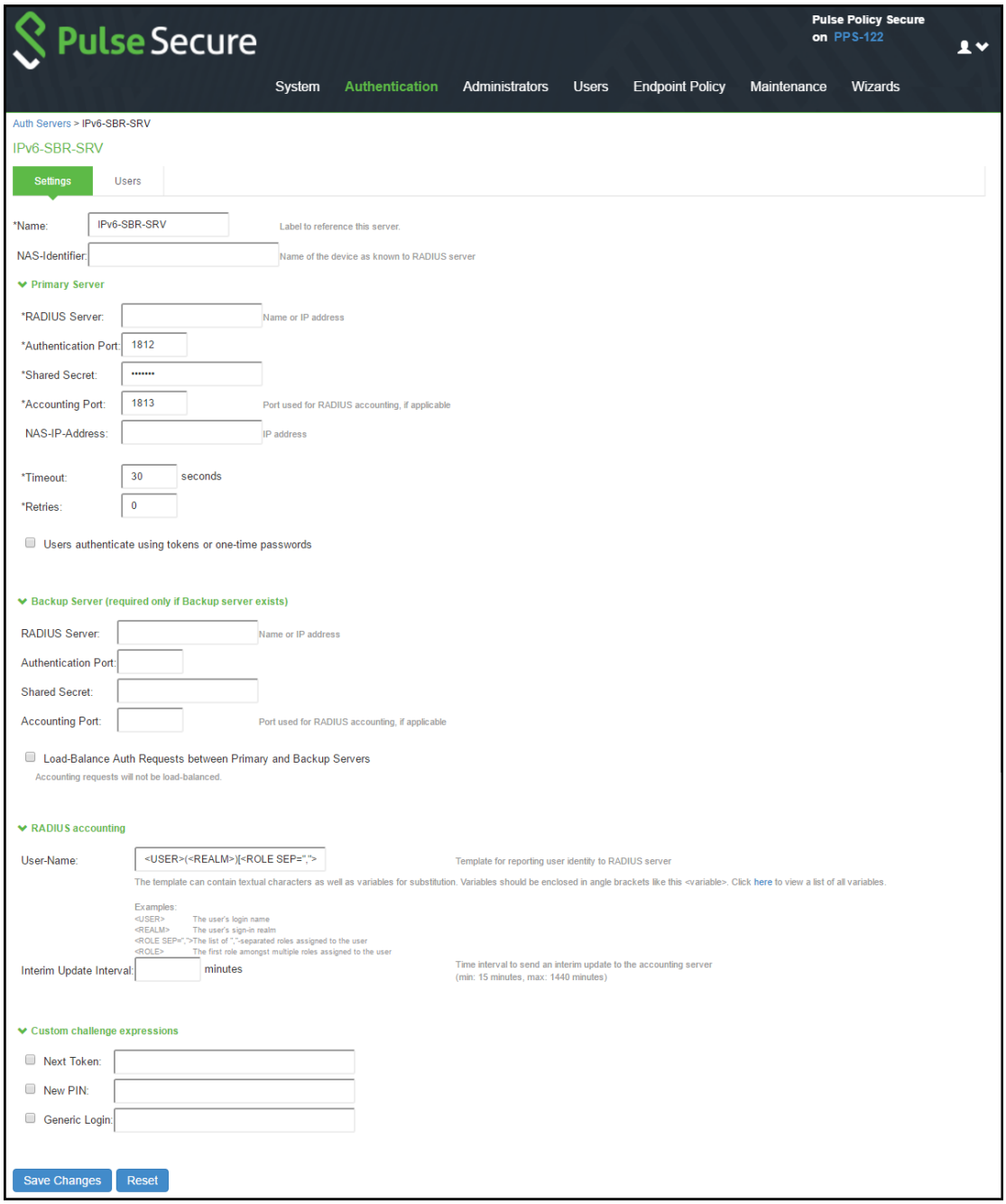


Table49: RADIUS Server Settings

Settings	Guidelines
Name	Specify a name to identify the server within the system.
NAS-Identifier	Specify the name that identifies the Network Access Server (NAS) client to the RADIUS server. NOTE: • If you do not specify the NAS identifier, the value specified in the Hostname field on the System > Network > Overview page of the administrator console is used. • If you use the RADIUS proxy feature, the NAS-Identifier field is not used. Proxy passes on the entire RADIUS packet including the NAS identifier from the client.

Settings	Guidelines
Primary Server	
Radius Server	Specify the name or IPv4/IPv6 address of the RADIUS server.
Authentication Port	Specify the authentication port value for the RADIUS server. Default port number: 1812, 1645 (legacy servers)
NAS-IP-Address	Specify the NAS IP address. NOTE: • If you leave this field empty, the internal IP address is passed to RADIUS requests. • If you configure the NAS IP address, then the system passes the value regardless of which cluster node sends the requests. • If you use the RADIUS proxy feature, this field is not used. Proxy passes on the entire RADIUS packet including the NAS IP address from the client.
Timeout (seconds)	Specify the interval of time to wait for a response from the RADIUS server before timing out the connection.
Retries	Specify the number of times to try to make a connection after the first attempt fails.
Users authenticate using tokens or one-time passwords.	Select this option to prompt the user for a token instead of a password. For example, you can use this option to dynamically prompt for a password or token based on sign-in policies by configuring two instances of the same authentication server. You can use one instance for wireless users with this option enabled and that prompts the user for a token, and another instance for wired users with this option disabled and that prompts the user for a password. NOTE: If you are using RADIUS proxy feature, this option is not used.
Backup Server (required only if Backup server exists)	
Radius Server	Specify the secondary RADIUS server. The authentication request is first routed to the primary RADIUS server, then to the specified backup server if the primary server is unreachable. Accounting messages are sent to the RADIUS server by each cluster node without consolidation. RADIUS accounting follows these assumptions: • If the cluster is active/passive, all users are connected to one node at a time. • If the cluster is active/active and does not use a balancer, users are connected to different nodes but are static. • If the cluster is active/active and uses a balancer, the balancer usually enforces a persistent source IP. In this case, users are always connected to the same node. NOTE: RADIUS does not support load balancing.
Authentication Port	Specify the authentication port.
Shared Secret	Specify the shared secret.
Accounting Port	Specify the accounting port.
Radius Accounting	

Settings	Guidelines
User-Name	Specify the user information to the RADIUS accounting server. You can enter any of the applicable session variables. Applicable variables include those that are set the time after the user signs in and maps to a role. The default variables for this field are as follows: • USER: Logs the username to the accounting server. • REALM: Logs the realm to the accounting server. • ROLE SEP=",": Logs the list of comma-separated roles assigned to the user. • ROLE: Logs the role to the accounting server. NOTE: If you assign the user to more than one role, the system separates them with commas.
Interim Update Interval (minutes)	Select this option to achieve more precise billing for long-lived session clients and during network failure. NOTE: • If you are using the RADIUS proxy feature, the fields in this section are not used. • The minimum interim update interval is 15 minutes. The data statistics (bytes in and bytes out) for RADIUS accounting might not be sent for a J-SAM/W-SAM/NC session if the session is less than 30 seconds long and the applications keep the connections open all the time.
Custom challenge expressions (Optional) Three types of challenge expressions exist with each automatically set to its pre-populated default. The custom option allows the administrator to configure the actual string pattern to match for any of the three modes. To add a custom expression, select the check box for the appropriate challenge expression type, and add a custom expression in the associated text box. NOTE: • If you use SecureID to authenticate users, then provide the user ID and the concatenation of PIN and the token value. • When using CASQUE authentication, specify:([0-9a-zA-Z/+=]+): as the custom expression for the Generic Login Challenge Expression. • If you are using the RADIUS proxy feature, the fields in this section are not used.	
Next Token	Specify the appropriate Next Token.
New PIN	Specify the New PIN.
Generic Login	Specify the Generic Login challenge to the user.

Using an ACE Server

This topic describes integration with an ACE Server (now named RSA Authentication Manager). It includes the following information:

- RSA Authentication Manager Overview
- Configuring Authentication with RSA Authentication Manager
- Displaying the User Accounts Table

RSA Authentication Manager Overview

This section describes support for using PPS with an ACE Server (now named RSA Authentication Manager). It includes the following sections:

- Understanding RSA Authentication Manager
- Feature Support
- Interoperability Requirements and Limitations

Understanding RSA Authentication Manager

RSA Authentication Manager (formerly known as ACE/Server) is an authentication and authorization server that allows user authentication based on credentials from the RSA SecurID® product from RSA Security Inc.

When you use RSA Authentication Manager as the authentication and authorization service for your Pulse Secure access management framework, users can sign in to PPS using the same username and password stored in the backend server.

Table50 describes RSA SecurID hardware token and software token user sign-in methods.

Table50: Sign-in Methods

Method	Action
Using a hardware token and the standard system sign-in page	The user browses to the standard system sign-in page, and then enters the username and password (consisting of the concatenation of the PIN and the RSA SecurID hardware token's current value). The system then forwards the user's credentials to the authentication server.
Using a software token and the custom SoftID system sign-in page	The user browses to the SoftID custom sign-in page. Then, using the SoftID plug-in, the user enters the username and PIN. The SoftID plug-in generates a passphrase by concatenating the user's PIN and token and passes the passphrase to the authentication server.

If the RSA Authentication Manager positively authenticates the user, the user gains access to the system. Otherwise, the RSA Authentication Manager:

- Denies the user access to the system.
- Prompts the user to generate a new PIN (New PIN mode) if the user is signing in to the system for the first time. Users see different prompts depending on the method they use to sign in.

  If the user signs in using the SoftID plug-in, then the RSA prompts the user to create a new pin; otherwise PPS prompts the user to create a new PIN.
- Prompts the user to enter the next token (Next Token mode) if the token entered by the user is out of sync with the token expected by RSA Authentication Manager. Next Token mode is transparent to users signing in using a SoftID token. The RSA SecurID software passes the token through the system to RSA Authentication Manager without user interaction.
- Redirects the user to the standard system sign-in page (SoftID only) if the user tries to sign-in to the RSA SecurID Authentication page on a computer that does not have the SecurID software installed.

Feature Support

Pulse Secure access management framework supports the following RSA Authentication Manager features:

- New PIN mode
- Next-token mode
- Data Encryption Standard (DES)/ Secure Dial-In (SDI) encryption
- Advanced Encryption Standard (AES) encryption
- Slave Authentication Manager support
- Name locking
- Clustering

Interoperability Requirements and Limitations

The following limitations apply when defining and monitoring an RSA Authentication Manager instance:

- You can only add one RSA Authentication Manager configuration to the system, but you can use that configuration to authenticate any number of realms.
- You cannot customize the load balancing algorithm.
- When you enter the New PIN or Next Token mode, enter the required information within three minutes. Otherwise, the system cancels the transaction and notifies the user to reenter the credentials.
- The system can handle a maximum of 200 RSA Authentication Manager transactions at any given time. A transaction only lasts as long as is required to authenticate against the RSA Authentication Manager.

  For example, when a user signs into the system, the RSA Authentication Manager transaction is initiated when the user submits the request for authentication and ends once the RSA Authentication Manager has finished processing the request. The user may then keep his or her session open, even though the RSA Authentication Manager transaction is closed.

Configuring Authentication with RSA Authentication Manager

To configure authentication with an ACE server:

1. Select **Authentication** > **Auth. Servers.**
2. Select **ACE Server** and click **New Server** to display the configuration page.
3. Complete the configuration as described in Table51.
4. Save the configuration.

Figure264:ACE server

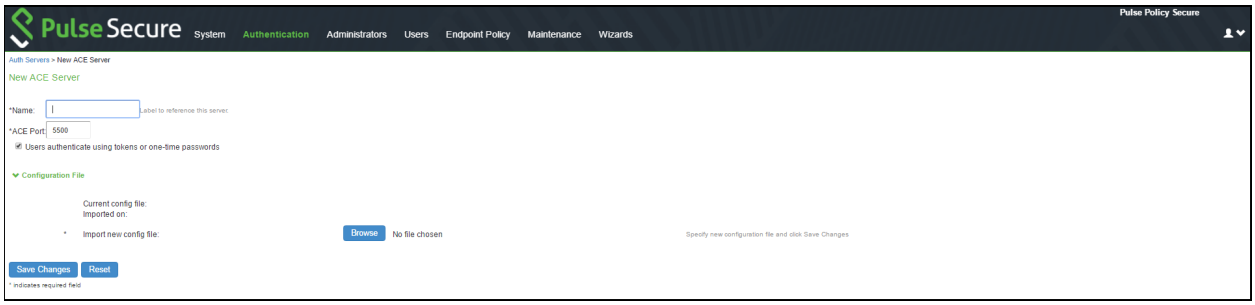


Table51: ACE Server Settings

Settings	Guidelines
Name	Specify a name to identify the server within the system.
ACE Port	Specify the default port of the authentication server. NOTE: If no port is specified in the sdconf.rec file, the default port is used.
Configuration File	
Current config file	Specify the RSA Authentication Manager configuration file. NOTE: You must update this file on the device anytime you make changes to the source file.
Imported on	Display the date on which the config file is imported.

Settings	Guidelines
Import new config file	Use the Choose File button to upload the sdconf.rec configuration file.
Node Verification File	
Node	Save the configuration to redisplay the configuration page. The updated page includes a section that lists a timestamp for the negotiation of the node secret between the system and the backend RSA server. The negotiation and verification automatically occurs after first successful log in. Do not expect entries in the table until at least one user has authenticated successfully.

Displaying the User Accounts Table

To display user accounts:

1. Select **Authentication > Auth. Servers**.
2. Click the link for the authentication server you want to manage.
3. Click the **Users** tab to display the user accounts table.

   The user accounts table includes entries for the accounts that have been created. The Last Sign-in Statistic column shows the last successful sign-in date and time for each user, the user's IP address, and the agent or browser type and version.
4. Use the controls to search for users and manage user accounts:

   - To search for a specific user, enter a username in the Show users named box and click **Update**.

     TIP: You can use an asterisk (*) as a wildcard, where * represents any number of zero or more characters. For example, to search for all usernames that contain the letters jo, enter ***jo***. The search is case-sensitive. To display the entire list of accounts again, type * or delete the field's contents and click **Update**.
   - To limit the number of users displayed on the page, enter a number in the Show *N* users box and click **Update**.
   - To terminate the user session and delete the account, select the check box next to the user account record and click **Delete**.

Using the SAML Server

This topic describes the local SAML authentication server. It includes the following information:

- Overview
- Configuring Authentication with the SAML Server
- Displaying the User Accounts Table

Overview

This section describes support for using the local SAML authentication server. It includes the following sections:

- Understanding SAML
- SAML Feature Support
- Interoperability Requirements and Limitations

Understanding SAML

SAML is an XML-based framework for communicating user authentication, entitlement, and attribute information. The standard defines the XML-based assertions, protocols, bindings, and profiles used in communication between SAML entities. SAML is used primarily to implement Web browser single sign-on (SSO). SAML enables businesses to leverage an identity-based security system like Connect Secure to enforce secure access to web sites and other resources without prompting the user with more than one authentication challenge.

For complete details on the SAML standard, see the OASIS web site:

http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=security

SAML Feature Support

When deployed as SAML service provider, PPS runs a local SAML server that relies on the SAML identity provider authentication and attribute assertions when users attempt to sign in to PPS. Note that authentication is only part of the PPS security system. The access management framework determines access to the system and protected resources.

PPS supports:

- HTTP Redirect binding for sending AuthnRequests
- HTTP Redirect binding for sending/receiving SingleLogout requests/responses
- HTTP POST and HTTP Artifact bindings for receiving SAML responses
- RequestedAuthnContext context class specifications

Note: PPS currently supports SAML server as Service Provider and PPS as SAML Identity Provider (IdP) is not supported.

Interoperability Requirements and Limitations

Before you begin:

- Check to see whether the SAML identity provider implements SAML 2.0 or SAML 1.1.
- Check to see whether the SAML identity provider uses HTTP POST or HTTP Artifact bindings for SAML assertions.
- Check to see whether the SAML identity provider has published a SAML metadata file that defines its configuration. If the SAML identity provider metadata file is available, configuration is simpler and less prone to error.
- Complete the system-wide SAML settings if you have not already done so. Select **System > Configuration > SAML > Settings**. For details, see “Configuring Global SAML Settings”.
- Add metadata for the SAML identity provider to the metadata provider list if you have not already done so. Select **System > Configuration > SAML**. For details, see “Managing SAML Metadata Files”.

The sign-in URL for which a session needs to be established for Connect Secure as a service provider is identified by the RelayState parameter (HTTP URL parameter for artifact and HTML form parameter for POST.) In a service provider initiated case, the system populates RelayState as an HTTP URL parameter while sending AuthnRequest. In the IdP-Initiated scenario (Connect Secure is a service provider and there is a third-party IdP), the IdP must be configured to set the appropriate Sign-in URL of Connect Secure in the RelayState parameter of the HTML form containing the SAML response. For more information, see the SAML 2.0 specification.

Configuring Authentication with the SAML Server

To configure the SAML server:

1. Select **Authentication > Auth. Servers**.

2. Select **SAML Server** and click **New Server** to display the configuration page.
3. Complete the configuration as described in Table 52.
4. Save the configuration.

Table 52: SAML Service Provider Profile

Settings	Guidelines
Name	Specify a name to identify the server instance.
Settings	
SAML Version	Select **2.0** or **1.1**, depending on the SAML version used by the SAML IdP.
Policy Secure Entity Id	This value is prepopulated. It is generated by the system, based on the value for the Host FQDN for SAML setting on the System > Configuration > SAML > Settings page.
Configuration Mode	Select **Manual** or **Metadata**. If a metadata file or location is available from the SAML identity provider, use the metadata option to make configuration simpler and less prone to error. To upload or set the location for the published metadata file, select **System > Configuration > SAML** and click the **New Metadata Provider** button.
Identity Provider Entity ID	The identity provider entity ID is sent as the Issuer value in the assertion generated by the SAML identity provider. If you use the metadata option, this setting can be completed by selecting the identity provider entity ID from the list. The list is populated by the identity provider entities defined in metadata files added to the System > Configuration > SAML page. If you complete this setting manually, specify the Issuer value in assertions generated by the SAML identity provider. Typically, you ask the SAML identity provider administrator for this setting.
Identity Provider Single Sign On Service URL	The identity provider SSO service URL is a URL provisioned by the SAML identity provider. The setting is required to support service-provider-initiated SSO. If missing, the system cannot successfully redirect the user request. If you use the metadata option, this setting can be completed by selecting the SSO service URL from the list. The list is populated by the identity provider entities defined in metadata files added to the System > Configuration > SAML page. If you complete this setting manually, ask the SAML identity provider administrator for this setting.
User Name Template	Specify how the system is to derive the username from the assertion. If the field is left blank, it uses the string received in the NameID field of the incoming assertion as the username. If you choose a certificate attribute with more than one value, the system uses the first matched value. For example, if you enter <certDN.OU> and the user has two values for the attribute (ou=management, ou=sales), the system uses “management”. To use all values, add the SEP attribute to the variable. For example, if you enter <certDN.OUT SEP=":">, the system uses “management:sales”. The attributes received in the attribute statement in the incoming assertion are saved under userAttr. These variables can also be used with angle brackets and plain text. If the username cannot be generated using the specified template, the login fails. If the NameID filed of the incoming assertion is of type X509Nameformat, then the individual fields can be extracted using system variable “assertionNameDN”. NOTE: Currently supported NameIDs are - EMAIL, X509_SUBJECT, WIN_DOMAIN_QUALIFIED. If a SAML request is received with a different NameId format, then processing of the request fails with unsupported NameId format error message.

Settings	Guidelines
Allowed Clock Skew (minutes)	Specify the maximum allowed difference in time between the system clock and the SAML identity provider server clock. NOTE: SAML is a time sensitive protocol. The time-based validity of a SAML assertion is determined by the SAML identity provider. If the SAML identity provider and SAML service provider clocks are askew, the assertion can be determined invalid, and you will receive the following error: **"SAML Transferred failed. Please contact your system administrator. Detail: Failure: No valid assertion found in SAML response."** Ensure that the clocks are synchronized using NTP server and that you set an Allowed Clock Skew value that accommodates any expected or permissible skew.
Support Single Logout	Single logout is a mechanism provided by SAML for logging out a particular user from all the sessions created by the identity provider. Select this option if the system must receive and send a single logout request for the peer SAML identity provider. If you use the metadata option, the Single Logout Service URL setting can be completed by selecting the SLO service URL from the list. The list is populated by the identity provider entities defined in metadata files added to the System > Configuration > SAML page. The system sends Single Logout requests to this URL. In addition, if you use the metadata option, the Single Logout Response URL setting is completed based on your selection for Single Logout Service URL. If the identity provider has left this setting empty in its metadata file, the system sends the Single Logout response to the SLO service URL. If you complete these settings manually, ask the SAML identity provider administrator for guidance. The Support Single Logout service for the identity provider must present a valid certificate.
SSO Method	
Artifact	When configured to use the Artifact binding, the system contacts the Artifact Resolution Service (ARS) to fetch the assertion using SOAP protocol. If the ARS is hosted on a HTTPS URL, then the certificate presented by the ARS is verified by the system. For this verification to pass successfully, the CA of the server certificate issued to the identity provider ARS must be added to the trusted server CA on the system. Complete the following settings to configure SAML using the HTTP Artifact binding: • Source ID. Enter the source ID for the identity provider ARS. Source ID is Base64-encoded, 20-byte identifier for the identity provider ARS. If left blank, this value is generated by the system. • Source Artifact Resolution Service URL. For metadata-based configuration, this field is completed automatically from the metadata file and is not configurable. For manual configurations, enter the URL of the service to which the SP ACS is to send ArtifactResolve requests. ArtifactResolve requests are used to fetch the assertion from the artifact received by it. • SOAP Client Authentication. Select **HTTP Basic** or **SSL Client Certificate** and complete the related settings. If you use an SSL client certificate, select a certificate from the device certificate list. • Select Device Certificate for Signing. Select the device certificate the system uses to sign the AuthnRequest sent to the identity provider SSO service. If you do not select a certificate, the system does not sign AuthnRequest. • Select Device Certificate for Encryption. Select the device certificate the system uses to decrypt encrypted data received in the SAML response. The public key associated with the device certificate is used by the identity provider for encryption.

Settings	Guidelines
POST	When configured to use the POST binding, the system uses a response signing certificate to verify the signature in the incoming response or assertion. The certificate file must be in PEM or DER format. The certificate you select should be the same certificate used by the identity provider to sign SAML responses. Complete the following settings to configure SAML using the HTTP POST binding: • Response Signing Certificate. If you use the metadata-based configuration option, select a certificate from the list. The list is populated by the identity provider entities defined in metadata files added to the System > Configuration > SAML page. If you configure these settings manually, browse to and upload the certificate to be used to validate the signature in the incoming response or assertion. If no certificate is specified, the certificate embedded in the response is used. • Enable Signing Certificate status checking. Select this option to check the validity of the signing certificate before verifying the signature. This setting applies to any certificate used for signature verification. If this option is enabled, the response will be rejected if the certificate is revoked, expired, or untrusted. If this option is selected, the certificate CA must be added to the Trusted Client CA store. If this option is not enabled, then the certificate is used without any checks. • Select Device Certificate for Signing. Select the device certificate the system uses to sign the AuthnRequest sent to the identity provider SSO service. If you do not select a certificate, the system does not sign AuthnRequest. • Select Device Certificate for Encryption. Select the device certificate the system uses to decrypt encrypted data received in the SAML response. The public key associated with the device certificate is used by the identity provider for encryption.
Authentication Context Classes	Use the **Add** and **Remove** buttons to select authentication context classes to be sent in the authentication requests to the SAML identity provider. These are included in the RequestedAuthnContext element. In the OASIS standard, an authentication context is defined as “the information, additional to the authentication assertion itself, that the relying party may require before it makes an entitlements decision with respect to an authentication assertion.” This feature supports all authentication context classes specified in the SAML 2.0 OASIS Authn Context specification. For example, if you select X509, the system sends the following context: <samlp:RequestedAuthnContext> <saml:AuthnContextClassRef xmlns:saml="urn:oasis:names:tc:SAML:2.0:assertion"> urn:oasis:names:tc:SAML:2.0:ac:classes:X509</saml:AuthnContextClassRef> </samlp:RequestedAuthnContext> In response, the SAML IdP sends the context data along with the authentication results. The system stores the context data in the session cache and as a system variable named samlAuthnContextClass. The system variable can be used in role mapping rules and resource policy detailed rules.
	Specify a comparison attribute within the RequestedAuthnContext element. The comparison attribute specifies the relative strengths of the authentication context classes specified in the request and the authentication methods offered by a SAML IdP. The following values defined in the SAML 2.0 OASIS core specification can be selected: • **exact**—Requires the resulting authentication context in the authentication statement to be the exact match of at least one of the authentication contexts specified. • **minimum**—Requires the resulting authentication context in the authentication statement to be at least as strong as one of the authentication contexts specified. • **maximum**—Requires the resulting authentication context in the authentication statement to be stronger than any one of the authentication contexts specified. • **better**—Requires the resulting authentication context in the authentication statement to be as strong as possible without exceeding the strength of at least one of the authentication contexts specified. Select the same value that is configured on the SAML IdP. If none is specified in the SAML IdP configuration, the implicit default is exact.

Service Provider Metadata Settings

Settings	Guidelines
Metadata Validity	Enter the number of days the metadata is valid. Valid values are 0 to 9999. 0 specifies the metadata does not expire.
Do Not Publish PPS Metadata	Select this option if you do not want to publish the metadata at the location specified by the Entity ID field.
Download Metadata	This button appears only after you have saved the authentication server configuration. Use this button to download the metadata of the current SAML service provider.

Displaying the User Accounts Table

To display user accounts, refer to the steps found in Displaying the User Accounts Table.

Access Control with SAML Server

In a SAML deployment, a SAML service provider is configured to request authentication from a SAML identity provider. The SAML identity provider responds with assertions regarding the identity, attributes, and entitlements (according to your configuration). The exchange enforces security and enables the SSO user experience.

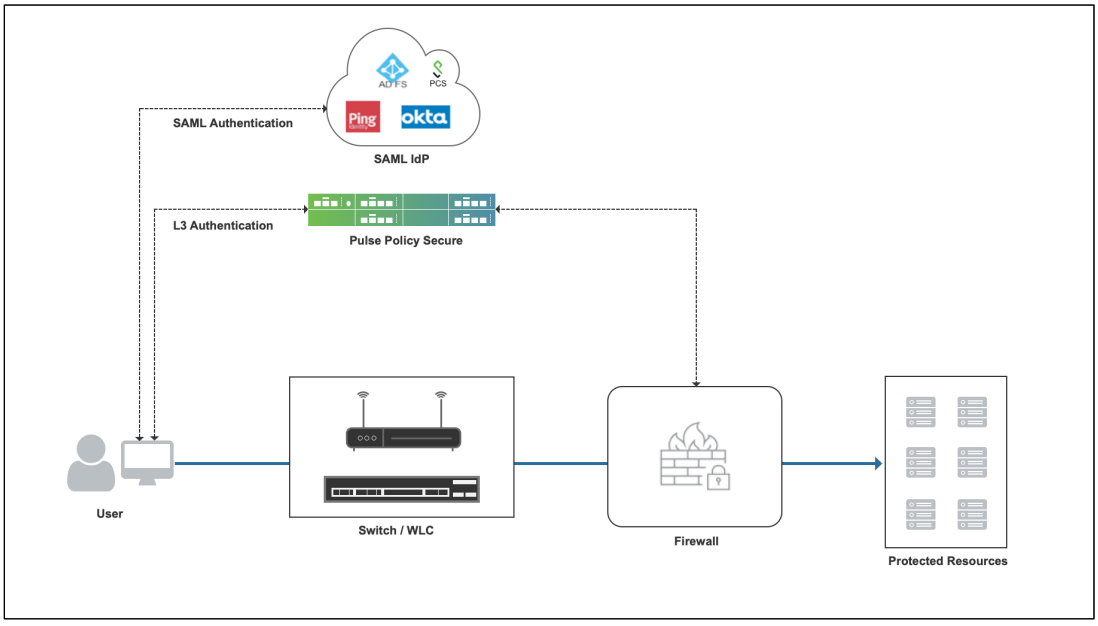
PPS as a SAML Service Provider

If you are working with a partner that has implemented a SAML identity provider, you can deploy the PPS as a SAML service provider to inter-operate with it, thereby enabling SSO for users who should have access to protected resources. In this model, the user is authenticated by the SAML identity provider. The system uses the SAML response containing the assertion to make an authentication decision.

The choices the identity provider makes to implement SAML determine the deployment choices, for example whether to use SAML 2.0 or SAML 1.1, whether to reference a published metadata configuration file, and whether to use a POST or artifact profile. When you deploy the system as a SAML service provider, you create a SAML authentication server configuration that references the partner SAML identity provider, and a set of access management framework objects (realm, role mapping rules, and sign-in policy) that reference the SAML authentication server.

Layer 3 Authentication and Enforcement using SAML Server

The below deployment diagram shows how to access firewall protected resources using SAML server on PPS.

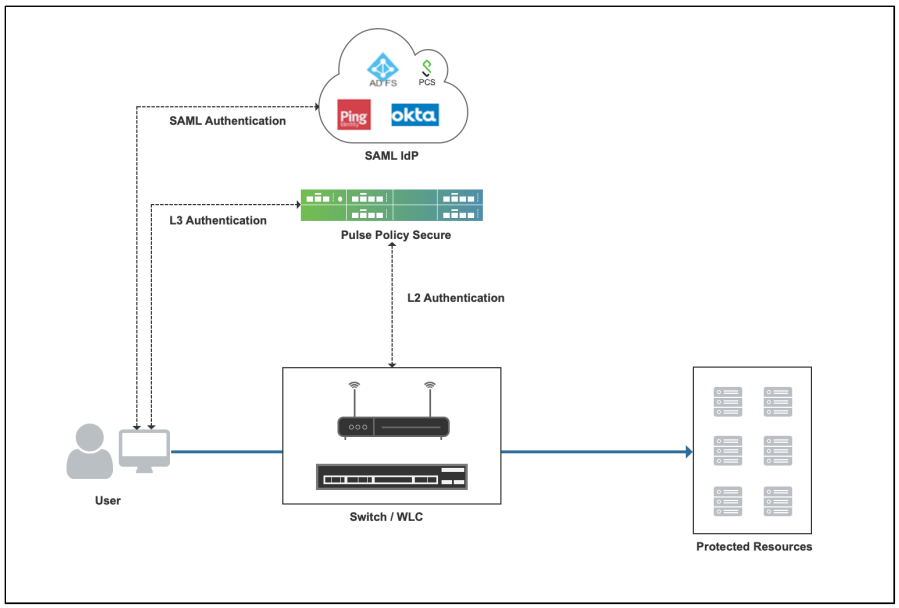


1. End user using an user agent (either a browser or a Pulse client) authenticates to PPS
2. PPS acting as a SAML Service Provider (SP), issues a SAML authentication (SAML AuthN) request to SAML IdP through the user agent. If SAML authentication request is valid, IdP authenticates the end user and generates SAML assertion and sends it to PPS (SAML SP) through user agent.
3. PPS validates the SAML assertion and if it's valid, authentication is successful.
4. The user is first authenticated with SAML IdP. Once end user is authenticated appropriate role is assigned and the user ID is pushed to firewall. The end user can access the protected resource.

Note: Pulse Client uses embedded browser for SAML authentication. It should be enabled on the Pulse Client connection settings in PPS.

Layer 2 Authentication and Enforcement using SAML Server

The below deployment diagram shows how to access switch protected resources using SAML server on PPS.



For Layer 2 access control using SAML server on PPS, below mechanism is used:

1. MAC address authentication is performed using either RADIUS or SNMP for Layer 2 authentication. The session is created on PPS after successful MAC authentication and the user is provided with a limited access role since the Host Checker is not performed.
2. The user must be able to access both PPS and SAML IdP after L2 authentication. For policy enforcement using MAC address authentication, see here.
3. Pulse Client or web browser is used to perform Layer 3 authentication using SAML server.
4. After successful Layer 3 authentication on PPS via SAML IdP, both Layer 2 (MAC authentication) and Layer 3 (SAML authentication) connections are bridged using MAC address.
5. Host Checker is performed and if the SAML authentication is successful the user is provided with Full Access Role.
6. The user can access protected resources.

Note: Layer 2 session is updated with the RADIUS attributes of the Layer 3 connection. The bridged session is used to perform Layer 2 access control. For more information on session bridging, see here.

SAML 2.0 Configuration Tasks

To use SAML server on PPS follow the below configuration steps:

- Configure SAML host FQDN under **Configuration > SAML > Settings**. This FQDN is used to generate SAML Entity Id. See Configuring System-Wide SAML Settings.
- Configure third party SAML IdP like Ping Federate, Okta. Get SAML IdP metadata and configure it under **Configuration > SAML > New Metadata Provider**. Under Metadata Provider configuration, "Identity Provider" roles should be selected since it is an SAML IdP metadata. (For screenshot, refer section "Admin UI changes")
- Configure SAML Server under **Authentication > Auth. Server**. See Configuring SAML Authentication server.

    - If SAML IdP's metadata is not configured, admin needs to configure IdP's information manually.
    - If only one IdP metadata is configured, IdP information is automatically populated. If multiple IdP metadata are configured, admin needs to selected approriate IdP's information.
    - If admin wants to sign or encrypt the request, appropriate certificates need to be selected.

- After configuring SAML server on PPS, the metadata of PPS acting as an SAML SP can be downloaded from SAML server page.
- Configure PPS metadata on SAML IdP and configured SAML SP details on IdP. See Configuring PPS as a SAML 2.0 Service Provider

Configuring System-Wide SAML Settings

This section describes tasks related to configuring system-wide SAML settings. It includes the following topics:

- Configuring Global SAML Settings
- Managing SAML Metadata Files

Configuring Global SAML Settings

The system-wide SAML settings impact all SAML service provider and identity provider instances.

To configure global SAML settings:

1. Select **System > Configuration > SAML**.
2. Click the **Settings** button to display the configuration page.
3. Complete the settings described in Table 53.
4. Click **Save Changes**.

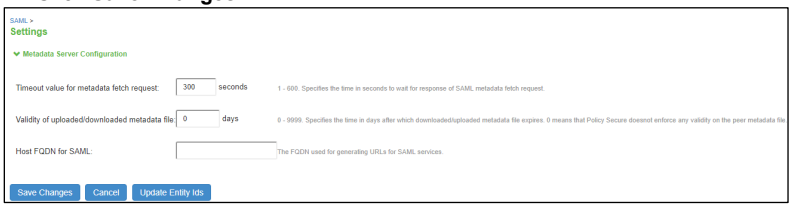


Table 53: SAML Global Configuration Guidelines

Settings	Guidelines
Timeout value for metadata fetch request	Specify the number of seconds after which a download request is abandoned. If the peer SAML entity publishes its metadata at a remote location, the system downloads the metadata file from the specified location.
Validity of uploaded/downloaded metadata file	Specify the maximum duration for which the system considers the metadata file of the peer SAML entity to be valid. If the metadata file provided by the peer SAML entity contains validity information, the lower value takes precedence.

Settings	Guidelines
Host FQDN for SAML	Specify the fully qualified domain name for the Connect Secure host. The value you specify here is used in the SAML entity ID and the URLs for SAML services, including: • Entity ID for SAML service provider and SAML identity provider instances. The SAML entitiy ID is the URL where the system publishes its SAML metadata file. • Single sign-on service URL • Single logout service URL • Assertion consumer service URL • Artifact resolution service URL BEST PRACTICE: The system uses HTTPS for these services. It is recommend to assign a valid certificate to the interface that has the IP address to which this FQDN resolves so that users do not see invalid certificate warnings.

Managing SAML Metadata Files

You use the System > Configuration > SAML pages to maintain a table of SAML metadata files for the SAML service providers and identity providers in your network. Using SAML metadata files makes configuration easier and less prone to error.

You can add the metadata files to the system by:

- Uploading a metadata file.
- Retrieving the metadata file from a well-known URL.

To add metadata files:

1. Select **System > Configuration > SAML**.
2. Click **New Metadata Provider** to display the configuration page.
3. Complete the settings described in Table 54.
4. Save the configuration.

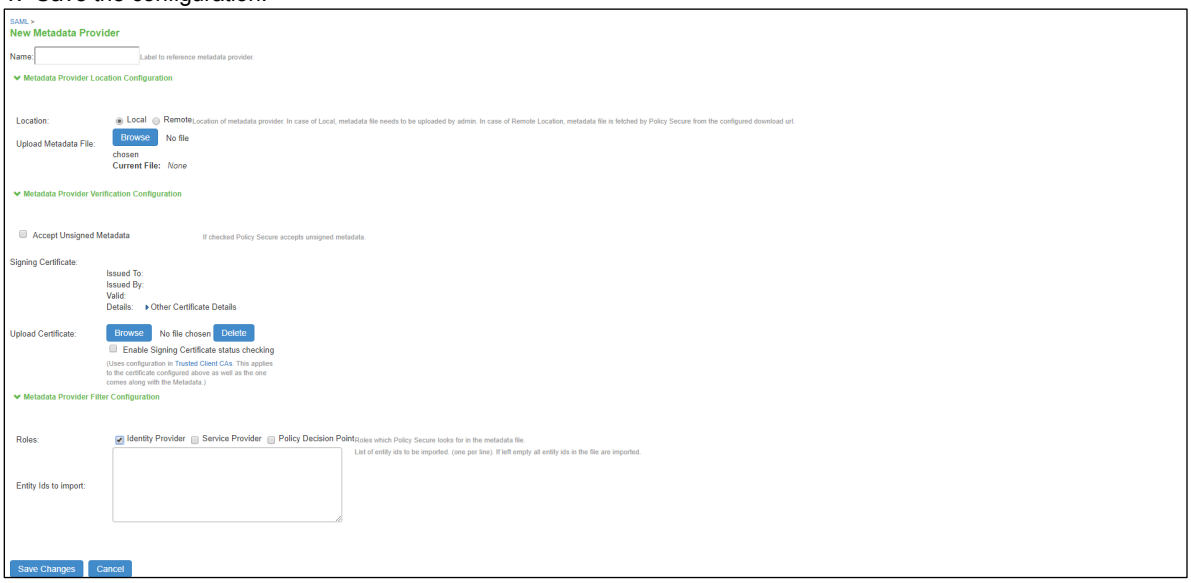


Table 54: SAML Metadata Provider Configuration Guidelines

Settings	Guidelines
Metadata Provider Location Configuration	Select one of the following methods: • **Local**. Browse and locate the metadata file on your local host or file system. • **Remote**. Enter the URL of the metadata file. Only http and https protocols are supported.
Metadata Provider Verification Configuration	
Accept Untrusted Server Certificate	If you specify a URL for the metadata provider, select this option to allow the system to download the metadata file even if the server certificate is not trusted. This is necessary only for HTTPS URLs.
Accept Unsigned Metadata	If this option is not selected, unsigned metadata is not imported. Signed metadata is imported only after signature verification.
Signing Certificate	Browse and locate the certificate that verifies the signature in the metadata file. This certificate overrides the certificate specified in the signature of the received metadata. If no certificate is uploaded here, then the certificate present in the signature of the received metadata is used. Select the **Enable Certificate Status Checking** option to verify the certificate before using it. Certificate verification applies both to the certificate specified here and the certificate specified in the signature in the metadata file.
Metadata Provider Filter Configuration	
Roles	Select whether the metadata file includes configuration details for a SAML service provider, identity provider, or Policy Decision Point. You may select more than one. If you select a role that is not in the metadata file, it is ignored. If none of the selected roles are present in the metadata file, the system returns an error.
Entity IDs To Import	Enter the SAML Entity IDs to import from the metadata files. Enter only one ID per line. Leave this field blank to import all IDs. This option is available only for uploading local metadata files.

The Refresh button downloads the metadata files from the remote location even if these files have not been modified. This operation applies only to remote locations; local metadata providers are ignored if selected.

To refresh a metadata file:

1. Select **System > Configuration > SAML**.
2. Select the metadata file to refresh and click **Refresh**.

To delete a metadata file:

1. Select **System > Configuration > SAML**.
2. Select the metadata file to delete and click **Delete**.

Configuring PPS as a SAML 2.0 Service Provider

This topic describes how to configure the system as a SAML service provider. When the system is a SAML service provider, it relies on the SAML identity provider authentication and attribute assertions when users attempt to sign in to the device. Note that authentication is only part of the security system. The access management framework determines access to the system and protected resources.

The system supports:

- HTTP Redirect binding for sending AuthnRequests
- HTTP Redirect binding for sending/receiving SingleLogout requests/responses
- HTTP POST and HTTP Artifact bindings for receiving SAML responses
- RequestedAuthnContext context class specifications

Before you begin:

- Check to see whether the SAML identity provider uses HTTP POST or HTTP Artifact bindings for SAML assertions.
- Check to see whether the SAML identity provider has published a SAML metadata file that defines its configuration. If the SAML identity provider metadata file is available, configuration is simpler and less prone to error.
- Complete the system-wide SAML settings if you have not already done so. Select **System > Configuration > SAML > Settings**. For details, see "Configuring Global SAML Settings".
- Add metadata for the SAML identity provider to the metadata provider list if you have not already done so. Select **System > Configuration > SAML**. For details, see "Managing SAML Metadata Files".

The sign-in URL for which a session needs to be established for the system as a service provider is identified by the RelayState parameter (HTTP URL parameter for artifact and HTML form parameter for POST.) In a service provider initiated case, the system populates RelayState as an HTTP URL parameter while sending AuthnRequest. In the IdP-Initiated scenario (Connect Secure is a service provider and there is a third-party IdP), the IdP must be configured to set the appropriate Sign-in URL of the system in the RelayState parameter of the HTML form containing the SAML response. For more information, see the SAML 2.0 specification.

To configure the system as a SAML service provider:

1. Select **Authentication > Auth. Servers**.
2. Select **SAML Server** from the New list and then click **New Server** to display the configuration page.
3. Complete the settings as described in Table 52.
4. Save the configuration.

After you save changes for the first time, the page is redisplayed and now has two tabs. Use the Settings tab to modify any of the settings pertaining to the SAML server configuration. Use the Users tab to monitor user sessions.

Next steps:

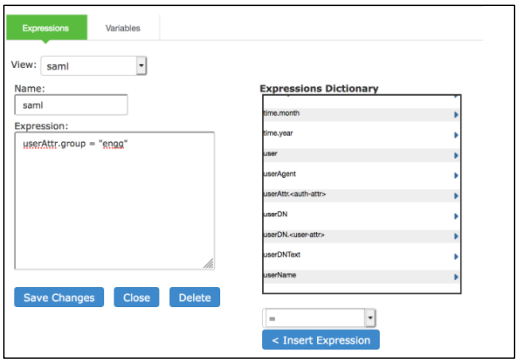
- Configure the access management framework to use the SAML authentication server. Start with realm and role mapping rules. For details, see "Creating an Authentication Realm" and "Specifying Role Mapping Rules for an Authentication Realm".
- Configure a sign-in policy. When using a SAML authentication server, the sign-in policy can map to a single realm only. For details, see "Defining a Sign-In Policy".

Configuring a Role Mapping Rule Based on a SAML Attribute

You can use role mapping rule custom expressions to include SAML Attribute statement as a factor in role determination. PPS uses attributes from attribute statement in "**User Name Template**" under **Authentication > Auth. Server > SAML Server.**

To configure role mapping rules:

1. Select **Users > User Realms**.
2. Create a new realm or edit a realm you have already created.
3. Click **New Rule** to display the configuration page.
4. Select **Custom Expression** and click **Update** to redisplay the configuration page with the controls related to custom expressions.
5. Click **Expressions** to display the server catalog dialog box.



6. On SAML IdP, attributes in attribute statement can be configured as name-value pairs and/or can be fetched from directory server. For example, an attribute with name="group" and value="engg" can be configured on IdP asserts that an authenticated user belongs to engineering group. SAML assertion from IdP contains this attribute in attribute statement.
7. Select **samlAuthnContextClass**, select an operator, and click **Insert Expression**.
8. Edit the expression template to match the AuthnContextClassRef data expected from the SAML IdP.
9. Save your changes to the variable expression and return to the rule configuration page.
10. Select the expression, roles for the rule, and the stop option (if desired).
11. Save your changes to the rule configuration and return to the realm configuration page.
12. Reorder the rules if necessary.
13. Save the realm configuration.

Using a SiteMinder Server

This topic describes integration with the SiteMinder server. It includes the following information:

- SiteMinder Server Overview
- Configuring the Back-End SiteMinder Server
- Configuring Authentication with a SiteMinder Server
- Displaying the User Accounts Table

SiteMinder Server Overview

This section describes support for using PPS with the SiteMinder server. It includes the following sections:

- Understanding SiteMinder Server
- Feature Support
- Interoperability Requirements and Limitations

Understanding SiteMinder Server

CA SiteMinder server is an authentication and authorization server.

When you configure the Pulse Secure access management framework to authenticate users with a SiteMinder policy server, the system passes the user's credentials to SiteMinder during authentication. Once SiteMinder receives the

credentials, it may use standard username and password authentication, RSA Authentication Manager SecurID tokens, or client-side certificates to authenticate the credentials.

The system also passes a protected resource URL to SiteMinder during authentication to determine which SiteMinder realm it should use to authenticate the user. When the system passes the protected resource URL, SiteMinder authorizes the user's URL against the realm that is associated with the resource and allows the user to seamlessly access any resources whose protection levels are equal to or less than the URL that was passed.

Feature Support

The Pulse Secure access management framework supports the following SiteMinder features:

- Single Sign-on Using SMSESSION Cookies
- Automatic Sign-In
- Authentication Schemes

Single Sign-on Using SMSESSION Cookies

The Pulse Secure access management framework enables single sign-on (SSO) to SiteMinder-protected resources using SMSESSION cookies. An SMSESSION cookie is a security token that encapsulates SiteMinder session information. Depending on your configuration, either the SiteMinder Web agent or the system creates an SMSESSION cookie and then posts the cookie to the following locations so the user does not have to reauthenticate to access additional resources.

- Pulse Secure access management framework-If the user tries to access a SiteMinder resource within the session (for example, from the system file browsing page), the system passes its cached SMSESSION cookie to the Web agent for authentication.
- The user's Web browser-If the user tries to access a SiteMinder resource from outside the session (for example, when using a protected resource on a standard agent), SiteMinder uses the cached SMSESSION cookie stored in the user's Web browser to authenticate/authorize the user.

Automatic Sign-In

If you enable the Automatic Sign-In option, the system can use an SMSESSION cookie generated by another agent to enable single sign-on from a SiteMinder resource. When a user accesses the system sign-in page with an SMSESSION cookie, the system verifies the SMSESSION cookie. Upon successful verification, the system establishes a session for the user. You can use the following authentication mechanisms when you enable automatic sign-in through the system:

- Custom agent-The system authenticates the user against the policy server and generates a SMSESSION cookie. When you select this option, you can enable SSO on other SiteMinder agents that use the same policy server. To enable SSO on these agents, update each of them to accept third-party cookies. If you select this option and the user enters his system session with an SMSESSION cookie, the system attempts automatic sign-in when the user enters the session.
- HTML form post-The system posts credentials to a standard Web agent that you have already configured. The Web agent then creates SMSESSION cookies. If you select this option, you cannot use SecurID New Pin and Next Token modes or client-side certificate authentication. If you select this option and the user enters his session with an SMSESSION cookie, the system attempts automatic sign-in when the user enters the session.
- Delegated authentication-The system delegates authentication to a standard agent. If this option is enabled, the system tries to determine the FCC URL associated with the protected resource. The system then redirects the user to the FCC URL with the system sign-in URL as the target. Upon successful authentication, the user is redirected back to the system with an SMSESSION cookie and the system does an automatic sign-in for the user.

Authentication Schemes

The Pulse Secure access management framework works with the following types of SiteMinder authentication schemes:

- Basic username and password authentication—The user's name and password are passed to the SiteMinder policy server. The policy server authenticates them to another server for authentication.
- RSA Authentication Manager SecurID token authentication—The SiteMinder policy server authenticates users based on a username and password generated by an RSA Authentication Manager SecurID token.
- Client-side certificate authentication—The SiteMinder policy server authenticates users based on their client-side certificate credentials. If you choose this authentication method, the Web browser displays a list of client certificates from which users can select. If you choose to authenticate users with this method, you must import the client certificate through the System > Certificates > Trusted Client CAs tab.

Interoperability Requirements and Limitations

The following requirements and limitations apply:

- The Automatic Sign-in feature is not supported for administrator roles. This feature is only available for end users.
- If you use the Authenticate using custom agent option, update all other Web agents to accept the device generated cookie, and apply a software patch to all other Web agents.
- PPS supports SiteMinder server version 6.0, version 5.5, and version 12.0. If you run older agents than the supported agents, you might experience cookie validation problems, including crossed log entries and intermittent user timeouts.
- You can choose which SiteMinder server version you want to support when you create a server instance. You can choose version 5.5, which supports both versions 5.5 and 6.0, or you can choose version 6.0, which supports only version 6.0, or version 12.0. There is no difference in the SiteMinder authentication server functionality based on which version you select. This option only controls the version of the SDK to use. We recommend you match the compatibility mode with the version of the policy server.
- When you use SiteMinder to authenticate, the primary and backup policy servers must run the same SiteMinder server software version. A mixed deployment (where the primary server runs a different server software version than the backup) is not supported.
- SiteMinder does not store the IP address in the SMSESSION cookie, and therefore cannot pass it to the system.
- SiteMinder sends the SMSESSION cookie to the system as a persistent cookie. To maximize security, the system resets the persistent cookie as a session cookie once authentication is complete.
- When you use SiteMinder to authenticate, the Pulse Secure access management framework disregards any system session and idle timeouts and uses session and idle timeouts set through the SiteMinder realm instead.
- When you use SiteMinder to authenticate, users must access the system using a fully qualified domain name. This is because the SiteMinder SMSESSION cookie is only sent for the domain for which it is configured. If users access the system using an IP address, they might receive an authentication failure and will be prompted to authenticate again.
- You can update all your standard Web agents to the appropriate SiteMinder Agent Quarterly Maintenance Release (QMR) to accept the cookies. If you are running SiteMinder version 5 Web agents, use the QMR5 hot fix. The system is compatible with version 5.x and later SiteMinder agents. Older versions of SiteMinder agents are susceptible to cookie validation failures.
- You can set the Accept Third Party Cookie attribute (AcceptTPCookie) to yes in the Web agent's configuration file (webagent.conf) or to 1 in the Windows Registry for the IIS Web server. The location of the attribute depends on the SiteMinder version and Web server you are using. Refer to the documentation provided with your SiteMinder server.

Configuring the Back-End SiteMinder Server

The following sections do not give complete SiteMinder configuration instructions—they are only intended to help you make SiteMinder work with the Pulse Secure access management framework. For in-depth SiteMinder configuration information, refer to the documentation provided with your SiteMinder policy server.

Configuring the SiteMinder Agent

A SiteMinder agent filters user requests to enforce access controls. For instance, when a user requests a protected resource, the agent prompts the user for credentials based on an authentication scheme and sends the credentials to a SiteMinder policy server. A Web agent is simply an agent that works with a Web server. When configuring SiteMinder to work with the Pulse Secure access management framework, you must configure the system as a Web agent in most cases.

If you select the Delegate authentication to a standard agent option, you must set the following options in the agent configuration object of the standard Web agent to host the FCC URL:

- <EncryptAgentName=no>
- <FCCCompatMode=no>

To configure the system as a Web agent on the SiteMinder policy server:

In the SiteMinder Administration interface, click the **System** tab.

1. Right-click **Agents** and select **Create Agent**.
2. Enter a name for the Web agent and a description. You must enter this name when creating a SiteMinder realm.
3. Select the **Support 5.x agents** option for compatibility with the system.
4. Under Agent Type, select **SiteMinder** and then select **Web Agent** from the list. This setting is required for compatibility with the system.
5. Under IP Address or Hostname, enter the name or IP address of the system.
6. In the Shared Secret box, enter and confirm a secret for the Web agent. Note that you must enter this secret when configuring the system.
7. Click **OK**.

Configuring the Authentication Scheme

Within SiteMinder, an authentication scheme is a way to collect user credentials and determine the identity of a user. You may create different authentication schemes and associate different protection levels with each. For example, you may create two schemes—one that authenticates users based solely on the users' client-side certificates and provides them a low protection level, and a second that uses RSA Authentication Manager SecurID token authentication and provides users a higher protection level.

To configure a SiteMinder authentication scheme:

In the SiteMinder Administration interface, select the **System** tab. Right-click **Authentication Schemes** and select **Create Authentication Scheme**.

1. Enter a name for the scheme and (optionally) a description. You must enter this name when configuring the SiteMinder realm.
2. Under Authentication Scheme, select one of the following options:

- **Basic Template**
- **HTML Form Template**
- **SecurID HTML Form Template**-If you are using SecurID authentication, you must choose SecurID HTML Form Template (instead of SecurID Template). Choosing this option enables the Policy Server to send ACE sign-in failure codes.
- **X509 Client Cert Template**
- **X509 Client Cert and Basic Authentication**

NOTE:

- You must select HTML Form Template to handle reauthentication.
- If you select X509 Client Cert Template or X509 Client Cert and Basic Authentication, you must import the certificate through System > Certificates > Trusted Client CAs.

3. Enter a protection level for the scheme. Note that this protection level carries over to the SiteMinder realm that you associate with this scheme.
4. Select **Password Policies Enabled for this Authentication Scheme** if you want to reauthenticate users who request resources with a higher protection level than they are authorized to access.
5. Select **Scheme Setup** tab, and enter the options required by your authentication scheme type.

   If you want the system to reauthenticate users who request resources with a higher protection level than they are authorized to access, you must enter the following settings:

   - Under Server Name, enter the hostname (for example, **sales.yourcompany.net**).
   - Select the **Use SSL Connection** check box.
   - Under Target, enter the sign-in URL defined plus the parameter “ive=1” (for example, /highproturl?ive=1). The system must have a sign-in policy that uses ***/highproturl** as the sign-in URL and only uses the corresponding SiteMinder authentication realm.
   - Clear the **Allow Form Authentication Scheme to Save Credentials** check box.
   - Leave **Additional Attribute List** empty.
6. Click **OK**.

If you change a SiteMinder authentication scheme on the policy server, you must flush the cache using the Flush Cache option on the Advanced tab.

Configuring the SiteMinder Domain

Within SiteMinder, a policy domain is a logical grouping of resources associated with one or more user directories. Policy domains contain realms, responses, and policies. When configuring the Pulse Secure access management framework to work with SiteMinder, you must give user access to a SiteMinder resource within a realm, and then group the realm into a domain.

To configure a SiteMinder domain:

1. Select the **System** tab, right-click **Domains** and select **Create Domain**, or click **Domains** and select an existing SiteMinder domain.
2. Add a realm to the domain.

Configuring the SiteMinder Realm

Within SiteMinder, a realm is a cluster of resources within a policy domain grouped together according to security requirements. When configuring SiteMinder to work with the Pulse Secure access management framework, you must define realms to determine which resources the users might access.

To configure a SiteMinder Realm:

In the SiteMinder Administration interface, In the SiteMinder Administration interface, select the Domains tab.

1. Expand the domain that you created.
2. Right-click **Realms** and select **Create Realm**.
3. In the Agent field, select the Web agent that you created.
4. In the Resource Filter field, enter a protected resource. This resource inherits the protection level specified in the corresponding authentication scheme.

   For the default protection level, enter **/ive-authentication**. You must enter this resource when configuring the system. If you use sign-in policies with nondefault URLs such as */nete or */cert, you must have corresponding resource filters in the SiteMinder configuration.
5. From the Authentication Schemes list, select the scheme that you created.
6. Click **OK**.

Configuring a Rule or Response Pair to Pass Usernames

Within SiteMinder, you can use rules to trigger responses during authentication or authorization. A response passes DN attributes, static text, or customized active responses from the SiteMinder policy server to a SiteMinder agent. When you configure SiteMinder to work with the Pulse Secure access management framework, you must create a rule that triggers when a user successfully authenticates. Then, you must create a corresponding response that passes the user's username to the system Web agent.

To create a new rule:

1. Select the Domain tab.
2. Expand the domain that you created and then expand **Realms**.
3. Right-click the realm that you created and select **Create Rule under Realm**.
4. Enter a name and (optionally) description for the rule.
5. Under Action, select **Authentication Events** and then select **OnAuthAccept** from the drop down list.
6. Select **Enabled**.
7. Click **OK**.

To create a new response:

1. Expand the domain that you created.
2. Right-click **Responses** and select **Create Response**.
3. Enter a name and (optionally) a description for the response.
4. Select **SiteMinder** and then select the Web agent.
5. Click **Create**.
6. From the Attribute list, select **WebAgent-HTTP-Header-Variable**.
7. Under Attribute Kind, select **Static**.

8. Under Variable Name, enter **IVEUSERNAME**.
9. Under Variable Value, enter a username.
10. Click **OK**.

Configuring Authentication with a SiteMinder Server

To configure authentication with SiteMinder server:

1. Select Authentication > Auth.Servers.
2. Select **SiteMinder Server** and click **New Server** to display the configuration page.
3. Complete the configuration as described in table below.
4. Save the configuration.

   After you have saved the configuration, the page that is redisplayed includes an Advanced tab.
5. Click the **Advanced** tab to display the configuration page.
6. Complete the configuration as described in Table56.
7. Save the configuration.

Figure265: SiteMinder Server Configuration Page

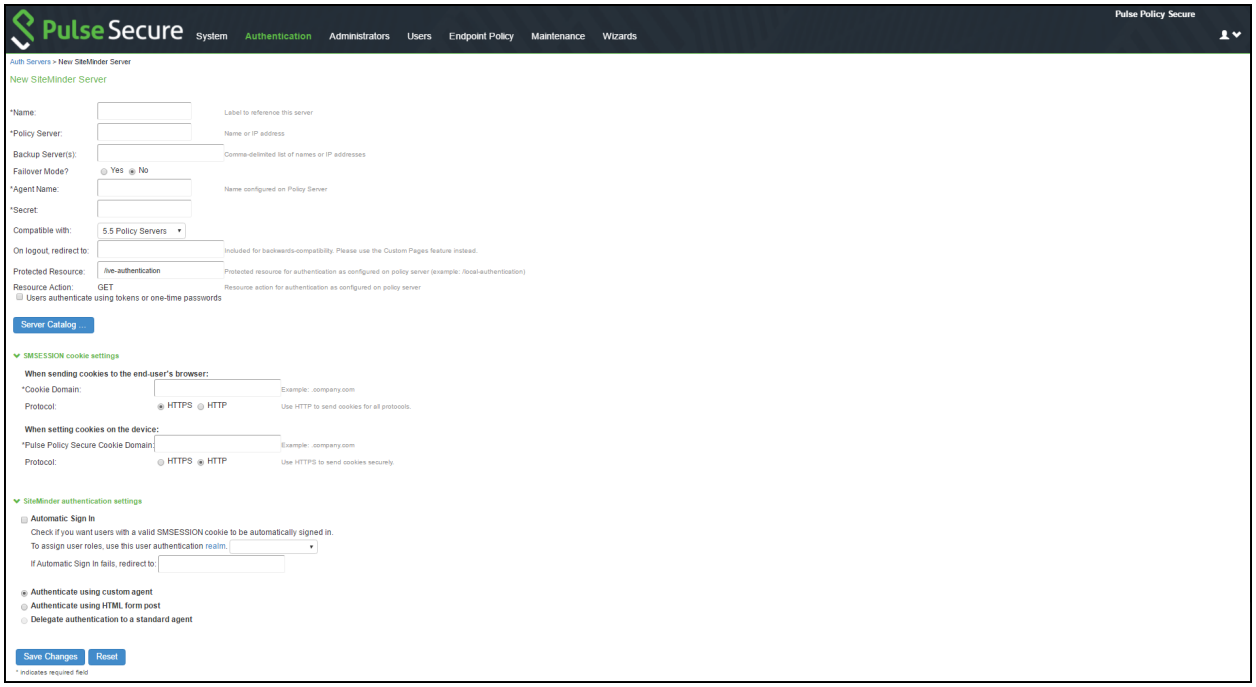


Table55: SiteMinder Server Settings

Settings	Guidelines
Name	Specify a name to identify the server within the system.
Policy Server	Specify name or IP address of the policy server.
Backup Server(s)	(Optional) Specify a comma-delimited list of backup policy servers.

Settings	Guidelines
Failover Mode?	Select one of the following failover mode options: • **Yes**–The device uses the main policy server unless it fails. • **No**–The device does the load balancing among all the specified policy servers.
Agent Name	Specify the agent name configured on the policy server.
Secret	Specify the shared secret configured on the policy server. The value is case sensitive.
Compatible with	Select a SiteMinder server version. • **5.5 Policy Servers**–Supports version 5.5 and version 6.0. This is the default. • **6.0 Policy Servers**–Supports only version 6.0 of the SiteMinder server API. • **12.0 Policy Servers**–Supports only version 12.0.
On log out, redirect to	Specify a URL to which users are redirected when they sign out of the device (optional). If you leave this field empty, users see the default sign-in page. The On log out, redirect to setting is included in the product release for backwards-compatibility. We strongly recommend that you use the customizable sign-in pages feature instead.
Protected Resource	Specify a default protected resource. If you do not create sign-in policies, the system uses this default URL to set the user's protection level for the session. The system also uses this default URL if you select the **Automatic Sign-In** option. If your users are signing in to the "*" URL (default device sign-in page), enter any URL ("/ive-authentication" is the default) to set the protection level to the default value. If you do create sign-in policies, the device uses those sign-in policies instead of this default URL. You must enter a forward slash (/) at the beginning of the resource. For example, enter **/local-authentication**.
Resource Action	Displays the resource action configured on the back-end SiteMinder server.
Users authenticate using tokens or one-time passwords	Select this option if you want the device to prompt the user for a token instead of a password; that is, if users submit tokens or one-time use passwords to the device. For example, you can use this option to dynamically prompt for a password or token based on sign-in policies by configuring two instances of the same authentication server. You can use one instance for wireless users who have this option enabled and it prompts the user for a token, and another instance for wired users who have this option disabled and it prompts the user for a password.
Server Catalog	Use the Server Catalog button to display the Server Catalog in a new window. Add the SiteMinder user attributes (such as the cookiename) that you want to use for role mapping.
SMSESSION cookie settings	
When sending cookies to the end-user's browser	Specify the cookie domain for either the end user or the device. A cookie domain is a domain in which the user's cookies are active. For example, the system sends cookies to the user's browser in this domain. Multiple domains should use a leading period and be comma-separated. For example, **.sales.myorg.com**, **.marketing.myorg.com**. Domain names are case-sensitive. You cannot use wildcard characters
	Select **HTTPS** to send cookies securely if other Web agents are set up to accept secure cookies, or **HTTP** to send cookies nonsecurely.
Cookie Domain and Protocol When the Cookie is Set on the Device	Enter the valid Internet domain for the cookie and where the browser of the user sends cookie contents. This cookie domain should be the same as the host domain. For example, .xyz.net
	Select HTTPS to send cookies securely if other Web agents are set up to accept secure cookies, or HTTP to send cookies non-securely.
SiteMinder authentication settings	

Settings	Guidelines
Automatic Sign In	Select this option to automatically sign in users with a valid SMSESSION cookie. Then, select the authentication realm to which the users are mapped. If you select this option, note that: • If the protection level associated with a user's SMSESSION cookie is different from the protection level of the realm, the protection level associated with the cookie is used. • This option uses SMSESSION cookie, which is already present in the browser to enable single sign-on. • This option provides a single sign-on experience for users. • This option enables users to sign in using a standard Siteminder Web Agent that generates an SMSESSION cookie. When you select this option, you must also configure the following sub options: • To assign user roles, use this user authentication realm–Select an authentication realm for automatically signed-in users. The users are mapped to a role based on the role mapping rules defined in the selected realm. • If Automatic Sign In fails, redirect to–Enter an alternative URL for users who sign in through the automatic sign-In mechanism. The users are redirected to the specified URL if the authentication fails and if there is no redirect response from the SiteMinder policy server. If you leave this field empty, users are prompted to sign back in.
Authenticate using custom agent	Select this option if you want to authenticate using the custom Web agent. Using this option, the system generates the SMSESSION cookie, just like any other Web agent configured within the organization.
Authenticate using HTML form post	Select this option if you want to post user credentials to a standard Web agent that you have already configured rather than contacting the SiteMinder policy server directly. If you select this option, the Web agent contacts the policy server to determine the appropriate sign-in page to display to the user. To configure the system to "act like a browser" that posts credentials to the standard Web agent, you must enter the following information. • **Target**–Specify the target URL. • **Protocol**–Specify the protocol for communication between the system and the specified Web agent. Select **HTTP** for non-secure communication. Select **HTTPS** for secure communication. • **Webagent**–Specify the name of the Web agent to obtain SMSESSION cookies. An IP address is not allowed for this field. (Specifying the IP address as the Web agent prevents some browsers from accepting cookies.) • **Port**– Specify the port for the protocol. Enter port **80** for HTTP or port **443** for HTTPS. • **Path**–Specify the path of the Web agent's sign-in page. The path must start with a backslash (/) character. In the Web agent sign-in page URL, the path appears after the Web agent. • **Parameters**– Specify the post parameters to be sent when a user signs in. Common SiteMinder variables that you can use include _ _USER_ _, _ _PASS_ _, and _ _TARGET_ _. These variables are replaced by the username and password entered by the user on the Web agent's sign-in page and by the value specified in the Target field. These are the default parameters for log in.fcc—if you have made customizations, you may need to change these parameters.
Delegate authentication to a standard agent	Select this option to delegate authentication to a standard agent. When the user accesses the system sign-in page, the FCC URL associated with the protected resource's authentication scheme is determined. The system redirects the user to that URL, setting the system sign-in URL as the target. After successfully authenticating with the standard agent, an SMSESSION cookie is set in the user's browser and the user is redirected back. The system then automatically signs in the user and establishes a session. You must enable the Automatic Sign-In option to use this feature. If you enable this option and a user already has a valid SMSESSION cookie when trying to access a resource, the system tries to automatically sign in using the existing SMSESSION cookie. If the cookie is invalid, the SMSESSION cookie and corresponding system cookies are cleared and a "timeout" page is displayed. The system successfully delegates authentication when the user clicks the **sign back in** option. If you select this option, your authentication scheme must have an associated FCC URL.

Table56: SiteMinder Advanced Configuration Options

Settings	Guidelines
Poll Interval (seconds)	Specify the interval at which the system polls the SiteMinder policy server to check for a new key.
Max. Connections	Control the maximum number of simultaneous connections that the system is allowed to make to the policy server. The default setting is 20.
Max. Requests/ Agent	Control the maximum number of requests that the policy server connection handles before the system ends the connection. If necessary, tune to increase performance. The default setting is 1000.
Idle Timeout (minutes)	Control the maximum number of minutes a connection to the policy server may remain idle (the connection is not handling requests) before the system ends the connection. The default setting of “none” indicates no time limit.
Authorize while Authenticating	Specify that the system should look up user attributes on the policy server immediately after authentication to determine if the user is truly authenticated. For example, if your SiteMinder server authenticates users based on an LDAP server setting, you can select this option to indicate that the system should authenticate users through the SiteMinder server and then authorize them through the LDAP server before granting them access. If the user fails authentication or authorization, the user is redirected to the page configured on the policy server.
Enable Session Grace Period	Eliminate the overhead of verifying a user’s SMSESSION cookie each time the user requests the same resource by indicating that the system should consider the cookie valid for a certain period. If you do not select this option, the system checks the user’s SMSESSION cookie on each request. Note that the value entered here does not affect session or idle timeout checking.
Validate cookie every N seconds (seconds)	Specify the time for the system to eliminate the overhead of verifying a user’s SMSESSION cookie each time the user requests the same resource by indicating that the system should consider the cookie valid for a certain period.
Ignore Query Data	Specify that the system does not cache the query parameter in its URLs. Therefore, if a user requests the same resource as is specified in the cached URL, the request should not fail.
Accounting Port	Specify that the value entered in this field must match the accounting port value entered through the Policy Server Management Console in the Web UI. By default, this field matches the policy server’s default setting of 44441.
Authentication Port	Specify that the value entered in this field must match the authentication port value entered through the Policy Server Management Console. By default, this field matches the policy server’s default setting of 44442.
Authorization Port	Specifies that the value entered in this field must match the authorization port value entered through the Policy Server Management Console. By default, this field matches the policy server’s default setting of 44443.
Agent Configuration Settings	
Overlook Session for Methods	Compare the request method to the methods listed in this parameter. If a match is found, Web Agent does not create a new or update an existing SMSESSION cookie, nor will it make any updates to the cookie provider for that request. You can enter multiple methods; use a comma to separate method names. If Overlook Session for Methods parameter is set but not Overlook Session for URLs, then all requests that match the methods defined in this parameter are processed (SMSESSION cookie creation/update is blocked). If both Overlook Session for Methods and Overlook Session for URLsparameters are set, both the method and the URL of the request are matched before proceeding. Then, all URLs with specified methods are processed (SMSESSION cookie creation/update is blocked).

Settings	Guidelines
Overlook Session for URLs	Compare the request URL to the URLs listed in this parameter. If a match is found, Web Agent does not create a new or update an existing SMSESSION cookie, nor will it make any updates to the cookie provider for that request. Specify a relative URL. For example: If the URL is http://fqdn.host/MyDocuments/index.html, enter **/MyDocuments/index.html** If Overlook Session for URLs is set but not Overlook Session for Methods, then all requests, regardless of the methods, matching the URLs defined in this parameter are processed (SMSESSION cookie creation/update is blocked). If both Overlook Session for Methods and Overlook Session for URLsparameters are defined, both the method and the URL of the request are matched before proceeding. Then, all URLs with specified methods are processed (SMSESSION cookie creation/update is blocked).
SiteMinder caching	
Flush Cache	Select this option to delete the resource cache, which caches resource authorization information for 10 minutes.

Displaying the User Accounts Table

To display user accounts:

1. Click the link for the authentication server you want to manage.
2. Click the **Users** tab to display the user accounts table.

   The user accounts table includes entries for the accounts that have been created. The Last Sign-in Statistic column shows the last successful sign-in date and time for each user, the user's IP address, and the agent or browser type and version.
3. Use the controls to search for users and manage user accounts:

   - To search for a specific user, enter a username in the Show users named box and click **Update**.

     TIP: You can use an asterisk (*) as a wildcard, where * represents any number of zero or more characters. For example, to search for all usernames that contain the letters jo, enter ***jo***. The search is case-sensitive. To display the entire list of accounts again, type * or delete the field's contents and click **Update**.
   - To limit the number of users displayed on the page, enter a number in the Show *N* users box and click **Update**.
   - To terminate the user session and delete the account, select the check box next to the user account record and click **Delete**.

Troubleshooting the SiteMinder Server Configuration

Problem

Description: At some point, you may encounter problems configuring the eTrust SiteMinder server interactions with the Pulse Secure system. You can use the following debugging tools to identify and resolve problems:

Solution

- Review the system log file. The system tracks failures of cookie validation and key rollovers.
- Review the Policy Server Authentication log files.
- Review the Standard Web Agent log file if you selected the **Authenticate using HTLM Form POST** option.
- Confirm that the system time is synchronized with the SiteMinder server system time. If the two system times are too divergent, the timeout settings might not function correctly, and might reject attempts to sign in.
- In the SiteMinder server, confirm that you have defined the proper Session Timeout options max timeout and idle in the SiteMinder Realm dialog.
- To view the CA SiteMinder error codes select System > Log/Monitoring > User Access page. For information on the CA SiteMinder error codes, see the SiteMinder documentation.

Using an SQL Auth Server

This topic describes integration with the SQL Auth server. It includes the following information:

- SQL Auth Server Overview
- Configuring Authentication with an Oracle SQL Auth Server
- Displaying the User Accounts Table

SQL Auth Server Overview

This section describes support for using the SQL (also known as Oracle Database server) as a PPS authentication server. It includes the following sections:

- Understanding SQL Auth Server
- Feature Support
- Interoperability Requirements and Limitations

Understanding SQL Auth Server

The SQL Auth server is widely deployed in the enterprise. Some enterprises use the SQL Auth server to store user credentials (usernames and passwords), MAC addresses, and other organizational information, such as group affiliations that are often the basis for authorization decisions. To support authentication and authorization against SQL Auth server databases, PPS supports an authentication server configuration that configures an Oracle Instant Client connection as well as relevant queries to the backend SQL Auth server.

Feature Support

Policy Secure uses Oracle Instant Client 11.2.0.2.0 to communicate with the SQL Auth server. The SQL Auth server version must support this version of the client. The Pulse Secure access management framework depends on the SQL Auth server features described in this section.

- SQL SELECT Statements
- SQL Stored Procedures
- SQL Format Specifiers
- SQL Statement Parameters
- SQL Password Hash Format

You can use the SQL queries for authentication, authorization and role mapping, or both.

SQL SELECT Statements

The authentication transaction is based on an SQL query that returns a password (and possibly other information) based on the name entered by the user attempting to log in.

While a sample SQL query is provided in the original configuration file, you must configure the SQL entry of the configuration file with a query appropriate to your database. The query you enter must be either an SQL SELECT or an SQL EXECUTE statement that contains additional syntax elements that are preprocessed by the SQL authentication module.

The SQL authentication module executes SQL statements in parameterized form. This means that the SQL statement is compiled once, with parameter markers (usually question marks) as placeholders for data items that vary from one execution to the next. Only upon execution of the statement are the actual data values supplied.

The SQL statement you compose must not include parameter markers directly. Instead, include the names of the parameters where parameter markers would appear, in an appropriate format.

This is an example of a parameter marker:

```
SELECT password, profile, fullname FROM usertable WHERE username = :username
```

The SQL authentication module translates the SQL statement provided, replacing parameter names with parameter markers prior to passing the SQL statement to the database engine.

The SQL statement can be very simple. Basically, all that is required is to look up a password and possibly some optional information based on a username. The SQL statement can also be quite complex; it can include inner joins, and it can contain expressions. The underlying database engine is responsible for handling the SQL statement; the SQL authentication module performs no interpretation of the SQL statement other than to translate parameter names to parameter markers.

SQL Stored Procedures

A stored procedure is a sequence of SQL statements that form a logical unit and perform a task. You can use stored procedures to encapsulate a set of queries or operations that can be executed repeatedly on a database server. For example, you can code operations on an employee database, such as password lookup, as stored procedures that can be executed by application code. Stored procedures can be compiled and executed with different parameters and results. Stored procedures can use any combination of input parameters (the values passed to the stored procedure at execution time) and output parameters (the values set or returned by the stored procedure to the calling application or environment).

This is an example of a called procedure:

```
BEGIN; myCalledProcedure( :username, :password!os, ipAddr!ios, filterId!o); END;
```

As shown in the example, the procedure is called myCalledProcedure with input variables as name and ipAddr, output parameters as password, ipAddr, and filterId. The names of the output parameters are the names of the attributes added to the server catalog used for role mapping and return attributes. The parameter consists of a colon (:), the name of the parameter, and a format specifier.

SQL Format Specifiers

The below table describes the SQL statement format specifiers with parameters in called procedures.

Table57: SQL Statement Format Specifiers

Specifier	Definition
i	Input parameter (Default if none is specified)
io	Input/output parameter
o	Output parameter
s	String type (default if none is specified)
n	Int type

SQL Statement Parameters

The below table describes the SQL statement parameter names and types.

Table58: SQL Statement Parameter Names and Types

Item	Type	Meaning for SQL Authentication
:username	String	Specifies the username as presented to the authentication server.
:password	String	Specifies the password as presented to the authentication server.
:realm	String	Specifies the realm as presented to the authentication server.
:ipAddr	String	Specifies the source IP address (L3 authentications only), which is sent as a string. For example, 10.17.1.155.
:userAgent	String	Specifies the user agent string.
:log inTime	Int	Specifies the log in time presented in the number of seconds.
:log inURL	String	Specifies the user URL of the sign-in policy of the user.
:callingStationId	String	Specifies the MAC address of the client presented as xx-xx-xx-xx-xx-xx for L3 authentications and in the format specified by the RADIUS client for L2 authentications.
:language	String	Specifies the language used by client as specified by IETF language tag. For example, en-US for English as used in the United States.

SQL Password Hash Format

The below table describes the different SQL password types.

Table59: Password Hash Format

Hash/Name	Definition	Password Format	Supported RADIUS Protocols
Automatic	Automatically determines hash format based on Format.	All	
Clear Text	No Encryption	PasswordText	PAP, CHAP, MSCHAP, MSCHAP-V2, EAP-JUAC, EAP-MSCHAP-V2, EAP-MD5-Challenge
SHA 1	SHA1+Base64 hash	{SHA}HashHashHash	PAP, EAP-JUAC

Hash/Name	Definition	Password Format	Supported RADIUS Protocols
Salted SHA 1	salted SHA1+Base64 hash	{SSHA}HashHashHashSalt	PAP, EAP-JUAC
NT Hash**	MD4 hash of the unicode form of password	{md4}HashHash	PAP, MSCHAP, MSCHAP-V2, EAP-JUAC, EAP-MSCHAP-V2

Interoperability Requirements and Limitations

The following limitation applies when defining and monitoring an SQL Auth server instance:

- The maximum number of connections to an Oracle database is limited to 50 connections for L2 and L3 log ins (concurrent and open RADIUS protocol), without any browser log ins.
- You must enter the SQL keywords in uppercase letters.

Configuring Authentication with an Oracle SQL Auth Server

To configure authentication with an SQL Auth server:

1. Select **Authentication > Auth.servers**.
2. Select **SQL Auth Server** and click **New Server** to display the configuration page.
3. Complete the configuration as described in Table60.
4. Save the configuration.

Figure266: SQL Auth Server Configuration Page

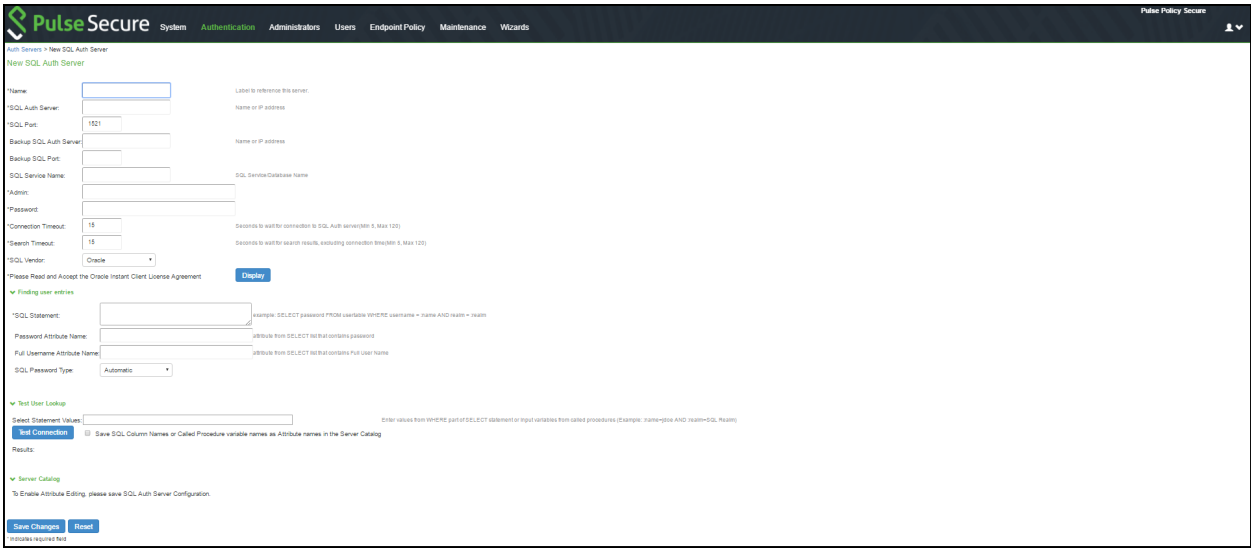


Table60: SQL Auth Server Settings

Settings	Guidelines
Name	Specify a name to identify the server within the system.
SQL Auth Server	Specify the SQL Auth server host name or IP address. The default value is 1521.
SQL Port	Specify the SQL port number through which the SQL Auth server is accessed.
Backup SQL Auth Server	(Optional) Specify the backup SQL Auth server host name.
Backup SQL Port	(Optional) Specify the backup SQL port number.
SQL Service Name	(Optional) Specify the SQL service name if SQL service name has been defined in the SQL Auth server configuration.
Admin	Specify the administrator username.
Password	Specify the password.
Connection Timeout	Specify the connection timeout value from 5 to 60 seconds. If this time is exceeded, and if there is a backup server defined, then the device attempts to reach the backup server.
Search Timeout	Specify the search timeout value from 5 to 60 seconds. It specifies the maximum amount of time the device will wait for the SQL Auth server to return search results.
SQL Vendor	Select **Oracle**. Read and accept the license agreement. You cannot save or test the configuration until you have accepted the license agreement.
Finding user entries	
SQL Statement	Specify the SQL statement to find the user entries. For example: SELECT password FROM usertable WHERE username = :username AND realm = :realm NOTE: You must enter the SQL keywords in uppercase letters.
Password Attribute Name	Specify the attribute name specified in the SQL statement that the device uses for password authentication. If the username that is entered exists in the database, then the authentication succeeds. If you are using the SQL Auth server for authorization, no password is necessary here.

Settings	Guidelines
Full Username Attribute Name	(Optional) Specify the attribute name specified in the SQL statement for the system to use when displaying the user's full name.
SQL Password Type	Select one of the following SQL password types: • Automatic • Clear Text • SHA 1 • Salted SHA 1 • NT Hash The SQL password type setting specifies the format of the hash used for the password. The values for the SQL password type include a prefix index that indicates how the password has been processed. The prefix is in clear-text between curly braces { } and is immediately followed by a hash value computed from the password. If no prefix is present in the value retrieved from the table Password column, the entire password is assumed to be in clear-text format.
Test User Lookup	
Select Statement Values	Enter the attributes necessary to fill in the WHERE part of the SQL statement and click the **Test Connection** button to save the server configuration and attempt to connect to the database server with the information you have entered. Upon a successful connection and retrieval of the user record, the server displays the results. It displays the entire returned user record (hiding the password) from the SELECT portion of the SQL statement. An error line is displayed if the connection to the SQL Auth server fails or if the user record could not be retrieved. The user record is displayed in the following format: attribute Name1 = value, attribute name2 = value, and so on. NOTE: When trying to populate the server catalog attributes for the SQL Auth server, you must enter data into all columns of interest for a record. Columns that are not assigned data are ignored during the lookup and are therefore not added appropriately to the server catalog.
Save SQL Column Names or Called Procedure variable names as Attribute names in the Server Catalog	Select this option to use the SQL query statement variables as server catalog attributes. You can use the server catalog in role mapping rules.
Server Catalog	
Attributes	The Attributes button appears after you have saved the server information or performed a test connection operation. Click the **Attributes** button to display the server catalog.

Troubleshooting Oracle Error Codes

The below table describes the Oracle error codes, cause, and action.

Table61: Oracle Error Codes

Error code	Cause	Action
ORA-00018: maximum number of sessions exceeded	All session state objects are in use.	Increase the value of the SESSIONS initialization parameter.
ORA-00019: maximum number of session licenses exceeded	All licenses are in use.	Increase the value of the LICENSE MAX SESSIONS initialization parameter.
ORA-00020: maximum number of processes (string) exceeded	All process state objects are in use.	Increase the value of the PROCESSES initialization parameter.

Using a Time-Based One-Time Password (TOTP) Authentication Server

This topic describes PPS integration with the Time-Based One-Time Password (TOTP) Authentication Server. It includes the following information:

- Overview
- Configuring Authentication with a TOTP Authentication Server
- Using Google Authenticator Application to Register to a TOTP Server
- Displaying the User Accounts Table
- Viewing/Generating Backup Codes

Overview

This section describes support for using the Local/Remote PPS TOTP authentication server. It includes the following sections:

- Understanding TOTP
- Interoperability Requirements and Limitations

Understanding TOTP

Time-based One-time Password Algorithm (TOTP) is an algorithm that computes a one-time password (token) from a shared secret key and the current time. Google Authenticator is one of such implementations of TOTP algorithms. PPS supports TOTP authentication by using the Google Authenticator algorithm for generation of shared secret key and token. Many third-party apps are available for almost all mobile and desktop operating systems for the generation of TOTP tokens.

Interoperability Requirements and Limitations

Before you begin:

- TOTP authentication server users' configuration is automatically synchronized within all nodes in a single cluster. If there are multiple clusters behind a DNS load-balancer, then the admin has to manually perform binary export/import user's configuration to all the nodes in different clusters.
- TOTP feature is configurable across clusters.
- First time users have to register a new TOTP user-account via web. End-users cannot use Pulse Desktop applications and Pulse Mac applications for new user registration.

CAUTION: Users with more than one TOTP account will get reset when the system software is upgraded. In such case, users have to re-register with TOTP.

- Two standalone nodes or separate clusters can be synced. For now, binary import/export of user configuration option can be used.

Note: For the users who are already using custom sign-in pages:

For TOTP authentication to work, existing custom sign-in pages need to include following sign-in pages:

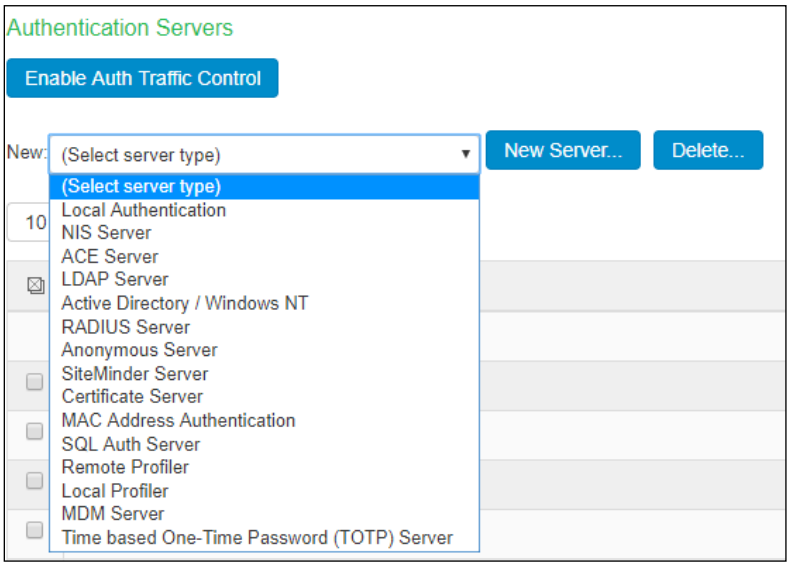
- TotpAuthRegister.thtml
- TotpAuthRegister-mobile-webkit.thtml
- TotpAuthRegister-ipad.thtml
- TotpAuthRegister-stdaln.thtml
- TotpAuthRegister-new-ux.thtml
- TotpAuthTokenEntry.thtml
- TotpAuthTokenEntry-new-ux.thtml
- TotpAuthTokenEntry-mobile-webkit.thtml
- TotpAuthTokenEntry-ipad.thtml
- TotpAuthTokenEntry-stdaln.thtml

These files can be downloaded from sample custom sign-in pages URL: https://<<PPS>>/dana-admin/download/sample.zip?url=/dana-admin/auth/custompage.cgi?op=Download&samplePage=sample

Configuring Authentication with a TOTP Authentication Server

To configure the TOTP server as Local:

1. Select **Authentication > Auth. Servers**.
2. Select **Time based One-Time Password (TOTP) Server** and click **New Server** to display the configuration page.



3. Complete the configuration as described in Table 62.
4. Save the configuration.

Figure 267: TOTP Authentication Server Page – Local

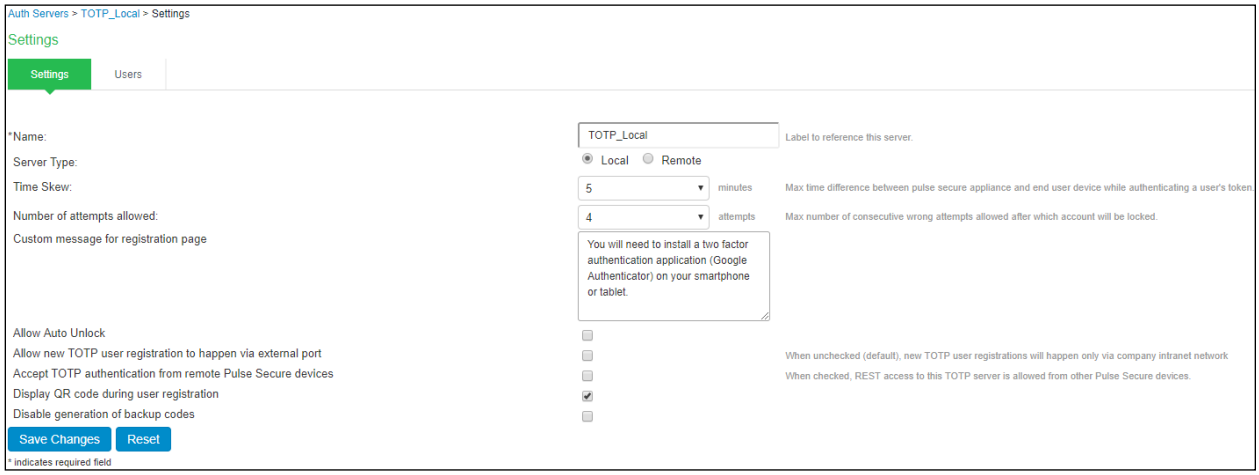


Table 62: TOTP Auth Server Settings - Local

Settings	Guidelines
Name	Specify a name to identify the server within the system.
Server Type	TOTP server can be configured as local or remote. Select Local. **Local**: TOTP context is created locally and user database is maintained locally on the same device.
Time Skew	Specify maximum time difference between PPS and end user device while authenticating a user's token. (minimum: 1 minute, maximum: 5 minutes).
Number of attempts allowed	Specify maximum number of consecutive wrong attempts allowed after which account will be locked (minimum: 1 attempt, maximum: 5 attempts).
Custom message for registration page	Specify a custom message which can be shown on new TOTP user registration web-page.
Allow Auto Unlock	When checked, locked account will be automatically unlocked after specified period. (minimum: 10 minutes, maximum: 90 days)
Allow new TOTP user registration to happen via external port	When unchecked (default), new TOTP user registrations will happen only via internal port
Accept TOTP authentication from remote Pulse Secure devices	When checked, REST access to this TOTP server is allowed from other Pulse Secure devices.
Display QR code during user registration	When checked, displays QR code during user registration.
Disable generation of backup codes	When unchecked, generates backup codes.

To configure the TOTP server as Remote:

1. Select **Authentication > Auth. Servers**.
2. Select **Time based One-Time Password (TOTP) Server** and click **New Server** to display the configuration page. See Figure *268*.
3. Complete the configuration as described in Table 63.
4. Save the configuration.

Note: If PPS is configured to use Remote TOTP server, then the remote server should have a valid certificate issued by a Trusted CA.

Figure 268: TOTP Authentication Server Page - Remote

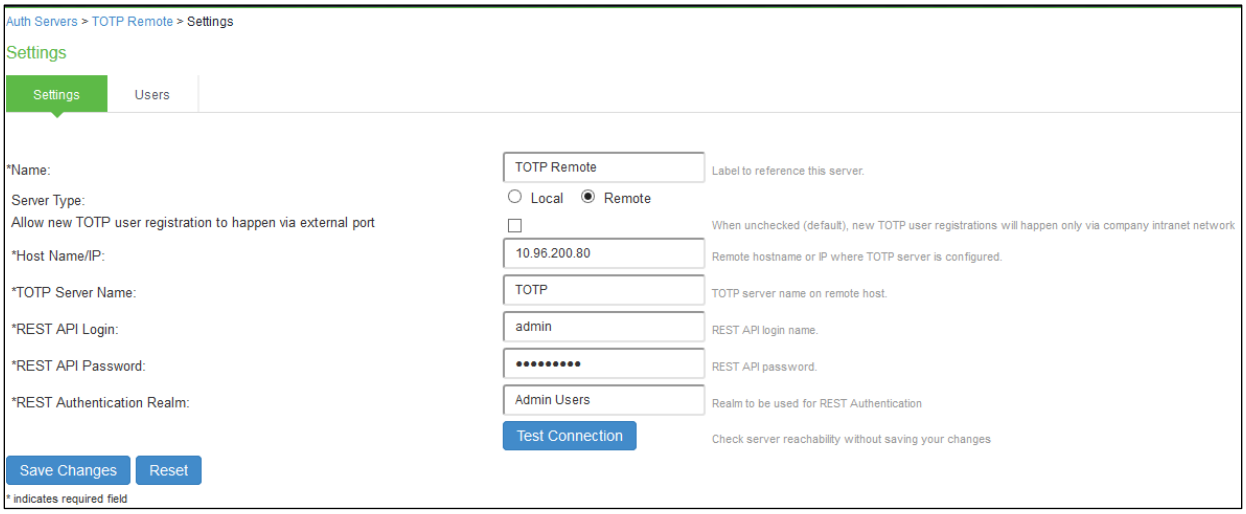


Table 63: TOTP Auth Server Settings - Remote

Settings	Guidelines
Name	Specify a name to identify the server within the system.
Server Type	TOTP server can be configured as local or remote. Select **Remote**. **Remote**: In this configuration, authentication check happens on the remote TOTP server. The user local device acts as a proxy between the user's client device and TOTP server. The communication to the remote device happens on REST API.
Allow new TOTP user registration via external port	Enable this option to allow TOTP user registrations through external port.
Host Name/IP	Specify remote host name or IP address where the TOTP server is configured.
TOTP Server Name	This is the name of the TOTP server configured on the Remote TOTP server.
REST API Login	Enter the REST API login name.
REST API Password	Enter the REST API password.
REST Authentication Realm	Enter the realm name, which refers to the realm that should be used for authenticating the rest user (using the authserver mapped to the Realm).

Configuring Admin/User Realm to Associate a TOTP Authentication Server as Secondary Authentication Server

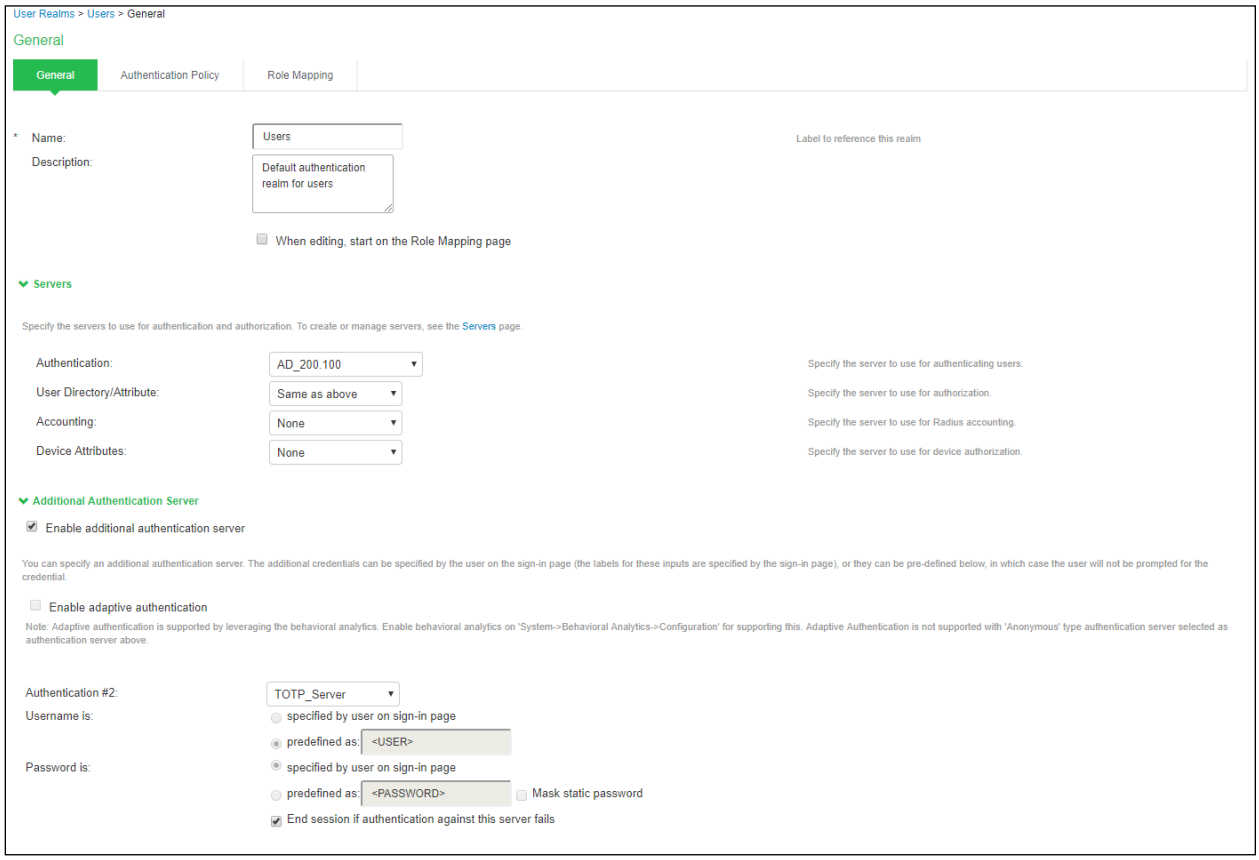
For example, to configure a user realm:

1. Select **Users > User Realms > New User Realm**.
2. Complete the settings for the user-realm.
3. Check the **Enable additional authentication server** option.
4. Under **Additional Authentication Server**, select any already created TOTP authentication-server from the **Authentication #2** dropdown, as shown in Figure *269*.

Note: Whenever admin selects TOTP authentication-server as the additional authentication server, then the **Username: Predefined as <USER>** and **Password: specified by user in sign-in page** options are set by default.

5. Click on **Save Changes**.

Figure 269: Configuring Admin/User Realm to Associate a TOTP Auth. Server as Secondary Auth. Server



Using Google Authenticator Application to Register to a TOTP Server

The admin can associate an end-user to a realm that has a secondary authentication server configured as TOTP authentication server.

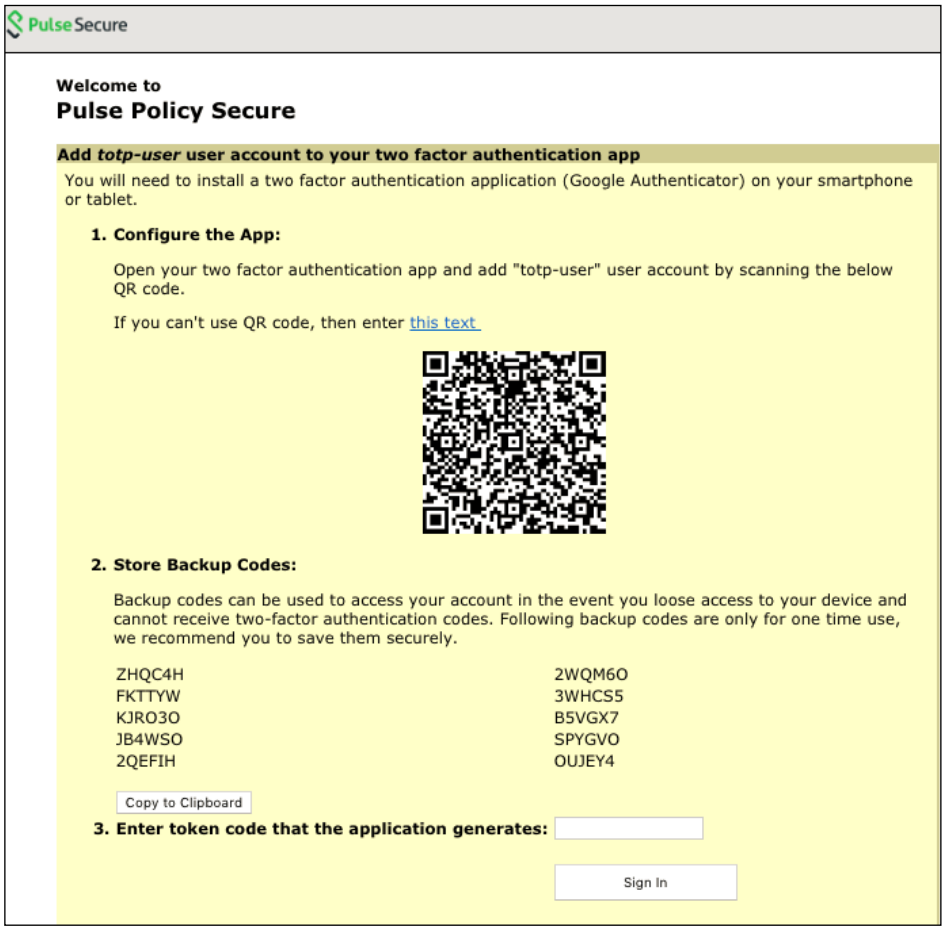
For first time registration via web, perform the following steps:

For example: Admin associates an end-user User1 to a user-realm that has the TOTP authentication-server configured as the secondary authentication-server.

When User1 for the first time, performs a login to the above configured user-realm:

1. After successful authentication with primary authentication-server, User1 is shown the TOTP registration page. See Figure 270.
2. User1 is given a TOTP registration key in text form/QR image form and 10 backup codes. User saves 10 backup codes in a safe place for using it later during authentication when end-user device (where Google Authenticator app is installed) is not available (in emergency).
3. Now, User1 opens the device where Google Authenticator app is installed, then either scans the QR image (or) manually adds a new user (for example: GA-User1) by entering the above given secret registration key.
4. The Google-Authentication app (for GA-User1) generates a new 6-digit number called as a token once in every 30 seconds.
5. Enter the current token in the registration page. Click on **Sign In**. On successful authentication with that token, User1 will be taken to his/her home page.

Figure 270: First Time Registration to a TOTP Server

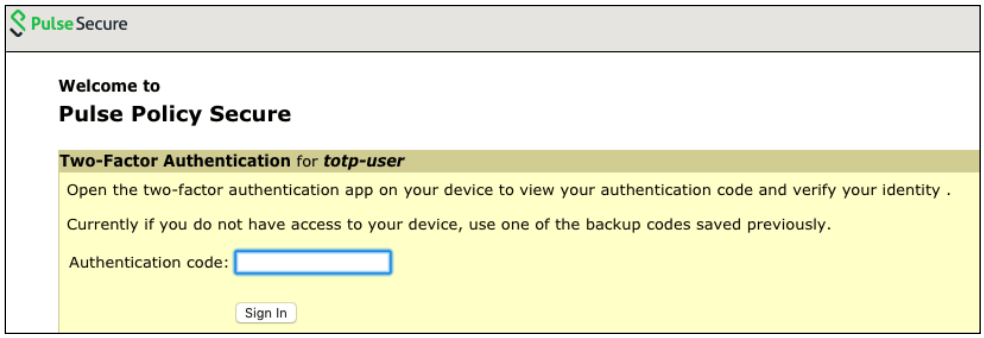


For already registered user, perform the following steps:

1. The already-registered user (For example: User1), whose realm was associated with secondary authentication server configured as TOTP authentication server, accesses PPS URL via web (User1 has already registered TOTP user in Google Authenticator app.)
2. After successful authentication with primary authentication server, user1 is shown TOTP Token entry page as seen in Figure 271.
3. User1 opens Google Authentication app that was installed in mobile (or PC), enters the current token to the **Authentication Code.** If mobile is not available, user can enter any of the unused backup codes.
4. On successful authentication with the token, User1 can enter any of the unused backup codes.

Note: A backup code can be used only once to successfully authenticate with the TOTP authentication server. Once used, the same backup code cannot be reused.

Figure 271: Google Authentication Token



Displaying the User Accounts Table

To display user accounts:

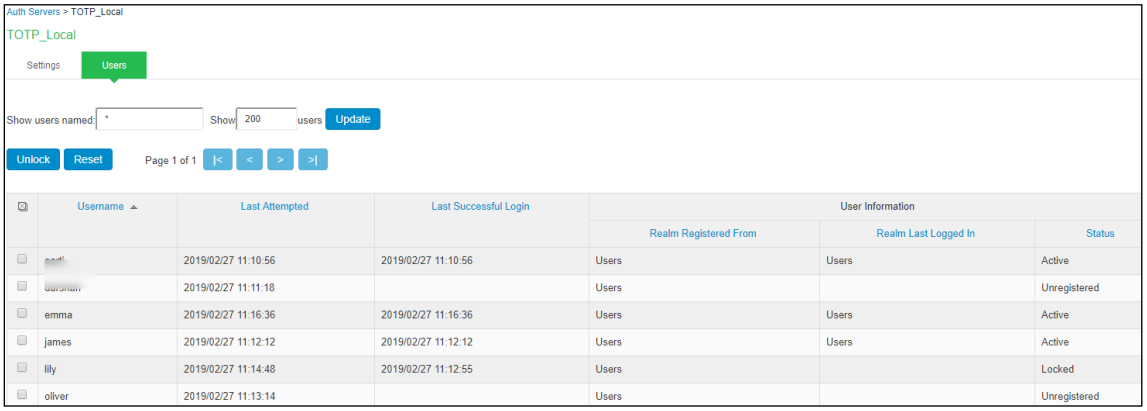
1. Select **Authentication > Auth.Servers**.
2. Click the link for the authentication server you want to manage.
3. Click the **Users** tab to display the user accounts table. The user accounts table includes entries for the accounts that have been created. See *Figure 19.*
    - The “Last Attempted” column shows the last time and date a user attempted to login.
    - The “Last Successful Login” shows the last successful sign-in date and time for each user.
    - Under the “User Information” column, there are details available for a user’s “Realm”, “Primary AuthServer” and the “Status” columns

      There are 3 possible states for the “Status" column:
        i. **Active:** TOTP user’s account is in use (that is user has used this account less than stale period of this TOTP authentication server)
        ii. **Locked:** TOTP user account has been locked due to maximum number of wrong login attempts
        iii. **Unregistered**: TOTP user has seen registration page, but yet to complete the registration by entering the correct token in the registration page.
4. Use the controls to search for users and manage user accounts:
    - To search for a specific user, enter a username in the Show users named field and click Update.

TIP: You can use an asterisk (*) as a wildcard, where * represents any number of zero or more characters. For example, to search for all usernames that contain the letters jo, enter *jo*. The search is case-sensitive. To display the entire list of accounts again, type * or delete the field’s contents and click Update.

- To limit the number of users displayed on the page, enter a number in the Show N user’s field and click **Update**.
- To unlock a user, select the specific user and click **Unlock**.
- To reset a user’s credentials, select the specific user and click **Reset**.

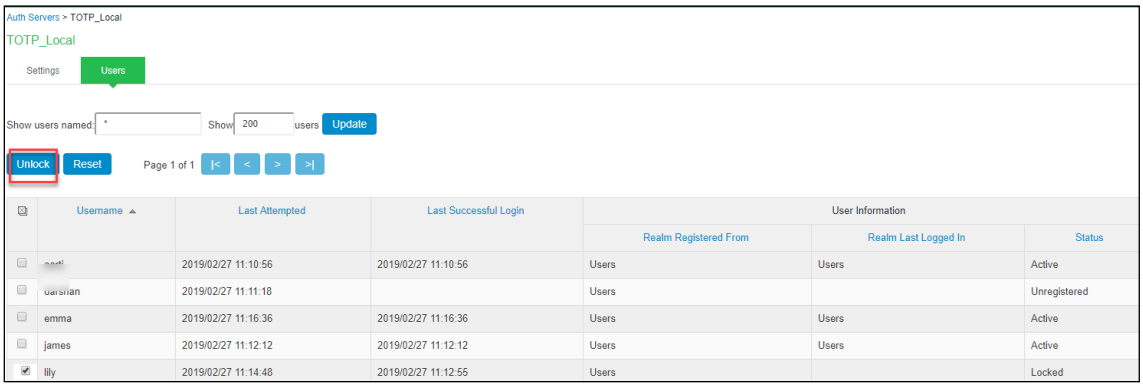
Figure 272: Displaying the User Accounts Table



To unlock a TOTP user's account:

1. Go to the **Users** tab. The list of users is displayed.
2. Select the user whose account you choose to unlock.
3. Click on the **Unlock** button.

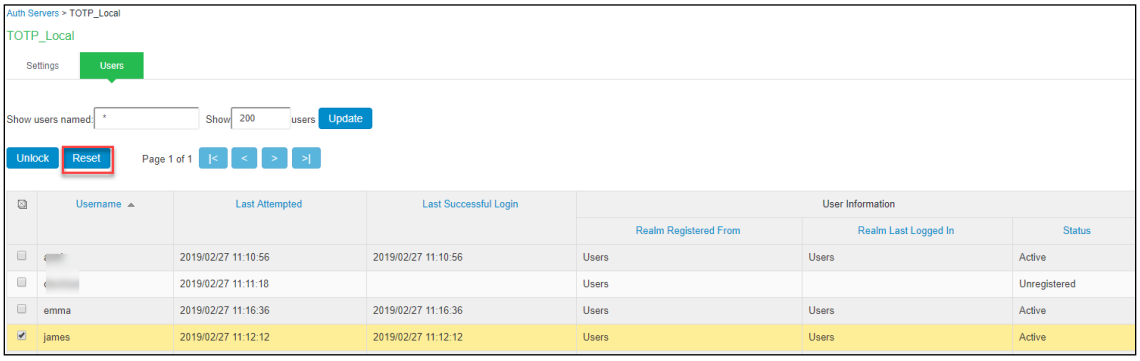
Figure 273: Unlocking a User



To reset a TOTP user's account:

1. Go to the **Users** tab. The list of users is displayed.
2. Select the user whose account you choose to reset.
3. Click on the **Reset** button. This removes the user entry from the table.

Figure 274: Resetting a User

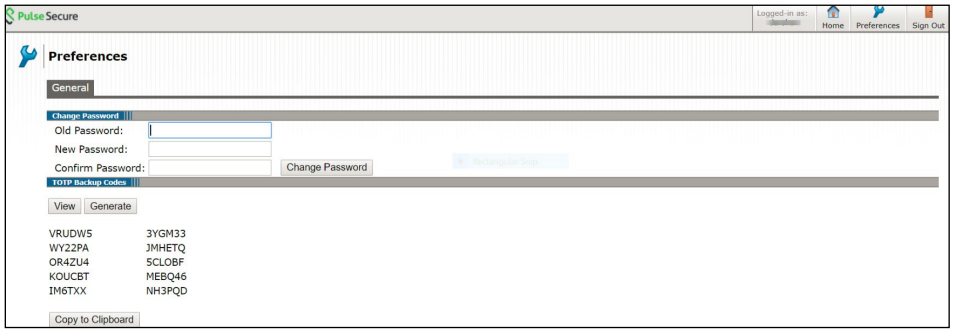


Viewing/Generating Backup Codes

To view/generate TOTP backup codes after successful login to a TOTP server via web:

1. User successfully authenticates to primary auth-server and TOTP auth-server via web.
2. Click on the **Preference** option on the top of the page.
3. In the **Preference** page, under TOTP Backup codes, click on either **View** or **Generate** to obtain user's TOTP backup codes.

Figure 275: View/Generate Backup Codes

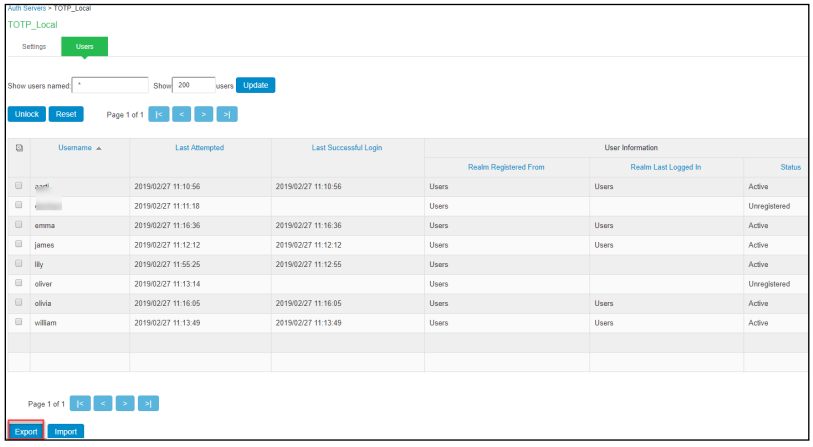


Exporting/Importing TOTP Users

To export/import TOTP users:

1. Select **Authentication > Auth. Servers**.
2. Click the link for the authentication server you want to manage.
3. Click the **Users** tab to display the user accounts table. The user accounts table includes entries for the accounts that have been created.
4. Use the **Export** and **Import** buttons located at the bottom of the user accounts table to export and import TOTP users data.

Figure 276: Export/Import TOTP Users



Network Device Administration using TACACS+

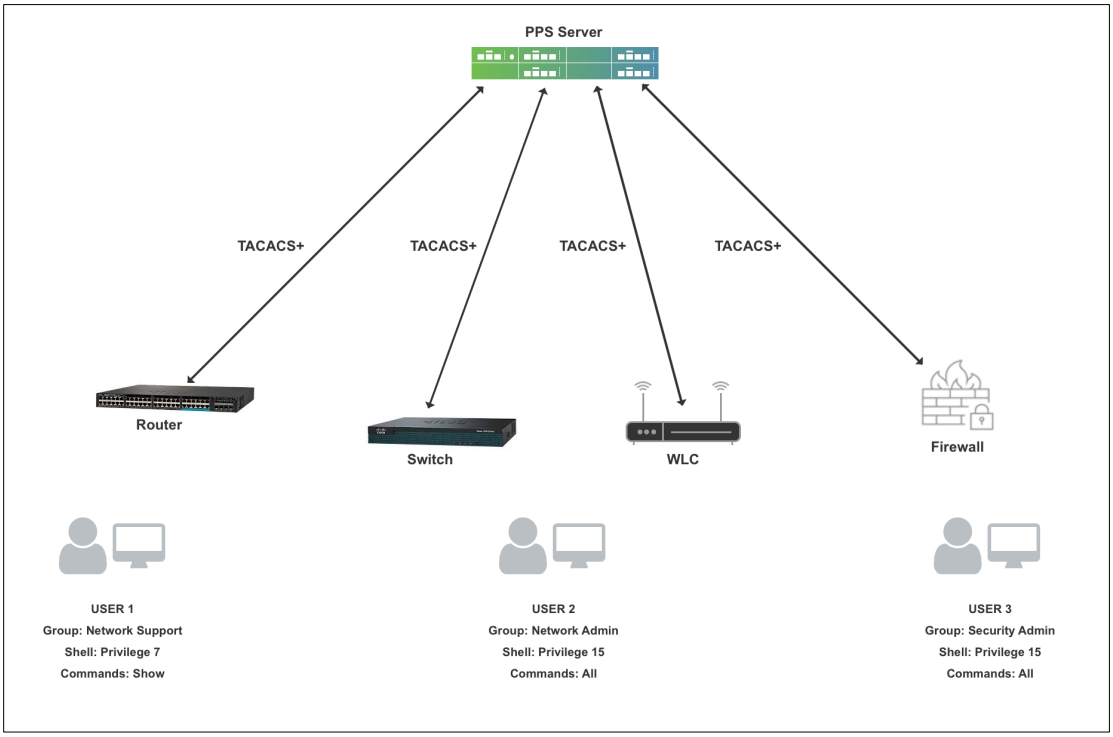
Overview

The network device administrators are required to configure and maintain the network devices such as switches, wireless access points, routers, and gateways. PPS supports configuring and coordinating the network devices through PPS Admin UI.

The administrator implements policies to determine who can login to a network device console, telnet session, secure shell (SSH) session to manage each device, what level of privilege do they have, what operations they can run (that is, the commands the admin user is permitted to run on the device) and also audit all the actions taken.

Managing these policies separately on each device is not just unmanageable but can lead to security incidents or errors that result in loss of service and network downtime due to undesired access. Most compliance requirements and security standards require using standardized tools to centralize authentication for administrative management.

Figure: TACACS+ Overview



The above deployment consists of 3 types of administrators:

- User1 - This admin belongs to Network Support Group and can only access show commands on router, switches and access points. The admin has no access to Firewall.
- User2 - This admin belongs to Network Admin Group and can access all commands on routes, switches and access points. The admin has no access to Firewall.
- User3- This admin belongs to Security admin group and an firewall administrator and does not have access to routers, switches and access points.

A large company will have many devices from different vendors. It requires administrators to manage the network with many hierarchical levels.

Without a centralized server for administration, every time a new device is deployed, several admin accounts needs to be created on the new device to assign the required privilege for each of the admin. Similarly, if a new admin onboards an functional organization, the account needs to be created on thousands of devices.

With PPS acting as a centralized server for device administration using TACACS+, a new admin can just be mapped to required group. A new Admin account can be configured either locally on PPS or any external servers such as AD, LDAP and so on. Similarly, when a new device is purchased, the only configuration is configuring PPS as a centralized server for device administration on device.

Licensing

TACACS+ user login does not consume any user license however either POLSEC license or Profiler license is required to be installed.

Authentication

Provides complete control of authentication through login and password.

Authorization

Provides fine-grained control over user capabilities for the duration of the user's session, which includes idle time-out, session duration. You can enforce restrictions on what commands a user may execute by configuring the privilege level for administrators. Within the privilege-level, further control can be forced by specifying command or regex match.

PPS supports 2 types of authorization techniques for administrators:

- Exec authorization- This determines a user’s privilege level when they are authenticated. The admins can run the commands, which are allowed in the user’s privilege level.
- Command authorization- TACACS+ command authorization provides centralized control of the commands available to PPS admin user. In this, every command is sent to PPS for authorization and command is permitted after getting authorized by PPS.
    - A Telnet, SSH, or console interface user who is previously authenticated by PPS using TACACS+ enters a command on the device.
    - The network device looks at its configuration to see if the command is at a privilege level that requires TACACS+ command authorization.
    - If the command requires authorization, the device consults the PPS to see if the user is authorized to use the command.
    - If the user is authorized to use the command, the command is executed.

Accounting

Collects and sends information used for auditing to the TACACS+ server. Network device administrators can use the accounting facility to track user activity for a security audit or to provide information for user billing. Accounting records include user identities, start and stop, executed commands.

Configuration

- Configuring Admin Role
- Configuring Admin Realm
- Configuring Device Group
- Configuring TACACS+ Client
- Configuring Shell Policies
- TACACS+ Command Sets
- Monitoring Device Administration
- Troubleshooting
- Appendix

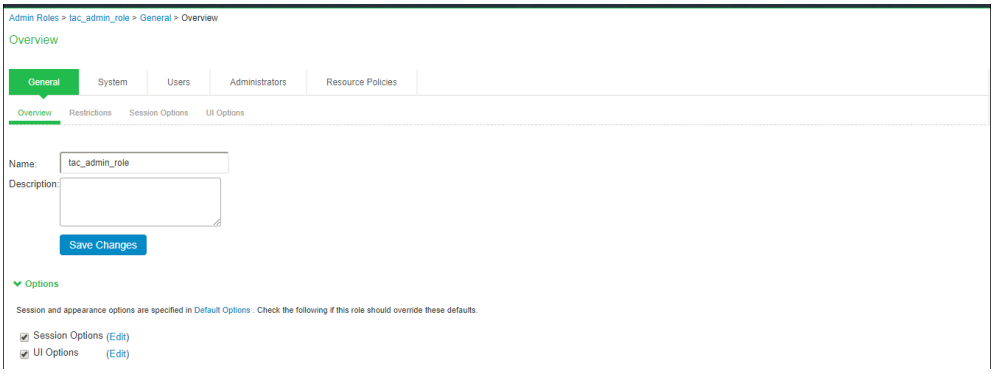
Configuring Admin Role

Admin role enables you to define granular administrative access privileges. For example, an organization would require multiple admin roles with different privilege levels to ensure protection from sensitive company information.

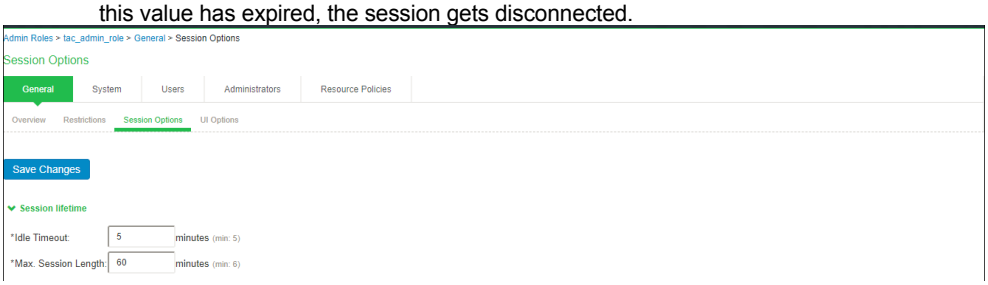
To create an Admin role for TACACS+:

20. Select **Administrators > Admin Roles > New Admin Role**. Enter a role name. You can create multiple admin roles with different privilege levels. For example, tac_admin_role

Figure: TACACS+ Admin Role



21. Under Session Options, specify the following attributes:
    - **Idle Time-out** - If no input is received or sent in the period specified, the session is disconnected.
    - **Max session length**- It specifies the maximum length of time that the session can exist. After this value has expired, the session gets disconnected.



Configuring Admin Realm

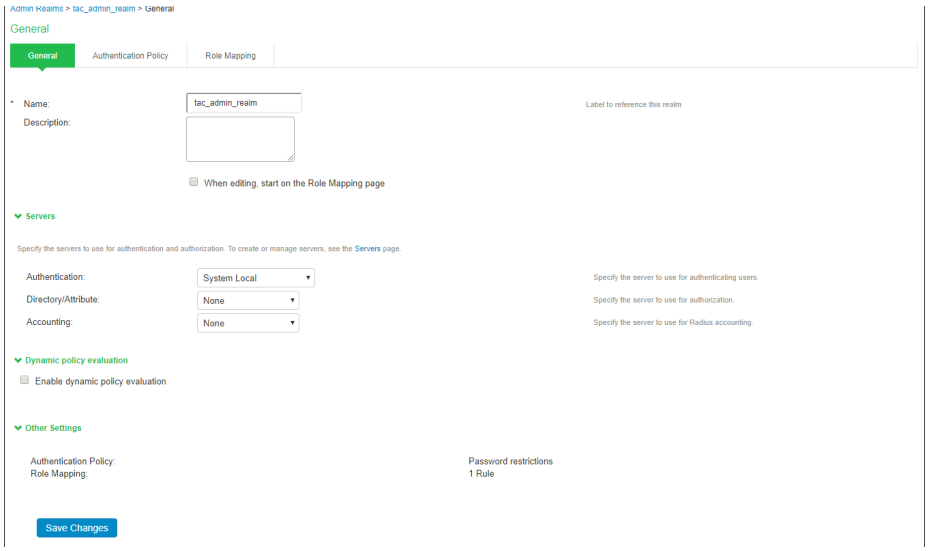
An authentication realm defines the authentication server with which end user is authenticated and the list of restrictions that must be satisfied on the client machine during sign-in. It also provides role mapping option to administrators for configuring the list of roles that needs to be assigned to the user. Role mapping provides flexibility to administrators in configuring how different set of roles need to be assigned to the user.

An admin can configure multiple admin realms when different authentication servers are required for authentication for different devices. Admin's can also use different backend servers for managing different device groups.

Create an Authentication realm and then associate the authentication server to it.

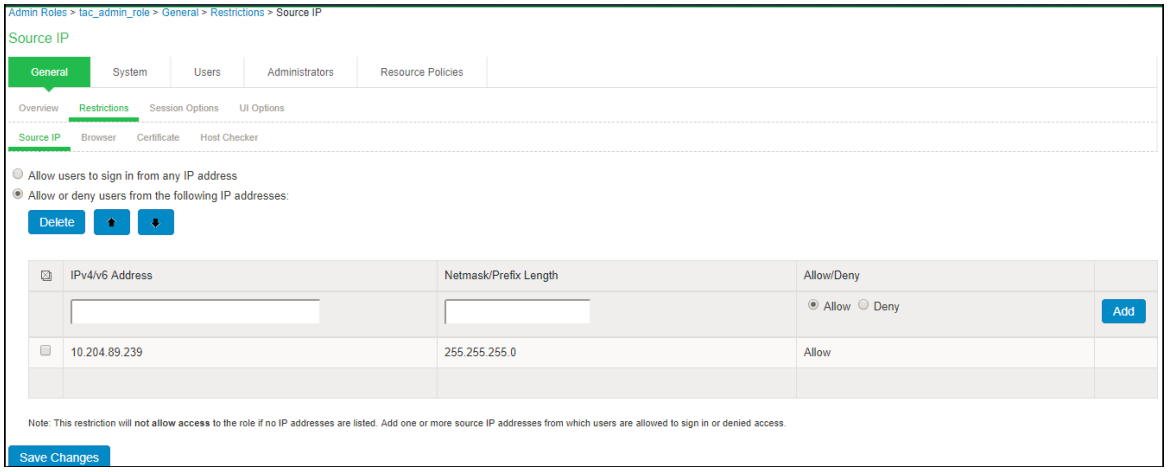
22. Select Administrators > Admin Realms > New Authentication Realm.
23. Under Servers, specify the Authentication server (AD, LDAP, Local, or RSA (ACE Server). For more information, see AAA Servers.

Figure: TACACS+ Admin Realm



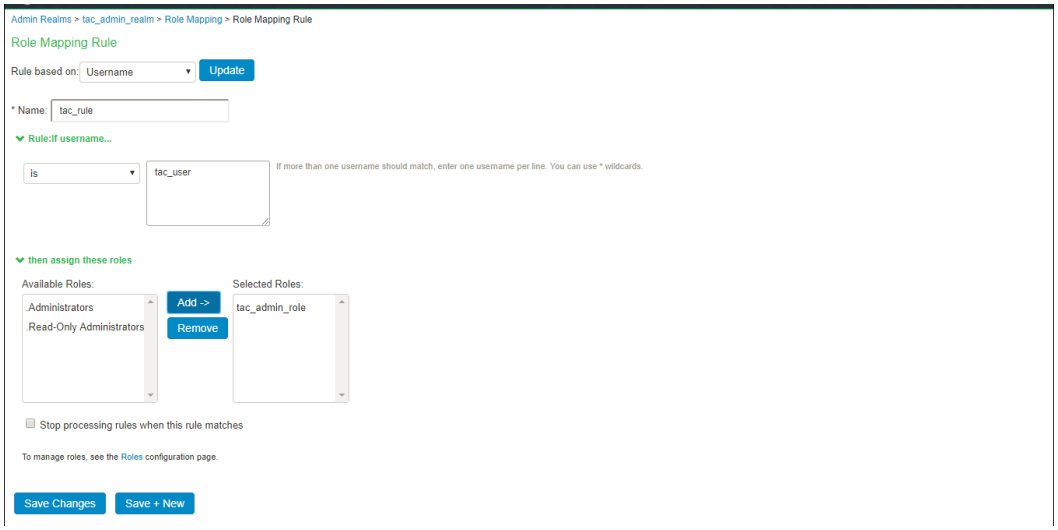
24. Configure any Admin role restrictions. For example, Source IP restriction.

Note: Browser, Host Checker, Certificate restrictions are not supported with TACACS+.



25. Set the role mapping rules. For example, create a rule to assign all users with username as tac_user to tac_admin_role.

    Figure: TACACS+ Admin Realm



Note: Role mapping rule execution is based on the order of the rules.

Configuring Device Group

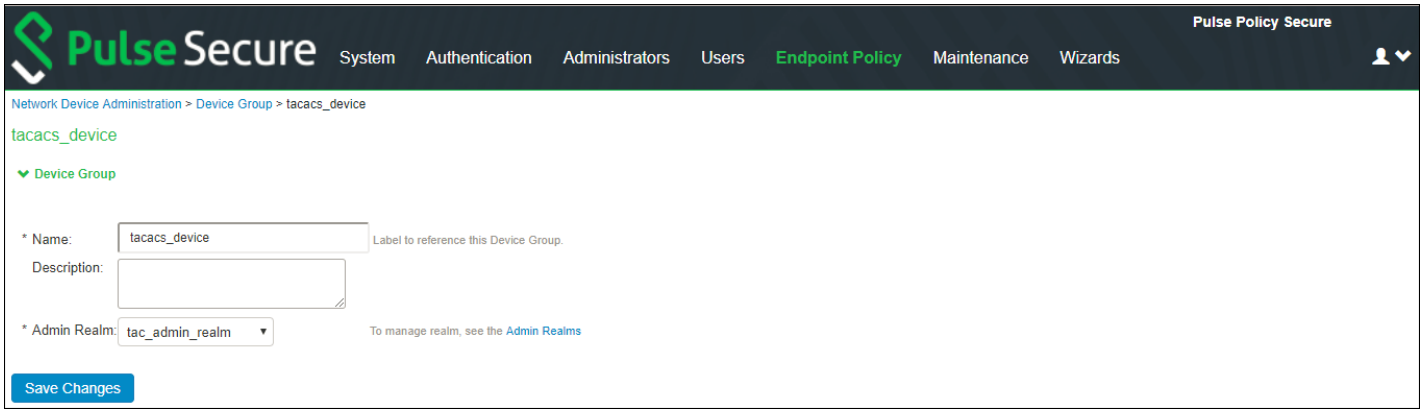
The device groups are created in a heterogeneous network where there are devices from multiple vendors with different command set. Devices with same command syntax are grouped so that it is easy to manage. PPS considers each group as a single unit while applying the shell policies.

For example, if your deployment has devices from multiple vendors, you can group them into multiple device groups based on their command syntax. Similarly, you can also create different device groups based on whether the device is a WLC/Switch.

To create a device group:

1. Select Endpoint Policy > Network Device Administration > Device Group.
2. Enter the name and description of the device group
3. Associate the previously created Admin Realm with the device group.
   A device group policy logically groups network devices by associating the devices with specific admin realm.
4. Click Save Changes.

Figure: TACACS+ Device Group



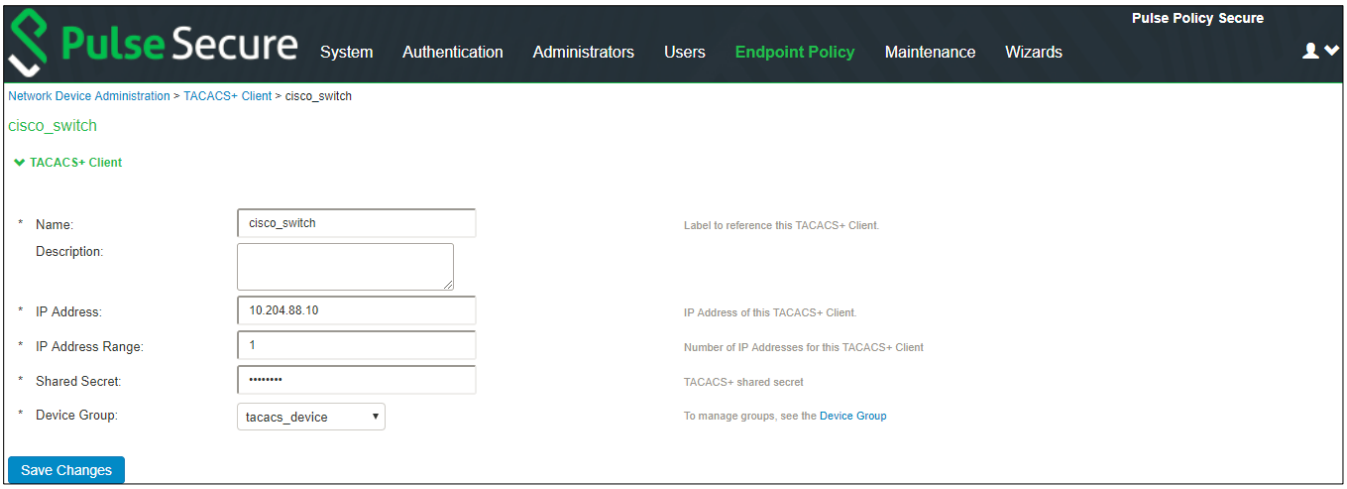
Configuring TACACS+ Client

A TACACS+ client policy specifies the information required for the device to connect to Pulse Policy Secure for admin access control. You can add the network devices as TACACS+ clients for the administrator to manage. PPS allows you to configure an IP address range for TACACS+ clients.

To create a TACACS+ client:

1. Select Endpoint Policy > Network Device Administration > TACACS+ Clients > New TACACS+ Client.
2. Enter a name for the TACACS+ client.
3. Enter a description.
4. Enter the IP address of the client.
5. Enter the IP address range for the TACACS+ clients.
6. Enter the shared secret.
7. Select the device group from the drop down.
8. Click Save Changes.

Figure: TACACS+ Client



Note: PPS does not support adding IPv6 TACACS+ clients.

Configuring Shell Policies

Define the Policies for the Admin Role and the corresponding Device Group. The Policies should be mapped with the selected Admin Roles and the Device Group.

To configure shell policies:

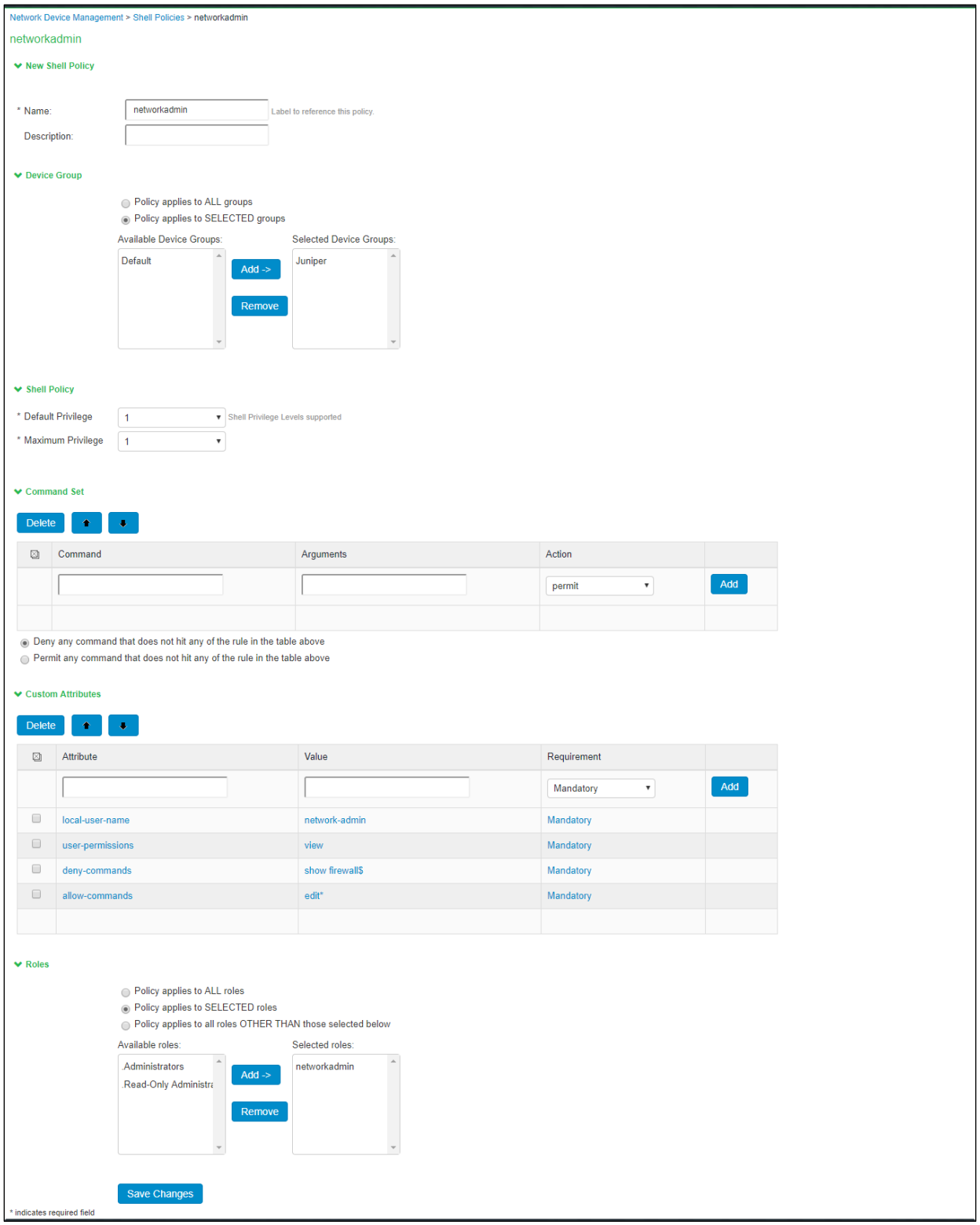
1. Select **Endpoint Policy > Network Device Administration > Shell Policies**.
2. Enter the name of the policy.
3. Enter the description.
4. Under Device Group, select the Device Group.
   - **Policy Applies to all groups**- If you select this option, the shell policy is applied to all the device groups.
   - **Policy Applies to selected groups**- If you select this option, the shell policy is applied only to the selected device group.
5. Under Shell Policy, Enter the Default and the Maximum Privilege level (1-15).
6. Under Command Set, Enter the command, arguments, and the action (permit/deny) for the Admin. If it doesn't match any rule it takes the default action:
   - Deny any command that does not hit any of the rule
   - Permit any command that does not hit any of the rule
7. Command authorization is supported on most of the switches such as HP and Cisco.

   However, devices such as F5 and Juniper does not support individual command authorization with TACACS+ server due to the delay in command execution. For F5 and Juniper devices the required set of commands are mapped to different roles locally as the roles are predefined. The TACACS+ server sends the desired role through the custom attributes during user authentication.

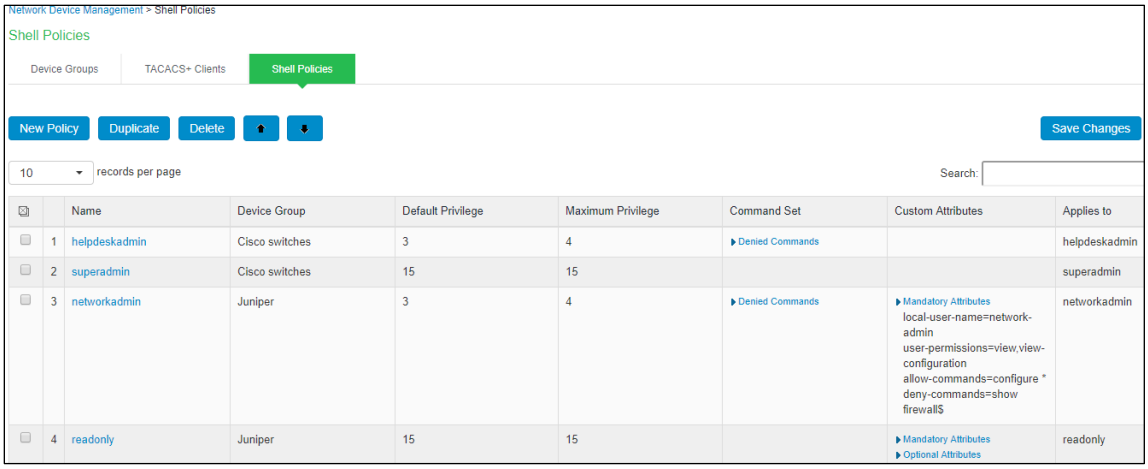
   Under **Custom Attributes**, enter the Attribute name, value, and specify the requirement as either mandatory or optional. Click **Add**.

   Mandatory arguments require that the client must understand the attribute and act upon it otherwise the authentication fails.
8. Under Roles, select the Admin Role.
   - **Policy Applies to all roles-** If you select this option, the shell policy is applied to all the admin roles.
   - **Policy Applies to selected roles**- If you select this option, the shell policy is applied only to the selected admin role.
   - **Policy Applies to all roles other than the selected role**- If you select this option, the shell policy is applied to all the admin roles other than the selected role.
9. Click **Save Changes**.

Figure: TACACS+ Shell Policy



The below page is displayed after configuring the shell policy using command set.



TACACS+ Command Sets

Command sets consists of a specific list of commands that can be executed by a network device administrator. PPS determines whether the administrator is authorized to execute these commands based on the privilege level configuration.

Regex (Wildcards)

A command line comprises the command and zero or more arguments. When PPS receives a command line (request), it handles the command and its arguments in different ways. It matches the command in the request with the command specified.

For example, Show device-[a-z]* st[a-z]*us

This command has 2 arguments.

- Argument 1 – device-[a-z]*
- Argument 2 – st[a-z]*us

The command arguments in the request are taken based on the order. After the command and arguments match to any of the command set based on the order corresponding action (permit/deny) is taken by PPS.

If command doesn't match with the any of the command set configured then default action will be taken. The default action taken can be:

- Deny any command that does not hit any of the rule
- Permit any command that does not hit any of the rule

Multiple command Sets

PPS checks all the commands in the command set sequentially for the first match.

It compares the command name from the network device with the exact command configured in the command set.

If the command matches and there are no arguments from device group

1. There are no arguments to match from device as well as no arguments configured, then the command set is considered as match
2. There are no arguments from device group but arguments are configured, then it's a no match
3. If arguments are sent by device group, then it is compared with regex pattern configured in arguments of the command set.

If argument is matched, then command set is considered as a match, and corresponding action is taken.

- If the first match has action as Permit, PPS designates the command set as Permit.
- If the first match has Deny, PPS designates the command set as Deny.

If the command doesn't match with any of the command set configured one of the below default action is taken.

PPS checks all the commands in the command set sequentially for the first match.

- Deny any command that does not hit any of the rule.
- Permit any command that does not hit any of the rule.

If there are many profiles then the first matching profile is applied.

Monitoring Device Administration

PPS provides various logs that allow you to view information related to accounting, authorization, and command accounting of devices configured with TACACS+.

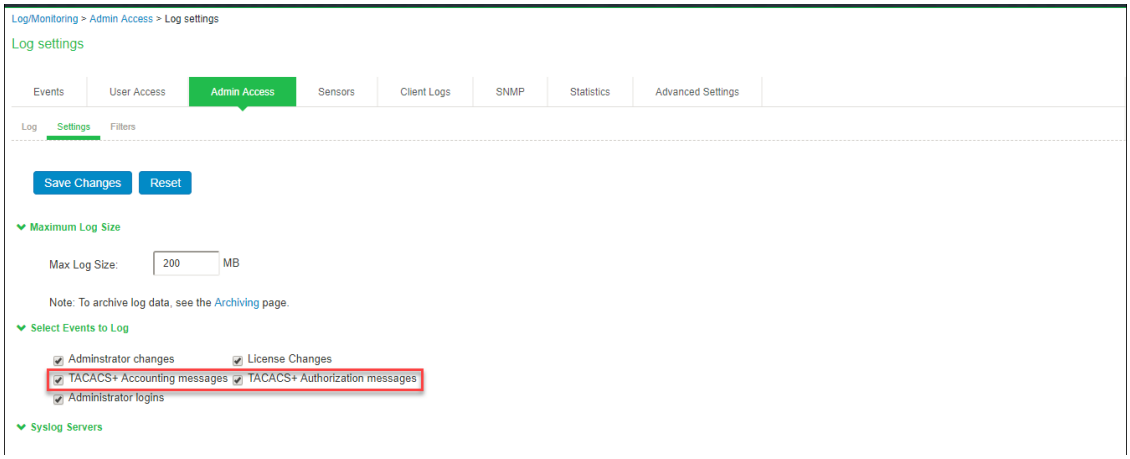
General recommendation – For recovery purposes, it is suggested to have a local backup account. The console login should be redirected to local.

To monitor device administration:

Select System > Log Monitoring > Admin Access:

1. To enable Accounting, you must click the checkbox for **TACACS+ Accounting messages**.
2. To enable authorization, you must click the checkbox for **TACACS+ Authorization messages.**

Figure: TACACS+ Device Administration



Troubleshooting

PPS provides logging and monitoring capabilities to help you track events and user activities. The system generates event logs related to system performance, administrator actions, network communications, access management framework results, user sessions, and so forth.

The available logs, includes:

- Event Logs- This file contains a variety of system events, such as session timeouts, systems errors and warnings, server restart notifications and connectivity requests.
- Admin Access Logs- This file contains administration information, including administrator changes to user, system and network settings, such as changes to session timeouts, license changes and so on.

TACACS+ Event and Admin Logs

Event Logs

1. Logging when count of TACACS+ connection reached system limit.

Minor – Limit of <max count> TACACS+ concurrent users reached

Minor	TAC31628	2018-01-31 14:40:48 - ic - [127.0.0.1] System()[] - Limit of 2 TACACS+ concurrent users reached

2. Dropping the incoming TACACS+ connection because received from unknown host.

Major - TACACS+ request received from unknown TACACS+ client <switch IP>

Major	TAC31629	2018-01-31 14:37:54 - ic - [127.0.0.1] System()[] - TACACS+ request received from unknown client 10.204.89.239

3. Dropping the incoming TACACS+ connection due to shared-secret mismatch.

Minor - Invalid TACACS+ packet from <switch IP>, discarding.

Minor	TAC31628	2018-01-31 14:35:58 - ic - [127.0.0.1] System()[] - Invalid TACACS+ packet from 10.204.89.239, discarding. Incorrect shared secret?

Admin Access Logs

1. Exec Authorization [Only when Authorization is enabled under authorization setting]
   - Log for exec authorization success

TACACS+ Shell authorization successful for <user> on switch-<switch ip> and attributes are: privilege = %d, idle-timeout = %d, session-timeout = %d

Info	TAC31611	2018-01-30 18:59:03 - ic - [xx.xxx.xx.xxx] tac_user(tac_admin_realm)[tac_admin_role] - 'TACACS+ Shell authorization successful for tac_user on 10.204.89.239 and attributes are: privilege = 15, idle-timeout = 5, session-timeout = 60'

- Log for exec authorization failure due to no shell policy assigned to roles.
  TACACS+ Shell authorization rejected for <user> on switch-<switch ip>. Reason- %s
  Reasons- No session found
  No Shell policy found for the assigned roles

Info	TAC31612	2018-01-30 19:06:45 - ic - [xx.xxx.xx.xxx] tac_user(tac_admin_realm)[tac_admin_role] - 'TACACS+ Shell authorization rejected for tac_user on 10.204.89.239. Reason: No Shell policy found for the assigned roles'

2. Command authorization [Only when Authorization is enabled under authorization setting]
   - Log for command authorization success.
     TACACS+ Authorization successful for command-%s from <user> on switch-<switch ip>

Info	TAC31611	2018-01-30 19:08:14 - ic - [xx.xxx.xx.xxx] tac_user(tac_admin_realm)[tac_admin_role] - 'TACACS+ Authorization successful for command-'show version' from tac_user on 10.204.89.239'

   - Log for command authorization failure due to no shell policy assigned to roles or due to deny under command set.
     TACACS+ authorization rejected for command-<cmd> from <user> on switch-<switch ip>. Reason- %s
     Reasons- . No session found

Info	TAC31612	2018-01-30 19:37:02 - ic - [xx.xxx.xx.xxx] tac_user(tac_admin_realm)[tac_admin_role] - 'TACACS+ authorization rejected for command-'show version' from tac_user on 10.204.89.239. Reason- No session found'

   - No Shell policy found for the assigned roles
   - Matched with the rule – [command = %s, Arguments = %s, action = %s] in shell policy-%s

Info	TAC31612	2018-01-30 19:11:31 - ic - [xx.xxx.xx.xxx] tac_user(tac_admin_realm)[tac_admin_role] - 'TACACS+ authorization rejected for command-'menu ' from tac_user on 10.204.89.239. Reason- Matched with the rule – [command = menu, Arguments = null, action = deny] in shell policy-tacacs_policy'

   - No match found. Default action is deny in shell policy-%s

Info	TAC31612	2018-01-30 19:12:31 - ic - [xx.xxx.xx.xxx] tac_user(tac_admin_realm)[tac_admin_role] - 'TACACS+ authorization rejected for command-'display arp' from tac_user on 10.204.89.239. Reason- No match found. Default action is 'deny' in shell policy-tacacs_policy'

3. Login Authentication: [Only when Administrator login is enabled under admin access setting]
   - Login Success

Info	AUT30684	2018-01-30 18:59:02 - ic - [xx.xxx.xx.xxx] tac_user(tac_admin_realm)[] - Primary authentication successful for tac_user/System Local from 10.204.59.223(Shell login to 10.204.89.239).

- Login failure due to authentication failure.

Info	AUT23458	2018-01-30 19:15:10 - ic - [10.204.59.223] tac_user(tac_admin_realm)[tac_admin_role] - Login failed using auth server System Local (Local Authentication). Reason: Failed

- Login failure due to restrictions.

Info	AUT23458	2018-01-30 19:04:23 - ic - [xx.xxx.xx.xxx] tac_user(tac_admin_realm)[tac_admin_role] - Login failed. Reason: No Roles

- Login failure due to no role available.

Info	AUT23458	2018-01-30 19:04:23 - ic - [xx.xxx.xx.xxx] tac_user(tac_admin_realm)[tac_admin_role] - Login failed. Reason: No Roles

- Session deletion due to accounting stop received

Info	AUT31627	2018-01-30 19:23:43 - ic - [xx.xxx.xx.xxx] tac_user(tac_admin_realm)[tac_admin_role] - 'Received a TACACS+ Accounting stop request. Terminated Session.'

- Session deletion due to session timeout.

Info	ADM20664	2018-01-30 19:34:40 - ic - [xx.xxx.xx.xxx] tac_user(tac_admin_realm)[tac_admin_role] - Session timed out for tac_user/tac_admin_realm due to inactivity (last access at 19:29:38 2018/01/30). Idle session identified during routine system scan.

4. Enable Authentication: [Only when Administrator login is enabled under admin access setting]
   - Enable authentication success.

Info	AUT30684	2018-01-30 19:28:09 - ic - [xx.xxx.xx.xxx] tac_user(tac_admin_realm)[] - Enable Service authentication successful for tac_user/System Local from 10.204.59.223(Shell login to 10.204.88.10).

   - Login failure due to authentication failure.

Info	AUT23458	2018-01-30 19:29:44 - ic - [xx.xxx.xx.xxx] tac_user(tac_admin_realm)[tac_admin_role] - Login failed using auth server System Local (Local Authentication). Reason: Failed

   - Login failure due to restrictions.

Info	AUT23458	2018-01-30 19:31:15 - ic - [xx.xxx.xx.xxx] tac_user(tac_admin_realm)[tac_admin_role] - Login failed. Reason: No Roles

- Login failure due to no role available.

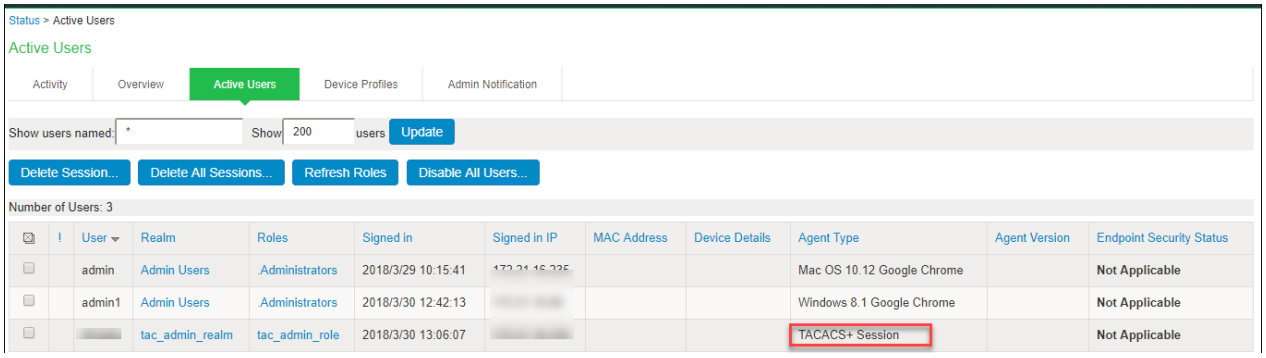
Info	AUT23458	2018-01-30 19:31:15 - ic - [xx.xxx.xx.xxx] tac_user(tac_admin_realm)[tac_admin_role] - Login failed. Reason: No Roles

5. Assigning custom attributes from PPS to TACACS+ client (Juniper, F5)

Info	TAC31778	2019-04-23 11:55:11 - PPS- [127.0.0.1] user7(Admin realm)[networkadmin] - User assigned TACACS+ attribute(s) (local-user-name=network-admin user-permissions=view deny-commands=show firewall$ allow-commands=edit*)

Once the session is established the session is seen as TACACS+ Session in the Active Users Page

Figure: TACACS+ Active Users



Appendix

The following example shows how to configure the switch to authenticate and account using TACACS+.

Output 1: Example: TACACS+ authentication, authorization, and accounting configuration for Cisco iOS.

**Authentication
aaa authentication login default group <group-name> local
aaa authentication enable default group <group-name> enable
**Authorization
aaa authorization exec default group <group-name> local
aaa authorization commands <privilege no.> default group <group-name> local
aaa authorization config-commands
**Accounting
aaa accounting exec default start-stop group <group-name>
aaa accounting commands <privilege no.> default start-stop group <group-name>
aaa accounting send stop-record authentication failure

****Mapping TACACS+ server IP to group**

aaa group server tacacs+ <group-name>
server-private <server-ip> key <shared-secret>

Output 2: Example: TACACS+ authentication and accounting configuration for HP switch.

tacacs-server host <host-ip> key <shared-secret>
aaa authentication telnet login tacacs
aaa authentication telnet enable tacacs
aaa authentication login privilege-mode
aaa accounting exec start-stop tacacs

Note- HP switches should be set with privilege level always. Enable authentication is not supported.

Output 3: Example: Juniper Switch

```
root@ex-2200# show system login
class class1 {
    idle-timeout 20;
}
class network-admin {
    idle-timeout 10;
}
user network-admin {
    uid 2002;
    class network-admin;
}
user remote-read-only {
    full-name "User template for remote read-only";
    uid 2014;
    class read-only;
}
user remote-super-users {
    full-name "User template for remote super-users";
    uid 2013;
    class super-user;
}
```

#show system tacplus-server
<PPS-IP> {secret “fkfljsfjsafjsaf”; }

#show system accounting
events [events];

#show system tacplus-options
service-name shell;

For more information on Juniper, see here.

Output 4: Example: F5 Device

Label	Sample Configuration
TACACS+ Authentication	https://support.f5.com/csp/article/K8811 **Note**: Configure Service Name as “shell” instead of “ppp” under configuration for TACACS+ authentication.
TACACS+ Accounting	https://support.f5.com/csp/article/K13762
Remote Role configuration using Custom attributes	https://devcentral.f5.com/Portals/0/Cache/Pdfs/2807/tacacs-remote-role-configuration-for-big-ip.pdf

Guest Access

This chapter covers the following topics:

Overview

PPS provides guest access management solution through which you can manage and secure your guest network access.

PPS supports the following mechanisms for guest access management:

- Guest Access through Guest User Account Manager (GUAM)
- Self-Registration
- Sponsor Approved Guest Access

Guest User Account Manager (GUAM)

The guest users use their own devices to access internet. A guest account can be created by a guest admin (GUAM) such as a receptionist. The GUAM user has below guest administration capabilities:

- Create temporary guest access accounts for guest users
- Create bulk accounts for numerous guest users
- Notify guest user credentials through email or text message.

Self-Registration

The guest self-registration enables a guest to access a Self–Registration URL and create their own guest account for internet access. The username and password for a self-provisioned guest account is delivered directly to the guest's web browser, or sent via SMS or email.

The self-registration workflow is described below:

1. The user connects to wireless network through guest SSID.
2. The user tries to access internet.
3. WLC redirects the user to PPS guest sign-in URL.
4. The user performs self-registration and signs-in through the credentials.
5. If the authentication is successful, the guest user can access internet.

Sponsor Approved Guest Access

The sponsor approved guest access provides access to the guest user only if it is approved by the Guest Sponsorer. The Sponsorer validates the guest user before giving the required access. This feature provides additional security by providing access only to valid guest users. The Sponsor takes the responsibility for the actions of the Guest and thus it brings accountability for the network usage and enhances the security of the network.

The sponsored guest access workflow is described below:

1. The Guest user connects to wireless network through guest SSID.
2. The Guest user performs the self-registration and the guest account will be created in disabled state and the access request is sent to the Sponsor (Employee/GUAM).
3. The Sponsorer will receive an email notification about the new guest access request.
4. The Sponsorer logins to the Sponsor portal and approves/denies the guest user.
5. If the Sponsor approves the request the guest account becomes active and an email/SMS notification is sent to guest about activation of the account. If sponsor denies the request, the guest account will be deleted and an email/SMS notification is sent to guest about deny access.

Deployments

This topic describes the deployment scenarios of the Guest access solution.

- Guest Access using WLC
- Guest Access using SRX/EX
- Guest Access using Cisco switch

Guest Access using WLC

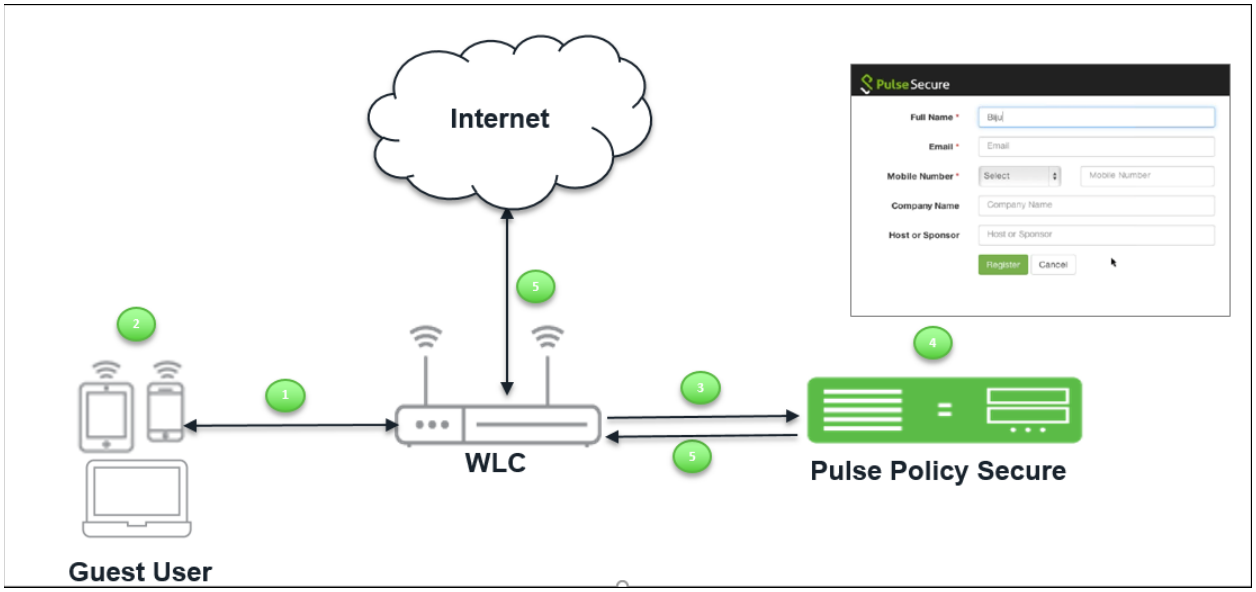
The guest access solution for wireless network can be deployed with leading Wireless LAN controllers. You can deploy wireless network with WLCs and wireless network for guests. The guest authentication is done with external authentication server and PPS server can be used as an external authentication server.

The assumption for this deployment the user has already deployed wireless network for guest using WLC and would like to have centralized authentication server. When wireless network is built with multiple vendors WLCs then it further becomes useful to have centralized authentication server.

The user flow is explained below:

1. Guest user comes on-premises and connects to guest SSID.
2. Guest user opens a browser to access an internet resource.
3. The user is redirected to PPS guest login page.
4. Guest user clicks the self-registration link from the guest login page and completes the registration process. If the Administrator has configured Host Checker policy then PPS evaluates the Host Checker results.
   - Pre authentication – Host Checker policies are evaluated first and then user is prompted for credentials. For configuration details, see User Realms.
   - Post authentication – User credentials are validated first and then the Host Checker policies are evaluated. For configuration details, see User Roles.
5. Guest user logins with guest user credentials. PPS validates the credentials and based on the result WLC redirects the guest user to the resource requested.

Figure 277: Guest Access using WLC



Guest Access using EX switch/SRX Firewall

When a PPS and an EX Series switch/SRX firewall is deployed, users must first sign into PPS for authentication before they can access a protected resource behind the EX Series switch/SRX firewall.

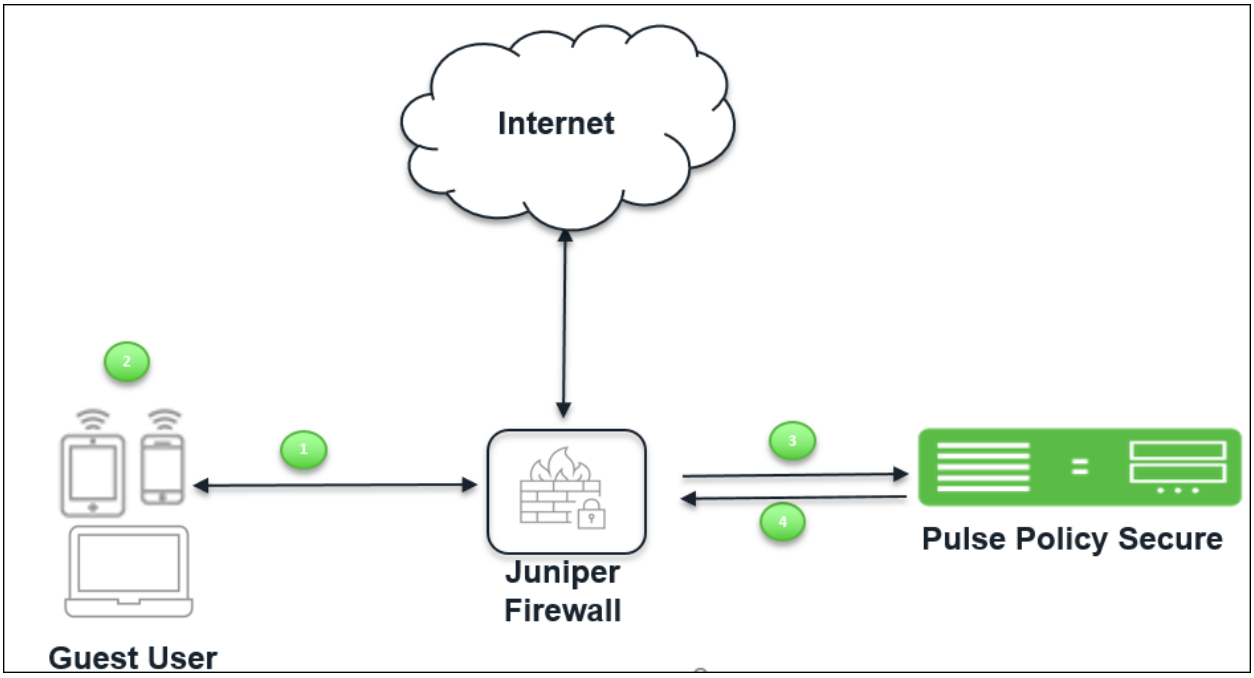
To facilitate sign-in, you can configure a redirect policy on the EX Series switch/SRX firewall to automatically redirect HTTP traffic destined for protected resources to PPS. When the sign-in page for the PPS is displayed, the user signs in, and access is granted to internet. These user accounts can be created by Guest User Account Manager.

The user flow is explained below:

1. Guest user comes on-premises and tries to connect to internet.
2. Guest user opens a browser to access an internet resource.
3. The Guest user is redirected to PPS login page.
4. If the Admin has configured Host Checker restrictions on the Guest role/realm then the Guest user is provided access only after Host Checker policies are evaluated.

   The Admin can configure the Host Checker in two ways:
   - Pre-Authentication (Host Checker restriction on guest realm)– The Host Checker policies are evaluated first and then user is prompted for credentials.
   - Post-Authentication (Host Checker restriction on guest role) – The user credentials are validated first and then the host checker policies are evaluated.
5. The Guest user logins with the credentials provided by the guest Admin (GUAM).

Figure 278: Guest Access using SRX/EX



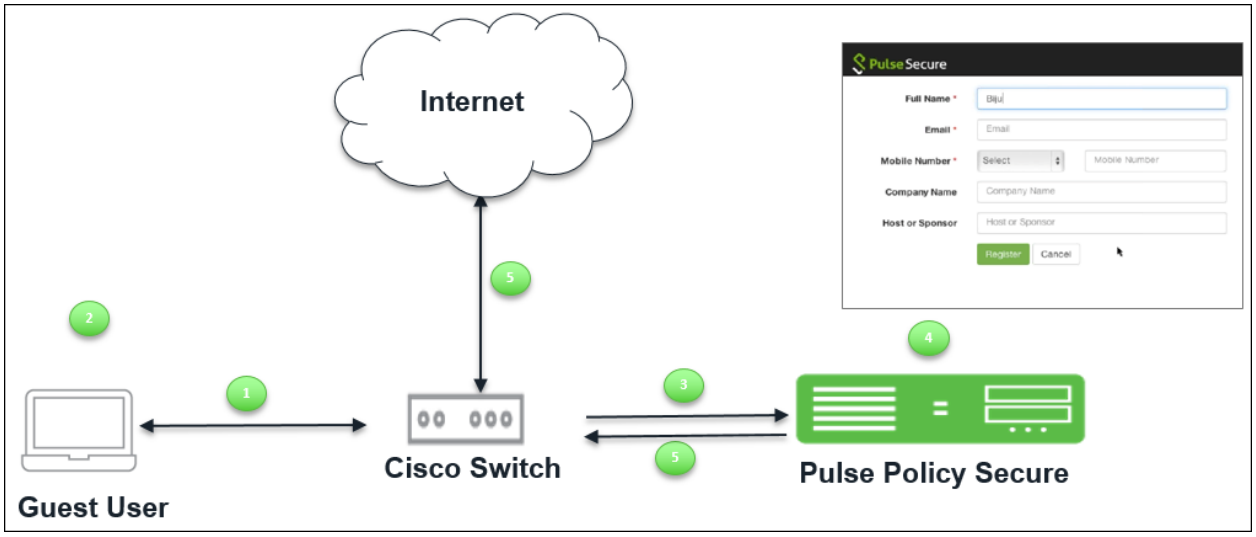
Guest Access using Cisco Switch

The guest access feature is supported for wired guest endpoints with Cisco switches. To facilitate sign-in, you can configure a redirect policy on the Cisco switch to automatically redirect HTTP traffic destined for protected resources through PPS. When the sign-in page for the PPS is displayed, the user signs in, and access is granted to internet.

The user flow is explained below:

1. Guest user comes on-premises and connects to LAN.
2. Guest user opens a browser to access an internet resource.
3. The user is redirected to PPS guest login page.
4. The Guest user self registers on PPS guest portal and receives the credentials over the email/SMS or on the UI. If the Administrator has configured Host Checker policy then PPS evaluates the Host Checker results.
    - Pre authentication – Host Checker policies are evaluated first and then user is prompted for credentials. For configuration details, see User Realms.
    - Post authentication – User credentials are validated first and then the Host Checker policies are evaluated. For configuration details, see User Roles.
5. The guest user gets authenticated and gets redirected to the requested internet resource.

Figure 279: Guest Access using Cisco Switch



The configuration details are covered in Configuring PPS for Guest Wired Authentication using Cisco Switch.

Configuring PPS for WLC Deployment

This section describes the configuration that is required on PPS to communicate with a Wireless LAN Controller (WLC) for Guest user management.

PPS server acts as RADIUS server that allows to centralize the authentication and accounting for the users. You can add Cisco, Aruba, or Ruckus WLC as a RADIUS client on PPS. Guest user Self-Registration options need to be configured in the authentication server used for managing guest accounts and in sign-in policy settings.

Default Configurations for Guest Access

PPS has some default configuration settings for convenience of the Admin users.

The default settings are:

- Sign-in Policies
- User Realms
- User Roles
- Location Groups
- Authentication Protocol Sets
- Authentication Server

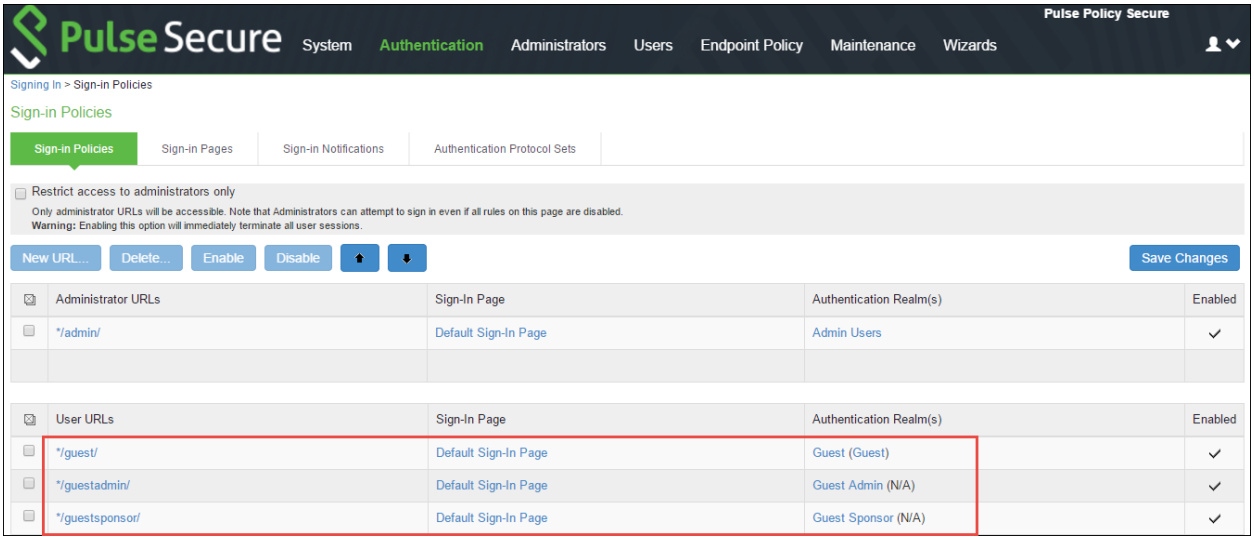
Sign-In-Policies

The */guestadmin/, */guest/, and */guestsponsor are the default Sign-in-Polices in PPS. A Sign-in Policy is mapped with a default Authentication Realm.

To view the Sign-in-Polices:

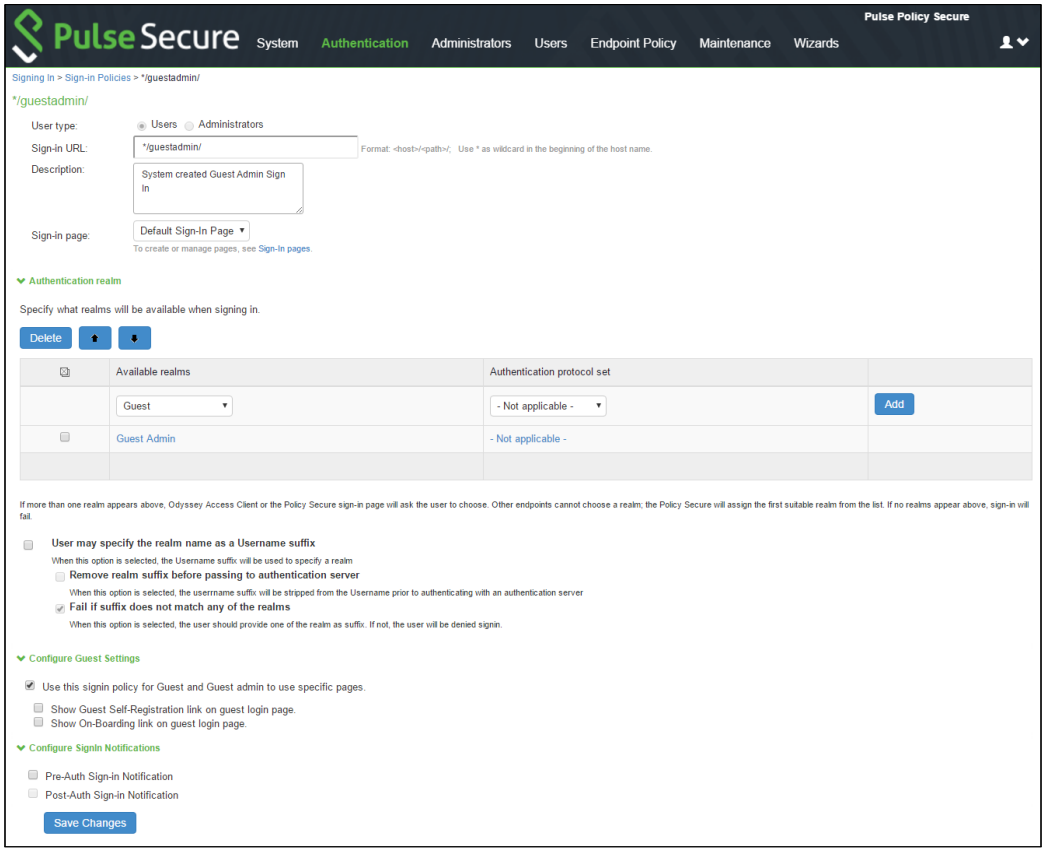
1. Select Authentication > Signing In > Sign-in Policies. The Sign-in Policies screen appears.

   Figure 280: Guest Sign-In Policies



2. Click on a Sign-in Policy to view the settings. You can make necessary changes or add realms in a Sign-in Policy and click **Save Changes.**

Figure 281: Default Guest Sign-In Policy



User Realms

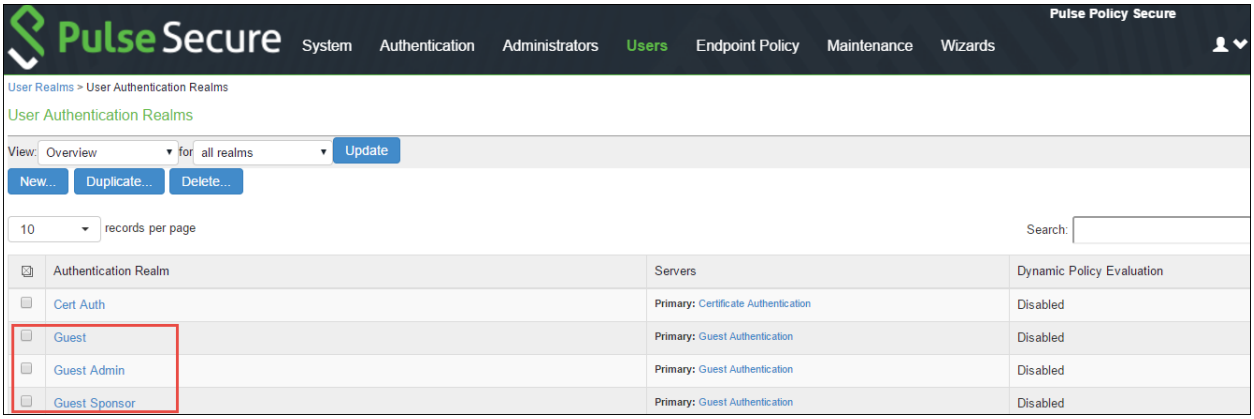
The Guest, Guest Admin and Guest Sponsor are the default user realms in PPS. A user realm is mapped with a default Role.

	Note: For a Guest Admin realm and Guest Sponsor Realm, Administrator must create the role mapping rule for the user name who has rights for creating Guest accounts.

To configure a guest admin realm:

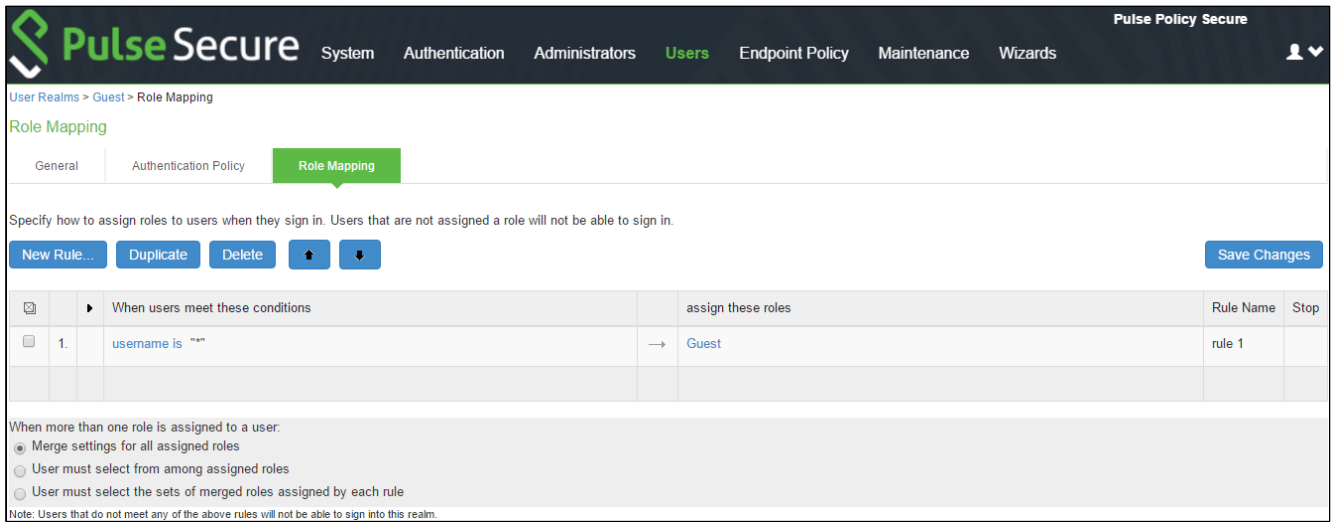
1. Select **Users** > **User Realms**. The User Authentication Realms screen appears.

   Figure 282: User Authentication Realm



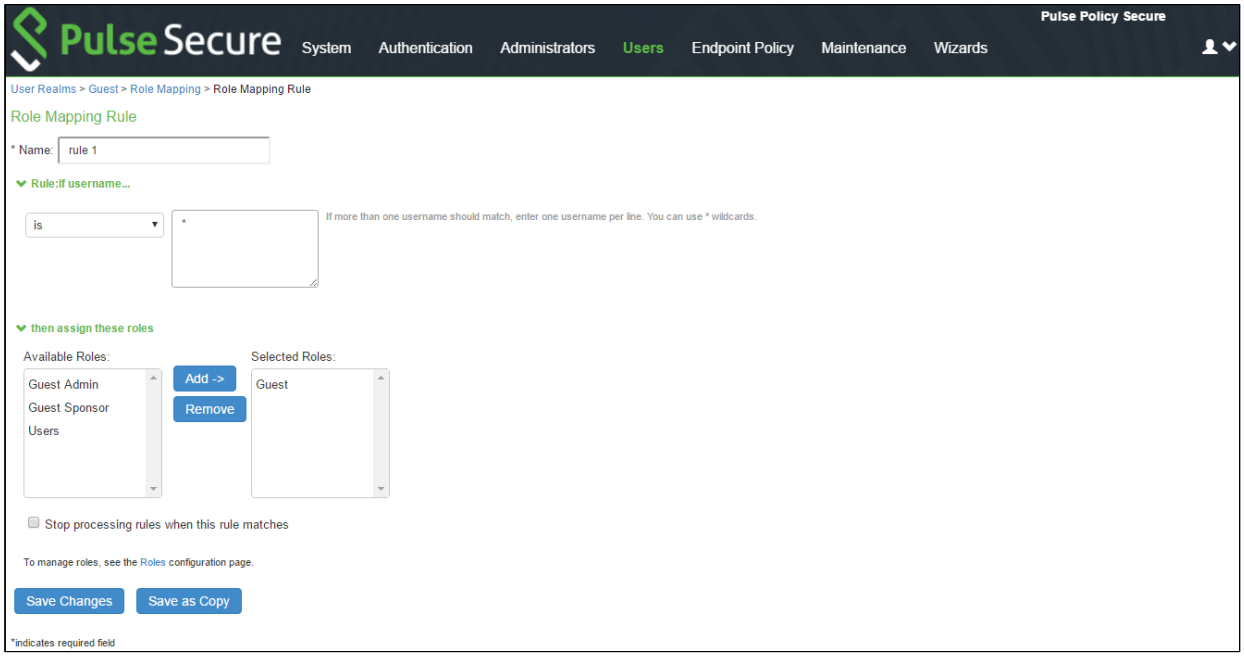
2. Click on a Guest Authentication Realm to view the settings. The Role Mapping screen of the Realm appears.

   Figure 283: User Realm - Role Mapping Page



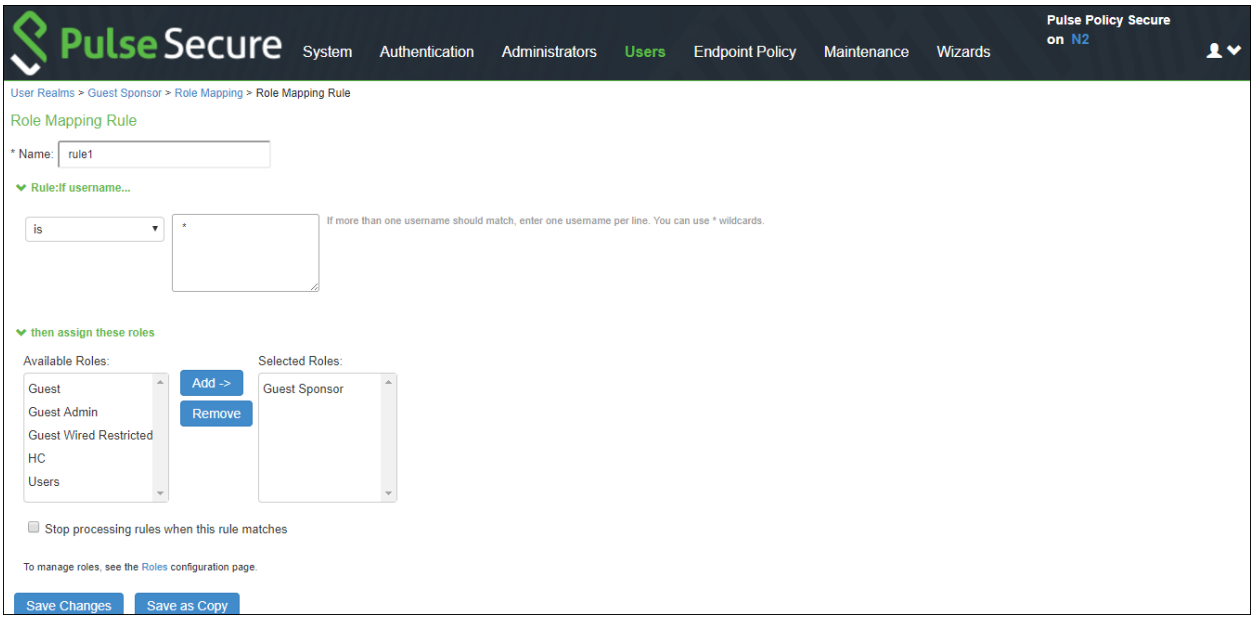
3. Click an existing Rule of the Role to view the settings.

Figure 284: User Realm - Role Mapping Rule



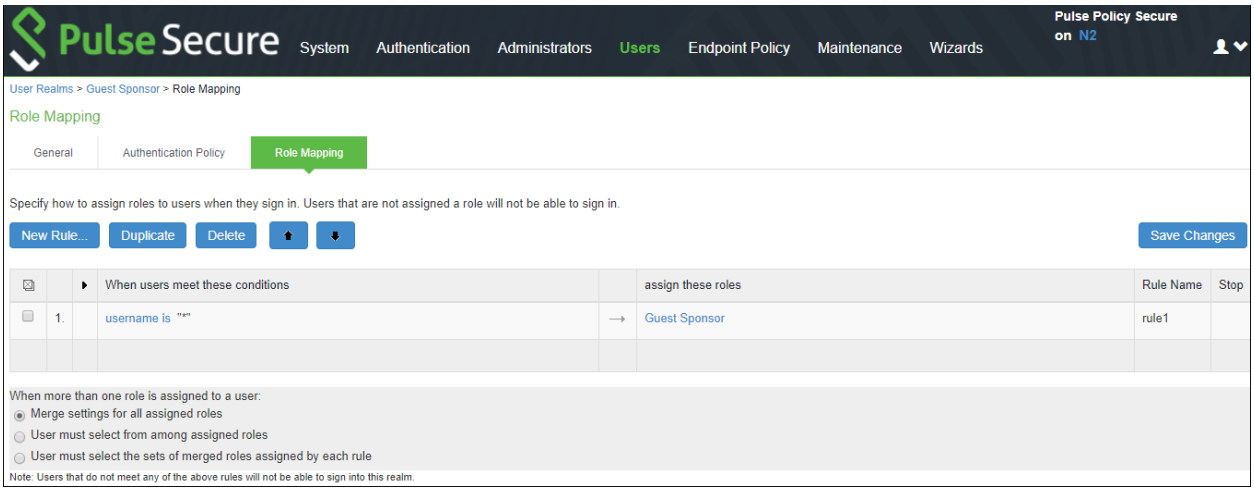
4. For Guest Sponsor, Click the **Guest Sponsor Realm** and specify how to assign the role. Click **New Rule** to add a new role and then click **Save Changes**.

   Figure 285: User Realm – Guest Sponsor



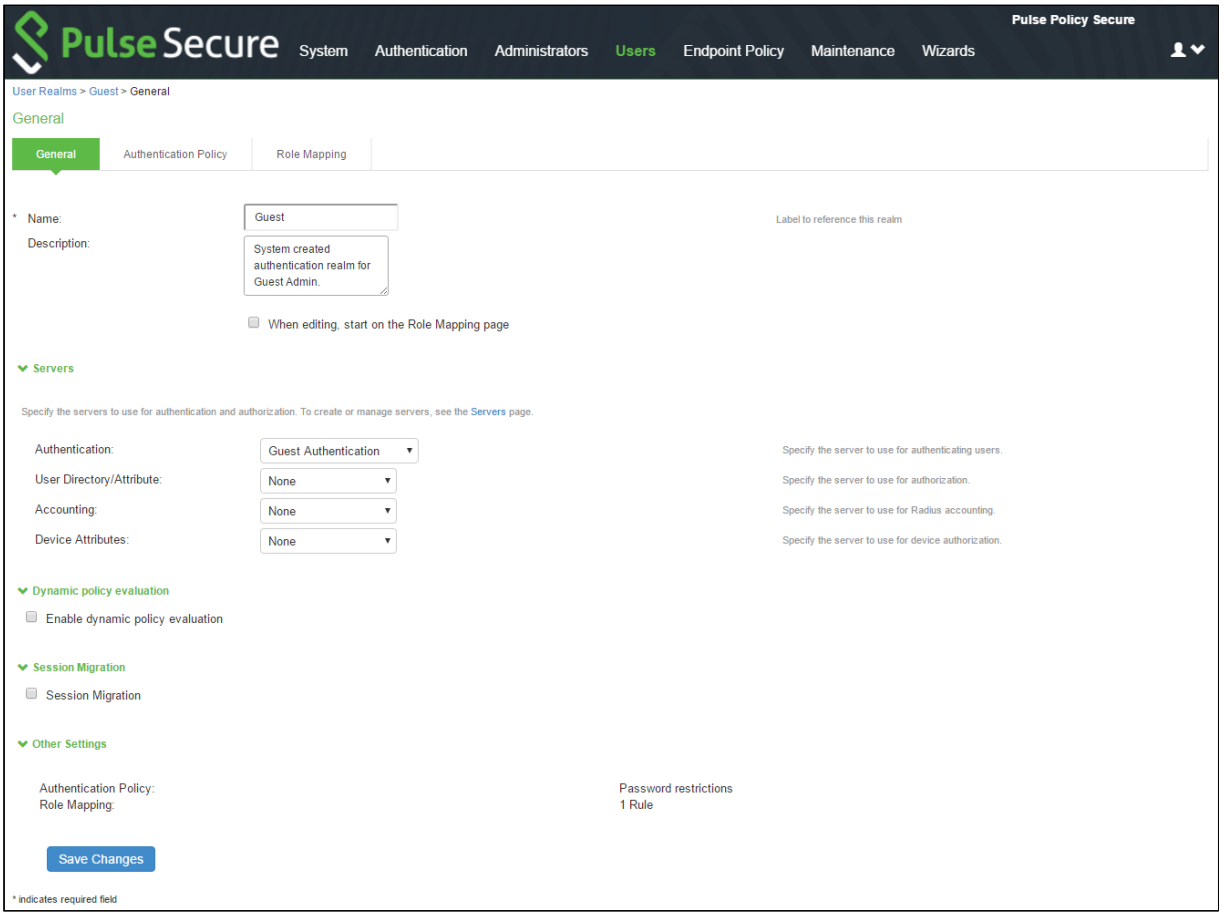
5. You can make necessary changes and click **Save Changes** to save the settings.

   Figure 286: Guest Sponsor Role Mapping



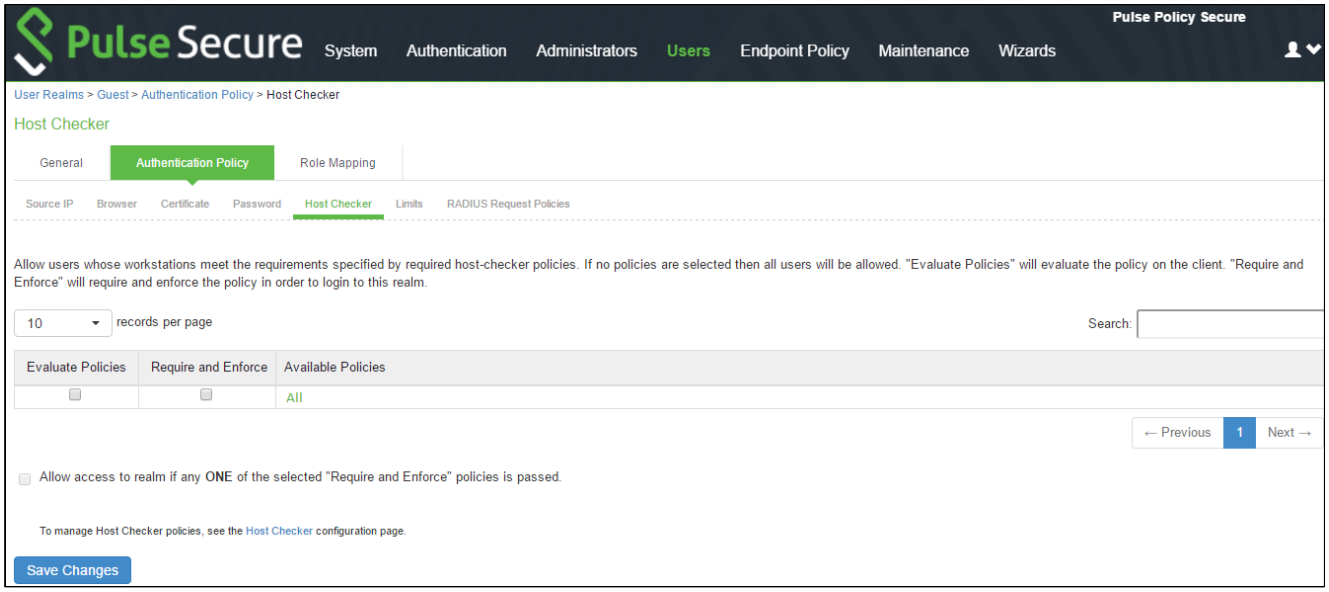
6. Click the **General** tab to view the settings. The **General** screen appears.

Figure 287: User Realm - General



7. You can make necessary changes and click **Save Changes** to save the settings.
8. Click **Host Checker**. You can make the necessary changes and click Save Changes.

Figure 288: User Realm – Host Checker



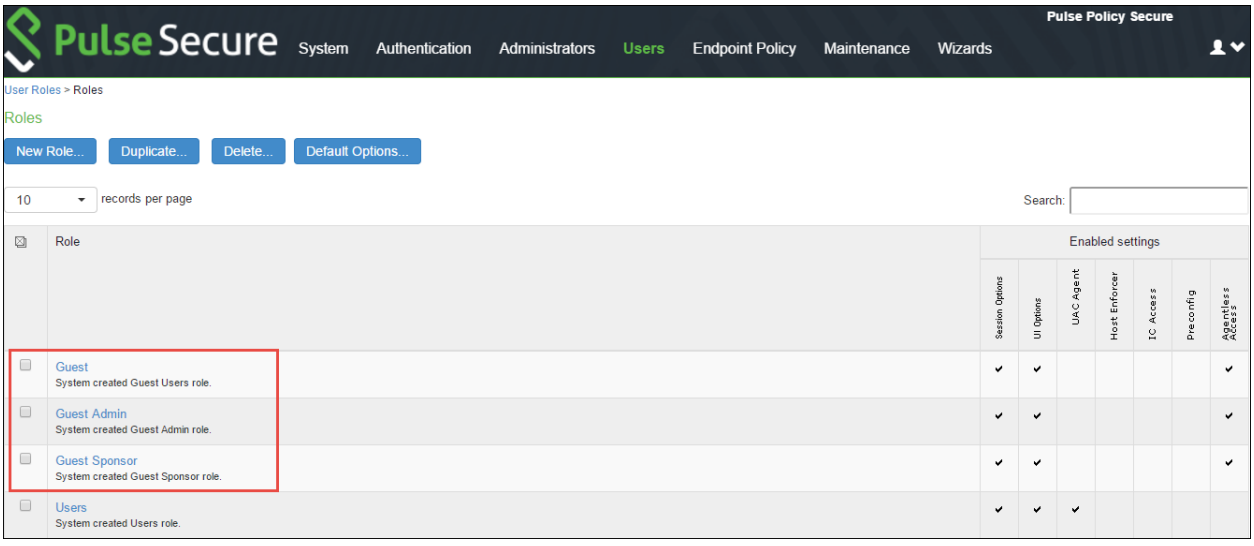
User Roles

The Guest Admin, Guest, and Guest Sponsor are the default user roles in PPS. A user realm is mapped with a default Role.

To view a User Role:

1. Select **Users** > **User Roles**. The Roles screen appears.

   Figure 289: User Roles

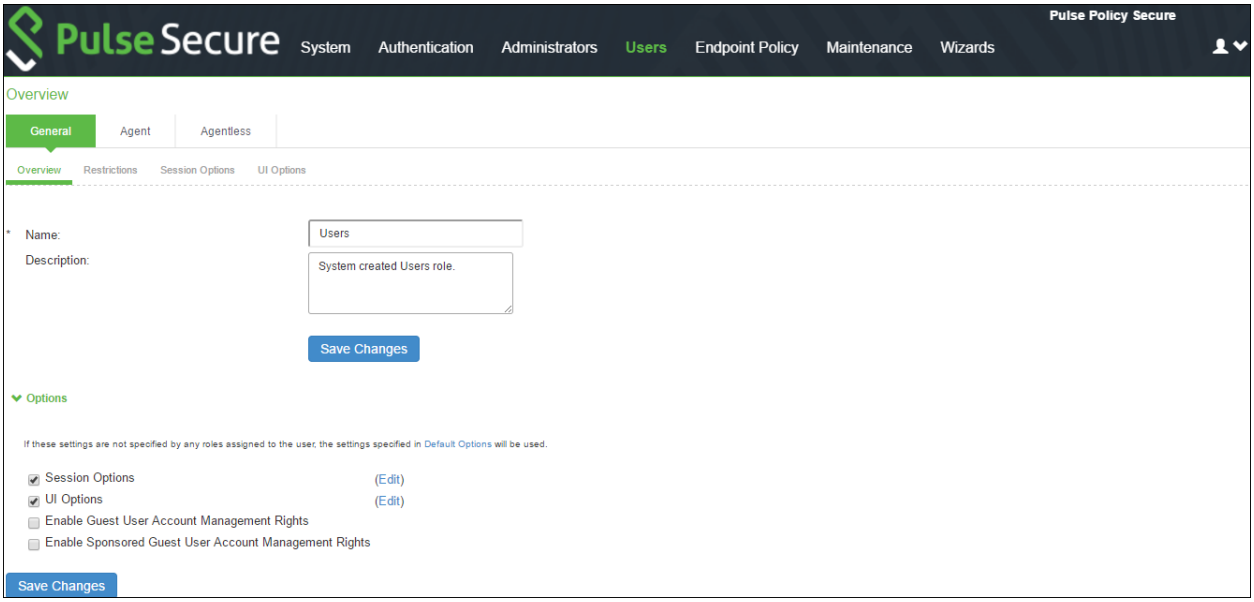


2. Click on a default Guest Role to view the settings.

   The **General > Overview** screen appears. You can make necessary changes and click Save Changes

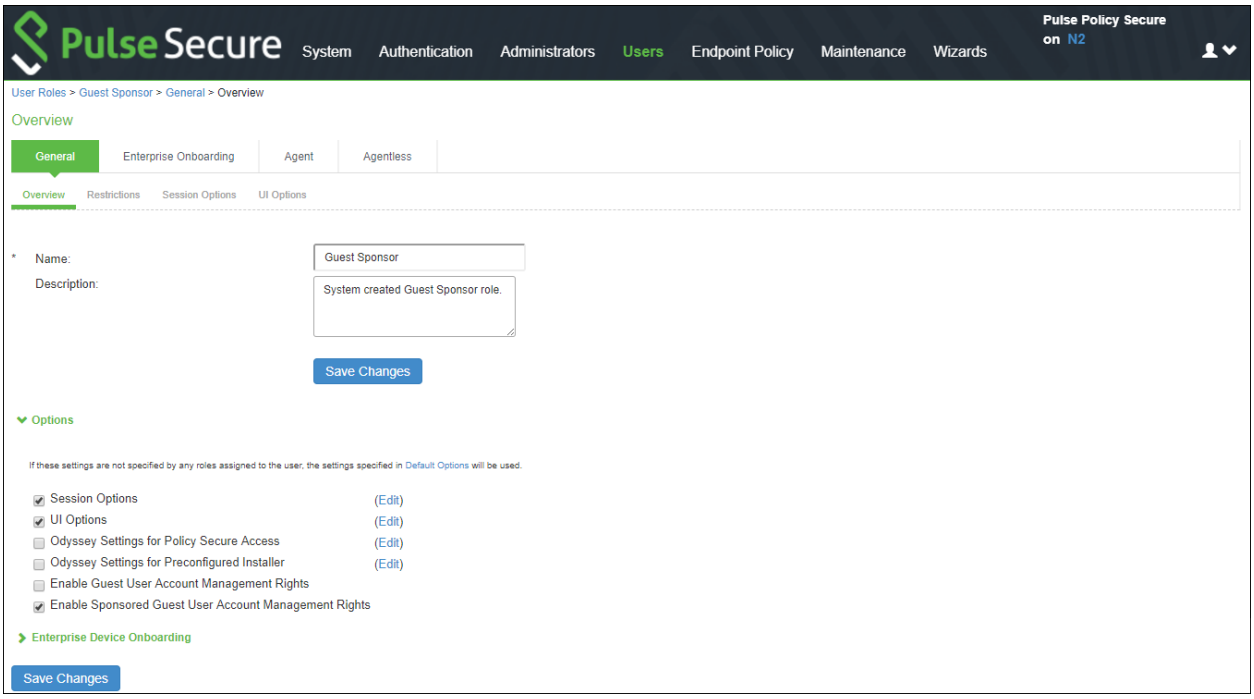
to save the settings.

Figure 290: Default User Role Settings



3. Click **Guest Sponsor** in the user role page to view the settings.

Figure 291: Guest Sponsor Role



4. You can go to other tabs of the User Roles, to view the default settings and make necessary changes.

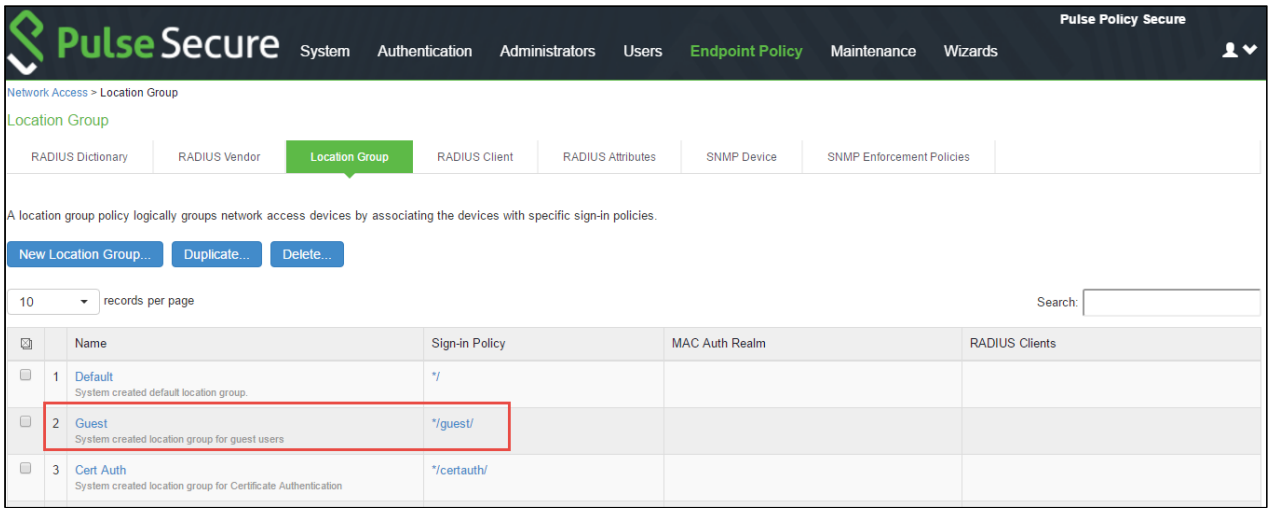
Location Groups

The 'Guest' is the default Location Group configured in PPS. A Location Group is mapped with a default Sign-in Policy and a default Realm.

To view a Location Group:

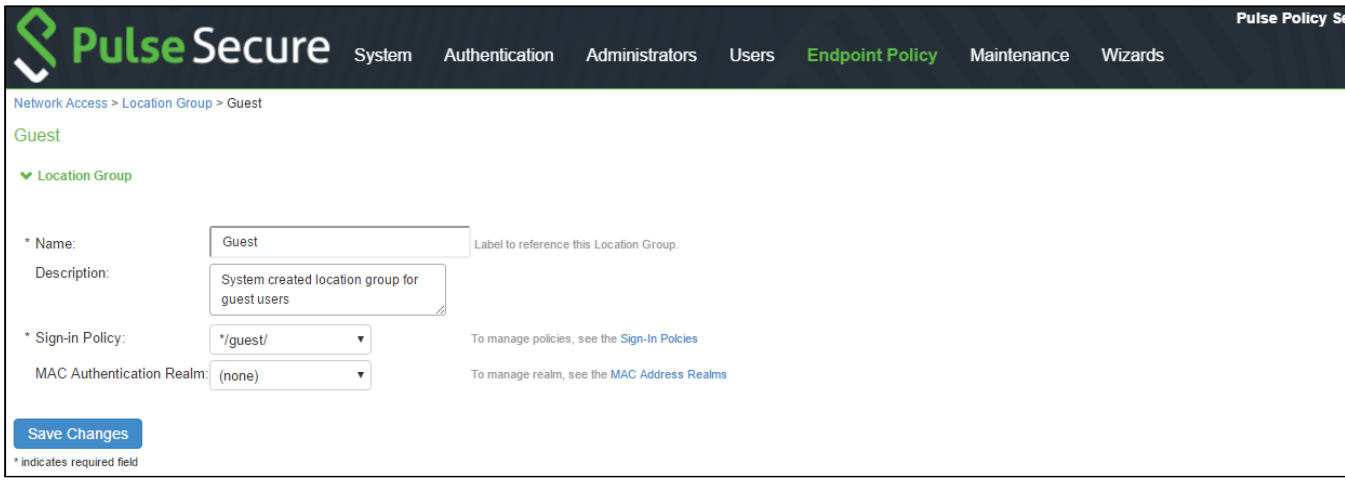
1. Select **Endpoint Policy > Network Access > Location Group**. The Location Group screen appears.

Figure 292: Location Group for Guest Access



2. Click the **Location Group** to view the settings.

Figure 293: Default Location Group



3. You can make necessary changes and click **Save Changes** to save the settings.

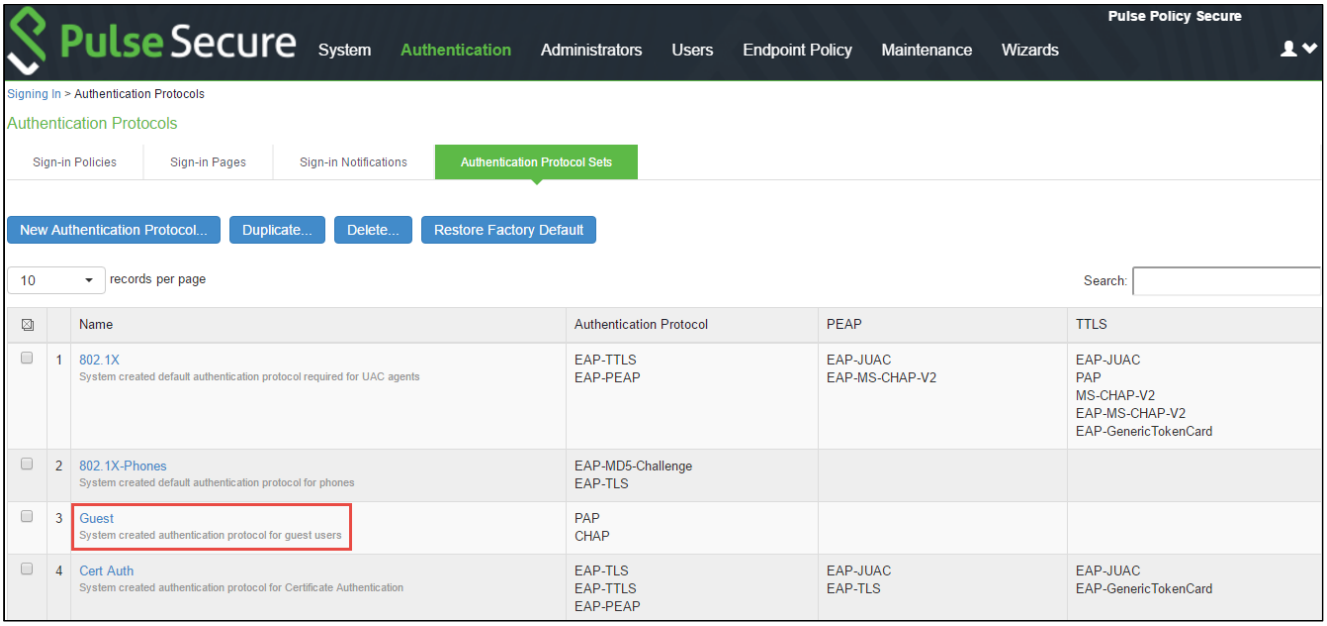
Authentication Protocol Set

The ‘Guest’ is the default Authentication Protocol Set configured in PPS.

To view the Authentication Protocol:

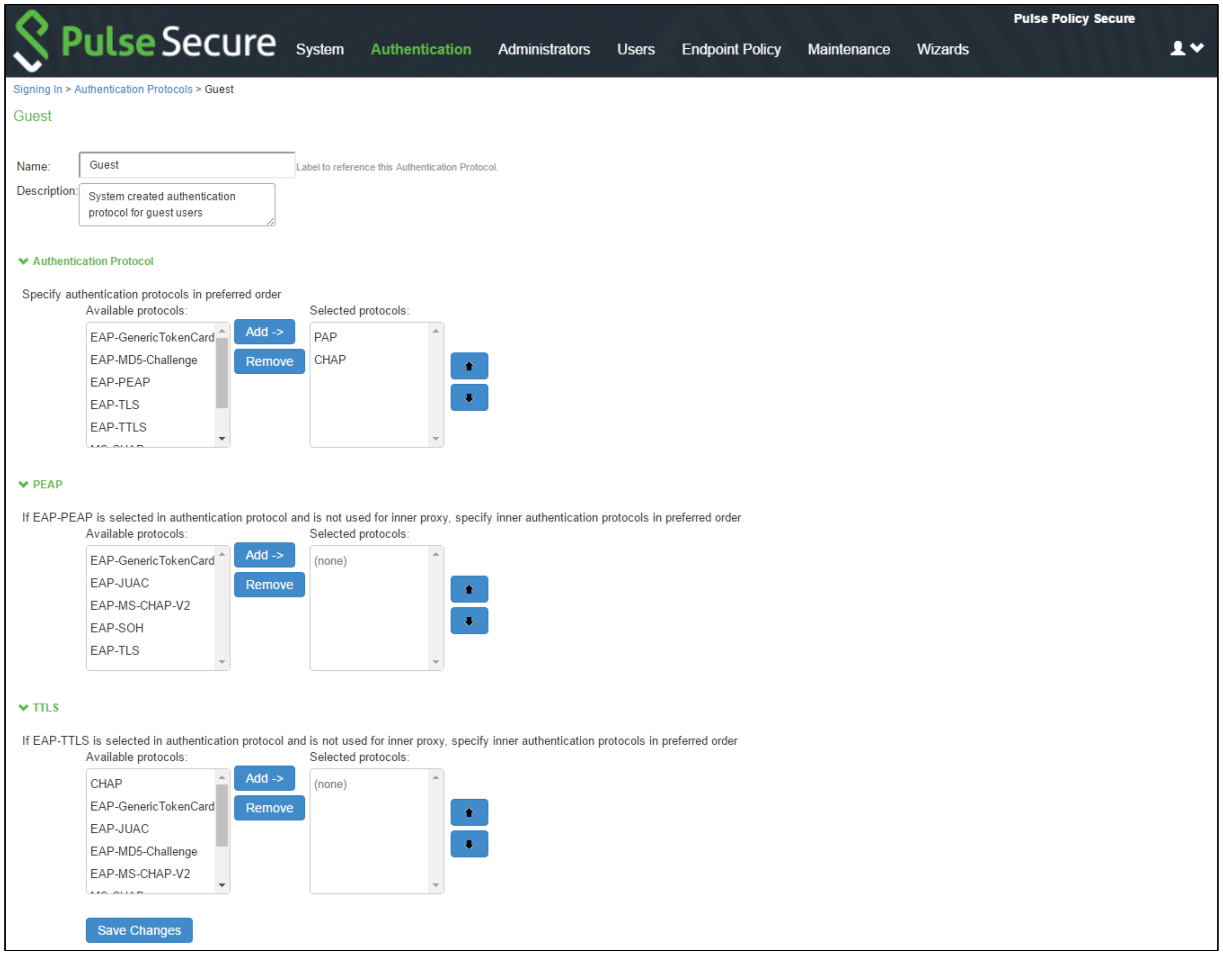
1. Select Authentication > Signing In > Authentication Protocol Sets. The Authentication Protocol screen appears.

   Figure 294: Authentication Protocols



2. Click the Authentication Protocol to view the settings.

Figure 295: Default Authentication Protocol Set



3. You can make necessary changes and click **Save Changes** to save the settings.

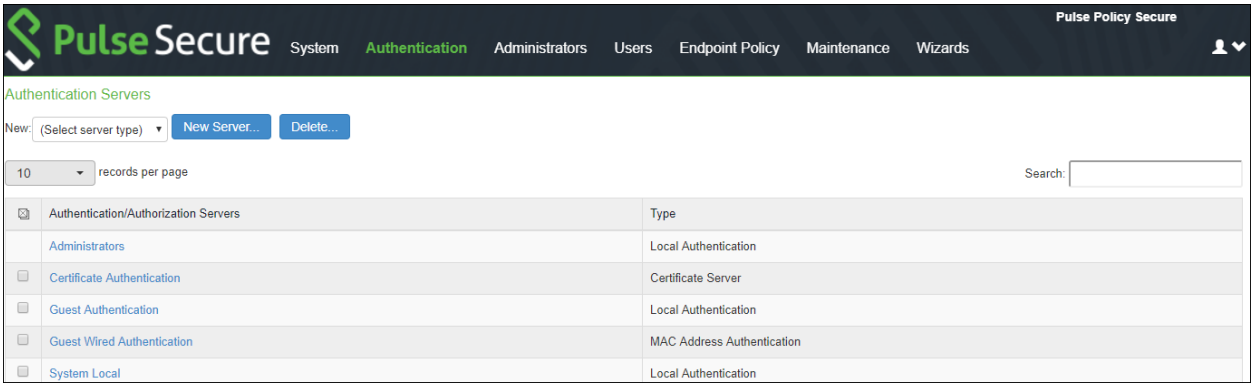
Authentication Server

The ‘Guest Authentication and Guest Wired Authentication are the default Authentication Servers configured in PPS.

To view the Authentication Server:

1. Select **Authentication > Auth. Servers**. The Authentication Servers screen appears.

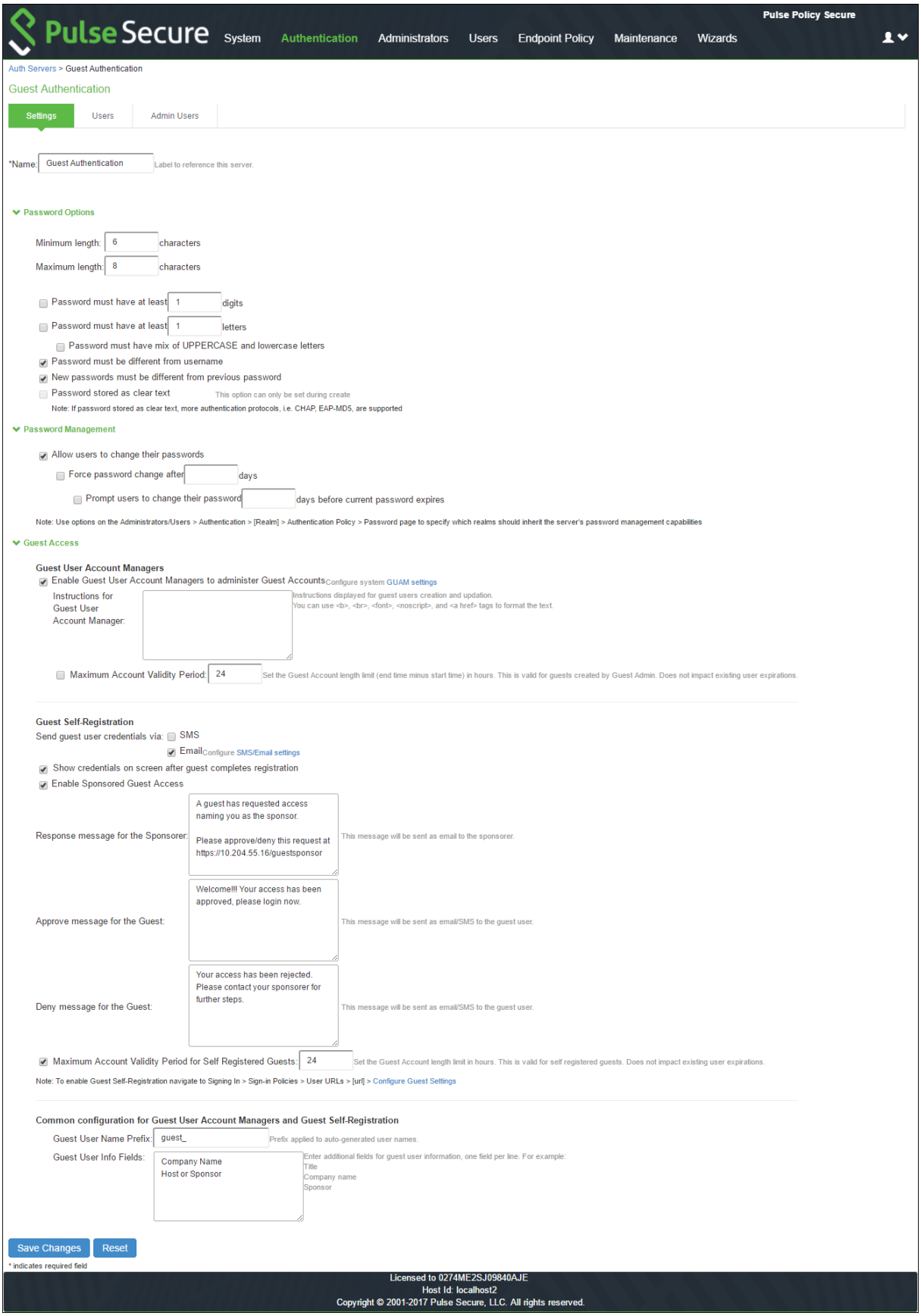
   Figure 296: Guest Authentication Server



2. Click the **Guest Authentication** server to view the settings.

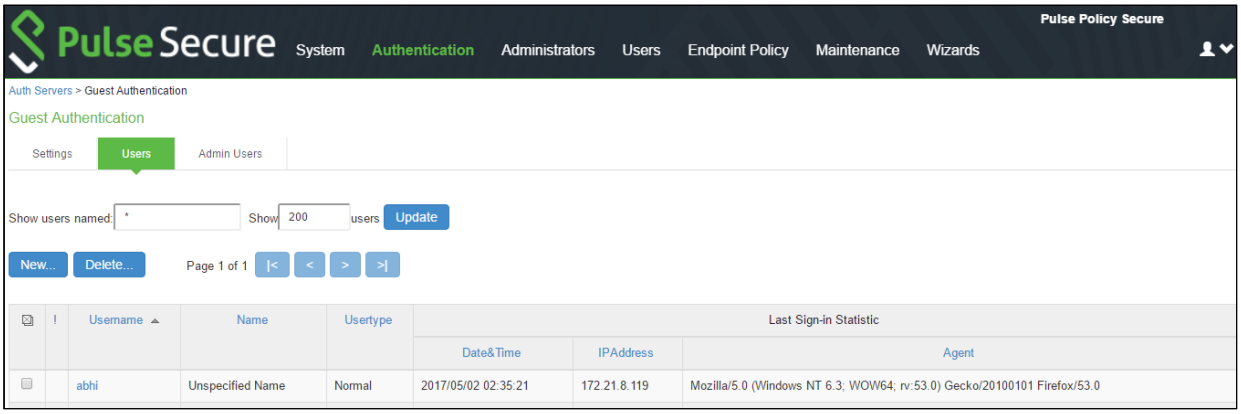
   The options under the **Settings** tab appears.

   Figure 297: Authentication Server Settings



3. You can make necessary changes and click **Save Changes** to save the settings.
4. Click the **Users** tab to view the guest users list. This page displays all the users that are created by guest self-registration option, GUAM, and Sponsorer.

Figure 298: Authentication Server - Users



Configuring RADIUS Client on PPS

PPS is configured with the default settings for RADIUS. You must configure only the RADIUS client and a RADIUS Return Attributes Policy.

To configure RADIUS Client on PPS:

1. Select **Endpoint Policy > Network Access > RADIUS Client > New RADIUS Client** to create a new RADIUS client. The New RADIUS Client screen appears.

Figure 299: Creating and configuring new RADIUS client-Aruba WLC

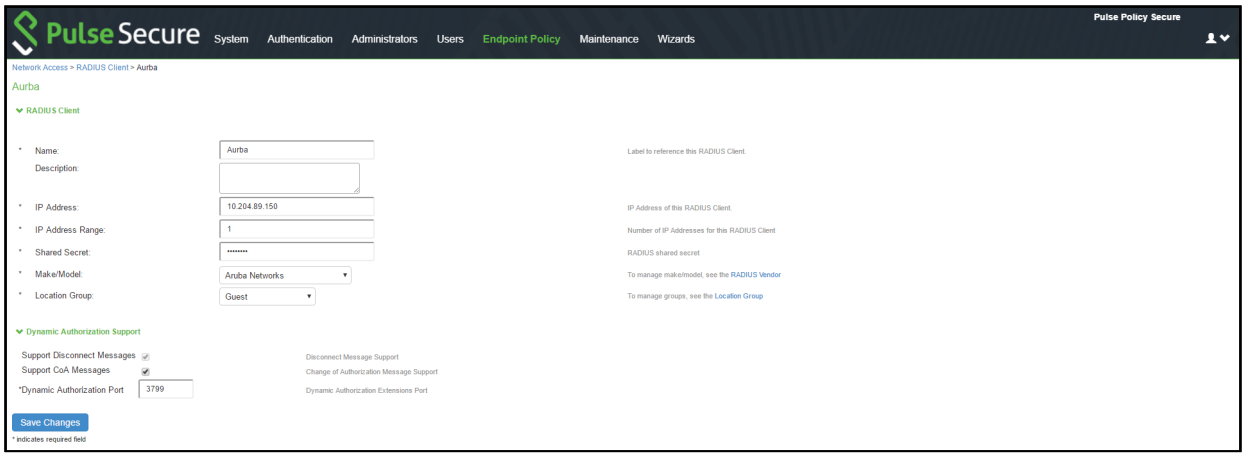


Figure 300: Creating and configuring new RADIUS client-Cisco WLC

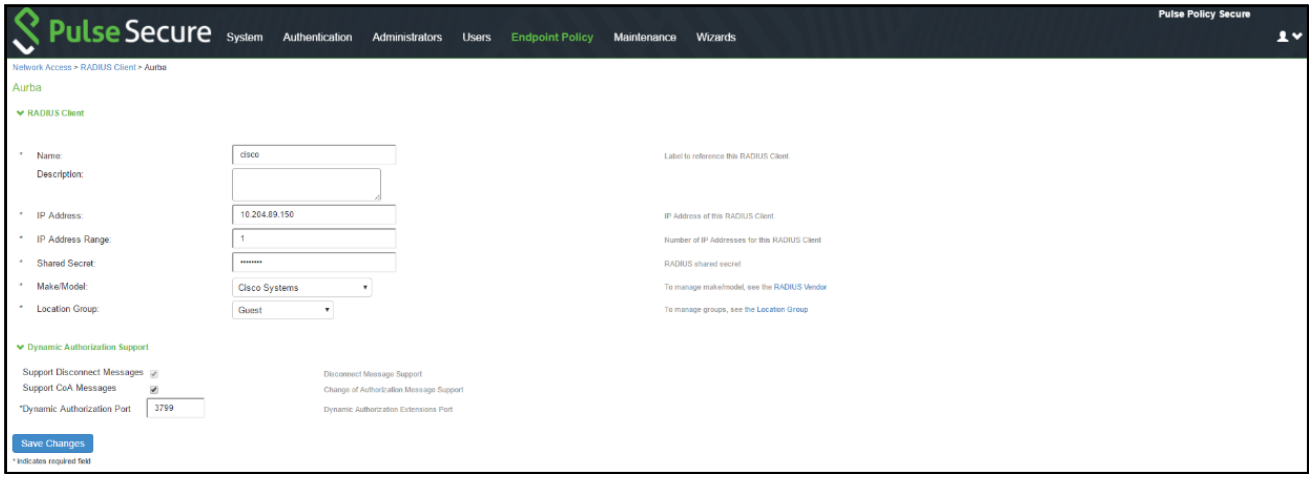
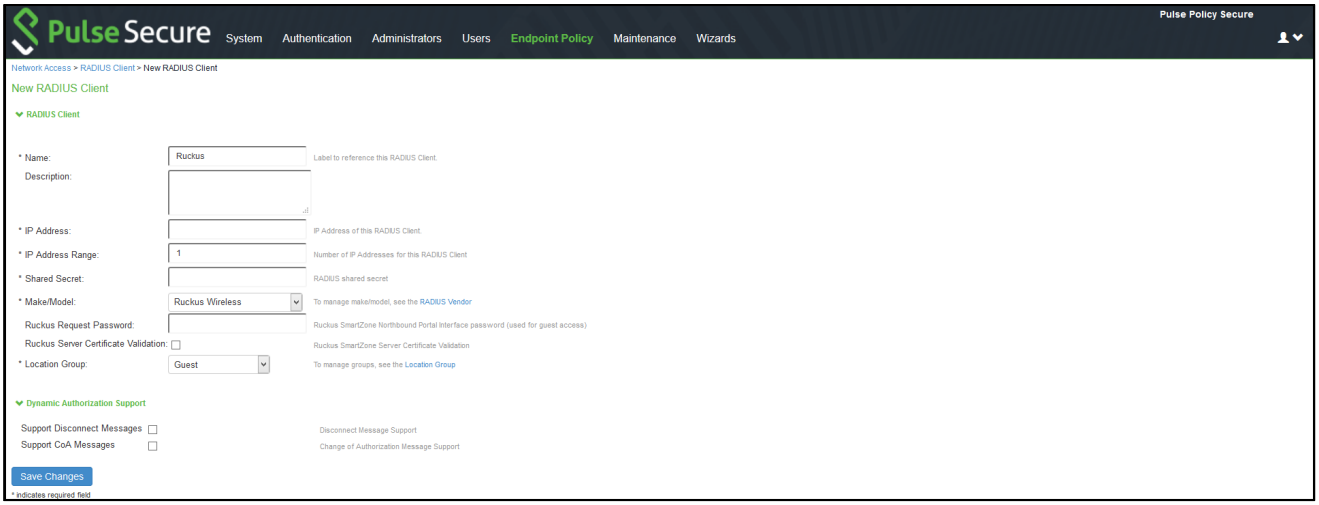


Figure 301: Creating and configuring new RADIUS Client-Ruckus WLC

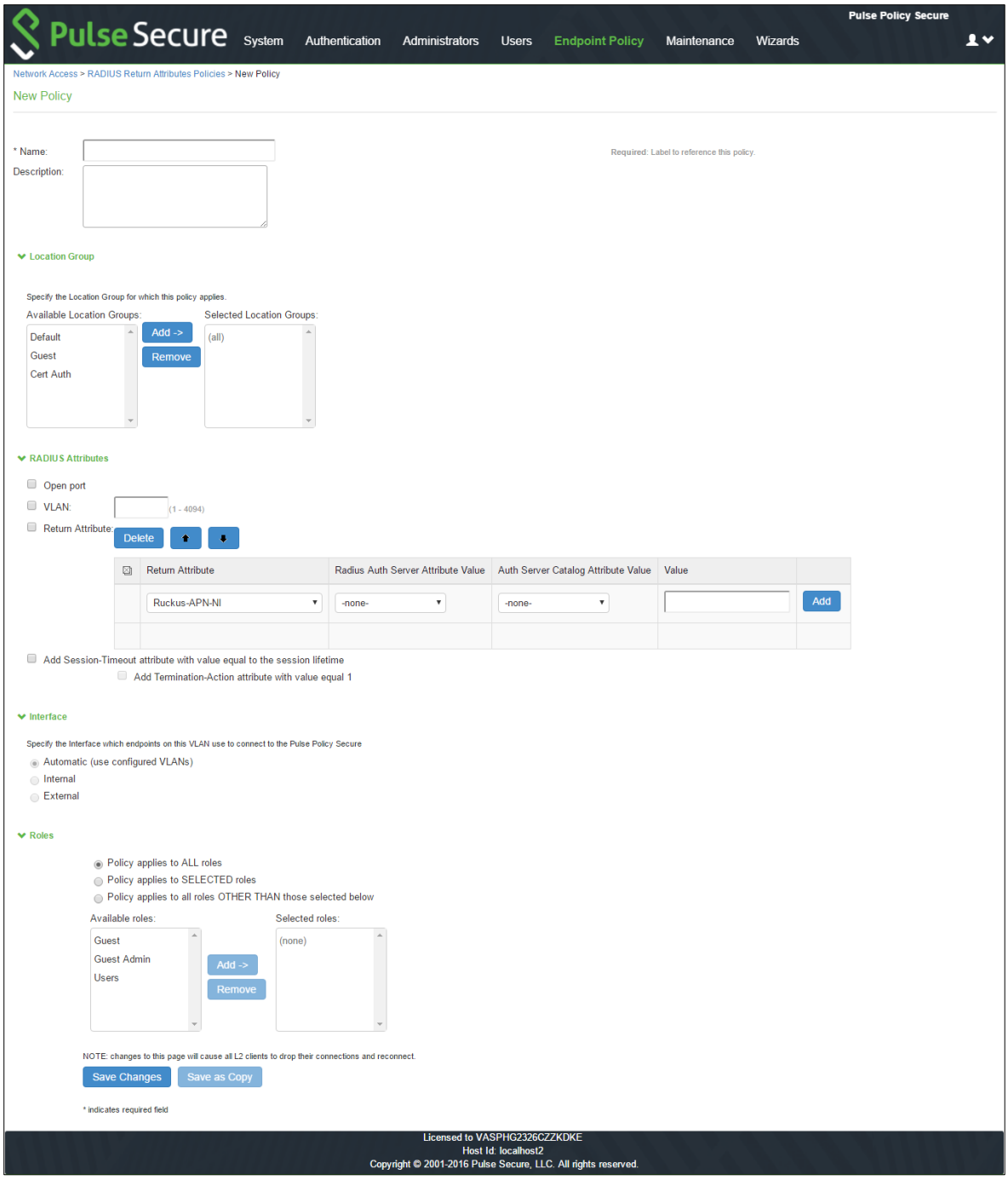


Configure the WLC (For example, Aruba, Cisco, Ruckus) as a RADIUS client and map with the default location group.

Note: You can enable Ruckus Server Certificate Validation option to validate the device certificate. See Verifying Device Certificates for understanding the validation procedure.

2. Click **Save Changes** to save the settings.
3. Select Endpoint Policy > Network Access > RADIUS Attributes > Return Attributes > New Policy to create a new RADIUS Return Attribute policy.

Figure 302: RADIUS Return Attribute Policy



4. Map with the default location group. Configure other return attributes and session-timeout attributes as required.
5. Click **Save Changes** to save the Return Attribute Policy.

Configuring SMTP and SMS gateway settings on PPS

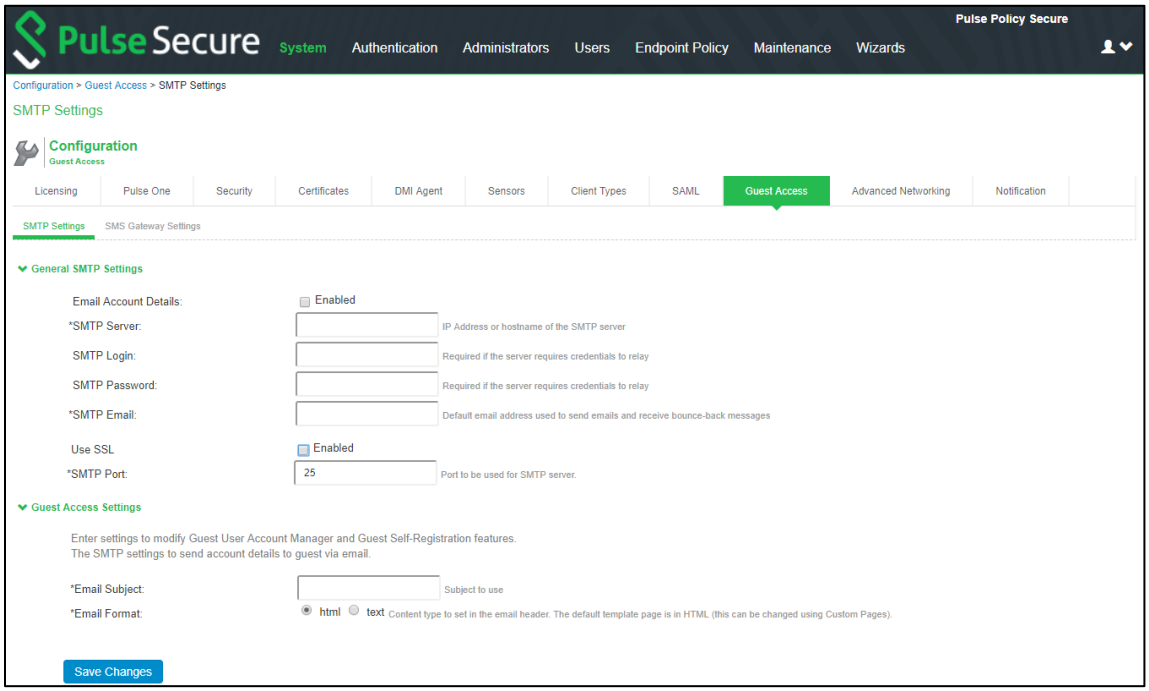
The SMTP and SMS configuration settings must be configured to enable guest users to create user accounts on their own.

SMTP Settings for Guest User Accounts

To configure the SMTP settings:

1. Select **System > Configuration > Guest Access > SMTP Settings**. The SMTP Settings screen appears.

   Figure 303: SMTP settings



2. Under **General SMTP settings**:
   a. Enter the host name or IP address of the SMTP server.
   b. Enter the SMTP login name.
   c. Enter the SMTP password.
   d. Enter the SMTP email address.
3. The **Use SSL** option supports the SMTP port 587.
4. Under Guest Access Settings:
   a. Enter the email subject.
   b. Select the email format- html, text.
5. Click **Save Changes**.

SMS Gateway Settings for Guest User Accounts

Short Message Service (SMS) is delivered through an SMS gateway service that supports HTTP, HTTPS, and SMTP (Simple Mail Transport Protocol) delivery. You need to subscribe to an external service to be able to deliver guest details using SMS. The SMS gateway sends SMS in formatted text message using HTTP/HTTPS interface (SMS message) and can also allow email message to be sent as an SMS. An example of an SMS gateway is clickatell.com. You should have a valid account with this third party.

To create an account with Clickatell:

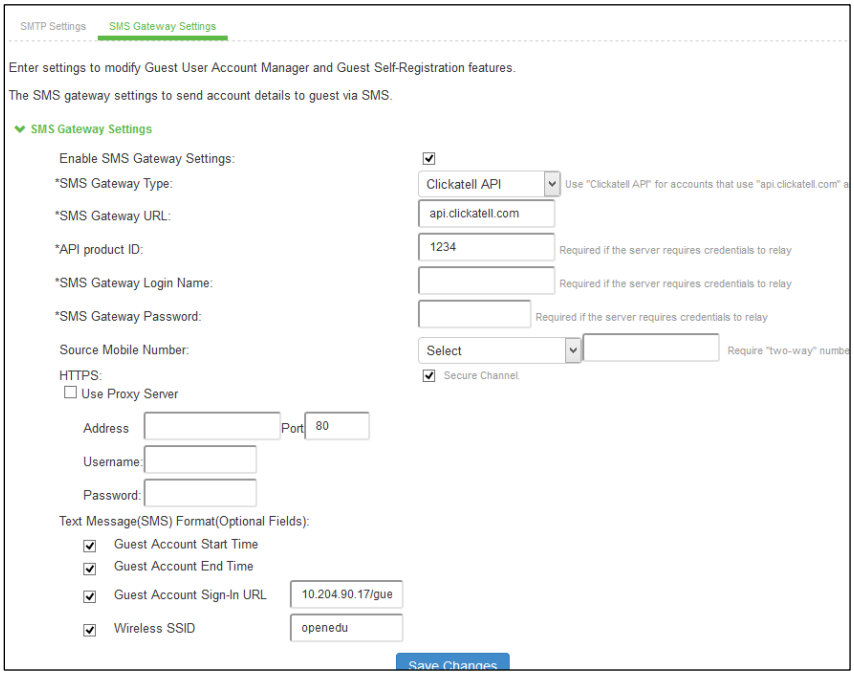
1. Go to http://www.clickatell.com/products/sms_gateway.php, and choose the appropriate API sub-product (connection method) you wish to use.
2. Click on the registration hyperlink.
3. Select the Account type you would like to use (Local or International).
4. Enter your personal information to complete the registration form.
5. Accept the Terms & Conditions.
6. Click Continue - An email containing your log in details such as account log in name, password, and clientID will be sent to the email address you have provided.
7. Activate your account – When user has logged in, and user will be on the Clickatell Central landing page and HTTP API will be added to the account and client API ID will be issued to the account. A single account may have multiple API IDs associated with it.

PPS integration with Clickatell

To enable the SMS gateway settings for Clickatell:

1. Select **System > Configuration > Guest Access > SMS Gateway Settings**. The SMS Gateway Settings screen appears.

Figure 304: SMS Gateway settings for Clickatell



2. Select the Enable SMS Gateway Settings check box.
3. Complete the configuration settings as described in the following table.
4. Click Save Changes.
5. Select the Country and enter the mobile number. Click **Send Test SMS**.

Table 64: Guest Access SMS Gateway Settings

Settings	Guidelines
SMS Gateway Settings	
SMS Gateway Type	Select the gateway type: Clickatell Platform- Select this option to send SMS as a text message. Use “Clickatell Platform" for accounts that use "platform.clickatell.com" as gateway. Clickatell API– Select this option to send SMS as a text message. Use "Clickatell API" for accounts that use "api.clickatell.com" as gateway. Clickatell Email2SMS – Select this option to use email format as an SMS using SMTP.
API product ID	Specify the API product ID that you received from Clickatell during account creation.
SMS Gateway Login Name	Specify the SMS gateway login name.
SMS Gateway Login password	Specify the SMS gateway login password.
Text Message (SMS) Format	(Optional) Select the following fields: Guest Account Start Time Guest Account End Time Guest Account Sign-in URL Wireless SSID
The following options apply if you select Clickatell Platform as gateway type.	
SMS Gateway URL	Specify the SMS Gateway URL. (Default) https://api.clickatell.com or http://api.clickatell.com
HTTPS	Select this option to use a secure connection. If you don't select this option user will be notified about clear text transmission of guest user credentials.
Use Proxy Server	Select this option to access the internet or SMS gateway URL using a proxy server.
Address	Specify the address of the proxy server and its port.
Username	Specify the username of the proxy server.
Password	Specify the password of the proxy server.
The following options apply if you select EasiSMS as gateway type.	
Send Test SMS	
Mobile Number	Select the country name and then specify a valid phone number of the guest user. The phone number should not include country code or any special character such as +,*, and so on. The PPS sends a test SMS with the login credentials to this mobile number through SMS.
Source Mobile Number	Specify the sender ID configured in Clickatell Account

PPS integration with EasiSMS

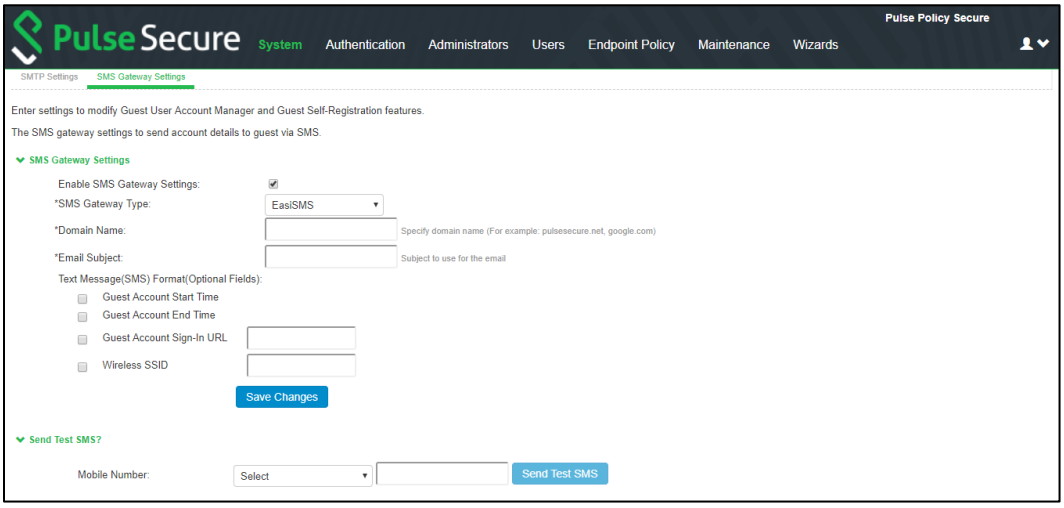
PPS integrates with EasiSMS through the SMTP server. EasiSMS uses an email format to send SMS to end user mobile phones.

Note: Ensure SMTP server is configured to use the EasiSMS feature.

To configure the SMS gateway settings for EasiSMS on PPS:

1. Select **System > Configuration > Guest Access > SMS Gateway Settings**. The SMS Gateway Settings screen appears.

   Figure 305: SMS Gateway settings for EasiSMS



2. Select **Enable SMS Gateway Settings** check box.
3. Select the SMS Gateway Type as **EasiSMS**.
4. Enter the Domain Name provided by EasiSMS.
5. Enter the unique ID in Email Subject provided by EasiSMS.
6. Optionally configure Text Message Format.
7. Click **Save Changes**.

When a guest user registers on the guest portal, the user receives an SMS with the login credentials that allows the user to access the resources.

Configuring Guest Access Settings on PPS

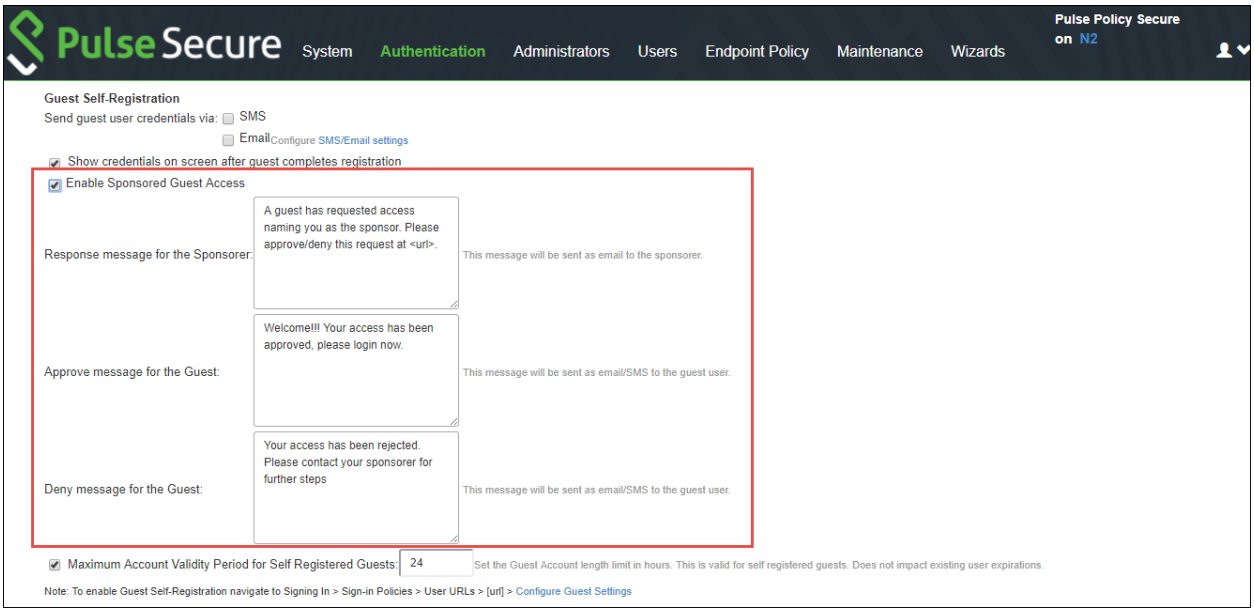
To configure guest access settings on PPS:

1. Select **Authentication > Auth. Servers > System Local > Settings**.
2. Under Guest Access Configurations:

    - Select the check box **Enable Guest User Account Managers** to administer Guest Accounts
    - Under the Guest Self-Registration select
      Send guest user credentials via
        - SMS
        - Email
        - Click the **SMS/Email settings** link and do the necessary settings.
    - Show credentials on screen after guest completes registration
    - **Maximum Account Validity Period for Self Registered Guest** – Default is 24 hours. You can change this as per the requirement.
    - For Sponsored Guest Access, select **Enable Sponsored Guest Access.**

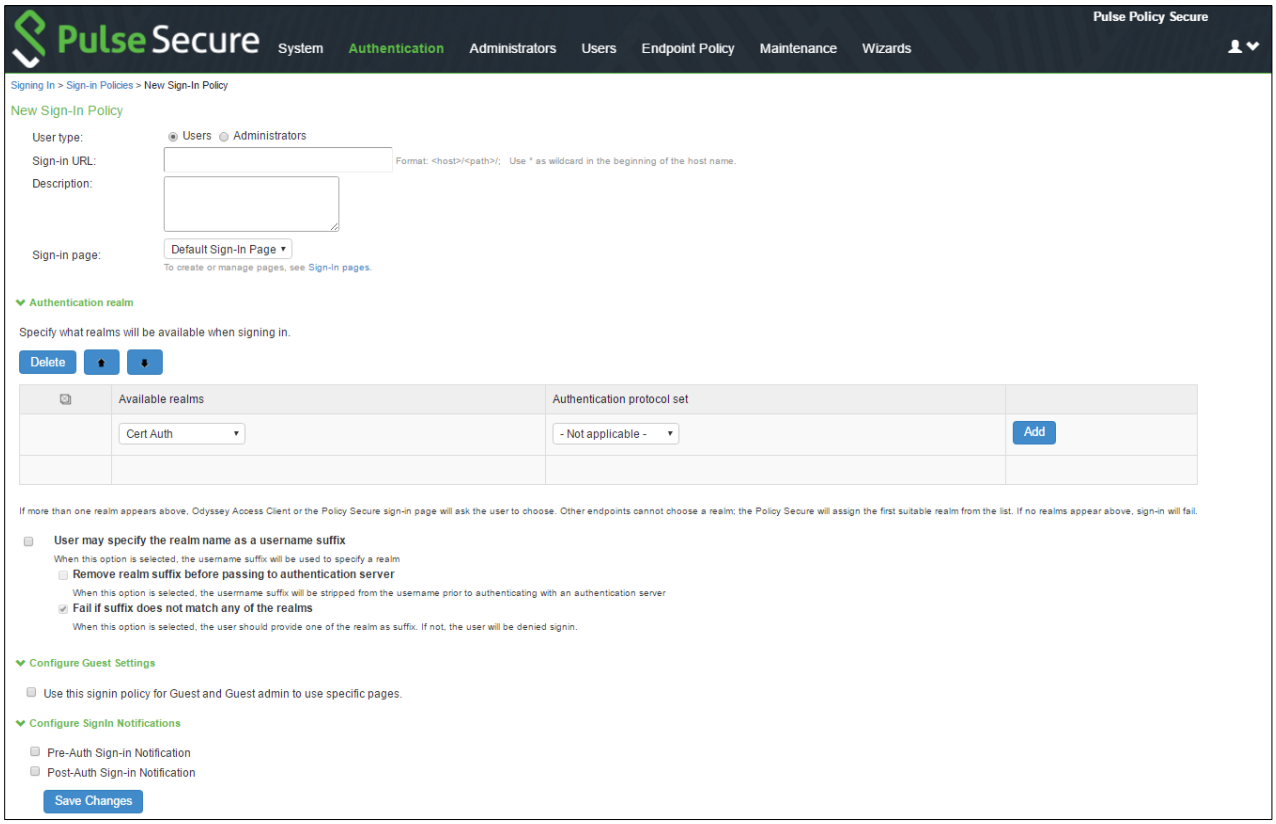
Note: Self-Registration is supported only with WLC deployment.

Figure 306: Guest Access Configuration



3. Select **Authentication >Signing In >Sign-In Policies**.

Figure 307: Sign-in Policy



4. Select the sign-in policy that is created earlier.
   Under **Configure Guest settings** select the check boxes:

   - Use this sign-in policy for Guest and Guest admin to use specific pages
   - Show Guest Self Registration link on the guest log in page.

   The **Register as Guest** link appears on the guest log in page.

Configuring PPS for SRX/EX Deployment

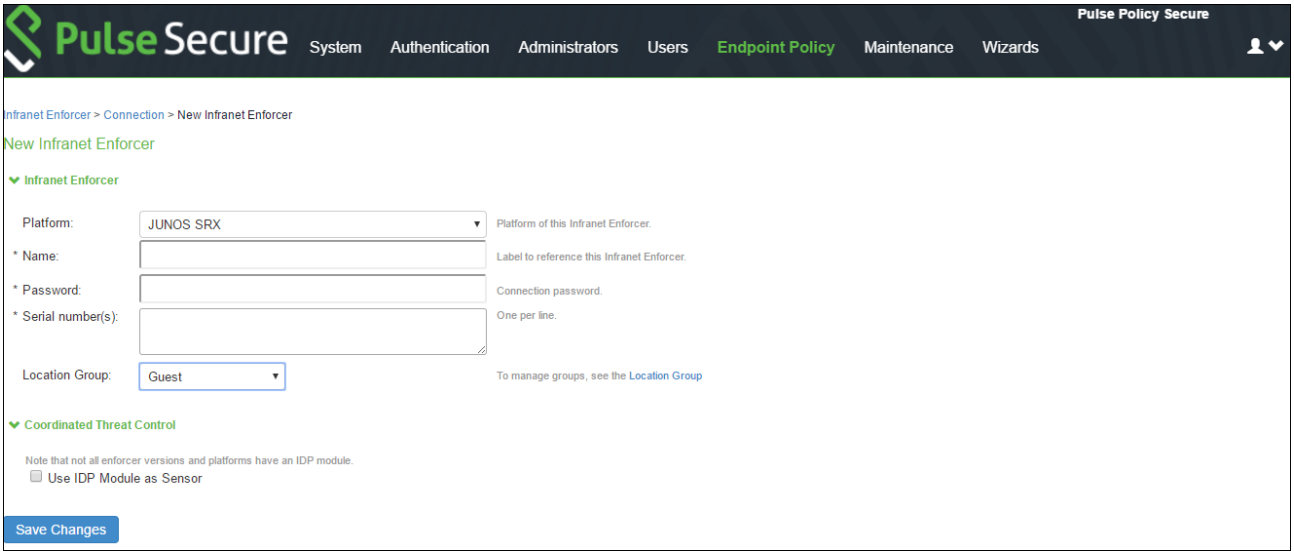
The Administrator must follow the below procedure for enabling guest access using SRX firewall:

- Default Configurations for Guest Access
- Configuring SMTP and SMS Gateway
- Configuring Guest Access Settings on PPS

To configure captive portal:

1. From PPS admin UI, select **Endpoint Policy > Infranet Enforcer > Connection** and add SRX/EX

Figure 308: Guest Access using SRX



2. From the SRX CLI configuration menu, configure a captive portal named guests that redirects the unauthenticated traffic to guest URL. For example, https://xyz.abc.local/guest
3. Create a new policy that redirects any source that attempts to access the server. For more information on configuration, see Captive Portal.
4. You can also create Host Checker restrictions on the Guest realm/role. For more information, see Host Checker Restrictions.

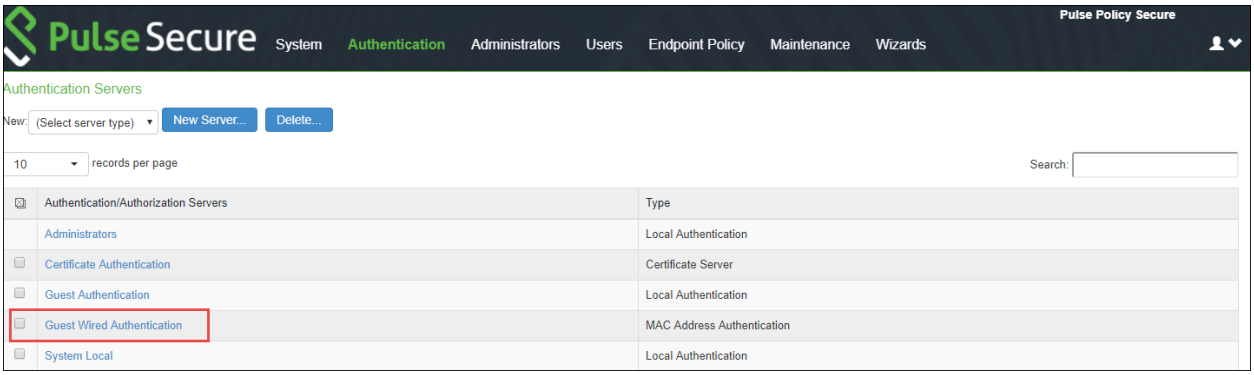
Configuring PPS for Guest Wired Authentication using Cisco Switch

This section describes the configuration that is required on PPS to communicate with a Cisco switch for Guest wired authentication.

To configure PPS for guest wired authentication:

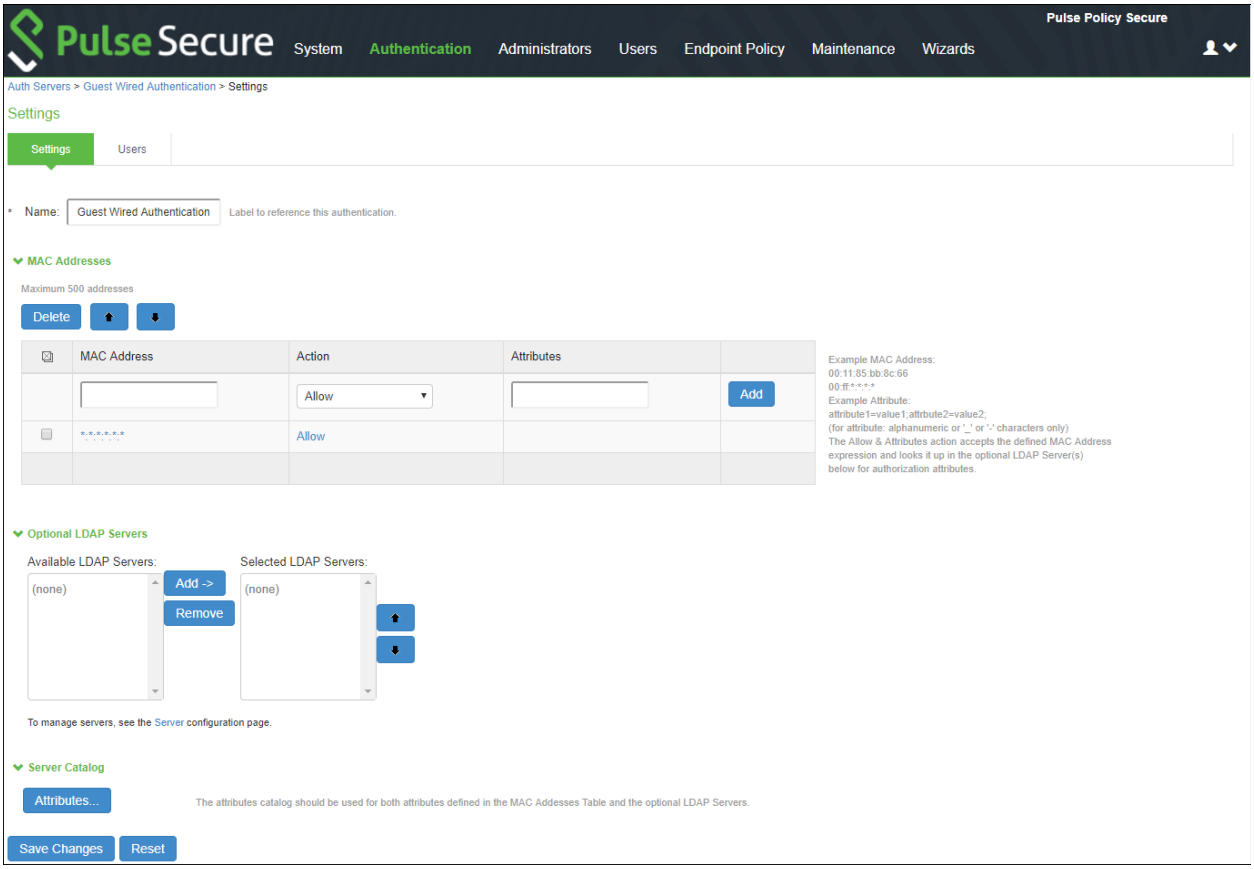
1. Select **Authentication > Auth. Servers**. The Authentication Servers screen appears.

Figure 309: Guest Wired Authentication



2. Click **Guest Wired Authentication** available by default to view the settings.

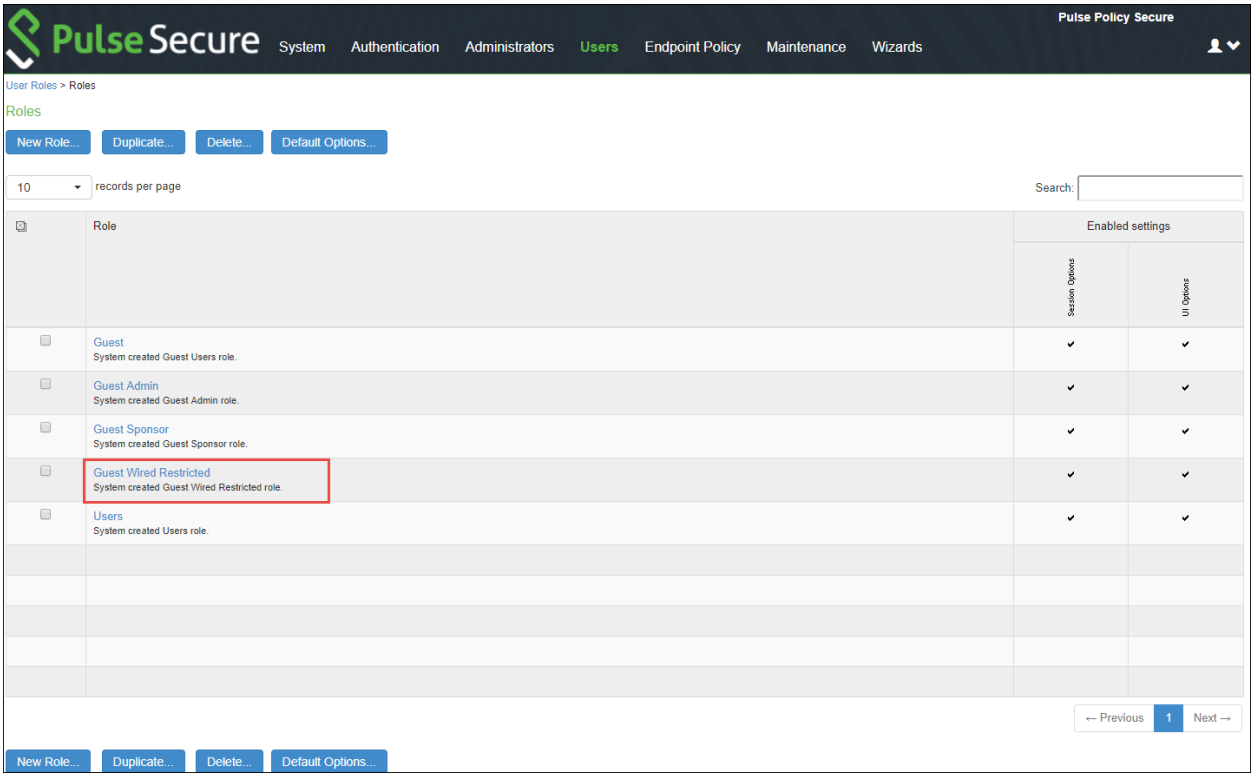
Figure 310: Guest Wired Authentication Settings



3. You can make the necessary changes and click **Save Changes**.

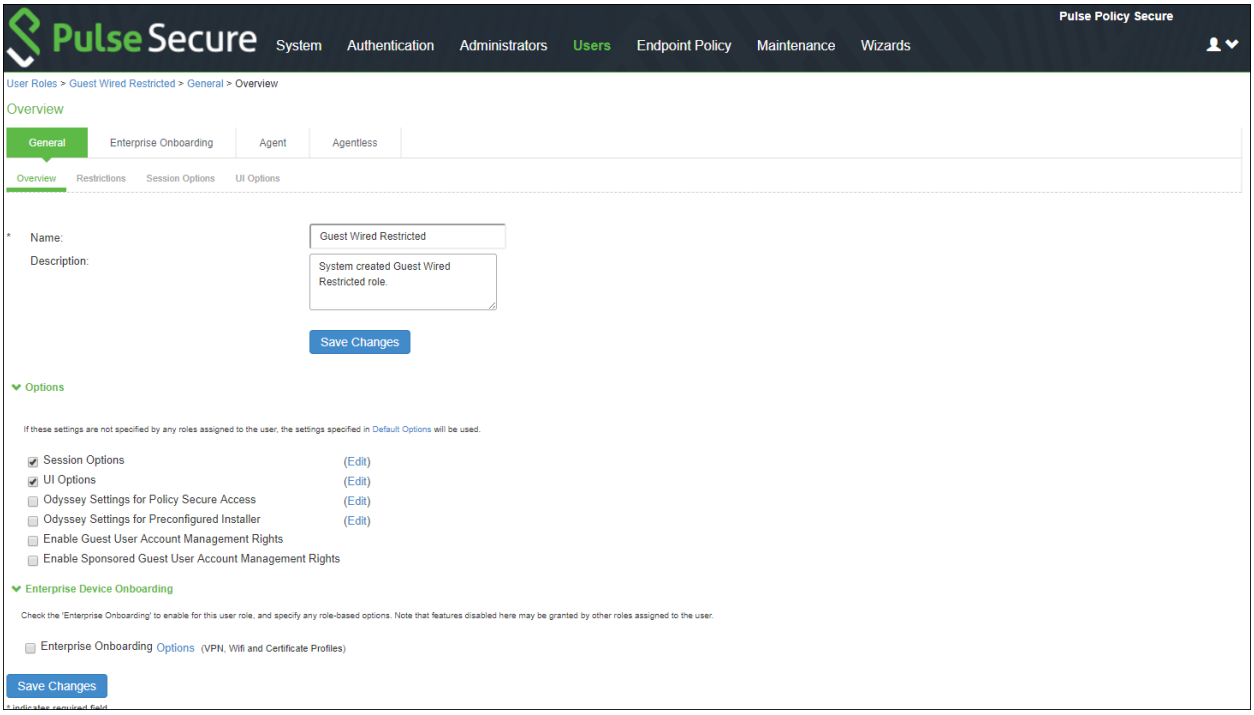
4. Select **Users > User Roles.** The User Roles page appears.

Figure 311: Guest Wired Restricted Role



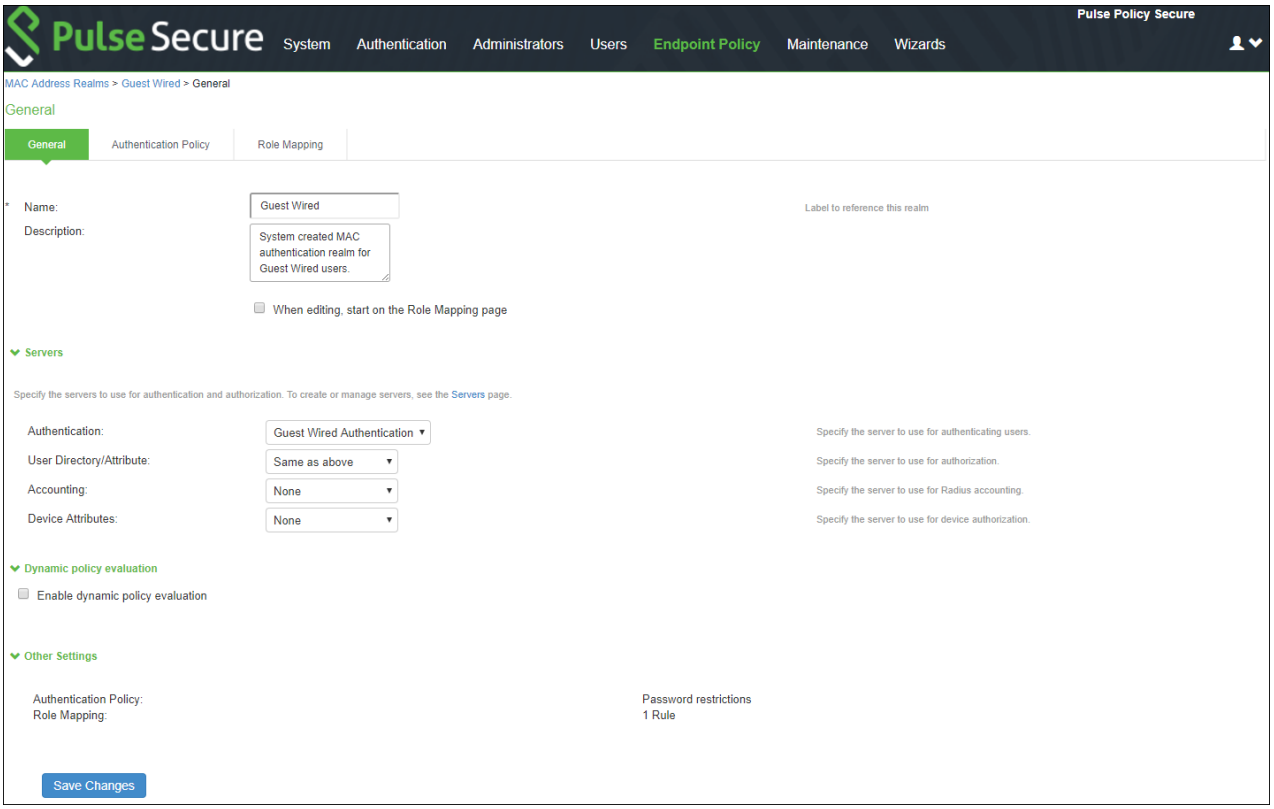
5. Click **Guest Wired Restricted** user role available by default. The Agentless access is enabled for this role. You can also configure Host Checker for assessing the compliance statuts of the endpoint.

Figure 312: Guest Wired Authentication General Settings



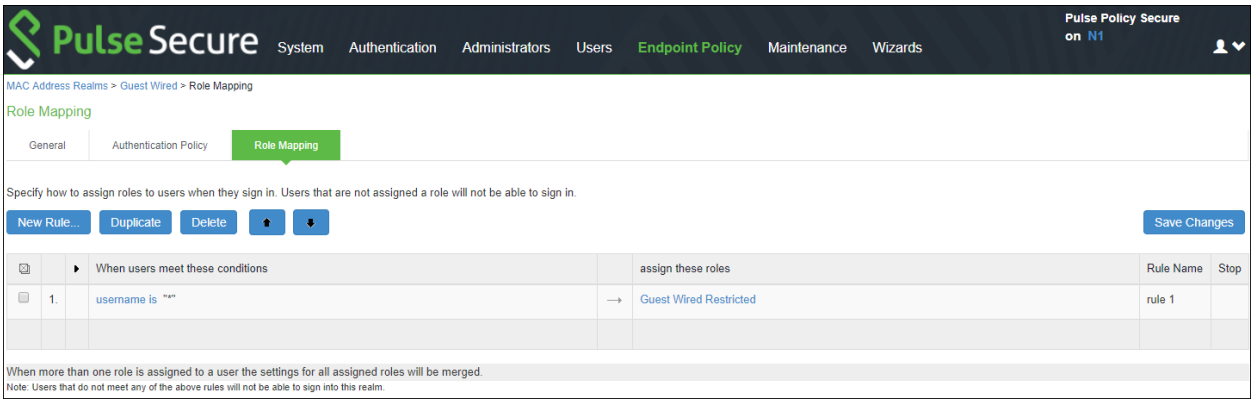
6. Select **Endpoint Policy > MAC Address Authentication Realms** and click **Guest Wired** authentication realm available by default.

Figure 313: MAC Auth Realm- Guest Wired



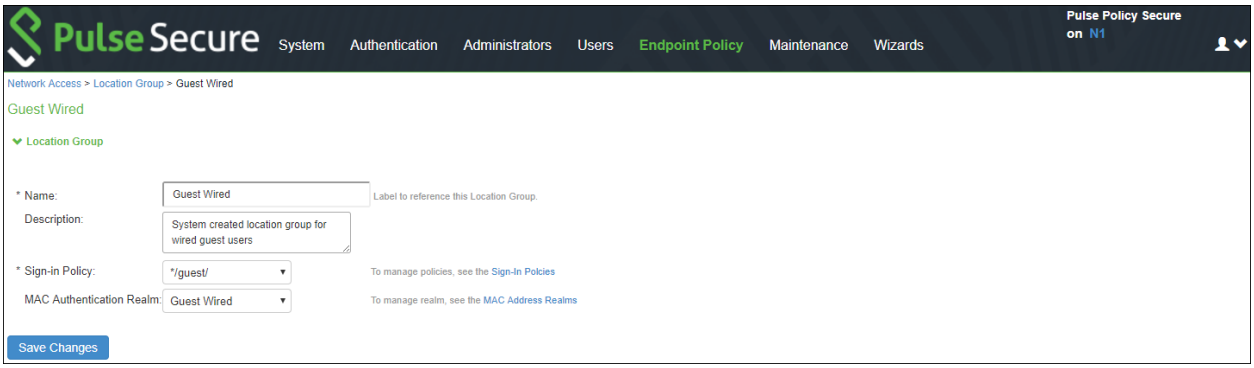
7. Select the default role mapping rule, which specifies the conditions to assign the Guest Wired Restricted role.

Figure 314: Guest Wired Role Map



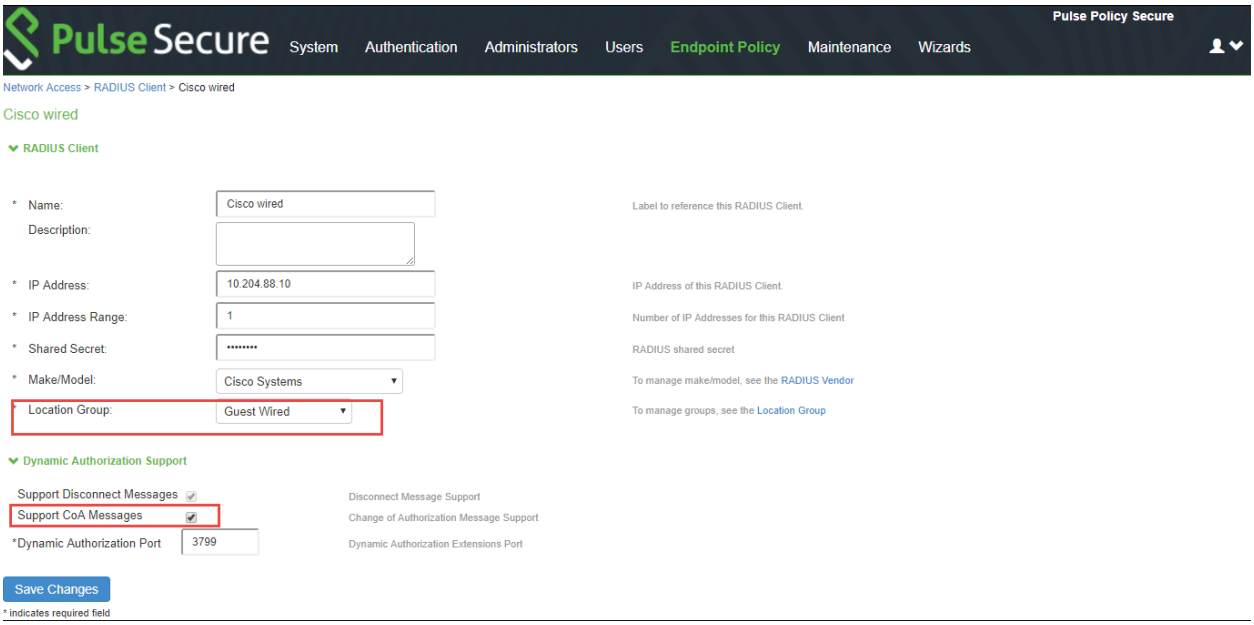
8. Select **Endpoint Policy > Network Access > Location Group**. Select **Guest Wired** as MAC Auth Realm.

Figure 315: Guest Wired Location Group



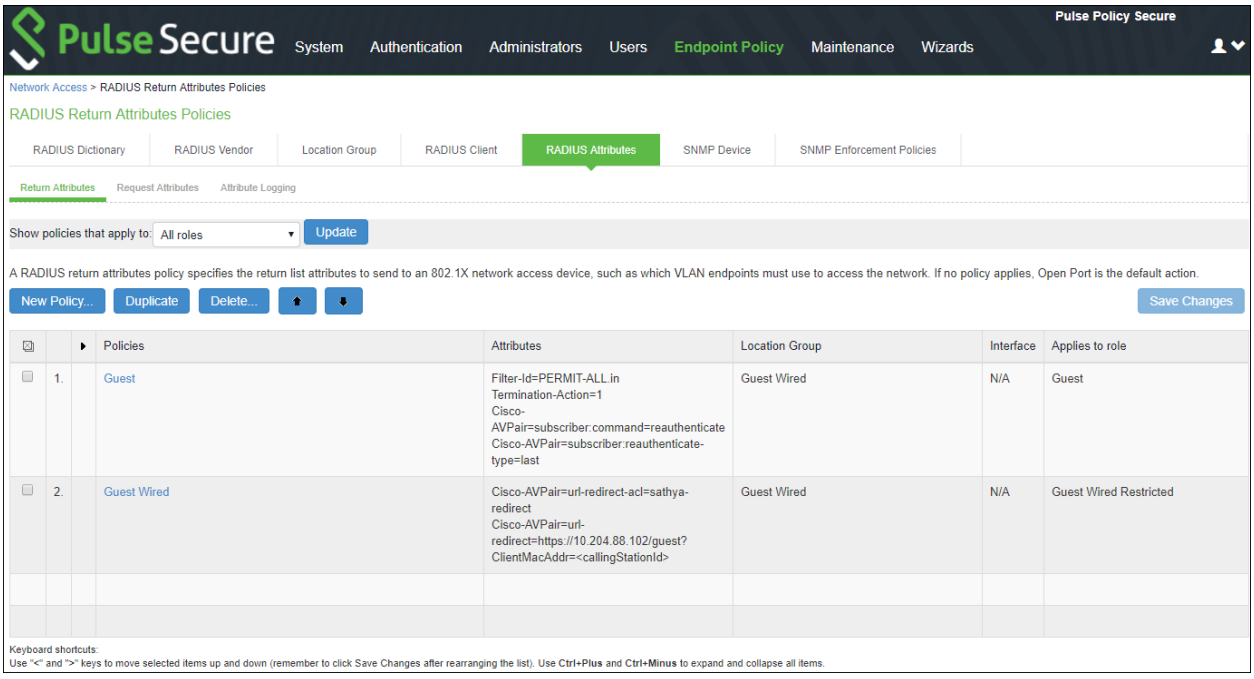
9. Configure the Cisco switch as a RADIUS client. Ensure that the **Guest Wired** location group and **Support CoA Messages** options are enabled.

Figure 316: RADIUS Client- Guest Wired



10. Configure the RADIUS return attributes for Guest Wired policy. The RADIUS return attributes are required for moving the endpoint to the appropriate VLAN.

Figure 317: RADIUS Return Attributes Guest Wired Authentication



11. The user configures the RADIUS URL-redirection attributes on the Cisco Switch. Using RADIUS URL-Redirection return attributes the Cisco switch redirects any initial HTTP/s traffic to PPS.
You must configure the following return attributes (supported only on Cisco switches):

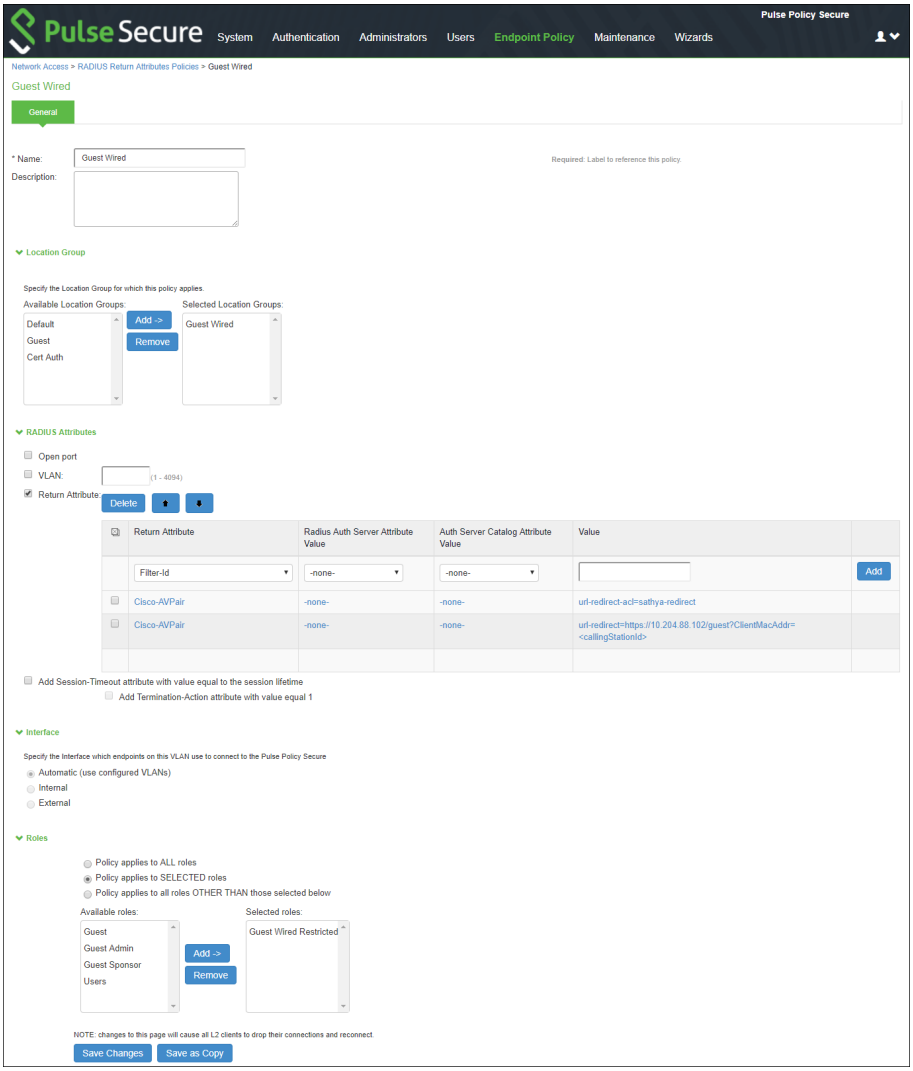
Cisco-AVPAIR=url-redirect-acl=REDIRECT_To_PPS Cisco-AVPAIR=url-redirect=https://<PPS-SIGN-IN-URL>/guest?ClientMacAddr=<callingStationId>

Here in redirect guest portal URL (*/guest), the "ClientMacAddr" is to identify the end client being redirected to PPS. As part of MAB authentication, PPS updates the value of radius return attribute "url-redirect" and replaces <callingStationId> with the client MAC address.

The RADIUS CoA configuration for various Cisco switch platforms is described below.

Cisco Platform	IOS Version	RADIUS CoA Configuration
3850	16.3	Filter-Id=PERMIT-ALL.in
2960X	15.2	Filter-Id=PERMIT-ALL.in
2960	12.2	Filter-Id=PERMIT-ALL.in CiscoAVPAIR=subscriber:command=reauthenticate Cisco-AVPAIR=subscriber:reauthenticate-type=last

Figure 318: RADIUS Attribute Policies Guest Wired



Configuring PPS for Sponsored Guest Access

This section describes the configuration that is required for configuring Sponsored Guest access.

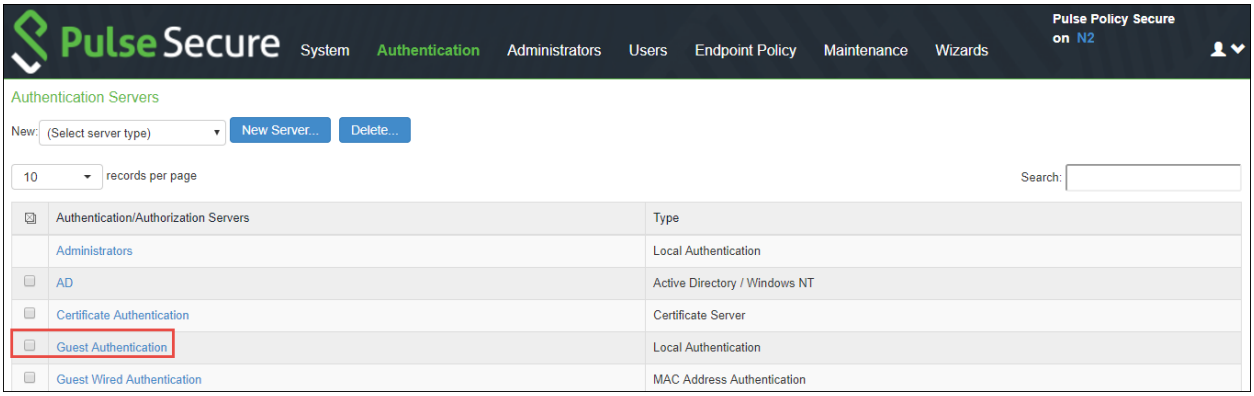
- Enable “Sponsored Guest Access" checkbox under Guest Authentication Server.

- Create a list of Sponsor's names in Guest Authentication Server.
- Create Role mapping rule in "Guest Admin" realm to point to "Sponsor" role for the list of sponsor's.
- If sponsor reside in AD, then AD needs to be selected as authentication server instead of "Guest Authentication" under "Guest Admin" realm.
- As part of default configuration, "sponsor" role is created with enabled sponsor management rights. This role can be used for sponsor approved guest access.

To configure PPS for Sponsored Guest access:

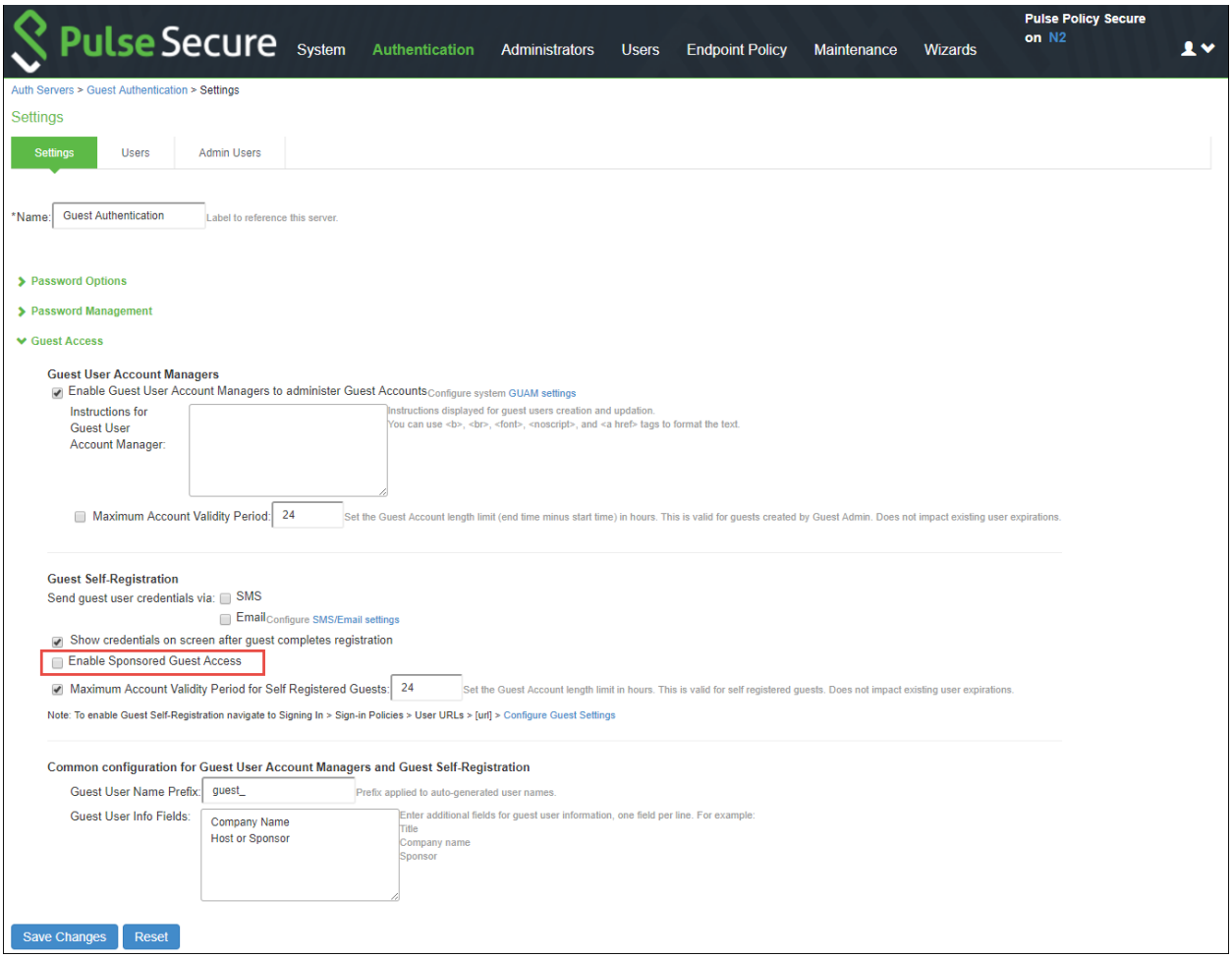
1. Select **Authentication > Auth. Servers**. The Authentication Servers screen appears. Click **Guest Authentication** available by default to view the settings.

   Figure 319: Guest Authentication



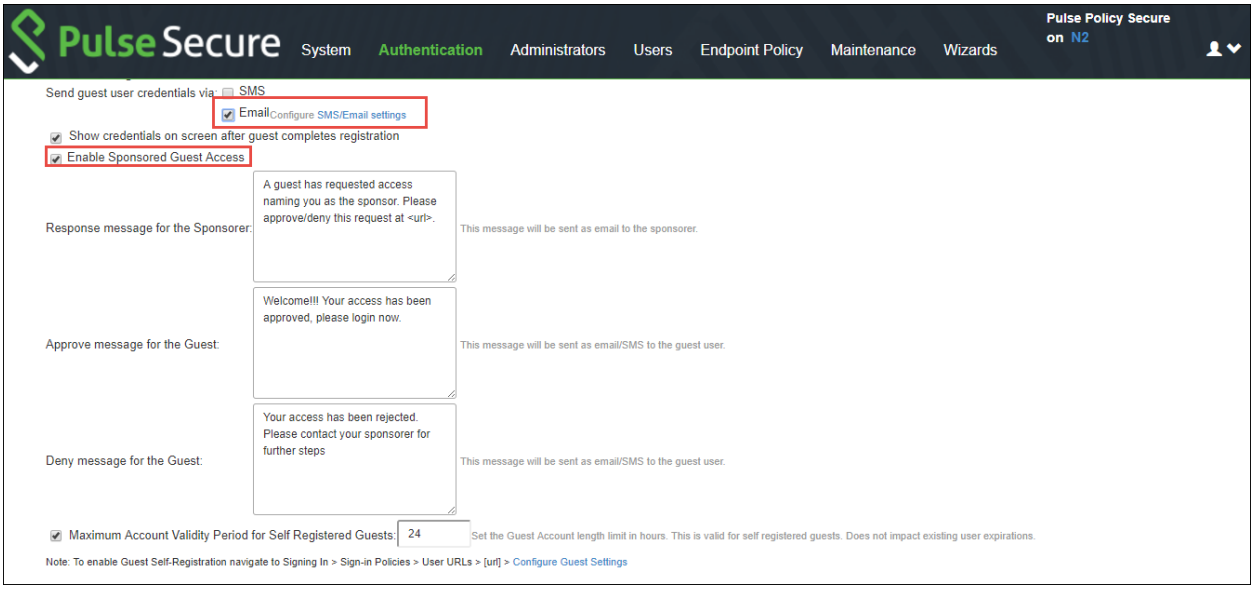
2. Select **Enable Sponsored Guest Access**.

   Figure 320: Guest Authentication Settings



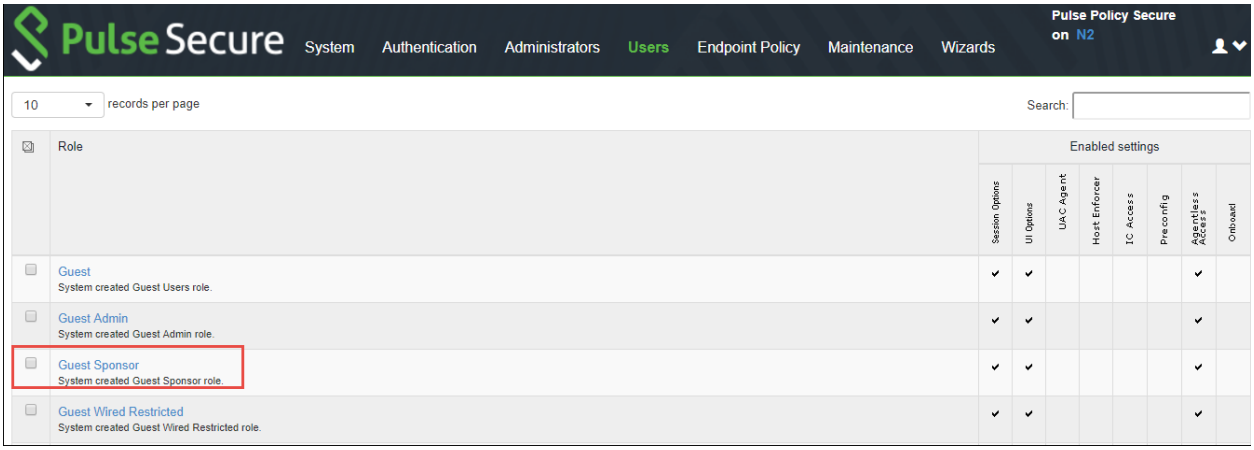
3. Select **Email** to send guest user credentials through email. You can make the necessary changes and click **Save Changes**.

Figure 321: Guest Authentication Settings



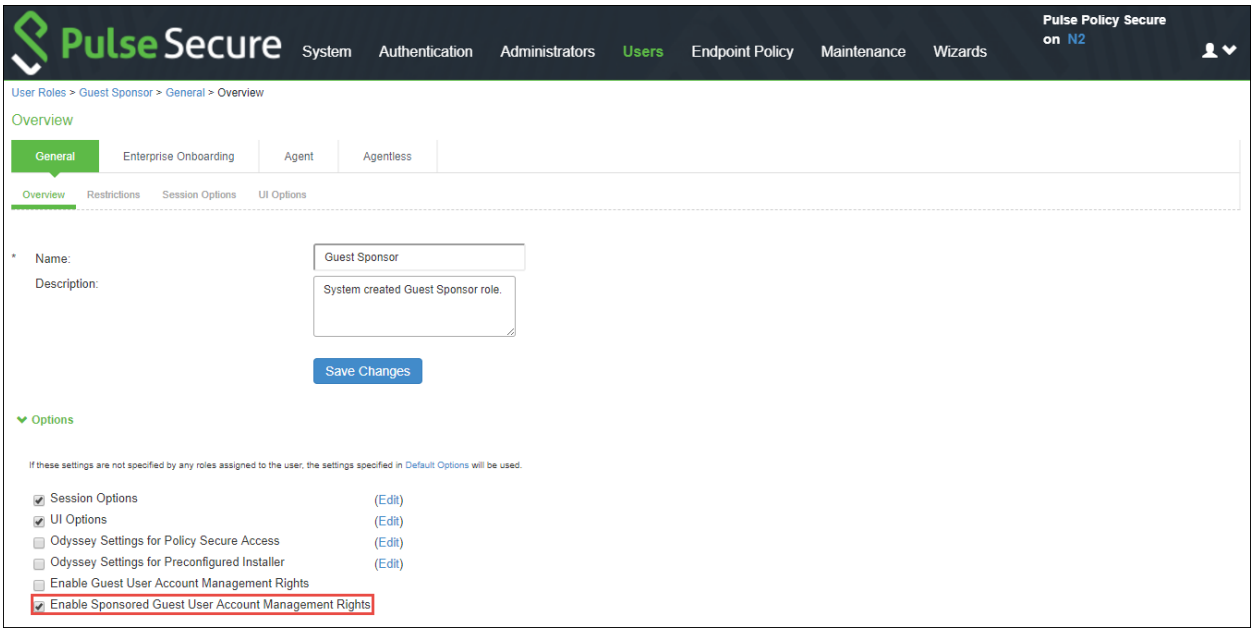
4. Select **Users > User Roles.** The User Roles page appears.

Figure 322: Guest Authentication Role

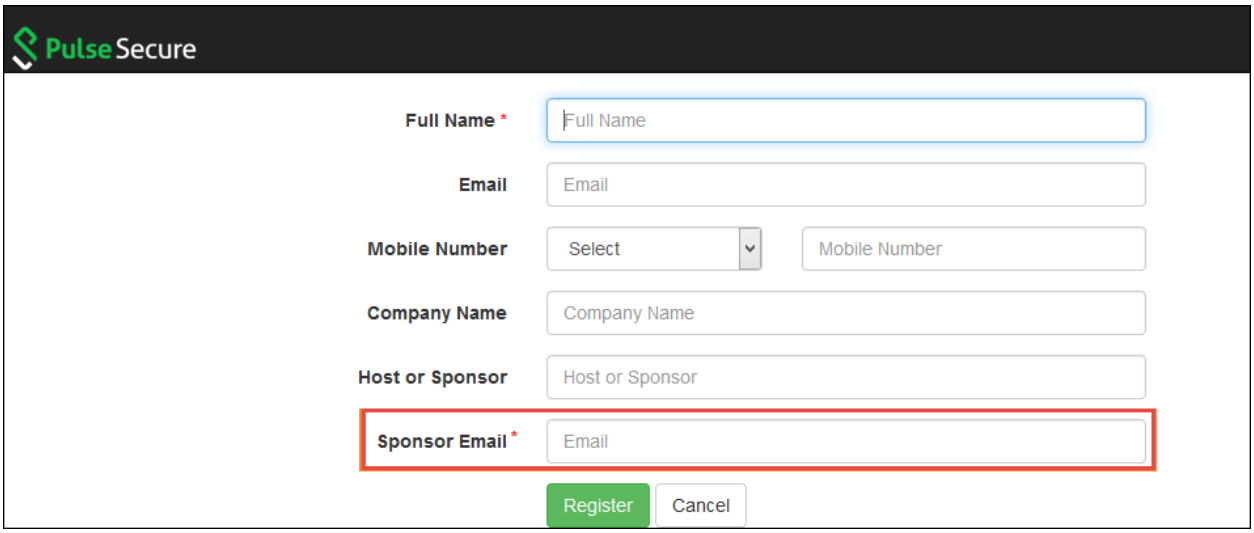


5. Click **Guest Sponsor** user role available by default. Select **Enable Sponsored Guest User Account Manager Rights**.

Figure 323: Guest Sponsor General Settings

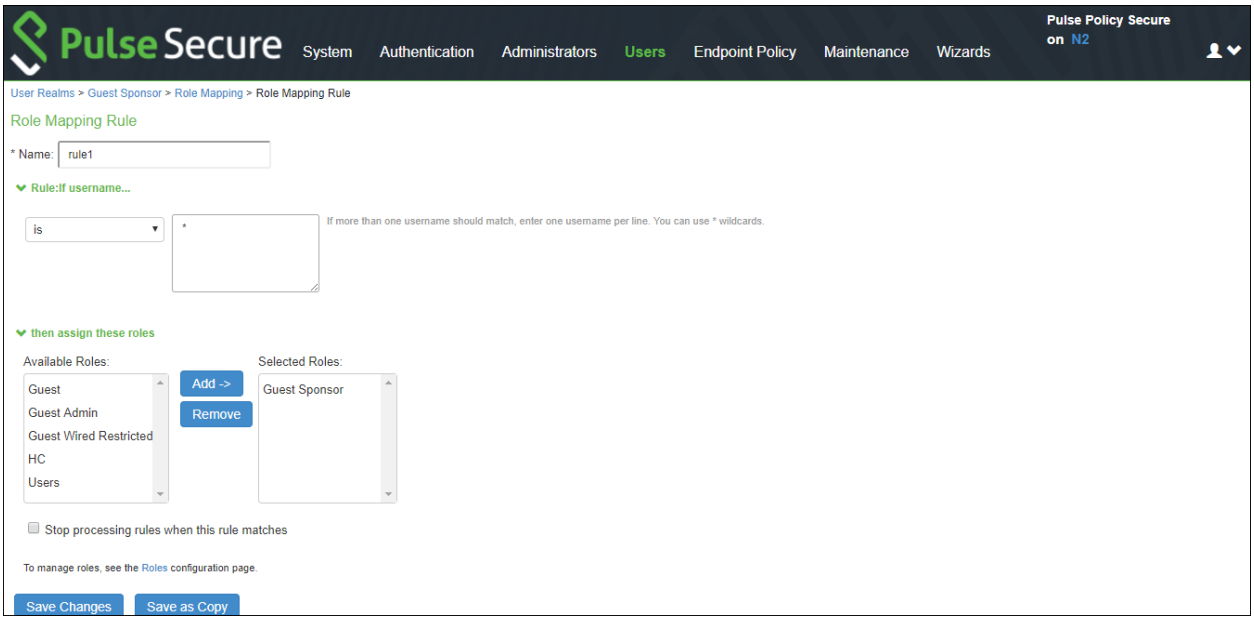


6. Once you configure Sponsor Guest Access. You can see the Sponsor email entry in the Guest Self registration page.



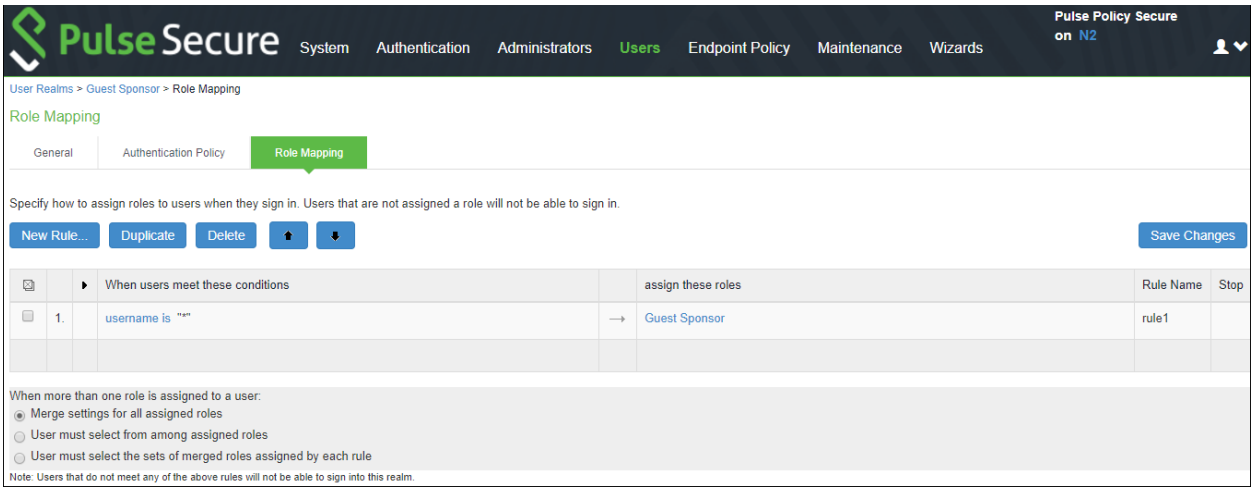
7. Select **Authentication > Signing In > Sign-in Policies** and use the default */guestsponsor/ sign-in policy.
8. Select **Users** > **User Realms**. Click the **Guest Sponsor Realm** and specify how to assign the role. Click **New Rule** to add a new role and then click **Save Changes**.

   Figure 324: User Realm – Guest Sponsor



9. Select **User Realms > Guest Sponsor > Role Mapping** and make necessary changes and click **Save Changes** to save the settings.

   Figure 325: Guest Sponsor Role Mapping



Enabling Onboarding Feature

Enterprise onboarding feature provides automated onboarding of BYOD clients on premises (WLAN & LAN). PPS enables personal devices to be automatically configured for corporate access.

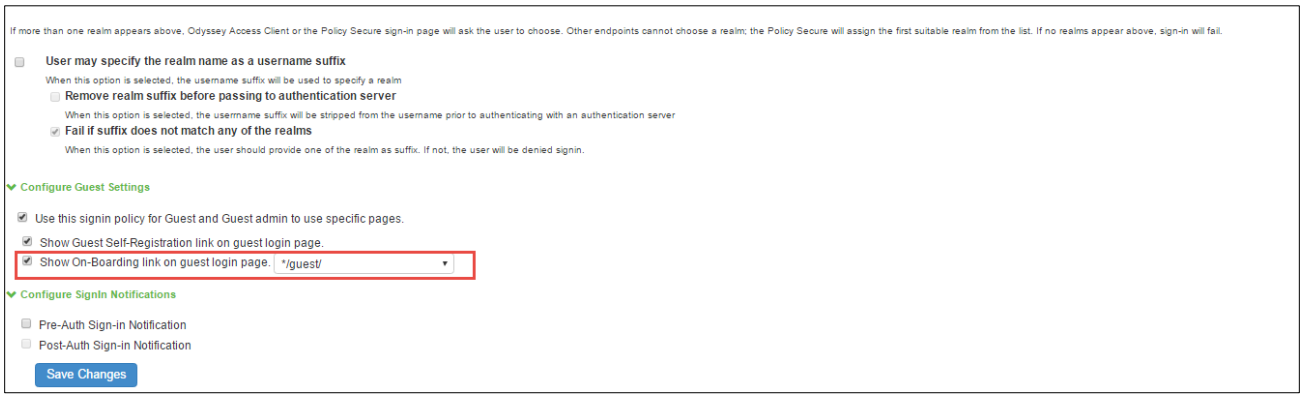
To enable this feature:

a. Select Authentication > Signing In > Sign-in Policies.

The **Sign-in Polices** tab displays the available sign-in policies.

b. Under the **User URLs** section select the default sign-in policy.

Figure 326: Onboarding



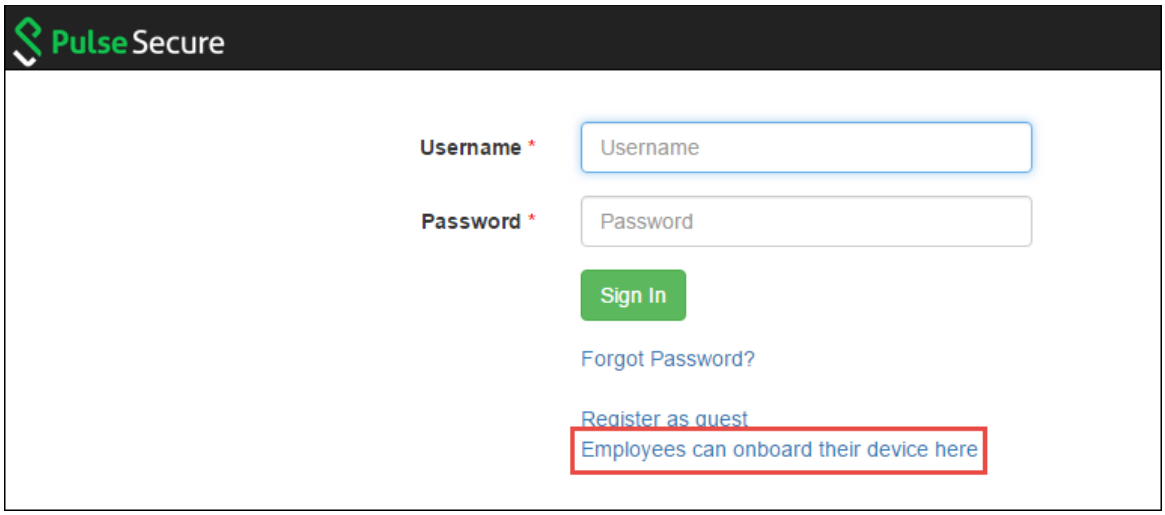
c. Select the **Show On-Boarding** link on guest log in page check box. A drop-down list appears next to it.

d. Select a required URL.

e. Click **Save Changes** to save the settings.

The **Employees can onboard their device here** link appears in an enterprise guest environment as shown in the following figure.

Figure 327: Onboarding link displayed in guest environment on PPS Login Page



Localization

In a localized guest user environment when a user tries to register as a guest all the fields are displayed in that localized language, except the **Company Name** and **Host or Sponsor** fields which are displayed in English language.

Note: French Language is used as an example.

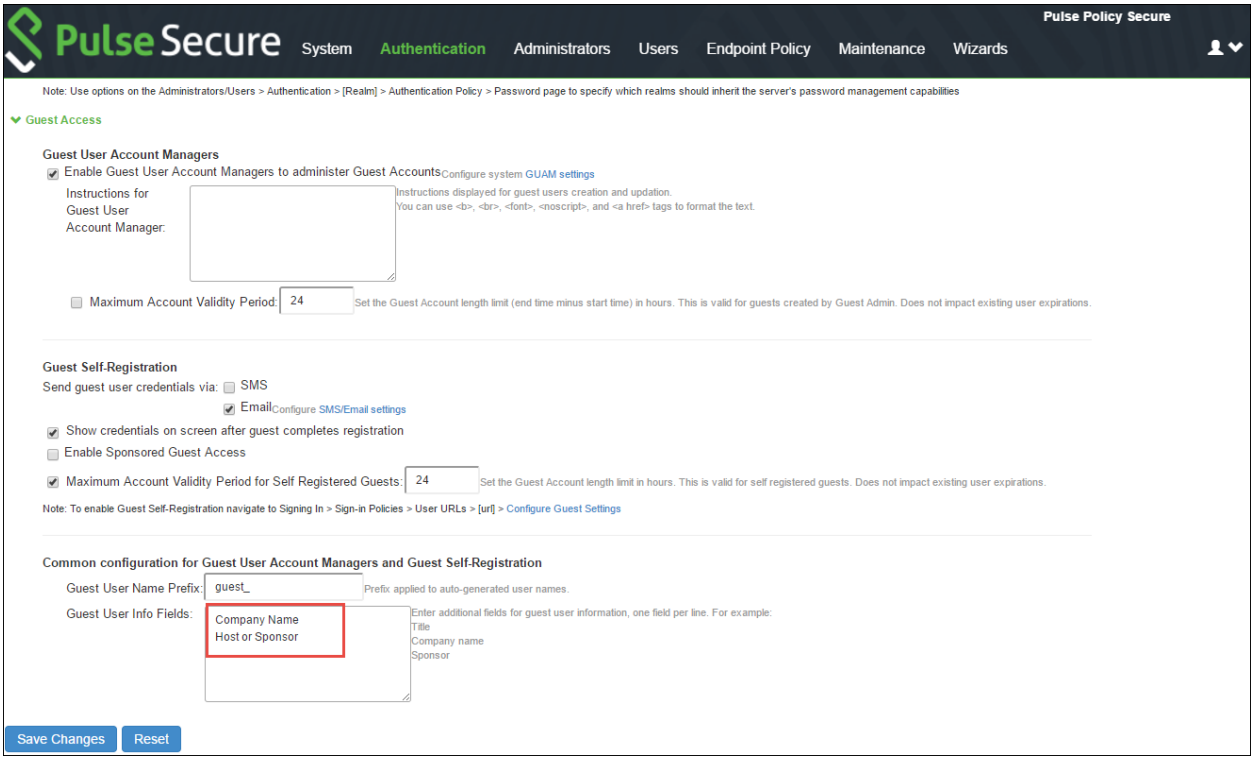
To localize these two fields, an Admin user must enter the translated field names of **Company Name** and **Host or Sponsor** fields in the Guest Access Configurations section in PPS.

To make these changes:

1. Select **Authentication > Auth.Servers**. The Authentication Servers screen appears.
   a. Select a default Authentication Server to make the changes.

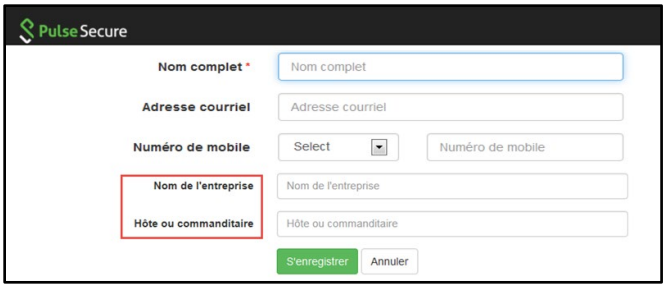
   The **Settings** tab of the Auth Server displays the settings.

   Figure 328: Guest Access Configurations- Update the marked fields in a localized language



   b. In the **Guest Access Configurations** section, enter the translated field names of **Company Name** and **Host or Sponsor** fields in the **Guest User Info Fields** box.
   c. Click **Save Changes** to save the settings.
   d. In the enterprise guest environment when a guest tries to register, the **Company Name** and **Host or Sponsor** fields are displayed in the respective language.

   Figure 329: Enterprise Guest Environment - Localization

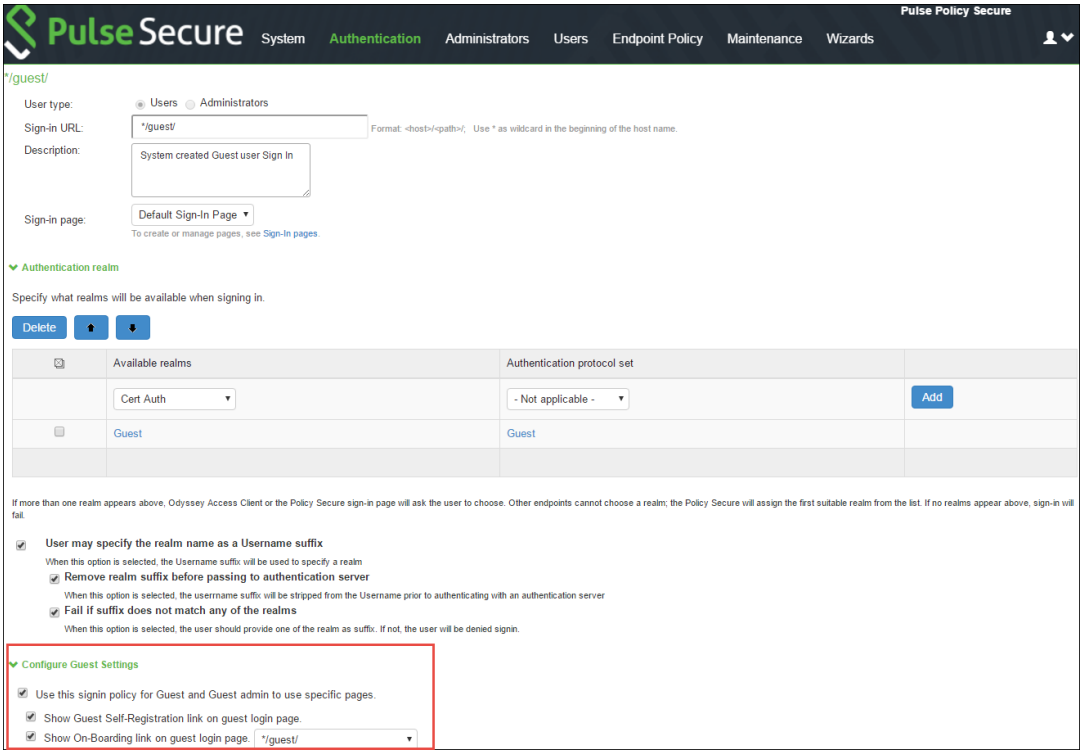


Guest Self Registration

To enable Guest Self-Registration:

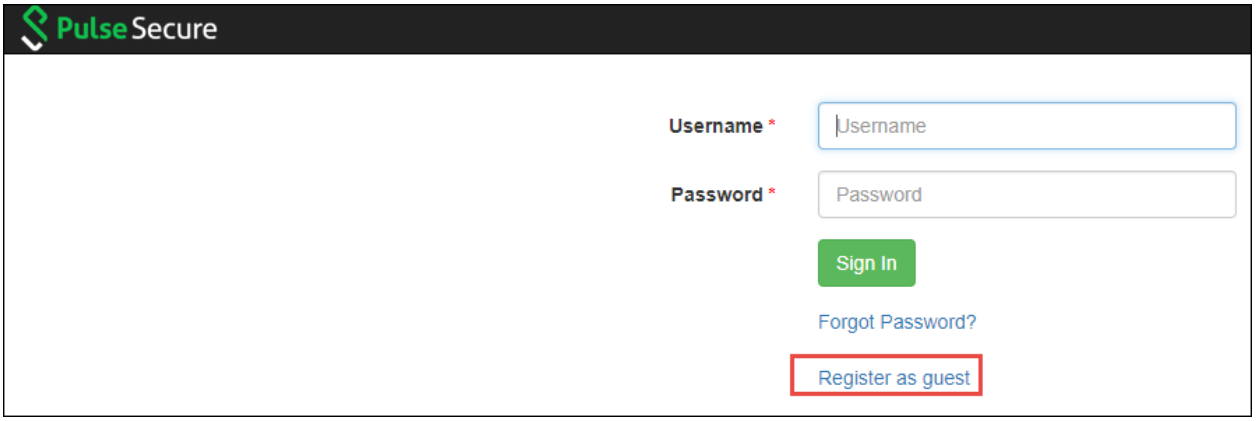
1. Select **Authentication > Signing In > Sign-in Policies > User URLs**.
2. Configure guest settings.

Figure 330: Guest settings



3. Login as guest user and click **Register as Guest**.

Figure 331: Guest-Login



4. Enter the name, email, contact number, company name, host or sponsor name.
5. Click **Register.**

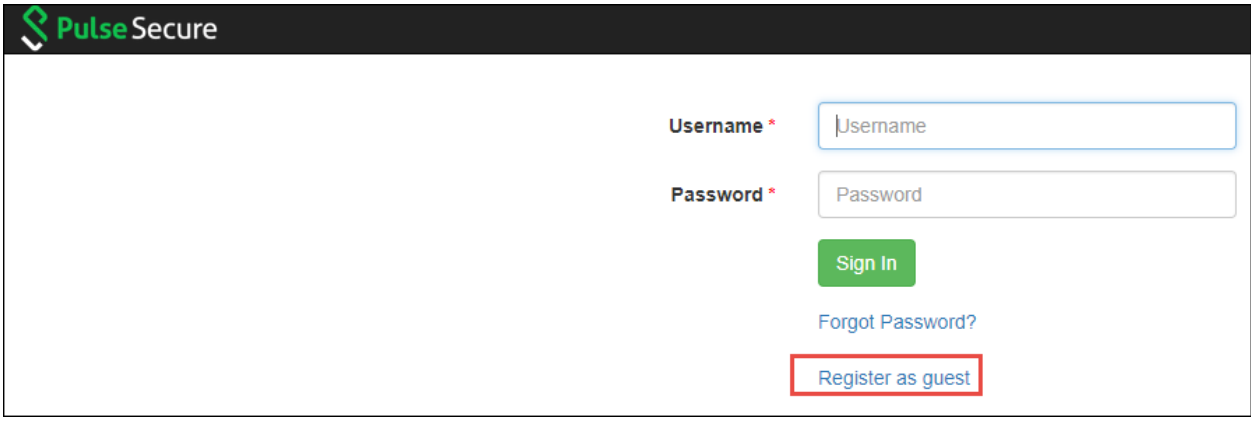
Guest Self Registration for Sponsor Approved Guest Access

The guest user logins and registers as guest by entering the contact information such as name, email, phone, company name, sponsor name and the sponsor email who approves/denies the guest access. Once the sponsorer approves the access request. The Guest user can access the internet resources.

The user flow for sponsor approved guest access is described below:

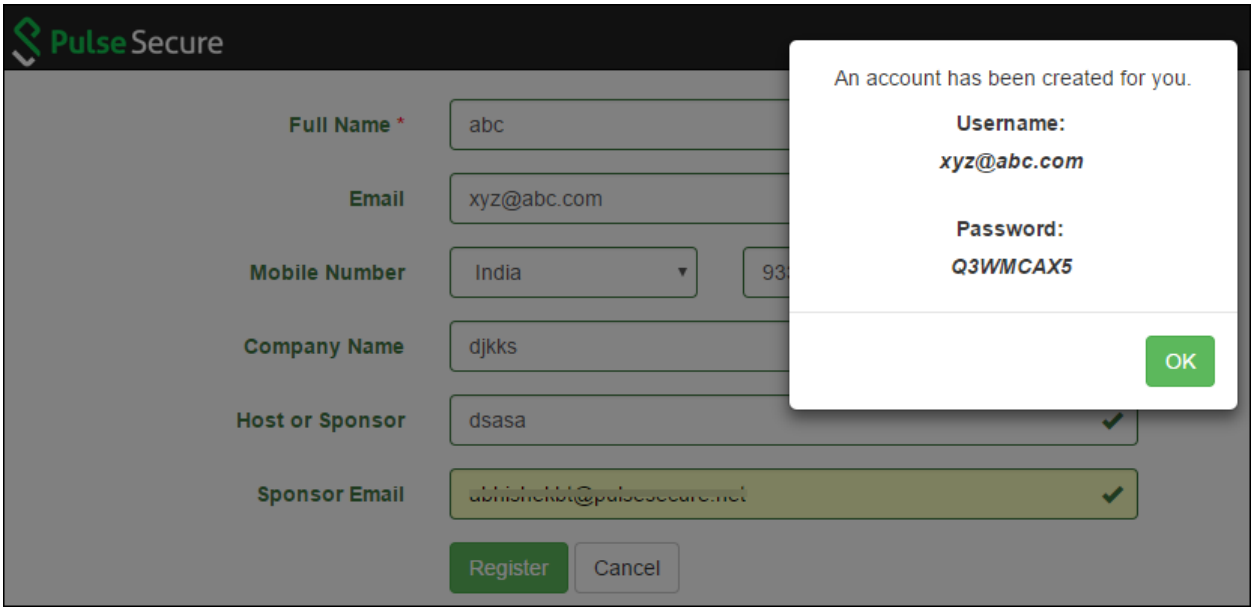
1. Open the guest URL and click Register as Guest.

Figure 332: Guest-Login



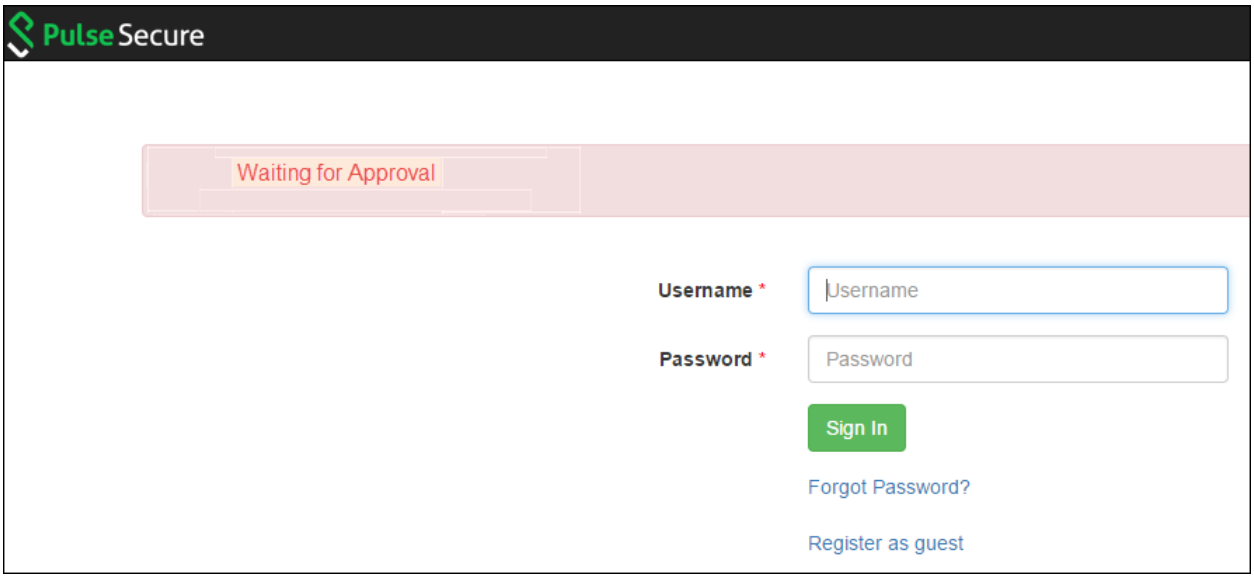
2. Enter the name, email, contact number, company name, host or sponsor name, and the sponsor email ID (Sponsored Guest Access) The sponsor email ID appears in the self-registration page only when the user enables Sponsored Guest Access option. See Configuring PPS for Sponsored Guest Access.

Figure 333: Guest-Self Registration Configuration



3. The Guest user tries to open the Guest Account using the credentials. The user fails to login as the account should be approved by the Sponsorer.

Figure 334: Guest User- Disabled

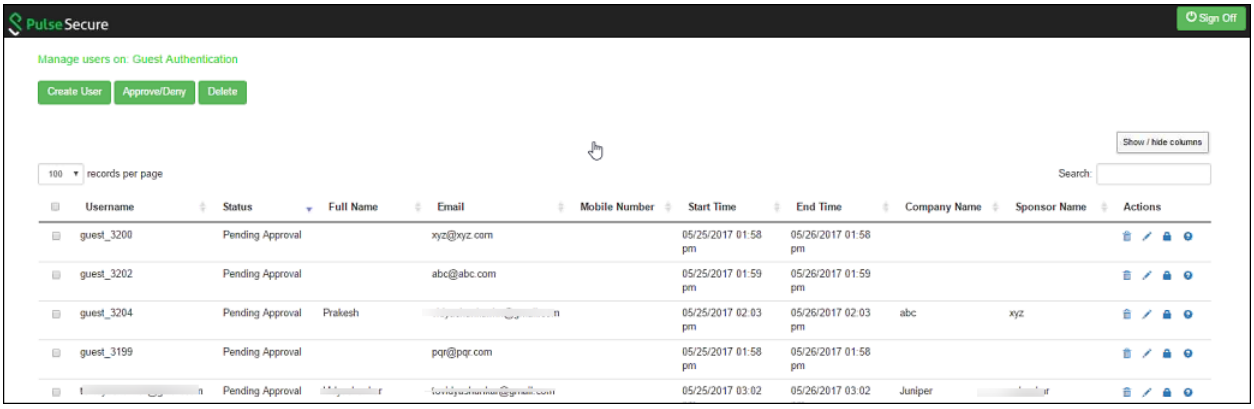


4. The Sponsor user receives an email notification to validate the Guest user.

Figure 335: Email Notification

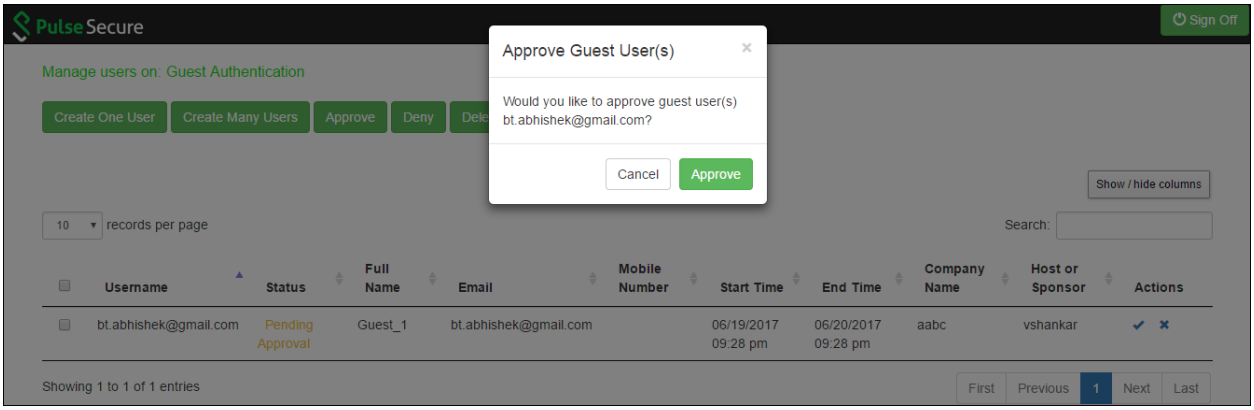
5. The Sponsorer logins with the user credentials and opens the Sponsor Portal to view the list of Guest users.

Figure 336: Sponsor Log In Page



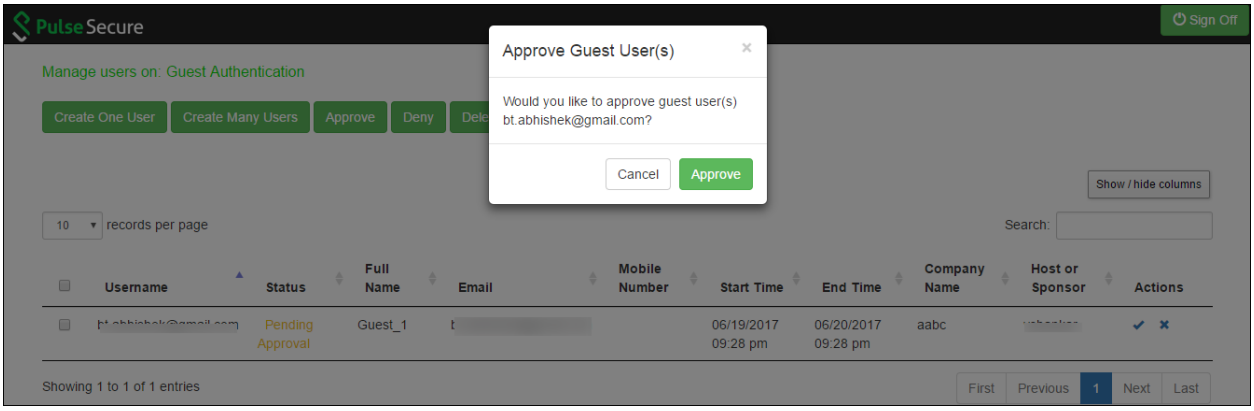
6. From the Sponsor page, the Sponsor user can click **?** icon and click **Approve** to approve the guest user account details. The following figure shows the Approve window.

Figure 337: Guest User – Approve



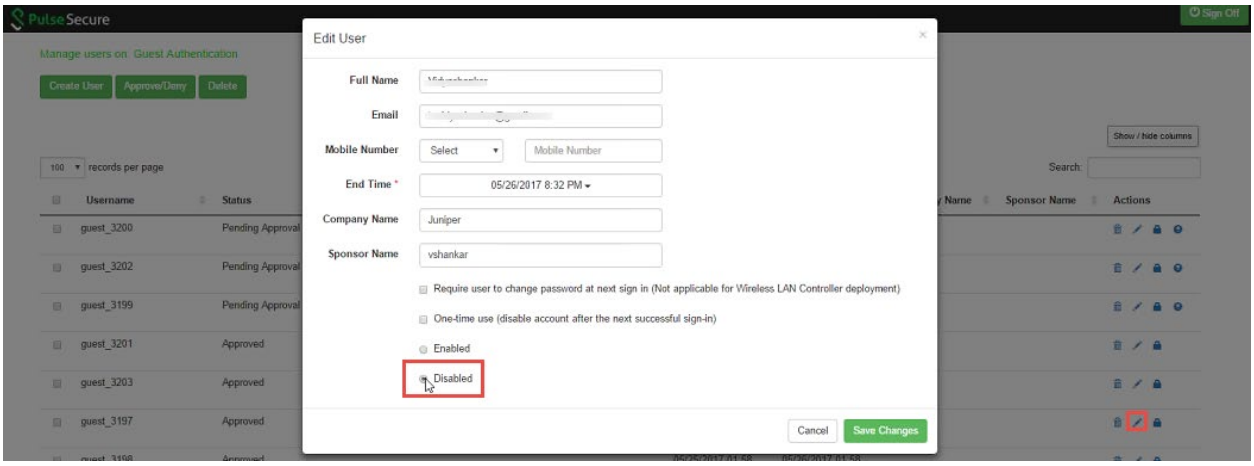
7. Click **Approve**. The Guest User receives a notification email describing that the access is approved.

Figure 338: Guest User – Approved



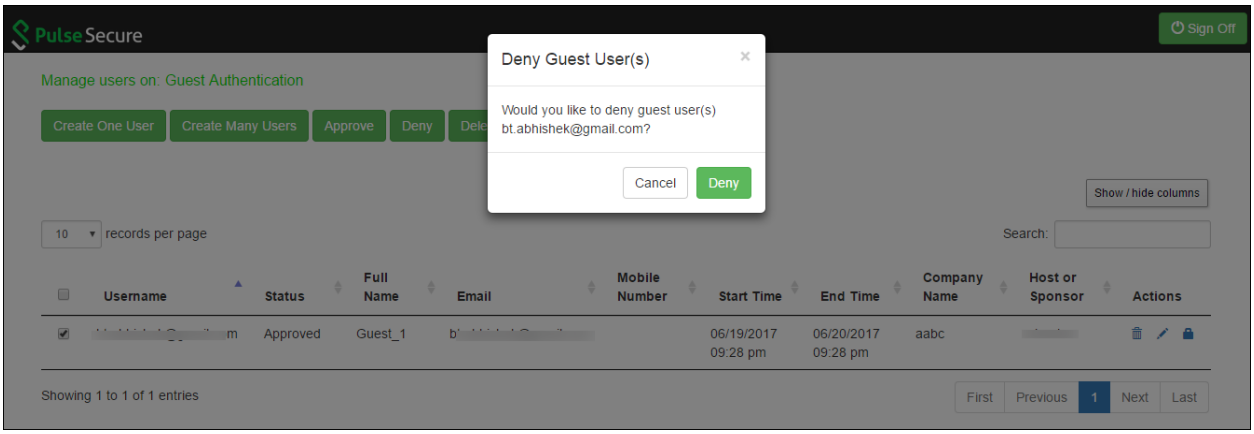
8. The Sponsor has the flexibility to edit the user details as shown below. For example, the Sponsorer can revoke the access by changing the setting to disabled.

Figure 339: Guest User –Edit



9. The following page is page is displayed if the Sponsor chooses to deny access to the Guest User. A notification email is sent to the Guest User describing that the access is denied.

Figure 340: Guest User – Denied



Guest User Administration

- Creating Guest User Accounts
- Creating Guest Sponsor

Creating Guest User Accounts

When the guest user account manager (GUAM) logs in through the sign-in page for the guest realm, an interface is presented for creating accounts as shown in the following figure. The GUAM can view all the guest users created by the GUAM, self registered, and sponsorer created users.

Figure 341: GUAM Page after Log In

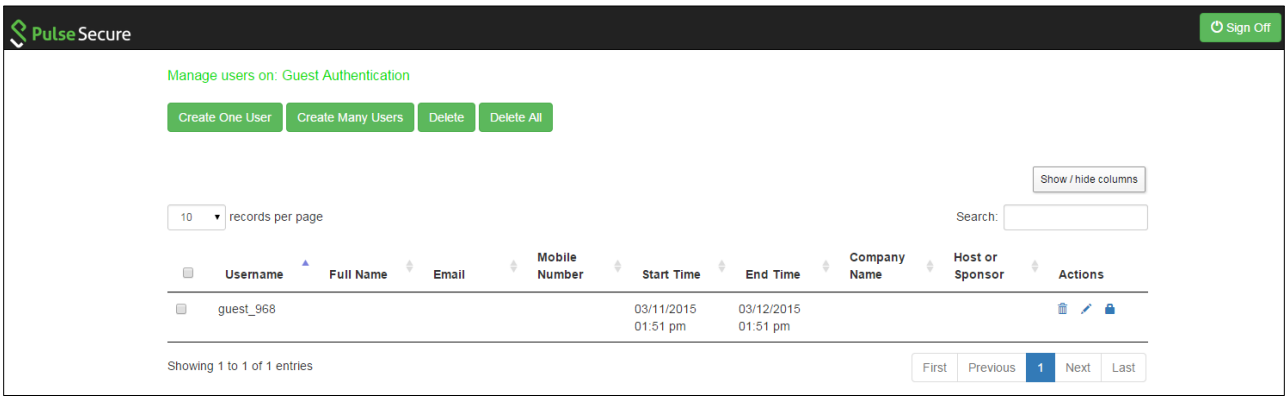


Table 65: Admin User Page - Field Descriptions

Settings	Guidelines
Create One User	Creates one user
Create Many Users	Creates multiple users
Delete	Deletes the selected users
Delete All	Deletes all the users on the page.
Show / hide columns	Select the option to hide or show specific columns.
	Deletes the record of the guest user.
	Resets the password of the guest user.

	Edits the details of the guest user.
Search	Searches for guest/s with specific names.

The following figure shows the page for adding a single guest user.

Figure 342: Guest User – Create One User Page

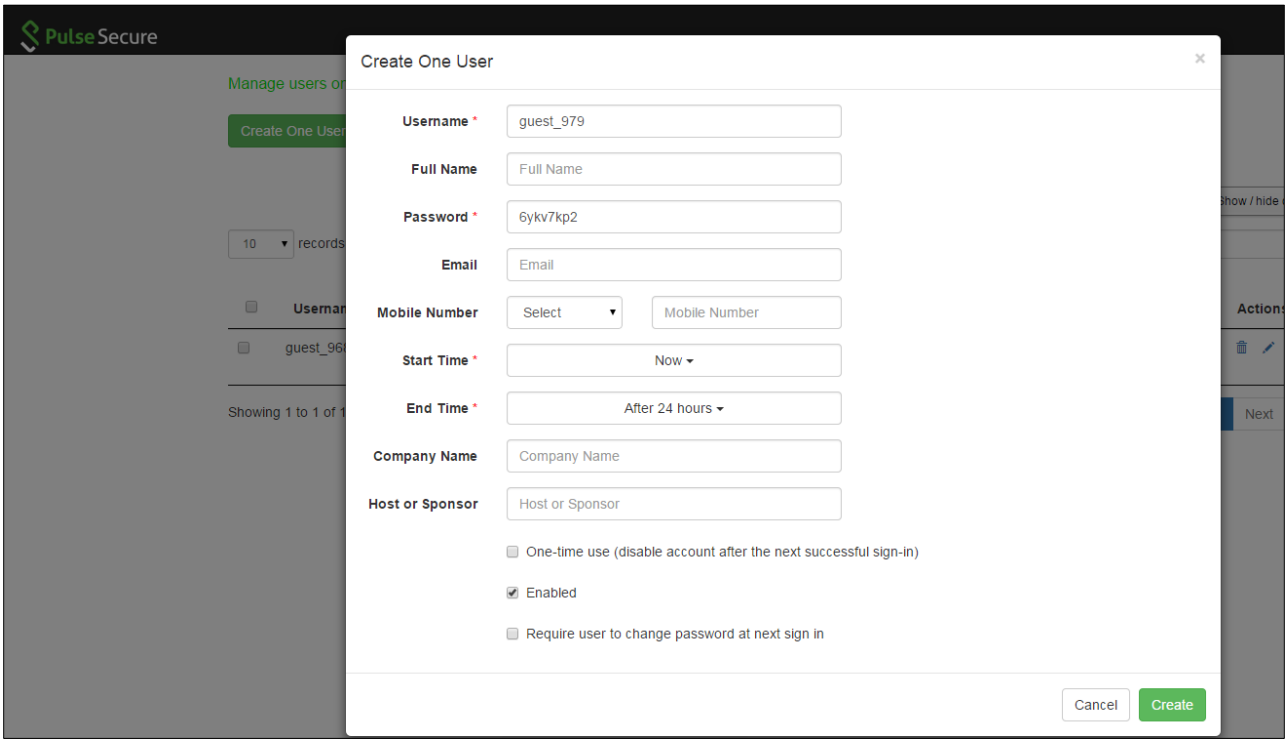


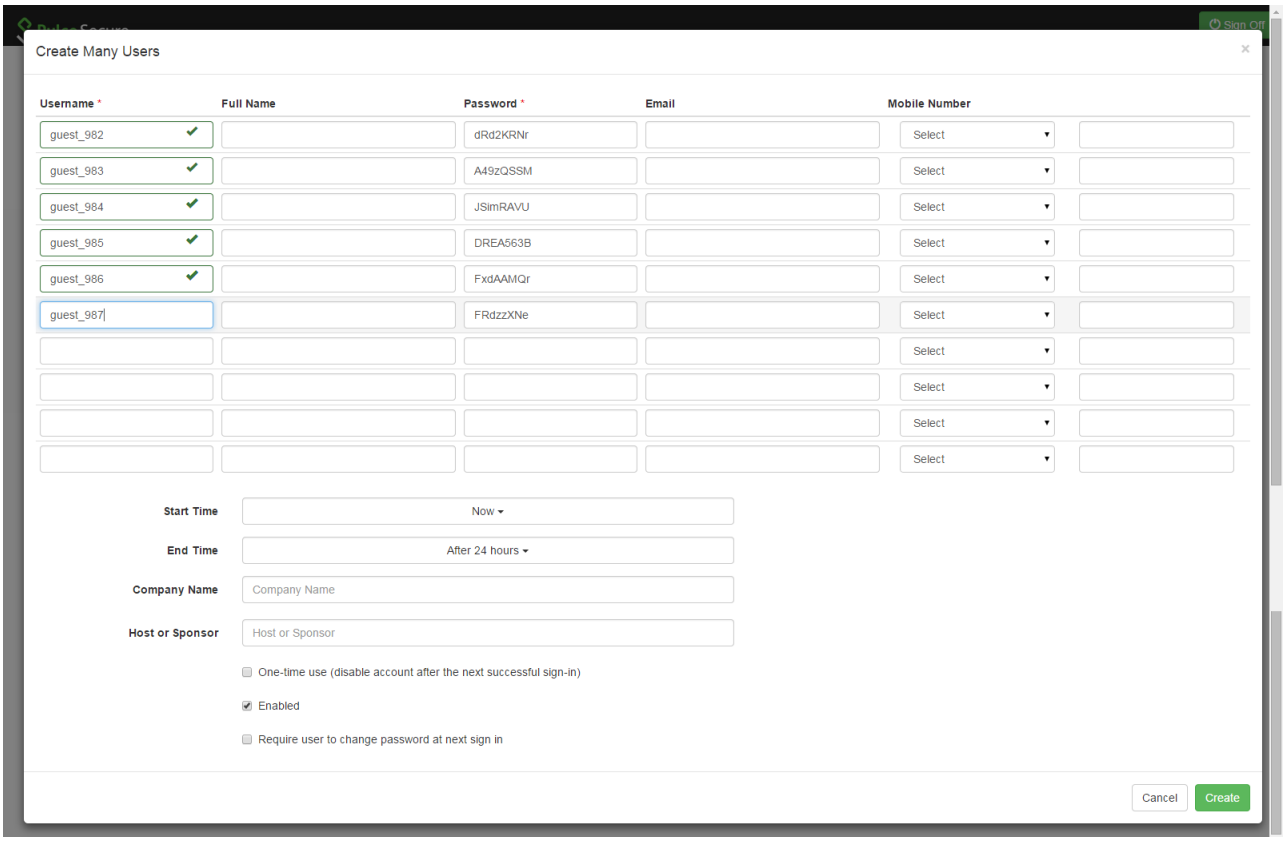
Table 66: Create One User Page Field Descriptions

Settings	Guidelines
Username	Specify an account username. If the local authentication server has been configured with a prefix for guest accounts, the username box is populated with the next username in the prefix-based sequence. We recommend you retain the guest_ prefix so that you can rely on the naming convention in your role mapping rules.
Full Name	Specify the name of the guest.
Password	A strong password is generated automatically, or you can specify a different password. After you have saved the configuration, the system displays the password characters as asterisks (*) instead of blanks or cleartext. **NOTE**: The password cannot be decrypted later unless the appropriate option is set when you create a local authentication server.
Mobile Number	Select the country name and then specify a valid phone number of the guest user. The PPS sends the login credentials to this mobile number through SMS.

Settings	Guidelines
Email	Specify an email address you can use to contact the guest if necessary.
Start Time	By default, the 'Now' option is displayed. You can specify a start time for the account activity period by clicking on the drop-down and selecting from the calendar menu.
End Time	By default, 'After 24 hours is displayed. You can specify an end of the account activity period. Click on the drop-down menu and select from the calendar menu. Once a user account has expired, it is deleted from the system. The process that deletes the guest user account runs every ten minutes. There may be a delay of some minutes before the account is purged. Even if the time or date on the system is moved ahead past the expiration time, the account could still be valid until the purge process runs. One-time user accounts are not affected by the ten-minute delay: one-time accounts are deleted immediately after the user exits.
Company Name	Enter the name of the company of the guest.
Host or Sponsor	Enter whether the guest is a Host or Sponsor.
One-time use	Select this option if you want the account deleted immediately after the guest user exits the browser or signs out.
Enabled	Select this option to enable the account
Require user to change password at next sign in	Select this option to prompt the user to change the configured password. **NOTE**: This option will not be supported in GUAM for WLC case. This option should not be enabled. Even if enabled, it will not have any effect.

The following figure shows the page for adding many users. The below table describes the user configuration.

Figure 343: Guest User – Create Many Users Page



The guest usernames and passwords are created by the system as you click in the **Username** text box.

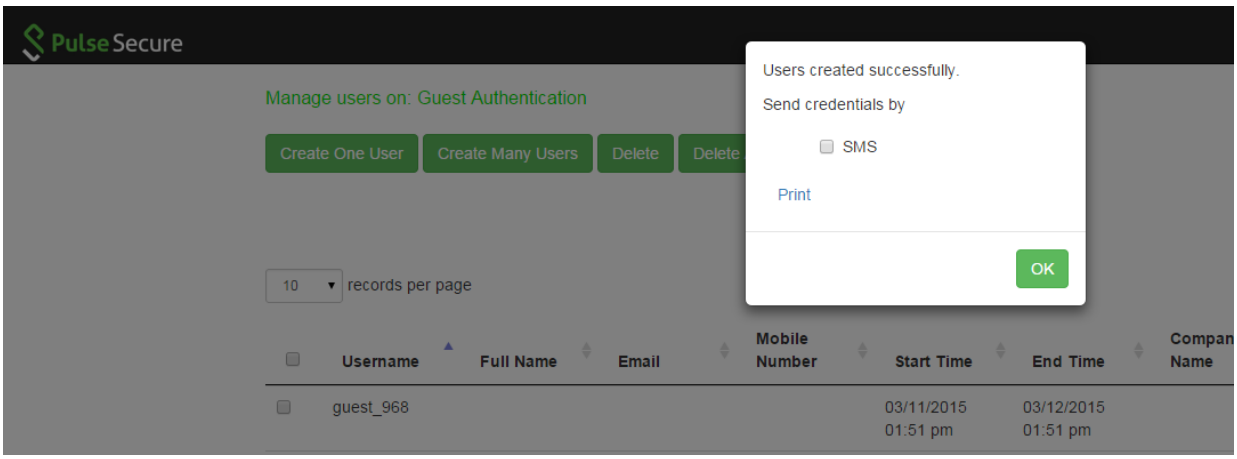
Table 67: Create Many Users Page - Field Descriptions

Settings	Guidelines
Username	Specify the prefix to be used for the multiple accounts you are creating.
Full Name	Enter the full name of the guest.
Password	A strong password is generated automatically, or you can specify a different password. After you have saved the configuration, the system displays the password characters as asterisks (*) instead of blanks or cleartext.
Start Time	You can specify a start time for the account activity period by clicking on the drop-down and selecting from the calendar menu
End Time	You can specify an end of the account activity period. Click on the drop-down menu and select from the calendar menu. Once a user account has expired, it is deleted from the system. The process that deletes the guest user account runs every ten minutes. There may be a delay of some minutes before the account is purged. Even if the time or date on the system is moved ahead past the expiration time, the account could still be valid until the purge process runs. One-time user accounts are not affected by the ten-minute delay: one-time accounts are deleted immediately after the user exits.
Company Name	Enter the name of the company of the guest. (Optional)
Host or Sponsor	Enter whether the guest is a Host or Sponsor. (Optional)
One-time use	Select this option if you want the account deleted immediately after the guest user exits the browser or

Settings	Guidelines
	signs out
Enabled	Select this option to enable the account.
Require user to change password at next sign in	Select this option to prompt the user to change the configured password **NOTE**: This option will not be supported in GUAM for WLC case. This option should not be enabled. Even if enabled, it will not have any effect.

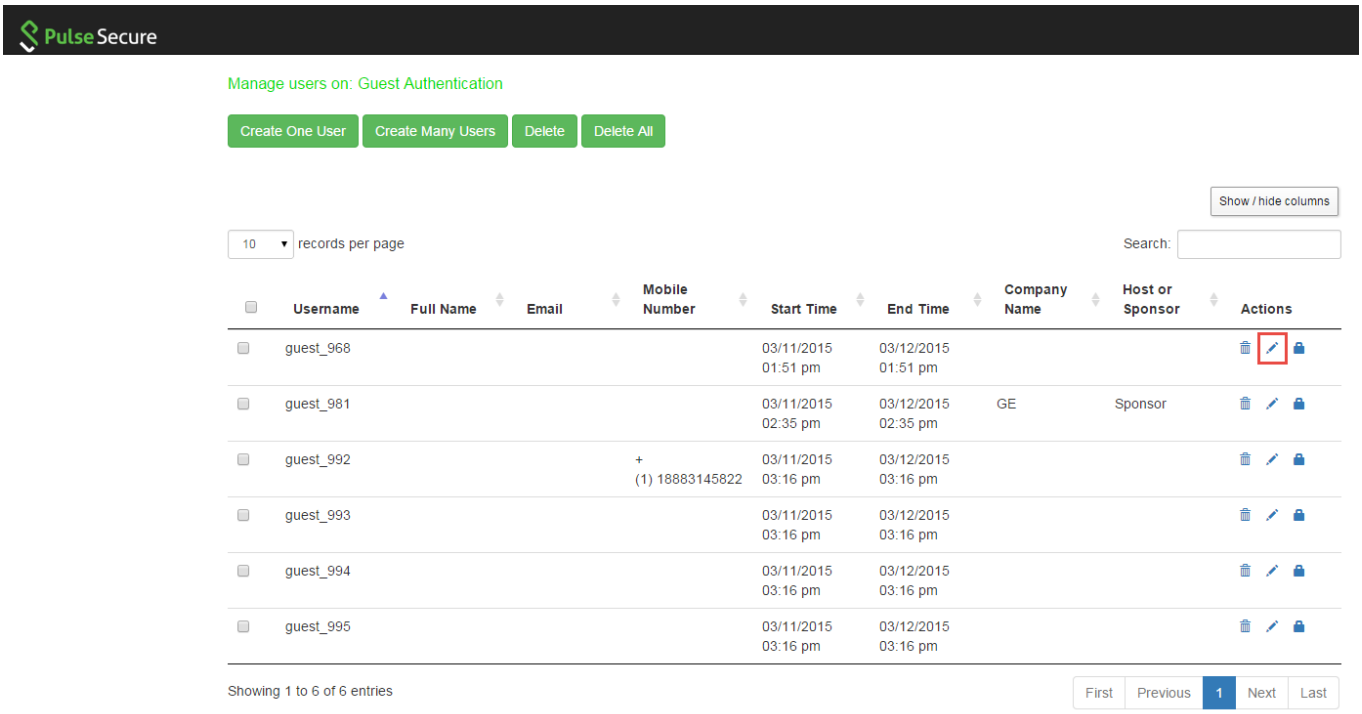
After the GUAM user clicks the **Create** button the following popup is displayed.

Figure 344: Multiple Users Created Popup Message



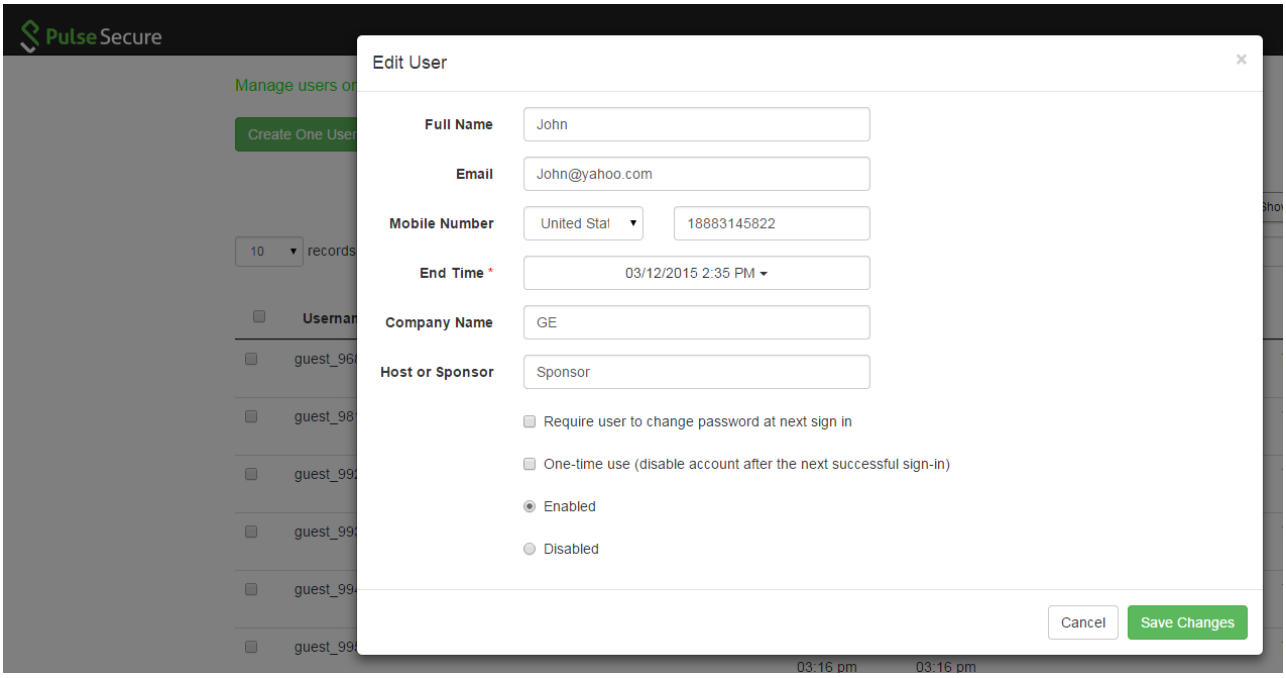
- Select **SMS** and click **OK** to send the credentials to the guests' mobiles.
- Click **Print** to generate a printout of the credentials.

Figure 345: Multiple users created - Displayed on the guest admin page



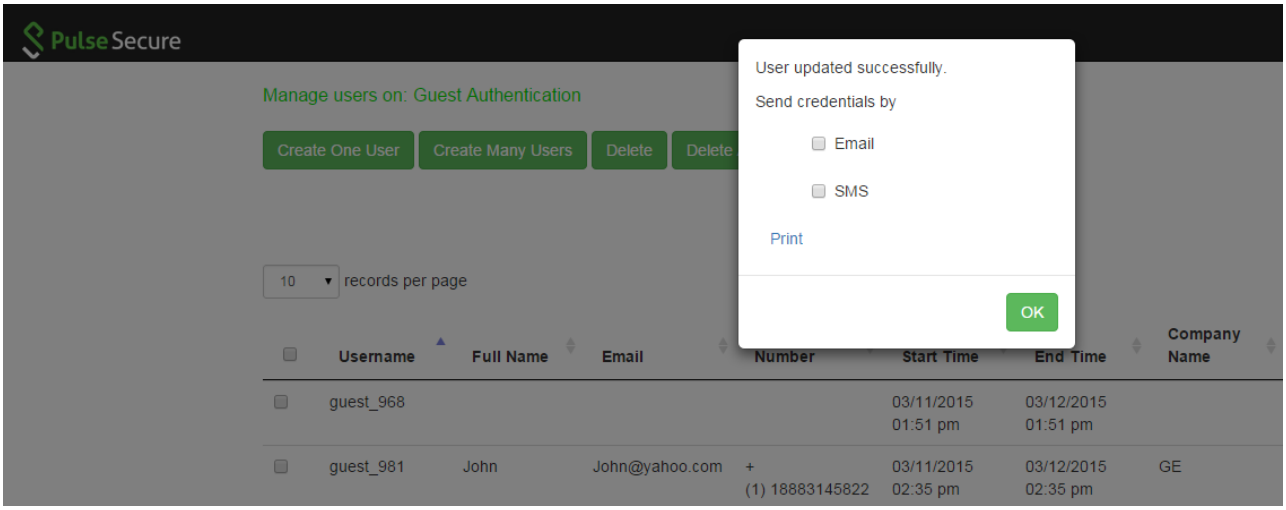
From the GUAM page, the GUAM user can click **Edit** icon of a guest user account to modify the guest user account details. The following figure shows the Edit User window.

Figure 346: Guest User – Edit User Page



After clicking **Save Changes** the following popup appears.

Figure 347: Guest User – Edit User Successful popup with Email, SMS, and Print options



From the GUAM page, the GUAM user can click **Print** to generate a printable record of the guest user account. _bookmark91

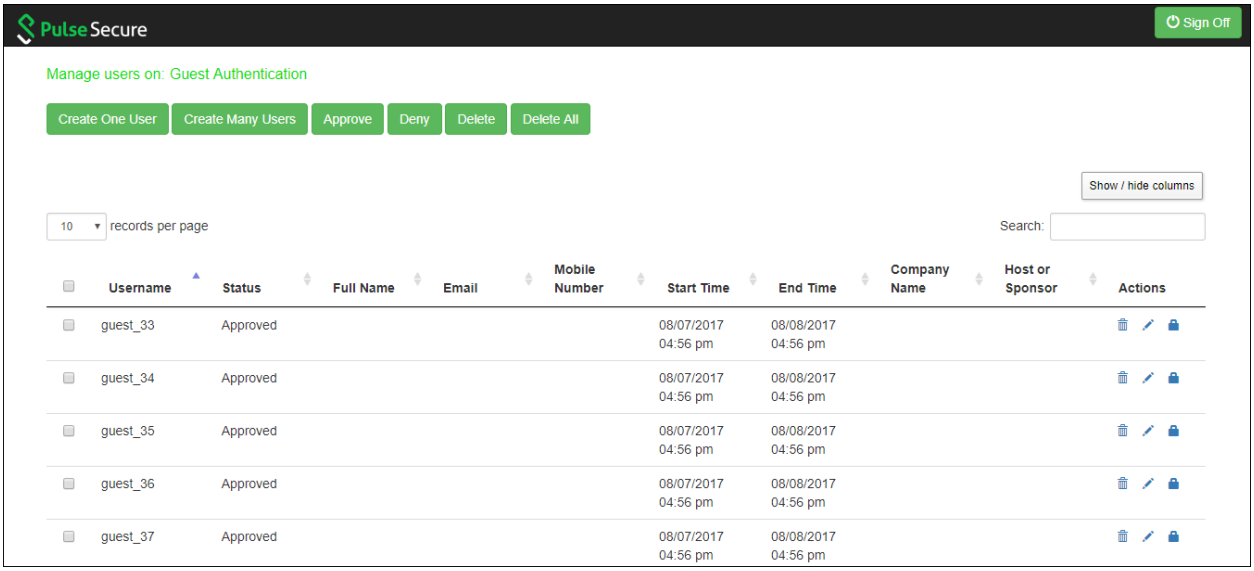
The following figure shows the print details page.

Figure 348: Guest User – Print Details Page

Creating Guest Sponsor Portal

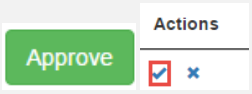
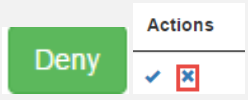
The Sponsor page is similar to GUAM page, where the Sponsor can see the list of guest users who marked the Sponsor while creating the guest user account. When the guest sponsor logs in through the sign-in page for the guest sponsor realm the following page is displayed for creating accounts. The Sponsor can see only the guest users created by the Sponsor and the Guest users who have marked someone as a Sponsor while creating guest user account.

Figure 349: Sponsor Log In Page



The below table describes the various fields on the Sponsor user page.

Table 68: Sponsor User Page - Field Descriptions

Settings	Guidelines
Create One User	Creates one user
Create Many Users	Creates multiple users
	Approves the guest user access.
	Denies the guest user access.
Delete	Deletes the selected users
Delete All	Deletes all the users on the page.
Show / hide columns	Select the option to hide or show specific columns.

	Deletes the record of the guest user.
	Resets the password of the guest user.
	Edits the details of the guest user.
Search	Searches for guest/s with specific names.

The following figure shows the page for adding a single guest user.

Figure 350: Guest User – Create One User Page

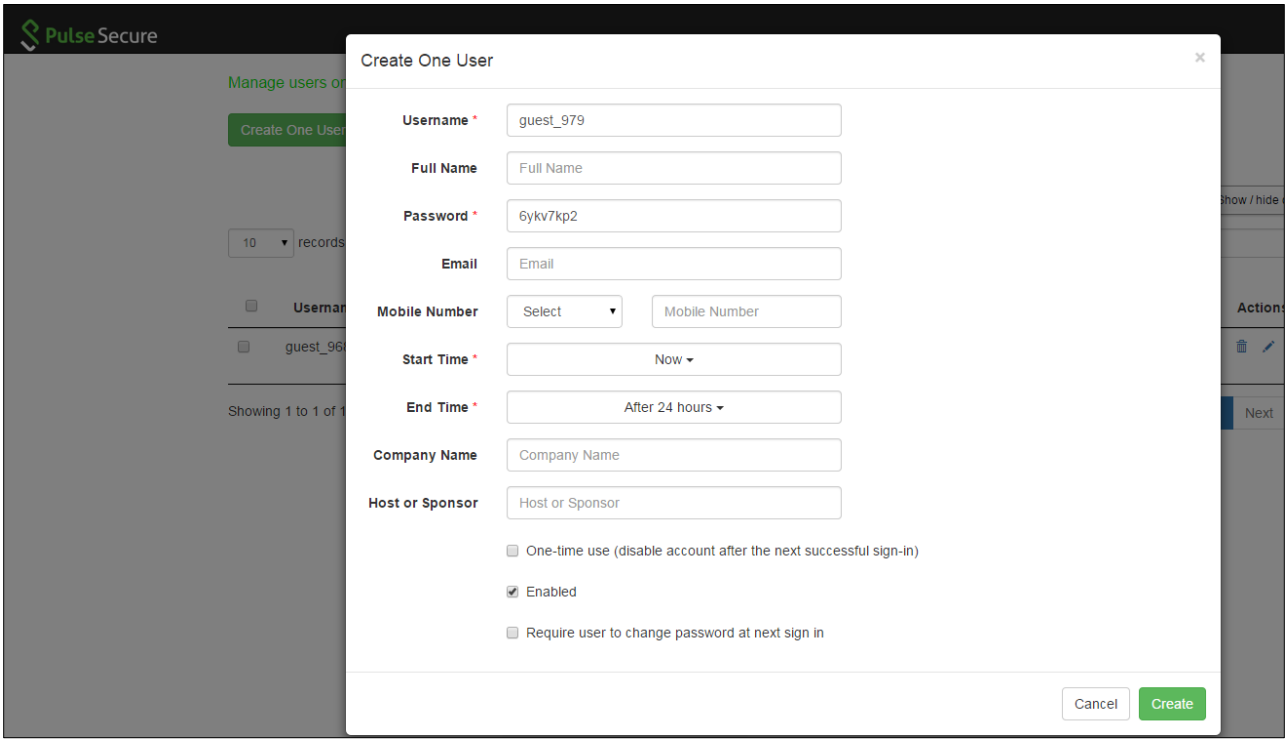


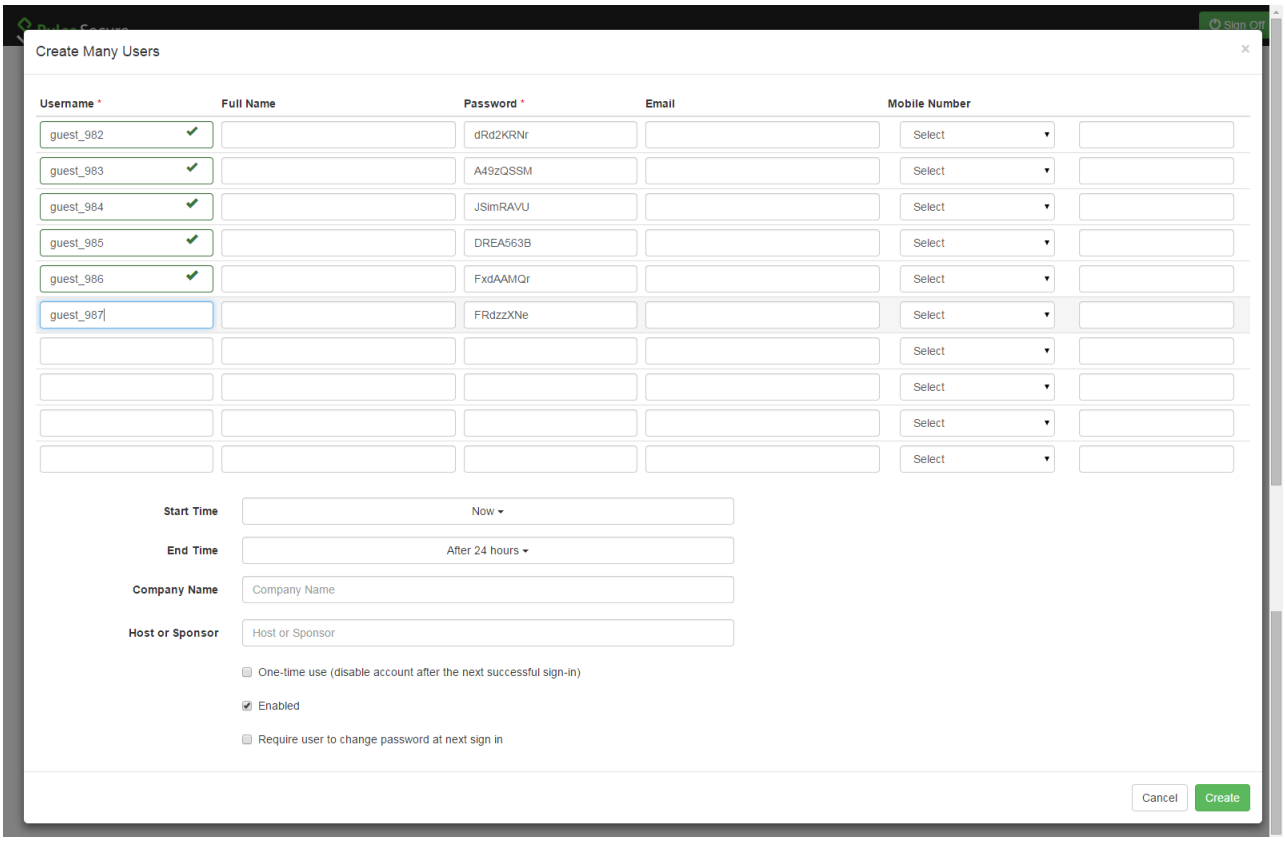
Table 69: Create One User Page Field Descriptions

Settings	Guidelines
Username	Specify an account username. If the local authentication server has been configured with a prefix for guest accounts, the username box is populated with the next username in the prefix-based sequence. We recommend you retain the guest_ prefix so that you can rely on the naming convention in your role mapping rules.
Full Name	Specify the name of the guest.
Password	A strong password is generated automatically, or you can specify a different password. After you have saved the configuration, the system displays the password characters as asterisks (*) instead of blanks or

Settings	Guidelines
	cleartext. **NOTE**: The password cannot be decrypted later unless the appropriate option is set when you create a local authentication server.
Mobile Number	Select the country name and then specify a valid phone number of the guest user. The PPS sends the login credentials to this mobile number through SMS.
Email	Specify an email address you can use to contact the guest if necessary.
Start Time	By default, the 'Now' option is displayed. You can specify a start time for the account activity period by clicking on the drop-down and selecting from the calendar menu.
End Time	By default, 'After 24 hours is displayed. You can specify an end of the account activity period. Click on the drop-down menu and select from the calendar menu. Once a user account has expired, it is deleted from the system. The process that deletes the guest user account runs every ten minutes. There may be a delay of some minutes before the account is purged. Even if the time or date on the system is moved ahead past the expiration time, the account could still be valid until the purge process runs. One-time user accounts are not affected by the ten-minute delay: one-time accounts are deleted immediately after the user exits.
Company Name	Enter the name of the company of the guest.
Host or Sponsor	Enter whether the guest is a Host or Sponsor.
One-time use	Select this option if you want the account deleted immediately after the guest user exits the browser or signs out.
Enabled	Select this option to enable the account
Require user to change password at next sign in	Select this option to prompt the user to change the configured password. **NOTE**: This option will not be supported in GUAM for WLC case. This option should not be enabled. Even if enabled, it will not have any effect.

The following figure shows the page for adding many users. The below table describes the user configuration.

Figure 351: Guest User – Create Many Users Page



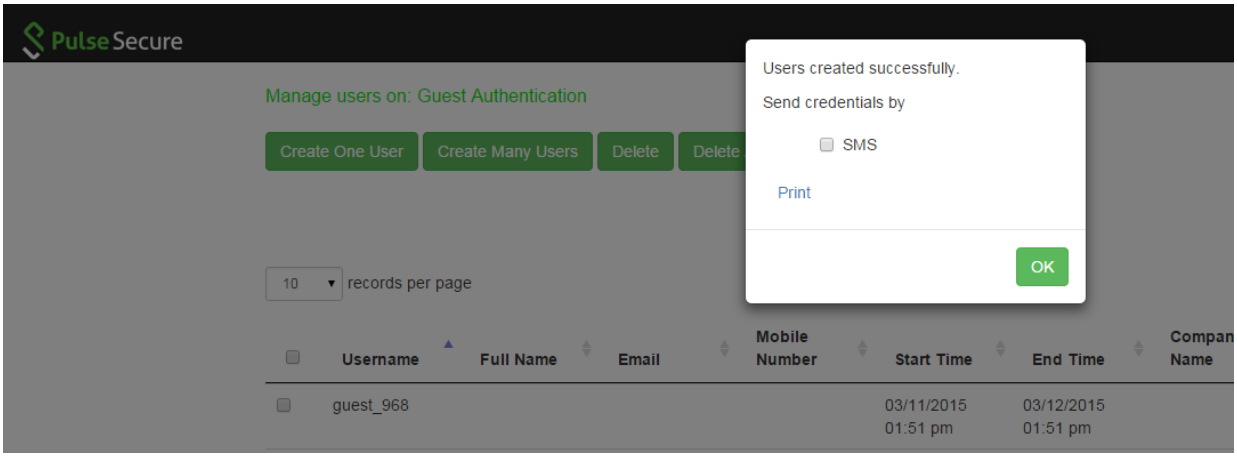
The guest usernames and passwords are created by the system as you click in the **Username** text box.

Table 70: Create Many Users Page - Field Descriptions

Settings	Guidelines
Username	Specify the prefix to be used for the multiple accounts you are creating.
Full Name	Enter the full name of the guest.
Password	A strong password is generated automatically, or you can specify a different password. After you have saved the configuration, the system displays the password characters as asterisks (*) instead of blanks or cleartext.
Start Time	You can specify a start time for the account activity period by clicking on the drop-down and selecting from the calendar menu
End Time	You can specify an end of the account activity period. Click on the drop-down menu and select from the calendar menu. Once a user account has expired, it is deleted from the system. The process that deletes the guest user account runs every ten minutes. There may be a delay of some minutes before the account is purged. Even if the time or date on the system is moved ahead past the expiration time, the account could still be valid until the purge process runs. One-time user accounts are not affected by the ten-minute delay: one-time accounts are deleted immediately after the user exits.
Company Name	Enter the name of the company of the guest. (Optional)
Host or Sponsor	Enter whether the guest is a Host or Sponsor. (Optional)
One-time use	Select this option if you want the account deleted immediately after the guest user exits the browser or signs out
Enabled	Select this option to enable the account.
Require user to change password at next sign in	Select this option to prompt the user to change the configured password **NOTE**: This option will not be supported in GUAM for WLC case. This option should not be enabled. Even if enabled, it will not have any effect.

After the GUAM user clicks the **Create** button the following popup is displayed.

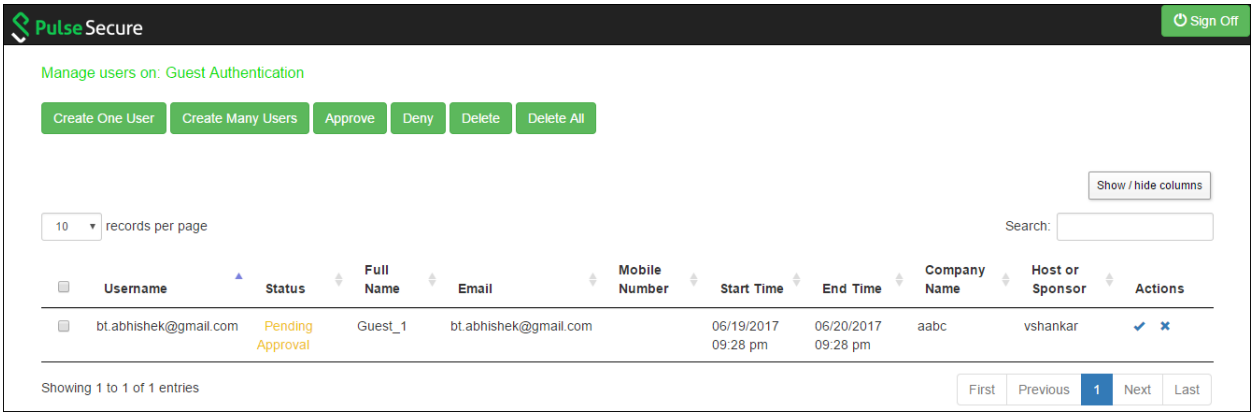
Figure 352: Multiple Users Created Popup Message



- Select **SMS** and click **OK** to send the credentials to the guests' mobiles.

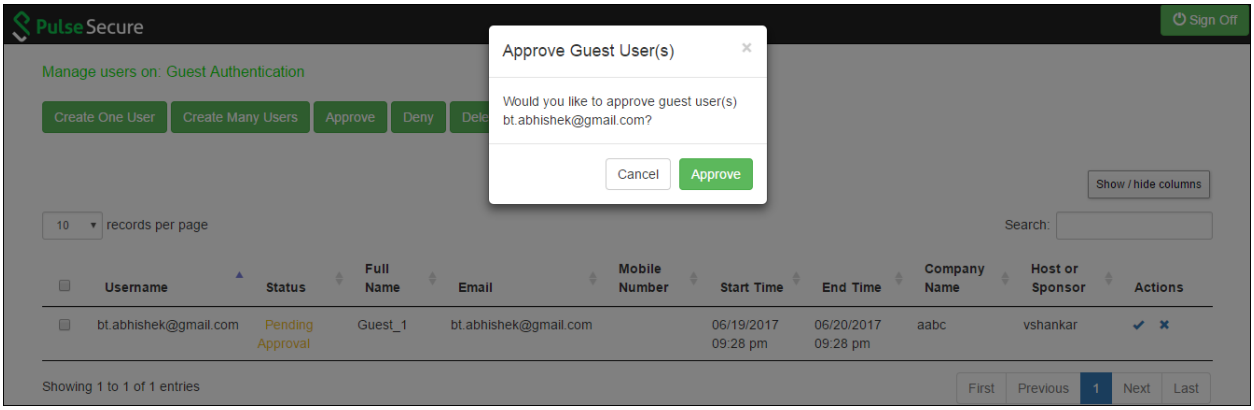
- Click **Print** to generate a printout of the credentials.

Figure 353: Multiple users created - Displayed on the Sponsor page



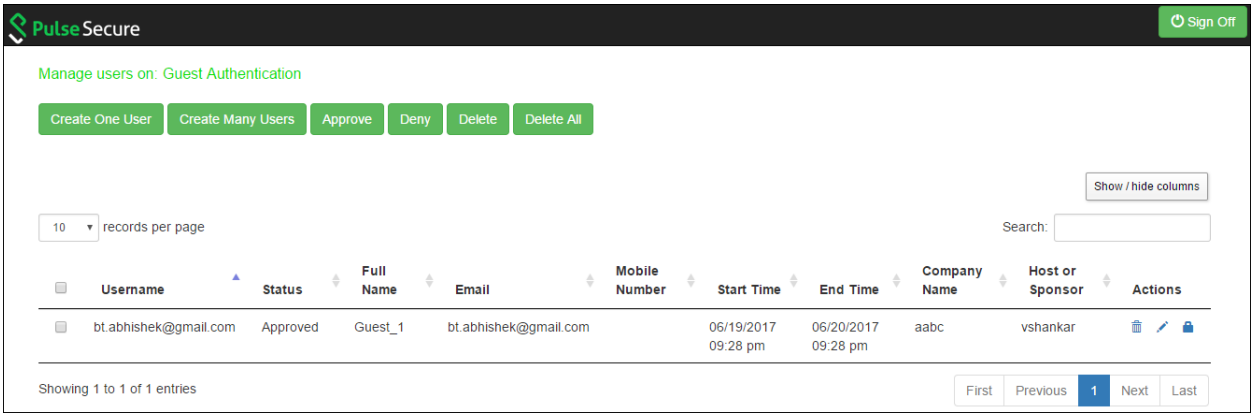
From the Sponsor page, the Sponsor user can click **Approve** icon of a guest user account to approve the guest user account details. The following figure shows the Approve window.

Figure 354: Guest User – Approve

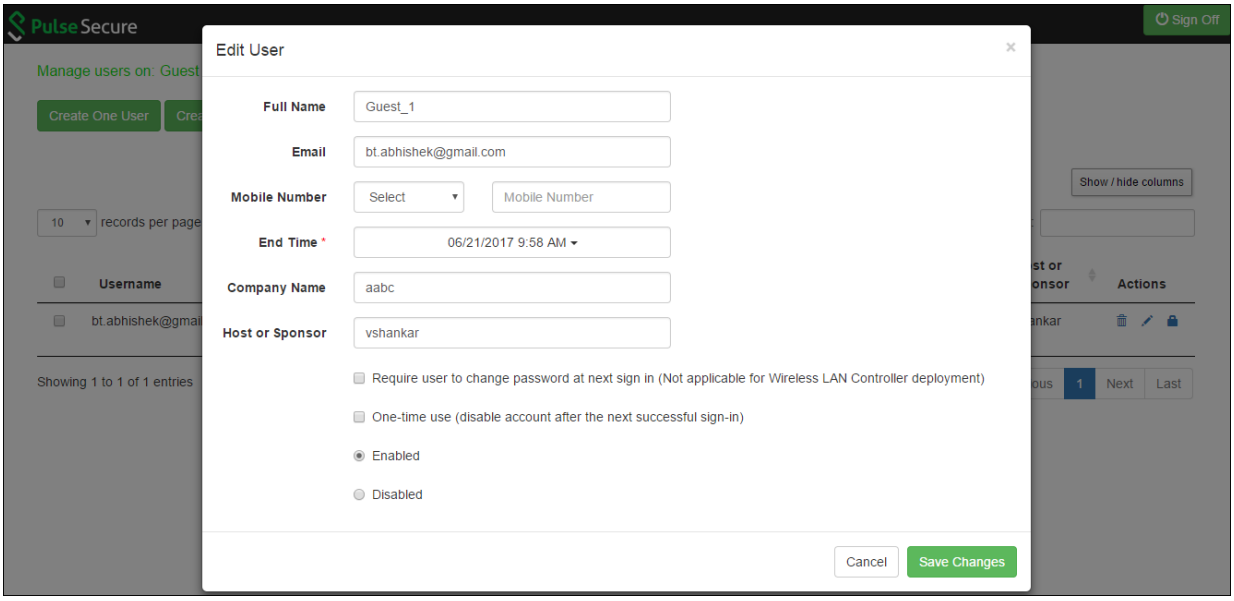


Click **Approve**. The Guest User receives a notification email describing that the access is approved.

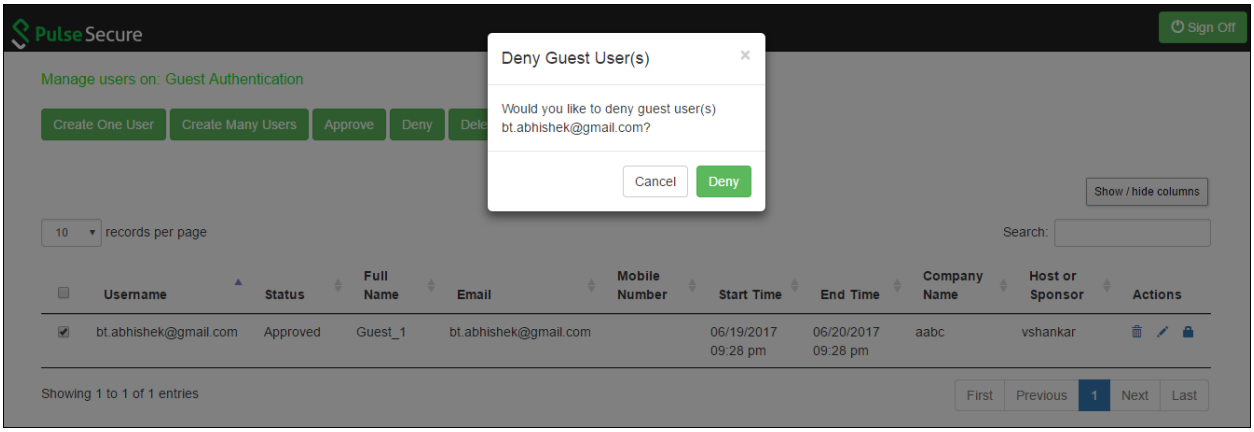
Figure 355: Guest User – Approved



The Sponsor has the flexibility to edit the user details as shown below.



The following page is page is displayed if the Sponsor chooses to deny access to the Guest User. A notification email is sent to the Guest User describing that the access is denied.



Customizing Guest Self Registration User Pages

The customization for GUAM is no more supported from the PPS 5.2 release.

This topic describes how to customize the Guest Self Register page. It includes the following information:

- Downloading the Sample Template Files
- Modifying the Sample Template Files
- Uploading Your Customized Files
- Using the Customized Pages

- Verifying the Customization

Downloading the Sample Template Files

The sample template zip file includes the following files which are added for the PPS 5.2 release:

- GuestLoginPage.thtml
- GuestLogout.thtml
- GuestSelfRegistration.thtml
- GuestForgotPassword.thtml
- GuestSigninNotifPreAuth.thtml

To download the sample template files:

1. Select **Authentication** > **Signing In** > **Sign in pages**. The Signing In screen appears.
2. Click Upload Custom Pages.

   The Upload Custom Sign-In Pages screen appears. This page hosts the sample.zip files which can be used to customize the guest sign in pages.
3. Click the **Sample** link in the Sample Template Files pane.
4. Download the latest sample.zip file.

Modifying the Sample Template Files

You can edit the HTML to modify the look and feel of your page. You can add, modify, or delete JavaScript functions and variables to customize the functionality presented on your page. This section provides examples of common customizations for Guest Self Registration pages. For a reference on the files, functions, and variables found in the templates included in the sample.zip file, see the Custom Sign-In Pages Developer Reference.

The below figure shows the contents of the GuestSelfRegistration.thtml file. The JavaScript functions and variables used for the standard user interface controls that appear in the predefined pages are highlighted in bold.

The table describes some of the common variables used in the templates and their meaning.

Table 71 Variables

Variable	Definition
I18N_FULL_NAME	Field for entering the full name of guest user.
I18N_USERNAME_ADMIN_EMAIL	Field for entering the email id of guest user.
I18N_USER_ADMIN_MOBILE_NUMBER	Field for entering mobile number of guest user.
I18N_USER_ADMIN_REGISTER	Register option in the Guest Self Registration page. Click the button after entering the user details.
I18N_CANCEL	Cancel option. Cancels the registration process and takes the user back to the Sign In page of Guest User

I18N_USERNAME_COLON	Username: field. It displays the username in the confirmation box.
I18N_PASSWORD_COLON	Password: field. It displays the password in the confirmation box.
I18N_USER_ADMIN_CREATING_ACCOUNT	Displays the message “An account has been created for you” in the confirmation box.

Figure 356: GuestSelfRegistration.thtml

```
<div id= "fnDiv" class="form-group required">

   <label for="fullname" class="col-sm-2 control-label"><% I18N_FULL_NAME %></label>

   <div id="fnDiv2" class="col-sm-5">

    <input type="text" class="form-control" id="fullname" name="fullname" placeholder="<% I18N_FULL_NAME %>" autofocus
validate>

   </div>

 </div>

 <div id= "emailDiv" class="form-group <%IF emailRequired == 1%> required <%END%>">

   <label for="email" class="col-sm-2 control-label"><% I18N_USER_ADMIN_EMAIL %></label>

   <div id="emailDiv2" class="col-sm-5">

    <input type="email" class="form-control" id="email" name="email" placeholder="<% I18N_USER_ADMIN_EMAIL %>"
validate>

   </div>

 </div>

 <div id= "mnDiv" class="form-group <%IF smsRequired == 1%> required <%END%>">

   <label for="mobilenumber" class="col-sm-2 control-label"><% I18N_USER_ADMIN_MOBILE_NUMBER %></label>

   <div id="mnDiv1" class="col-sm-2">

     <select id="cmbCountryCode" class="form-control" name="cmbCountryCode" <%disabled%>>

       <% FOREACH country = countryCode %>

         <option id="<% country.id %>" value="<% country.id %>" <%IF countrySelected == country.id%> selected <%END%>>
<% country.name %> </option>

       <%END%>

     </select>

   </div>

   <div id="mnDiv2" class="col-sm-3">

    <input type="tel" class="form-control" id="mobilenumber" name="mobilenumber" placeholder="<%
I18N_USER_ADMIN_MOBILE_NUMBER %>" validate>

   </div>
```

```
</div>
```

Removing Fields

You can remove fields from the user interface form by deleting the HTML and JavaScript that define them from the sample file. For example, to delete the “Email” option box, delete the following HTML and variables:

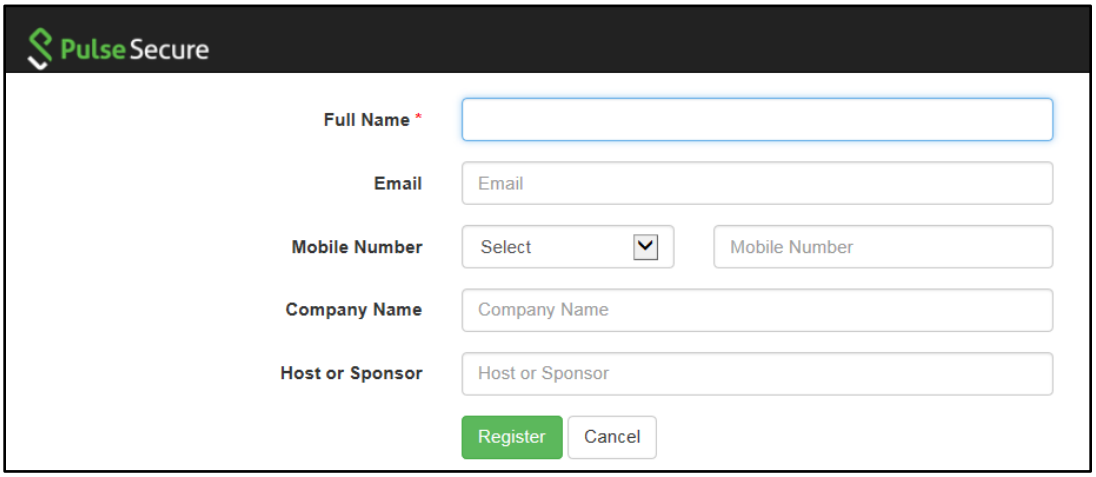
Example

```
<div id= "emailDiv" class="form-group <%IF emailRequired == 1%> required <%END%>">

  <label for="email" class="col-sm-2 control-label"><% I18N_USER_ADMIN_EMAIL %></label>

  <div id="emailDiv2" class="col-sm-5">

   <input type="email" class="form-control" id="email" name="email" placeholder="<% I18N_USER_ADMIN_EMAIL %>" validate>

  </div>

 </div>
```

NOTE: Never delete or modify the following required variables:

- Guest_Includes–
- signinAgainUrl–
- LoginPageErrorMessage–Specifies the error message. The device generates the error message in case of an error otherwise it will be empty
- preAuthSNText

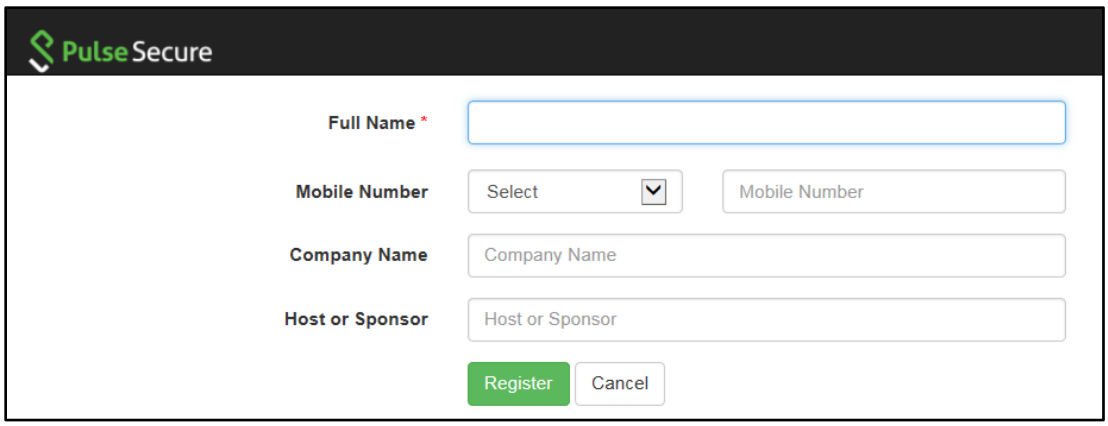
Figure 357: Default Guest Self Registration Page



NOTE: You can add a field in the html to display messages

The below figure shows the result of the customization

Figure 358: Custom Guest Self Registration Page - Email field removed



Editing Fields

You can edit fields in the user interface form by editing the HTML and JavaScript that define them from the sample file. For example, to edit the "Mobile Number" option box as 'Contact Number", edit the following HTML and variables:

Script Before Editing

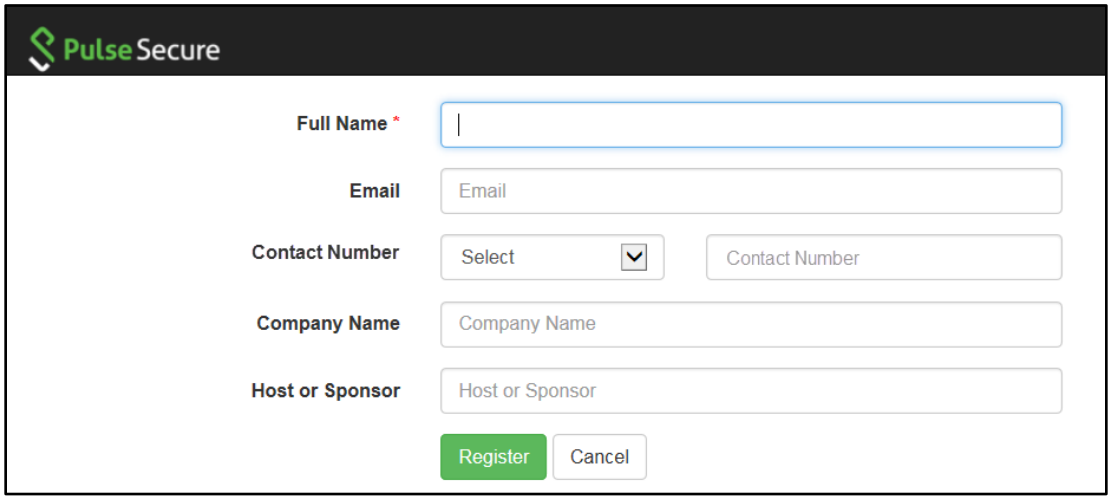
```
    <div id= "mnDiv" class="form-group <%IF smsRequired == 1%> required <%END%>">
    <label for="mobilenumber" class="col-sm-2 control-label"> <% I18N_USER_ADMIN_MOBILE_NUMBER %>Contact
Number</label>
    <div id="mnDiv1" class="col-sm-2">
      <select id="cmbCountryCode" class="form-control" name="cmbCountryCode" <%disabled%>>
        <% FOREACH country = countryCode %>
          <option id="<% country.id %>" value="<% country.id %>" <%IF countrySelected == country.id%> selected
<%END%>> <% country.name %> </option>
        <%END%>
      </select>
    </div>
    <div id="mnDiv2" class="col-sm-3">
     <input type="tel" class="form-control" id="mobilenumber" name="mobilenumber" placeholder="<%
I18N_USER_ADMIN_MOBILE_NUMBER %>" validate>
    </div>
</div>
```

Script After Editing

```
    <div id= "mnDiv" class="form-group <%IF smsRequired == 1%> required <%END%>">
    <label for="mobilenumber" class="col-sm-2 control-label"> Contact Number</label>
    <div id="mnDiv1" class="col-sm-2">
      <select id="cmbCountryCode" class="form-control" name="cmbCountryCode" <%disabled%>>
        <% FOREACH country = countryCode %>
          <option id="<% country.id %>" value="<% country.id %>" <%IF countrySelected == country.id%> selected
<%END%>> <% country.name %> </option>
        <%END%>
      </select>
    </div>
    <div id="mnDiv2" class="col-sm-3">
     <input type="tel" class="form-control" id="mobilenumber" name="mobilenumber" placeholder="Contact Number"
validate>
    </div>
</div>
```

The below figure shows the result of the customization

Figure 359: Custom Guest Self Registration Page – Mobile Number to Contact Number



Uploading Your Customized Files

After you have edited the sample template files, save the files with the same name and add them to the sample.zip file (replacing the previous files).

To upload the files to the system:

- Select Signing In > Sign-in pages.
- Click **Browse** to select the sample.zip file containing the custom templates and assets.
- Click Upload Custom Pages.

The Upload Custom Sign-In Pages screen appears.

Table 72 Guidelines for Configuring a Customized Collection

Setting	Guidelines
Sign-In Pages	
Name	Specify the name for the sign-in page.
Page Type	Specify the page type. Access is selected by default.
Template File	Select the template file in zipped format that contains the custom templates and assets.
Upload	
Skip validation checks during upload	Select this option to skip the validation checks for the template file.
Upload Custom Pages	Select this option to upload the custom pages.

Using the Customized Pages

After you have uploaded the customized files, you can associate them with your Guest Self Registration sign-in page.

To use the customized pages:

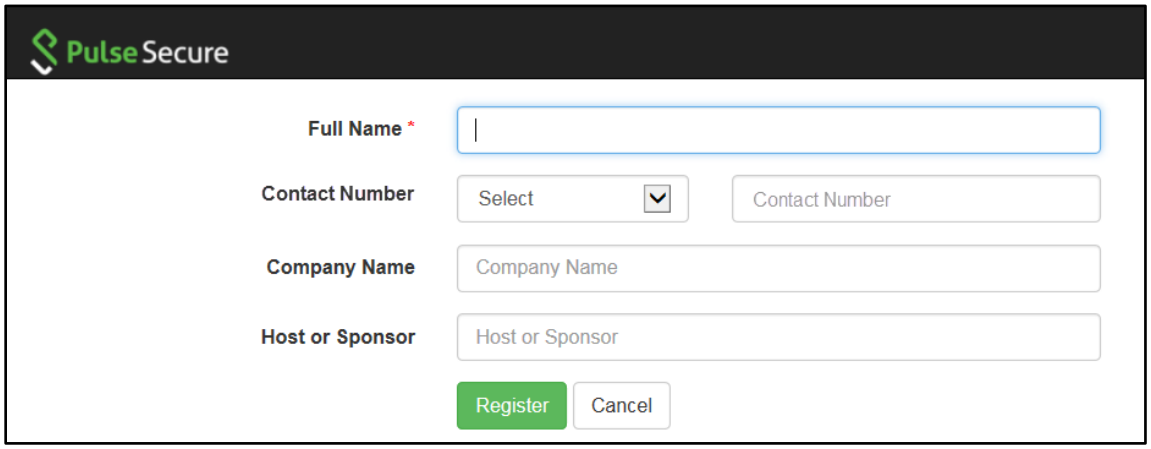
1. Select **Authentication** > **Signing-In** > **Sign-In Policies** to display the sign-in policies configuration page.
    e. Select the custom sign-in page from the drop-down list.
    f. Click Save Changes.

Verifying the Customization

Sign in to the Guest Self Registration sign-in page as a guest user account manager and verify that the customizations you have made were applied.

_bookmark77The below figure shows the customized Guest Self Registration page, without the **Email ID** field, and the **Mobile Number** field changed as **Contact Number**.

Figure 360: Customized Guest Self Registration Page



Configuring Cisco 2500 WLC

Configuring Cisco WLC for PPS GUAM and Guest Self-Registration

This section explains the steps to configure Cisco 2500 WLC for deploying PPS GUAM and Guest Self-Registration feature. This section provides examples of how to configure the Cisco WLC. For more information, see Cisco documentation.

Configuration required on Cisco WLC for Local AP mode

Configuring RADIUS server

1. Login to Cisco WLC. Select **Security > AAA > RADIUS**. Configure PPS server as authentication and accounting servers.

    - **Support for RFC 3576** - Enable this option to trigger RADIUS disconnect when required.

Figure 361: Authentication server settings

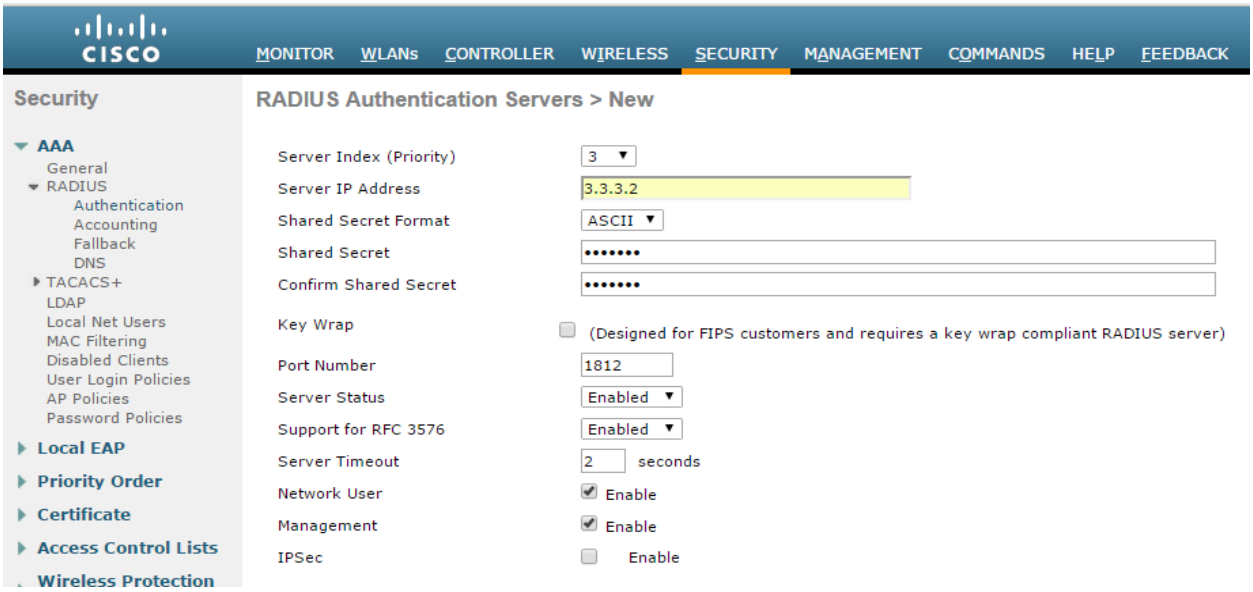
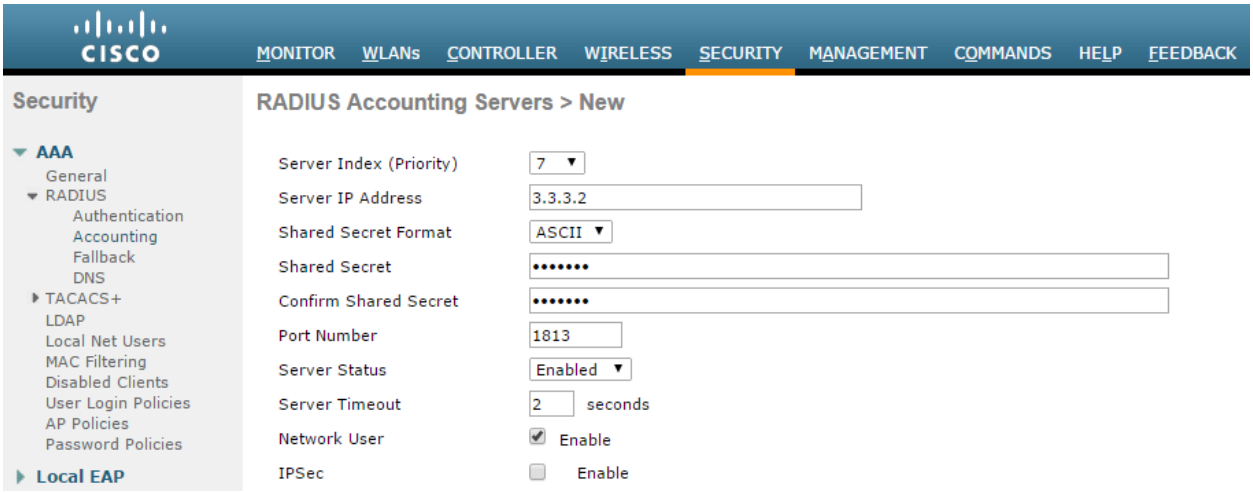


Figure 362: Accounting server settings



Using CLI

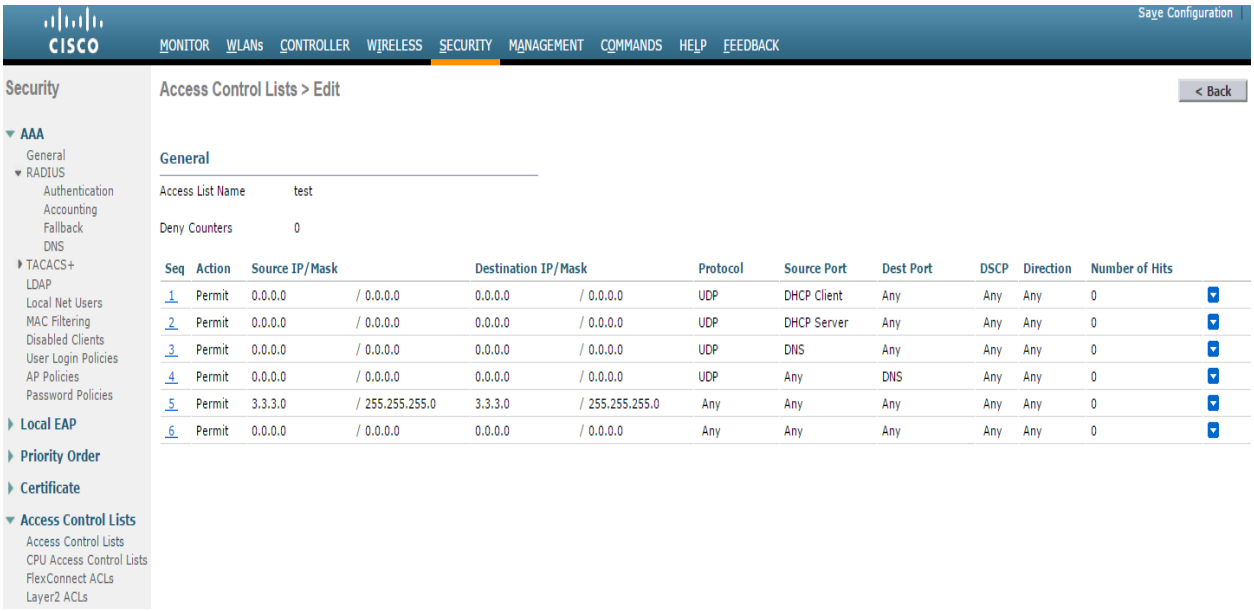
Before creating the radius server, you need to allot an index number to it which is not currently in use. To find out the index numbers which are currently in use in WLC, use the following command

show radius summary
Go through the authentication servers and accounting servers section in the displayed output. Use an unused index number for adding radius authentication or accounting server.
config radius auth add <RADIUS auth server ID> <RADIUS server IP> 1812 ascii <password>
config radius auth disable < RADIUS auth server ID >
config radius auth rfc3576 enable < RADIUS auth server ID >
config radius auth enable < RADIUS auth server ID >
config radius acct add <RADIUS acct server ID > <RADIUS server IP> 1813 ascii <password>

Configuring ACLs

1. On the CISCO WLC main screen go to **Security > Access Control Lists**. Create an IPv4 ACL list to allow DNS, DHCP and PPS (Traffic).

Figure 363: Creating an IPv4 ACL



Using CLI

To see all the ACLs that are configured on the controller enter the following command:

show acl summary
To create an ACL with name test
config acl create test
To create a rule in the test ACL
config acl rule add test 1 # Creating Rule No 1
config acl rule protocol test 1 17 # 17 is UDP protocol
config acl rule source port range test 1 68 68 # 68 is DHCP client port number
config acl rule action test 1 permit # Allow access

config acl rule add test 2 # Creating Rule No 2
config acl rule protocol test 2 17
config acl rule source port range test 2 67 67 # 67 is DHCP server port number
config acl rule action test 2 permit

config acl rule add test 3 # Creating Rule No 3
config acl rule protocol test 3 17
config acl rule source port range test 3 53 53 # Port 53 for DNS
config acl rule action test 3 permit

config acl rule add test 4 # Creating Rule No 4
config acl rule protocol test 4 17
config acl rule destination port range test 4 53 53
config acl rule action test 4 permit

config acl rule add test 5 # Creating Rule No 5
config acl rule source address test 5 3.3.3.2 255.255.255.255
config acl rule action test 5 permit

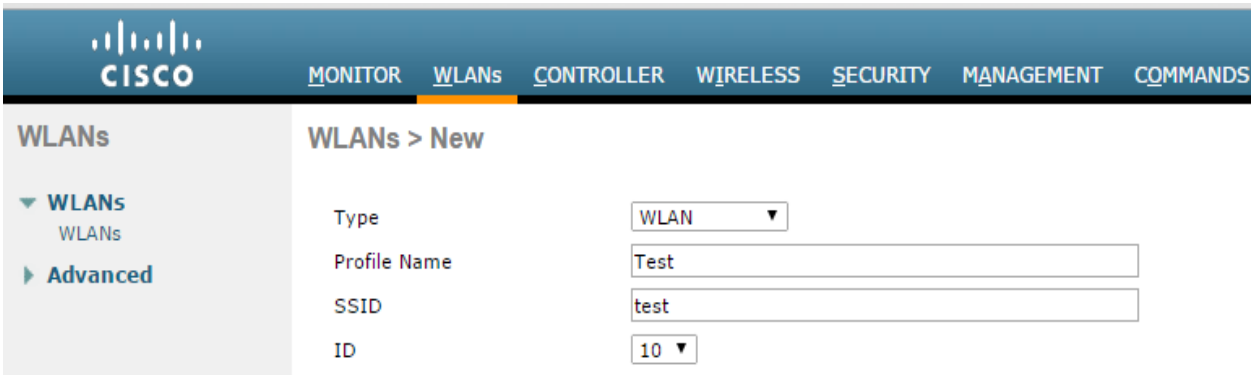
config acl rule add test 6 # Creating Rule No 6
config acl rule destination address test 6 3.3.3.2 255.255.255.255
config acl rule action test 6 permit

Configuring WLAN

To configure Cisco WLAN:

1. On the CISCO WLC main screen select **WLANs** tab and create a new WLAN.

Figure 364: Creating a WLAN

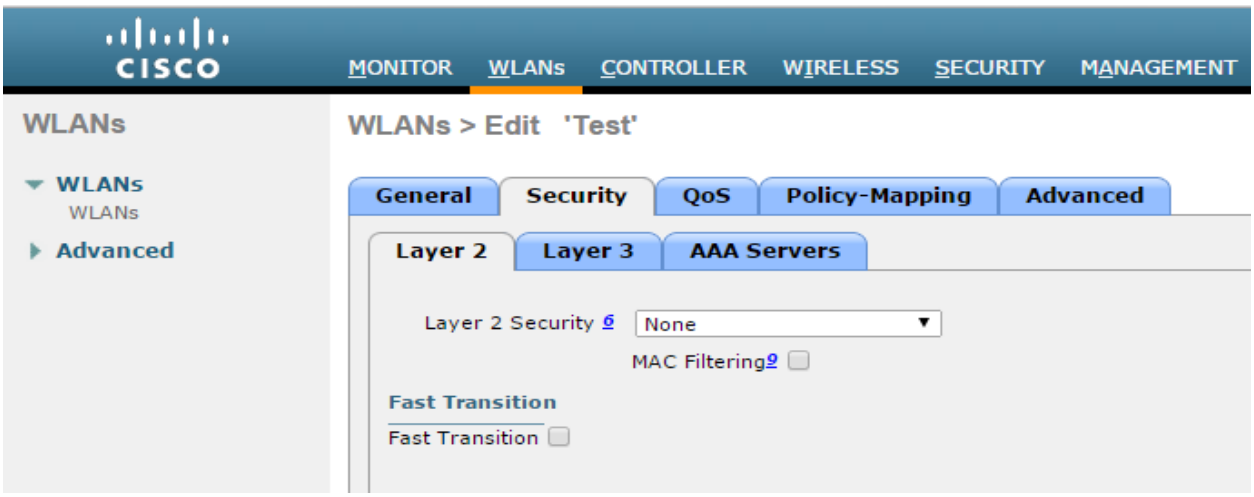


g. Select to **General** tab and enable **Status** checkbox

Figure 365: WLAN - General settings

h. Select **Security > Layer 2** in **WLANs** tab. Select 'None' from the **Layer 2 Security** drop-down list.

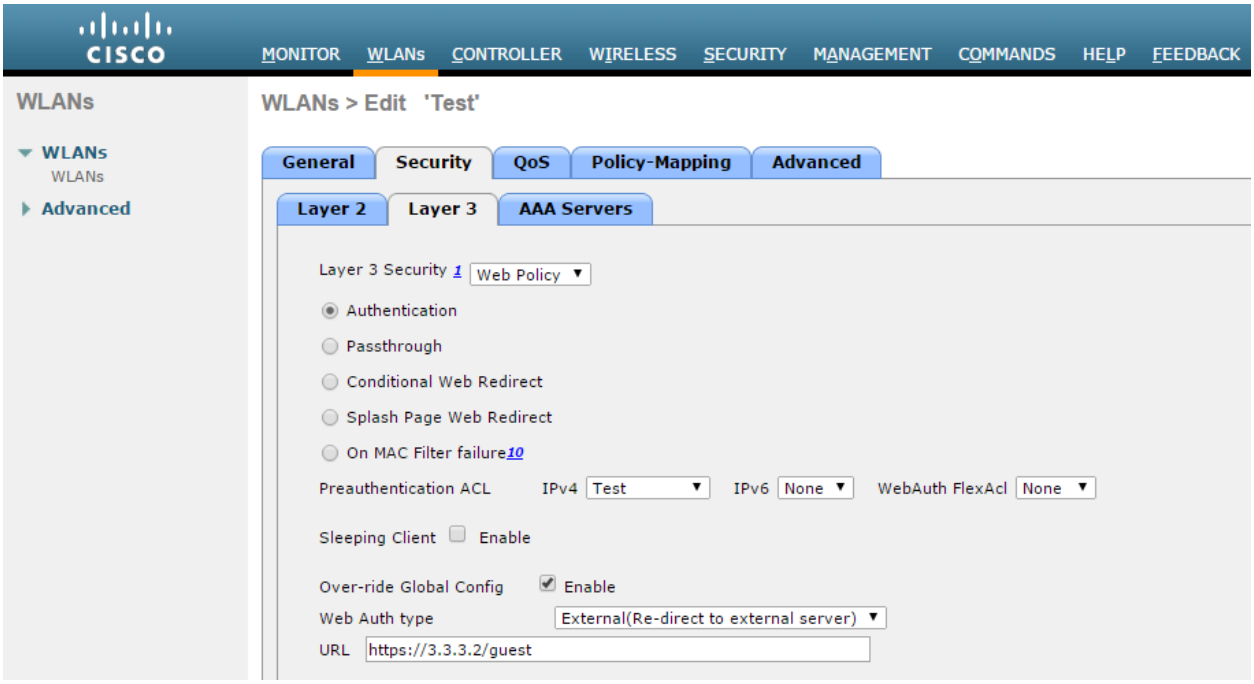
Figure 366: WLAN Layer 2 settings



i. Select **Security** > **Layer3** in WLANs tab.

- From the **Layer 3 security** drop-down list select 'Web Policy'.
- For **Preauthentication ACL**, associate the ACL that is created earlier for IPv4.
- Over-ride Global Config - Select the **Enable** check box.
- From the **Web auth type** drop-down list select External (Re-direct to external server)
- **URL** – Enter the PPS (Guest sign-in URL) for redirection URL.

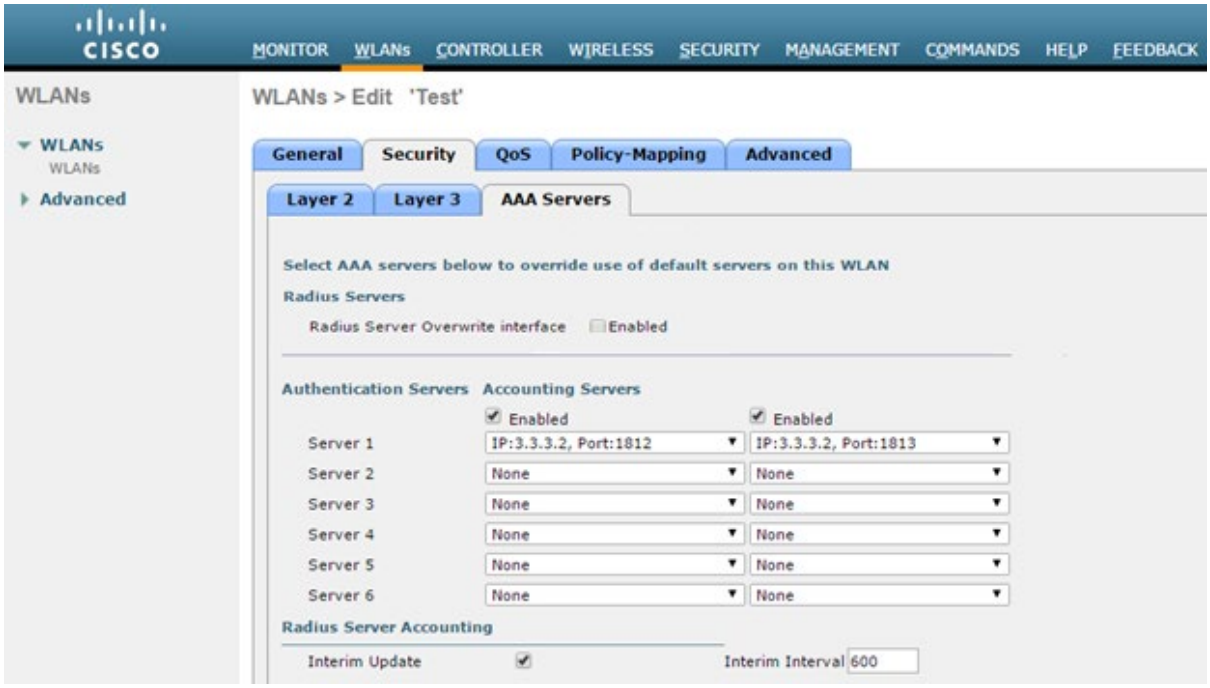
Figure 367: WLAN Layer 3 settings



j. Select **Security > AAA Servers** tab. Configure RADIUS server for authentication and

accounting.

Figure 368: WLAN – AAA Server settings

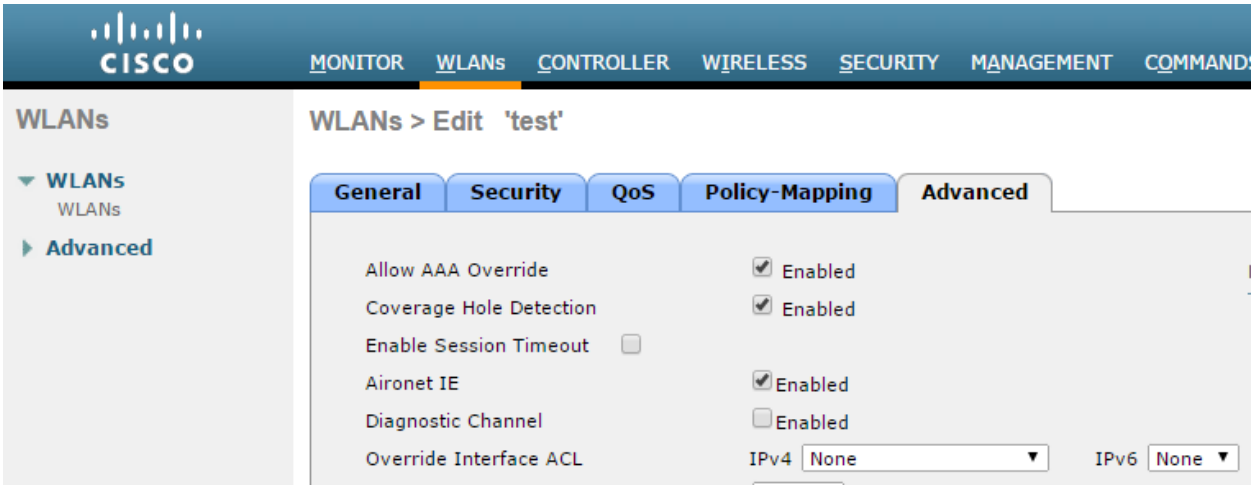


k. Select the **Interim Update** check box.

Note: Instead of management port, if some other Interface/Interface Group (G) is selected during WLAN creation then **Radius Server Overwrite interface** option must be enabled.

I. Select **Advanced** tab and enable **Allow AAA Override** checkbox.

Figure 369: WLAN – Advanced settings



Using CLI

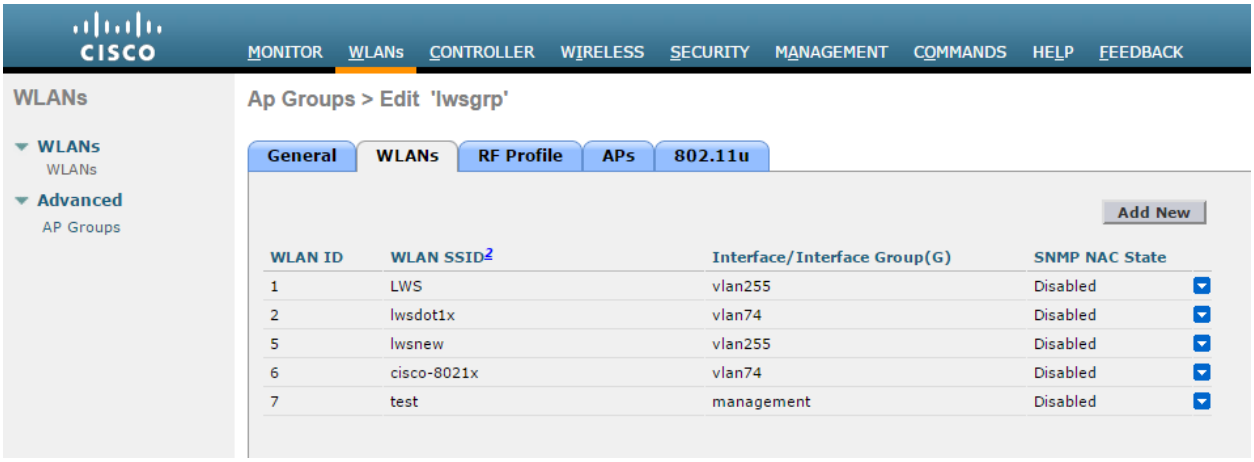
Before creating a new WLAN verify the existing WLANs on the WLC using the following command and use an unused index id for the new WLAN

show wlan summary
To create a new WLAN
config wlan create <WLAN_ID> <Profile name> <SSID>
Ex: - config wlan create 10 Test Test # Test is the WLAN name and SSID
config wlan interface <WLAN_ID> <interface-name>
Ex: - config wlan interface 10 management # assigning the WLAN to management port
config wlan security wpa disable <WLAN_ID>
config wlan security web-auth enable <WLAN_ID>
config wlan custom-web global disable <WLAN_ID>
config wlan custom-web ext-webauth-url <ext-webauth-url> <WLAN_ID>
config wlan custom-web webauth-type external <WLAN_ID>
config wlan security web-auth acl <WLAN_ID> <ACL_name>
config wlan radius_server auth add <WLAN_ID> <Radius_auth_server_ID>
config wlan radius_server acct add <WLAN_ID> <Radius_acct_server_ID>
config wlan radius_server overwrite-interface enable <WLAN_ID> (This command is required only if instead of management, some other interface is configured for WLAN. Please
check steps 2 and 5)
config wlan radius_server acct interim-update enable <WLAN_ID>
config wlan radius_server acct interim-update <Interval> <WLAN_ID>
config wlan aaa-override enable <WLAN_ID>
config wlan enable <WLAN_ID>

Configuring AP Group

1. On the CISCO WLC main screen go to **WLANs > Advanced > AP Groups** screen and map WLAN to the Local AP (Campus Only mode) group.

Figure 370: Mapping WLAN with the Local AP



Using the CLI

config wlan apgroup interface-mapping add <APgroup Name> <WLAN ID> <interfacename>

To save the configuration use the following command:
save config

Configuration Required on Cisco WLC in Remote AP mode

Configuring RADIUS server

1. Login to Cisco WLC. Go to **Security > AAA > RADIUS**. Configure PPS server as authentication and accounting server.

    - **Support for RFC 3576** - Enable this option to trigger RADIUS disconnect when required.

NOTE: Support for RFC3576 for RADIUS disconnect does not work properly with Cisco 2500, 5500, 7500, and 8500 series.

Figure 371: Authentication server settings

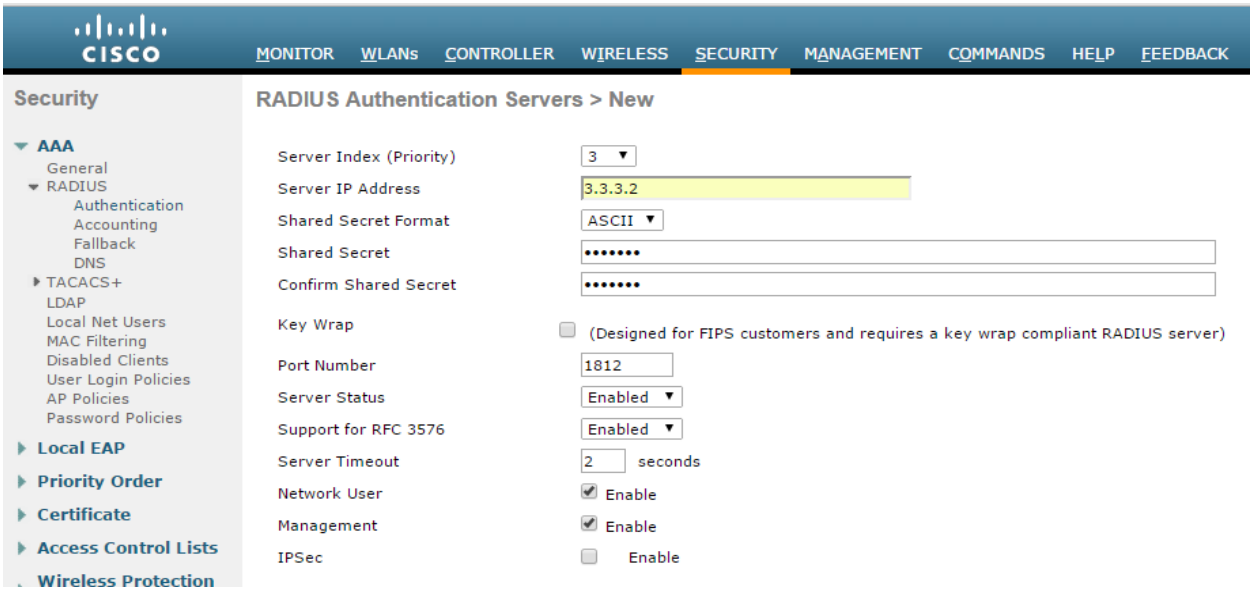
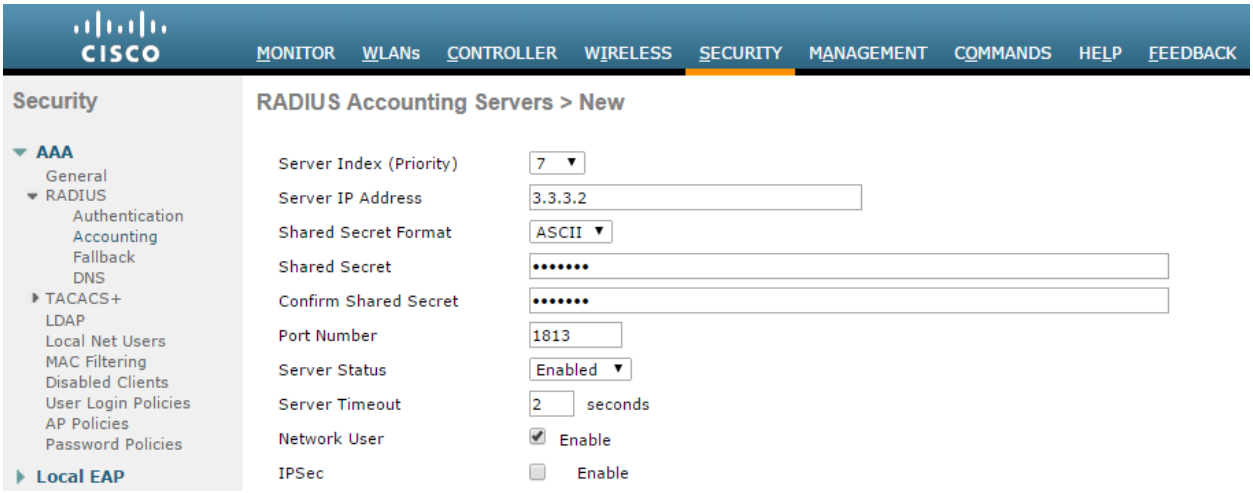


Figure 372: Accounting server settings



Using the CLI

Before creating the radius server, you need to allot an index number to it which is not currently in use. To find out the index numbers which are currently in use in WLC, use the following command

show radius summary

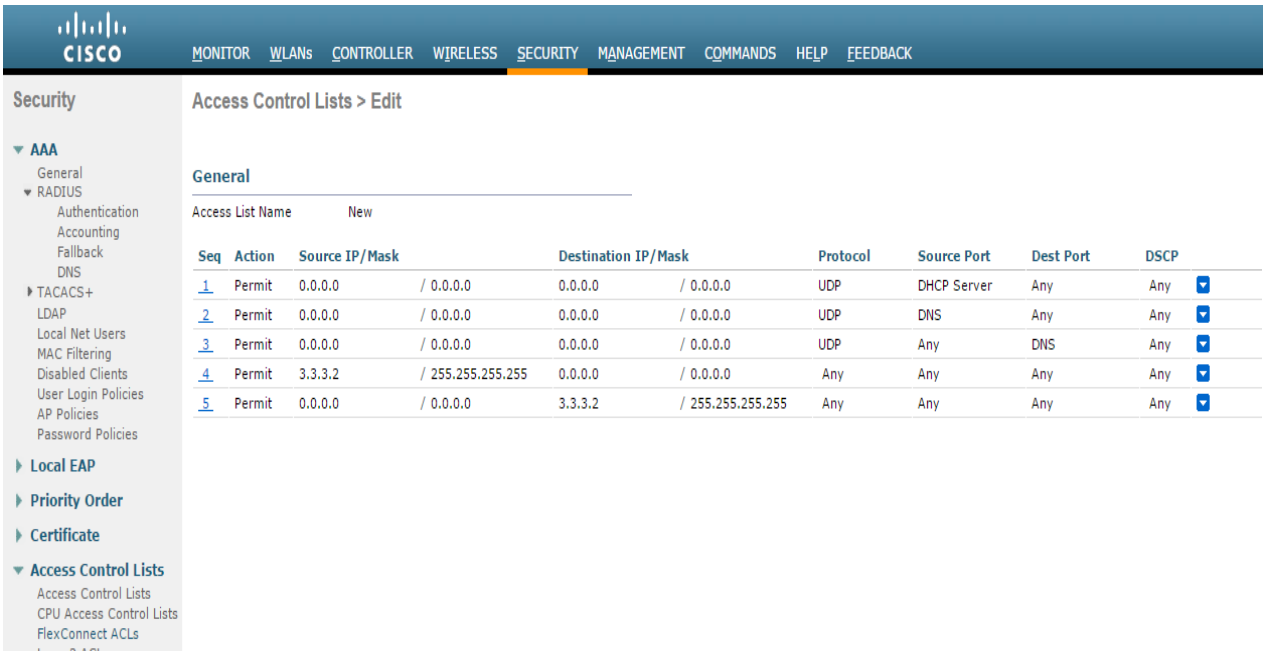
Go through the authentication servers and accounting servers section in the displayed output. Use an unused index number for adding radius authentication or accounting server.

config radius auth add <RADIUS auth server ID> <RADIUS server IP> 1812 ascii <password>
config radius auth disable < RADIUS auth server ID >
config radius auth rfc3576 enable < RADIUS auth server ID >
config radius auth enable < RADIUS auth server ID >
config radius acct add <RADIUS acct server ID > <RADIUS server IP> 1813 ascii <password>

Configuring FlexConnect ACLs

1. Select **Security > Access Control Lists > FlexConnect ACLS**. Create a FlexConnect ACL list to allow DNS, DHCP and PPS (Traffic).

Figure 373: FlexConnect ACL list



Using the CLI

To see all the ACLs that are configured on the controller enter the following command:

show flexconnect acl summary

To create a new ACL

config flexconnect acl create <ACL name>

To create rules in the newly created ACL

config flexconnect acl rule add <ACL name> <Rule number1>
config flexconnect acl rule protocol <ACL name> <Rule number1> 17 # 17 is UDP
config flexconnect acl rule source port range <ACL name> <Rule number1> 68 68 # 68 is DHCP client port number
config flexconnect acl rule action <ACL name> <Rule number1> permit # Allow access

config flexconnect acl rule add <ACL Name> <Rule number2>
config flexconnect acl rule protocol <ACL name> <Rule number2> 17
config flexconnect acl rule source port range <ACL name> <Rule number2> 67 67 # 67 is DHCP server port number
config flexconnect acl rule action <ACL name> <Rule number2> permit

config flexconnect acl rule add <ACL name> <Rule number3>
config flexconnect acl rule protocol <ACL name> <Rule number3> 6
config flexconnect acl rule source port range <ACL name> <Rule number3> 53 53 # Port 53 for DNS
config flexconnect acl rule action <ACL name> <Rule number3> permit

config flexconnect acl rule add <ACL name> <Rule number4>
config flexconnect acl rule protocol <ACL name> <Rule number4> 6
config flexconnect acl rule destination port range <ACL name> <Rule number4> 53 53 #port 53 for DNS
config flexconnect acl rule action <ACL name> <Rule number4> permit

config flexconnect acl rule add <ACL name> <Rule number5>
config flexconnect acl rule source address <ACL name> <Rule number5> <PPS IP> <Subnetmask>
config flexconnect acl rule action <ACL name> <Rule number5> permit

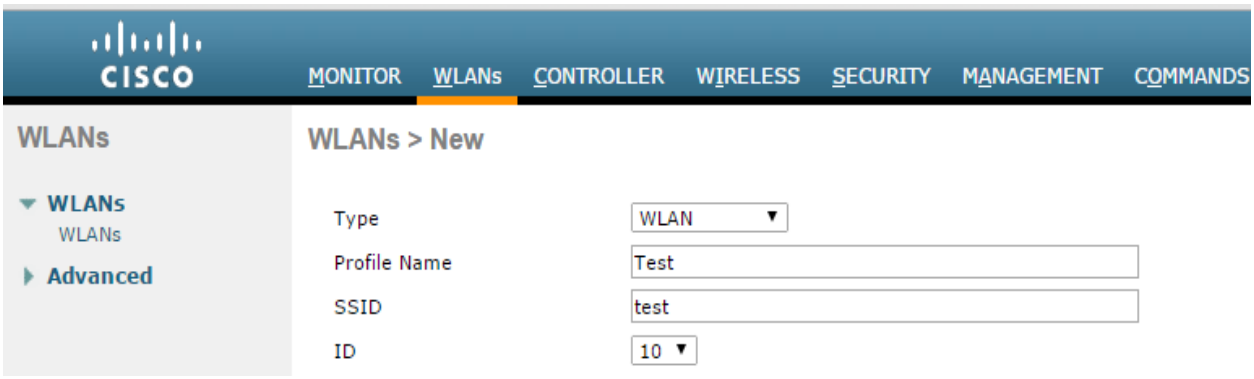
config flexconnect acl rule add <ACL name> <Rule number6>

config flexconnect acl rule destination address <ACL name> <Rule number6> <PPS IP> <Subnetmask>
config flexconnect acl rule action <ACL name> <Rule number6> permit

Configuring WLAN

1. Go to **WLANs** tab and create a new WLAN.

Figure 374: Creating a WLAN

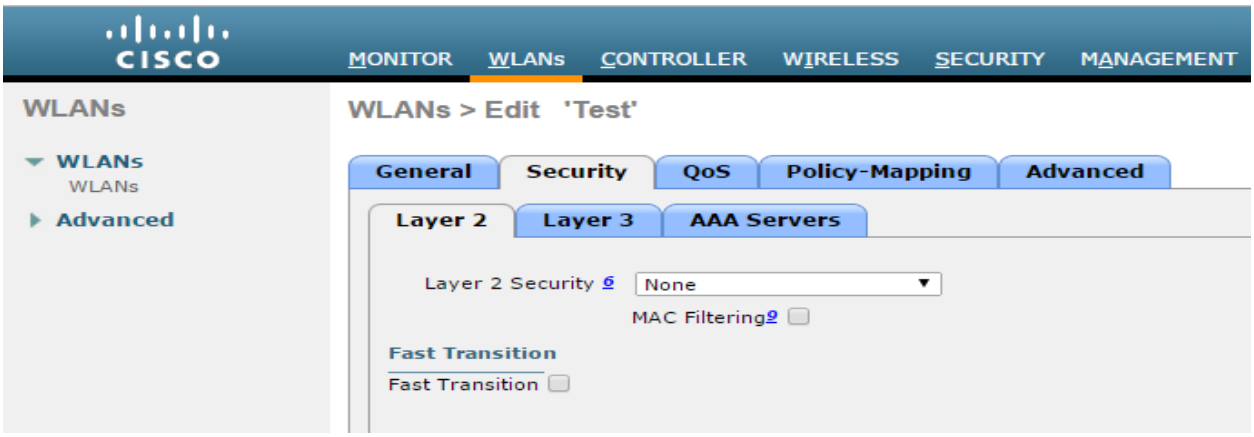


2. Navigate to **General** tab and enable **Status** checkbox.

Figure 375: WLAN - General settings

3. Go to **Security > Layer 2** in WLAN settings. From the **Layer 2 Security** drop-down list Select 'None'

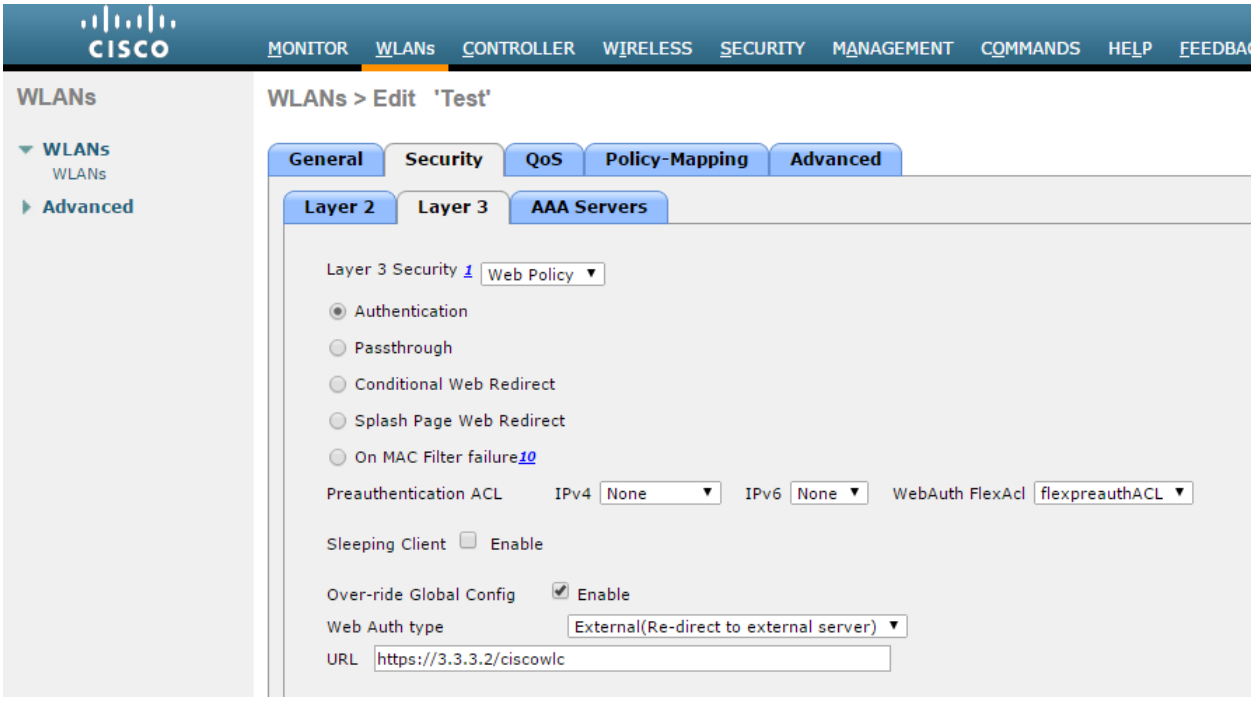
Figure 376: WLAN – Layer 2 settings



4. Go to Security > Layer3 in WLANs tab.

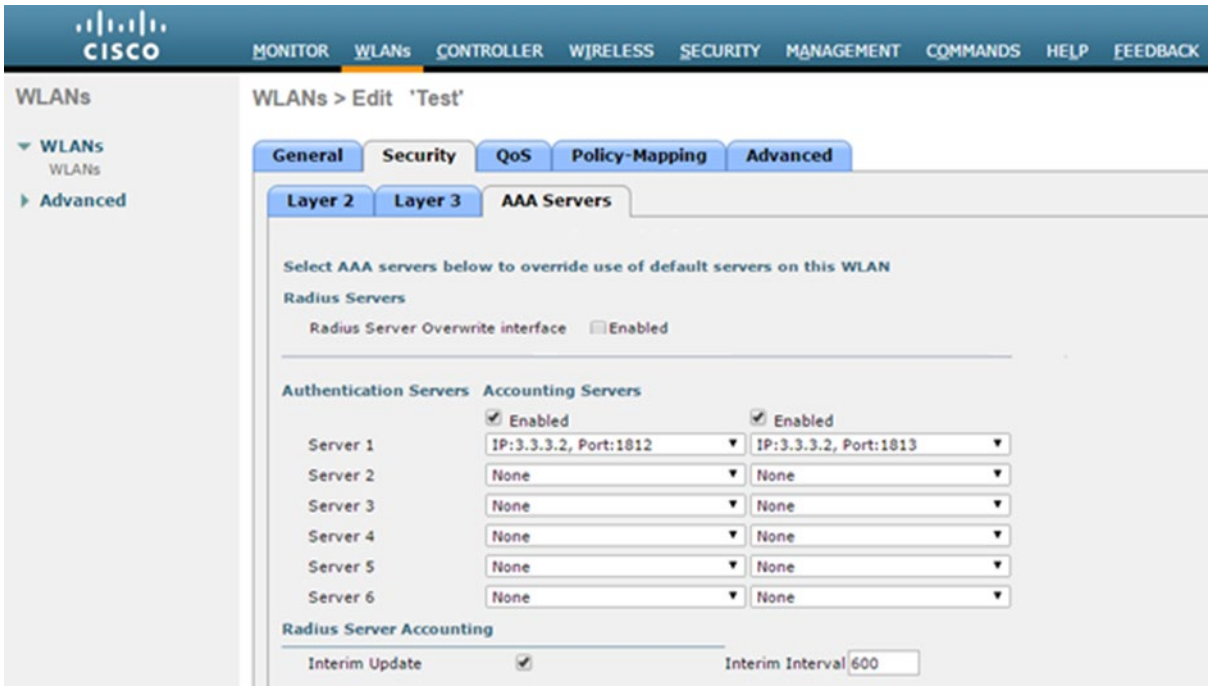
   - From the **Layer 3 security** drop-down list select 'Web Policy'.
   - For **Preauthentication ACL**, associate the FlexConnectACL that is created earlier.
   - Over-ride Global Config - Select the Enable check box.
   - From the **Web auth type** drop-down list select External (Re-direct to external server)
   - **URL** – Enter the PPS (Guest sign-in URL) for redirection URL.

Figure 377: WLAN – Layer 3 settings

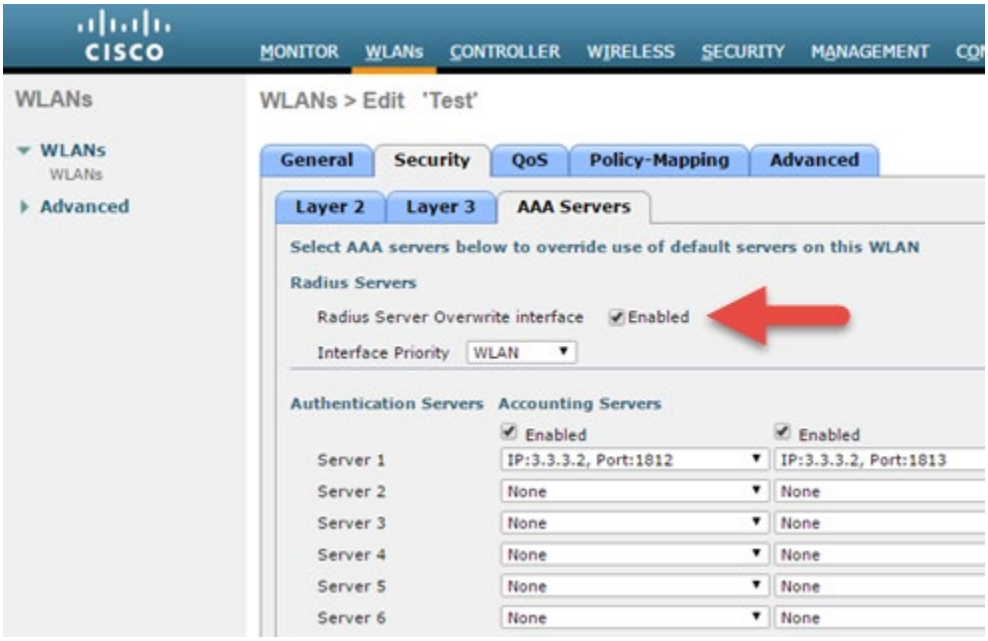


5. Go to **Security > AAA Servers** in **WLANs** tab. Configure RADIUS server for authentication and accounting.

Figure 378: WLAN – AAA Server settings

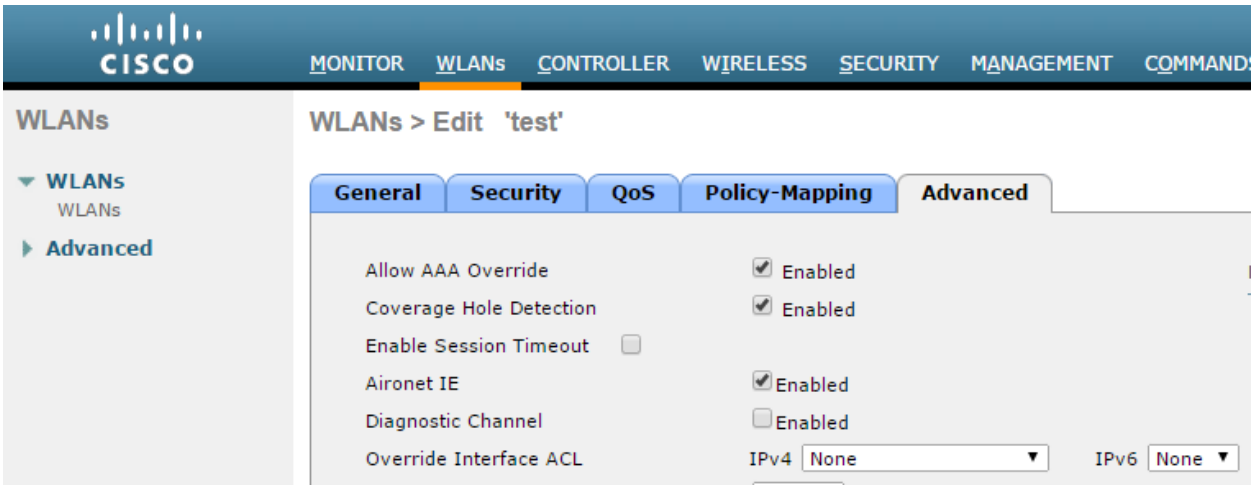


6. Select the **Interim Update** check box.



7. Select **Advanced** tab and enable **Allow AAA Override** checkbox.

Figure 379 WLAN – Advanced settings



Using the CLI

Before creating a new WLAN verify the existing WLANs on the WLC using the following command and use an unused index id for the new WLAN

show wlan summary

To create a new WLAN:

config wlan create <WLAN_ID> <Profile name> <SSID>
eg: config wlan create 10 Test Test # Test is the WLAN name and SSID
config wlan interface <WLAN_ID> <interface-name>
eg: config wlan interface 10 management # assigning the WLAN to management port
config wlan security wpa disable <WLAN_ID>
config wlan security web-auth enable <WLAN_ID>
config wlan custom-web global disable <WLAN_ID>
config wlan custom-web ext-webauth-url <ext-webauth-url> <WLAN_ID>
config wlan custom-web webauth-type external <WLAN_ID>
config wlan security web-auth flexacl <WLAN_ID> <ACL_name>
config wlan radius_server auth add <WLAN_ID> <Radius_auth_server_ID>
config wlan radius_server acct add <WLAN_ID> <Radius_acct_server_ID>
config wlan radius_server overwrite-interface enable <WLAN_ID> (This command is required only if instead of management, some other interface is configured for WLAN.
Please check steps 2 and 5)
config wlan radius_server acct interim-update enable <WLAN_ID>
config wlan radius_server acct interim-update <Interval> <WLAN_ID>
config wlan aaa-override enable <WLAN_ID>
config wlan enable <WLAN_ID>

Configuring AP Group

1. On the CISCO WLC main screen go to **WLANs > Advanced > AP Groups** screen and map WLAN Flexl AP (Remote AP mode) group.

Figure 380: Mapping WLAN Flexl AP

Using the CLI

config wlan apgroup interface-mapping add <APgroup Name> <WLAN ID> <interfacename>

Adding ACLs in FlexConnect Group

To add ACLs in FlexConnect Group:

1. Select **Wireless** >**FlexConnect Groups**. Click on the required FlexConnect Group and select **ACL Mapping** > **Policies**. Add all the required FlexConnect ACLs to this group. This configuration is required when admin wants to push ACL name using RADIUS return attributes from PPS.

Figure 381: Adding ACLs in FlexConnect Group

Using the CLI

To see all the flexconnect groups that are configured on the controller enter the following command:

show flexconnect group summary

To add policy ACLs in the flexconnect group use the following command:

config flexconnect group <flex-group> policy acl add <flexconnect_ACL>

Save the config using the following command:

save config

Configuring Cisco 3850 WLC

- Configuring Cisco WLC using Web GUI
- Configuring Cisco WLC using CLI

Configuring Cisco WLC using Web GUI

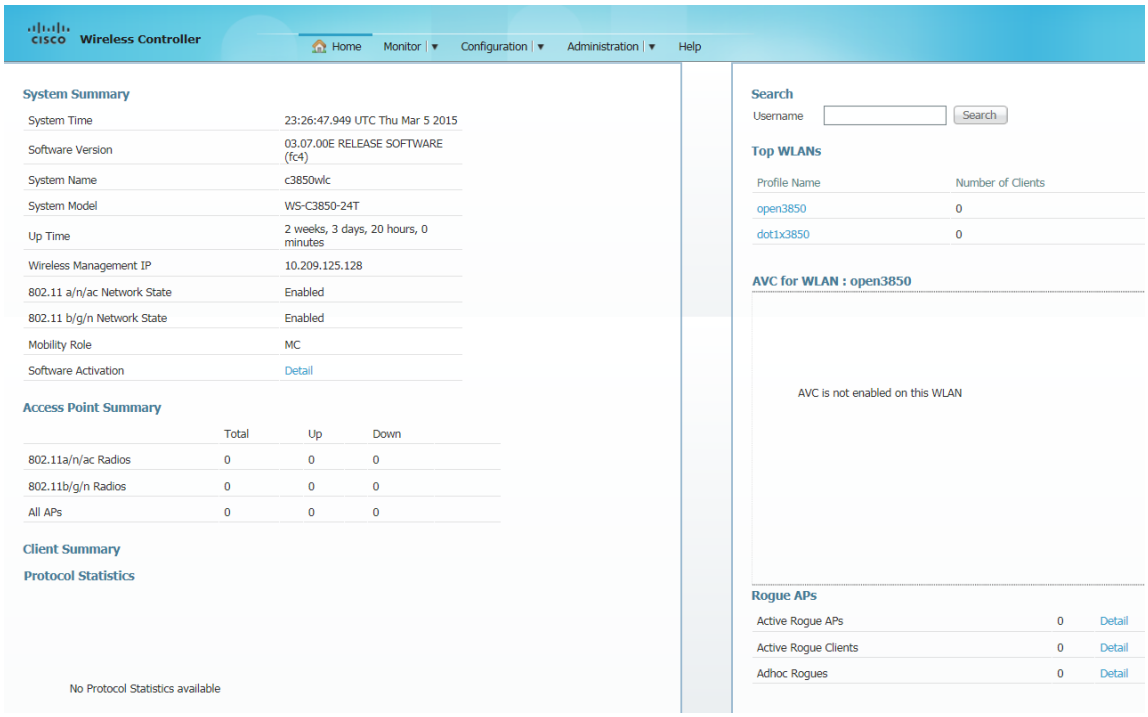
You can configure CISCO WLC 3850 by performing the steps as stated below:

1. Create a RADIUS server.
2. Create a Radius Server Group and map with the newly created RADIUS server
3. Create an Authentication list and map with the newly created Radius Server Group.
4. Create an Accounting list and map with the newly created Radius Server Group.
5. Create an Authorization list and map with the newly created Radius Server Group.
6. Create a Webauth Parameter Map
7. Create an Access List
8. Create a Sequence Number
9. Create a Wireless SSID

To configure the CISCO WLC 3850:

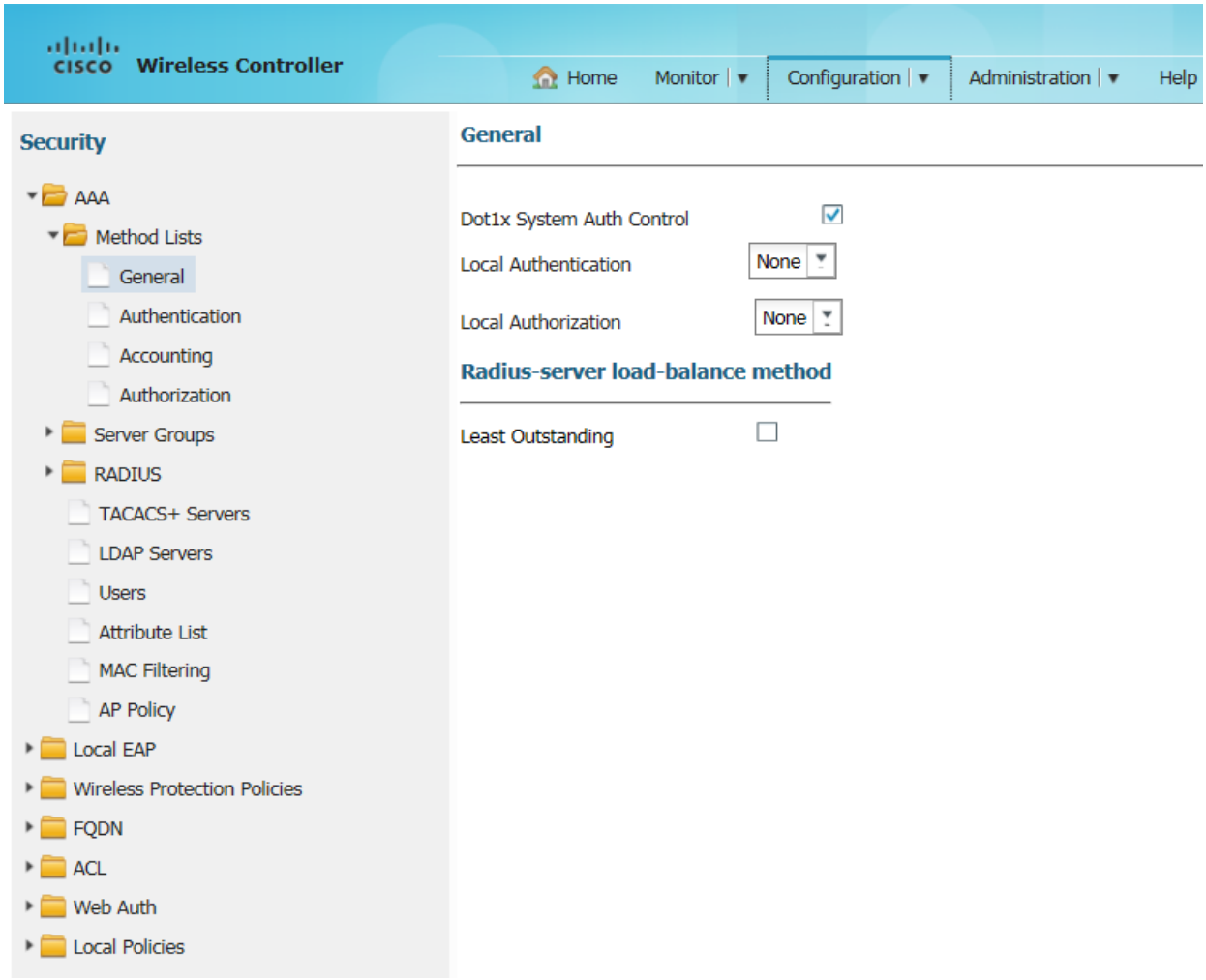
1. Login to CISCO WLC. The CISCO Wireless Controller home page appears.

Figure 382: CISCO Wireless Controller home page



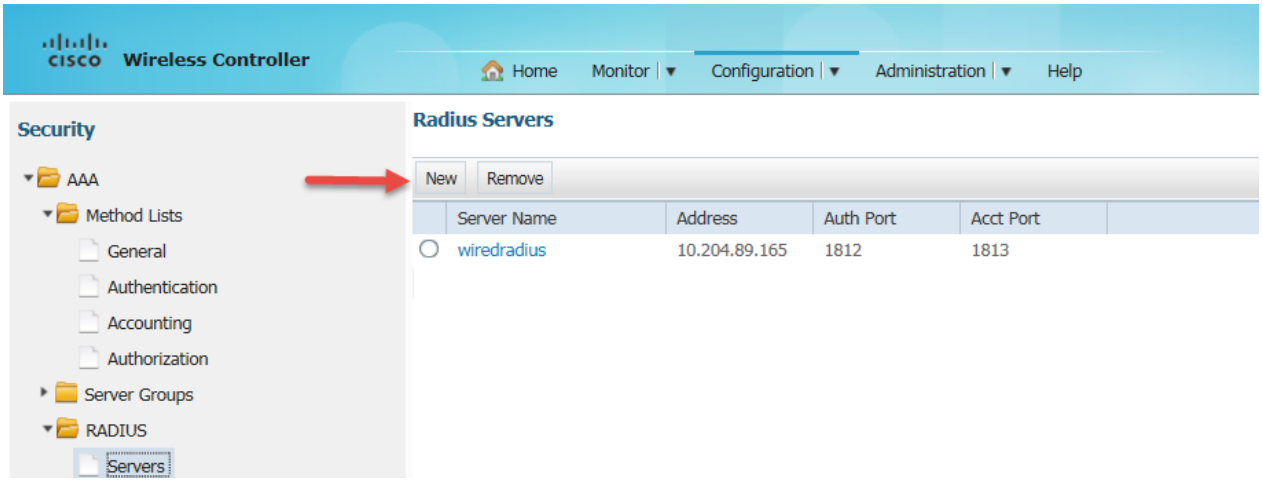
2. From the **Configuration,** drop-down list select **Security**. The options under the **Security** section are displayed.

Figure 383: Security section



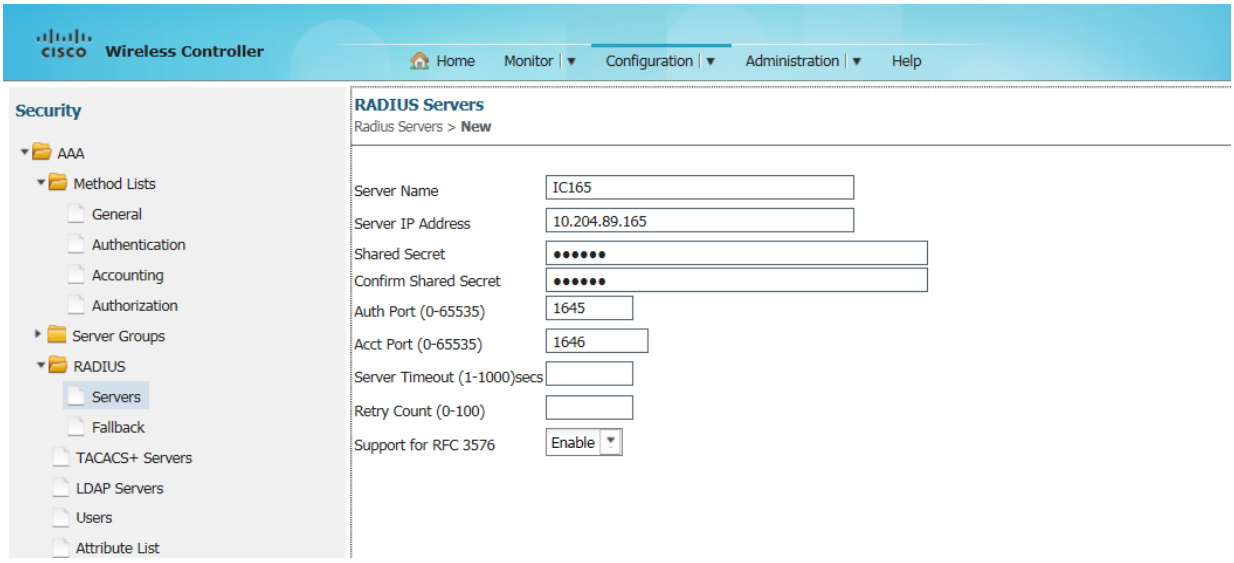
3. Select **AAA** > **Radius** > **Servers** to create a Radius server. The **Radius Server** screen appears.

Figure 384: Radius Servers



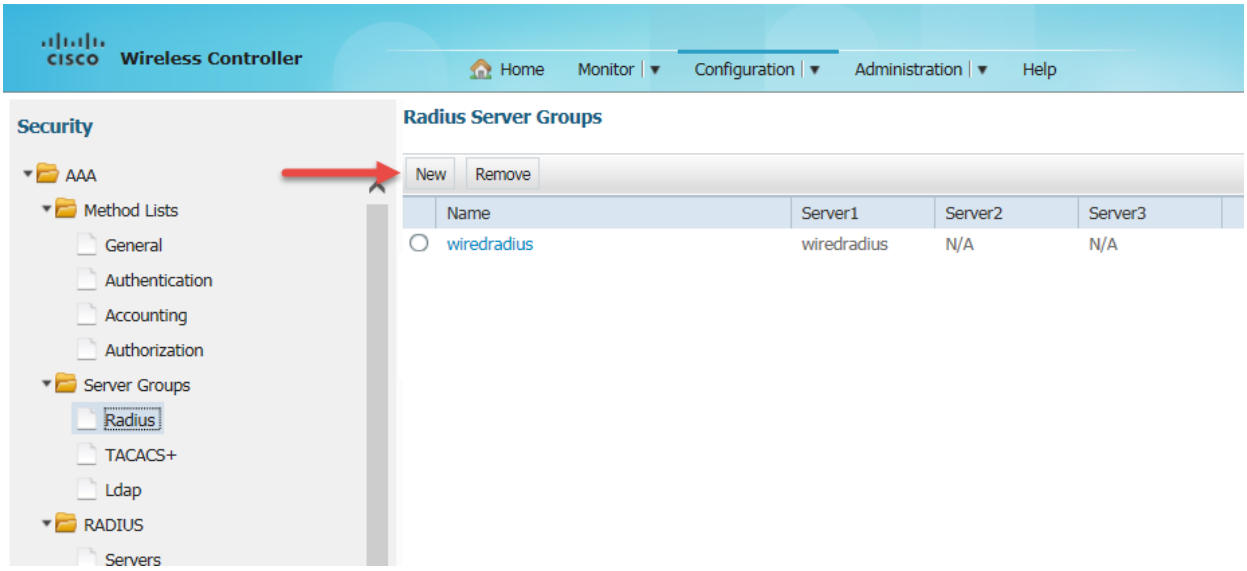
Click **New** to create a Radius server.

Figure 385: Creating a Radius Server



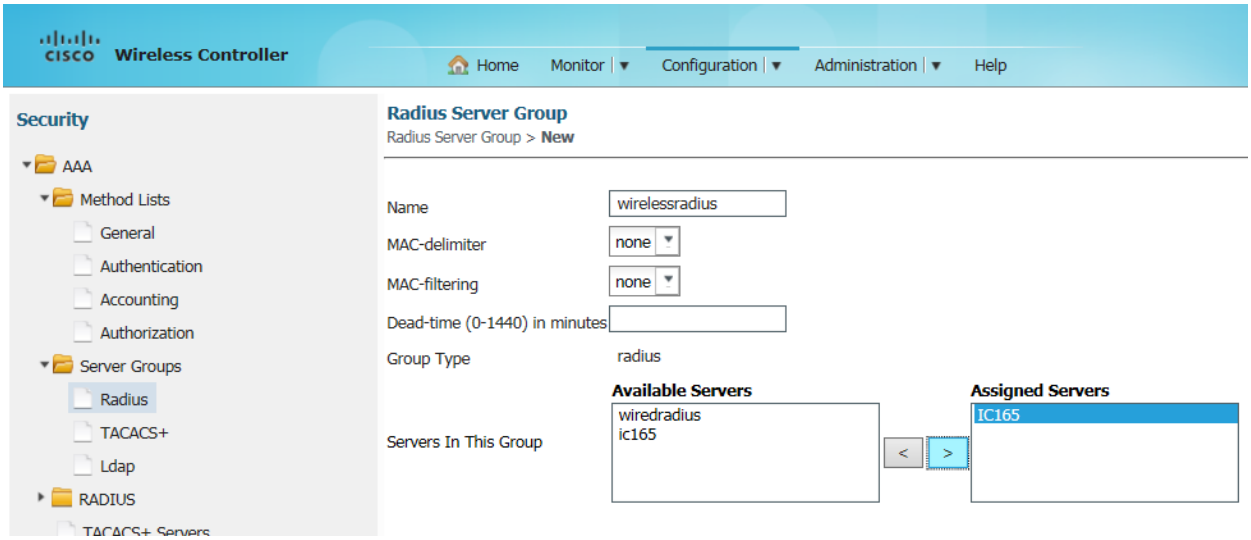
4. Enter relevant details and click **Apply** at the right top corner of the page. A new RADIUS server is created
5. Select **AAA** > **Server Groups** > **Radius** to create a Radius Server Group. The Radius Server Groups screen appears

Figure 386: Radius Server Groups



6. Click **New** The Radius Server Group > New screen appears.

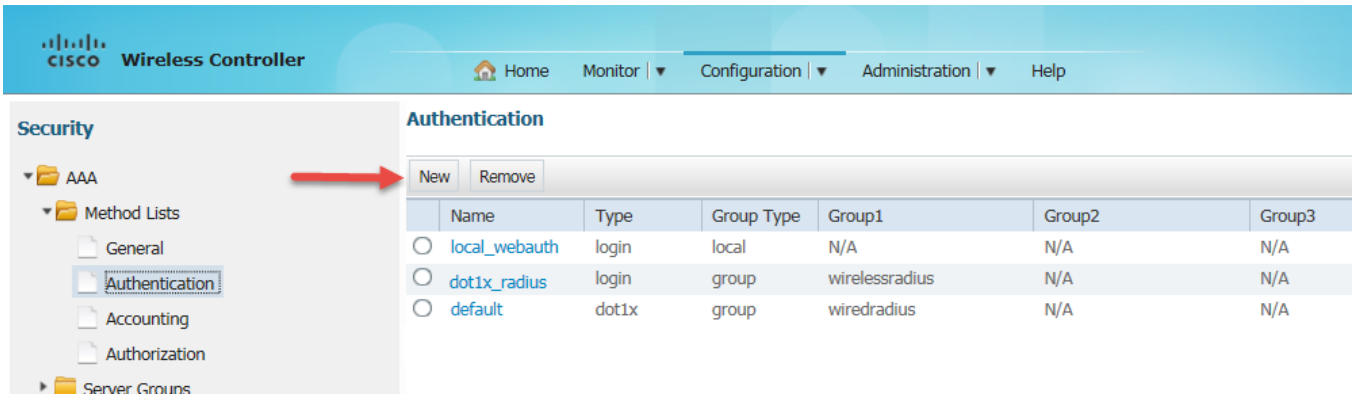
Figure 387: Creating a Radius Server Group



Enter a name in the **Name** field. From the **Available Servers** box select the server which you have created in step 5 and click the button > to move it to the **Assigned Servers** box.

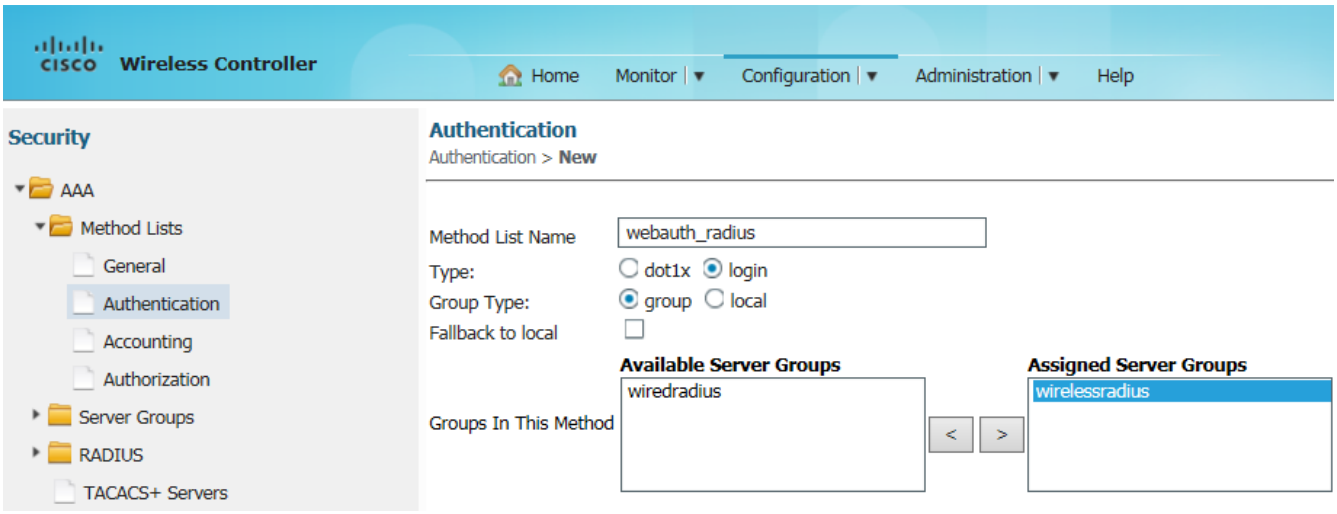
7. Click **Apply** to save the Radius Server Group.
8. Select **AAA** > **Method List** > **Authentication** to create an Authentication list.
   The Authentication screen apears.

Figure 388: Authentication list



9. Click **New**. The Authentication > New screen appears.

Figure 389: Creating a new Authentication list

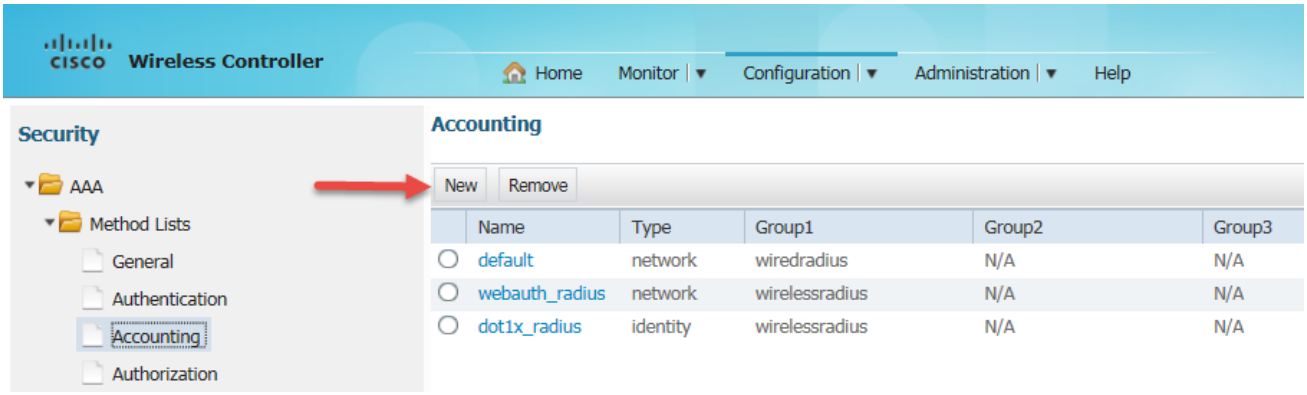


Enter the details in the fields as follows:

- In the **Method List Name** field enter webauth_radius
- For Type, select **login**
- For **Group Type** select group
- Select the 'wirelessradius' server group that you have created earlier from the **Available Server Groups** box and click > to move it to the **Assigned Server Groups** box.

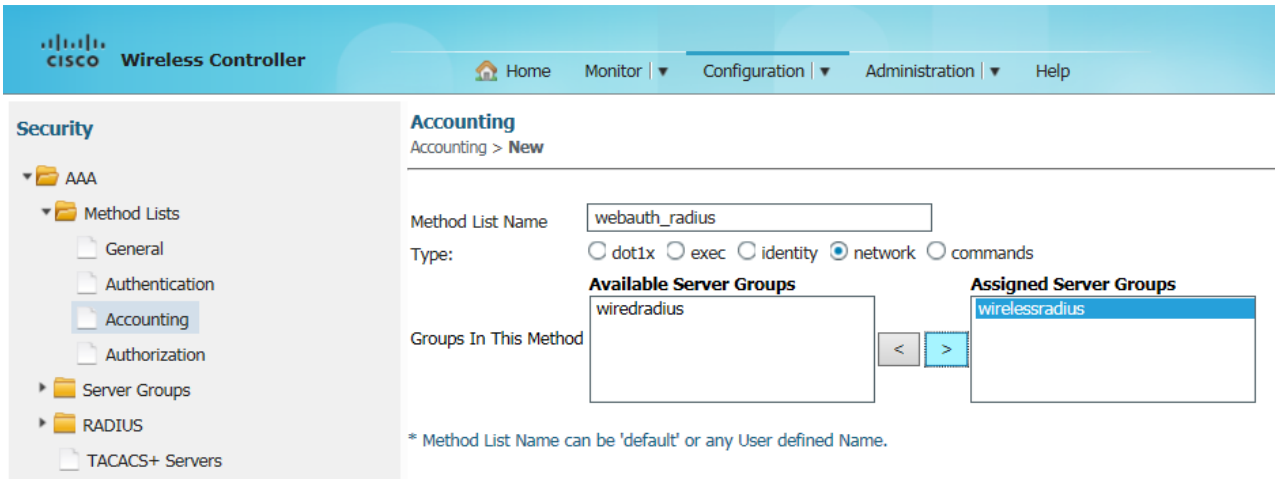
10. Click **Apply** to save the Authentication.
11. Select **AAA** > **Method List** > **Accounting** to create an Accounting list. The Accounting screen appears.

Figure 390: Accounting list



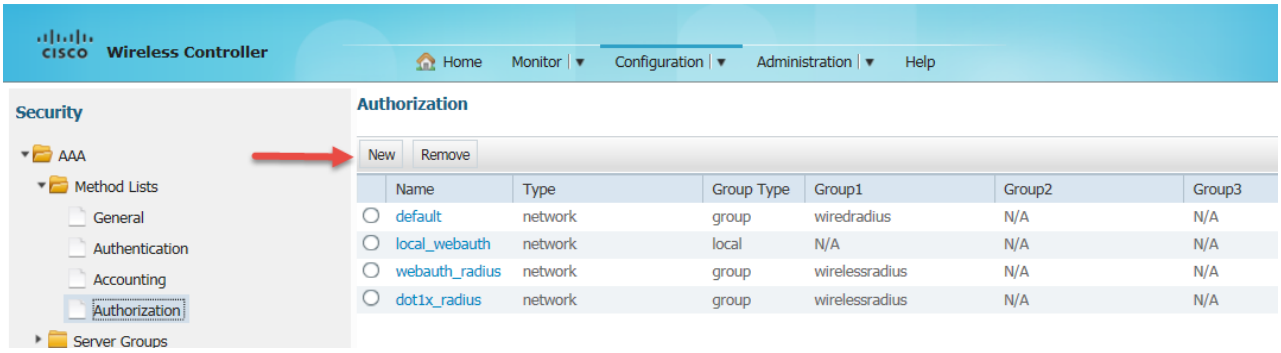
12. Click **New** to create an Accounting list. The Accounting > New screen appears.

Figure 391: Creating an Accounting list



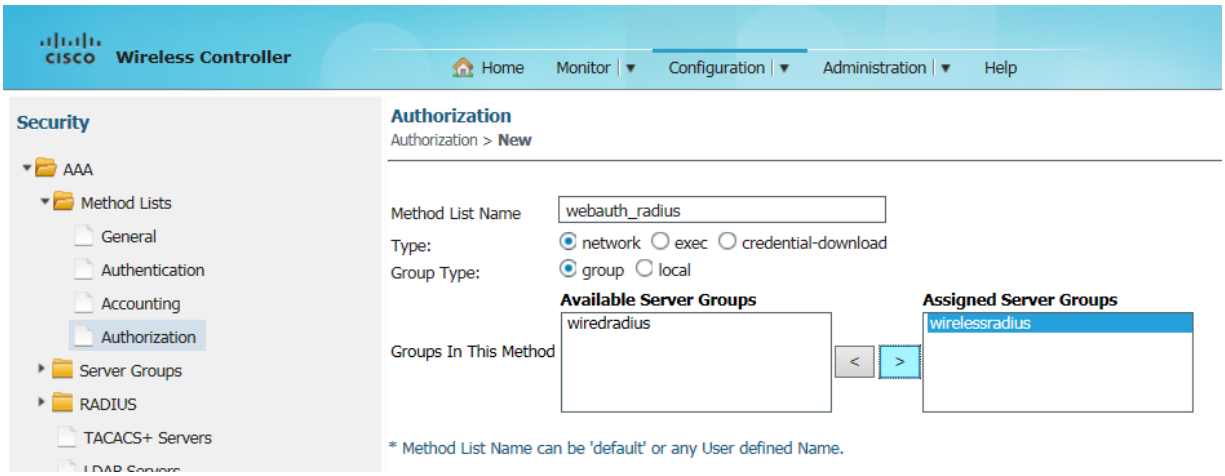
13. Enter the details in the fields as follows:
    - In the **Method List Name** field enter webauth_radius.
    - For Type, select **network.**
    - Select the 'wirelessradius' server group that you have created earlier from the **Available Server Groups** box and click > to move it to the **Assigned Server Groups** box.
14. Click **Apply** to save the Accounting list.
15. Select **AAA** > **Method Lists** > **Authorization** to create an Authorization list. The Authorization screen appears.

Figure 392: Authorization list



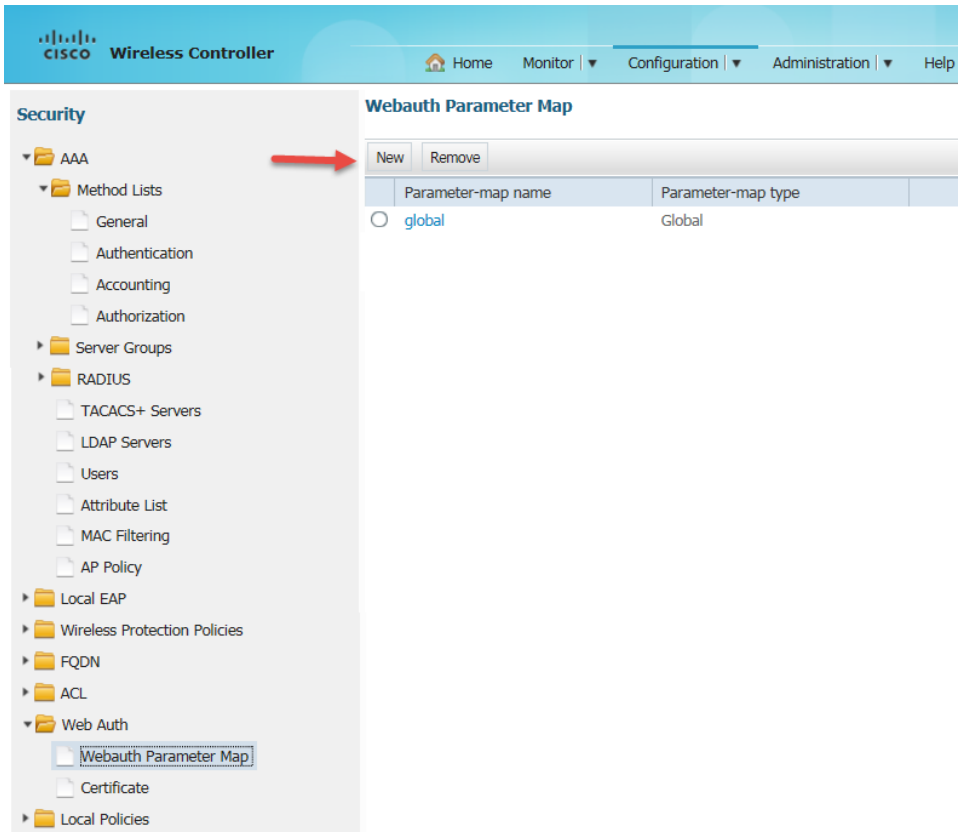
16. Click **New** to create an Authorization list. The Authorization > New screen appears.

Figure 393: Creating an Authorization list



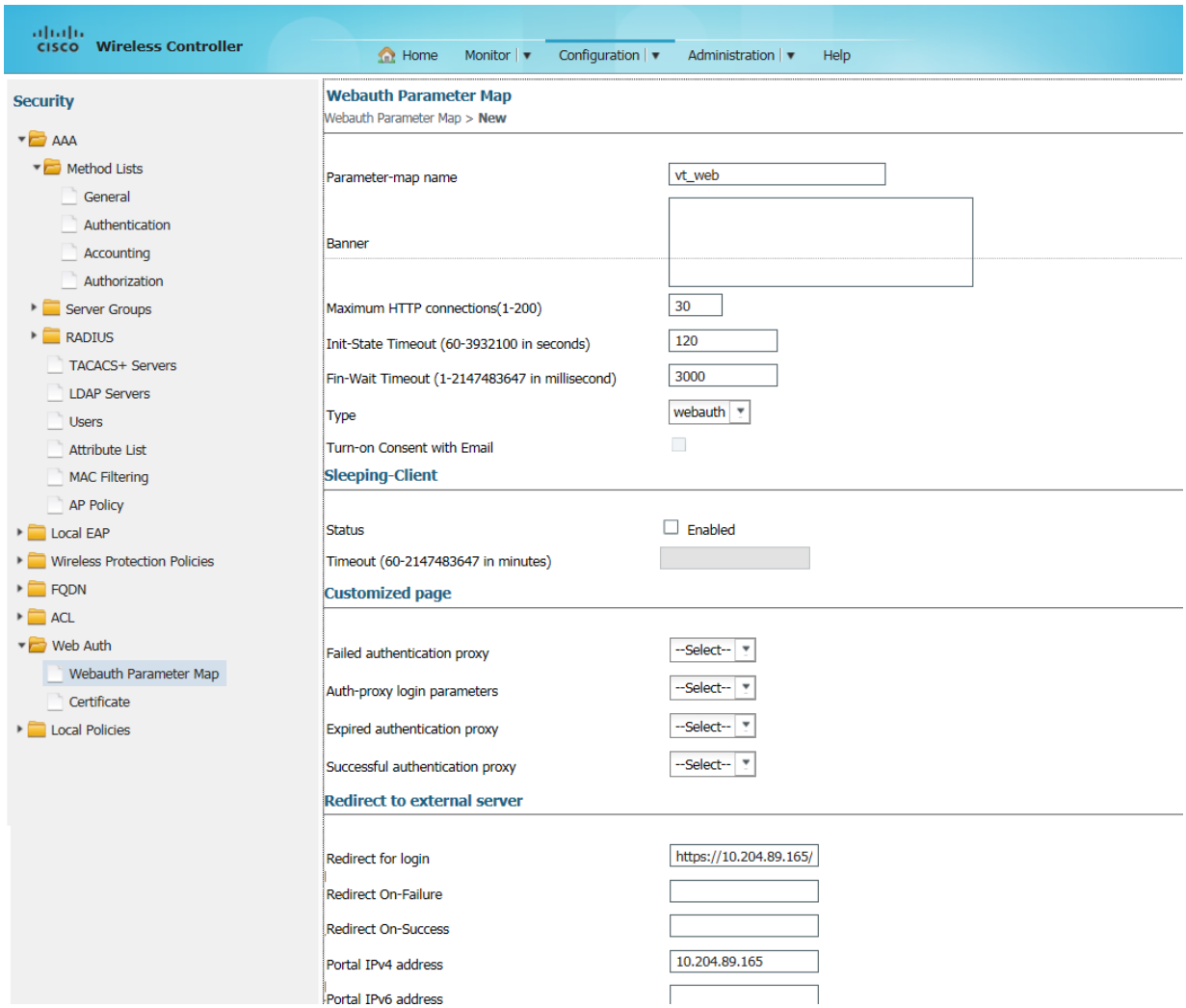
17. Enter the details in the fields as follows:
    - In the **Method List Name** field enter webauth_radius.
    - For Type, select **network.**
    - For Group Type select group.
    - Select the 'wirelessradius' server group that you have created earlier from the **Available Server Groups** box and click > to move it to the **Assigned Server Groups** box.
18. Click **Apply** to save the Authorization list.
19. Select **Web Auth** > **Webauth Parameter Map** to create a Webauth Parameter Map. The Webauth Parameter Map screen appears.

Figure 394: Webauth Parameter Map



20. Click **New** to create a Webauth Parameter Map. The Webauth Parameter Map > New screen appears.

Figure 395: Creating a Webauth Parameter Map



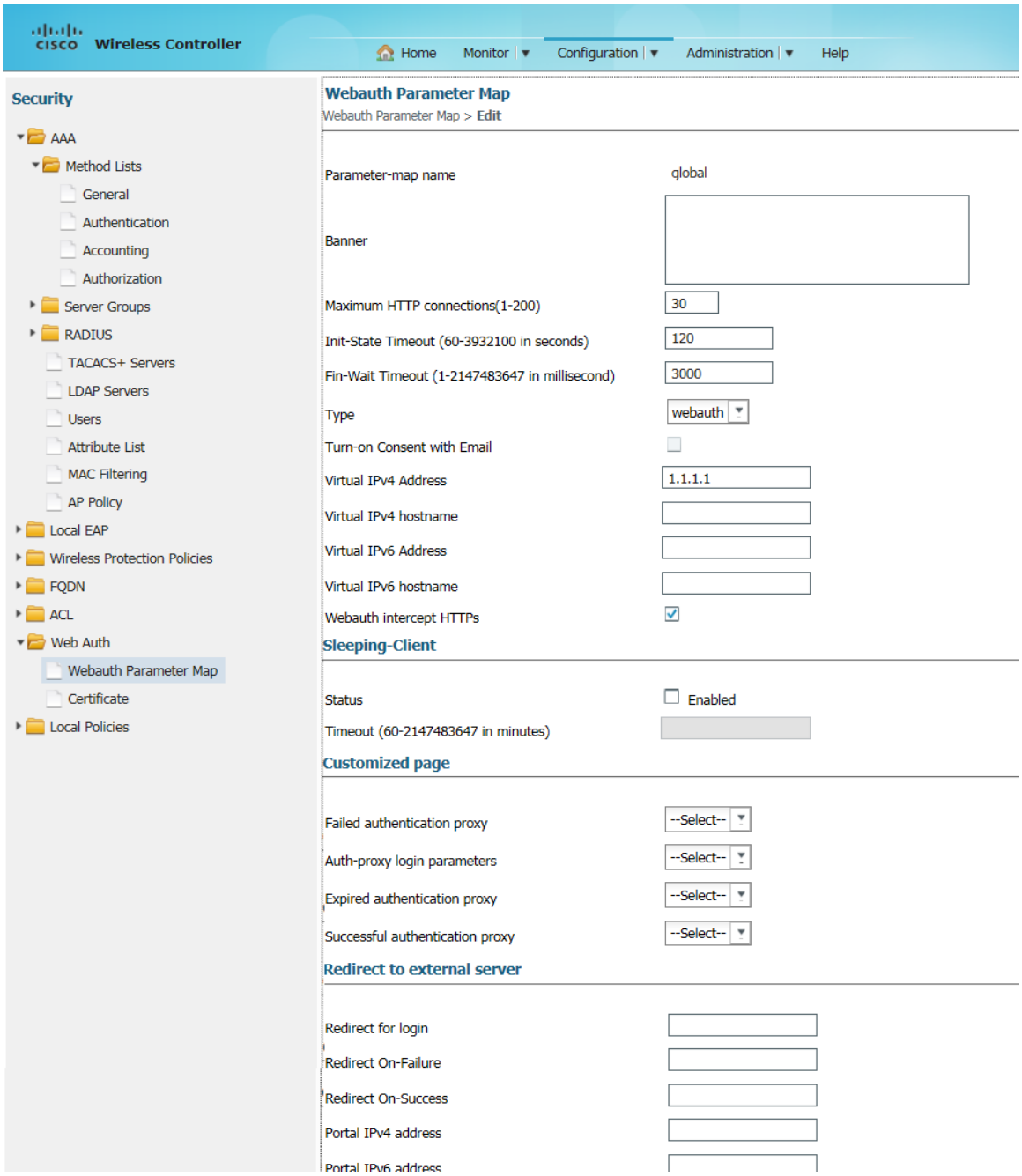
21. Enter the details in the fields as follows:

    - In the **Parameter – map name** field enter vt_web.
    - In Maximum HTTP connections (1-200) enter 30.
    - In Init-State Timeout (60-3932100 in seconds) enter 120.
    - In Fin-Wait Timeout (1-2147483647 in millisecond) enter 3000
    - In **Redirect for login** field enter https://10.204.89.165/guest - This is the PPS URL to which a guest is redirected when tried to access a website.
    - In **Portal IPv4 address** enter 10.204.89.165

22. Click **Apply** to save the Webauth Parameter Map.

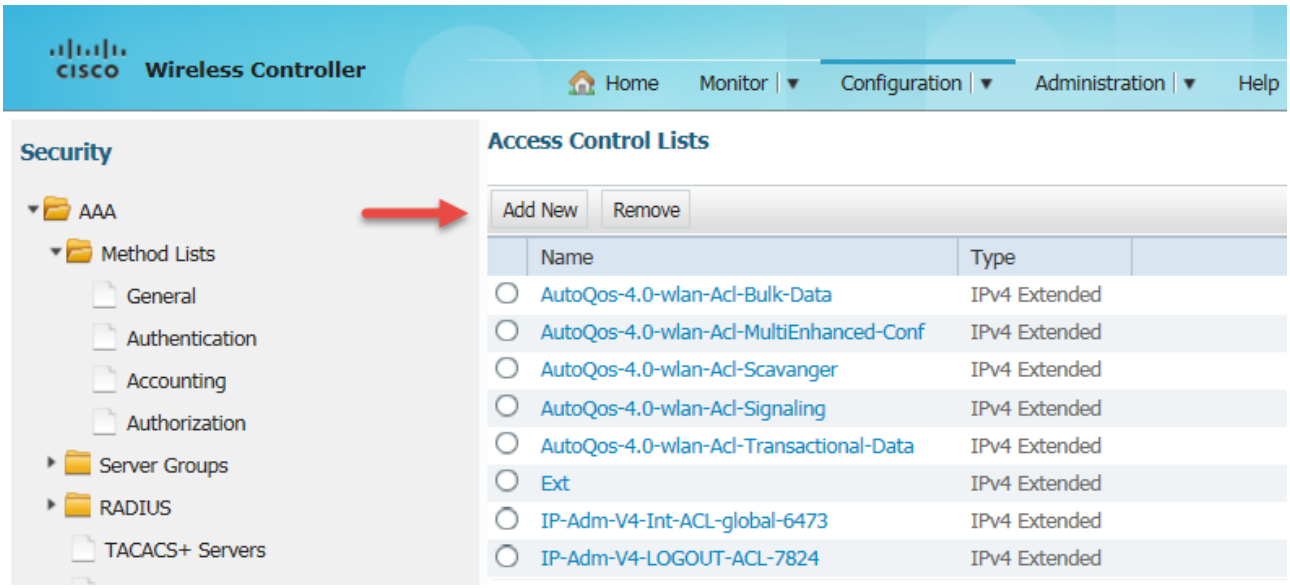
NOTE: A default Webauth Parameter Map is created a shown in the following figure.

Figure 396: Default Webauth Parameter Map



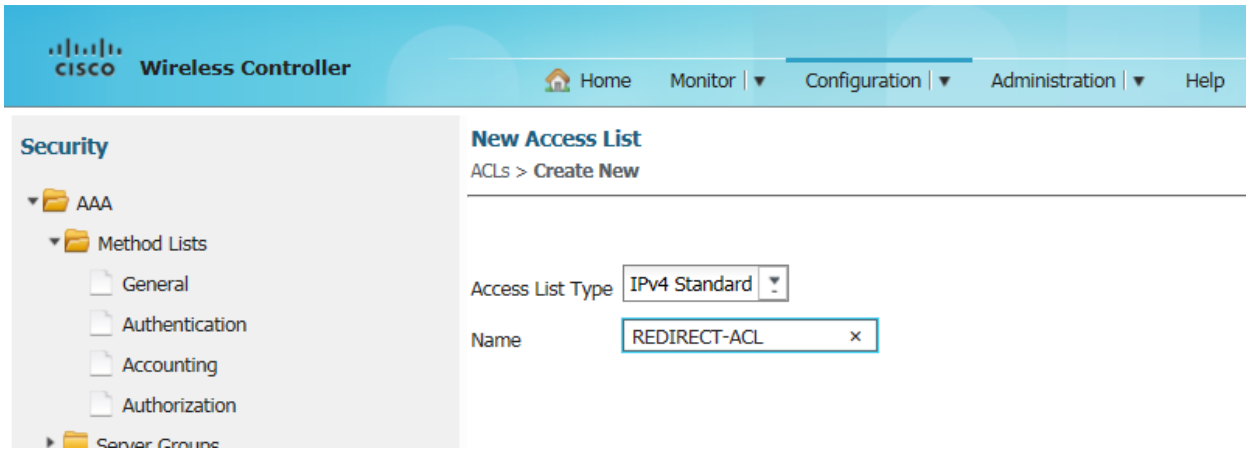
23. Select **ACL** > **Access Control List** to create an Access Control List. The Access Control Lists screen appears.

Figure 397: Access Control List



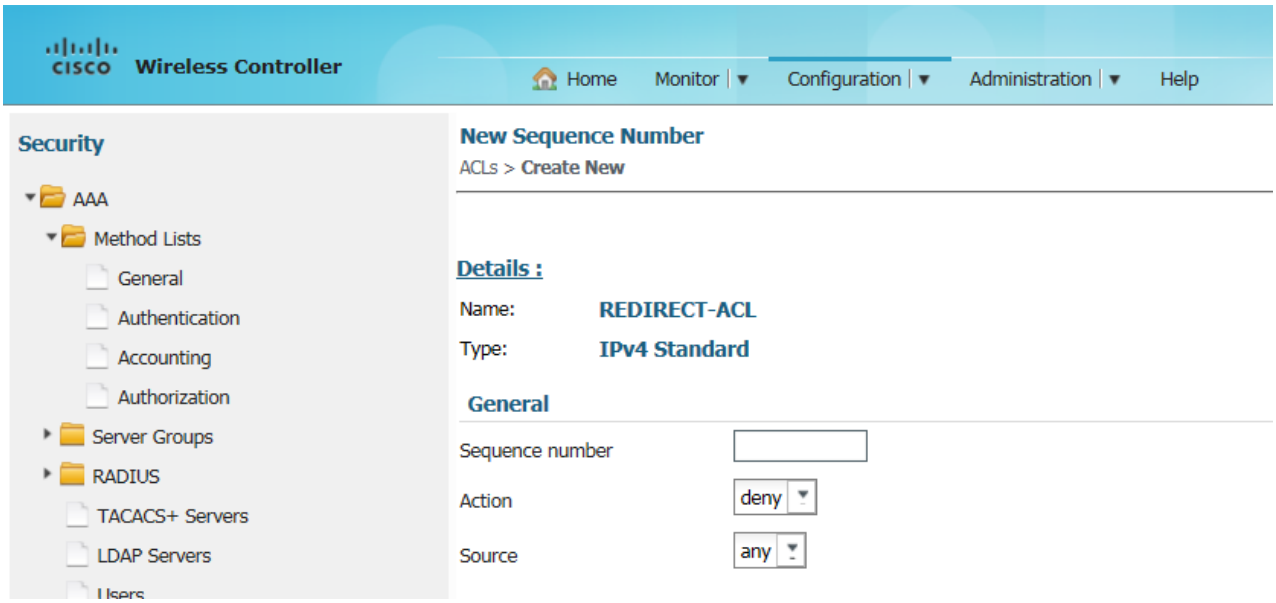
24. Click **Add New**. The New Access List screen appears.

Figure 398: Creating an Access Control List



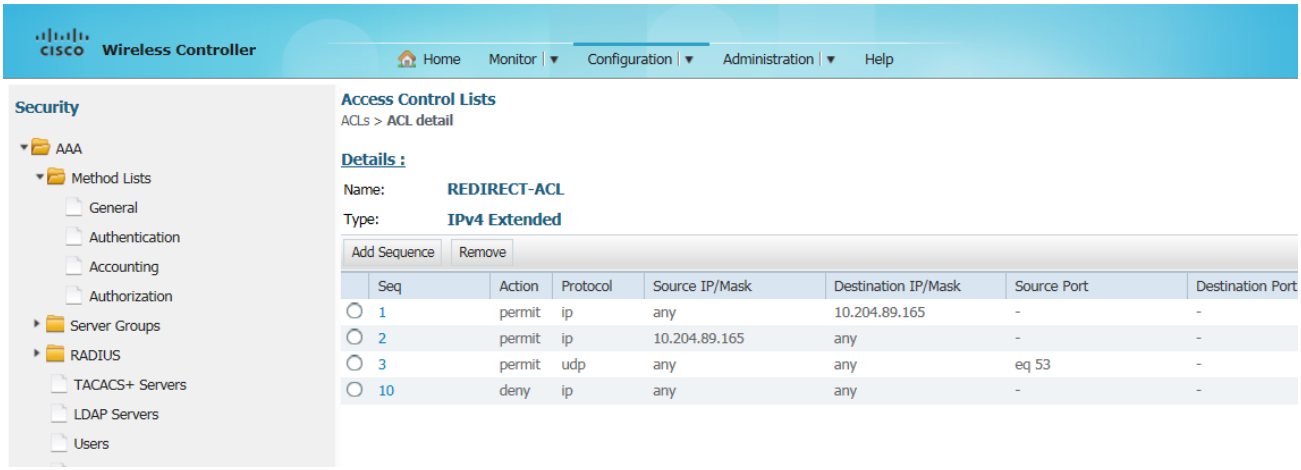
25. In the **Name** field enter REDIRECT-ACL and then click **Apply** at the right top corner. The New Sequence Number screen appears.

Figure 399: Creating a Sequence Number



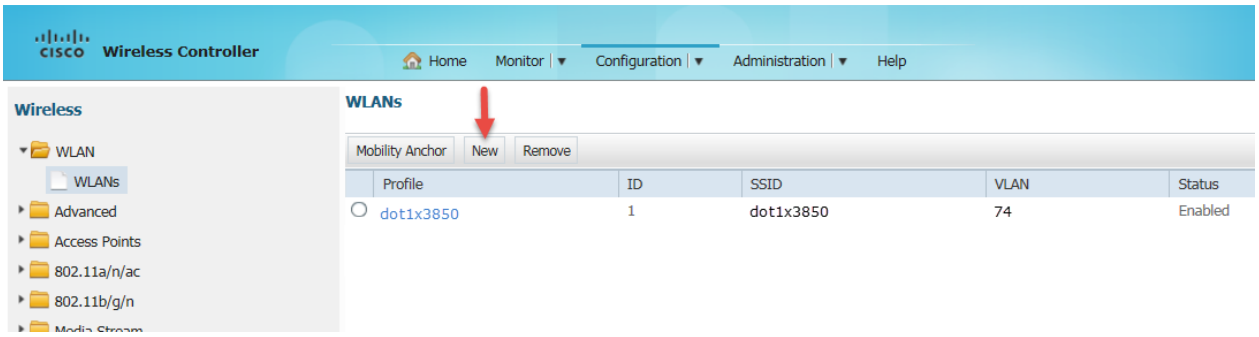
26. Enter relevant details and click **Apply**. Allow traffic to the Pulse Policy server IP address - 10.204.89.165.

Figure 400: Connecting with Pulse Policy server IP address



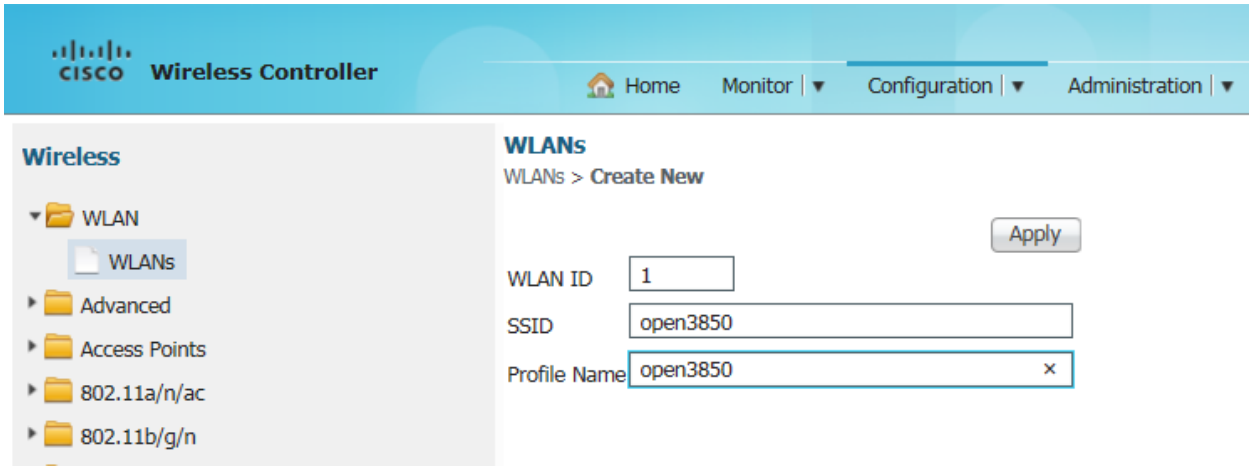
27. On the main menu select **Configuration** > **Wireless** to create a Wireless SSID. The WLANs screen appears.

Figure 401: WLANs



28. Click **New**. The WLANs > Create New screen appears.

Figure 402: Creating a WLAN



29. Click **Apply**. The WLAN is created and displayed in WLANs screen.

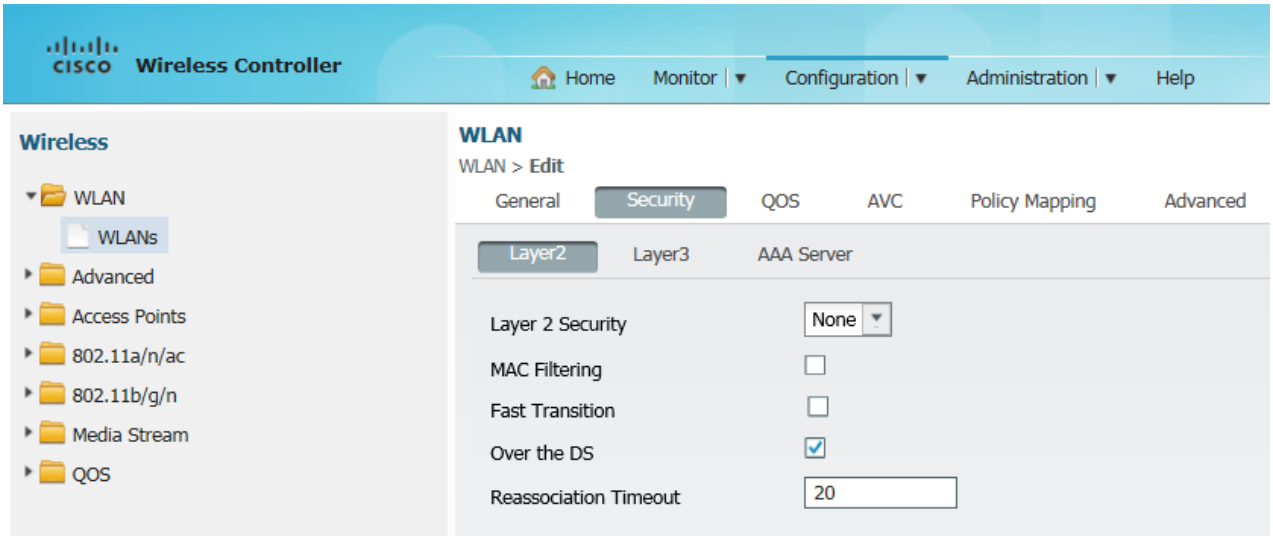
Figure 403: Newly created WLAN

30. Click the WLAN to configure. The **General** tab options of the WLAN appears.

Figure 404: WLAN - General screen

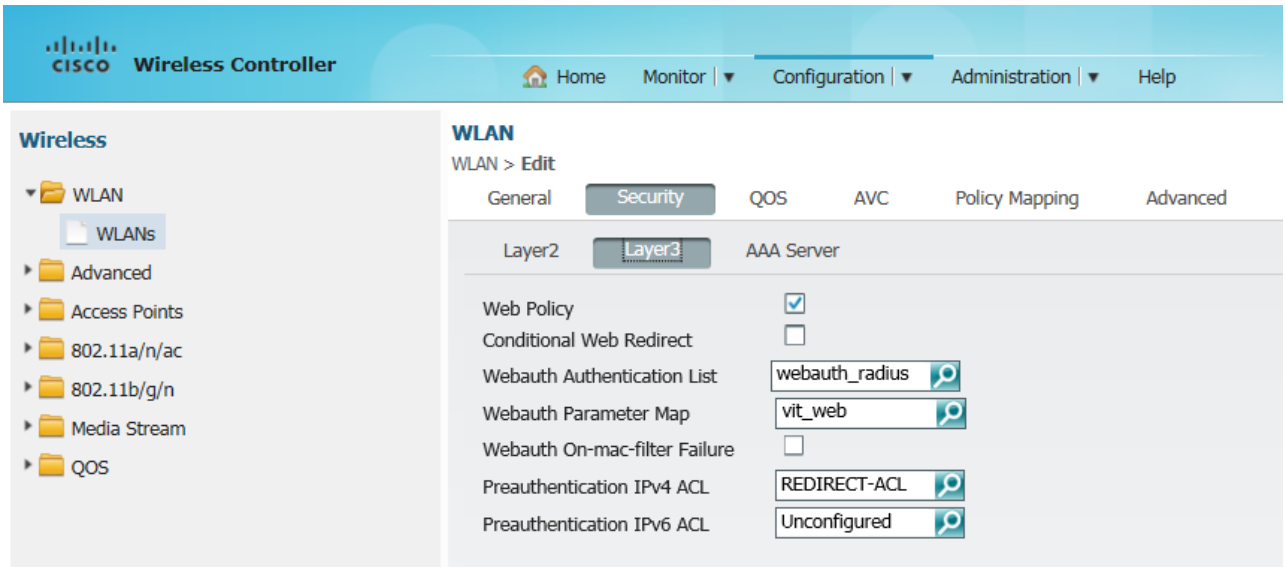
31. Select the options as shown in the above figure and then click **Apply** to save the configurations.
32. Click the **Security** tab. The options under **Security** > **Layer2** appears.

Figure 405: WLAN - Security - Layer2



33. Select the options as shown in the above figure and then click **Apply** to save the configurations.
34. Click **Layer3** The options under **Layer3** appears.

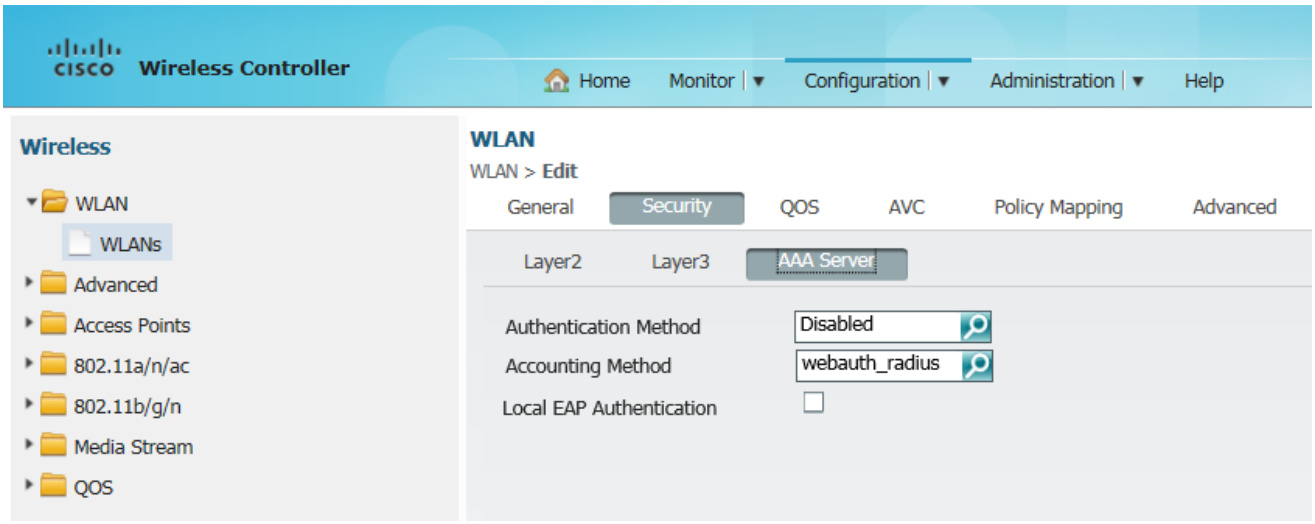
Figure 406: WLAN - Security - Layer3



35. Select the options:
    - For **Webauth Authentication List** select ‘webauth_radius’ which you have created earlier.
    - For **Preauthentication IPv4 ACL** select ‘REDIRECT-ACL’ which you have created earlier.
36. Click **Apply** to save the configurations.
37. Click AAA Server.

The options under **AAA Server** appears.

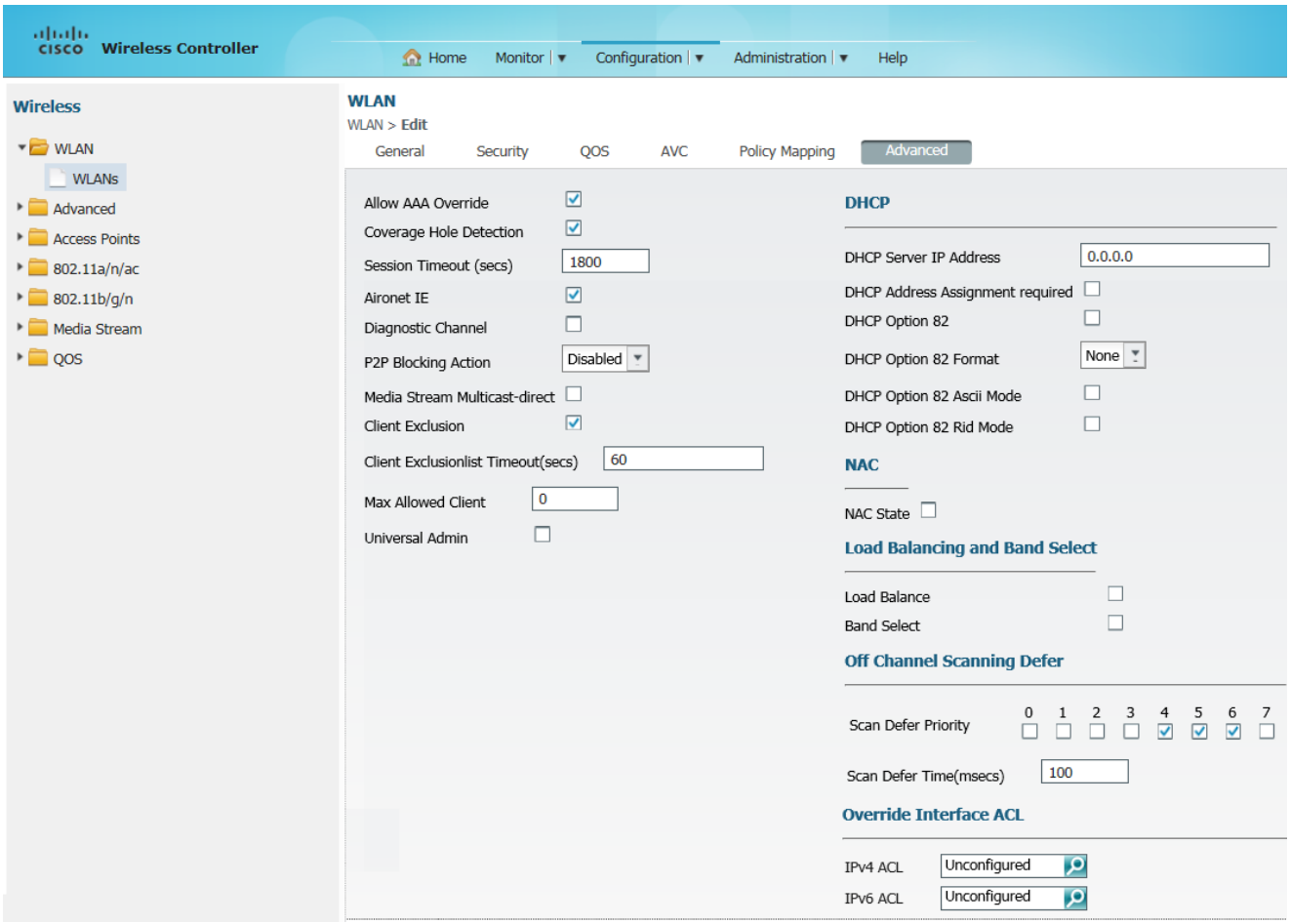
Figure 407: WLAN - Security - AAA Server



38. From the **Accounting Method** drop-down list select ‘webauth_radius’ which you have created earlier. Click **Apply** to save the configurations.
39. Click **Advanced**.

The options under **Advanced** appears.

Figure 408: WLAN - Advanced settings



40. Select the check box **Allow AAA Override,** so that radius attribute sent from PPS can be applied. Select other options as shown in the above figure and then click **Apply** to save the configurations.

Configuring Cisco WLC using CLI

Configuring RADIUS server

```
radius server <RADIUS-Profile-Name>
 address ipv4 <RADIUS-Server-IP> auth-port <auth-port> acct-port <acct-port>
 key <RADIUS-Shared-Secret>
```

Configuring server group

```
aaa group server radius <Server-group-name>
 server name <RADIUS-Server-name>
```

Configuring AAA method lists

```
aaa authentication login <authentication-list-name> group <Server-group-name>
aaa authorization network <authorization-list-name> group <Server-group-name>
aaa accounting network <accounting-list-name>
 action-type start-stop
 group <Server-group-name>
```

Configuring Webauth Parameter-map

```
parameter-map type webauth <Webauth-name>
 type webauth
 redirect for-login <PPS-guest-URL>
 redirect portal ipv4 <PPS-IP>
```

Configuring IPv4 extended ACL

```
ip access-list extended <ACL-Name>
 permit ip any host <PPS-IP>
 permit ip host <PPS-IP> any
 permit udp any eq domain any
 deny ip any any
```

Configuring WLAN profile

```
wlan <wlan-profile-name> <wlan-id> <ssid-name>
 aaa-override
 accounting-list <accountung-list-name>
 client vlan <vlan-id>
 ip access-group web <ipv4-acl>
 no security wpa
 security web-auth
 security web-auth authentication-list <authentication-list-name>
 security web-auth parameter-map <parameter-map name>
 no shutdown
```

Configuring Cisco 2620 for Guest Wired Authentication

```
policy-map type control subscriber POLICY_Gi1/0/24
 event session-started match-all
 10 class always do-until-failure
  10 authenticate using mab priority 10
  event authentication-failure match-first
  5 class DOT1X_FAILED do-until-failure
  10 terminate dot1x
  20 authentication-restart 60
  10 class MAB_FAILED do-until-failure
  10 terminate mab
   20 authenticate using dot1x priority 20
    20 class DOT1X_NO_RESP do-until-failure
   10 terminate dot1x
   20 authentication-restart 60
  40 class always do-until-failure
   10 terminate mab
   20 terminate dot1x
   30 authentication-restart 60
  event agent-found match-all
  10 class DOT1X_MEDIUM_PRIO do-until-failure
   10 authenticate using dot1x priority 20
   event authentication-success match-all
  10 class always do-until-failure
   10 activate service-template DEFAULT_LINKSEC_POLICY_SHOULD_SECURE
```

Configuring Interface

```
switchport mode access
 authentication periodic
 authentication timer reauthenticate server
 access-session host-mode multi-domain
 access-session port-control auto
 no snmp trap link-status
 dot1x pae authenticator
 spanning-tree portfast
 service-policy type control subscriber POLICY_Gi1/0/24
```

Configuring ACLs

```
C2960X(config)#ip access-list extended as-redirect   (Configure the same on PPS Radius Return Attributes)
C2960X(config-ext-nacl)#deny ip any host 10.xxx.xx.xxx   (PPS IP)
C2960X(config-ext-nacl)#permit ip any any
C2960X(config-ext-nacl)#do wr mem
```

Configuring RADIUS CoA

```
under aaa server radius dynamic-author :
client 10.xxx.xx.xxx server-key xxx . Save
radius server test
 address ipv4 10.xxx.xx.xxx auth-port 1645 acct-port 1646
 key r
C2960X(config)#aaa group server radius dsad-IPV6
C2960X(config-sg-radius)#server name test
/**Go to interface : type mab and save**/
C2960X(config)#interface GigabitEthernet 1/0/14
C2960X(config-if)#mab
```

Configuring Aruba WLC

Configuring Aruba WLC for PPS Guest Self-Registration

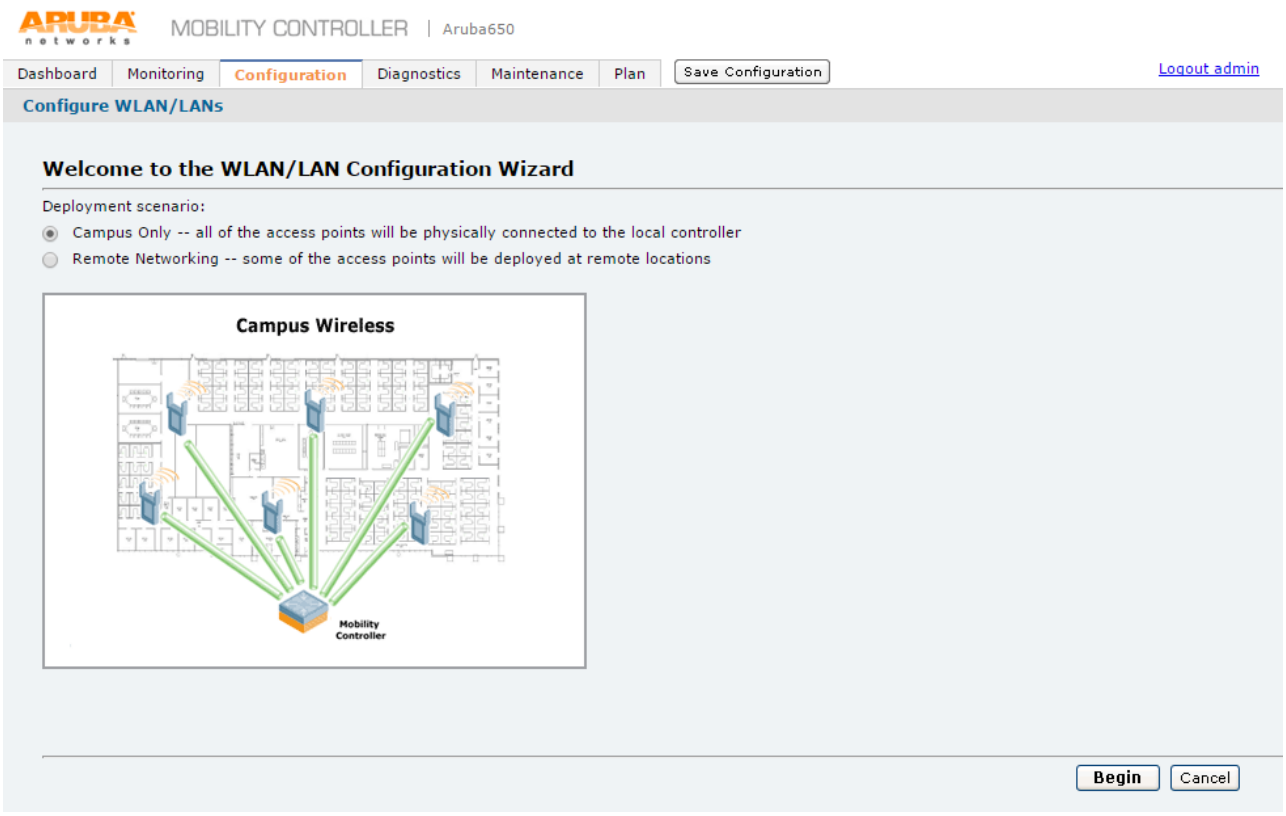
This sections explains the steps to configure Aruba WLC for deploying PPS GUAM and 'Guest Self-Registration' feature. This section provides examples of how to configure the Aruba WLC. For more information, see Aruba documentation.

Configuration required on Aruba WLC for Campus Only mode

WLAN Configuration for Campus Only mode

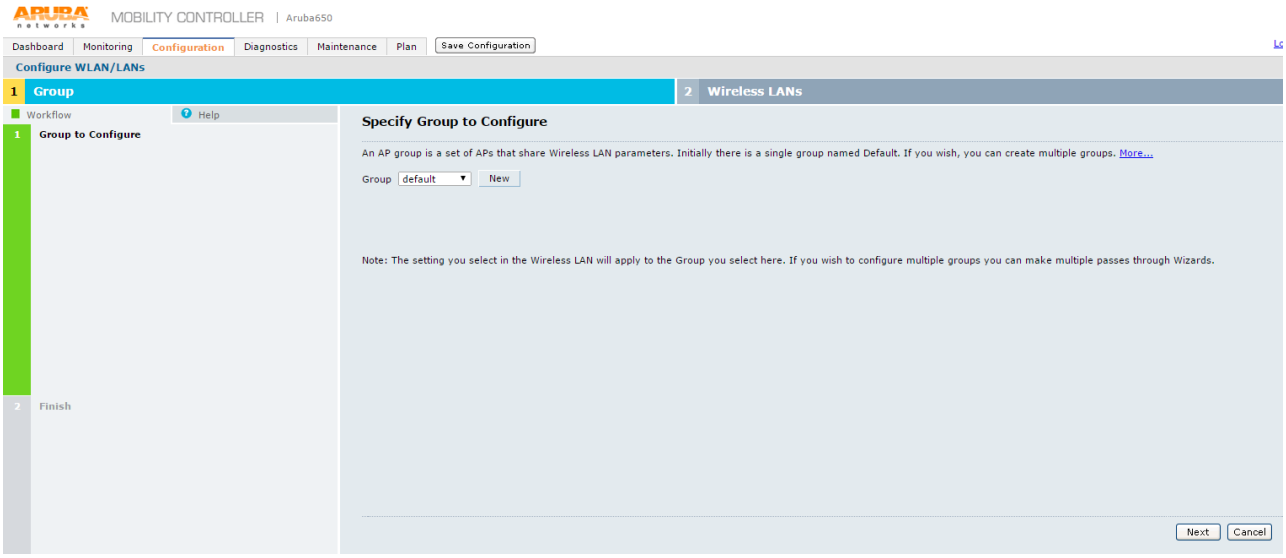
1. Login to Aruba WLC. Select **Configuration** > **Wizards** > **WLAN/LAN Wizard**. The Welcome to the WLAN/LAN Configuration Wizard appears.

   Figure 409: WLAN Configuration



2. Select **Campus Only** option and click **Begin**. The Specify Group to Configure screen appears

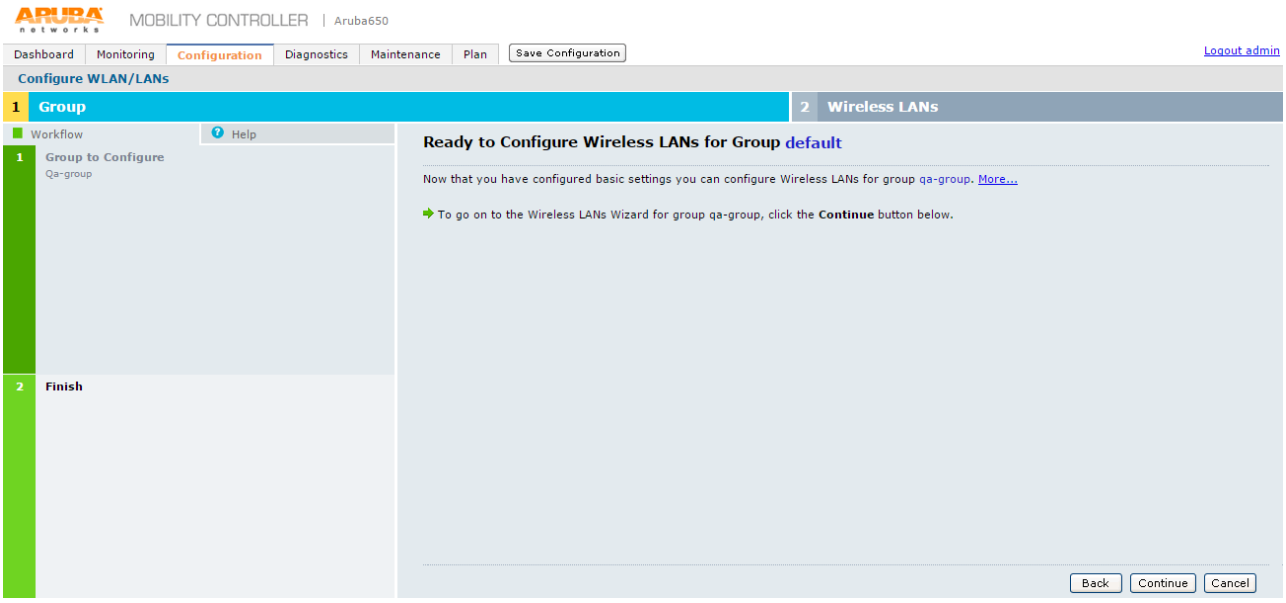
Figure 410: WLAN Configuration – Specifying a Group



3. On **Specify Group to Configure** screen select an existing AP group or create a new AP group and click

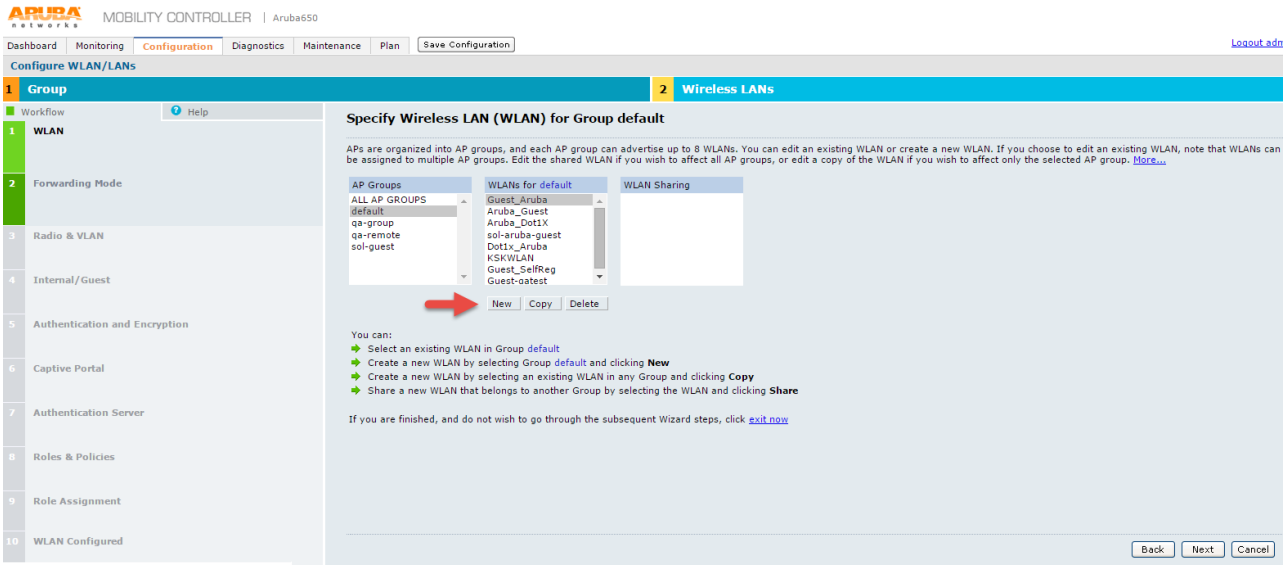
Next. The Ready to Configure Wireless LANs for Group screen appears.

Figure 411: WLAN Configuration – Wirless LANs configuration



4. Click **Continue** button. The Specify Wireless LAN (WLAN) for Group default screen appears

Figure 412: Specifying a WLAN



5. On Specify Wireless LAN (WLAN) for Group default screen, select a group from the AP Groups list.

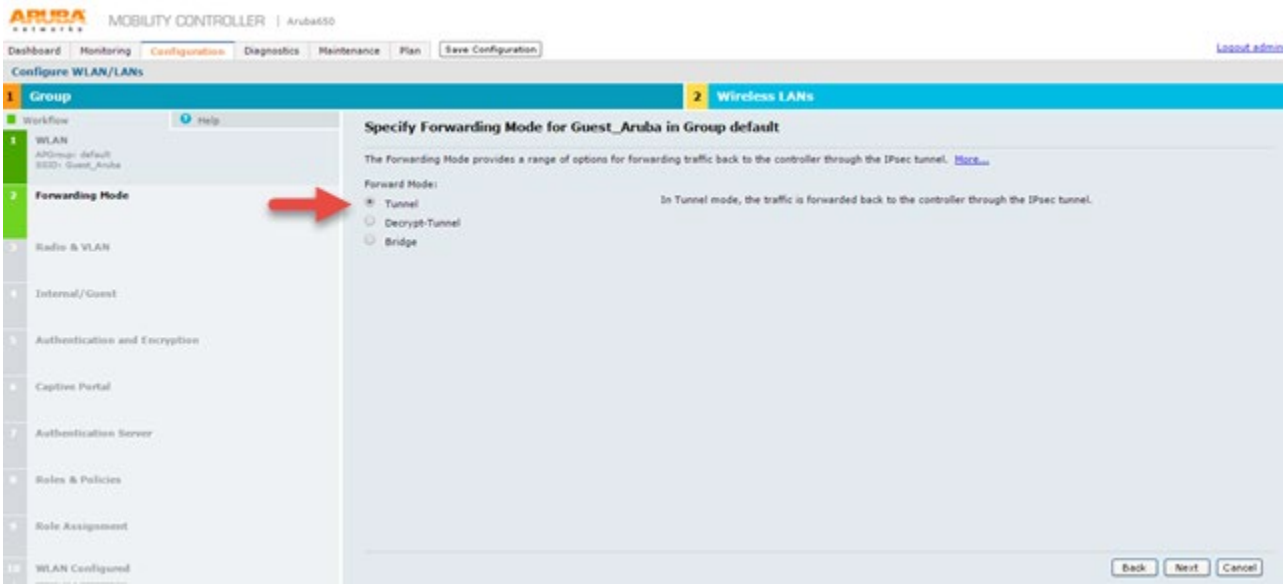
   - In the **WLANS for** list select an existing WLAN, or

- Click **New** to create a new WLAN

6. Click **Next**.

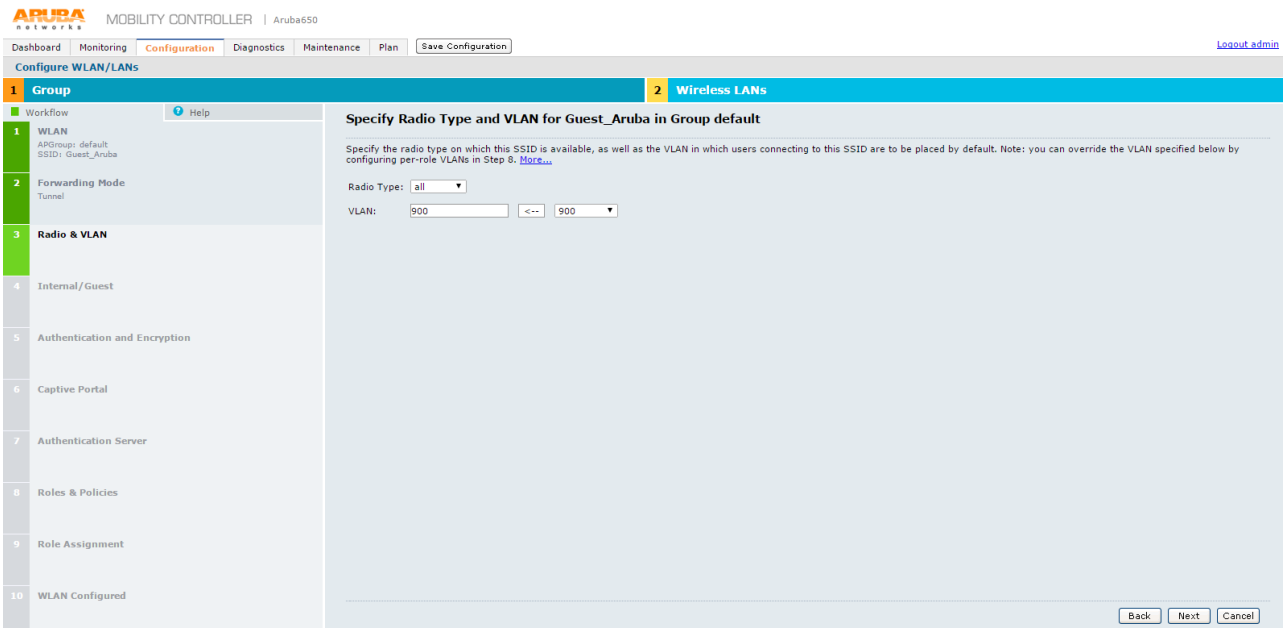
The Specify Forwarding Mode for Guest_Aruba in Group default screen appears

Figure 413: Forwarding Mode configuration



7. On Specify Forwarding Mode for Guest_Aruba in Group default screen, under Forward Mode, select **Tunnel** option and click **Next**. The Specify Radio Type and VLAN for Guest_Aruba in Group default screen appears.

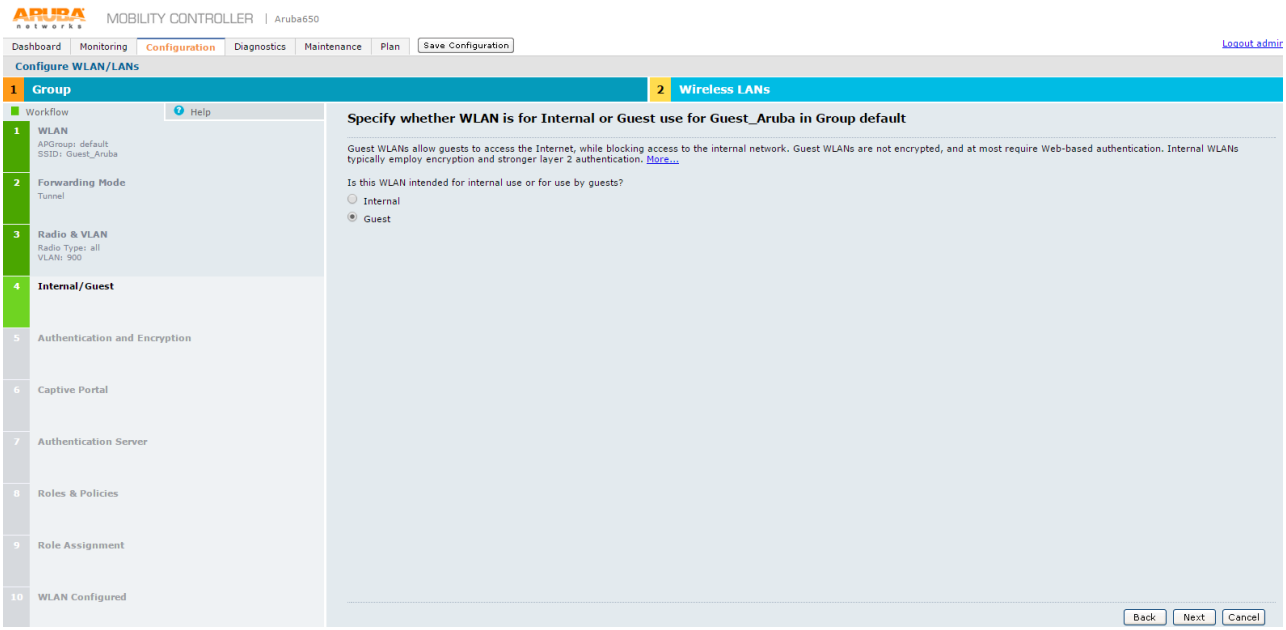
Figure 414: Radio and VLAN configuration



8. On Specify Radio Type and VLAN for Guest_Aruba in Group default screen select:
    - **Radio Type** - Select 'all' from the drop-down list
    - **VLAN** - Select required options from the drop-down list and click the arrow button to include in the **VLAN** box.
9. Click **Next**.

    The Specify whether WLAN is for Internal or Guest use for Guest_Aruba in Group default screen appears

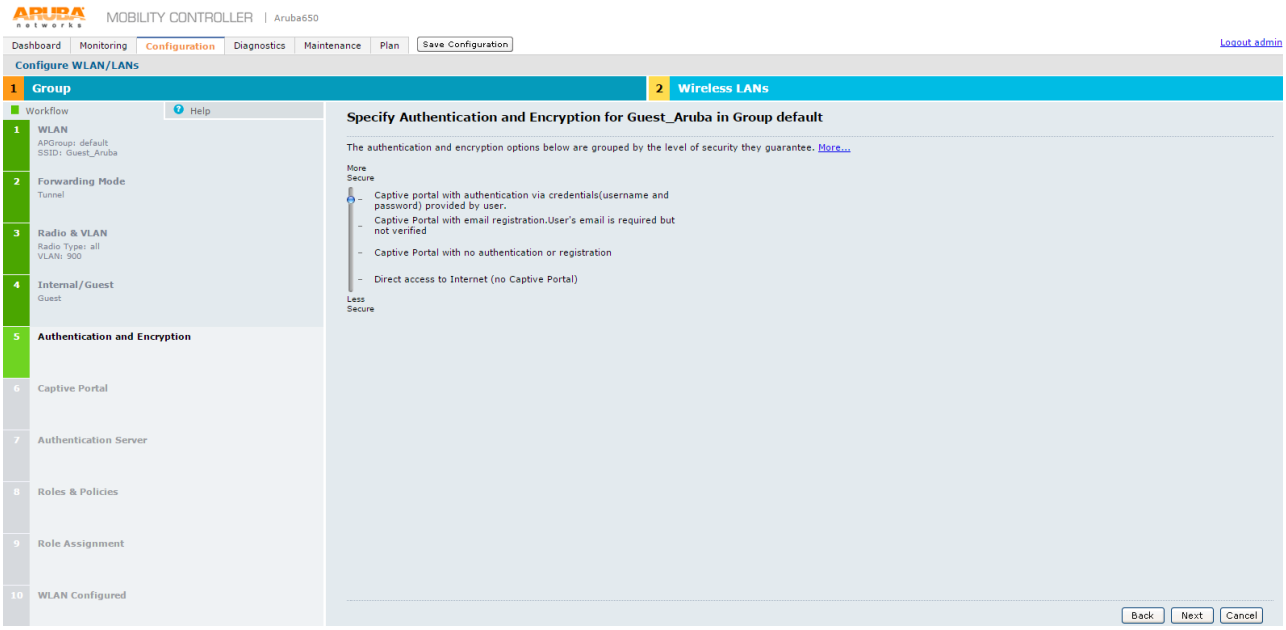
Figure 415: Internal Guest configuration



10. Specify whether WLAN is for Internal or Guest use for Guest_Aruba in Group default screen specify the purpose of the WLAN. Select **Guest** option for WLAN use and click **Next**.

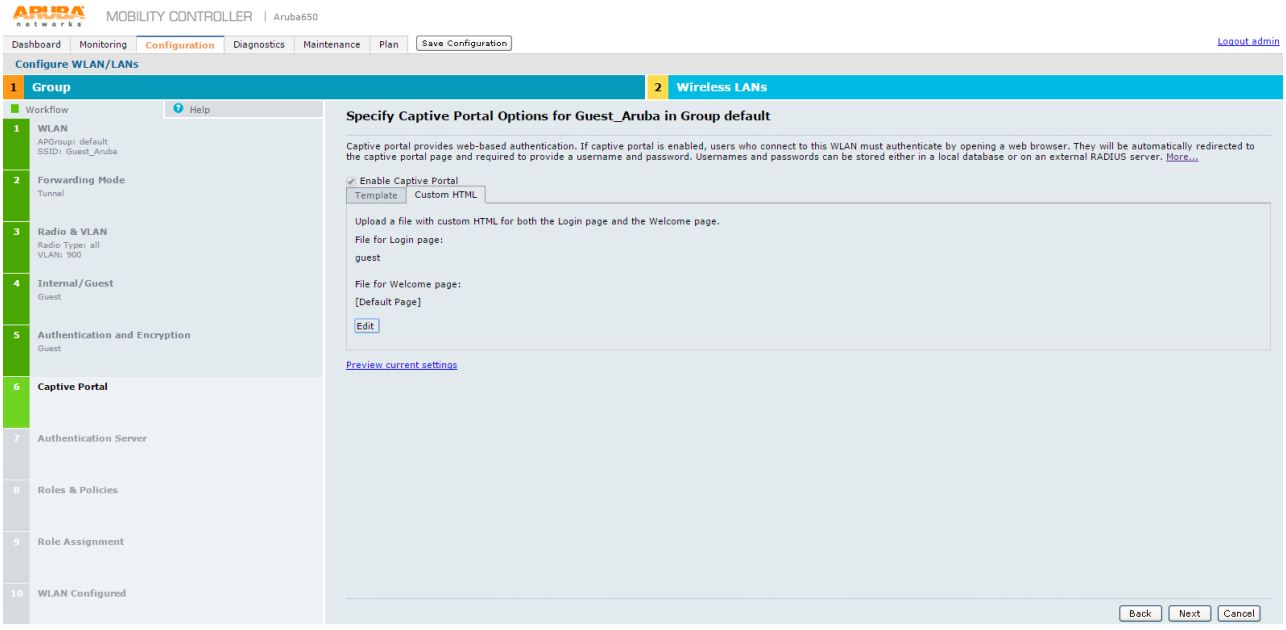
The Specify Authentication and Encryption for Guest_Aruba in Group default screen appears.

Figure 416: Authentication and Encryption



11. On Specify Authentication and Encryption for Guest_Aruba in Group default screen move the slider to **Captive portal with authentication via credentials** option and click **Next**. The Specify Captive Portal Options for Guest_Aruba in Group default screen appears.

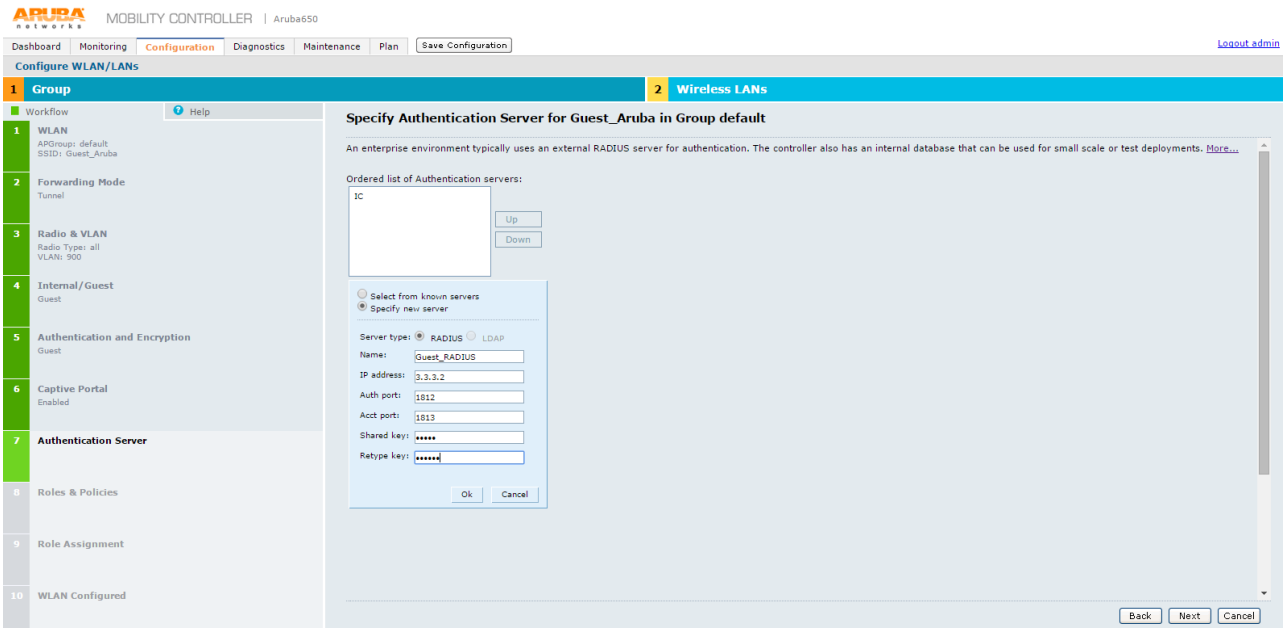
Figure 417: Captive Portal options



12. Specify Captive Portal Options for Guest_Aruba in Group default screen, click **Next**.

The Specify Authentication Server for Guest_Aruba in Group default screen appears.

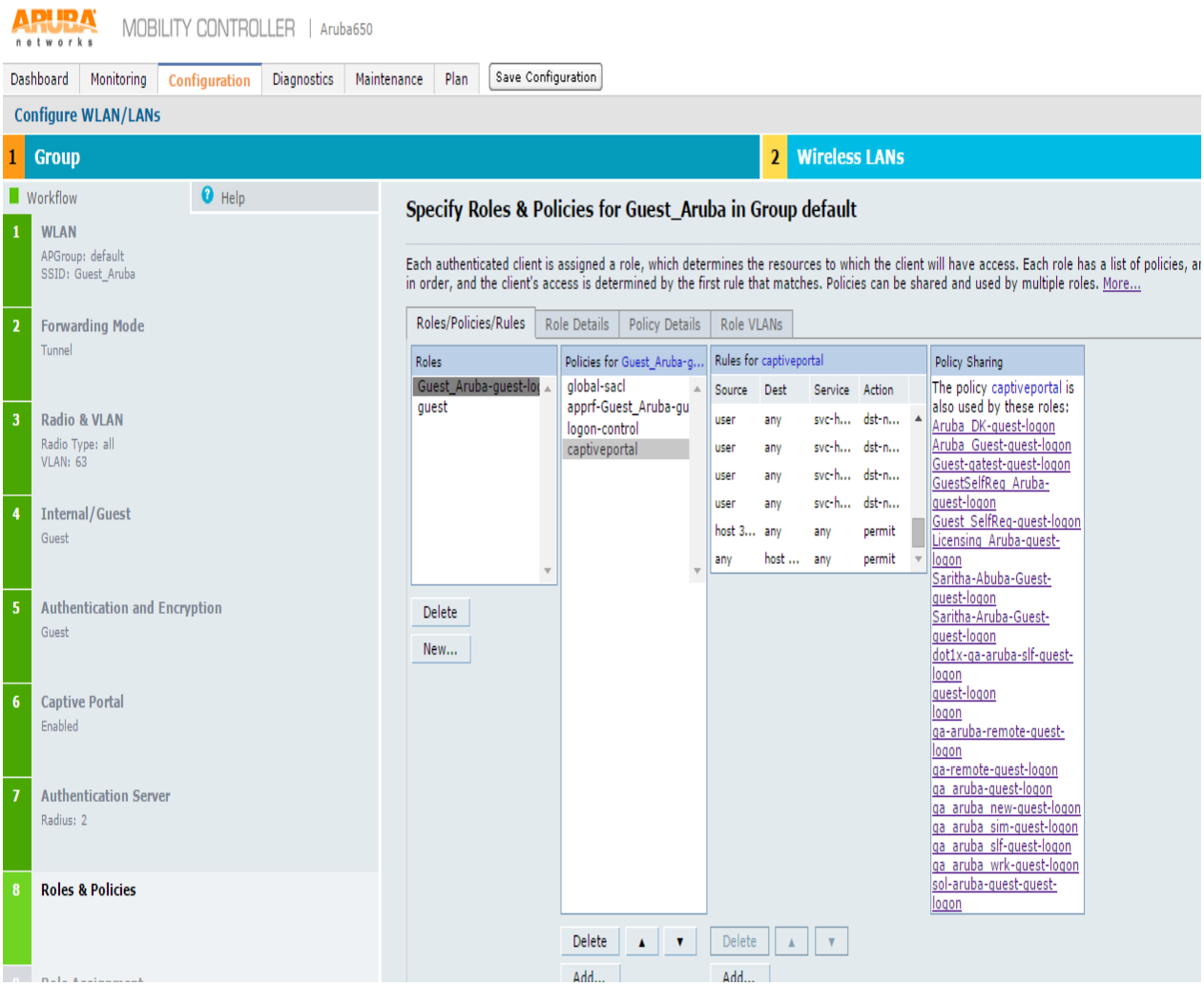
Figure 418: Authentication Server configuration



13. On Specify Authentication Server for Guest_Aruba in Group default screen, specify PPS server as the authentication server and click **Next**.

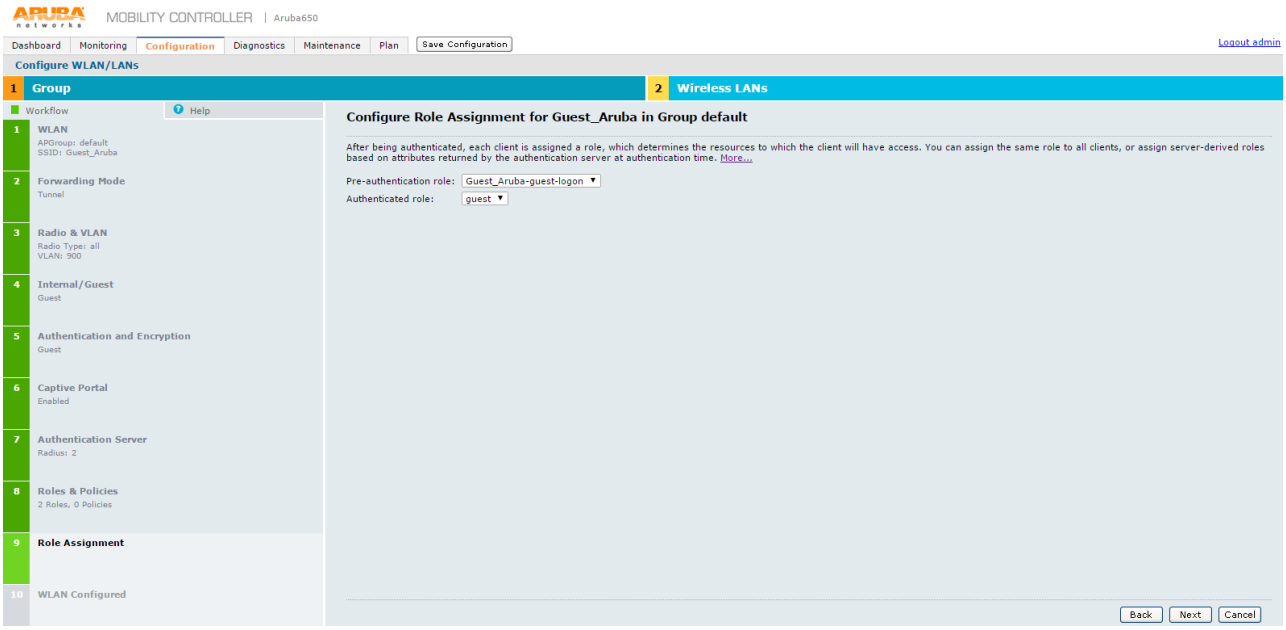
The Specify Roles & Policies for Guest_Aruba in Group default screen appears.

Figure 419: Specifying Roles and Policies



14. On Specify Roles & Policies for Guest_Aruba in Group default screen, configure the roles and click **Next**. The Configure Role Assignment for Guest_Aruba in Group default screen appears.

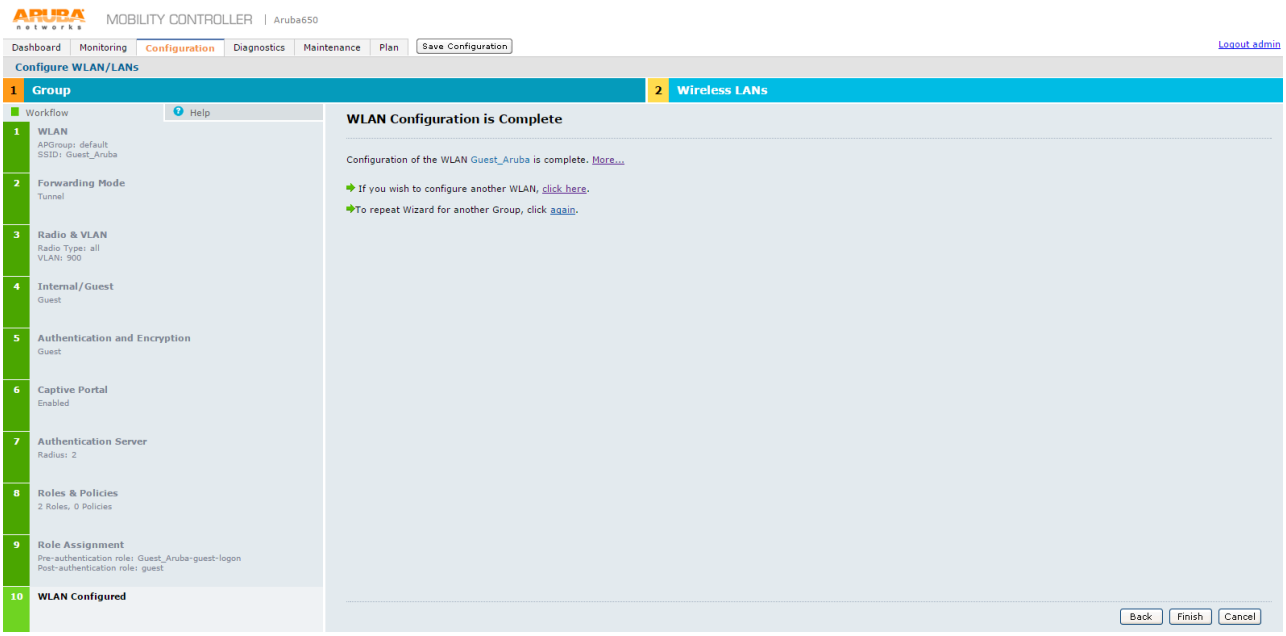
Figure 420: Configuring Role Assignment



15. On Configure Role Assignment for Guest_Aruba in Group default screen, click **Next**.

The WLAN Configuration is Complete screen appears.

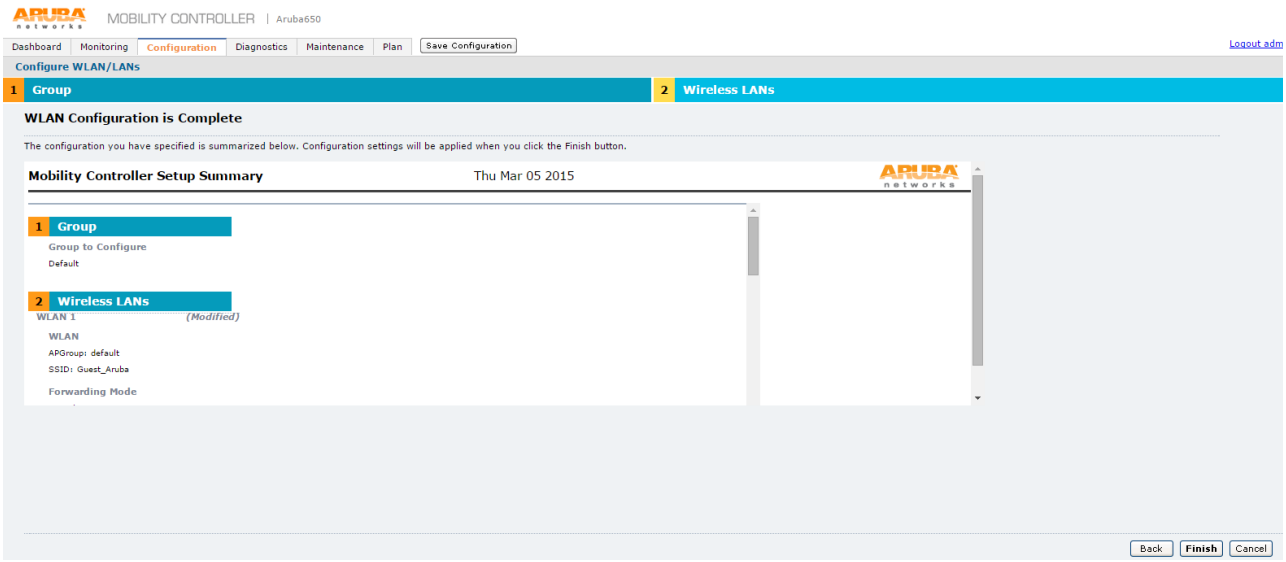
Figure 421: WLAN configuration complete message



16. Click **Finish** to complete the configuration.

The WLAN Configuration is Complete screen appears displaying the summary of the configuration.

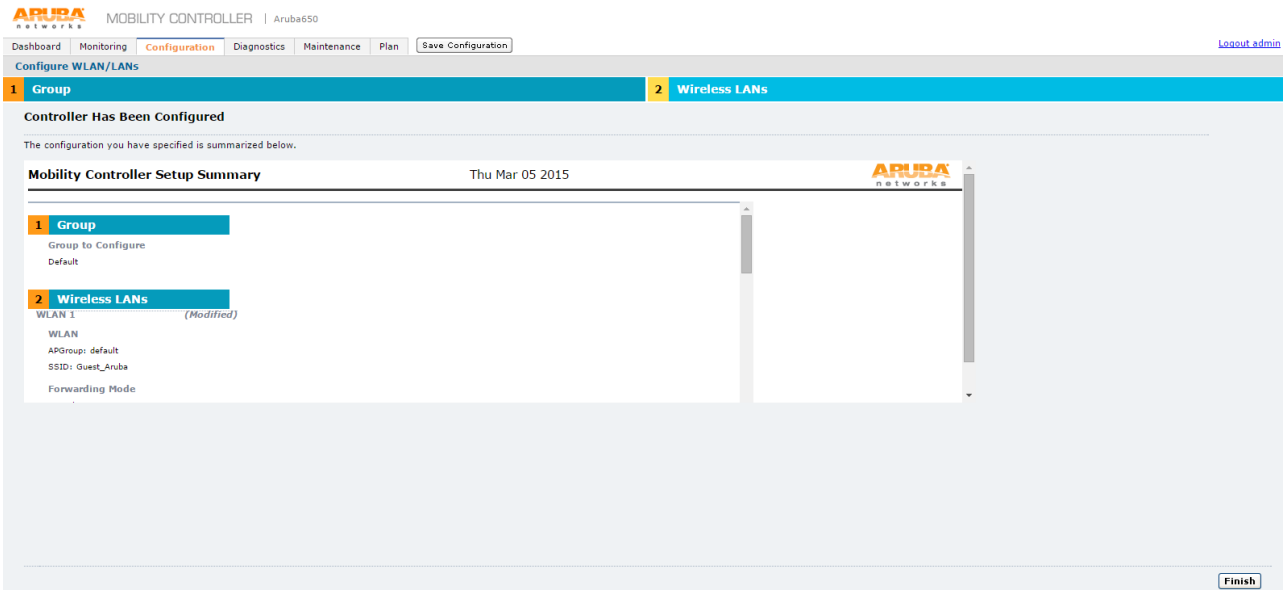
Figure 422: WLAN configuration complete message with details



17. Click **Finish**.

The Controller Has Been Configured screen appears.

Figure 423: Controller configured



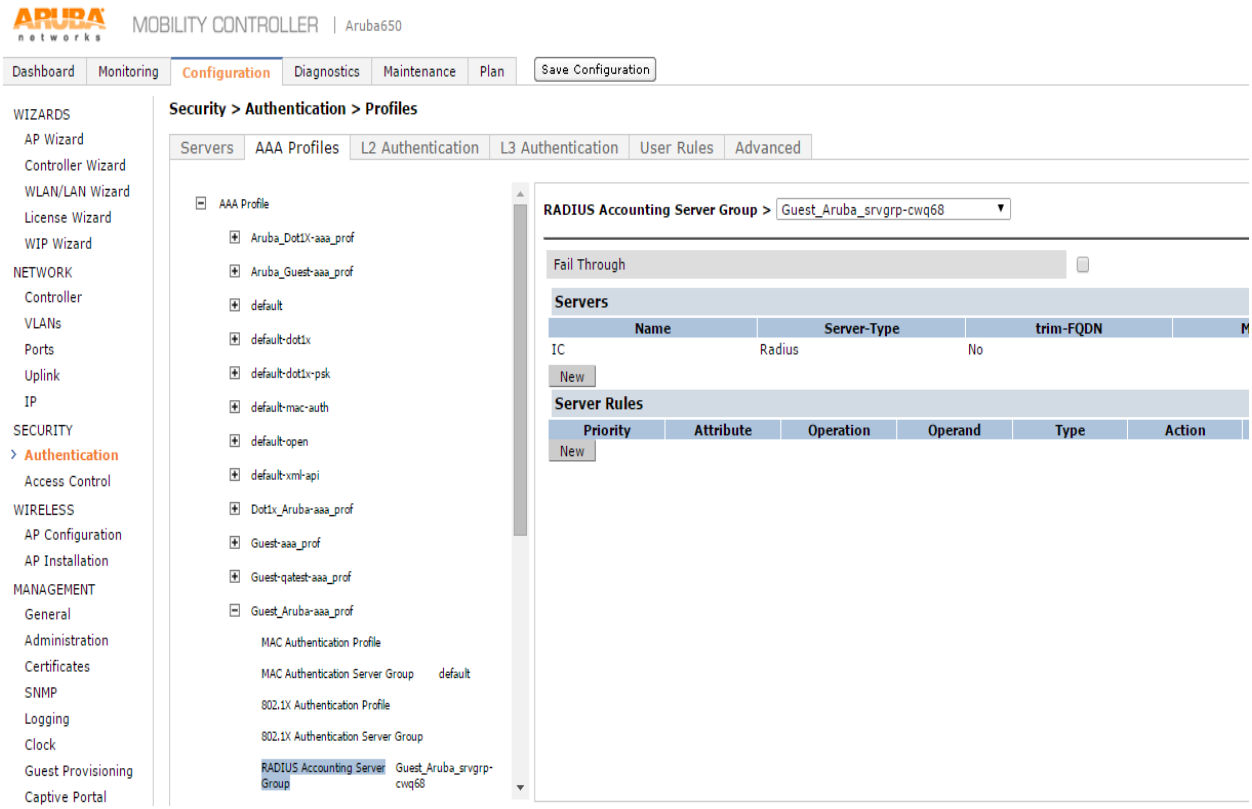
18. Click **Finish**.

    The system refreshes and takes you to the **Configuration** tab.

19. Select **Security** > **Authentication** > **AAA Profiles** and click on RADIUS Accounting Server Group.

    Select an appropriate server group for RADIUS Accounting Server Group.

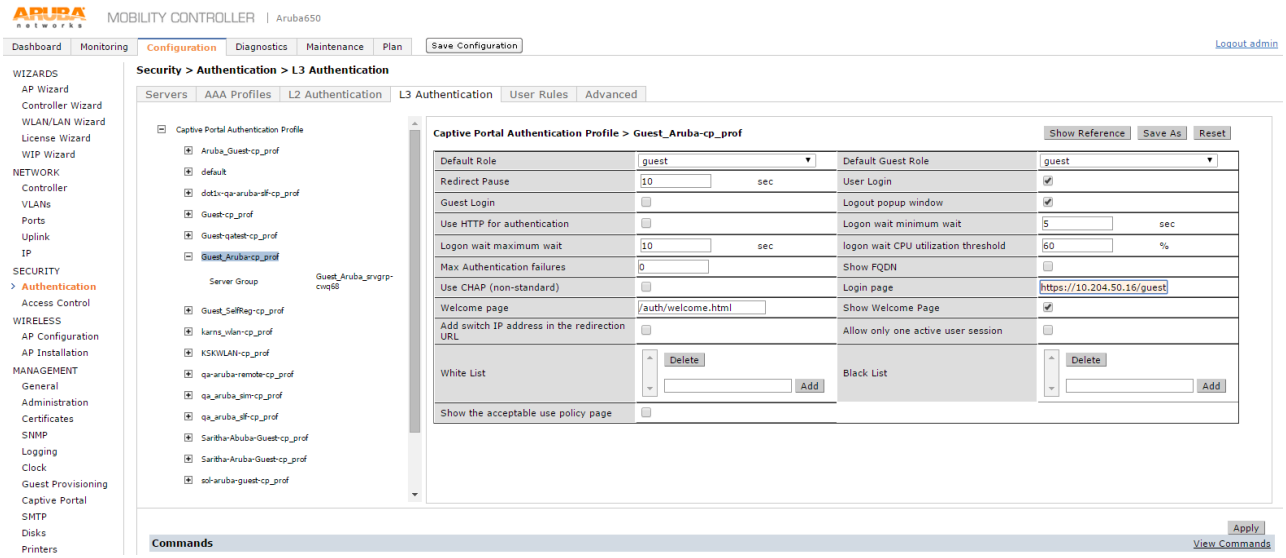
Figure 424: RADIUS Accounting Server Group



External Captive Portal Configuration

1. In Aruba WLC select **Configuration** > **Security** > **Authentication** > **L3 authentication**.
   The L3 authentication screen appears.

Figure 425: L3 Authentication configuration

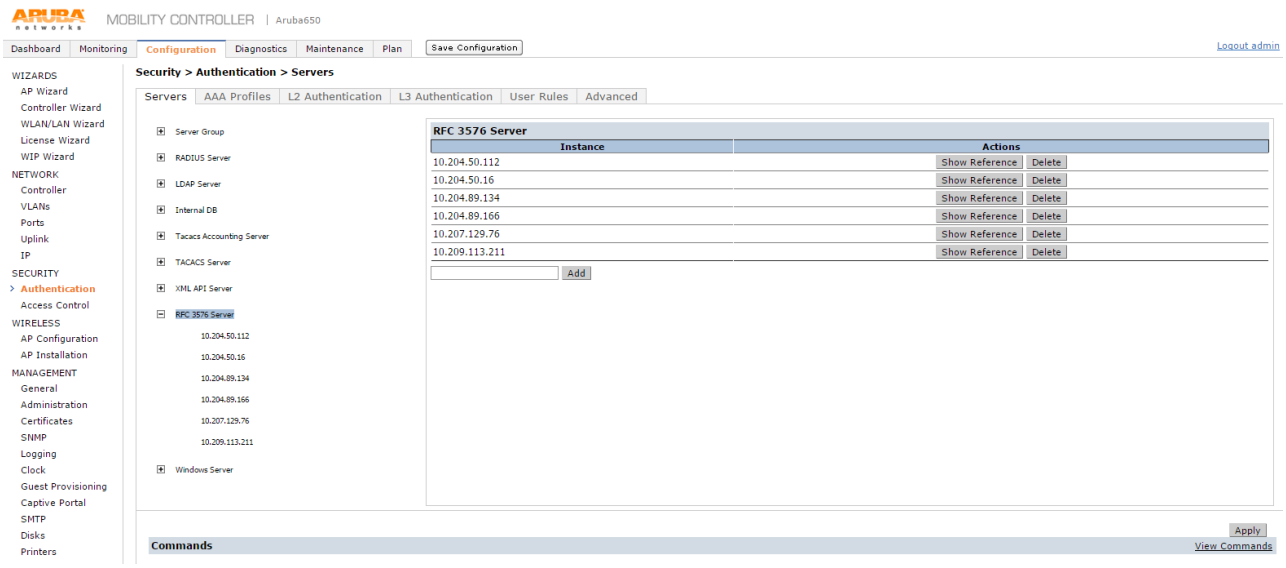


2. Click **Captive Portal Authentication Profile**. The list expands. Select the corresponding profile of the above configured WLAN.
   - Select the check box **Add switch IP addressin the redirection URL**.
   - In the **Login page** box enter the PPS guest access URL that is configured as part of PPS configuration.
3. Click **Apply** to save the configuration.

RFC 3576 server configuration

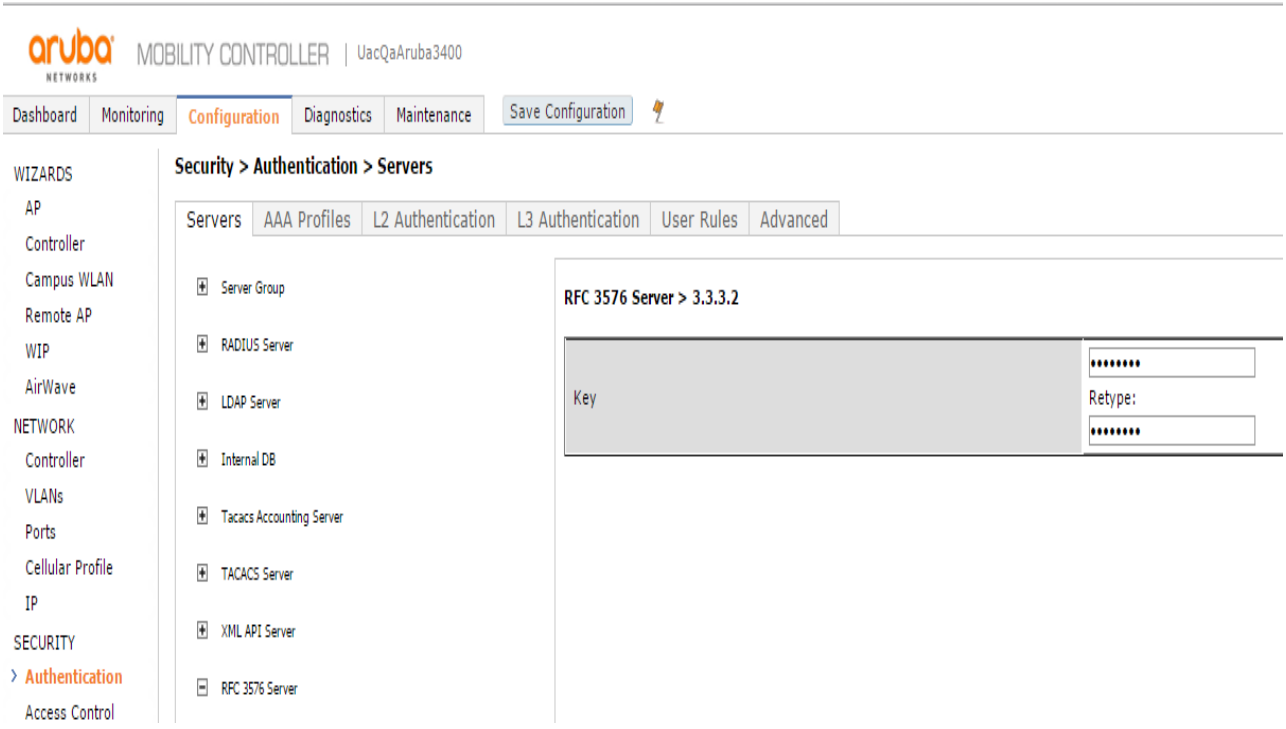
1. In Aruba WLC go to **Configuration > Security > Authentication > Servers** tab.
   A list of configured servers is displayed.

Figure 426: RFC 3576 Server Configuration



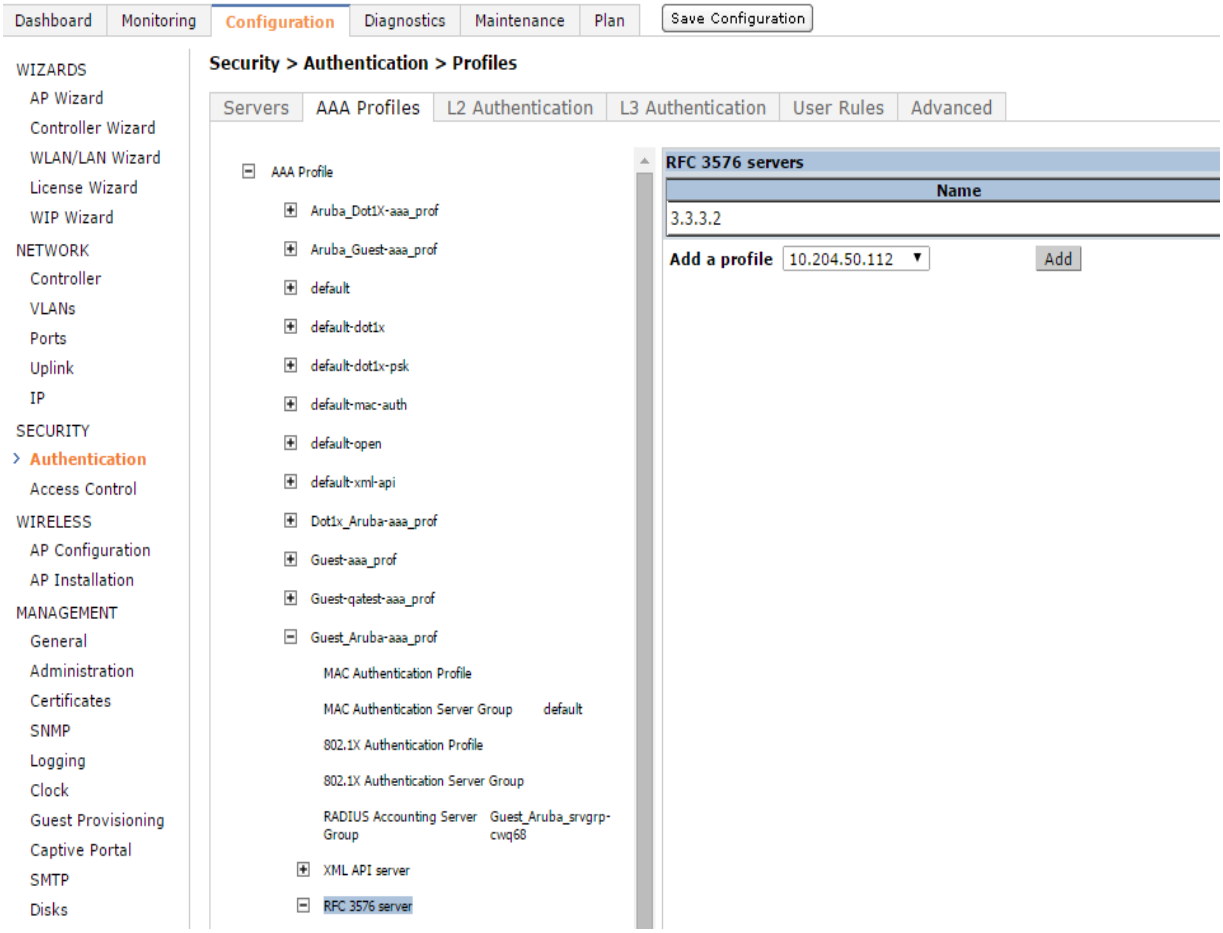
2. Click the **RFC 3576 Server** and add PPS as RFC 3576 server, for supporting disconnect messages.
3. Click on the RFC server that is newly created to provide the key.

Figure 427: RFC Server - Key Details



4. Select **Security** > **Authentication** > **AAA Profiles**. Go to AAA profile and click on RFC 3576 server. Add the server that is newly created in step1.

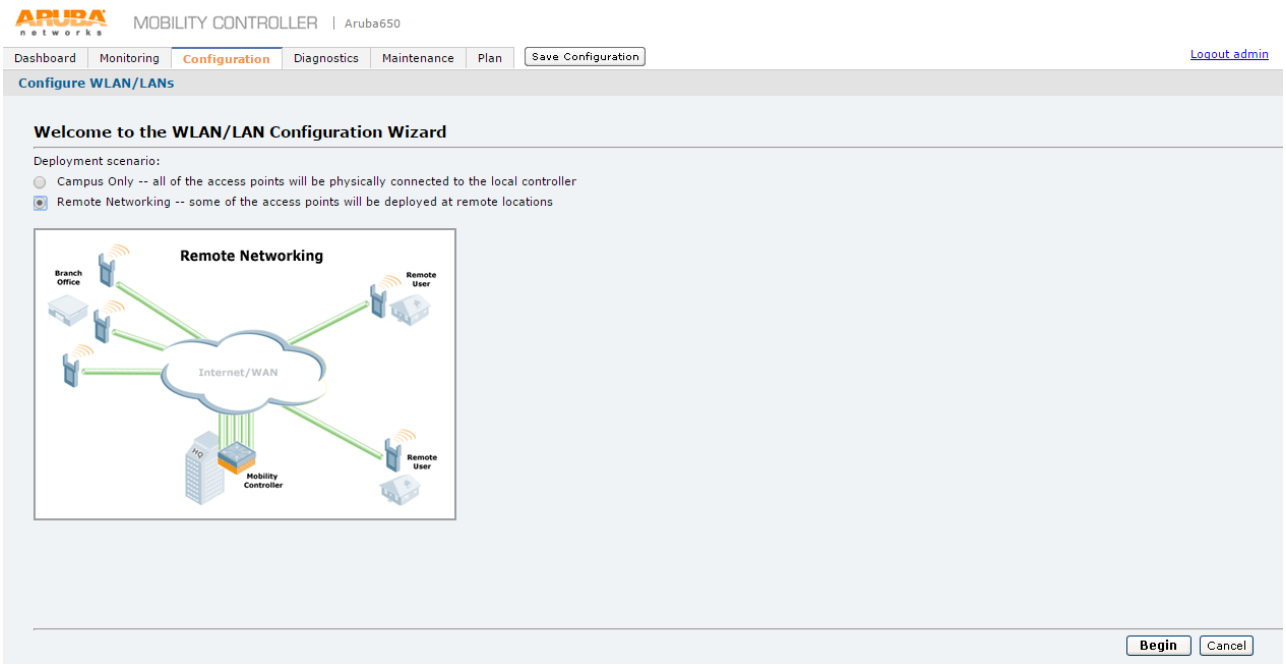
Figure 428: RFC Server - Adding a server



WLAN Configuration for Remote Networking mode on Aruba WLC

1. Login to Aruba WLC. Select **Configuration** > **Wizards** >**WLAN/LAN Wizard**. The Welcome to the WLAN/LAN Configuration Wizard screen appears.

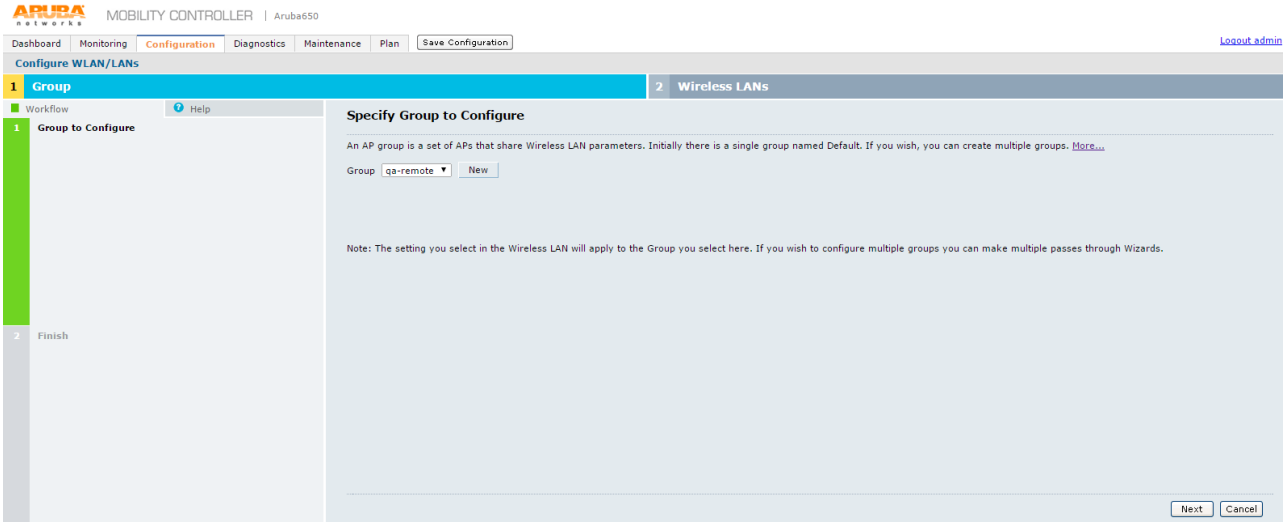
Figure 429: Remote Networking configuration



2. Select **Remote Networking** option and click **Begin**.

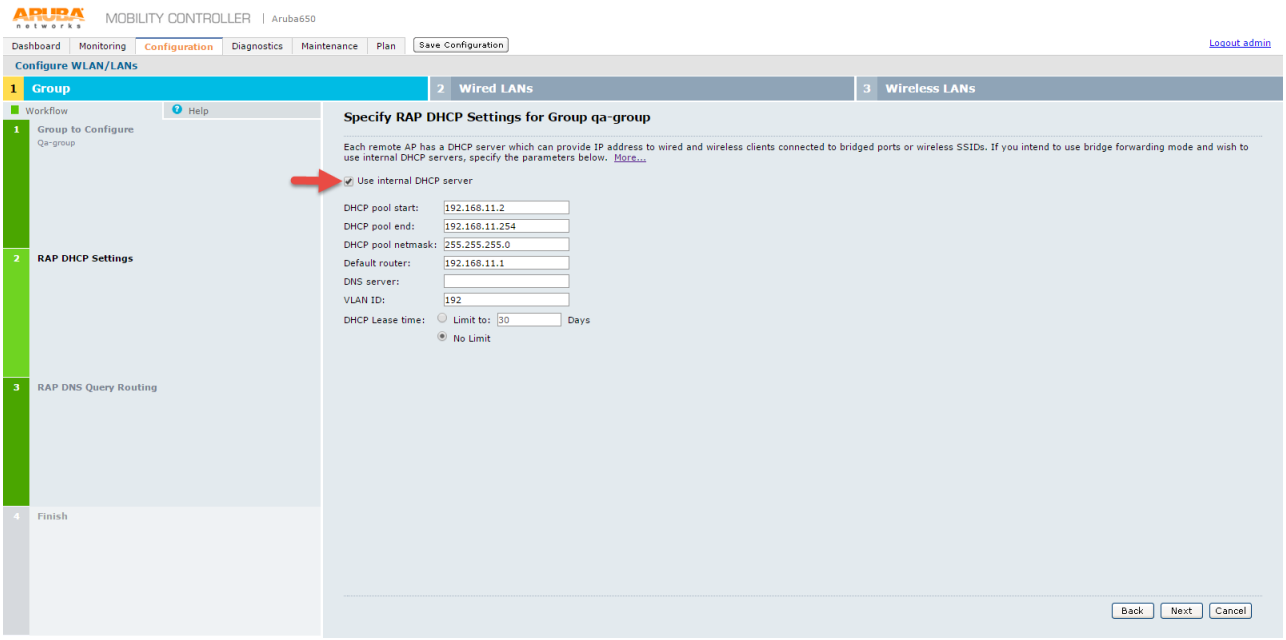
The Specify Group to Configure screen appears.

Figure 430: Group configuration



3. On Specify Group to Configure screen, select an AP group and click **Next**.

Figure 431: RAP DHCP Settings



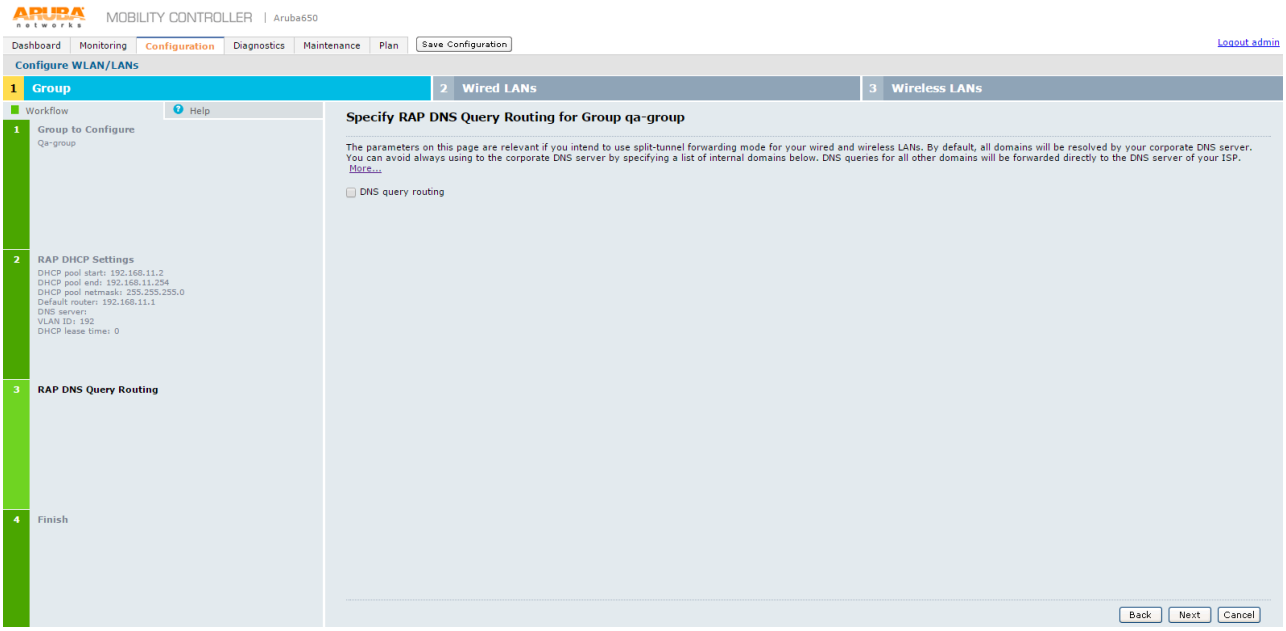
4. On Specify RAP DHCP settings for Group qa-group screen, configure:

   - DHCP pool start
   - DHCP pool end
   - DHCP pool netmask
   - Default router
   - DNS server
   - VLAN ID
   - DHCP Lease time – Select the required option and set the limit.

5. Click **Next**.

   The Specify RAP DNS Query Routing for Groups qa-group appears.

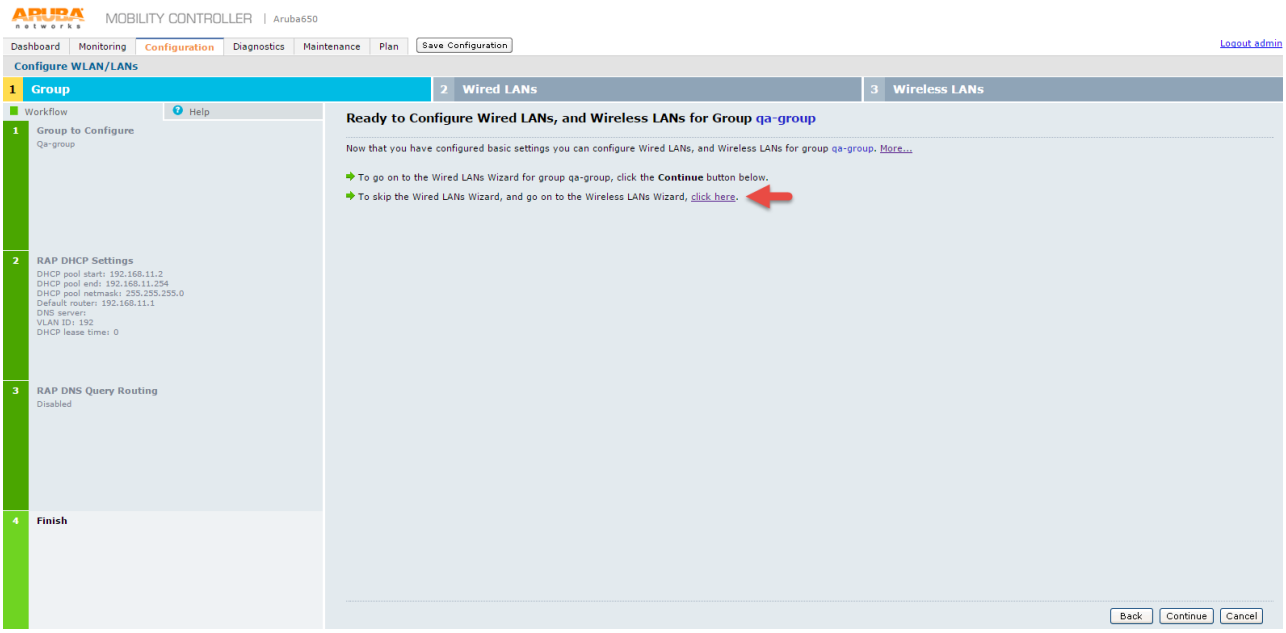
Figure 432: RAP DNS Query Routing



6. On the Specify RAP DNS Query Routing for Groups qa-group screen click **Next**.

The Ready to Configure Wired LANs, and Wireless LANs for Group screen appears.

Figure 433: Configuring Wireless LANs



7. On Ready to Configure Wired LANs, and Wireless LANs for Group screen, click Wireless LANs Wizard link.
8. Follow the Steps 4-18 of Campus Only mode to complete Wireless WLAN configuration.

9. Follow External Captive Portal Configuration of Campus Only mode to configure Captive Portal for Remote Networking mode.
10. Follow RFC 3576 Configuration of Campus Only mode to configure PPS as RFC 3576 server.

Configuring Aruba WLC in campus only mode using CLI

To configure Aruba WLC for Guest Access in campus only mode via command-line interface, access the CLI in config mode and issue the following commands.

Configuring RADIUS server:

aaa authentication-server radius <RADIUS-profile-name>
host <PPS ip-address>
key <password>

Configuring Server Group:

aaa server-group <server-group-name>
auth-server <RADIUS-profile-name>

Configuring AAA profile:

aaa profile <AAA-profile-name>

Configuring SSID profile:

wlan ssid-profile <ssid-profie-name>
essid <ssid-name>
ssid-enable
no hide-ssid
opmode opensystem

Configuring Captive portal:

aaa authentication captive-portal <CP-profile-name>
login-page <PPS-guest-URL>
switchip-in-redirection-url
server-group <server-group-name>
user-logon
no guest_logon
default-role guest

Creating a User-role:

user-role <Role-Name>
captive-portal <CP-profile-name>
access-list session logon-control
access-list session captiveportal

Attaching initial-role to AAA profile:

aaa profile <AAA-profile-name>
initial-role <role-name>

Configuring Firewall policy rules for PPS: ip access-list session captiveportal

host <PPS-IP> any permit position 1
any host <PPS-IP> any permit position 2

Configuring Virtual-AP and associating SSID profile:

wlan virtual-ap <vap-profile-name>
forward-mode tunnel
vlan <vlan-id>
ssid-profile <ssid-profile-name>
aaa-profile <AAA-profile-name>

Configuring AP group and associating Virtual-AP profile:

ap-group default

If it is another ap-group, give as required.

virtual-ap <vap-profile-name>

Configuring RFC-3576 server:

aaa rfc-3576-server <PPS-IP>
key <password>

Attaching RFC-3576 server to AAA profile:

aaa profile <aaa-profile-name>
rfc-3576-server <PPS-IP>

Attaching RADIUS accounting server group to AAA profile:

aaa profile <aaa-profile-name>
radius-accounting <server-group-name>

Configuring Aruba WLC in Remote Networking mode using CLI

To configure Aruba WLC for Guest Access in Remote Networking mode via command-line interface, access the CLI in config mode and issue the following commands.

Configuring RADIUS server:

aaa authentication-server radius <RADIUS-profile-name>
host <PPS ip-address>
key <password>

Configuring Server Group:

aaa server-group <server-group-name>
auth-server <RADIUS-profile-name>

Configuring AAA Profile:

aaa profile <AAA-profile-name>

Configuring SSID Profile:

wlan ssid-profile <ssid-profie-name>
essid <ssid-name>
ssid-enable
no hide-ssid
opmode opensystem

Configuring Captive Portal:

aaa authentication captive-portal <CP-profile-name>

login-page <PPS-guest-URL>
switchip-in-redirection-url
server-group <server-group-name>
user-logon
no guest_logon
default-role guest

Creating a User-role:

user-role <Role-Name>
captive-portal <CP-profile-name>
access-list session logon-control
access-list session captiveportal

Attaching initial-role to AAA profile:

aaa profile <AAA-profile-name>
initial-role <role-name>

Configuring Firewall policy rules for PPS:

ip access-list session captiveportal
host <PPS-IP> any any permit position 1
any host <PPS-IP> any permit position 2

Configuring Virtual-AP and associating SSID profile:

wlan virtual-ap <vap-profile-name>
forward-mode tunnel
vlan <vlan-id>
ssid-profile <ssid-profile-name>
aaa-profile <AAA-profile-name>

Configuring DHCP server on Remote AP:

ap system-profile <name>
rap-dhcp-default-router <ipaddr>
rap-dhcp-dns-server <ipaddr>
rap-dhcp-lease <days>
rap-dhcp-pool-start <ipaddr>
rap-dhcp-pool-end <ipaddr>
rap-dhcp-pool-netmask <netmask>
rap-dhcp-server-vlan <vlan>

Configuring AP group and associating Virtual-AP profile:

ap-group default

If it is another ap-group, give as required.

virtual-ap <vap-profile-name>
  ap-system-profile <name>

Configuring RFC-3576 server:

aaa rfc-3576-server <PPS-IP>
key <password>

Attaching RFC-3576 server to AAA profile:

aaa profile <aaa-profile-name>
rfc-3576-server <PPS-IP>

Attaching RADIUS accounting server group to AAA profile:

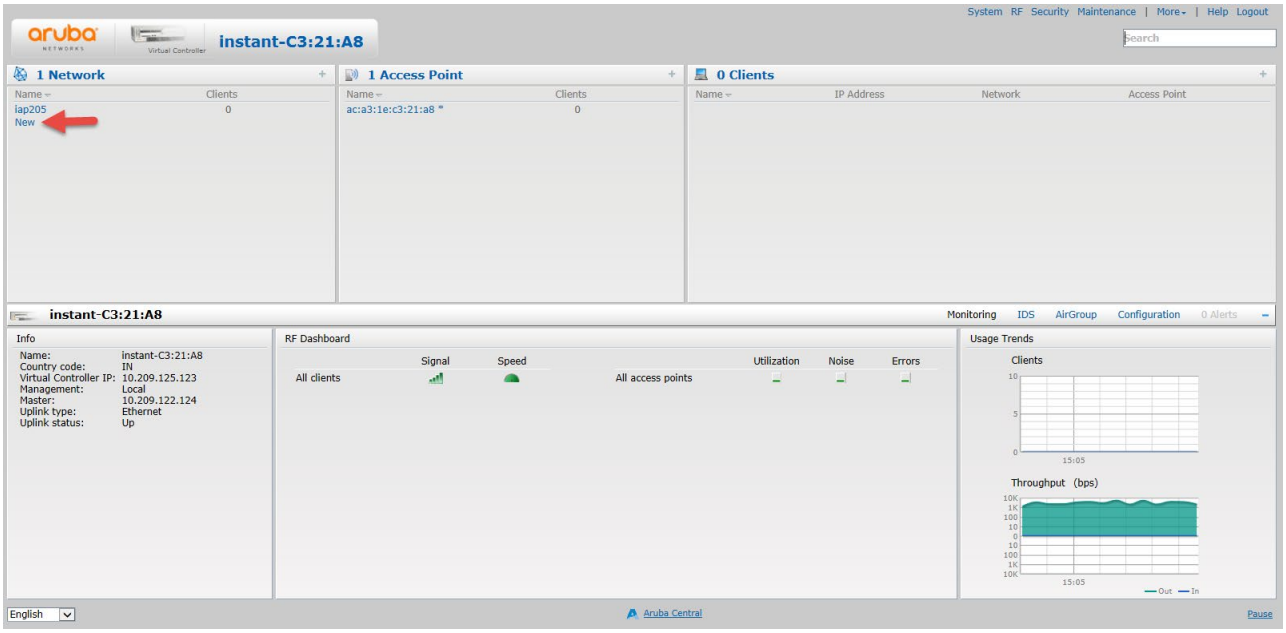
aaa profile <aaa-profile-name>
radius-accounting <server-group-name>

Configuring Aruba Instant Access Point

To configure Aruba Instant Access Point:

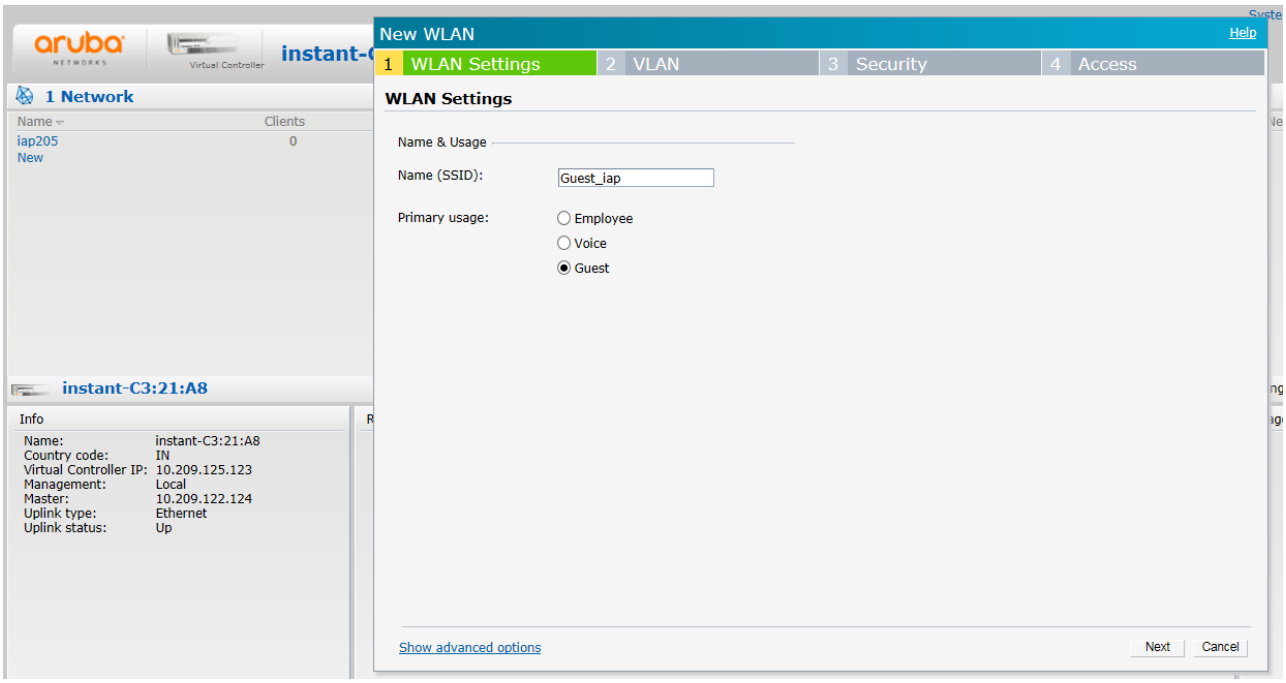
1. Login to the Aruba Instant Access portal. The Aruba Instant page appears.

Figure 434: Aruba Instant Home Page



2. Click **New** to create a new SSID. The **New WLAN** window appears.

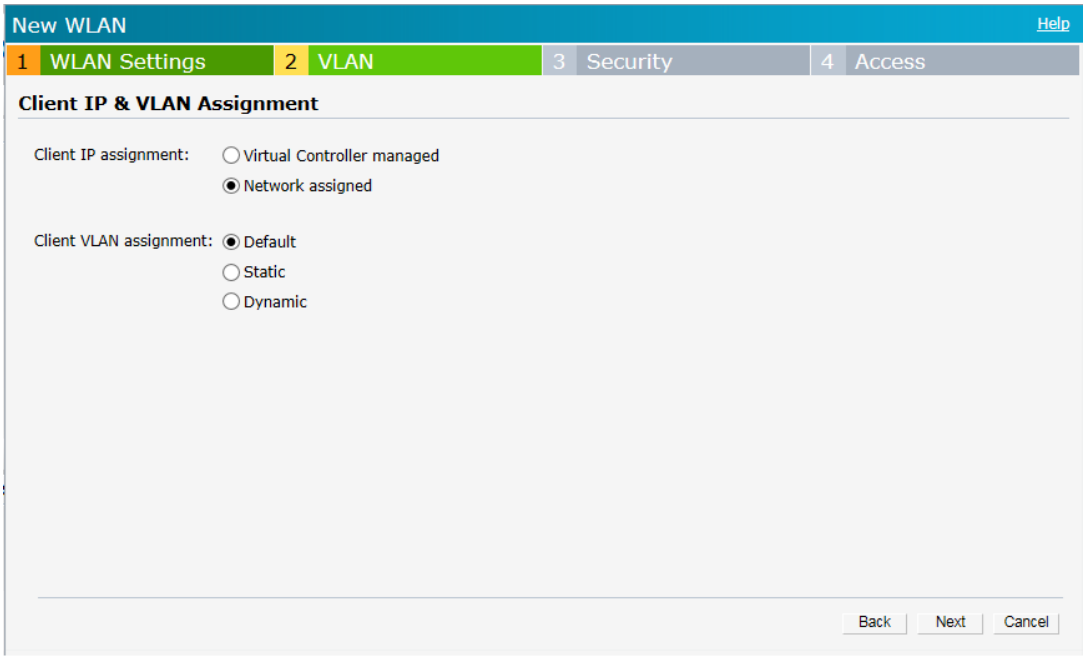
Figure 435: Creating a New WLAN



3. In the WLAN Settings tab:
    - In the **New (SSID)** field enter a name for the SSID.
    - In the **Primary usage** options select **Guest**.
4. Click **Next**.

    The **VLAN** tab options appears.

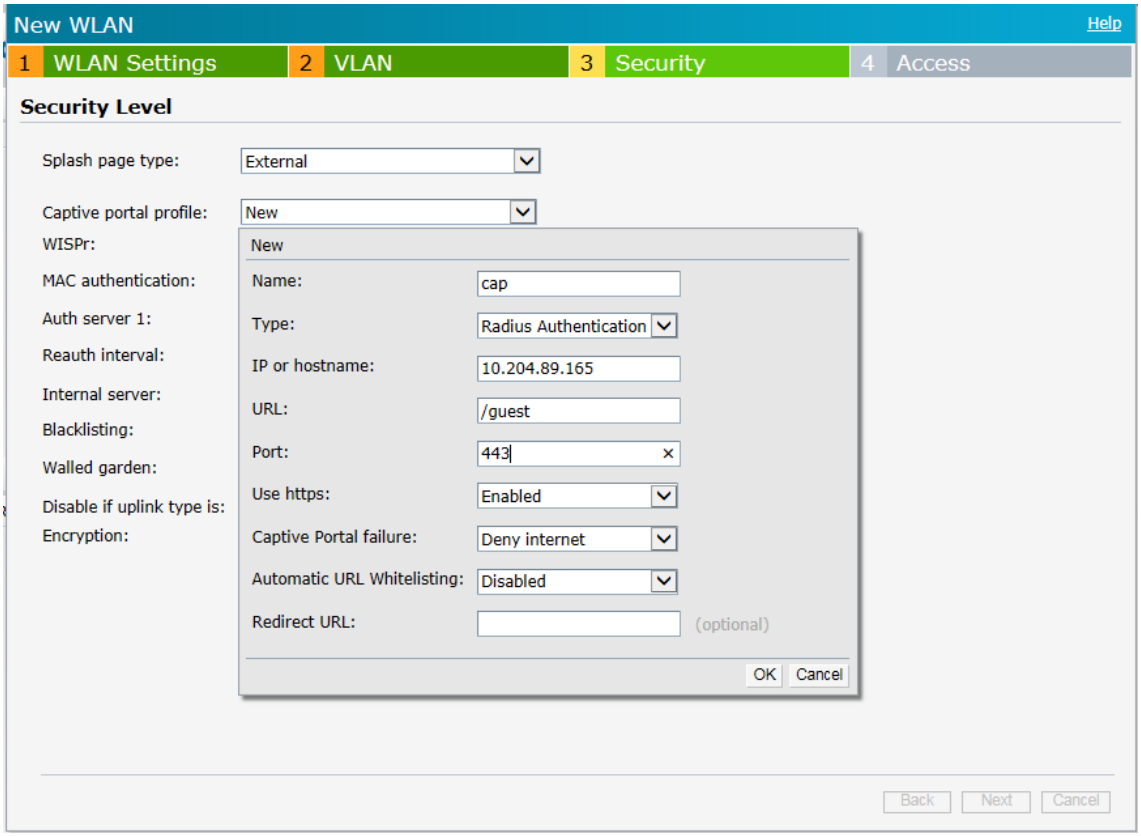
Figure 436: VLAN Settings



5. Keep the DHCP setting as per your network design.
   - Client IP assignment here **Network Assigned** is chosen.
   - For Client VLAN assignment here **Default**. is chosen
6. Click **Next**.

   The **Security** tab options appear.

Figure 437: Security Settings



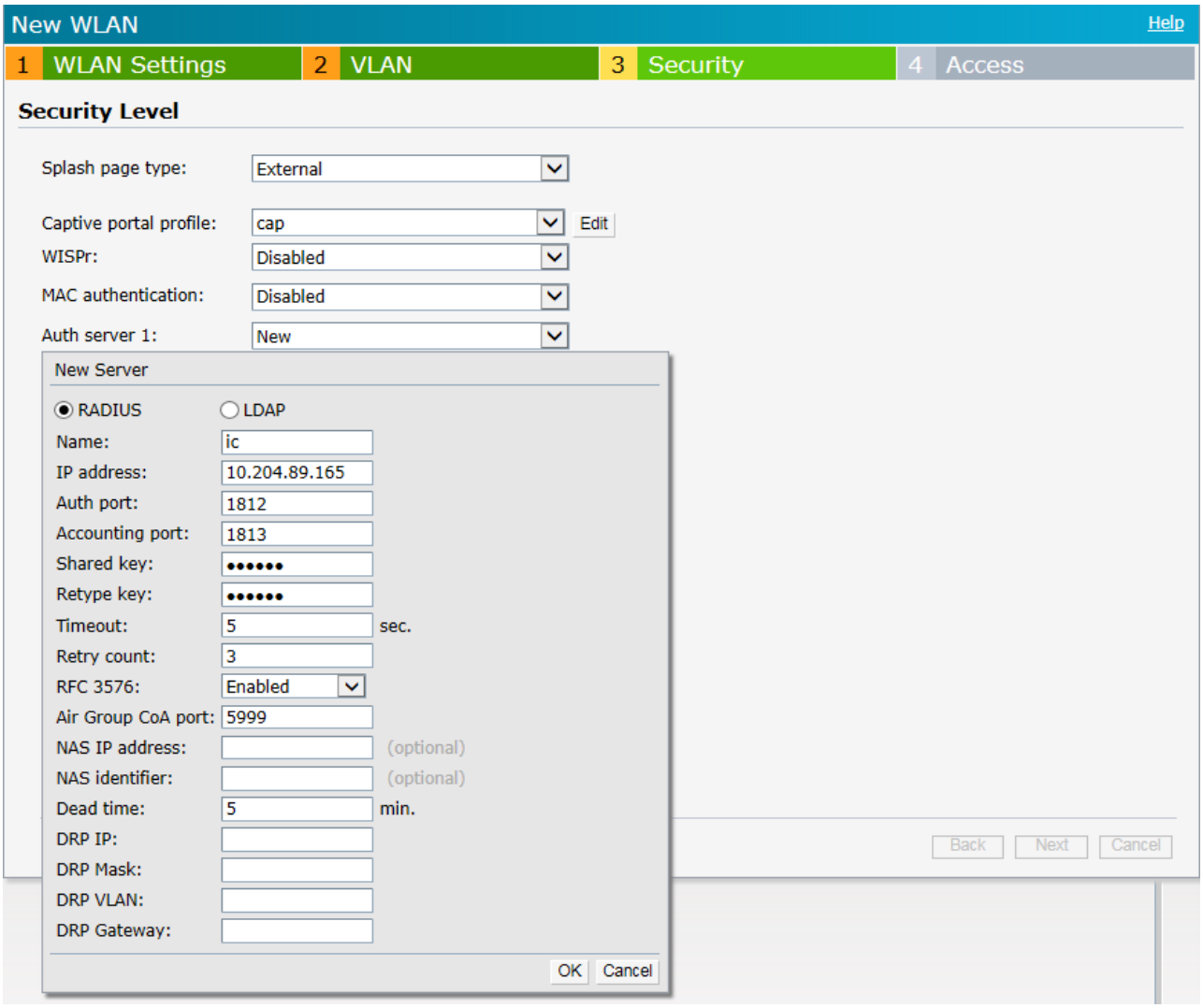
7. In the **Security Level** section do the following:
   - From the **Security page type,** drop-down list select **External**.
   - From the **Captive portal profile,** drop-down list select **New**

     The **New** screen appears.

     Enter the details as shown in the above figure and then click **OK**.

     The newly created captive portal appears in the **Captive portal profile** drop-down list.

Figure 438: Security Settings - Creating a New Server



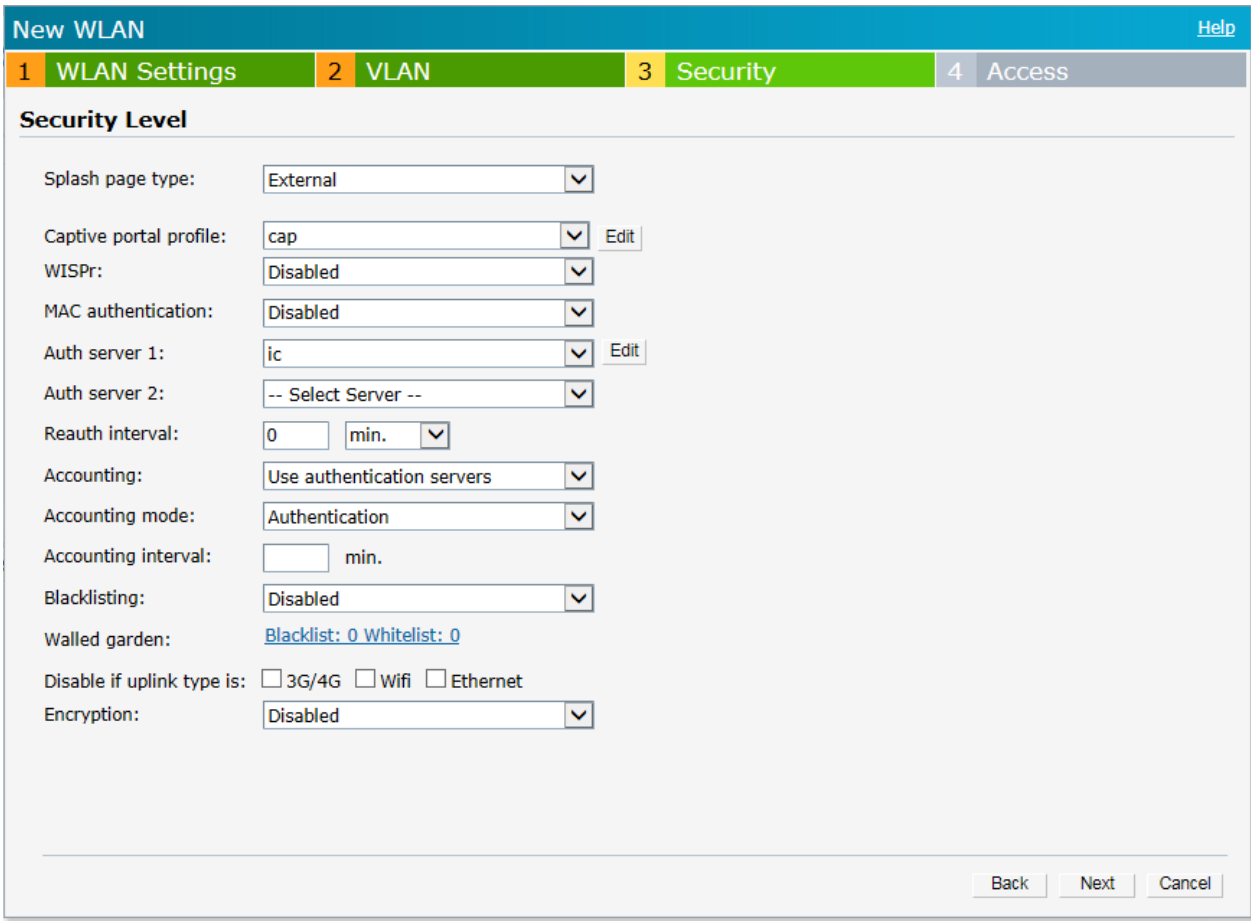
8. From the **Auth server 1** drop-down list select **New**.

   The **New Server** screen appears.

   Create a server pointing to PPS server. Enter the details as shown in the above figure and then click **OK**.

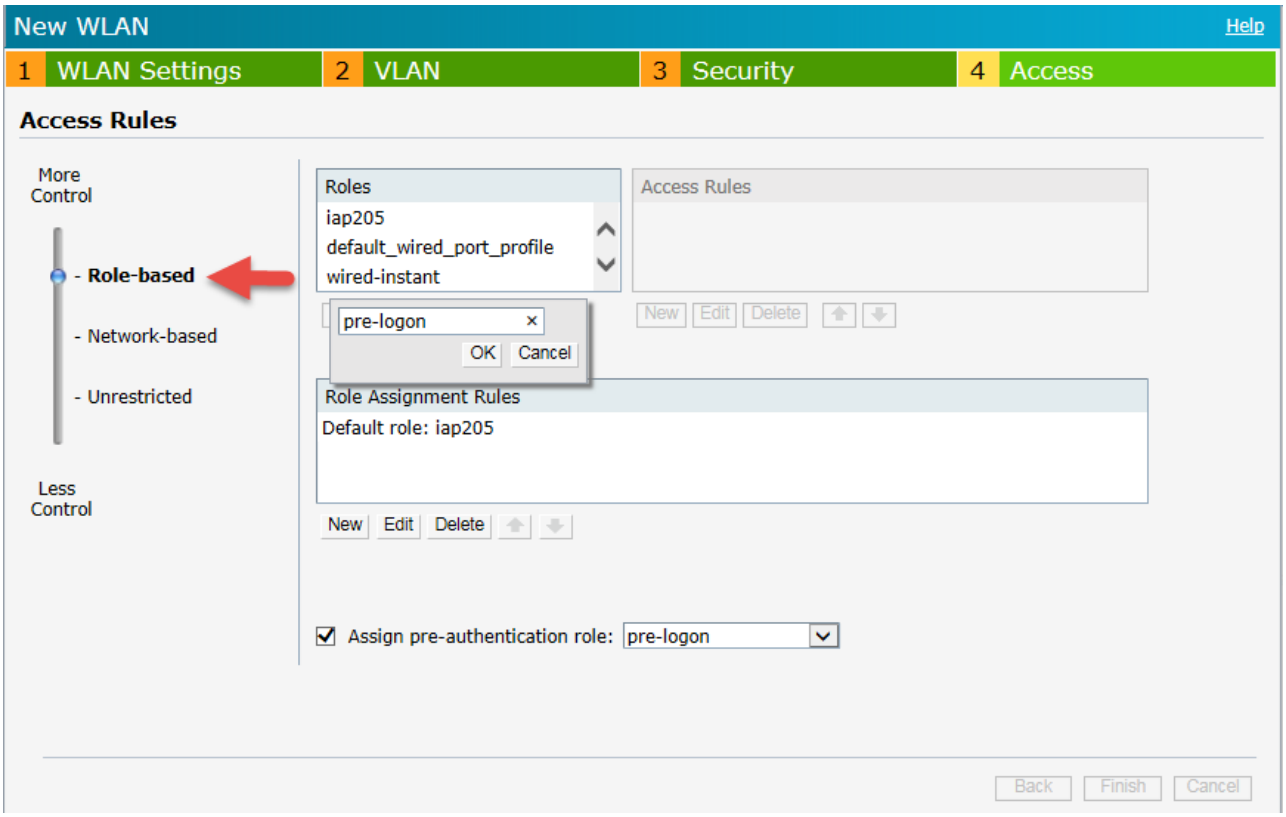
   The configured **Security** tab options appear as in the following figure.

Figure 439: Security Settings



9. Click **Next**. The **Access** tab options appear.

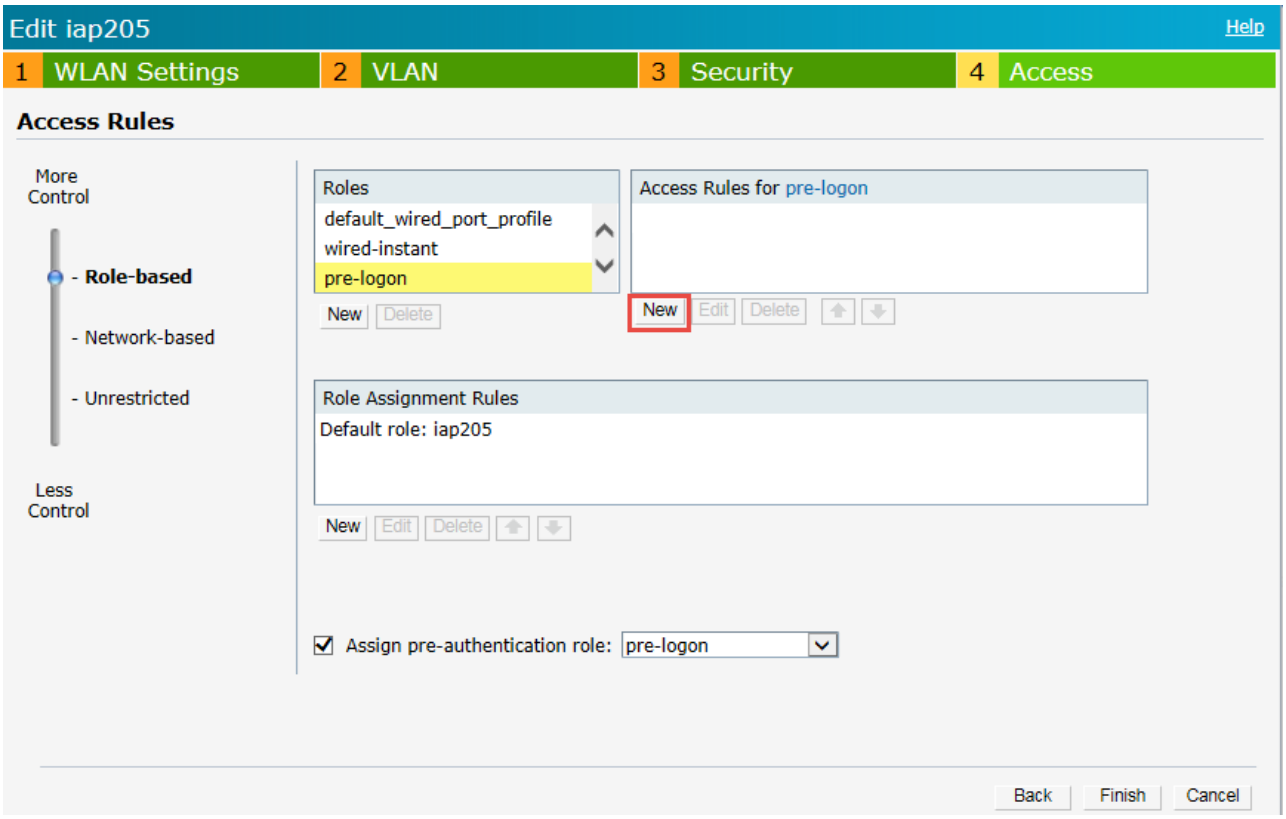
Figure 440: Access Settings



10. In the Access Rules section:

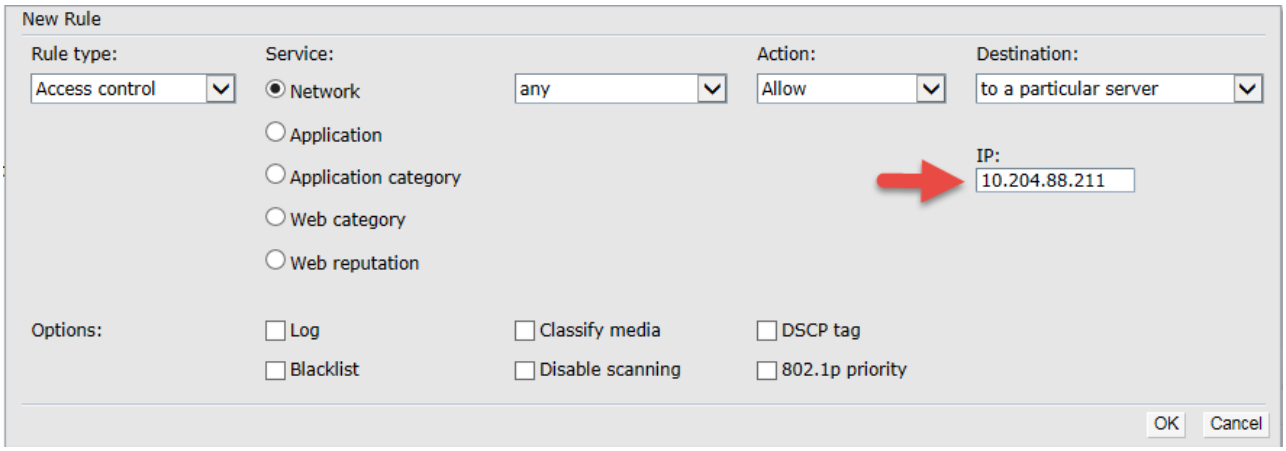
    - Move the slider to **Role-based**,
    - Under the **Roles** section, click **New** to create a new role 'pre-logon'.

Figure 441: Access Settings - Creating a Role



11. Under the **Access Rules** section click **New** to create an access rule for the role. The New Rule window appears.

Figure 442: Access Settings - Creating a Rule



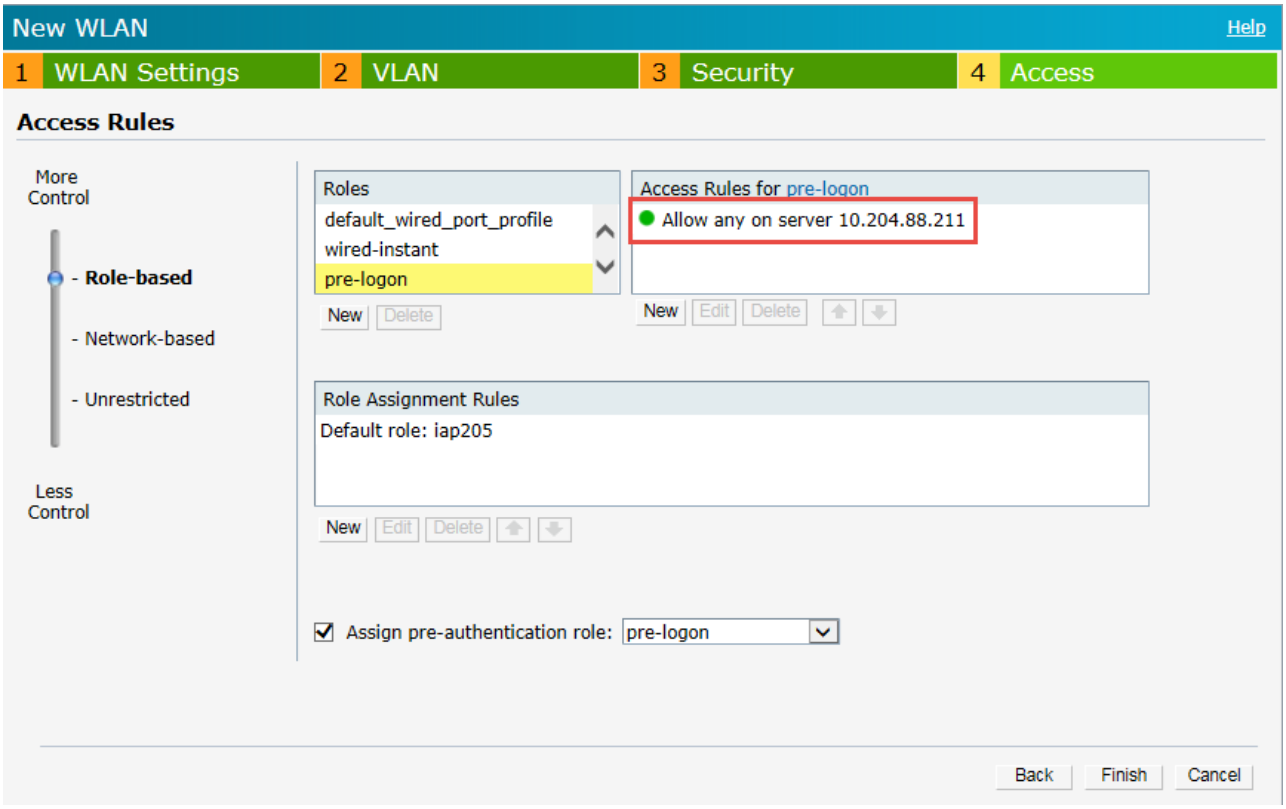
12. Select the options as shown in the above figure.

- From the **Destination** drop-down list select 'to a particular server'.
- In the **IP** box enter the PPS server's IP address.

Click **OK**.

The Access Rule appears in the **Access Rules for** list box.

Figure 443: Access Settings - Creating an Access Rule

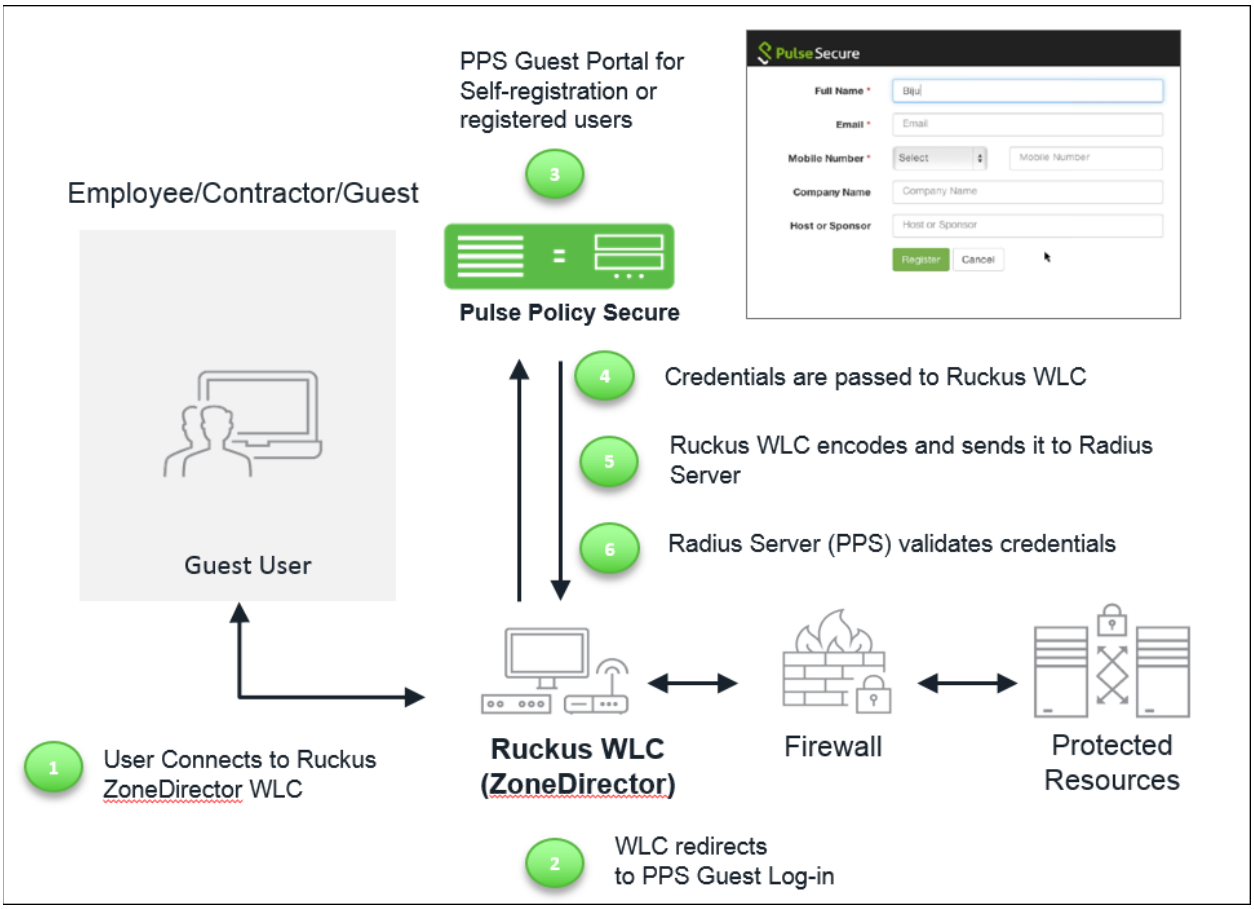


13. Select the **Assign pre-authentication role** check box and then select ‘pre-logon’ from the drop-down list.
14. Click **Finish** to complete the settings.

Configuring Ruckus WLC

Ruckus WLC is configured as Radius Client where PPS is the Radius Server. The below figure illustrates the workflow of Guest Access on PPS for Ruckus WLC. This section provides examples of how to configure the Ruckus WLC. For more information, see Ruckus documentation.

Figure 444: Guest Access on PPS for Ruckus WLC



To configure Ruckus WLC with PPS:

1. Connect user/endpoint to the Ruckus Wireless network with open SSID over 802.1X with restricted access through ACLs.
2. Redirect Ruckus WLC guest to external (PPS) captive portal when guest tries to access a web-resource.
3. Enter credentials on captive portal page.
4. For guest access authentication, PPS provides guest user credentials to Ruckus SmartZone WLC's management interface via REST API.
5. Ruckus WLC can encode the credentials and send it to a RADIUS server (PPS) through Radius Access Request.
6. The RADIUS server validates the credentials and sends a RADIUS response, which contains standard RADIUS attributes and Vendor Specific Attributes.

7. Ruckus WLC provides network access to the guest by changing VLAN based on PPS role-based policy.

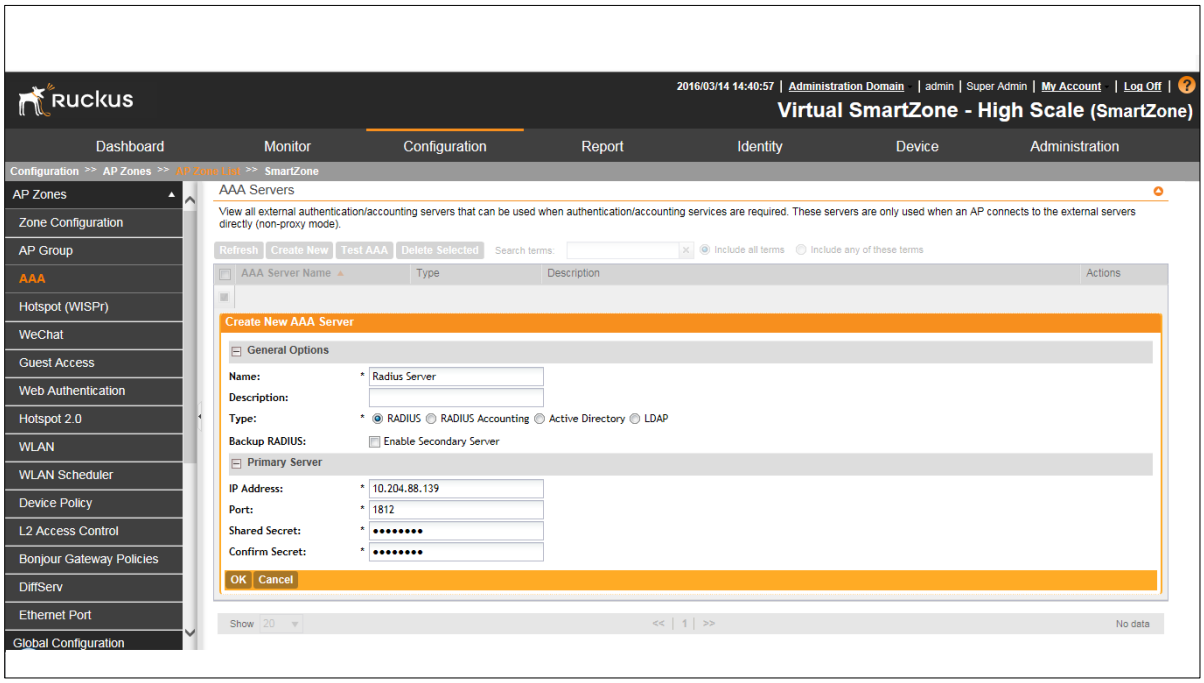
Ruckus SmartZone WLC Configuration

The Ruckus SmartZone software platform provides unified software architecture across wireless LAN (WLAN) controllers, for appliance, virtualized and cloud environments for deployment flexibility.

To configure SmartZone WLC:

1. Configure PPS as Radius Sever.
2. Select **Configuration > AP Zone > Zone Name > AAA servers> Create New**.
3. Configure Name, IP Address, Shared Secret and Confirm Secret.

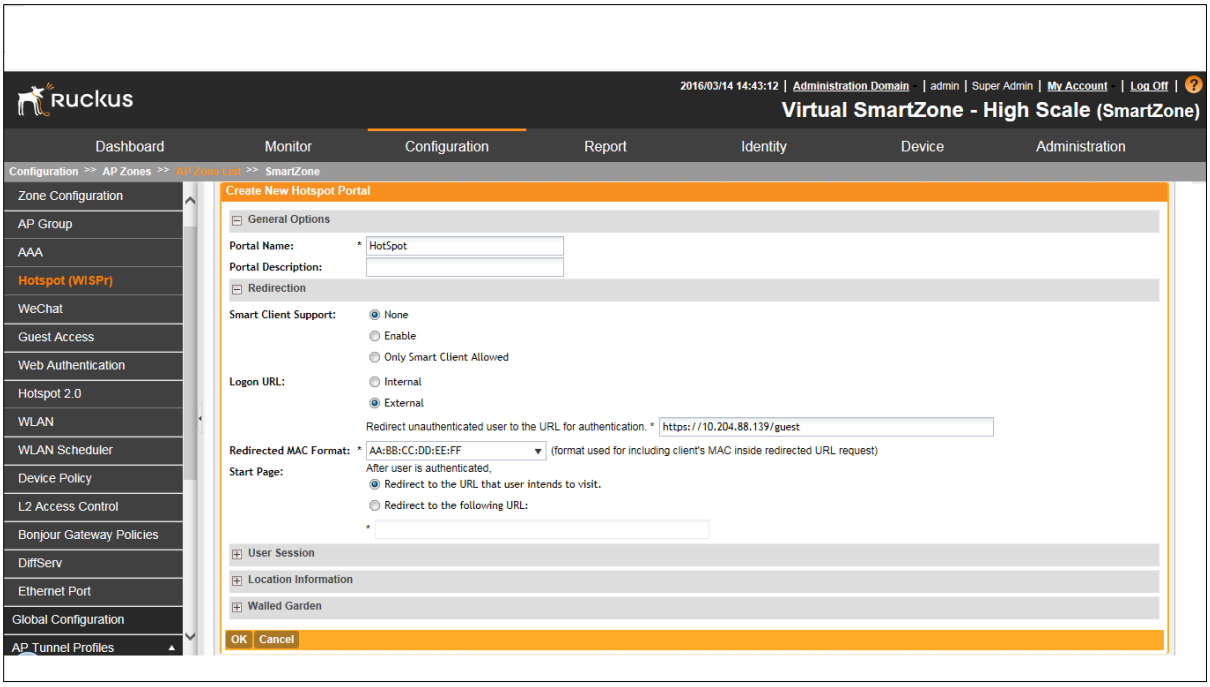
Figure 445: SmartZone WLC Configuration



To configure Hotspot (WISPr) service:

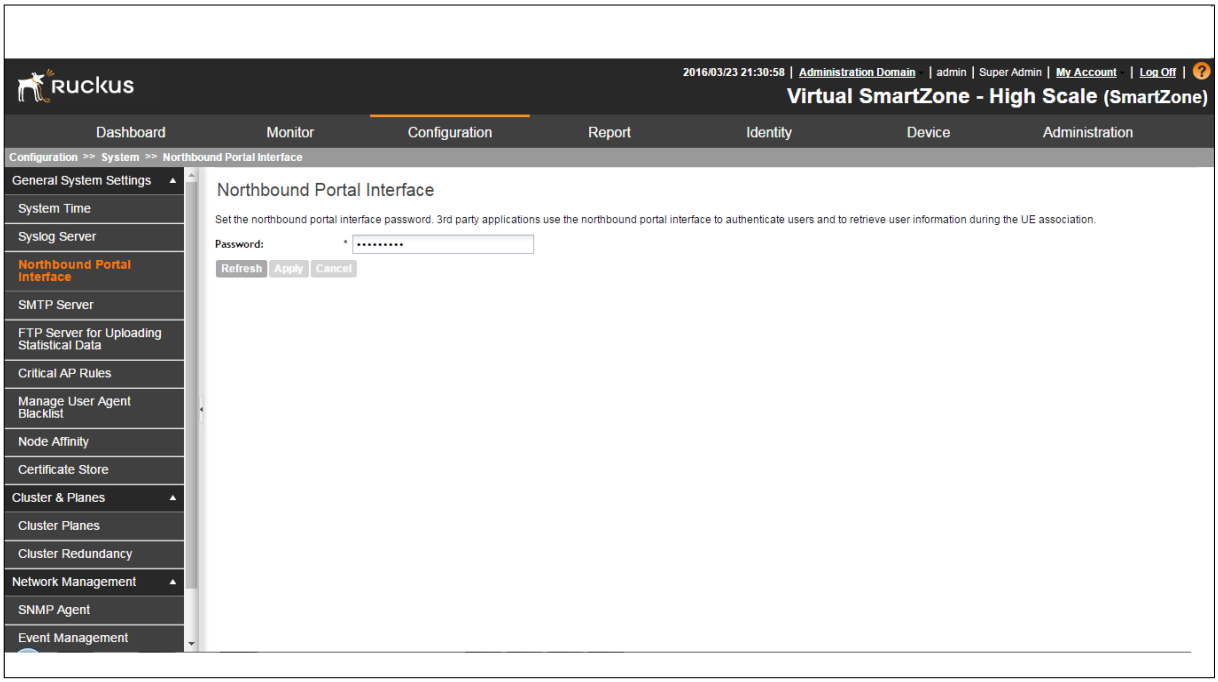
1. Select Configuration > AP Zone > Zone Name > Hotspot (WISPr)> Create New.

Figure 446: SmartZone Hotspot Service



2. Configure Portal Name, Login URL text box with https://pps-ip/guest.
3. Configure Northbound Interface password as Ruckus Request Password on Radius Client page in PPS.

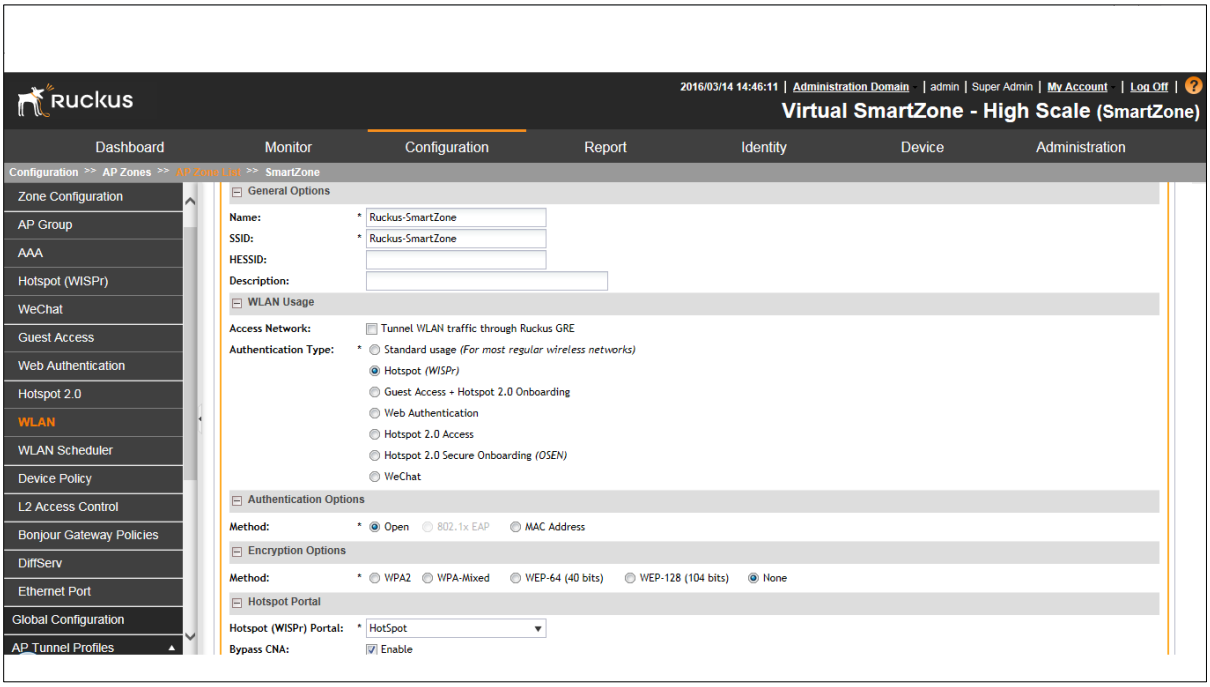
Figure 447: Northbound Portal Interface – Ruckus SmartZone



To configure WLAN:

4. Select Configuration > AP Zone > Zone Name >WLAN > Create New.
5. Configure Name, SSID, Authentication type as “Hotspot (WIPSr) “, Authentication Method as “open” and Encryption as “None”.
6. Select Hotspot configured from drop down list and select Authentication Server.

Figure 448: SmartZone WLAN

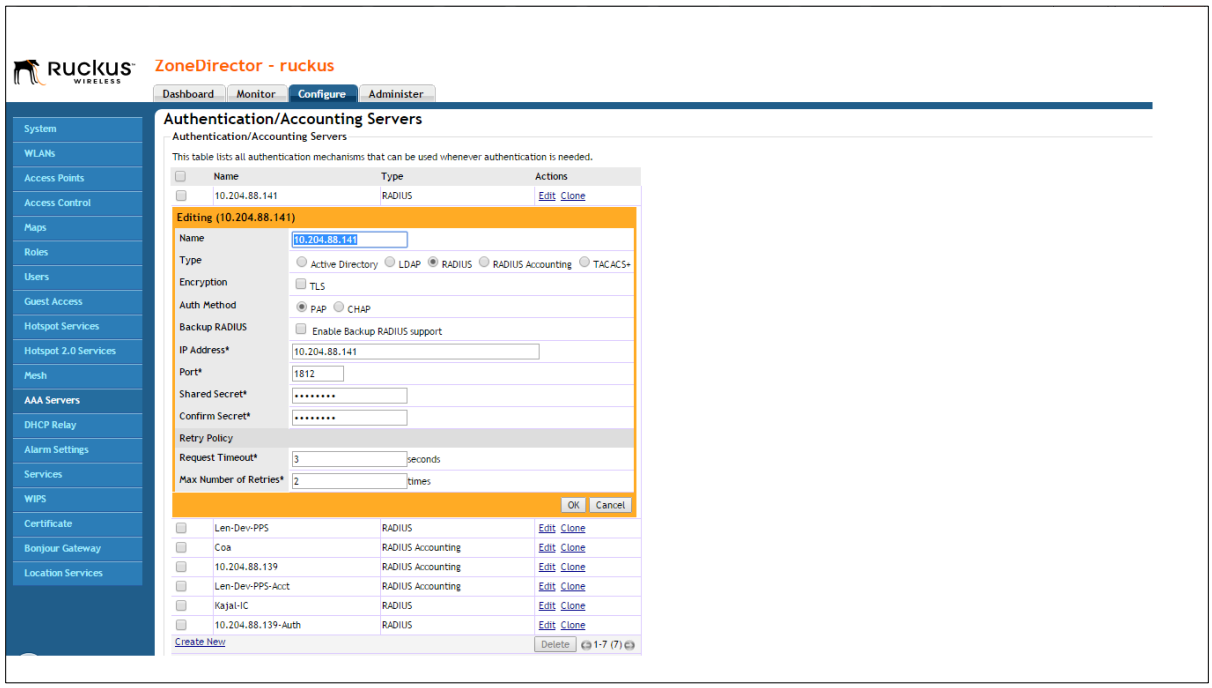


Ruckus ZoneDirector WLC Configuration

The following steps give configuration of Ruckus ZoneDirector WLC:

1. Configure PPS as Radius Sever.
2. Select Configuration > AP Zone > Zone Name > AAA servers > Create New.
3. Enter Name, select “Type” as “Radius”, IP Address, Shared Secret and Confirm Secret.

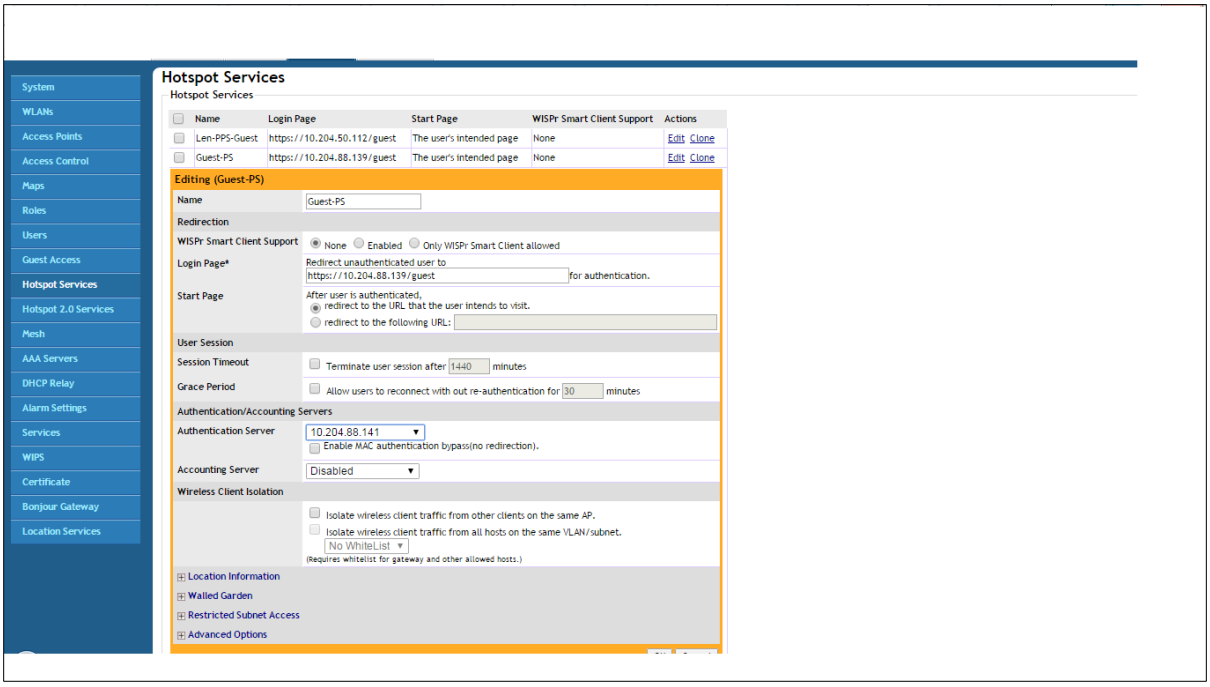
Figure 449: ZoneDirector WLC Configuration



To configure Hotspot (WISPr) service:

1. Select **Configuration > AP Zone > Zone Name > Hotspot Services>Create New**.
2. Configure Name, Login page text box with https://pps-ip/guest.
3. Select authentication server configured in AAA servers.

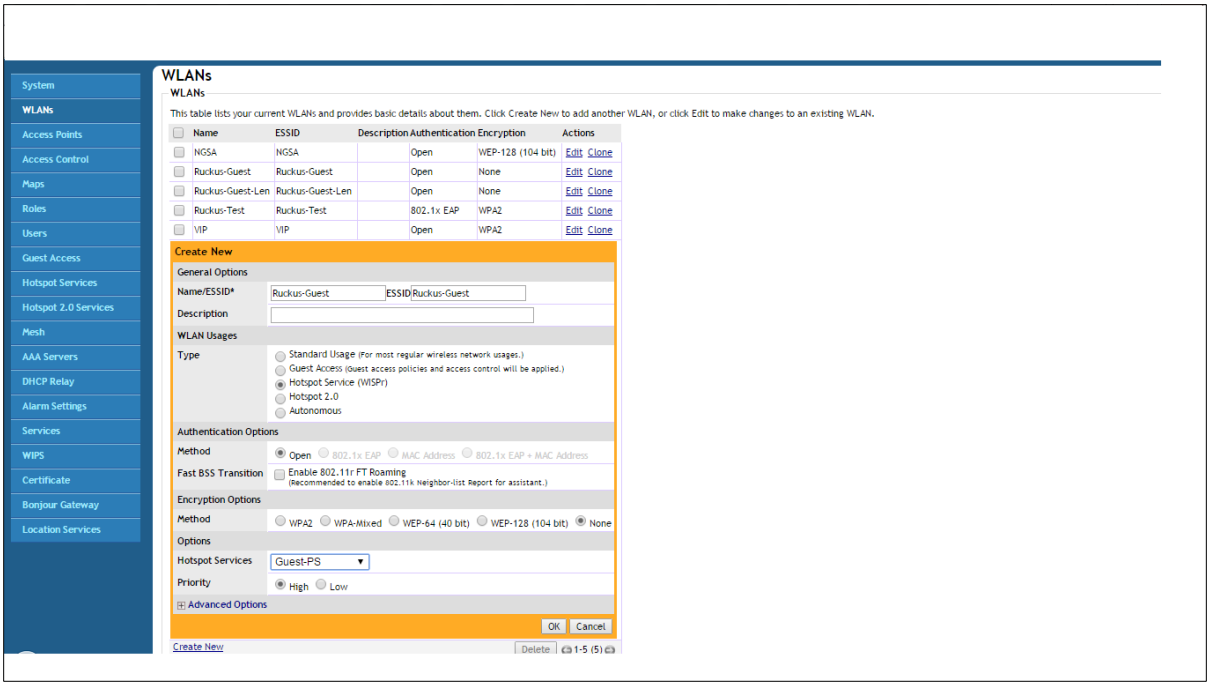
Figure 450: ZoneDirector Hotspot Services



To configure WLAN:

1. Go to **Configuration > AP Zone > Zone Name >WLAN > Create New**.
2. Enter the Name, SSID, Authentication type as “Hotspot (WIPSr)“, Authentication method as “Open” and Encryption as “None”.
3. Select Hotspot services as “Guest PS” from drop down list.

Figure 451: ZoneDirector WLAN



1. Click **OK** to save changes to the settings.

Verifying Device Certificates

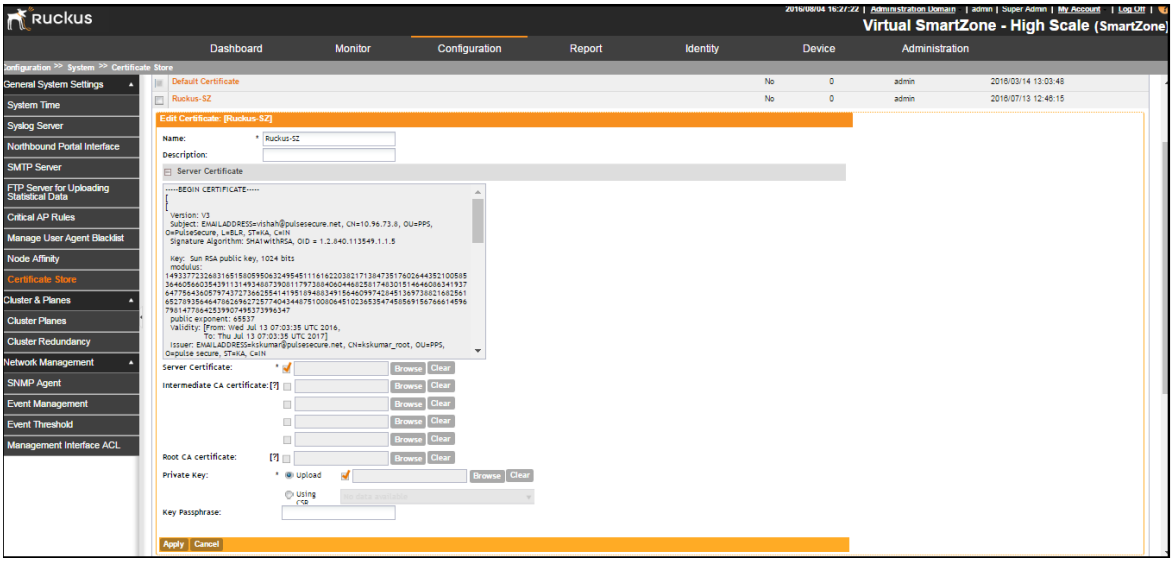
Ruckus device certificate validation enhances the security between PPS and the Ruckus device for guest access. It allows PPS to verify whether the server certificate is from a trusted source. This topic describes how to configure the PPS for validating device certificates, create certificates on Ruckus, and check the validity of the certificate.

Step1: Creating a Server Certificate

To create a CSR:

1. From Certificate Server generate a Server Certificate with private key and import the certificate on Ruckus SmartZone.
2. To import the certificate on Ruckus, select **Configuration > System > Certificate Store > Import**.

Figure 452: Creating Server Certificate



Step2: Importing the Certificate on PPS

To import the certificate on PPS:

1. Obtain the root CA from the certificate server for the generated certificate.
2. Select **System > Configuration > Certificates > Trusted Server CAs > Import Trusted Server CA** and import the certificate.

Step3: Adding Ruckus Wireless device as RADIUS Client

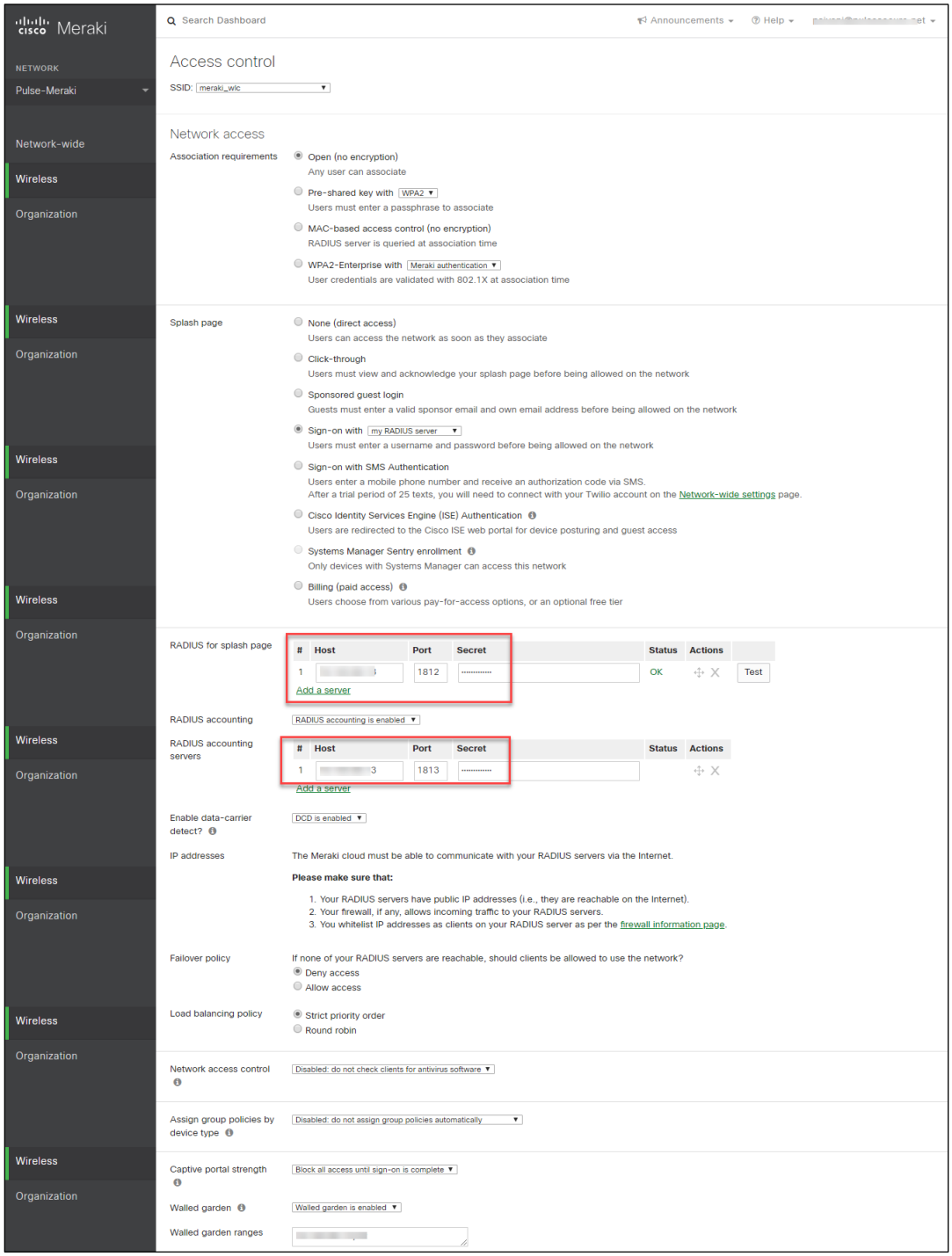
To add Ruckus wireless device to PPS:

1. Select **Endpoint policy > Network Access > RADIUS Client > New RADIUS Client**.
2. Select **Ruckus Wireless** as a Radius client and enable **Ruckus Server Certificate Validation**.
3. (Optional) From client machine, perform a guest authentication, if the guest user is able to authenticate then the certificate is valid. Otherwise it is an invalid certificate or certificate is not available.
4. (Optional) Verify the event logs to check if there are any certificate invalid logs.

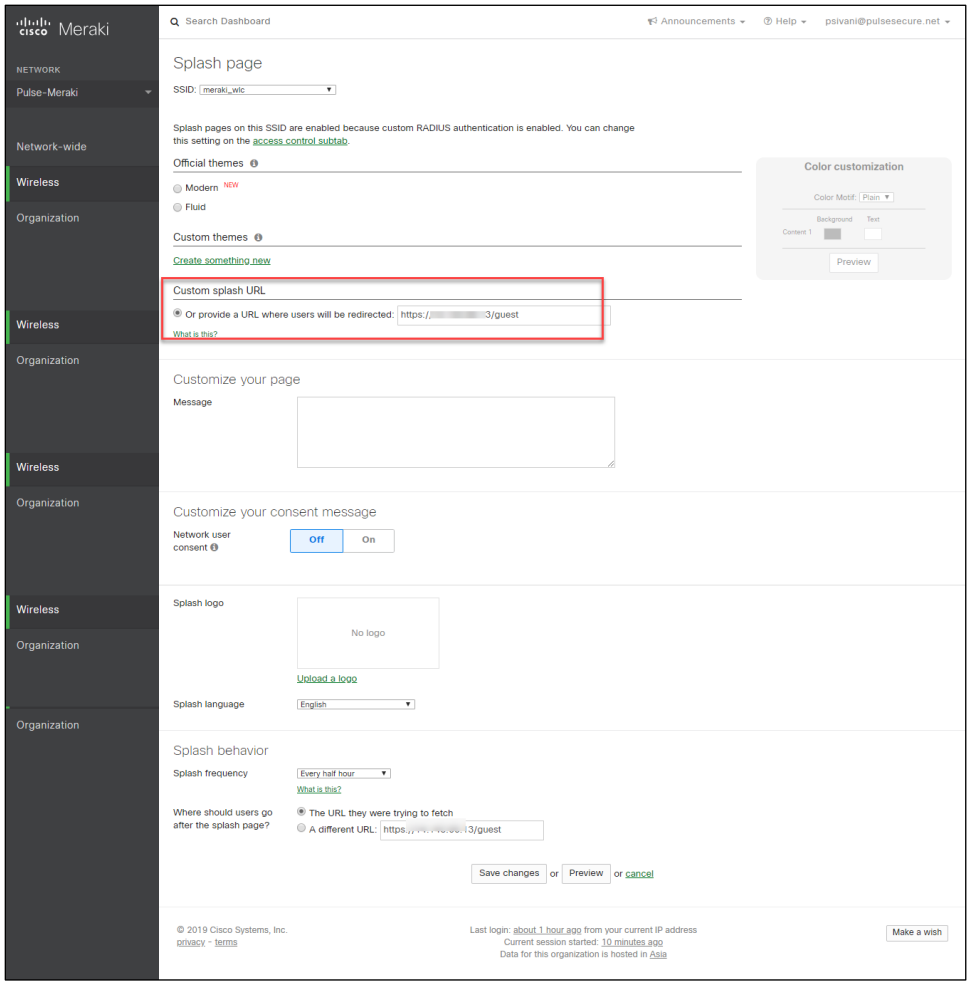
Cisco Meraki WLC Configuration

The following steps give configuration of Cisco Meraki WLC:

1. Configure PPS as Radius Sever.
2. Select **Wireless > Access Control** > **Select SSID.**
3. Configure Radius Authentication and Accounting Server for the Splash page.



4. Navigate to **Wireless > Splash Page**. Configure the PPS URL where the users will be redirected.



For more information, see Meraki documentation.

Enterprise Onboarding

This chapter covers the following topics:

- Overview
- Deployments
- Configuring Enterprise Onboarding
- Troubleshooting

Overview

PPS Enterprise Onboarding feature automatically configures and provisions mobile and personal devices running on platforms such as Windows, MAC OSX, Android, and iOS. It enables them to securely connect to the enterprise network in support for Bring Your Own Device (BYOD) initiatives.

The onboarding provides a way to configure Wireless, VPN, and device certificate profiles on a device. Using these profiles the users can securely connect to enterprise network and access enterprise resources. The profiles can be configured on a single PPS server dedicated to onboarding or on each server.

The supported profiles depend on the device type and whether the Pulse Secure client is installed. For enterprise onboarding a separate license called "*Advanced Mobile Licenses – Onboarding"* is required.

NOTE:

- Android platform supports all profiles. However, Pulse Secure application must be installed during onboarding.
- iOS platform supports all profiles through Safari browser.
- Windows platform supports Wi-Fi and certificate profiles (IE, Firefox, or Chrome browser). The Pulse Secure client onboarding application must be installed during onboarding. Windows 8 RT and Windows 8 Phone are not supported.
- MAC OSx platform supports Wi-Fi and certificate profiles (Safari browser).

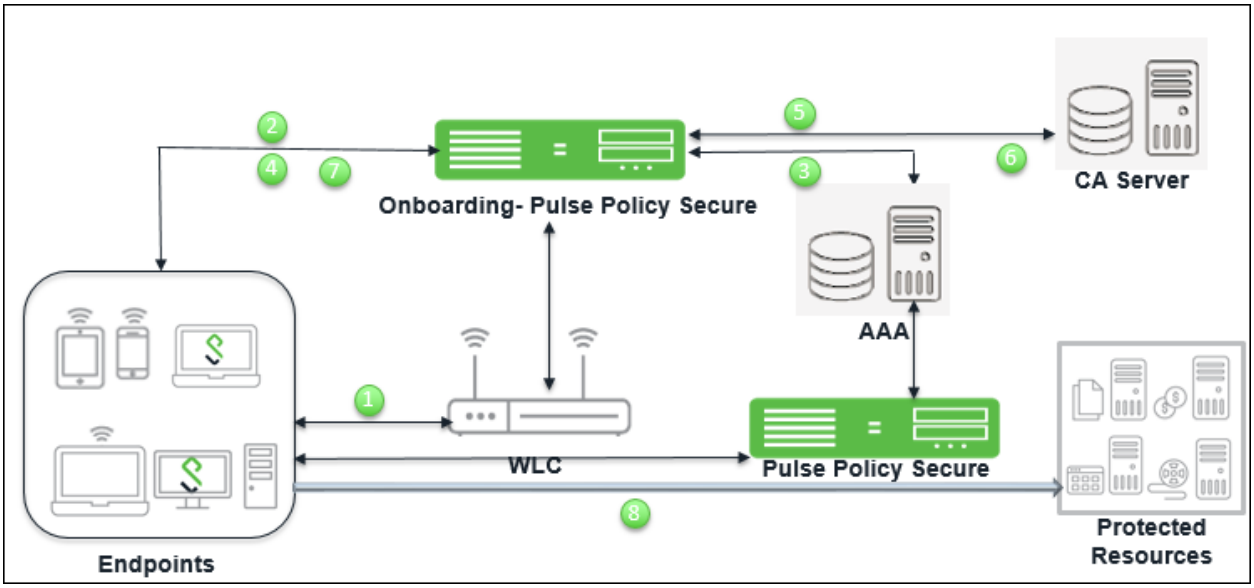
You can see more information on the supported platforms in the Supported Platform document.

You can also define the profiles on an external MDM server. If an external MDM server is used, the user will see a link and instructions on the onboarding page to continue onboarding. Onboarding is initiated from the browser.

Deployments

Enterprise Onboarding allows users to securely access enterprise network resources with any device. Wi-Fi, VPN and certificate profiles can be defined and downloaded to a device during onboarding, depending on the device type. The deployment diagram illustrates how a BYOD user can get onboarded through PPS to connect to enterprise network and access enterprise resources.

Figure 453: Enterprise Onboarding



The workflow for enterprise onboarding is described below:

15. User tries to connect to enterprise network using the BYOD.
16. WLC is configured with Captive portal, which redirects the user to PPS login page where the devices can be onboarded.
17. User is authenticated through AAA framework.
18. User is provided with an onboarding link.
19. To generate and provision device certificate, PPS submits CSR to CA server.
20. CA server signs the CSR and sends the certificate to PPS.
21. PPS pushes the configured profiles to devices.
22. User logins and access the network.

Configuring Enterprise Onboarding

This section covers the configuration for enterprise onboarding. It involves configuring the profiles, SCEP server and CSR templates.

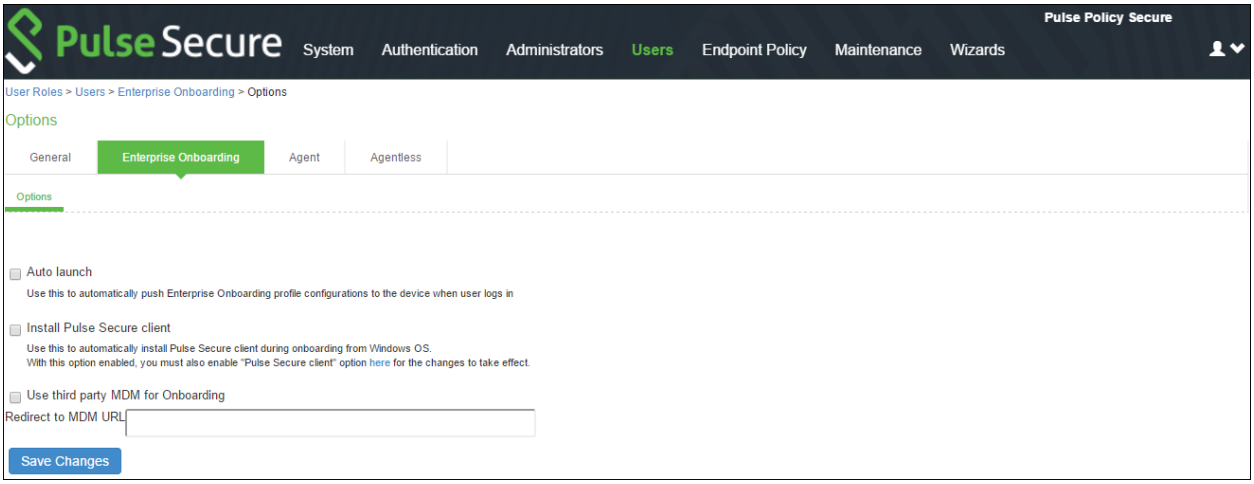
The Administrator can perform the following configurations for enterprise onboarding:

Configuring Enterprise Onboarding for a User Role

Enterprise onboarding is enabled in the user role, and each profile can be applied to all user roles or specific roles. The SCEP server and CSR templates allow certificates to be generated dynamically for device and server authentication.

To enable enterprise onboarding for a user role:

1. In the admin console, choose **Users > User Roles >** *RoleName* **> General > Overview**.
2. In the Enterprise Device Onboarding section, select the **Enterprise Onboarding** check box.
3. Click **Save Changes**.
4. Click the **Enterprise Onboarding** tab or click **Options** next to the **Enterprise Onboarding** check box to specify the following:
   - **Auto launch** – Displays the onboarding page when the user logs in to PPS if enterprise onboarding is enabled for the user's role (the default). If this option is disabled, an onboarding link is displayed on the home page.
   - **Install Pulse Secure client** – Select this option to automatically install Pulse Secure Client during windows onboarding.
   - **Use third party MDM for onboarding** – Displays a link on the onboarding or home page where the user can download profiles from an MDM server. Enter the URL for the MDM page in the text box.



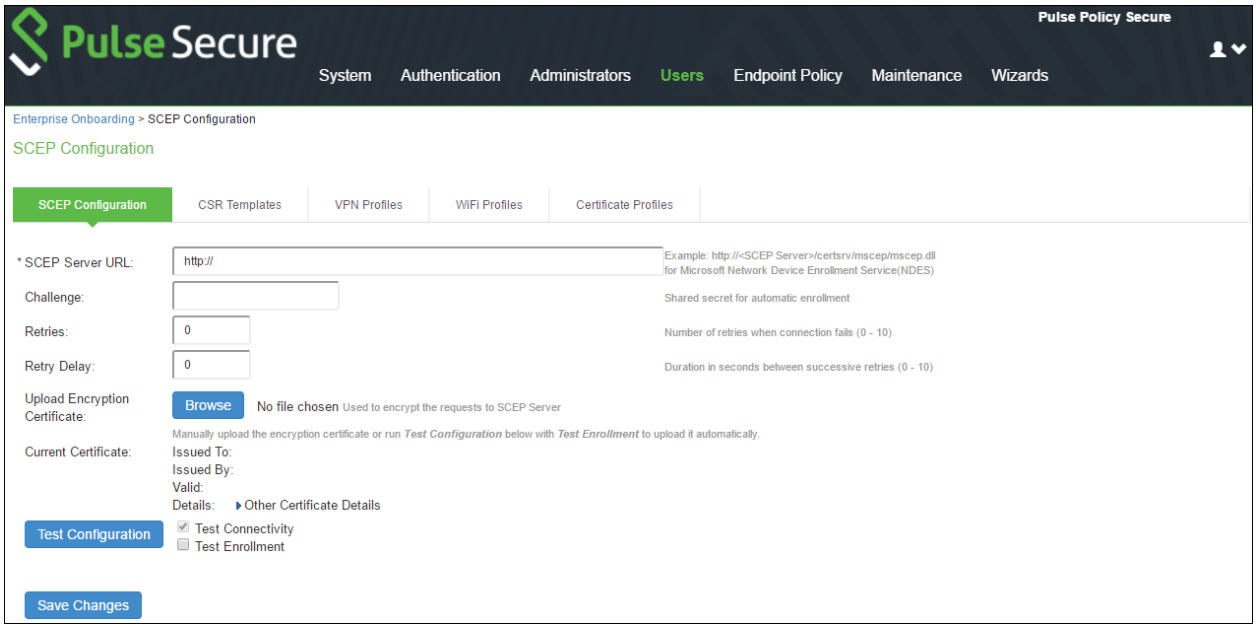
5. Click **Save Changes**.

Configuring the SCEP Server

The Simple Certificate Enrollment Protocol (SCEP) server configuration and CSR templates allows each client device to dynamically obtain certificates for authentication. The SCEP server and CSR templates allow certificates to be generated dynamically for device and server authentication.

To define the SCEP server:

1. Select **Users > Enterprise Onboarding**.
2. Click SCEP Configuration.



3. Complete the configuration as described below.

Setting	Description
SCEP Server URL	Enter the URL for a SCEP server. The following SCEP servers are supported: • Microsoft AD 2008 • Symantec mPKI
Challenge	Specify the password required by the SCEP server.
Retries	Specify the number of attempts to access the server when the first attempt fails.
Retry Delay	Specify the number of seconds between retry attempts.
Upload Encryption Certificate	Click **Browse** to upload the certificate used to encrypt SCEP requests. To upload the certificate automatically, select the **Test Enrollment** check box, select a CSR template, and click **Test Configuration**.

4. Click **Save Changes**.

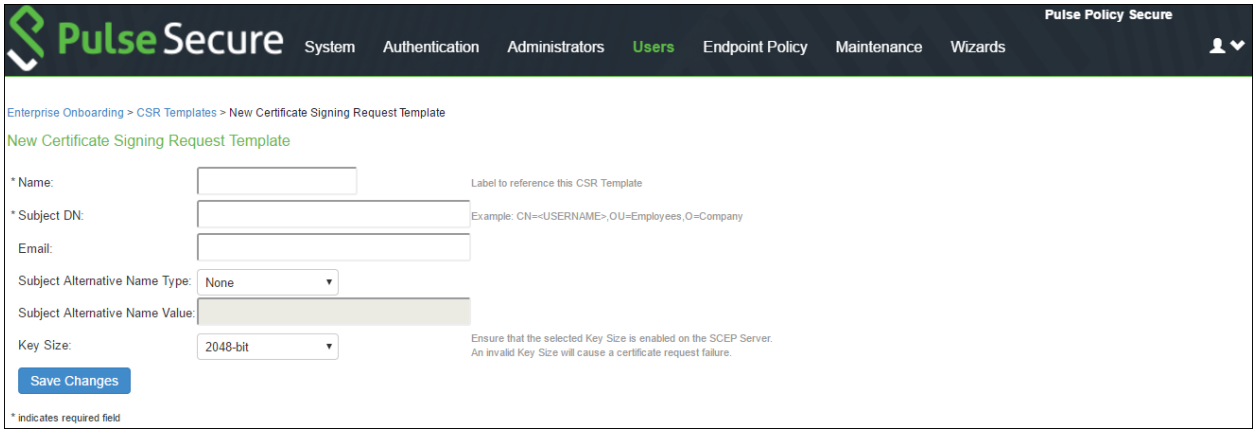
Configuring CSR Templates

If the SCEP server is configured, the Certificate Signing Request (CSR) templates can be used in the VPN, Wi-Fi, and certificate profiles to allow each onboarded device to dynamically obtain certificates for authentication on iOS devices. Up to 10 templates can be defined.

NOTE: All LDAP attributes (such as **<ldap.userAttrName>**) and variables (such as **<user>**) can be used in the Subject DN, Email, and Subject Alternative Name Value fields. However, if you enter an LDAP variable with a string vector data type in the Subject Alternative Name Value field, only the first value in the string will be used.

To configure CSR templates:

1. In the admin console, choose **Users > Enterprise Onboarding > CSR Templates**.
2. To add a template, click **New CSR Template** or select an existing template that you want to change, duplicate, or delete. Clicking **Duplicate** creates a copy of the selected template with **Copy of** before the template name.



3. Specify the following information:

Setting	Description
Name	Specify the template name displayed in the list of CSR templates.
Subject DN	Specify the subject distinguished name. For example: **CN=<USERNAME>,OU=Engineering,O=Comp** All LDAP attributes (such as **<ldap.userAttrName>**) and variables (such as **<user>**) can be used.
Email	(Optional) Specify an email address with the <USER> variable, such as **<USER>@sample.net**.
Subject Alternative Name Type	Select an alternative name type if the CA requires an alternative subject name. The types include RFC-822 Name (an e-mail address), DNS domain name, URI, and IP address.
Subject Alternative Name Value	Specify one or more values for the selected alternative name type. Multiple values must be separated by a comma or space. NOTE: If an LDAP variable is specified that has a string vector data type, only the first value in the string will be used.
Key Size	Select the key size used by the SCEP server.

4. Click **Save Changes**.

Configuring VPN Profiles

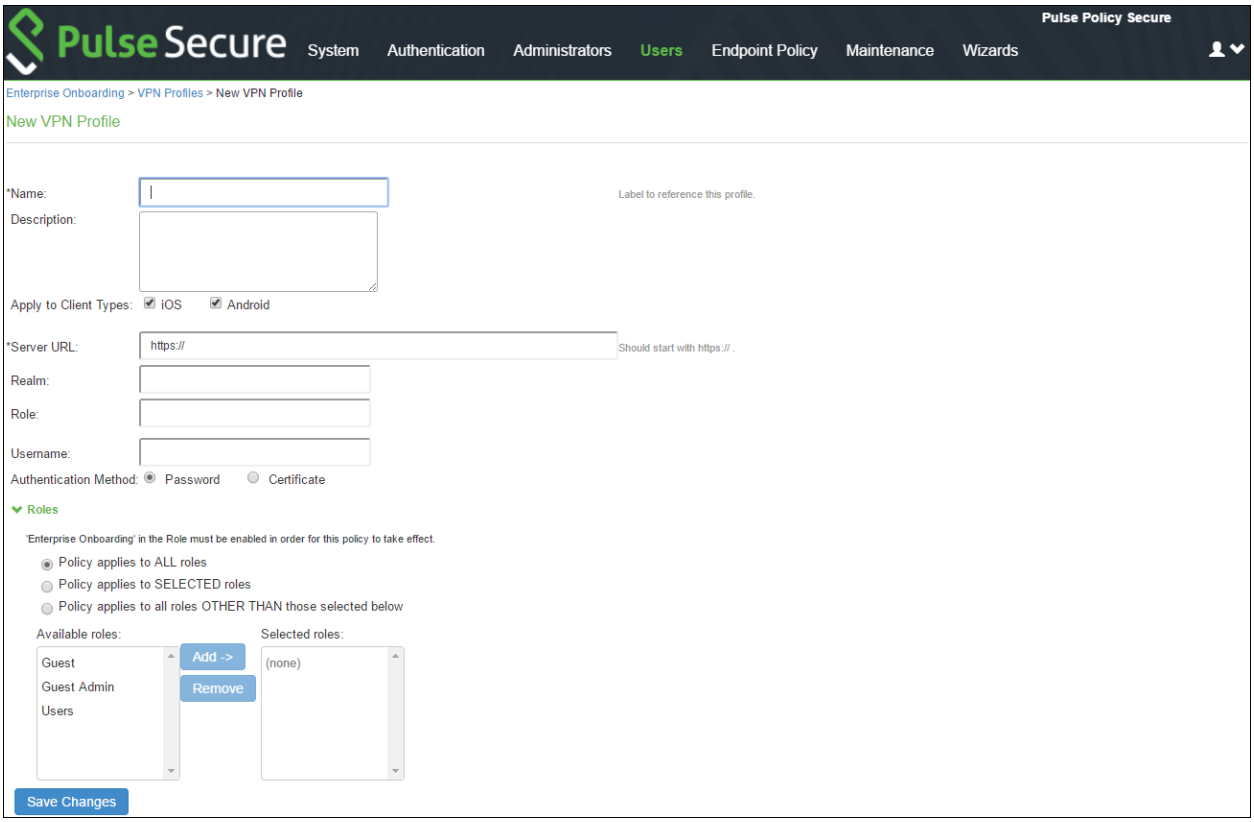
VPN profiles provide Android and iOS devices with secure access to enterprise networks. One or more VPN profiles can be assigned to specific user roles or to all roles. Up to 10 profiles can be defined.

NOTE: All LDAP attributes (such as **<ldap.userAttrName>**) and variables (such as **<user>**) can be used in the Username, Realm, and Role fields.

To define VPN profiles:

1. In the admin console, choose **Users > Enterprise Onboarding > VPN Profiles**.
2. To add a profile, click **New Profile** or select an existing profile that you want to change, duplicate, or delete. Clicking **Duplicate** creates a copy of the selected profile with **Copy of** before the profile name.

   The first profile that matches a user's role and client type becomes the default VPN profile on the client. Use the arrow keys to move a profile up or down the list.



3. Specify the following profile information:

Setting	Description
Name	Specify the name to be displayed in the list of VPN profiles.
Description	(Optional) Enter a description of the VPN profile.
Apply to Client Types	Select the device types the profile applies to (Android and iOS only).
Server URL	Specify the URL of the VPN server (must be a PPS device).
Realm	Specify the realm name. The realm is required only if the sign-in URL has the **User picks from a list of authentication realms** option enabled.

Setting	Description
Role	Specify the user role. The user role is required if the role mapping rules for the user realm specify multiple roles and the **User must select from among assigned roles** option is enabled.
Username	Specify the <USER> variable for the user name.

Authentication Method	Select **Password** or **Certificate** for the user authentication method. For certificate authentication, specify the following:
	• **Use CSR Template**—Select the CSR template used to obtain the certificate. To create a CSR template, see "Defining CSR Templates".
	• **Enable VPN On Demand**—Select this option to allow iOS devices to establish the VPN when a specific host or domain is accessed. To specify the first host or domain:
	  • **Match Domain or Host**—Enter a hostname or a partial domain name. For example, if you enter **example.com**, a match occurs when the user accesses any domain that ends with **example.com**, such as **www.test-example.com**.
	  • **On Demand Action**—When a match occurs on the specified host or domain, select whether a VPN is always established, never established, or only if the DNS look-up fails (**Establish If Needed**). Selecting **Never Establish** does not prevent an existing VPN from being used.
	To add another domain, click the **+** button. To remove a domain, select the check box next to the domain and click the **-** button. Up to 10 domains can be defined.

Roles	Select one of the following options: • **Policy applies to ALL roles**—To apply this profile to all users. • **Policy applies to SELECTED roles**—To apply this profile only to users who are mapped to roles in the Selected roles list. Make sure to add roles to this list from the Available roles list. • **Policy applies to all roles OTHER THAN those selected below**—To apply this profile to all users except for those who map to the roles in the Selected roles list. Make sure to add roles to this list from the Available roles list.

4. Click **Save Changes**.

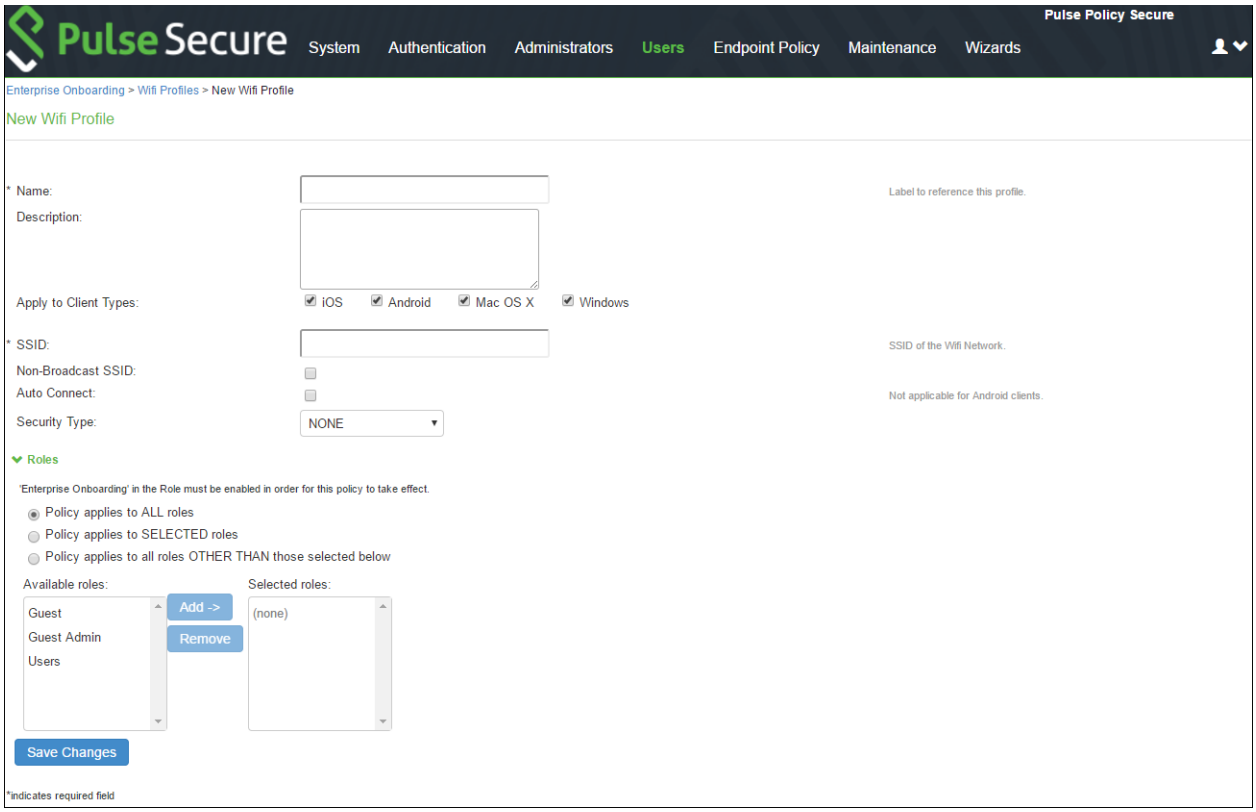
Configuring Wi-Fi Profiles

Wi-Fi profiles provide Android, iOS, MAC OS X, and Windows devices with secure access to wireless networks. One or more Wi-Fi profiles can be assigned to specific user roles or to all roles. Up to 10 profiles can be defined.

NOTE: All LDAP attributes (such as **<ldap.userAttrName>**) and variables (such as **<user>**) can be used in the Username and Password fields for the WPA Enterprise and WPA2 Enterprise security types.

To define Wi-Fi profiles:

1. In the admin console, choose **Users > Enterprise Onboarding > WiFi Profiles**.
2. To add a profile, click **New Profile** or select an existing profile that you want to change, duplicate, or delete. Clicking **Duplicate** creates a copy of the selected profile with **Copy of** before the profile name.



3. Specify the following profile information:

Setting	Description
Name	Specify the name to be displayed in the list of Wi-Fi profiles.
Description	(Optional) Enter a description of the profile.
Apply to Client Types	Select the device types the profile applies to (Android, iOS, MAC OS X, and Windows).
SSID	Specify the server set ID of the wireless network.
Non-Broadcast SSID	Select the check box if the wireless network does not broadcast its identity.
Auto Connect	Select the check box to connect the client automatically when the network is detected (not supported by Android clients).

Setting	Description
Security Type	Select the type of authentication used by the network, and specify the password or enterprise settings, as required: • **None**—No authentication required. • **WEP**—Wired Equivalent Privacy used for a non-enterprise network. Enter the network shared key in the displayed text box. • **WPA Personal** or **WPA2 Personal**—Wi-Fi Protected Access used for a non-enterprise network. You can select the encryption method (AES or TKIP) and enter the network shared key in the displayed text box (applies to Windows clients only). • **WPA Enterprise** or **WPA2 Enterprise**—Wi-Fi Protected Access used for an enterprise network. Select the Extensible Authentication Protocols (EAP) supported by the network's RADIUS authentication server. For Android devices, note the following: ◦ Android 4.3 or later is required ◦ For the EAP-TLS protocol, the CA certificate must be configured (along with the client certificate) on Samsung devices for authentication. ◦ An 802.1x RADIUS server certificate must be signed by a private root CA. Authentication fails if the certificate is signed by an intermediate root CA.
EAP	For the WPA Enterprise and WPA2 Enterprise security types, select the supported EAP protocols and specify the associated authentication settings: • **None**—If none of the EAP protocols is selected (Android devices only), enter the <USER> and <PASSWORD> variables in the Username and Password fields. NOTE: iOS, MAC OS X, and Windows clients require at least one of the EAP types to be selected (PEAP, EAP-TLS, or EAP-TTLS).
PEAP	The PEAP protocol is supported by all clients. Specify the following: • **Inner Authentication Method**—Select the protocol used to authenticate the username and password (None or MSCHAPv2). The None option is valid only for Android devices. • **Username and Password**—Enter the <USER> and <PASSWORD> variables. • **Outer Identity**—Specify an alternate username to be used outside the encrypted tunnel, such as **anonymous**, to conceal the user's identity in unencrypted packets. • **Trusted Server Name(s)**—Specify the IP address or fully qualified domain name of one or more trusted RADIUS servers used by the network. Multiple servers must be separated by a semicolon. • **Trusted CA Certificate**—For Windows clients, select the Trusted Root CA of the RADIUS server certificate, even if the device certificate is signed by an intermediate CA. The Trusted Root CA must be configured in a certificate profile before it can be selected here (see "Defining Certificate Profiles"). For iOS, MAC OS X, and Android clients, if the RADIUS server certificate is signed by an intermediate CA, create a certificate profile for the intermediate CA, and then select the certificate here. The certificate profile ensures that the intermediate CA is downloaded to the client.

Setting	Description
EAP-TLS	The EAP-TLS protocol is supported by all clients. Specify the following: • **Username**—Enter the <USER> variable. • **Use CSR Template**—Select the CSR template used to obtain the certificate. To create a CSR template, see "Defining CSR Templates". • **Trusted Server Name(s)**—Specify the IP address or fully qualified domain name of one or more trusted RADIUS servers used by the network. Multiple servers must be separated by a semicolon. • **Trusted CA Certificate**—For Windows clients, select the Trusted Root CA of the RADIUS server certificate, even if the device certificate is signed by an intermediate CA. The Trusted Root CA must be configured in a certificate profile before it can be selected here (see "Defining Certificate Profiles"). NOTE: On Windows 7 clients that have multiple certificates, users are prompted to select the certificate for 802.1x connections that use EAP-TLS. For iOS, MAC OS X, and Android, if the RADIUS server certificate is signed by an intermediate CA, create a certificate profile for the intermediate CA, and then select the certificate here. The certificate profile ensures that the intermediate CA is downloaded to the client.
EAP-TTLS	The TTLS protocol is supported by all clients. Specify the following: • **Inner Authentication Method**—Select the protocol used to authenticate the username and password (None, PAP, or MSCHAPv2). The None option is valid only for Android devices. • **Username and Password**—Enter the <USER> and <PASSWORD> variables. • **Outer Identity**—Specify an alternate username to be used outside the encrypted tunnel, such as **anonymous**, to conceal the user's identity in unencrypted packets. • **Trusted Server Name(s)**—Specify the IP address or fully qualified domain name of one or more trusted RADIUS servers used by the network. Multiple servers must be separated by a semicolon. • **Trusted CA Certificate**—For Windows clients, select the Trusted Root CA of the RADIUS server certificate, even if the device certificate is signed by an intermediate CA. The Trusted Root CA must be configured in a certificate profile before it can be selected here (see "Defining Certificate Profiles"). Also, if the RADIUS server certificate is signed by an intermediate CA, then the public intermediate CA must be configured in a certificate profile to ensure that the intermediate CA is downloaded to the client along with the Wi-Fi TTLS profile configuration. For iOS, MAC OS X, and Android clients, if the RADIUS server certificate is signed by an intermediate CA, create a certificate profile for the intermediate CA, and then select the certificate here. The certificate profile ensures that the intermediate CA is downloaded to the client.
Roles	Select one of the following options: • **Policy applies to ALL roles**—To apply this profile to all users. • **Policy applies to SELECTED roles**—To apply this profile only to users who are mapped to roles in the Selected roles list. Make sure to add roles to this list from the Available roles list. • **Policy applies to all roles OTHER THAN those selected below**—To apply this profile to all users except for those who map to the roles in the Selected roles list. Make sure to add roles to this list from the Available roles list.

4. Click **Save Changes**.

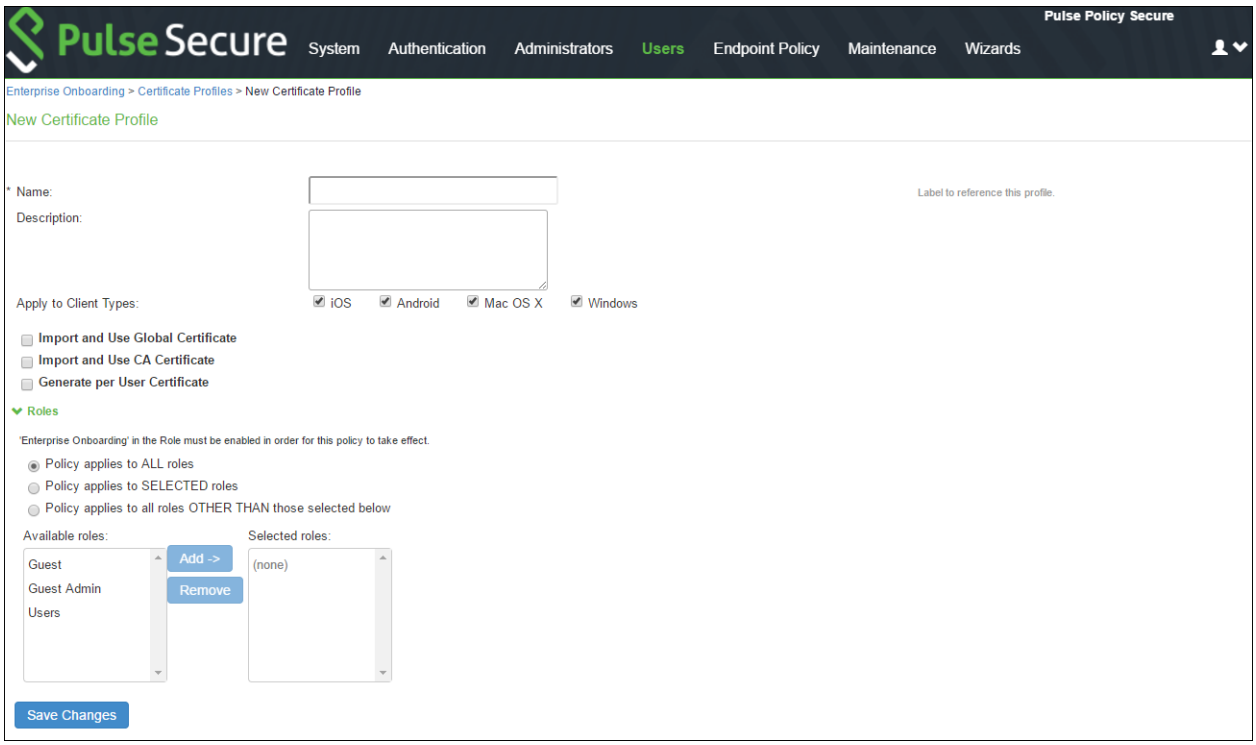
Configuring Certificate Profiles

Certificate profiles specify the device certificates sent to each client device during onboarding. Up to 10 profiles can be defined.

NOTE: For security reasons, certificate profiles cannot be included in the XML export or import.

To define certificate profiles:

1. In the admin console, choose **Users > Enterprise Onboarding > Certificate Profiles**.
2. To add a profile, click **New Profile** or select an existing profile that you want to change, duplicate, or delete. Clicking **Duplicate** creates a copy of the selected profile with **Copy of** before the profile name.



3. Specify the following information:

Setting	Description
Client Types	Select the device types the profile applies to (Android, iOS, MAC OS X, and Windows).
Import and Use Global Certificate	Select this option to use the PPS global certificate to authenticate the client device. Click **Import Certificate & Key**, click **Browse** to locate the certificate file, and then click **Import**. For more information about device certificates, see "Using Device Certificates".
Import and Use CA Certificate	Select this option to import any CA certificate (public Root CA, private Root, public intermediate CA, or private intermediate CA). These CA's can be used in Wi-Fi profiles and must be downloaded to the client devices. Click **Import and Use CA Certificate**, click **Browse** to locate the certificate, and then click **Import CA Certificate**.
Generate per User Certificate	Select this option to use the SCEP server and a CSR template to generate a certificate for each client. Select a CSR template from the Use Certificate Template list. To create a CSR template, see "Defining CSR Templates".

Setting	Description
Roles	Select one of the following options: • **Policy applies to ALL roles**—To apply this profile to all users. • **Policy applies to SELECTED roles**—To apply this profile only to users who are mapped to roles in the Selected roles list. Make sure to add roles to this list from the Available roles list. • **Policy applies to all roles OTHER THAN those selected below**—To apply this profile to all users except for those who map to the roles in the Selected roles list. Make sure to add roles to this list from the Available roles list.

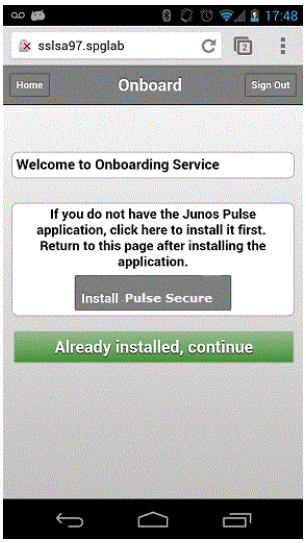
4. Click **Save Changes**.

Example: Onboarding Android Devices

To onboard an Android device:

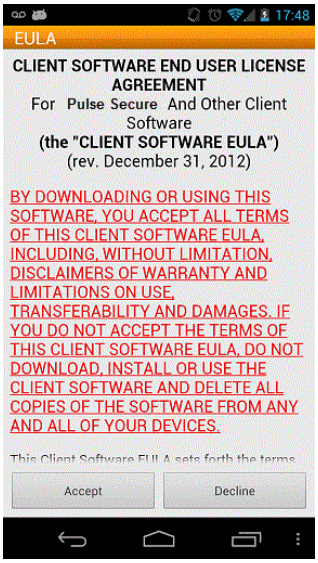
1. Enter the onboarding URL in the browser.

Figure454: Onboarding Start Page



2. The End User License Agreement Page (EULA) is displayed.

Figure455: End User License Agreement



3. On the Pulse Secure client onboarding Wizard page, read the instructions carefully and tap **Next**.

Figure456: Onboarding Wizard Start Page

4. On the CA certificate provisioning page, tap **OK**.

5. Paste the password from the clipboard to extract the certificates, and tap **OK**.

Figure457: Certificate Provisioning Page

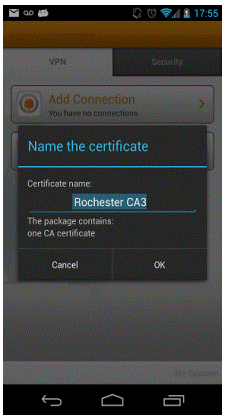
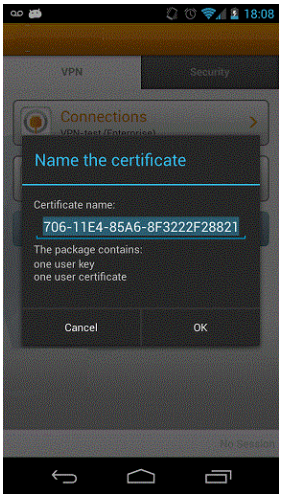


Figure458: Certificate Password Page

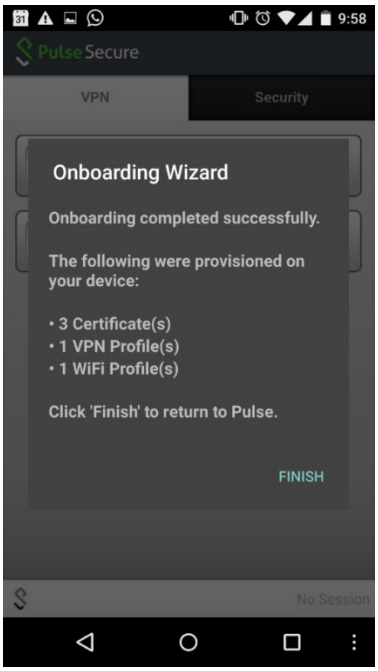
6. Tap **OK** to confirm the certificate name.

Figure459: Certificate Name Page



7. View the number of certificates and profiles provisioned on the client, and tap **Finish**.

Figure460: Onboarding Wizard Summary Page



8. If onboarding fails due to an error, tap **Retry**. Users should contact their administrator if onboarding fails after three attempts.
9. If onboarding is successful, tap the **VPN** tab to view the provisioned VPN connections.
10. Tap the Wi-Fi icon to view the provisioned Wi-Fi networks. To enable a Wi-Fi connection, select the network and tap the Connect icon.

Viewing Onboarded Devices

The Device Management page lists the following types of devices:

- **Onboarded devices**— Devices that have Enterprise Onboarding enabled in the user's role and have been onboarded during device registration. After a device is onboarded, it is displayed on the Device Management page until it is deleted.

The username, user roles, operating system, and registration date are shown for each device, along with the onboarded, and access status. Devices that become inactive or invalid must be deleted manually.

To view the Device Management page:

1. Select **System > Status > Devices**.
2. Use the controls described in table below to view and manage the devices.

Table73: Device Management Page

Buttons	Administrative Actions
Update	• To refresh the page, click **Update**. • To view a specific user, enter the username in the Show Users Named box and click **Update**. If you do not know the exact username, use an asterisk (*) as a wildcard character. • To change the number of displayed devices, enter a number in the Show N devices box and click **Update**. TIP: To change the sort, click a column header.

Buttons	Administrative Actions
Delete	To delete one or more devices, select the check box next to the appropriate devices and click **Delete**. If an onboarded device is deleted in error, the user must re-onboard the device. ActiveSync-only devices that are deleted in error are added automatically by the next ActiveSync.
Delete All	To delete the all devices, click **Delete All**.

Troubleshooting

You can use the following message IDs in the user access log for troubleshooting:

- AUT31186—Indicates the status of an onboarding attempt (failed or successful)
- AUT31152—Indicates onboarding failed because the maximum device limit of 10000 has been reached
- AUT31187—Indicates the attempt to build a configuration profile failed due to an error
- AUT31188—Indicates a configuration profile was generated successfully, and lists the names of the profiles contained in the configuration profile

The following message IDs are related to device limits:

- SYS31177—Indicates the number of devices onboarded is nearing the system limit of 10000.
- SYS31178—Indicates the number of devices onboarded has exceeded the system limit of 10000 (critical error).
- SYS31193—Information message generated by a background process that attempts to delete device records when 95% of system limit (10000) is reached. It displays the number of device records deleted, the current number of onboarded devices, and the system limit.

NOTE:

- If profile generation in the server is successful, but it fails in the client while installing, then the client logs should be analysed for the failure.

Clustering

This chapter provides an overview of the clustering. It includes the following information:

Overview

A PPS cluster is a group of PPS devices that act like a single PPS device, which enables high availability, load balancing and parallel processing. A PPS cluster pair is used to refer to a cluster of two PPS devices and a multiunit PPS cluster refers to a cluster of more than two PPS devices.

Clustering provides the following benefits:

- Load balancing- It refers to efficiently distributing the incoming request across a group of PPS devices. It optimizes resource usage, maximizes throughput, minimizes response time, and avoids overload of any single device.
- High Availability (HA)- It provides increased availability and enables uninterrupted access to data even if one of the devices fails.

Deployments

PPS supports two types of cluster deployments:

- Deployment of Active/Active Cluster
- Deployment of Active/Passive Cluster

Requirements and Limitations

The following are the requirements and limitations for clustering:

- Cluster members must run the same software version.
- Cluster members must use the same hardware platform.
- State synchronization must occur only through the internal Network Interface Card (NIC). Ensure the cluster communication and resource access must take place over an internal network.
- You can deploy active/active or active/passive clustering only within the same IP subnet.

NOTE: We recommend you to use Pulse One instead of cluster to sync only the configuration across devices.

Deployment of Active/Active Cluster

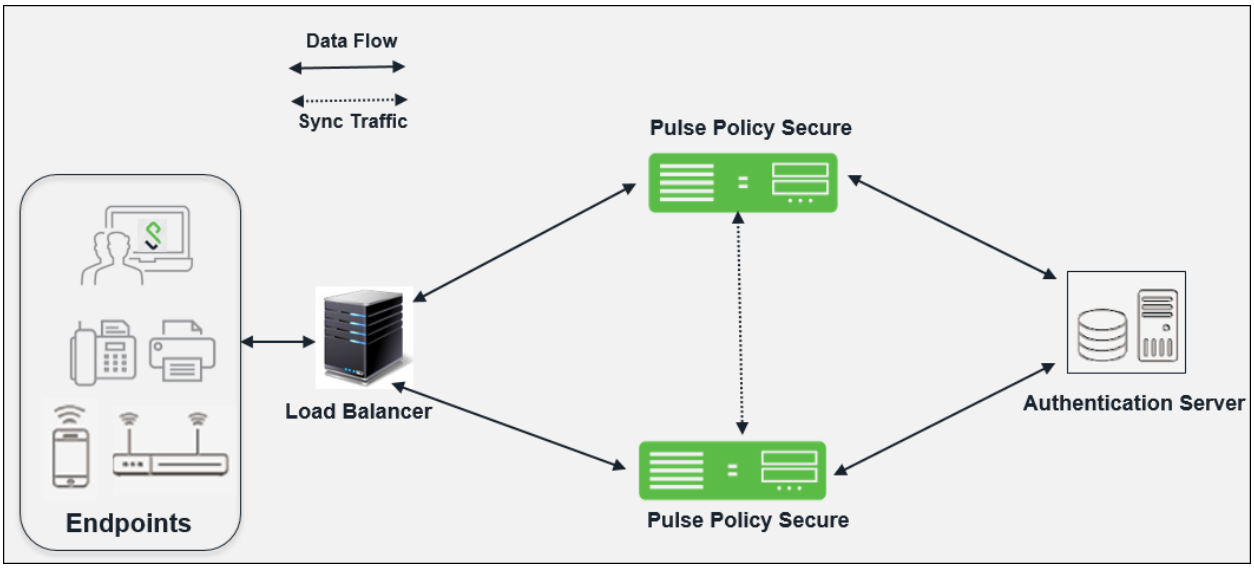
An Active/Active deployment provides load balancing and high availability. PPS relies on an external load balancer for distributing the load among PPS nodes. Active/Active cluster configuration allows increased aggregate system throughput; however, it does not provide increased scalability beyond the total licensed users. It also provides seamless failover, which is achieved by state synchronization between the devices.

If a node goes offline, the load balancer adjusts the load on the active nodes. Users do not need to sign in again, however some session information entered a few seconds before the active machine went offline, such as cookies and passwords, may not have been synchronized on the current device, in which case users may need to sign in again.

NOTE:

- WAN clustering is not supported.
- You can deploy up to 8 nodes for PSA-7000. All other platform models support 2 node clusters only. The system (UI) allows adding up to 8 nodes. However, only up to 4 nodes in a cluster have been officially qualified.

Figure461: Active/Active Cluster

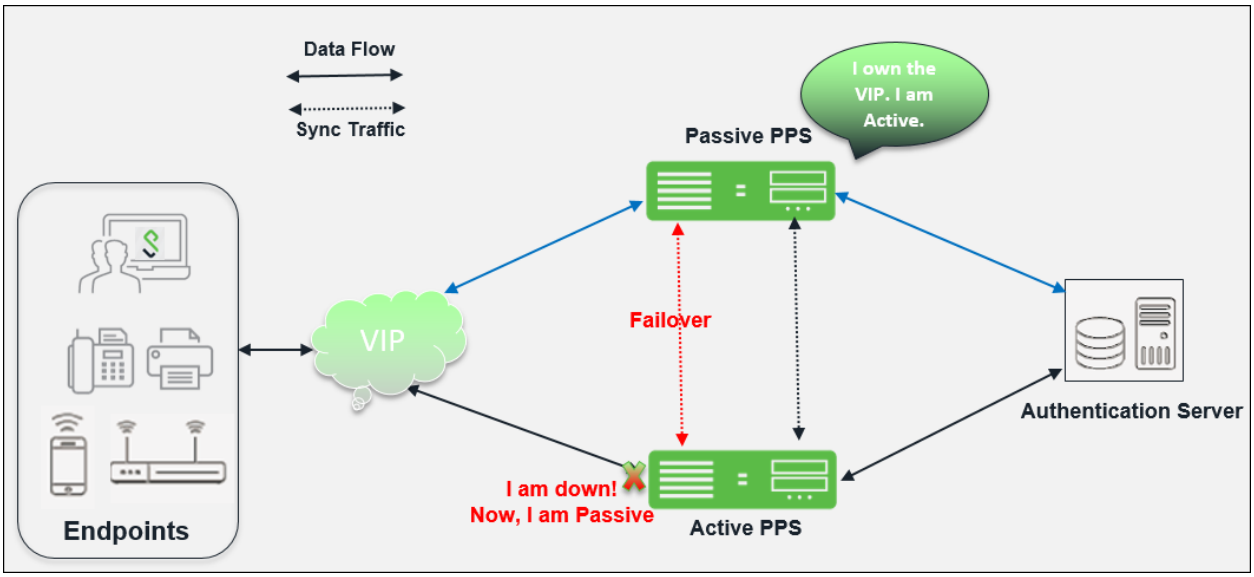


Deployment of Active/Passive Cluster

An active/passive cluster configuration provides high availability. Active/Passive deployment allows seamless failover without the need to set up any external equipment. The states are synchronized between the two devices for all the configurations so that the devices are virtually identical.

Active/Passive clustering is supported only if the members of the cluster pair are in the same subnet because the VIP address must be shared by both the members. PPS uses a virtual IP (VIP) address to address the cluster pair in addition to addressing each device. The IP address takeover (IPAT) approach is used for the VIP address. If the active node fails, the passive node takes over the VIP address and sends a gratuitous Address Resolution Protocol (ARP) message notifying other networking devices that it now owns the VIP address. You should check that other devices in your network, especially the next-hop gateways, will consider the gratuitous ARP messages.

Figure462: Active/Passive Cluster



Cluster Configuration

This section lists the following topics:

- Admin UI Configuration
- Serial Console Configuration

Admin UI Configuration

This section describes the configuration performed through Admin UI:

- Creating a Cluster
- Configuring an Active/Active or Active/Passive Cluster
- Adding Cluster Members
- Joining a Node to an Existing Cluster
- Deleting a Cluster
- Verifying the Cluster Status

Creating a Cluster

To create a cluster:

1. Select **System > Clustering > Create Cluster**.

Figure463: Creating Cluster

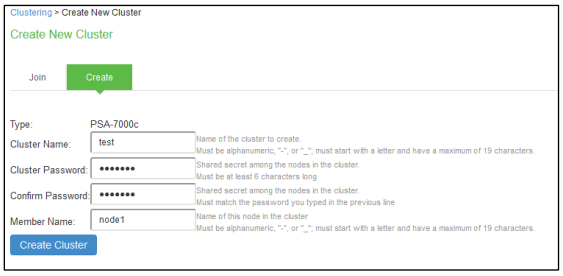
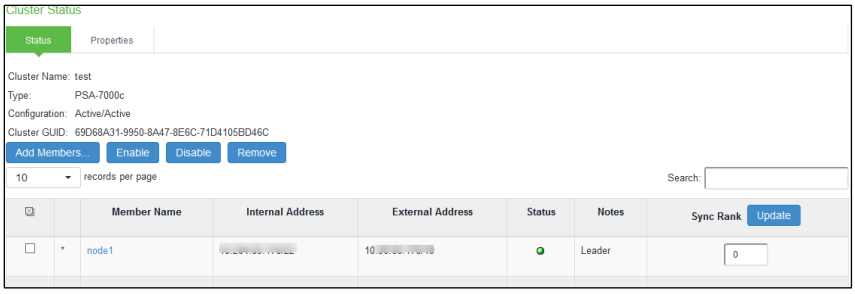


Table74: Creating Cluster

Settings	Actions
Cluster Name	Specifies a name to identify the cluster.
Cluster Password	Specifies the cluster password. You need to enter the password again when specifying additional nodes to join the cluster. All nodes in the cluster use this password to communicate.
Confirm Password	Specifies the password that is confirmed.
Member Name	Specifies the name of this node in the cluster.

2. Click **Create Cluster**. When prompted to confirm the cluster creation, click **Create**. After the device initializes the cluster, the Clustering page displays the Status and Properties tabs.



Configuring an Active/Active or Active/Passive Cluster

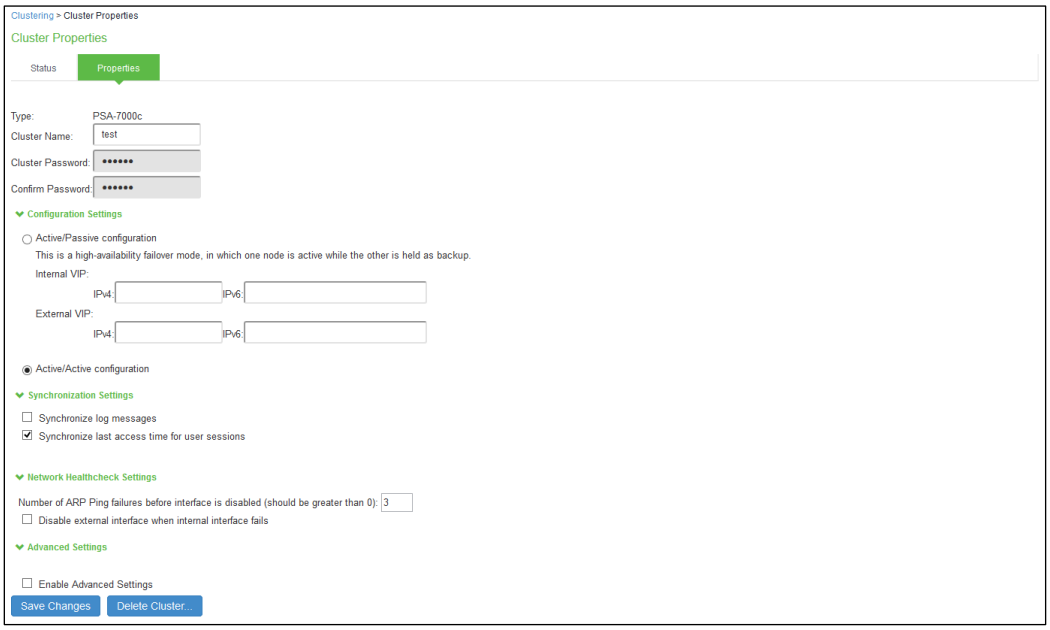
Once the cluster is created, you can modify the cluster properties to configure the cluster as an Active/Passive cluster. The cluster is created as an Active/Active cluster by default.

Note: If IPv6 is required, then configure both the nodes with IPv6 settings before creating the cluster.

To configure the cluster properties:

1. Click **Properties tab of the cluster.**

Figure 464: Cluster Properties Page



2. Complete the configuration as described in table. Active/Active configuration is selected by default.

Table75: Clustering Property Settings

Settings	Actions
Cluster Name	Identifies the cluster.
Configuration Settings	
Active/Passive configuration	Runs a cluster pair in active/passive mode. Then specify an internal VIP (virtual IP address) and an external VIP if the external port is enabled.

Settings	Actions
Active/Active configuration	(Default) Runs a cluster pair in active/active mode. This configuration runs a cluster of two or more nodes in active/active mode using an external load balancer. NOTE: To change a two-unit active/passive cluster to an active/active cluster with more than two nodes, first change the configuration of the two-unit cluster to active/active and then add the additional nodes.
Synchronization Settings	
Synchronize log messages	Propagates all log messages among the devices in the cluster.
Synchronize last access time for user sessions	Propagates the latest user access information across the cluster.
Network Health Check Settings	
Number of ARP Ping Failures	Specifies the number of ARP ping failures allowed before the internal interface is disabled.
Disable external interface when internal interface fails	Disables the external interface of the device if the internal interface fails.
Advanced Settings	
	Specifies the timeouts for the underlying cluster system. Do not change any values under this setting unless instructed to do so by Pulse Secure Global Support Center (PSGSC).

NOTE:

- If your cluster node configurations diverge because of changes made to one node while another is disabled or unavailable, the system manages the remerging of the configurations automatically for up to 16 updates. Beyond the maximum number of allowable updates, you might need to intervene and remerge the configurations manually. In some instances, the system might be unable to remerge the configurations if there is not enough overlapping configuration information between two nodes to manage the internode communication.

  For example, for a two-node cluster in which the two nodes are partitioned from each other because of a network outage, if the internal network IP address of one of the nodes changes in one of the partitions, the two partitions are unable to rejoin, even when the network is repaired. In such a case, you must remerge the configurations manually.
- If you configure your cluster as active/passive, synchronize last access time for user sessions option is automatically selected.

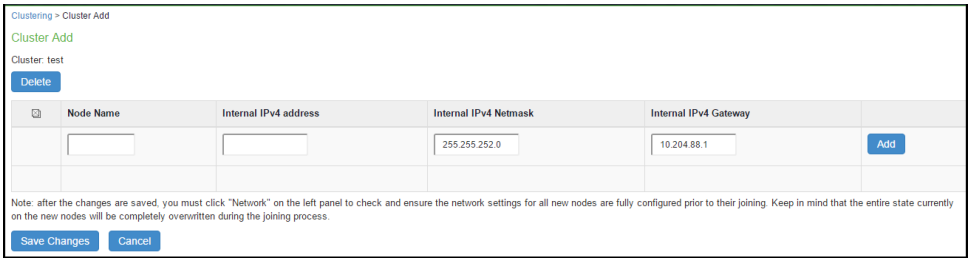
3. Click **Save Changes**.

Adding Cluster Members

To add multiple nodes to a cluster:

1. Select **System > Clustering > Cluster status**.
2. Click **Add Members**.
3. Enter the node name and internal IP address.
4. Modify or add the default internal netmask and internal gateway addresses, if necessary.
5. Click **Add**.

Figure465: Add Cluster Member Page



6. Repeat the process until you have added all the nodes.
7. Click **Save Changes** to save the node configurations.

The system automatically enables the added nodes, even if they are unreachable.

NOTE:

- You configure the node-specific settings for the newly added node manually because binary import options are not useful.
- The only recommended binary import option into a cluster is “Import everything except network settings and licenses” from the Maintenance > Import/Export > Configuration page, which restores cluster-wide configuration (sign-in, realms, roles, resource policies etc.) from a backup binary file. As this option skips node-specific settings, you must perform step 2 manually to populate the newly joined node with the right set of node-specific settings.

License Server

If a license server needs to be configured on both the nodes of a cluster, then perform the following steps:

1. Select **Configuration >Licensing > Configure Server**.
2. Select the setting for Entire cluster.
3. Configure the License server IP and preffered network.
4. Click **Save Changes**.

Joining a Node to an Existing Cluster

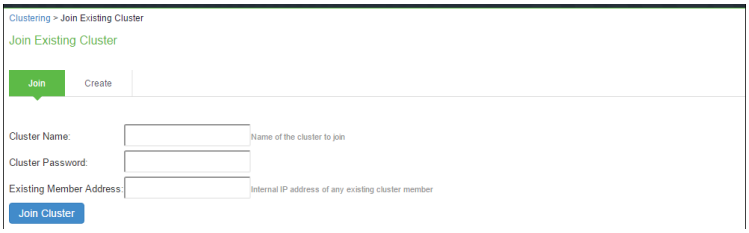
The following procedure describes how to join a node to the existing cluster.

To join additional nodes to the cluster:

1. From an existing cluster member, select the **System > Clustering > Cluster Status** tab and specify the node you want to add to the cluster.
2. Select the **System > Clustering > Join** tab and enter:
   - The name of the cluster to join
   - The cluster password you specified when defining the cluster
   - The IP address of an active cluster member
3. Click **Join Cluster**. When prompted to confirm joining the cluster, click **Join**.

NOTE: The join cluster operation validates IPv4 and IPv6 settings for all the physical ports (internal, external, and management) against those present in the existing cluster. For example, the external port IPv6 settings present on Node-Y are compared against external port IPv6 settings that were specified for the Node-Y add member operation entered on the primary node (Node-X). If there is a mismatch, the join operation fails with an appropriate error message.

Figure466: Joining Cluster



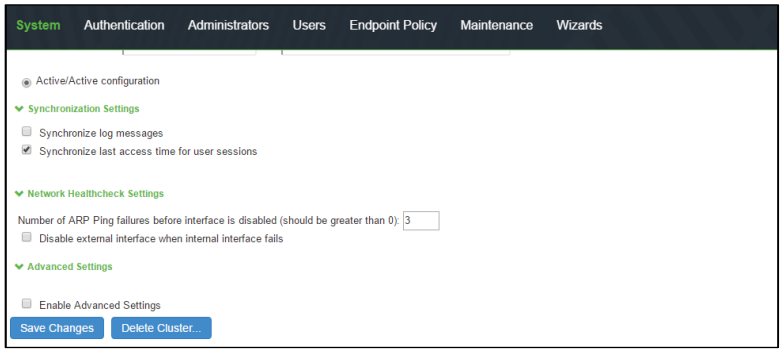
Deleting a Cluster

If you delete a cluster, all the nodes begin running as standalone systems.

To delete a cluster:

1. Select the **System > Clustering > Properties** page.
2. Click the **Delete Cluster** button.
3. Click **Save Changes**.

Figure467: Deleting Cluster



Verifying the Cluster Status

You can verify the cluster status on any node using **System > Clustering > Cluster Status** page. The list displays each node in the cluster along with its status. In an Active/Passive cluster, you can verify which node owns the VIP and you can force a manual fail over to the passive node by selecting the Fail-over VIP option.

Figure468: Verifying Cluster Status Page

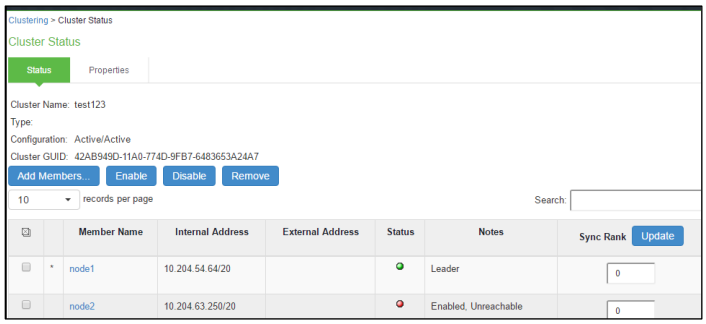


Table76: Cluster Status

GUI Element	Description
Status Information labels	Displays the cluster name, type, configuration, internal VIP, and external VIP for an active/passive cluster.
Add Members button	Click this button to specify a node you intend to add to the cluster. You can add multiple nodes at the same time.
Enable button	Click this button to add a node that was previously disabled. When you add a node, all state information is synchronized on the node.
Disable button	Click this button to disable a node within the cluster. The node retains awareness of the cluster but does not participate in state synchronizations or receive user requests unless members sign in to the node, directly.
Remove button	Click this button to remove the selected node or nodes from the cluster. After removal, the node runs in standalone mode.
Fail-Over VIP	Click this button to failover the VIP to the other node in the active/passive cluster. Only available if cluster is configured as active/passive.
Member Name column	Lists all nodes belonging to the cluster. You can click on a node's name to modify its name and network settings.
Internal Address column	Shows the internal IP address of the cluster member using Classless Interdomain Routing (CIDR) notation.
External Address column	Shows the external IP address of the cluster member using CIDR notation. Note that this column shows only the external IP address of the cluster leader unless you specify a different address for the node on its individual network settings page, which is accessible by clicking its name in the Member Name column. If you change the external IP address on the Network > Network Settings page, the change affects all cluster nodes.
Status column	Shows the current state of the node: • Green light, Leader—The node is the active member of an active/active cluster and is handling user requests. • Green light/enabled—The node is handling user requests and participating in cluster synchronization. • Yellow light/transitioning—The node is joining the cluster. • Red light/disabled—The node is not handling user requests or participating in cluster synchronization. • Red light/enabled, unreachable —The node is enabled but because of a network issue, it cannot be reached. NOTE: A node's state is considered standalone when it is deployed outside of a cluster or after being removed from a cluster.

GUI Element	Description
Notes column	Shows the status of the node's connection to the cluster: • OK—The node is actively participating in the cluster. • Transitioning—The node is switching from the standalone state to the enabled state. • Unreachable—The node is not aware of the cluster. A cluster member might be unreachable even when it's online and can be pinged. Possible reasons include: its password is incorrect, it doesn't have information about all cluster nodes, it's configured with a different group communication mode, it is running a different service package version, or the machine is turned off.
Sync Rank column	Specifies the synchronization order for nodes when a node rejoins a cluster. Accepts sync ranks from 0 (lowest rank) to 255 (highest rank). The highest rank takes precedence. If two nodes have identical sync ranks, the alphanumeric rank of the member name is used to determine precedence.
Update button	Updates the sync rank after you change the precedence of the nodes in the Sync Rank column.

Load Balancer for Active/Active Cluster

In active/active mode, you have the option of using an external load balancer with a cluster. The load balancer hosts the cluster VIP and routes user requests to a node defined in its cluster group based on source-IP routing. If a node goes off line, the load balancer adjusts the load on the active nodes. Users do not need to sign in again.

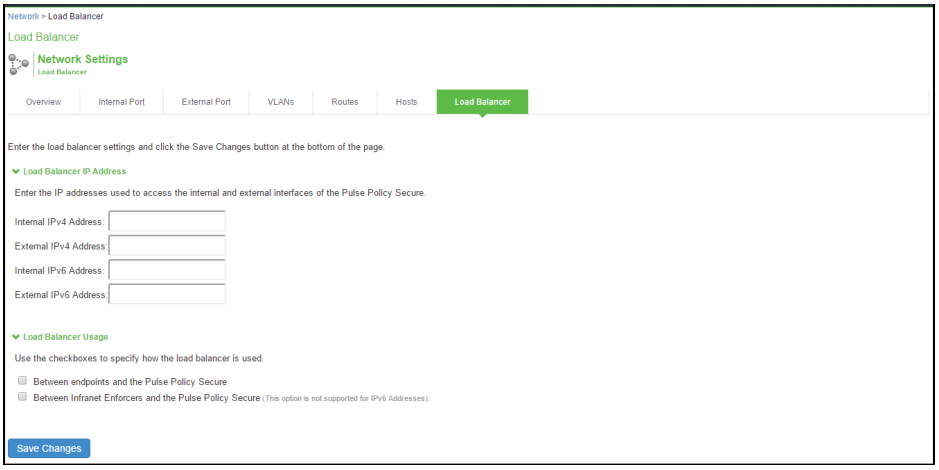
The following are the recommendations while choosing and configuring a load balancer for your cluster:

- Listens to traffic on multiple ports
- Manages traffic using assigned source and destination IP addresses (not destination port)

To add a load balancer using an active/active configuration:

1. Select **System > Network > Load Balancer**.

Figure469: Network Settings Page



2. Enter the IPv4/IPv6 address of the interface connected to the load balancer in the appropriate port window. Do not enter addresses in both fields unless the load balancer is connected to both interfaces.
3. Select the appropriate load balancer usage options.
    - Between endpoints and PPS
    - Between Infranet Enforcers and PPS
4. Click **Save Changes**.

Health Checking a Server from Load Balancer

The system hosts an HTML page that provides service status for each node in a cluster. External load balancers can check this resource to determine how to effectively distribute the load among all the cluster nodes.

To perform the Layer 7 health check for a node:

Using a web browser browser, enter the URL: https://<PPS Series device-Hostname>/dana-na/healthcheck/healthcheck.cgi?status=all

This returns either HTTP Status 200 OK or 500 Internal Error. If this returns HTTP Status 200 OK, the following additional parameters are shown:

Parameter Name	Value	Description
CPU-UTILIZATION	0-100	Specifies the CPU utilization percentage (0-100).
SWAP-UTILIZATION	integer	Specifies the swap utilization percentage of the device (0-100).
DISK-UTILIZATION	integer	Specifies the used disk space percentage (0-100).
USER-COUNT	integer	Specifies the total number of licensed users logged in to the device. This does not include any MAC address users or Radius users.
MAX-LICENSED-USERS-REACHED	boolean	Specifies the maximum number of licensed users reached.

The following example performs the Layer 7 health check from an external load balancer:

GET /dana-na/healthcheck/healthcheck.cgi?status=all HTTP/1.1\r\nHost: localhost\r\n\r\n

The concept of receive string is used for health check. The receive string is configured on the load balancer is used to decide whether the node is active or inactive. It is a regular expression that checks for a value present in the response. For example, PPS sends a page to the load balancer that has USER-COUNT=25 indicating that the number of active licensed users on that device is 25.

A receive string of USER-COUNT\=([0-9]|[0-9][1-9]|100); means check if USER-COUNT is between 0 and 100. In this example, 25 is between 0 and 100 and the load balancer marks the device as active and considers it for load balancing.

Serial Console Configuration

If you are adding a factory-set device to a cluster, we recommend that you use the serial console, which enables you to join an existing cluster during the initialization process by entering minimal information. When a node joins a cluster, it receives the cluster state settings, which overwrite all settings on a device with an existing configuration and provide new machines with the required preliminary information. You can also use the serial console to disable the node. If the node is in a synchronization state, you cannot access its admin console. Therefore, if you need to upgrade or reboot the node, for example, you must first disable the node from a cluster through its serial console.

Joining a Node to a Cluster

To add a node to a cluster through its serial console:

1. Connect to the serial console of the device you want to add to the cluster.
2. Reboot the device and watch its serial console. After the system software starts, a message appears stating that the device is about to boot as a standalone node and to press the Tab key for clustering options. Press the Tab key as soon as you see this option.

   NOTE: The interval to press the Tab key is five seconds. If the device begins to boot in standalone mode, wait for it to finish and then reboot again.
3. Enter 2 to join an existing cluster.
4. Enter the requested information, including:
   - The internal IP address of an active member in the cluster
   - The cluster password, which is the password you entered when defining the cluster
   - The name of the device to add
   - The internal IP address of the device to add
   - The netmask of the device to add
   - The gateway of the device to add
5. The active cluster member verifies the cluster password and that the new device's name and IP address match what you specified in the admin console. If the credentials are valid, the active member copies all its state data to the new cluster member, including certificate, user, and system data.
6. From the Admin Console, select System > Clustering > Cluster Status of any active cluster member to confirm that the new member's Status is green, indicating that the node is now an enabled node of the cluster (status is green).

NOTE:

If you add a node running an earlier version service package to a cluster, the node automatically detects the mismatch, gets the newer package from the cluster, and joins the cluster.

Disabling a Clustered Node

To disable a node within a cluster using its serial console:

1. Connect to the serial console of the device you want to disable within the cluster
2. Enter 4 for the System Operations option.
3. Enter 8 for Disable Node option.
4. Enter y when the serial console prompts you to confirm that you want to disable the node.
5. From the Admin console, verify that the node has been disabled (status is red) within the cluster by selecting System > Clustering > Status of any active cluster member.

Restarting or Rebooting Cluster Nodes Using Its Serial Console

When you create a cluster of two or more nodes, the clustered nodes act as a logical entity. When you reboot one of the nodes using either the serial console or the admin console, all nodes in the cluster restart or reboot.

To reboot only one node:

1. Connect to the serial console of the device you want to disable within the cluster.
2. Enter 4 for System Operations option.
3. Select **System > Clustering > Status** to disable the node you want to restart or reboot within the cluster.
4. Under system operations select the appropriate menu option 9 <Reboot this device>, 10 <Shutdown this device>, or 11 <Restart Services>.
5. Reboot the node, then enable the node within the cluster again.

WAN Clustering

Overview

A WAN cluster is a group of independent servers/nodes separated by WAN networks working together as a single system to provide load balancing and high scalability for clients and services. WAN cluster works only in active-active cluster operation mode.

Clustering supports following types of synchronization settings:

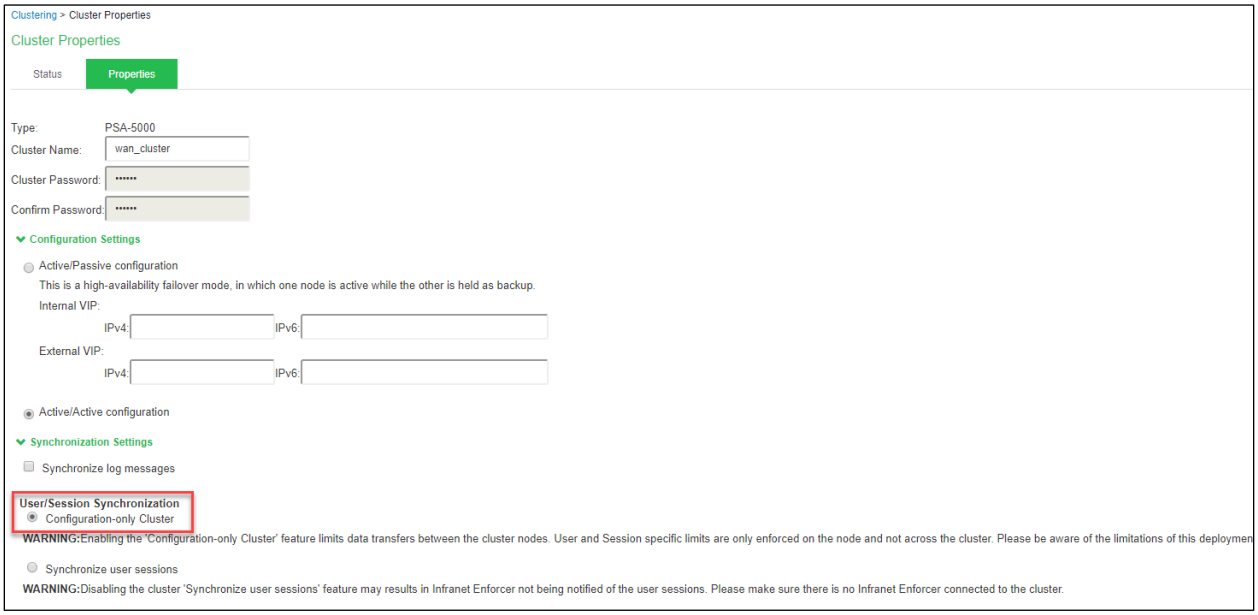
- Configuration-only Cluster - Only configuration will be synced across the cluster nodes
- Synchronize user sessions - Configuration and user session information will be synced across the Cluster nodes

Note: WAN cluster only supports Configuration-only Cluster and does not support Synchronize user sessions.

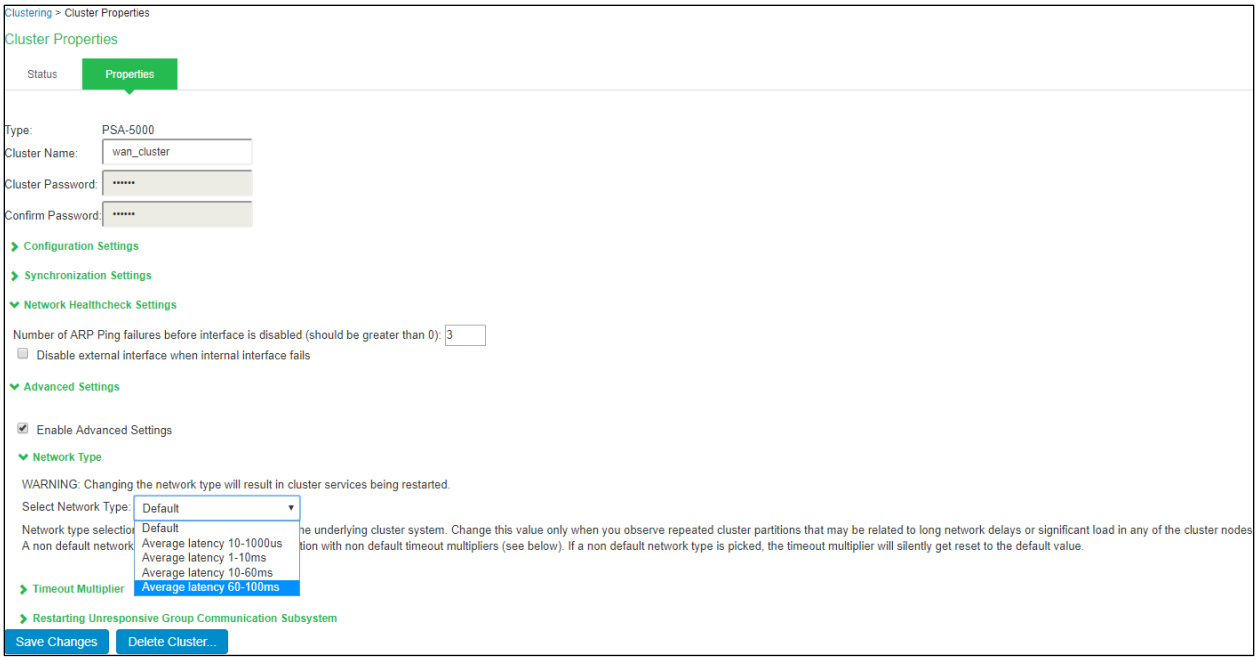
Configuring an Active-Active Configuration-only WAN Cluster

To configure an Active/Active Configuration-only WAN cluster:

1. Configure an Active/Active cluster as mentioned in the Configuring Active/Active cluster section.
2. Select **System > Clustering > Cluster Properties** and select **Configuration-only Cluster** as shown in the screen below.



3. Under **Advanced Settings**, select **Enable Advanced Settings** and then select the **Network Type** as **Average latency 60-100ms** or **Average latency 10-60ms** for WAN cluster.

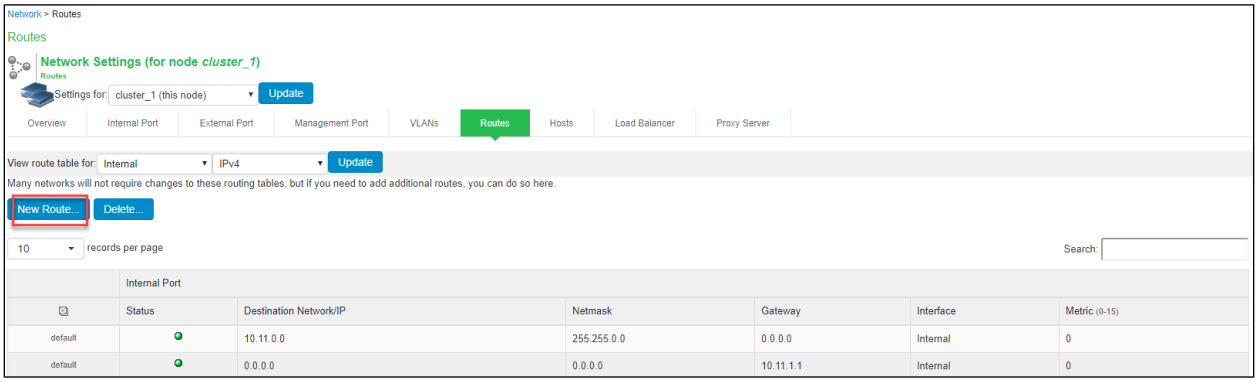


Note:

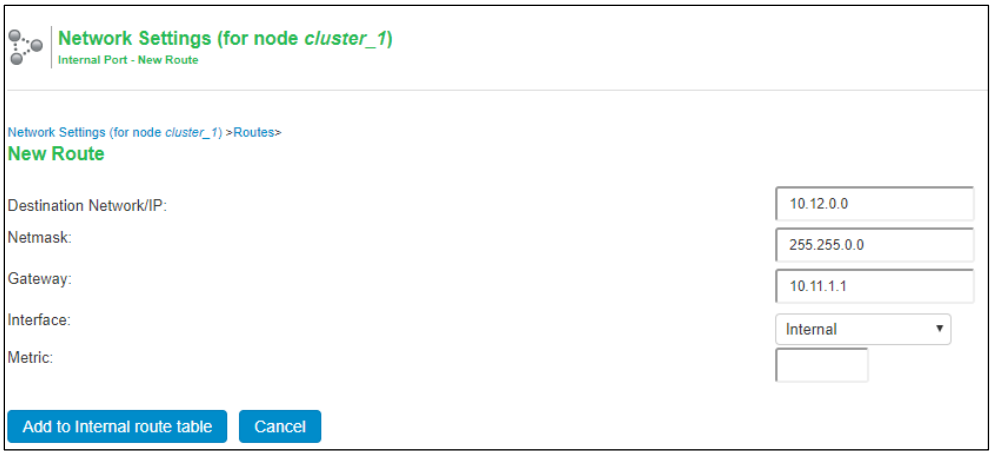
- WAN cluster configuration is only recommended on PSA7000 platforms.
- In an Active/Active WAN cluster, if the networks of all the internal ports of the PPS/Nodes are in different subnets, it is mandatory to add specific static network routes on every PPS/Node to reach every other PPS/Node in the cluster for better cluster communication during PPS/Node failover or downtime.

To add a specific static route on a PPS/Node to reach another PPS/Node in the cluster:

1. Select **System > Network > Routes**.
2. Click **New Route**.



3. Based on the Network's Topology the Static Route needs to be added on PPS/Node to reach other PPS/Node in WAN Cluster. Below is an example where static route is added on PPS Configured in 10.11.0.0/16 network having gateway 10.11.1.1 to reach another PPS/Node Configured in 10.12.0.0/16.



4. The same steps need to be repeated on every PPS/Node in the Active/Active WAN cluster.

Monitoring and Troubleshooting

If you have a problem with a cluster, a Pulse Secure Global Support Center (PSGSC) representative might ask you to create a snapshot that includes group communication statistics to assist with debugging the cluster problem. When you enable the group communication monitor, the system records statistics related to all the cluster nodes. As the local node communicates with other nodes in the cluster, the system captures statistics related to intra cluster communication. The Group Communication tab is displayed only when you enable clustering on your system. On a standalone system, you do not have access to the Group Communication tab.

You can also enable the cluster networking troubleshooting server on the Network Connectivity page.

NOTE:

- Performing excessive node monitoring can impact system performance and stability. You should only perform extensive monitoring when directed by your Pulse Secure Global Support Center (PSGSC) representative.
- Performing log synchronization across cluster nodes can impact your system performance and stability.

This section covers the following topics:

- Group Monitoring
- Node Monitoring
- Network Connectivity Monitoring
- Monitoring using SNMP Traps
- Troubleshooting
- Restarting or Rebooting Cluster Nodes

Group Monitoring

To enable group communication monitoring:

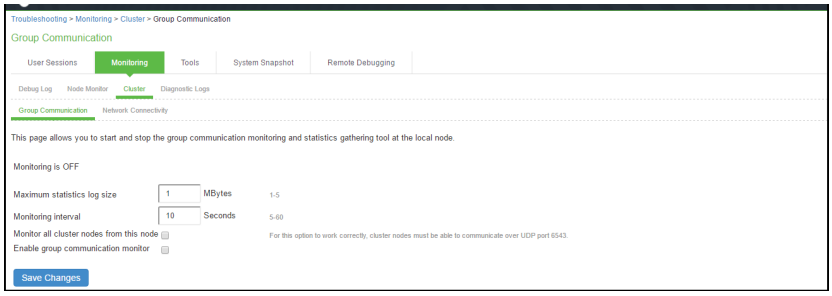
1. Enter the maximum size of the statistics log.
2. Enter the interval, in seconds, at which events are to be logged.

3. If you want to monitor all cluster nodes from the current local node, select the **Monitor all cluster nodes from this node** check box. If you do not check this option, the group communication monitor gathers statistics only for the local node.

NOTE: If you select the Monitor all cluster nodes from this node option, the cluster nodes must be able to communicate over UDP port 6543.

4. Select the Enable group communication monitoring check box to start the monitoring tool.
5. Click **Save Changes**.

Figure470: Troubleshooting using Group Communication



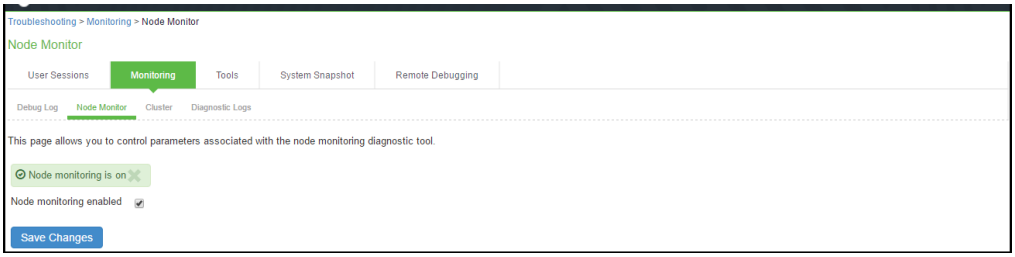
6. If you want to include the node monitoring results in the system snapshot, choose Maintenance > Troubleshooting > System Snapshot, and select the Include debug log check box.
7. Take a system snapshot to retrieve the results.

Node Monitoring

To enable node monitoring:

1. Select **Maintenance > Troubleshooting > Monitoring > Node Monitor** to enable the node monitor.
2. Enter the maximum size for the node monitor log.
3. Enter the interval, (in seconds) at which node statistics are to be captured.
4. Select the **Node monitoring enabled** check box to start monitoring cluster nodes.

Figure471: Troubleshooting using Node Monitor



5. For Maximum node monitor log size, enter the maximum size (in MB) of the log file. Valid values in the range of 1 - 30.
6. Specify the interval (in seconds) that defines how often nodes are to be monitored.
7. Select the commands to use to monitor the node.
8. If you select dsstatdump, enter its parameters as well.

9. Click **Save Changes**.
10. To include the node monitoring results in the system snapshot, select Maintenance > Troubleshooting > System Snapshot, and select the Include debug log check box.
11. Take a system snapshot to retrieve the results.

Network Connectivity Monitoring

Use the Network Connectivity tab to enable the cluster node troubleshooting server and to select a node on which to perform troubleshooting tasks. The troubleshooting tool allows you to determine the network connectivity between cluster nodes.

The server component of this tool runs on the node to which connectivity is being tested. The client component runs on the node from which connectivity is being tested. The basic scenario for testing connectivity is this:

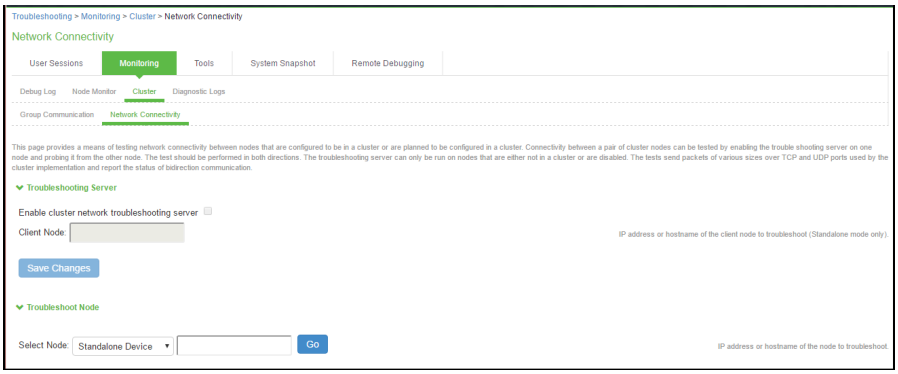
- The administrator starts the server component on the passive node.
- The administrator tests the connectivity to the server node from the Active node, by starting the client component on the active node and then contacting the passive node running the server component.

NOTE: The server component must be run on nodes that are configured as either standalone or in a cluster but disabled. Cluster services cannot be running on the same node as the server component.

To enable network connectivity monitoring:

1. Select Maintenance > Troubleshooting > Cluster > Network Connectivity and **Enable cluster network troubleshooting server** check box to enable the server component.

Figure472: Troubleshooting using Network Connectivity



2. Click **Save Changes**.
3. On another machine, select **Maintenance > Troubleshooting > Cluster > Network Connectivity**.
   Perform one of the following steps:
   - Select a node from the list.
   - Enter the IP address of the server node.
4. Click **Go** to begin troubleshooting the machine on which the server component is running.
5. Click the **Details** link below the fields to view the results.

Monitoring using SNMP Traps

You can monitor clusters using the standard logging tools. Specifically, you can use several cluster-specific SNMP traps to monitor events that occur on your cluster nodes, such as:

- External interface down
- Internal interface down
- Disabled node
- Changed virtual IP address (VIP)
- Deleted cluster node (cluster stop)

NOTE: In general, it is desirable to configure your SNMP traps on a clusterwide basis so that any given cluster node can send its generated traps to the right target. Setting up clusterwide configuration for the traps is particularly important when you also use a load balancer, because you might not know which node is responsible for a specific operation. In that case, the load balancer can independently determine which cluster node can manage an administrative session.

You can use SNMP traps that are included in the Pulse Secure Standard MIB to monitor these events. These traps include:

- **iveNetExternalInterfaceDownTrap**—Supplies type of event that brought down the external interface.
- **iveNetInternalInterfaceDownTrap**—Supplies type of event that brought down the internal interface.
- **iveClusterDisableNodeTrap**—Supplies the cluster name on which nodes are disabled, along with a space-separated list of disabled node names.
- **iveClusterChangedVIPTrap**—Supplies the type of the VIP, whether external or internal, and its value before and after the change.
- **iveClusterDelete**—Supplies the name of the cluster node on which the cluster delete event was initiated.

These traps are always enabled and available in the MIB. You cannot disable the traps.

Troubleshooting

You can use a built-in feature on the clustering Status page to identify the status of each cluster node. Mouse over the Status light icon to display a tool tip containing a hexadecimal number. The hexadecimal number is a snapshot of the status of the system.

Table77: Cluster Status

Value	Meaning
0x000001	System is in standalone mode.
0x000002	System is in cluster disabled state.
0x000004	System is in cluster enabled state.
0x000008	System is unreachable (because it is offline, has the wrong password, has a different cluster definition, different version, or other problem).
0x00002000	The node owns the VIPs (on) or not (off).
0x000100	System is synchronizing its state from another node (initial synchronizing phase).
0x000200	System is transitioning from one state to another.
0x00020000	Group communication subsystems at the local and remote nodes are disconnected from each other.
0x00040000	Management interface (mgt0) is displayed disconnected.
0x00080000	Management gateway is unreachable for ARP ping.

Value	Meaning
0x000800	Interface int0 displays disconnected (no carrier).
0x001000	Interface int1 displays disconnected (no carrier).
0x002000	System is syncing its state to another node that is joining.
0x004000	Initial Synchronization as master or slave is taking place.
0x008000	System is the leader of the cluster.
0x010000	The spread daemon is running and the cache server is connected to it.
0x020000	The gateway on int0 is unreachable for ARP pings (see log file).
0x040000	The gateway on int1 is unreachable for ARP pings (see log file).
0x080000	Leader election is taking place.
0x100000	Server lifecycle process is busy.
0x200000	System is performing post state synchronization activities.
0x30004	• The spread daemon is running and the cache server is connected to it. • The gateway on int0 is unreachable for ARP pings (see log file). • System is in cluster enabled state.
0x38004	• The spread daemon is running and the cache server is connected to it. • The gateway on int0 is unreachable for ARP pings (see log file). • System is the leader of the cluster. • System is in cluster enabled state.

Each code, as you see it in the system, may relate specifically to one state. However, each code may represent a combination of states, and so the actual code does not appear in the above table. Instead, the code you see in the system is the sum of several of the hexadecimal numbers shown above. You will need to factor out the codes, as in the following example:

- 0x38004—The rightmost digit (4) in this hexadecimal number corresponds to:
  - 0x000004—The system is in a cluster enabled state.
- 0x38004—The digit in the fourth position from the right (8) corresponds to:
  - 0x008000—This system is the leader of the cluster.
- 0x38004—The leftmost digit (3) in this hexadecimal number does not exist in the table, which indicates that it corresponds to the sum of two other digits, in this case, 1 and 2, as shown in the following codes:
  - 0x020000—The gateway on int0 is unreachable for ARP pings (see log file).
  - 0x010000—The spread daemon is running and the cache server is connected to it.

Restarting or Rebooting Cluster Nodes

When you create a cluster of two or more nodes, the clustered nodes act as a logical entity. When you reboot one of the nodes using either the serial console or the admin console, all nodes in the cluster restart or reboot.

To reboot only one node:

1. Select **System > Clustering > Status** to disable the node you want to restart or reboot within the cluster.
2. Select **Maintenance > System > Platform**.
3. Reboot the node, then enable the node within the cluster again.

Appendix

Licensing

PPS software include a Pulse Secure Licensing and Software Download Center @ https://my.pulsesecure.net, that lets you configure the license server to allow administrators to view all configured systems and move those licenses as needed. Other devices on the network lease licenses from the central license server. For more information, see License Management Guide.

Starting with PPS version 5.0, clustering works as follows:

- Clustering does not require a license.
- Place an equal number of licenses on each appliance, when they are joined together to form a cluster, the user licenses add up so that the cluster supports all the licensed users.
  For example, building a 1,000-user cluster is done by bringing together two appliances with 500 user licenses in each of the two units.
- For third-party features, each node in a cluster should have similar license counts.
- The maximum number of concurrent users allowed in a cluster is the sum of all user licenses of all connected nodes

If your client devices are using PPS prior to release 5.0:

- A license is no longer required to create a cluster. Prior to Release 4.0, to create a multiple node cluster that supports multiple concurrent users, you were required to purchase one ADD-ccccE license for one cluster node, and n-1 CL licenses (one for each of the remaining cluster nodes). For example, to create a 4-node cluster supporting 2000 concurrent users, you needed to purchase one ADD-2000E license and 3 CL licenses.
- CL licenses are no longer necessary but are still supported. When you upgrade to Release 4.0, your existing licenses continue to work. There is no cluster grace period for the node with a CL license installed. When the node with a CL license installed disconnects, the capacity computation is the same as before Release 4.0.
- A 5-day *cluster grace period* provides license flexibility when a node crashes or loses connectivity with the rest of the cluster.
- We recommend that you distribute your ADD licenses equally across the cluster to avoid losing large number of licenses when a node disconnects from the cluster.

The below table illustrates why we recommend distributing licenses equally across all cluster nodes.

Table78: License Distribution Examples

License Distribution	Example
Example 1: Equal distribution	Suppose Node A and Node B are part of a cluster, and each node has 500 concurrent user licenses then the maximum number of licenses is 1000. Suppose Node B disconnects from the cluster. Until the clustering grace period ends, the maximum number of licenses on Node A is 500 (from Node A's original license) + minimum (licenses on Node A (500), licenses on Node B (500)) = 500 + 500 = 1000. After the grace period ends, the maximum number of licenses on Node A reverts to its original license of 500.

License Distribution	Example
Example 2: Unequal distribution	In this example, Node A and Node B are part of a cluster. Node A has 600 ADD licenses and Node B has 400 ADD licenses then the maximum number of licenses is 1000. Suppose Node B disconnects from the cluster. Until the clustering grace period ends, the maximum number of licenses on Node A is 600 (from Node A's original license) + minimum (licenses on Node A (600), licenses on Node B (400)) = 600 + 400 = 1000. After the grace period ends, the maximum number of licenses on Node A is 600. Suppose Node A disconnects from the cluster. Until the clustering grace period ends, the maximum number of licenses on Node B is 400 (from Node B's original license) + minimum (licenses on Node A (600), licenses on Node B (400)) =400+400 = 800. After the grace period ends, the maximum number of licenses on Node B is 400.
Example 3. Unequal distribution (extreme)	In this example, Node A and Node B are part of a cluster. Node A has 1000 ADD licenses and Node B has no ADD licenses. Suppose Node B disconnects from the cluster. Until the clustering grace period ends, the maximum number of licenses on Node A is 1000 (from Node A's original license) + minimum (licenses on Node A (1000), licenses on Node B (0)) = 1000 + 0 = 1000. After the grace period ends, the maximum number of licenses on Node A is 1000. Suppose Node A disconnects from the cluster. Until the clustering grace period ends, the maximum number of licenses on Node B is 0 (from Node B's original license) + minimum (licenses on Node A (1000), licenses on Node B (0)) =0+0 = 0. After the grace period ends, the maximum number of licenses on Node B is 0. For the scenarios in Examples 2 and 3, we recommend you distribute the licenses equally amongst the nodes.

Configuring IPv6 on an Existing IPv4 Active/Passive Cluster

We recommend as a best practice that you configure IPv6 host and network settings on individual nodes before you create a cluster. In some cases, such as routine upgrade, you have already created a cluster configuration and only want to add IPv6 addresses to the existing interface configuration. If so, follow the procedures in this section precisely.

NOTE: You must leave IPv6 disabled until the last step of the procedures shown below.

To modify the internal port configuration for the cluster:

1. Select System > Network > Internal Port > Settings.
2. Under Settings for, select Entire cluster.
3. Complete the configuration for the IPv6 prefix and the IPv6 gateway, but do not enable IPv6.
4. Verify that all the nodes are up and running, are in sync, and are in reachable state. Complete synchronization of the cluster pair might take a few minutes.
5. Under Settings for, select Node 1.
6. Configure the IPv6 address, but do not enable IPv6.
7. Verify both the nodes are up and running and in reachable state.
8. Repeat steps 6-8 for Node 2.
9. Select **System > Network > Internal Port > Virtual Ports**.
10. Update the cluster virtual port configuration to add the IPv6 address.
11. Select System > Network > Internal Port > Settings.
12. Under Settings for, select Entire cluster.
13. Select Enable IPv6.
14. To modify the external port configuration for the cluster:
15. Select System > Network > External Port > Settings.
16. Under Settings for, select Entire cluster.
17. Complete the configuration for the IPv6 prefix and the IPv6 gateway, but do not enable IPv6.

18. Verify that all the nodes are up and running, are in sync, and are in reachable state. Complete synchronization of the cluster pair might take a few minutes.
19. Under Settings for, select Node 1.
20. Configure the IPv6 address, but do not enable IPv6.
21. Verify both the nodes are up and running and in reachable state.
22. Repeat steps 6-8 for Node 2.
23. Select System > Network > External Port > Virtual Ports.
24. Update the cluster virtual port configuration to add the IPv6 address.
25. Select System > Network > External Port > Settings.
26. Under Settings for, select Entire cluster.
27. Select Enable IPv6.

Cloud Secure

Cloud Secure provides secure, seamless, and compliant access to cloud resources on a hybrid IT environment where companies are combining the best of the cloud with their own localized data centers. Cloud Secure solution integrates with multiple Pulse Secure products such as Pulse Connect Secure, Pulse Policy Secure, Pulse Workspace etc.

Cloud Secure provides great level of flexibility with integration to various Third-Party vendors such as MDM vendors, IdP vendors etc. It is a licensed feature, so the Administrator should procure and install the required license.

For more details about the configuration, various deployment scenarios, reports, etc. refer to Cloud Secure documentation available on Pulse Secure Techpubs site.

For On-Premise deployment usecase, see Configuring PPS for On-Premise users.

For Cloud Application Visibiity, see CAV Overview.

System Management

This part covers the following chapters:

- Network and Host Administration
- Certificate Security Administration
- FIPS Level 1 Support (Software FIPS)
- File Management
- Dashboard and Reports
- System Maintenance

Network and Host Administration

This chapter describes how to configure network and host settings. It includes the following information:

Network and Host Administration Overview

When you install and initially set up the device, you use the serial port console to set basic network and host settings. To get started, you must use the serial console to configure these settings for the internal interface. You have the option to use the serial console to configure network and host settings for the external interface and the management interface. The network and host settings you configure with the serial port console include:

- IPv4/IPv6 address
- Netmask
- Default gateway
- Speed and duplex
- MTU
- DNS
- Default domain
- WINS

Once the internal interface has been configured, you can use the admin console Network Settings pages to modify settings for the internal interface, to enable and configure the external interface and the management interface, and to configure or manage advanced networking features, including:

- Hostname
- IPv6 addresses
- VLAN ports
- Virtual ports
- Route table entries

- Host mapping table entries
- ARP cache entries
- Neighbor discovery cache entries
- System date and time (manual configuration) or NTP

Configuring the Internal Port

The internal port connects to the local area network (LAN). The internal port settings are configured when you run the setup wizard from the serial console as part of the installation procedure. You can use the System > Network pages to make changes to the configuration.

To modify the internal port configuration:

1. Select **System > Network > Internal Port > Settings** to display the configuration page.
2. Complete the configuration as described in table below.
3. Save your changes.

Figure473: Internal Port Configuration Page

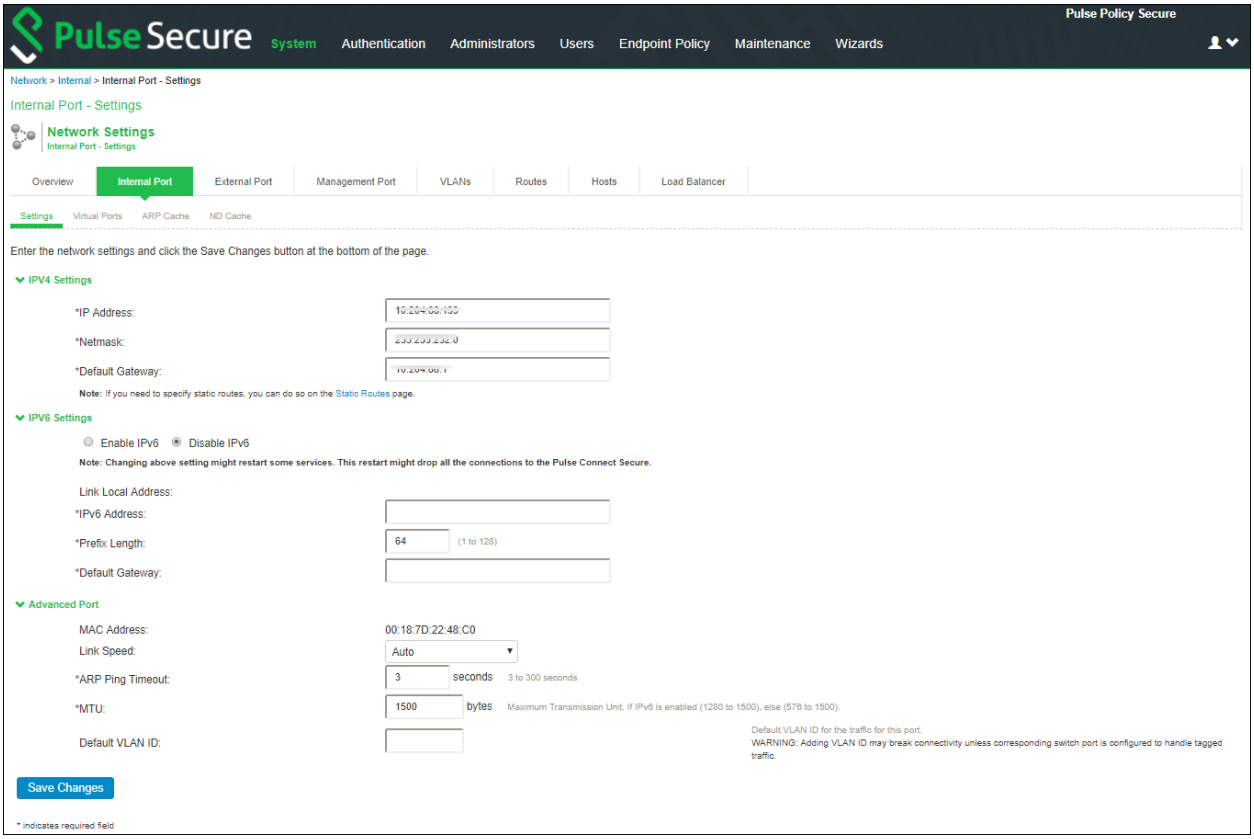


Table79: Internal Port Configuration Guidelines

Settings	Guidelines
IPv4 Settings	
IP Address	Assign an IP address. You must assign an IPv4 address to the internal interface. An IP address is an identifier for a computer or device on a TCP/IP network. Networks using the TCP/IP protocol route messages based on the IP address of the destination. The format of an IPv4 address is a 32-bit numeric address written as four numbers separated by periods. Each number can be 0 to 255.
Netmask	Assign a netmask. A netmask indicates which part of an IP address indicates network identification and which part indicates the host identification. For example, the IP address and netmask 10.20.30.1 255.255.255.0 (or 10.20.30.1/24) refer to all the hosts in the 10.20.30.0 subnet. The IP address and netmask 10.20.30.1 255.255.255.255 (or 10.20.30.1/32) refer to a single host.
Default Gateway	Specify the IPv4 address for the default gateway for the routing domain to which the device belongs. A gateway is the router that resides at the point of entry to the current routing domain, often called the default gateway.
IPv6 Settings	
Enable IPv6 / Disable IPv6	Disabled by default. Enable to support access from IPv6 endpoints. When you enable IPv6, the system acquires a link local address. If you switch from enabled to disabled, the system clears the link local address.
Link Local Address	Display the auto configured link local address (after you have enabled and saved the IPv6 configuration).
IPv6 Address	Specify a routable IPv6 address, such as a global unicast address that your network plan has provisioned for this host and interface. Automatic configuration methods are not supported. You must specify the appropriate address manually.
Prefix Length	Specify how many of the higher order contiguous bits of the IPv6 address comprise the prefix (the network portion of the IPv6 address). The default is 64.
Gateway	Specify the IPv6 address for the default gateway for the routing domain to which the device belongs. A gateway is the router that resides at the point of entry to the current routing domain, often called the default gateway.
Advanced Settings	
MAC Address	Display the MAC address for the interface.
Link Speed	Specify the speed and duplex combination for the interface. If you run SNMP_GET and then change the Link Speed value, you must wait at least 5 minutes after submitting the change before running SNMP_GET again.
ARP Ping Timeout	(IPv4 only.) Specify how long the system should wait for responses to Address Resolution Protocol (ARP) requests before timing out. Cluster nodes send ARP requests to the gateways of other nodes to determine if they are properly communicating with one another. If you have not deployed a cluster, the system does not use this setting. If the node belongs to a cluster, the timeout interval that you specify is synchronized across the cluster. In multisite clusters, you can override this setting for the individual nodes in the cluster using options in the System > Clustering page. Use caution when changing this setting in active/passive clusters, however, because the system also uses the ARP Ping Timeout setting on the Internal tab as a failover timer for the VIP.

Settings	Guidelines
MTU	Specify the maximum transmission unit. If IPv6 is enabled, the valid range is 1280 to 1500. If IPv6 is not enabled, the valid range is 576 to 1500. We recommend you retain the default MTU setting (1500) unless you must change the setting for troubleshooting purposes.
Dafault VLAN ID	(Optional) Specify the default VLAN ID for the traffic of this port. When this parameter is set, all the traffic on this interface is subsequently tagged with the set VLAN ID and also accepts only incoming traffic with the same tag. Necessary changes are required on the connected switch port to handle bi-directional tagged traffic. **Note:** • If default VLAN ID is set incorrectly or the connected switch port is not configured accordingly, the interface can become unreachable. • Default VLAN ID cannot be set if IPv6 is enabled. • Default VLAN ID is supported in a clustered environment. • In case of VMware ESXi based Virtual Appliance(VA), set the vSwitch configuration to port 4095 to allow PPS to tag the traffic. • The set default VLAN ID should be added as a member in the physical port of switch and the same VLAN should be removed from native VLAN ID.

Configuring the External Port

The external port connects to the Internet. You can use the System > Network pages to configure the external port.

To configure the external port:

1. Select **System > Network > External Port > Settings** to display the configuration page.
2. Complete the configuration as described below.
3. Save your changes.

Figure474: External Port Configuration Page

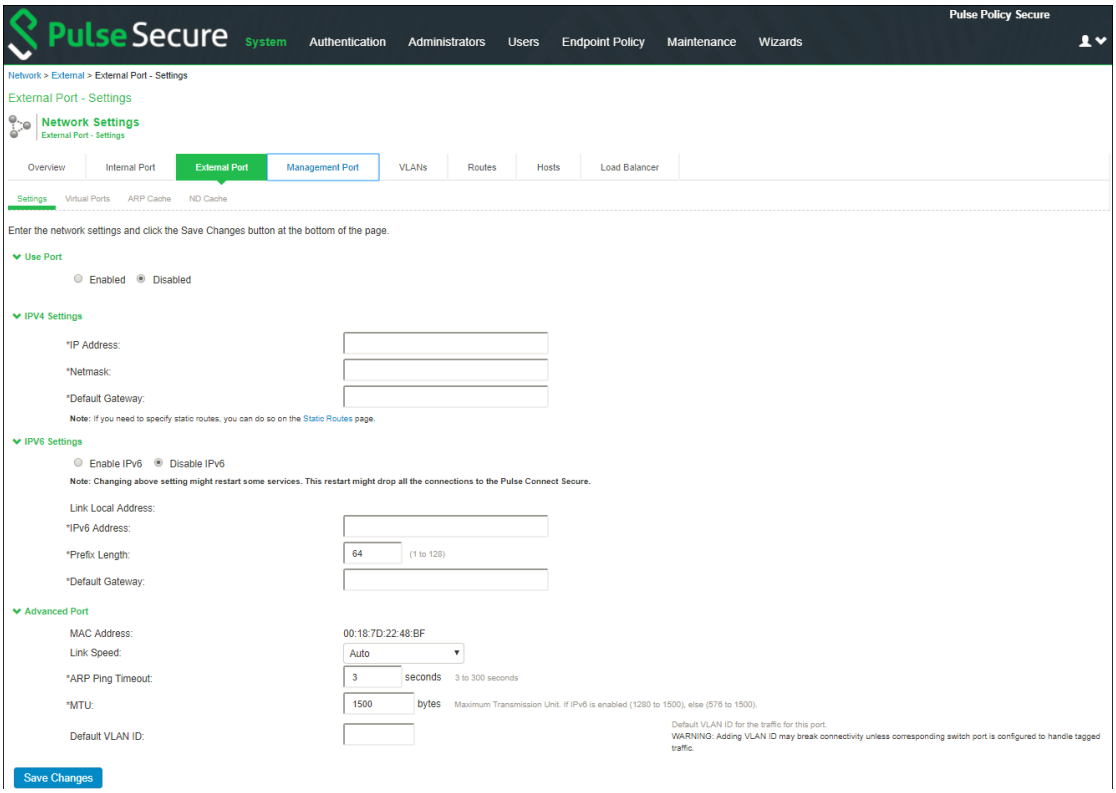


Table80: External Port Configuration Guidelines

Settings	Guidelines
Use Port?	
Use Port?	Select **Enabled** to use the port; otherwise, select **Disabled**.
IPv4 Settings	
IP Address	Specify an IP address. An IP address is an identifier for a computer or device on a TCP/IP network. Networks using the TCP/IP protocol route messages based on the IP address of the destination. The format of an IPv4 address is a 32-bit numeric address written as four numbers separated by periods. Each number can be 0 to 255.
Netmask	Specify a netmask. A netmask indicates which part of an IP address indicates network identification and which part indicates the host identification. For example, the IP address and netmask 10.20.30.1 255.255.255.0 (or 10.20.30.1/24) refer to all the hosts in the 10.20.30.0 subnet. The IP address and netmask 10.20.30.1 255.255.255.255 (or 10.20.30.1/32) refer to a single host.
Default Gateway	Specify the IPv4 address for the default gateway for the routing domain to which the device belongs. A gateway is the router that resides at the point of entry to the current routing domain, often called the default gateway.
IPv6 Settings	
Enable IPv6 / Disable IPv6	Disabled by default. Enable to support access from IPv6 endpoints. When you enable IPv6, the system acquires a link local address. If you switch from enabled to disabled, the system clears the link local address.
Link Local Address	Display the auto configured link local address (after you have enabled and saved the IPv6 configuration).
IPv6 Address	Specify a routable IPv6 address, such as a global unicast address that your network plan has provisioned for this host and interface. Automatic configuration methods are not supported. You must specify the appropriate address manually.
Prefix Length	Specify how many of the higher order contiguous bits of the IPv6 address comprise the prefix (the network portion of the IPv6 address). The default is 64.
Gateway	Specify the IPv6 address for the default gateway for the routing domain to which the device belongs. A gateway is the router that resides at the point of entry to the current routing domain, often called the default gateway.
Advanced Settings	
MAC Address	Display the MAC address for the interface.
Link Speed	Specify the speed and duplex combination for the interface. If you run SNMP_GET and then change the Link Speed value, you must wait at least 5 minutes after submitting the change before running SNMP_GET again.
ARP Ping Timeout	(IPv4 only.) Specify how long the system should wait for responses to Address Resolution Protocol (ARP) requests before timing out. Cluster nodes send ARP requests to the gateways of other nodes to determine if they are properly communicating with one another. If you have not deployed a cluster, the system does not use this setting. If the node belongs to a cluster, the timeout interval that you specify is synchronized across the cluster. In multisite clusters, you can override this setting for the individual nodes in the cluster using options in the System > Clustering page. Use caution when changing this setting in active/passive clusters, however, because the system also uses the ARP Ping Timeout setting on the Internal tab as a failover timer for the VIP.

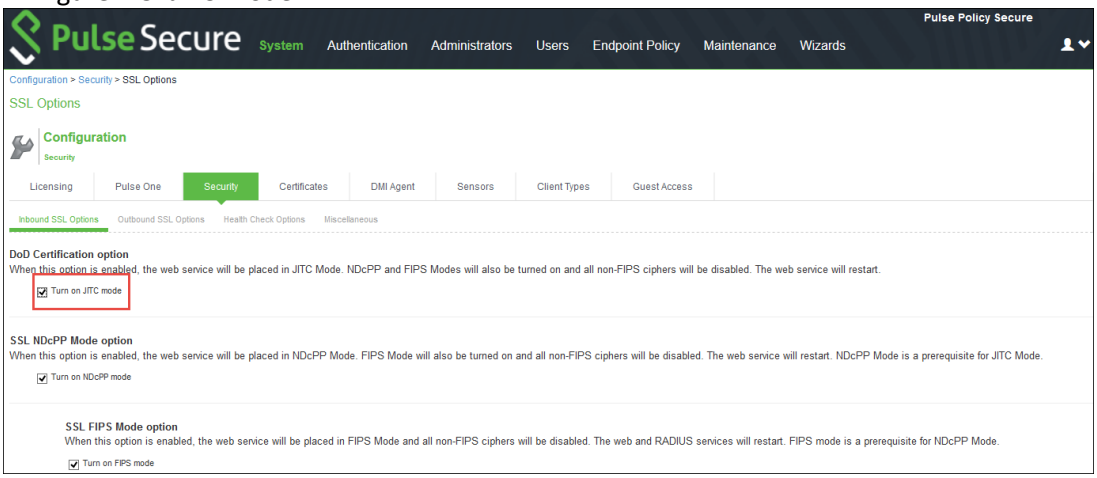
Settings	Guidelines
MTU	Specify the maximum transmission unit. If IPv6 is enabled, the valid range is 1280 to 1500. If IPv6 is not enabled, the valid range is 576 to 1500. We recommend you retain the default MTU setting (1500) unless you must change the setting for troubleshooting purposes.
Default VLAN ID	(Optional) Specify the default VLAN ID for the traffic of this port. When this parameter is set, all the traffic on this interface is subsequently tagged with the set VLAN ID and also accepts only incoming traffic with the same tag. Necessary changes are required on the connected switch port to handle bi-directional tagged traffic. **Note:** • If default VLAN ID is set incorrectly or the connected switch port is not configured accordingly, the interface can become unreachable. • Default VLAN ID cannot be set if IPv6 is enabled. • Default VLAN ID is not supported in a clustered environment. • In case of VMware ESXi based Virtual Appliance(VA), set the vSwitch configuration to port 4095 to allow PPS to tag the traffic. • The set default VLAN ID should be added as a member in the physical port of switch and the same VLAN should be removed from native VLAN ID.

JITC Mode Option

To enable the Joint Interoperability Test Command (JITC) mode:

1. Select **System > Configuration > Security > Inbound SSL** Options.
2. Under DOD certification option, enable **Turn on JITC mode**.

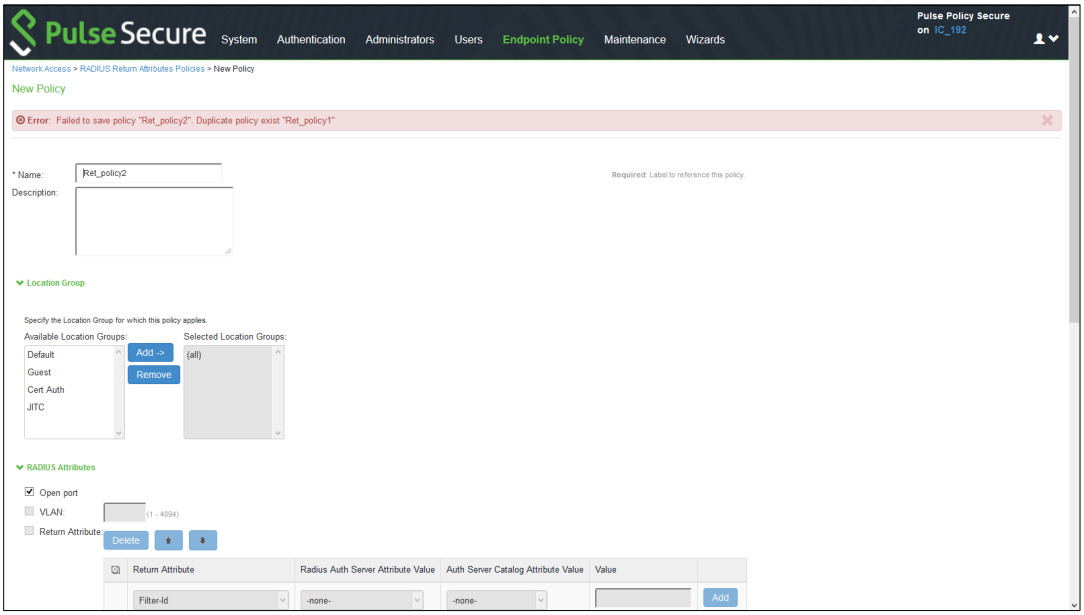
Figure475: JITC Mode



Note: NDcPP and FIPS mode are automatically enabled after enabling the **JITC mode.**

3. Click **Save Changes**.
4. With JITC mode enabled, PPS detects any duplicate RADIUS Return and Request Attribute policies and an error message is displayed if the user tries to create a duplicate policy.

Figure476:RADIUS Return/Request Attribute Policy

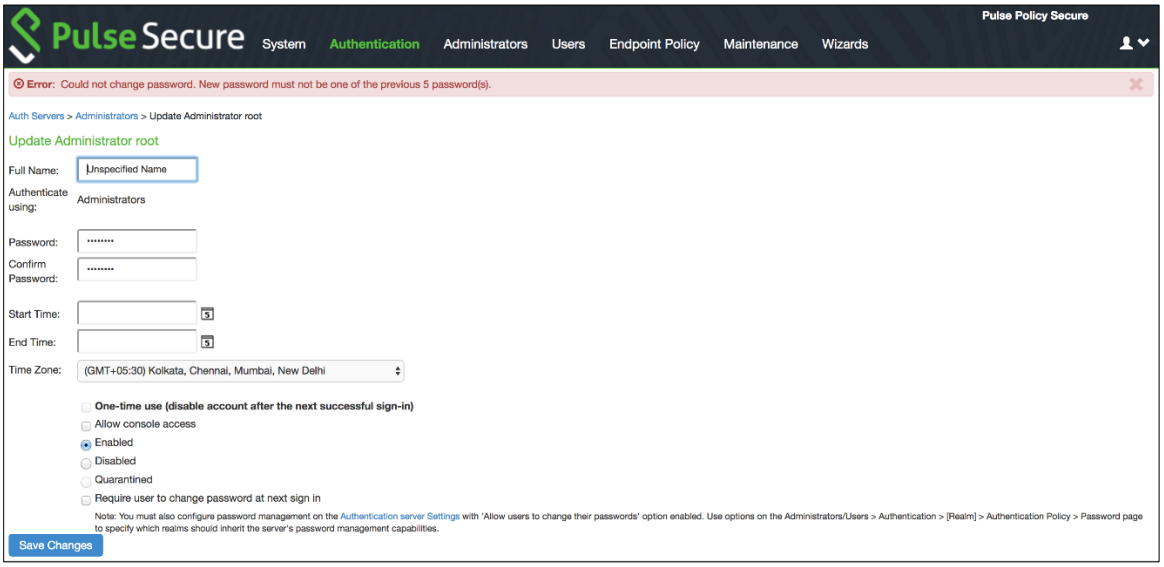


Note: With JITC mode enabled, only the first match duplicate RADIUS policy found is reported in the error message.

Important Factors to Consider

Password Strengthening: When JITC is enabled, PPS does not allow an administrator to configure a password exactly same as previously configured 5 passwords. An error message is displayed in this case.

Figure477:Password Strenghtening



Notification for Unsuccessful Admin Login Attempts: With JITC Mode on, PPS shows a banner with the count of unsuccessful login attempts. This includes any change in the Admin status that would have happened since the last successful login. Upon clicking on the banner, the Administrator is directed to the status page, which provides more details about status or configuration change since last login. These configuration changes are cleared before the next login so that admin can see different set of configuration changes, if anything happened from the last login.

Figure478: Banner for Unsuccessful Admin Login Attempts

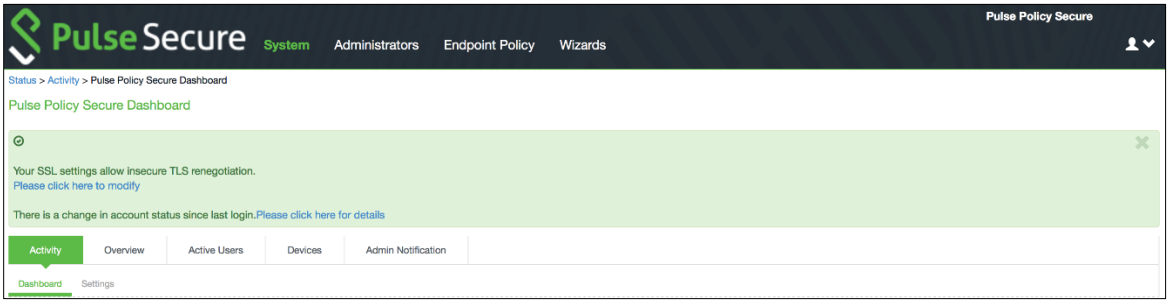
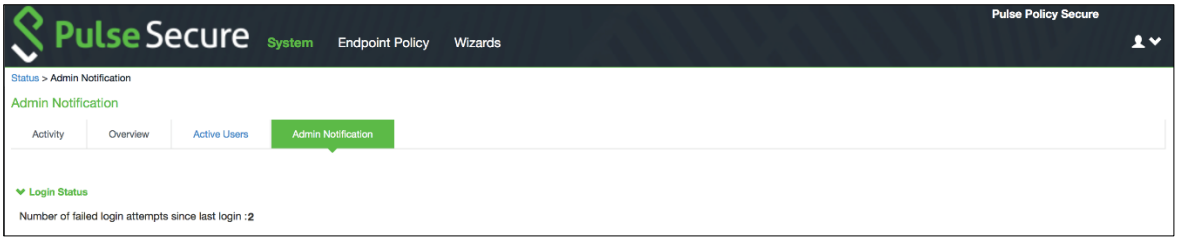


Figure479: Admin Notification for Unsuccessful Admin Login Attempts

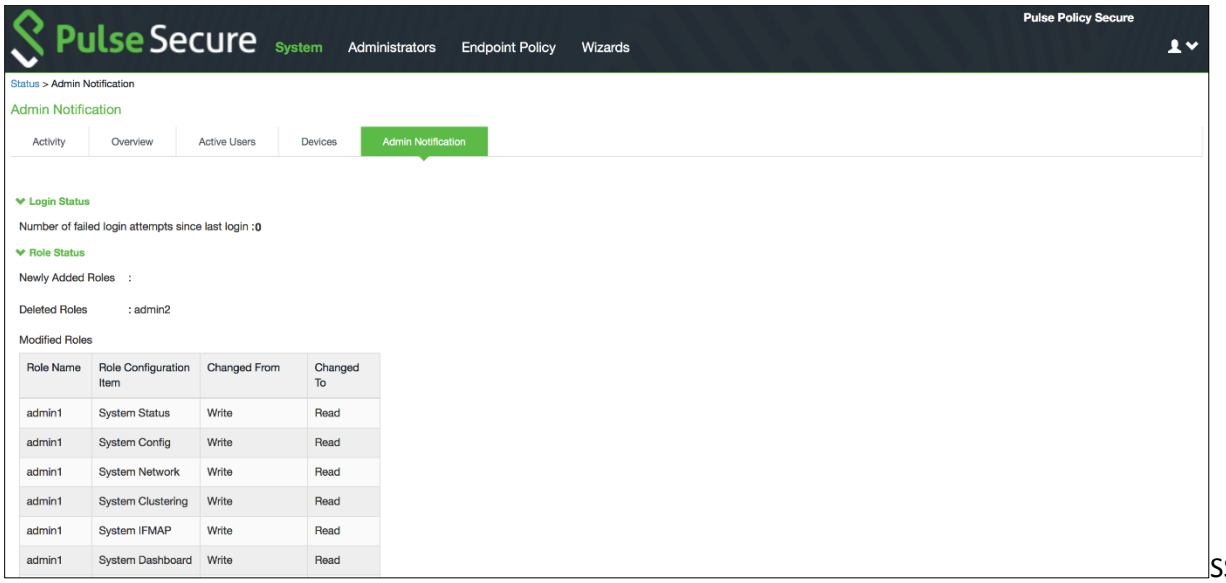


Re-authentication of Admin Users: PPS will force the administrator to re-authenticate with PPS whenever the following conditions occur:

- Add Role
- Delete Role
- Modify the Role
- Delete the Realm
- Update the Realm
- During DPE (Dynamic Policy Evaluation)

Configuration Change Notification: For details about configuration changes and status information since last login, go to **System > Status >Admin Notification.**

Figure480: Configuration Change Notification for Admin Users



SSL

NDcPP Mode Option

NDcPP mode can be enabled in the Inbound tab with a checkbox. This status is also applied over to the Outbound tab. Turning on NDcPP automatically turns on FIPS mode and disables SSL/TLS Version TLS1.0 and below. Also, NDcPP Mode allows to choose only 16 Ciphers under Custom Encryption Strength. Turning on the NDcPP checkbox selects all the NDcPP ciphers by default on both, the Inbound and Outbound sides.

NOTE: When the NDcPP Mode is enabled, backend server like Windows 2008 R2 which supports the SSL/TLS Version only till TLS1.0 cannot be connected.

syslog-ng server

- Connection to syslog-ng server does NOT get established, since syslog-ng does not support TLSv1.1 and TLSv1.2.

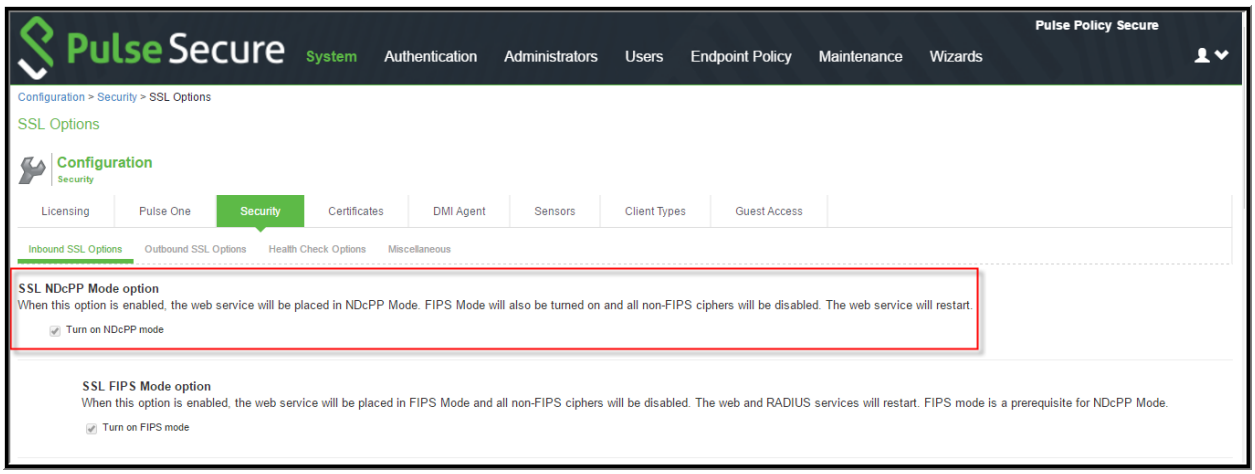
rsyslog

- Supports only till TLSv1.1. So, connection would not get established, if Outbound SSL Options is set to use TLSv1.2.

NOTE:

- To be NDcPP compliant, NTP Update Interval needs to be limited to 60 minutes. This is to avoid the potential drift becoming too excessive.
- For incoming client certificate during client certificate authentication and for incoming server certificate during backend syslog server connection 1024 bit Key Length is not allowed in both NDcPP and FIPS Mode where as SHA1 Signature Algorithm is not allowed only in FIPS Mode and is allowed in NDcPP Mode. This restriction is not applicable for Outgoing Certificates from PPS during SSL Negotiation.

Figure 481: SSL NDcPP Mode Option

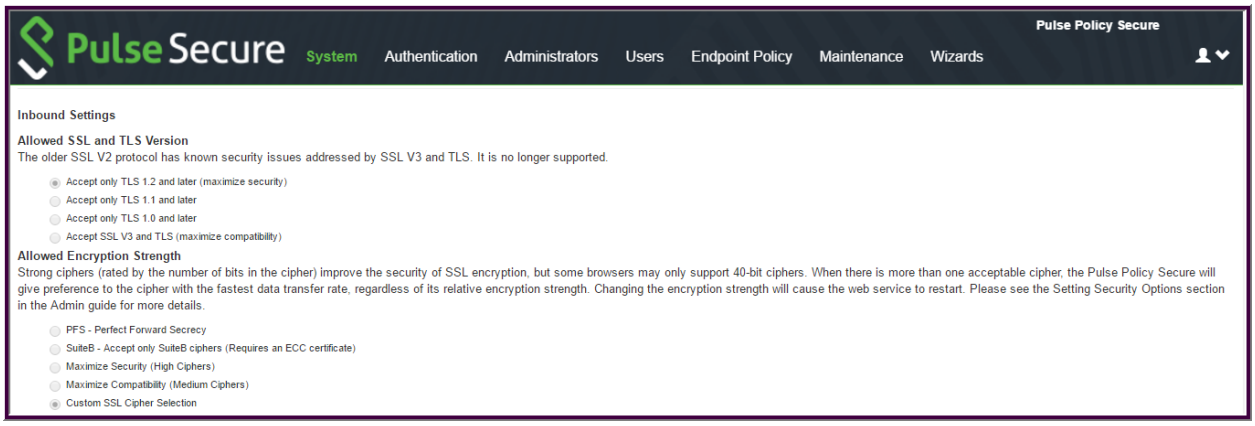


Inbound Settings

When the NDcPP mode is enabled, the following settings appear by default in the Inbound SSL Options page:

- The **Accept only TLS 1.1 and later** is enabled by default in the Allowed SSL and TLS Version settings. Only the **Accept only TLS 1.1** and **Accept only TLS 1.2** options can be chosen. The **Accept only TLS 1.0 and later** and the **Accept SSL V3 and TLS (maximize compatibility)** are disabled. See Figure 482.
- With regards to the Allowed Encryption Strength settings the **Custom SSL Cipher Selection** is enabled by default with NDcPP Ciphers. All other options are disabled.

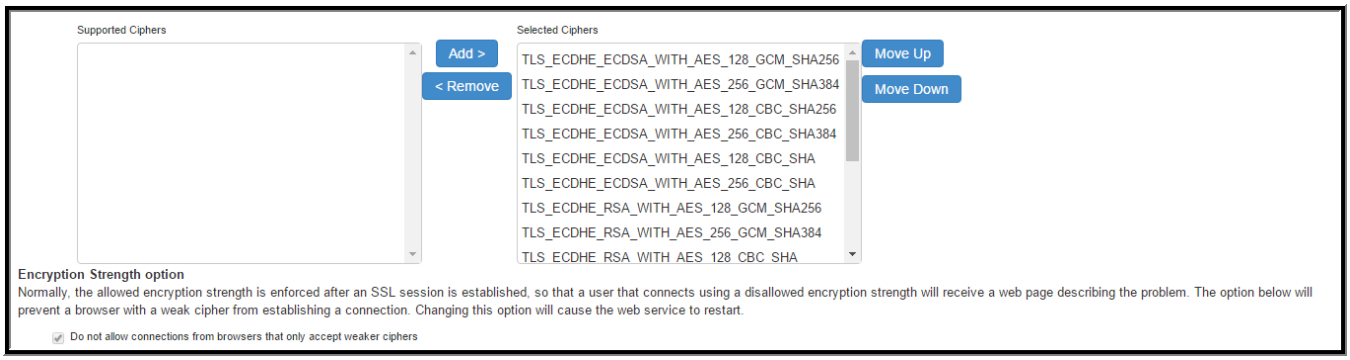
Figure 482: NDcPP Inbound Settings Page



The following is a list of Selected Ciphers in the Inbound Settings with the NDcPP mode enabled:

- TLS_RSA_WITH_AES_128_CBC_SHA
- TLS_RSA_WITH_AES_256_CBC_SHA
- TLS_DHE_RSA_WITH_AES_128_CBC_SHA
- TLS_DHE_RSA_WITH_AES_256_CBC_SHA
- TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA
- TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA
- TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA
- TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA
- TLS_RSA_WITH_AES_128_CBC_SHA256
- TLS_RSA_WITH_AES_256_CBC_ SHA256
- TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA256
- TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA384
- TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256
- TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384
- TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256
- TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384

Figure 483: Selected Ciphers in the Inbound Settings with the NDcPP Mode

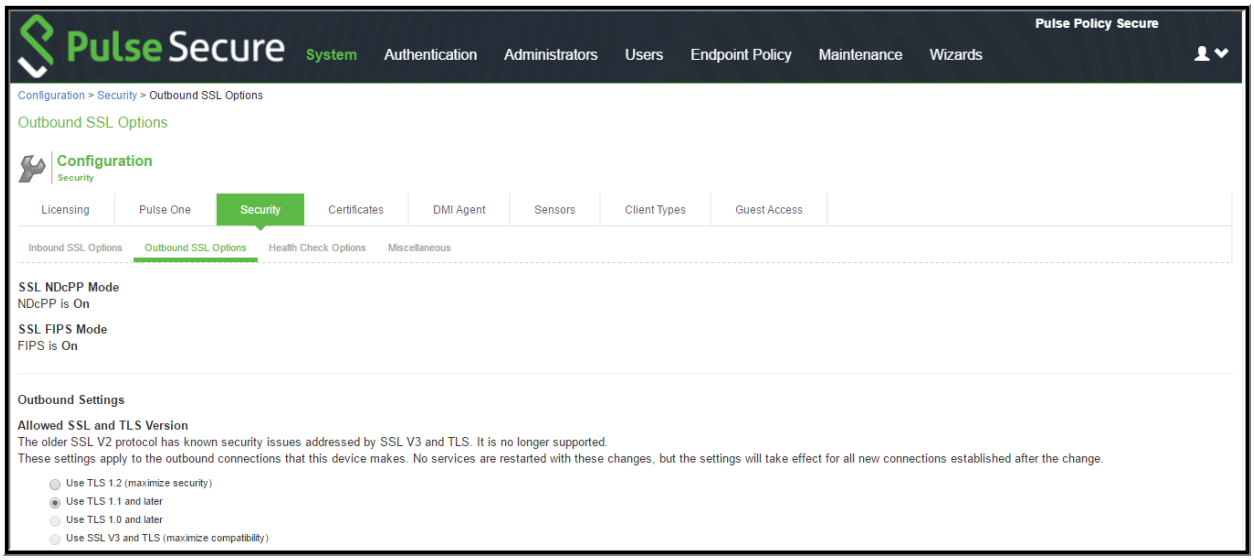


Outbound Settings

When the NDcPP mode is enabled, the following settings appear by default in the Outbound SSL Options page:

- The **Accept only TLS 1.1 and later** is enabled by default in the Allowed SSL and TLS Version settings. Only the **Accept only TLS 1.1** and **Accept only TLS 1.2** are editable. The **Accept only TLS 1.0 and later** and the **Accept SSL V3 and TLS (maximize compatibility)** are disabled.
- With regards to the Allowed Encryption Strength settings the **Custom SSL Cipher Selection** is enabled by default. All other options are disabled.
- Only the NDcPP ciphers configured in the Outbound SSL options settings are sent in the Outbound connections (PPS —> backend SSL).

Figure 484: NDcPP Outbound Settings Page

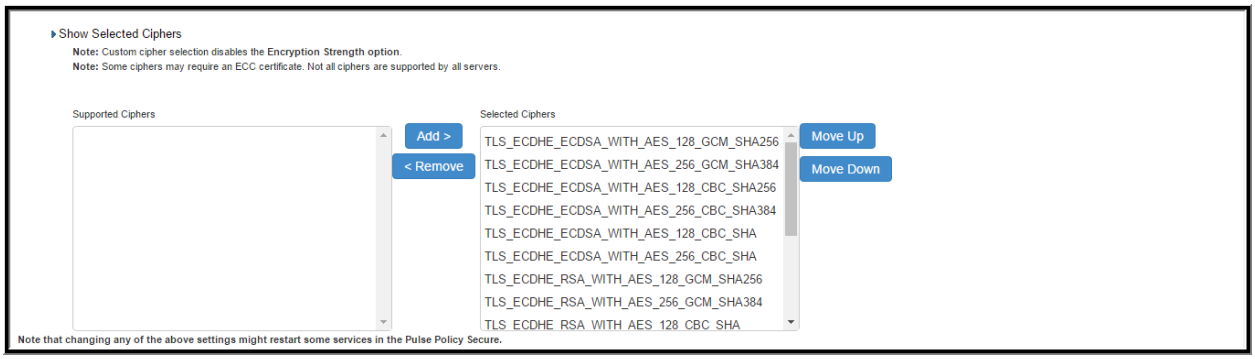


The following is a list of Selected Ciphers in the Outbound Settings with the NDcPP mode enabled:

- TLS_RSA_WITH_AES_128_CBC_SHA
- TLS_RSA_WITH_AES_256_CBC_SHA
- TLS_DHE_RSA_WITH_AES_128_CBC_SHA
- TLS_DHE_RSA_WITH_AES_256_CBC_SHA
- TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA
- TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA
- TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA

- TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA
- TLS_RSA_WITH_AES_128_CBC_SHA256
- TLS_RSA_WITH_AES_256_CBC_ SHA256
- TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA256
- TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA384
- TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256
- TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384
- TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256
- TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384

Figure 485: Selected Ciphers in the Outbound Settings with the NDcPP Mode



Using the Management Port

This topic describes how to configure the management port. It includes the following information:

- Management Port Overview
- Supported Platforms
- Configuring the Management Port
- Using the Serial Console to Configure the Management Port
- Configuring Administrator Access

Management Port Overview

You connect the management port to an Ethernet switch or router that is part of your internal local area network (LAN) and that can connect to your network management infrastructure. When the management port is enabled, the following traffic is directed out the management port: archiving (FTP/SCP), NTP, push config, SNMP, syslog. When the management port is not enabled, that traffic uses the internal port.

Supported Platforms

The following hardware platforms are equipped with a management port:

PSA Series

Configuring the Management Port

To configure the management port:

1. Select **System > Network > Management Port > Settings** to display the configuration page.
2. Complete the configuration as described below.

3. Save your changes.

Figure486: PPS Management Port Configuration Page

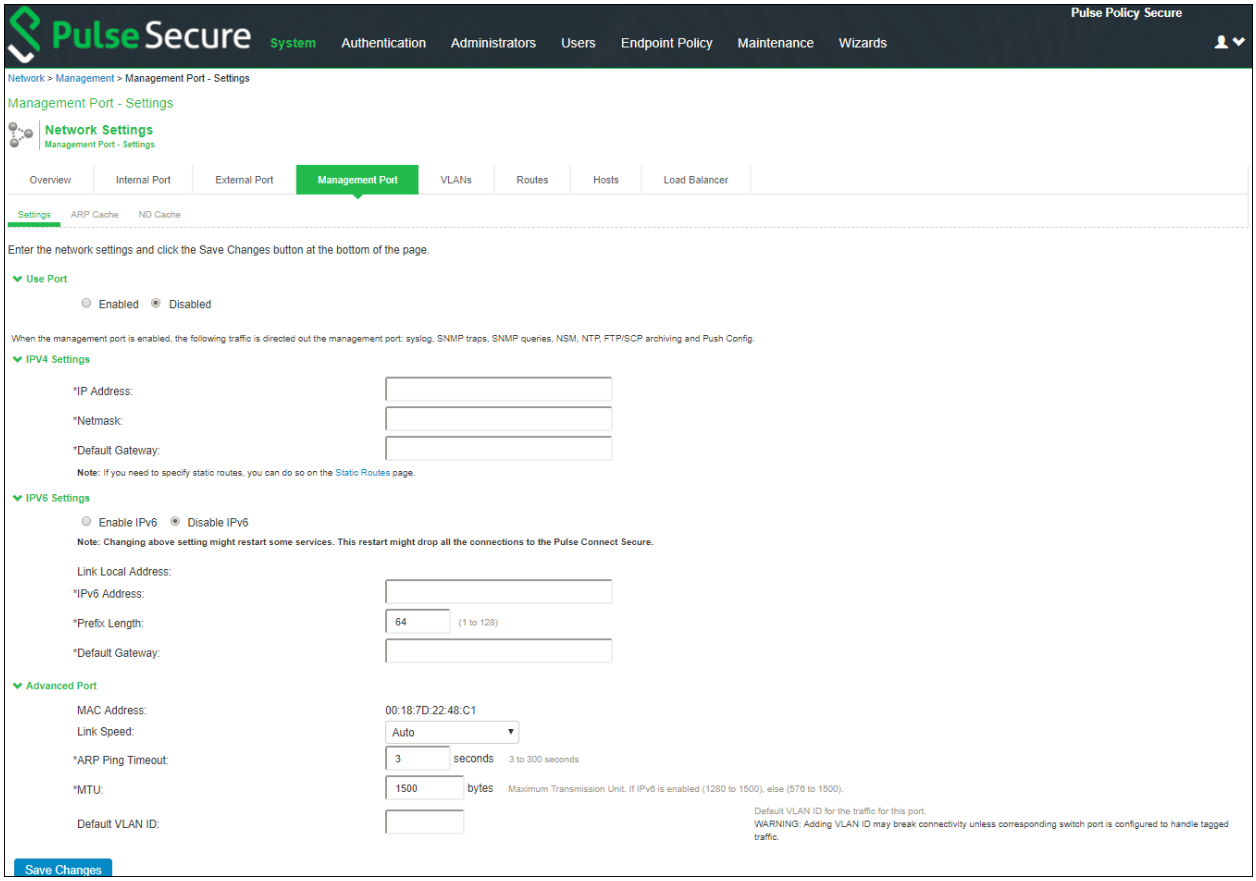


Table81: Management Port Configuration Guidelines

Settings	Guidelines
Use Port?	
Use Port?	Select **Enabled** to use the port; otherwise, select **Disabled**.
IPv4 Settings	
IP Address	Specify an IP address. An IP address is an identifier for a computer or device on a TCP/IP network. Networks using the TCP/IP protocol route messages based on the IP address of the destination. The format of an IPv4 address is a 32-bit numeric address written as four numbers separated by periods. Each number can be 0 to 255.
Netmask	A netmask indicates which part of an IP address indicates network identification and which part indicates the host identification. For example, the IP address and netmask 10.20.30.1 255.255.255.0 (or 10.20.30.1/24) refer to all the hosts in the 10.20.30.0 subnet. The IP address and netmask 10.20.30.1 255.255.255.255 (or 10.20.30.1/32) refer to a single host.
Default Gateway	Specify the IPv4 address for the default gateway for the routing domain to which the device belongs. A gateway is the router that resides at the point of entry to the current routing domain, often called the default gateway.

Settings	Guidelines
IPv6 Settings	
Enable IPv6 / Disable IPv6	Disabled by default. Enable to support network management traffic over IPv6 networks. When you enable IPv6, the system acquires a link local address. If you switch from enabled to disabled, the system clears the link local address.
Link Local Address	Display the auto configured link local address (after you have enabled and saved the IPv6 configuration).
IPv6 Address	Specify a routable IPv6 address, such as a global unicast address that your network plan has provisioned for this host and interface. Automatic configuration methods are not supported. You must specify the appropriate address manually.
Prefix Length	Specify how many of the higher-order contiguous bits of the IPv6 address comprise the prefix (the network portion of the IPv6 address). The default is 64.
Gateway	Specify the IPv6 address for the default gateway for the routing domain to which the device belongs. A gateway is the router that resides at the point of entry to the current routing domain, often called the default gateway.
Advanced Settings	
MAC Address	Display the MAC address for the interface.
Link Speed	Specify the speed and duplex combination for the interface. If you run SNMP_GET and then change the Link Speed value, you must wait at least 5 minutes after submitting the change before running SNMP_GET again.
ARP Ping Timeout	(IPv4 only.) Specify how long the system should wait for responses to Address Resolution Protocol (ARP) requests before timing out. Cluster nodes send ARP requests to the gateways of other nodes to determine if they are properly communicating with one another. If you have not deployed a cluster, the system does not use this setting. If the node belongs to a cluster, the timeout interval that you specify is synchronized across the cluster. In multisite clusters, you can override this setting for the individual nodes in the cluster using options in the System > Clustering page. Use caution when changing this setting in active/passive clusters, however, because the system also uses the ARP Ping Timeout setting on the Internal tab as a failover timer for the VIP.
MTU	Specify the maximum transmission unit. If IPv6 is enabled, the valid range is 1280 to 1500. If IPv6 is not enabled, the valid range is 576 to 1500. We recommend you retain the default MTU setting (1500) unless you must change the setting for troubleshooting purposes.
Default VLAN ID	(Optional) Specify the default VLAN ID for the traffic of this port. When this parameter is set, all the traffic on this interface is subsequently tagged with the set VLAN ID and also accepts only incoming traffic with the same tag. Necessary changes are required on the connected switch port to handle bi-directional tagged traffic. **Note:** • If default VLAN ID is set incorrectly or the connected switch port is not configured accordingly, the interface can become unreachable. • Default VLAN ID cannot be set if IPv6 is enabled. • Default VLAN ID is not supported in a clustered environment. • In case of VMware ESXi based Virtual Appliance(VA), set the vSwitch configuration to port 4095 to allow PPS to tag the traffic. • The set default VLAN ID should be added as a member in the physical port of switch and the same VLAN should be removed from native VLAN ID.

Using the Serial Console to Configure the Management Port

To configure management port network settings from the serial console:

1. Start a serial console session.
2. Select item 1, **System Settings and Tools**.
3. Select item 10, **Configure Management port**. The text indicates if the option is enabled or disabled.
4. Enter the network settings for the Management Port, as prompted.

NOTE: If you enable the Management Port but neglect to configure the IP address and netmask, the port reverts to a disabled state. Also, you cannot clear Management Port settings from the serial console when the port is disabled, though you can clear them from within the admin console.

5. When prompted to accept the changes, if they are correct, enter y. Otherwise, repeat the process to correct the settings.
6. Close the serial console.

Configuring Administrator Access

You can configure the Administrators > Admin Realm > Authentication Policy > Source IP restrictions configuration to enable administrator sign-in through the management port.

You can use Administrator realms to control administrator access to system ports, including the management port.

To control administrator access to the management port:

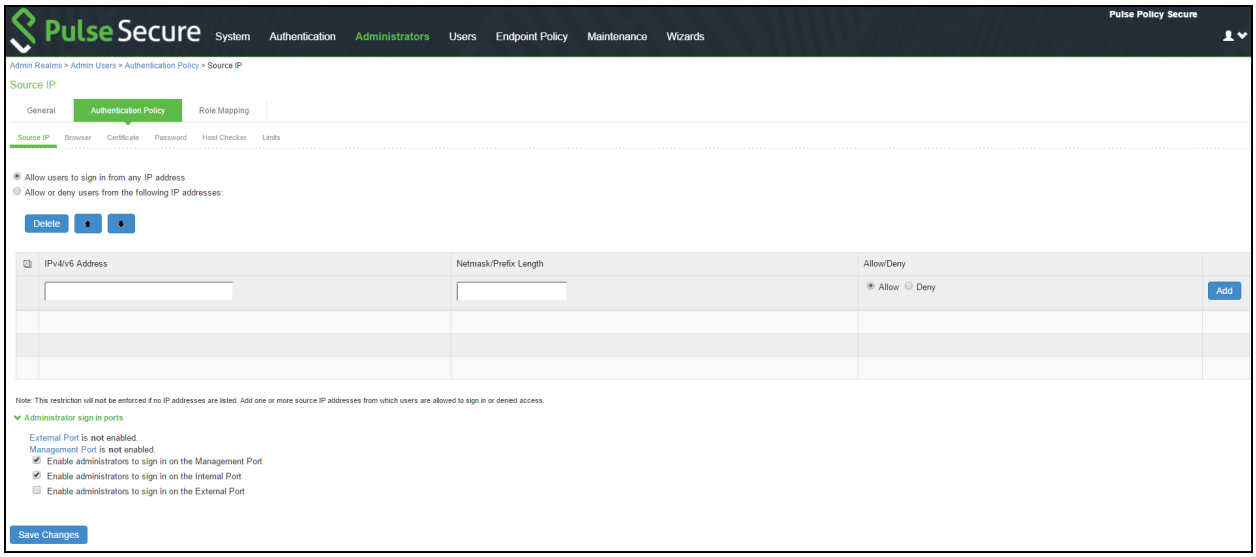
Enable the management port.

1. Perform one of the following steps:
   - Select **Administrators > Admin Realms > Admin Users** to modify the default admin users realm.
   - Select **Administrators > Admin Realms**, then click **New**, to create a new administrator realm.
2. Select the **Authentication Policy > Source IP**.
3. Select one of the following options:
   - Allow users to sign in from any IP address—Allows users to sign in from any IP address to satisfy the access management requirement.
   - Allow or deny users from the following IP addresses—Specifies whether to allow or deny users access from all the listed IP addresses, based on their settings.

   To specify access from an IP address:

   - Enter the IP address and netmask.
   - Select either Allow to allow users to sign in from the specified IP address, or Deny to prevent users from signing in from the specified IP address.
4. Select the available options to allow administrators to sign in to all available ports, to the management port or the internal port only, or to restrict them from signing in to any of the ports. In some cases, you may inadvertently limit administrative access completely. If this occurs, you can reconfigure the ports by way of the serial console.
5. Select from the following available options:
   - Enable administrators to sign in on the management port.
   - Enable administrators to sign in on the internal port.
   - Enable administrators to sign in on the external port.

Figure487: Configuring Administrator Access



Configuring VLAN Ports

Your network design might include VLANs to provide network segmentation. When connected to a trunk port on a VLAN-enabled switch, the system encounters traffic from all VLANs. This is useful for network designs with separate VLANs for separate classes of users or endpoints, and for making the system accessible from all VLANs. You can use RADIUS attributes to place different users in different network segments.

The system supports IEEE 802.1Q VLAN tagging. You must define a VLAN port for each VLAN. The internal port must be assigned to the root system and must be marked as the default VLAN. Routes to servers reachable from the VLAN interfaces must have the next-hop gateway set to the configured gateway for the VLAN interface, and must have the output port defined as the VLAN port.

When you save the configuration for a new VLAN port, the system creates two static routes by default:

- The default route for the VLAN pointing to the default gateway.
- The interface route to the directly connected network.

To configure a VLAN port:

1. Select **System > Network > VLANs**.
2. Click New Port to display the configuration page.
3. Complete the configuration as described in table below.
4. Save your changes.

Figure488: VLAN Port Configuration Page

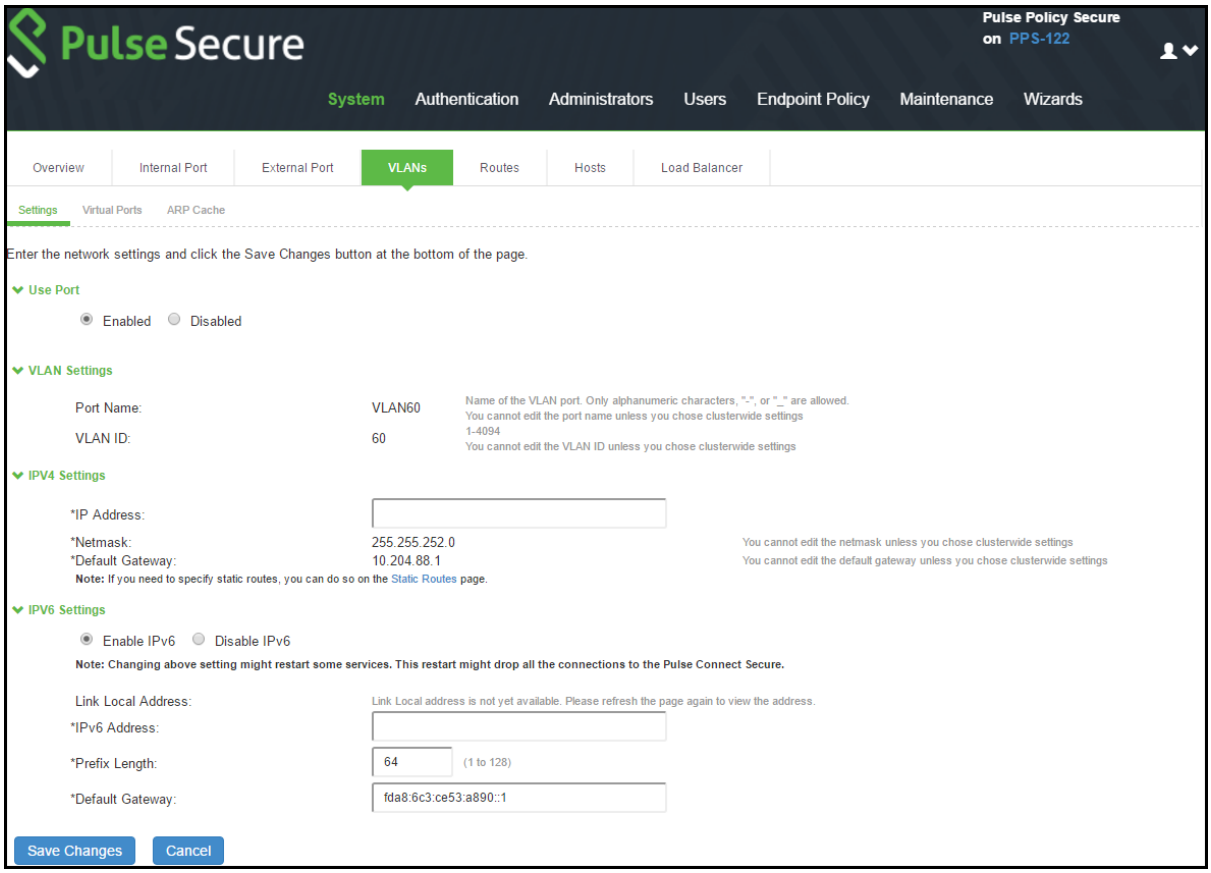


Table82: VLAN Port Configuration Guidelines

Settings	Guidelines
Use Port?	
Use Port?	Select **Enabled** to use the port; otherwise, select **Disabled**.
VLAN Settings	
Port Name	Specify a name that is unique across all VLAN ports that you define on the system or cluster. Only alphanumeric characters, "-", or "_" are allowed.
VLAN ID	Specify a number between 1 and 4094. The VLAN ID assignment must be unique on the system.
IPv4 Settings	
IP Address	Specify an IP address and netmask combination that is from the same network as the VLAN. VLAN IP addresses must be unique. You cannot configure a VLAN to have the same network as the internal port. For example, if the internal port is 10.64.4.30/16 and you configure a VLAN as 10.64.3.30/16, you might get unpredictable results and errors. The format of an IPv4 address is a 32-bit numeric address written as four numbers separated by periods. Each number can be 0 to 255.
Netmask	Specify a netmask. A netmask indicates which part of an IP address indicates network identification and which part indicates the host identification. For example, the IP address and netmask 10.20.30.1 255.255.255.0 (or 10.20.30.1/24) refer to all the hosts in the 10.20.30.0 subnet. The IP address and netmask 10.20.30.1 255.255.255.255 (or 10.20.30.1/32) refer to a single host.
Default Gateway	Specify the IPv4 address for the default gateway for the routing domain to which the device belongs. A gateway is the router that resides at the point of entry to the current routing domain, often called the default gateway.

Settings	Guidelines
IPv6 Settings	
IPv6 settings	Select Enable IPv6 to use the port; otherwise, select Disable IPv6.
IPv6 Address	Specify a routable IPv6 address, such as a global unicast address that your network plan has provisioned for this host and interface. Automatic configuration methods are not supported. You must specify the appropriate address manually.
Prefix Length	Specify how many of the higher order contiguous bits of the IPv6 address comprise the prefix (the network portion of the IPv6 address). The default is 64.
Default Gateway	Specify the IPv6 address for the default gateway for the routing domain to which the device belongs. A gateway is the router that resides at the point of entry to the current routing domain, often called the default gateway.

NOTE:

- Link speed, ARP ping timeout, and MTU settings are inherited from the internal port configuration.
- To configure an external VLAN port, Select **System > Network > VLANs > External Port > New VLAN Port - Settings**.
- To configure a Management port, Select **System > Network > VLANs > Managment Port > New VLAN Port - Settings**.

Using Virtual Ports

This topic describes virtual ports. It includes the following information:

- Configuring Virtual Ports
- Using Device Certificates with Virtual Ports

Configuring Virtual Ports

You can use virtual ports to provide different groups of users access to the same system using different IP aliases and domains.

Virtual ports are associated with the physical internal port and physical external port. The virtual port shares all the network settings with the associated physical port, except for the IP address.

When you configure virtual ports, you are creating name-IP address pairs. The names and IP addresses must be unique in your network. An alias can include IPv4 addresses, IPv6 addresses, or both. However, the corresponding IP protocol must be enabled on the physical port for the addresses to take effect.

To configure a virtual port:

1. Select **System > Network > PortName > Virtual Ports**. PortName is Internal Port or External Port.
2. Click New Port to display the configuration page.
3. Complete the configuration as described in table below.
4. Save your changes.

Figure489: Virtual Port Configuration Page

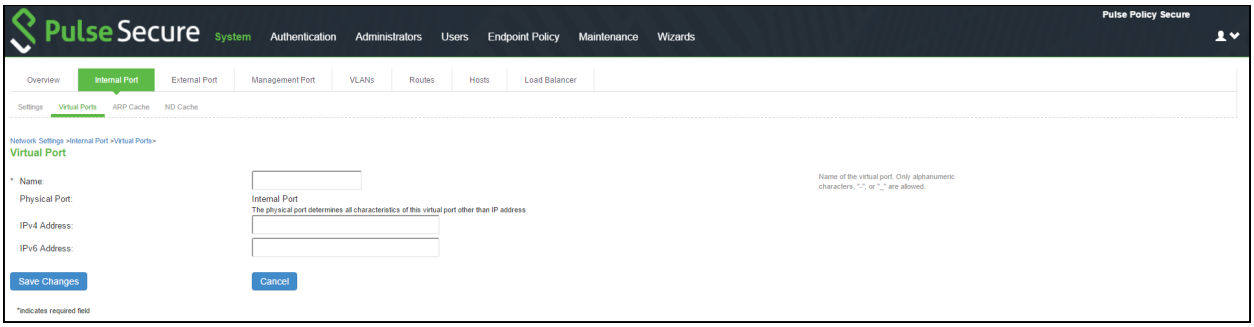


Table83: Virtual Port Configuration Guidelines

Settings	Guidelines
Name	Specify a name for the virtual port. The names and IP addresses in the virtual port configuration must be unique in your network.
Physical Port	Display the name of the physical port associated with the virtual port. The virtual port inherits link speed, ARP ping timeout, and MTU settings from the physical port configuration.
IPv4 Address	Specify an IPv4 address. An alias can include IPv4 addresses, IPv6 addresses, or both. However, the corresponding IP protocol must be enabled on the physical port for the addresses to take effect.
IPv6 Address	Specify an IPv6 address. An alias can include IPv4 addresses, IPv6 addresses, or both. However, the corresponding IP protocol must be enabled on the physical port for the addresses to take effect.

Using Device Certificates with Virtual Ports

Virtual ports can be used to create multiple fully qualified domain names for user sign-in. When a user tries to sign in using the IP address defined in a virtual port, the system presents the certificate associated with the virtual port to initiate the SSL transaction.

You can approach the digital certificate security and virtual ports implementation in either of the following ways:

- Associate all hostnames with a single certificate—With this approach, you use a single wildcard certificate to validate the identity of all system hostnames, regardless of which hostname is used to sign in. A wildcard certificate includes a variable element in the domain name, making it possible for users who sign in from multiple hosts to map to the “same” domain. For example, if you create a wildcard certificate for *.yourcompany.com, the system uses the same certificate to validate its identity to users who sign in to employees.yourcompany.com as it does to users who sign into partners.yourcompany.com.
- Associate each hostname with its own certificate—With this approach, you associate different hostnames with different certificates. Create a virtual port for each hostname. A virtual port activates an IP alias on a physical port. For example, you can create two virtual ports on a single appliance, mapping the first virtual port to the IP address 10.10.10.1 (sales.yourcompany.com) and the second virtual port to the IP address 10.10.10.2 (partners.yourcompany.com). Then you can associate each of these virtual ports with its own certificate, ensuring that users authenticate through different certificates.

To associate certificates with virtual ports:

1. Create virtual ports.
2. Import the device certificates.
3. Associate the device certificates with the virtual ports:
    a. Select **System > Configuration > Certificates > Device Certificates**.
    b. Click the link of the device certificate you want to configure to display the configuration page.
    c. Use the controls in the “Present certificate on these ports” section to associate ports with the certificate.

Configuring the System Date and Time

You can use the admin console to set the system date and time manually or by configuring a network time protocol (NTP) server. The system supports NTPv4, which is backwards compatible with NTPv3 and NTPv2.

BEST PRACTICE: We recommend you use NTP to synchronize the date and time clocks on all network systems. Using NTP obviates issues that might occur with cluster synchronization, network communication that uses time-sensitive protocols, such as SAML, and implementation of time-based policies, such as local authentication server account expiration. In addition, using NTP as a standard in your network rationalizes timestamps in logs, which facilitates reporting and troubleshooting.

On a VMware virtual appliance, the data may be erased each hour if the same NTP server is not defined on the license server, and on the ESXi server.

To set the system date and time:

1. Select **System > Status** to display the System Status dashboard.
2. Click the System Date and Time **Edit** link to display the configuration page.
3. Complete the configuration as described below
4. Save the configuration.

Table84: Date and Time Configuration Guidelines

Settings	Guidelines
Time Zone	Select your time zone. Selecting the appropriate time zone enables the system to automatically adjust the time for Daylight Saving Time changes.
Use NTP Server	
NTP Server	Specify the fully qualified domain name or IP address for the NTP server.
Key	If you are using NTPv4, specify the symmetric key. The key must be pre-synchronized with the NTP server. For example, if you want to configure NIST's clock as the NTP server, you must request a key beforehand and have NIST send that key to you. The key for MD5 is in the following format: *KeyNumber* M *KeyValue* The key for SHA1 is in the following format: *KeyNumber* SHA1*KeyValue*
Secondary NTP Server	Specify the fully qualified domain name or IP address for a secondary NTP server. If the system fails three times to reach the primary server or if the authentication fails three times, the system attempts to contact the secondary NTP server.
Key	If you are using NTPv4, specify the symmetric key.
Update Interval	Specify an update interval. The maximum interval is 999999 (enforced by the user interface).
Set Time Manually	
Date	Specify the date. You can click **Get from Browser** to automatically populate the Date and Time fields.
Time	Specify the time and select **AM** or **PM**.

Configuring NTP and Other Services Traffic Over Any Physical Interface

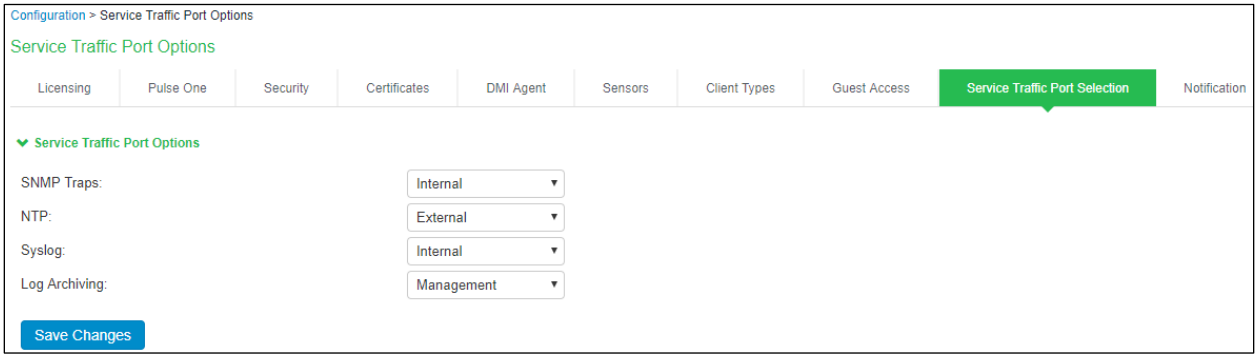
The NTP, SNMP, Syslog, and Log archiving services are set to send the traffic through Management port by default. In case the Management port is not available, the traffic is routed through Internal port. Now, an administrator can modify the settings of NTP and other services to any physical interface.

The following procedure describes the steps to configure the ports for the services. Before you proceed, ensure the External and Management ports are enabled for use in the network settings.

To configure Service Traffic Port Options:

1. Select **System > Configuration > Service Traffic Port Selection**.
2. For the individual service, select the required port from the drop-down list.

Figure490: Service Traffic Port Selection



In a cluster environment, when a node joins the cluster, configuration of the node is replaced with the configuration of other nodes in the cluster.

Configuring Network Services

You configure DNS and WINS services when you initially configure the system with the serial console. If necessary, you can use the System > Network > Overview page to modify the configuration. You can also use this page to configure a hostname.

The network services overview page also displays the node name (if the node belongs to a cluster), and the status and interface statistics for the internal port, external port, and management port.

To configure network services:

1. Select **System > Network > Overview** to display the configuration page.
2. Complete the configuration as described below.
3. Save your changes.

Figure491: Network Services Configuration Page

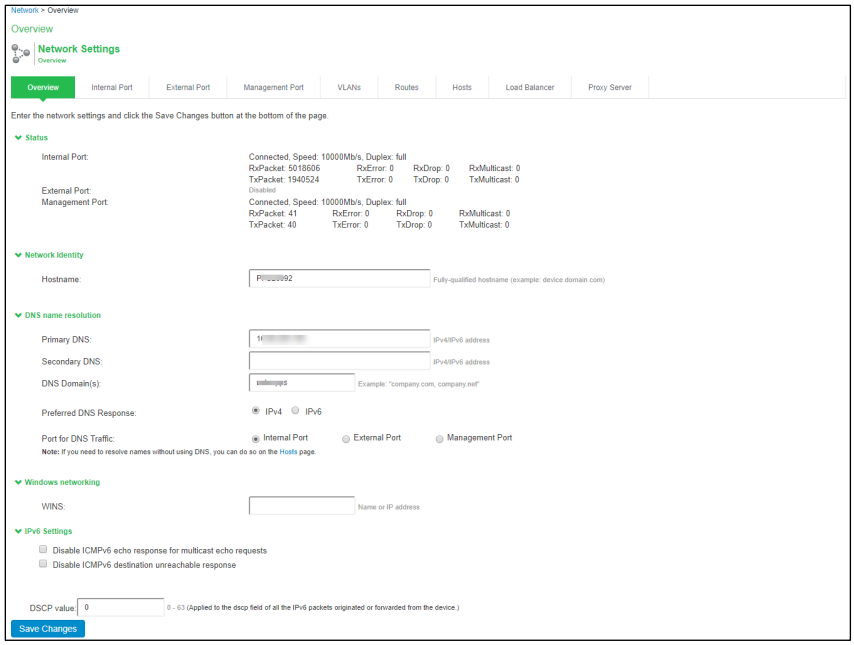


Table85: Network Services Configuration Guidelines

Settings	Guidelines
Status	
Status	Display interface statistics for the internal port, external port, and management port.
Network Identity	
Hostname	Specify a fully qualified hostname. For example, **domain.company.com**. The hostname cannot exceed 30 characters
DNS Name Resolution	
Primary DNS	Specify the IPv4/IPv6 address for the primary DNS server.
Secondary DNS	Specify the IPv4/IPv6 address for the secondary DNS server.
DNS Domain(s)	Specify a comma-separated list of default domains. The system searches the domains in the order they are listed.
Preferred DNS response	Determines the preferred DNS response from the DNS server. • Select IPv4 if PPS sends and receives only IPv4 hostname resolution requests and responses from the DNS server. • Select IPv6 if PPS sends and receives both IPv4 and IPv6 hostname resolution requests and responses from the DNS server.
Port for DNS Traffic	Administrator can modify the DNS setting to any physical interface namely Internal Port, External Port or Management Port. • DNS port will be set to Internal port for fresh installation or an upgrade. • The setting can be configfured as node-specific or cluster-wide in case of a cluster.
Windows Networking	
WINS	Specify the hostname or IP address of a local or remote Windows Internet Naming Service (WINS) server that you use to associate workstation names and locations with IP addresses.

Managing the Routes Table

The system populates the routes table with dynamic, auto-discovered routes. Many networks will not require changes to this routing table. If necessary, you can delete routes or add static routes.

To manage the routes table:

1. Select **System > Network > Routes** to display the routes table.
2. Use the controls described in below table to manage the routes table.

Figure492: PPS Routes Table

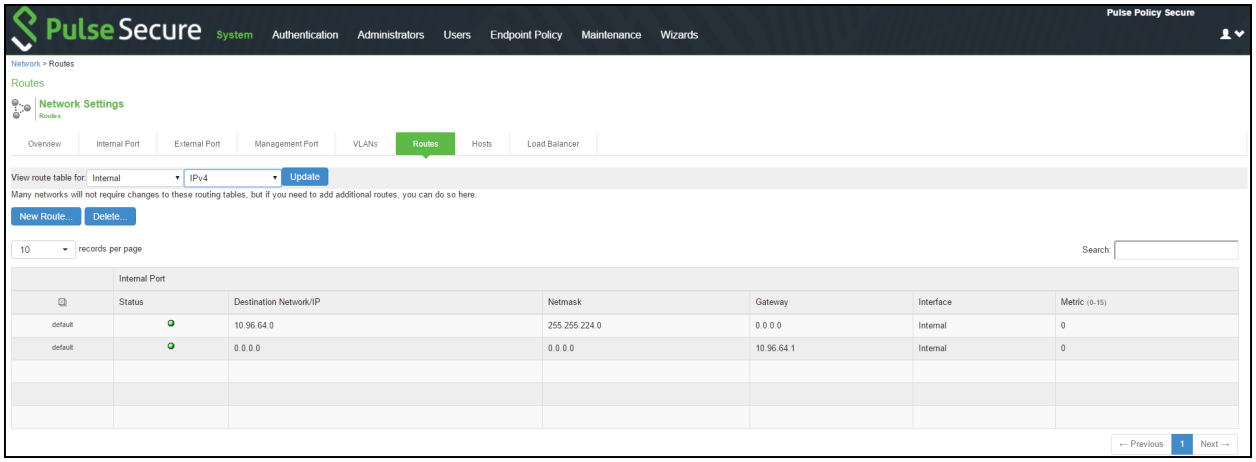


Table86: Routes Table Controls

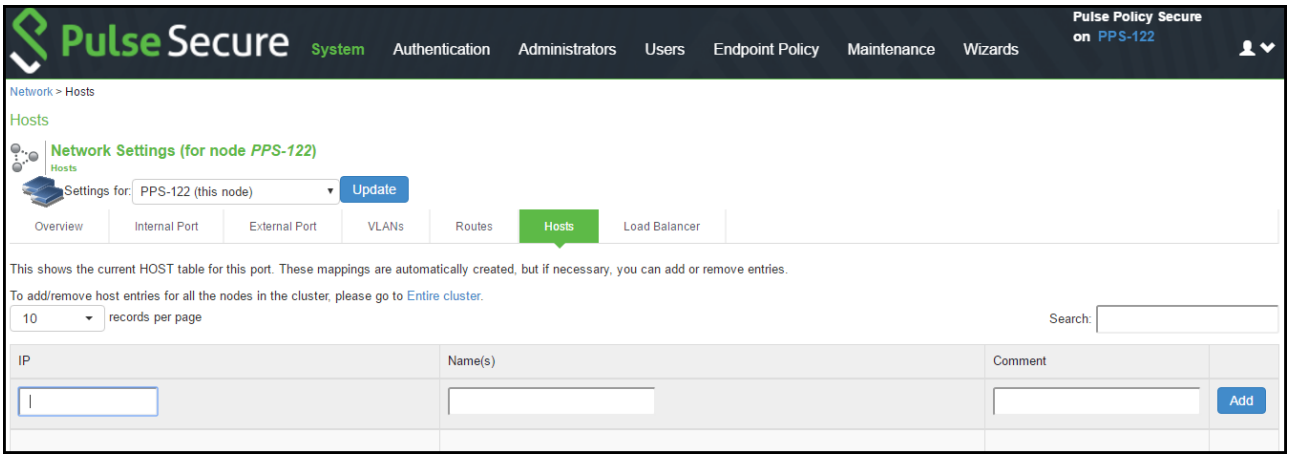
Controls	Description
View route table for	Use the controls to change the display to show the route table for internal, external, or management interfaces; and for IPv4 or IPv6 routes.
Delete	Select a row in the table and click **Delete** to delete a route.
New Route	Click **New Route** and complete the configuration to add a route to the table. You must specify a valid IP address, gateway, DNS address, and metric. The metric is a way of comparing multiple routes to establish precedence. Generally, the lower the number (from 1 to 15), the higher the precedence. Thus, a route with a metric of 2 is chosen over a route with a metric of 14. The metric value of zero (0) identifies the route as one that should not be used.

Managing the Hosts Table

In general, the system uses the configured DNS servers to resolve hostnames, but it also maintains a local hosts table that can be used for name resolution. The system populates some entries from host-IP address pair settings in your configuration. You can add host-IP address mappings for other hosts that might not be known to the DNS servers used by the system, or in cases where DNS is not reachable.

To manage the hosts table:

1. Select **System > Network > Hosts** to display the hosts table.
2. Figure493: PPS Hosts Table



3. Use the controls described in the below table to manage the hosts table.

Table87: Hosts Table Controls

Controls	Description
Add	Specify an IP address, hostname, and comment (a description for the benefit of system administrators), and click **Add**.
Delete	Click the delete icon in the last column to delete the row from the table.

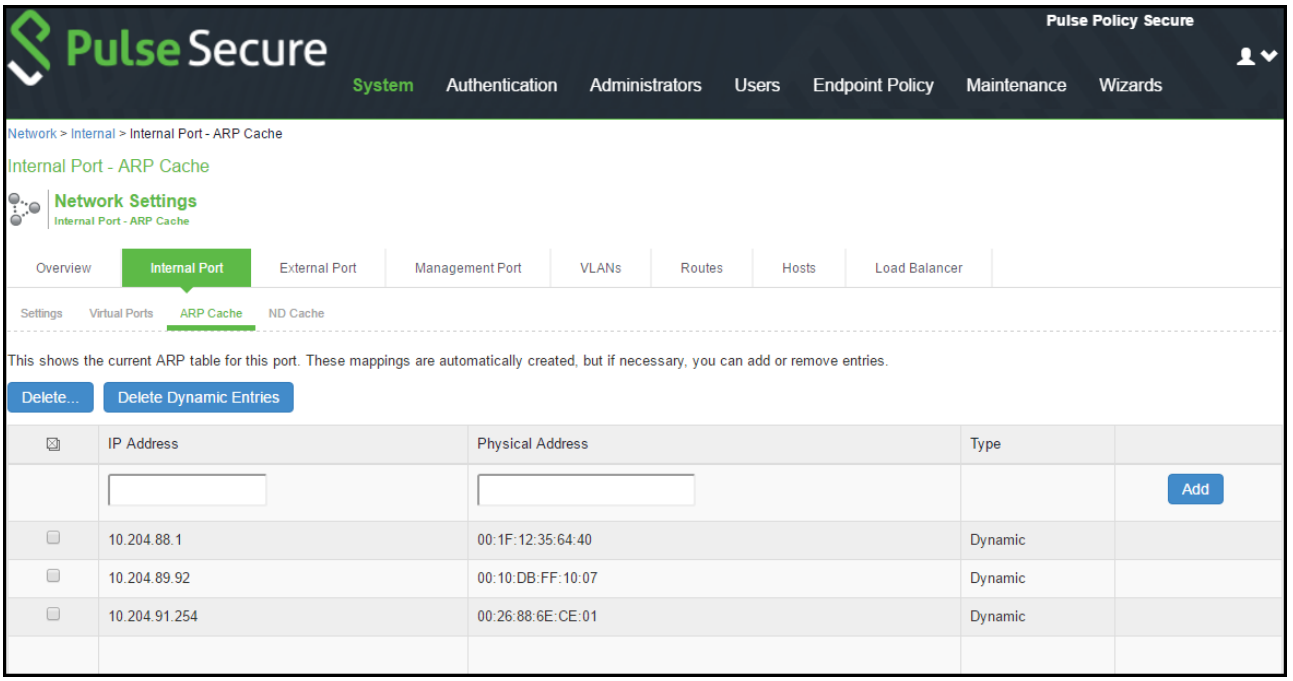
Managing the ARP Table

ARP stands for Address Resolution Protocol. In IPv4 networking, network nodes use ARP to maintain information about peer network nodes. ARP is used to associate the Layer 3 IP address with a Layer 2 MAC address of neighboring peer nodes. The system maintains an ARP table with dynamic, cached entries, and you can add static entries if necessary. The system caches dynamic entries for up to 20 minutes. Dynamic entries are deleted during a reboot. Static entries are restored after a reboot.

To manage the ARP table:

1. Select **System > Network > *Port* > ARP Cache**. *Port* is the Internal Port, External Port, or Management Port tab.

   Figure494: PPS ARP Table



2. Use the controls described in table below to manage the ARP table.

Table88: ARP Table Controls

Controls	Description
Delete	Select a row in the table and click **Delete** to delete the entry.
Delete Dynamic Entries	Delete all dynamically discovered entries.
Add	Specify an IP address, a MAC address, and click **Add** to add an entry. If you add an entry that has the same IP address as an existing entry, the system overwrites the existing entry with your new entry.

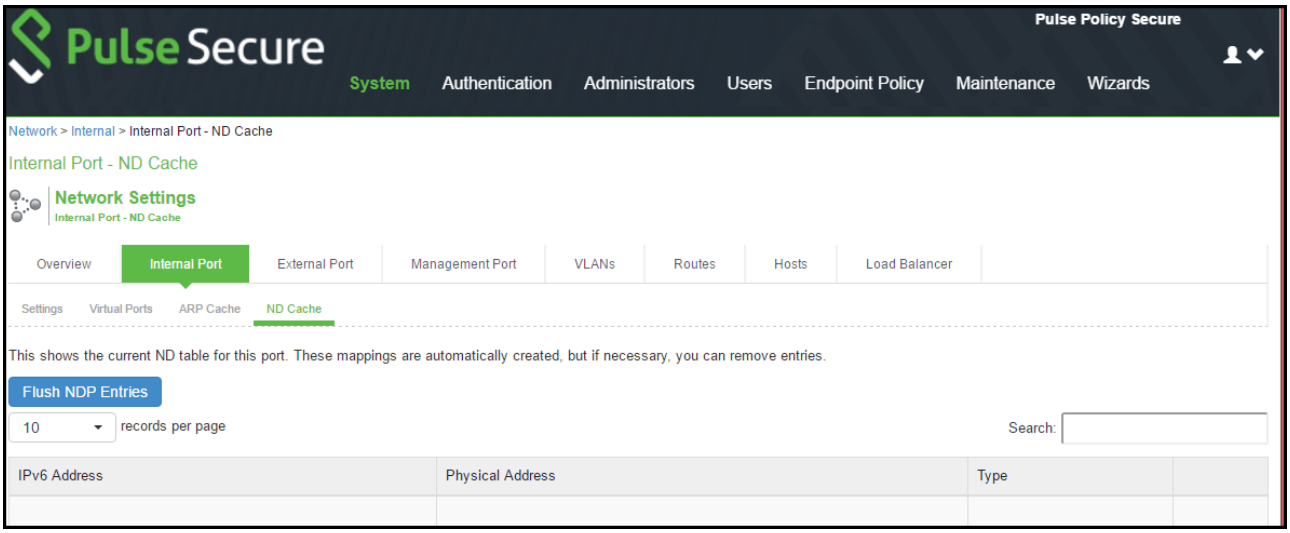
Managing the Neighbor Discovery Table

In IPv6 networking, network nodes use the Neighbor Discovery Protocol (NDP) to determine the Layer 2 MAC addresses for neighboring hosts and routers. The system uses NDP to maintain a cache of neighboring routers that are reachable and can forward packets on its behalf.

To manage the neighbor discovery table:

1. Select **System > Network > *Port* > ND Cache**. *Port* is the Internal Port, External Port, or Management Port tab.
2. Select **Flush NDP Entries** to delete all dynamically discovered entries.

Figure495: PPS Neighbor Discovery Table



Configuring SSL Options

Use the System > Configuration > Security > SSL Options page to change the default security settings. We recommend that you use the default security settings, which provide maximum security, but you may need to modify these settings if your users cannot use certain browsers or access certain Web pages.

TLS_DHE_RSA_WITH_AES_128_CBC_SHA TLS_DHE_RSA_WITH_AES_256_CBC_SHA cipher suites are supported. Both these ciphers use RSA for server authentication and ephemeral Diffie-Hellman (DHE) for key exchange. RSA server certificate is required for these ciphers. Only TLS_DHE_RSA_WITH_AES_256_CBC_SHA is available with the **Accept 168-bit and greater** option. In the Custom SSL Cipher configuration, TLS_DHE_RSA_WITH_AES_128_CBC_SHA is available only when **AES-Medium** is selected and TLS_DHE_RSA_WITH_AES_256_CBC_SHA is available only when **AES-High** is selected. Both ciphers are lower in priority over the other widely used cipher suites.

Enabling Granular Cipher Selection for Setting the Security Options

Granular cipher selection provides an administrator the ability to select specific ciphers and the preferred ordering of the selected ciphers. This feature also provides presets like Suite-B and PFS. There are two tabs, Inbound OpenSSL options and Outbound OpenSSL options. With this feature the administrator can select the ciphers that TLS/SSL connections will use. The Inbound OpenSSL options apply to all incoming connections. Outbound OpenSSL options apply to the following services:

- SCEP
- Syslog
- LDAPS
- Start TLS

NOTE: FIPS Mode Settings is common for both Inbound and Outbound SSL Options.

A common cipher library has been added which can be used by both, the inbound and outbound connections. The outbound options are listed in a separate tab next to the inbound settings. The outbound settings have presets for High and Medium ciphers along with custom options. There is no PFS or SuiteB presets on the outbound side. From 5.3R3 release onwards, support for preset Low has been removed and the same can be configured using Custom SSL Cipher Selection option. For the SuiteB preset to work, PPS should have ECC Device Certificate mapped to Internal or External Port. SuiteB preset does not work if the ECC Device Certificate is mapped only to virtual port.

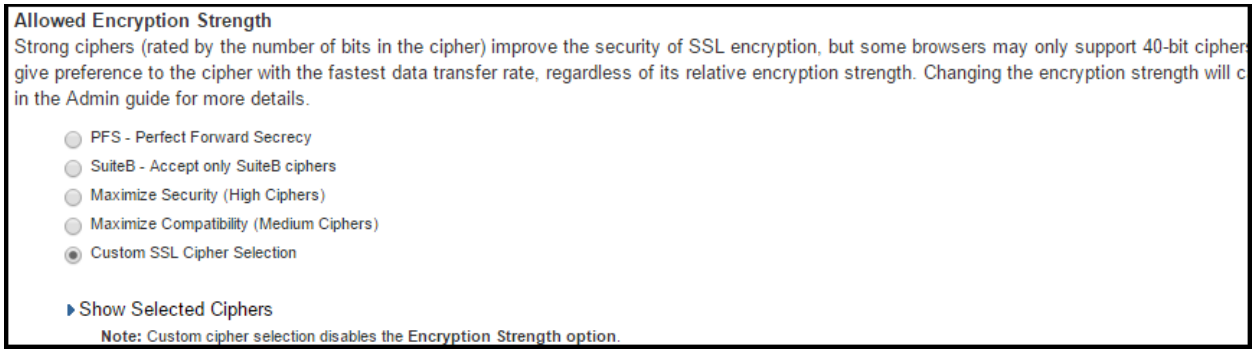
Enabling Inbound SSL Options

Only when FIPS mode is turned on, the FIPS compliant ciphers are available to be chosen from the Supported Ciphers panel. FIPS mode is editable only on the inbound option page.

To set the security options with Inbound SSL options:

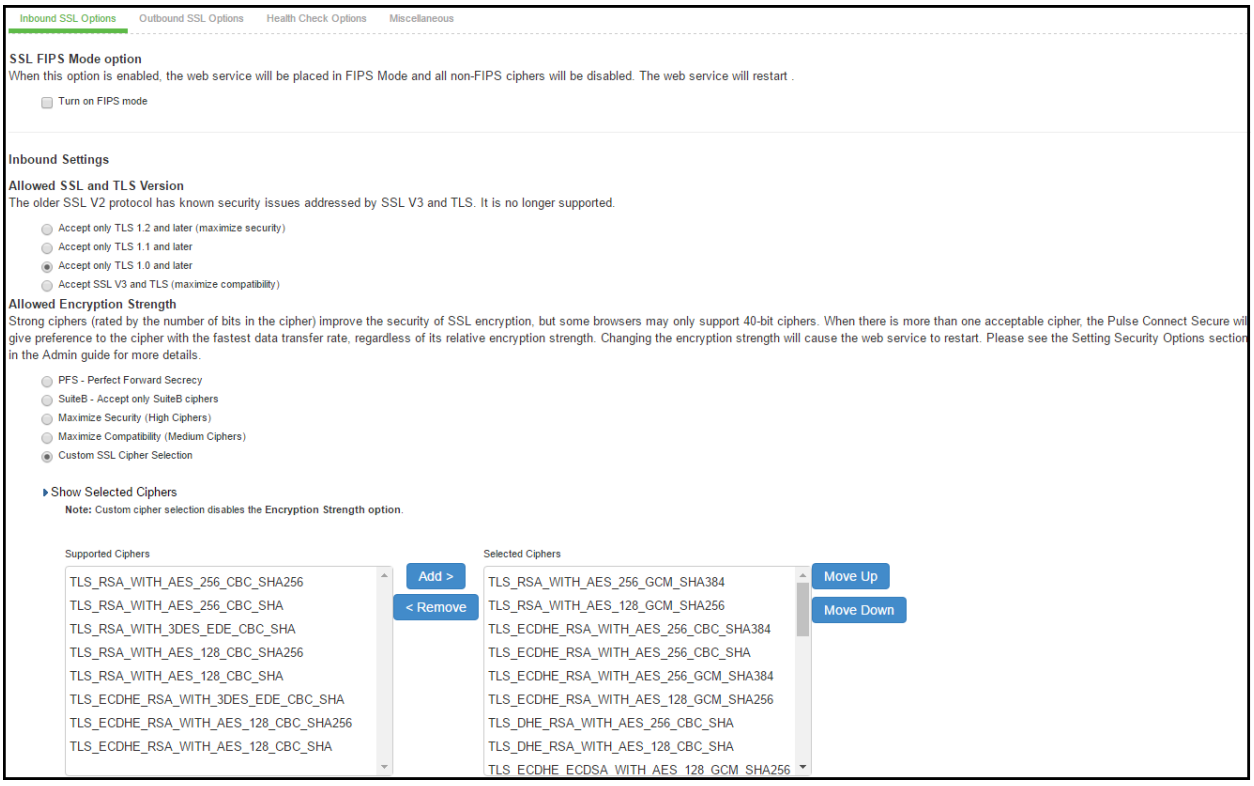
1. In the admin console, select **System > Configuration > Security > Inbound SSL Options**.
2. Under Allowed Encryption Strength choose **Custom SSL Cipher Selection**.

Figure496: Setting Custom SSL Cipher Selections



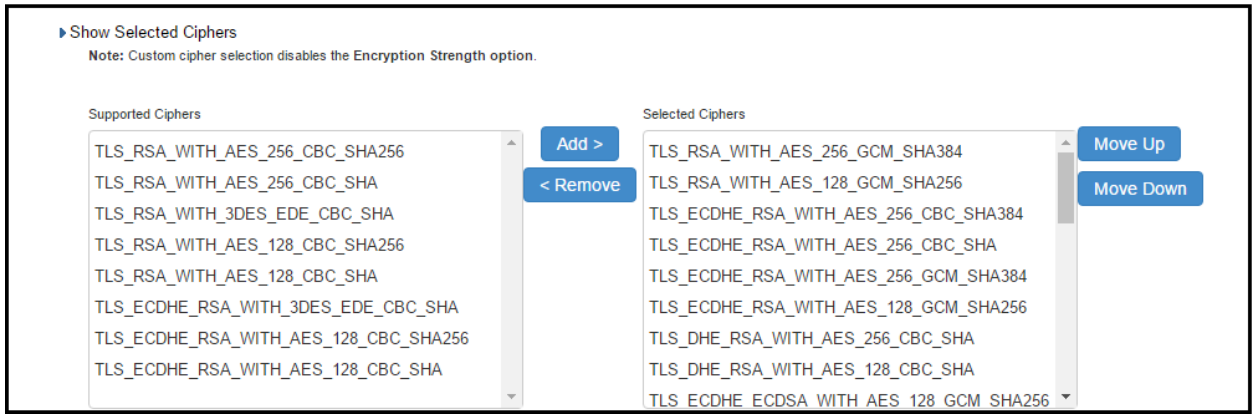
3. The two panels of **Supported Ciphers** and **Selected Ciphers** are displayed. Supported ciphers has the entire list of ciphers supported for the selected SSL or TLS version. Selected ciphers list the currently selected ciphers list. The below figure shows the two panels (Supported Ciphers and Selected Ciphers). Note that the Selected Ciphers and Supported Ciphers List will also be displayed for all Preset like PFS or SuiteB or Medium or High.

Figure497: Supported Ciphers and Selected Ciphers Panels



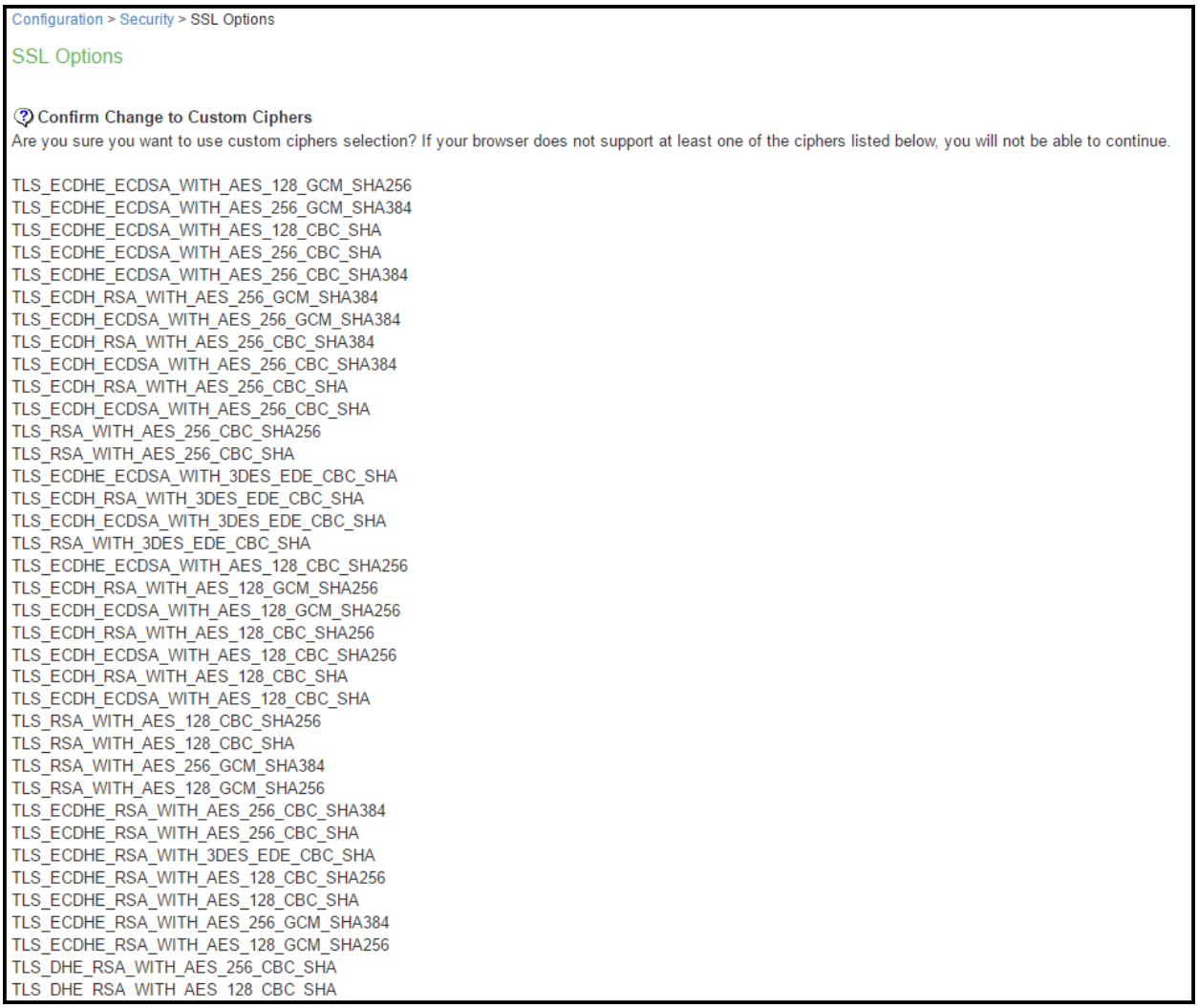
1. For adding a cipher, click the cipher string on the left panel and then click **Add** or double click the cipher name in the left panel.
2. To remove the cipher, click the cipher name on the right panel and then click **Remove** or double click on the cipher name on the right side.
3. The selected ciphers on the right are listed in order of their priority from top to bottom. To change the priority of the ciphers, click on the cipher name and then click on **Move Up** to increase priority or the **Move Down** button to decrease the priority.

Figure498: Setting Custom SSL Cipher Selections



A list of the custom ciphers to be used on the device's port is displayed in the order the web server will select them. Note that Suite B ciphers are listed on top. End users who now log in to external virtual port p_ecdsa256 must have at least one of the listed ciphers installed on their browser or else they cannot log in to the server.

Figure499: Confirming Custom Ciphers



4. Click **Change Allowed Encryption Strength**.

NOTE: When custom ciphers are selected, there is a possibility that some ciphers are not supported by the web browser. Also, if any of ECDH/ECDSA ciphers are selected, they require ECC certificate to be mapped to the internal/external interface. If ECC certificate is not installed, administrator may not be able to log in to the box. The only way to recover from this situation is to connect to the system console and select option 8 to reset the SSL settings from the console menu. Option 8 resets the SSL settings to its default. So, the previously set SSL settings are lost. This is applicable only to Inbound SSL settings.

Enabling Outbound SSL Options

We can configure non FIPS ciphers only for Outbound SSL Settings using Custom Cipher Selection option. There are options to change different SSL/TLS versions and different encryptions in the Outbound SSL Settings. The below figure shows the Outbound SSL Settings.

Figure500: Outbound SSL Settings

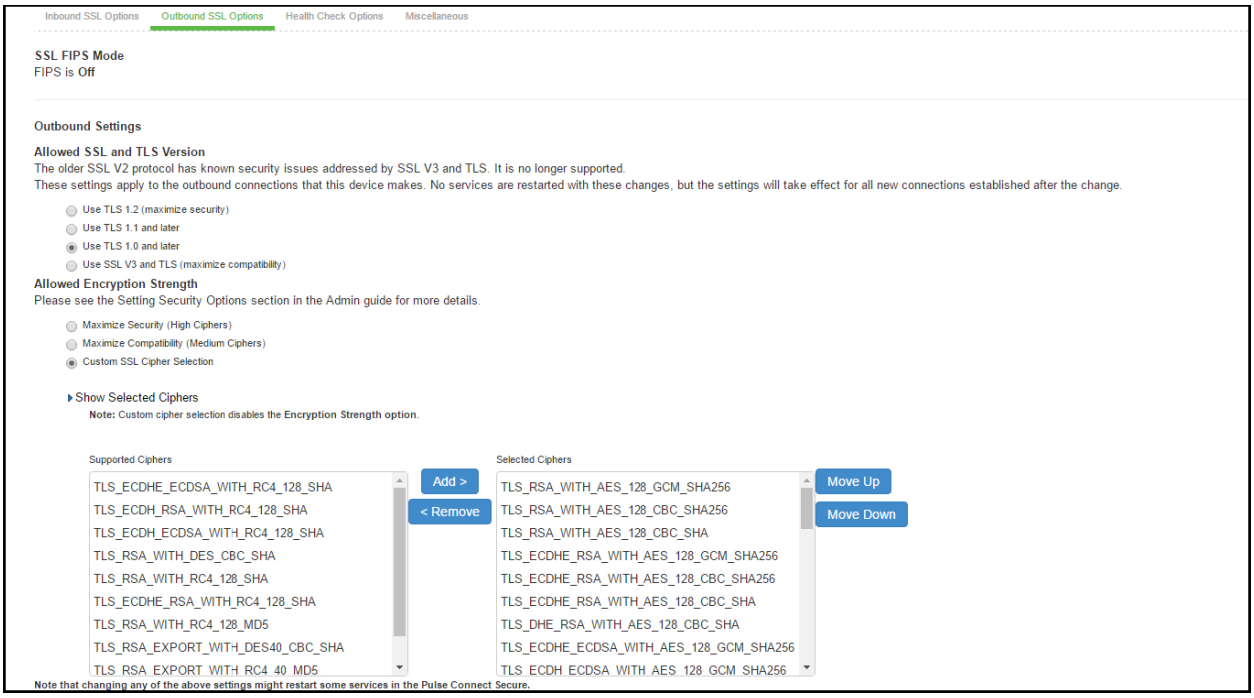


Table89: SSL Options Configuration Guidelines

Settings	Guidelines
SSL FIPS Mode option	**Turn on FIPS mode**— Select this option to enable FIPS mode.
Allowed SSL and TLS Version	Specify encryption requirements for clients. By default, the system requires SSL version 3 and TLS. The system honors this setting for all Web server traffic and all types of clients. You can require users who have older browsers that use SSL version 2 to update their browsers, or you can change this setting to allow SSL version 3, and TLS.
Allowed Encryption Strength	**Accept only 168-bit and greater**— If you select this option the system gives preference to 256-bit AES over 3DES. **Accept only 128-bit and greater**— (Default) If you select this option the system gives preference to RC4 ciphers. You can require users to have this level of encryption strength or change this default to an option compatible with the user base. **Accept 40-bit and greater**—If you select this option the system gives preference to RC4 ciphers. Older browsers that predate the change in the U.S. export law in year 2000 that required 40-bit cipher encryption for international export, can still use 40-bit encryption. **Custom SSL Cipher Selection**—Specify a combination of cipher suites for the incoming connection from the user's browser. If you select the **AES/3DES** option, the system gives preference to 256-bit AES over 3DES. NOTE: When using 168-bit encryption, some Web browsers may still show 128-bit encryption (the gold lock on the browser status bar) even though the connection is 168-bit. This is typically a limitation of the browser's capability.
Encryption Strength option	The allowed encryption strength is enforced after an SSL session is established, so that a user connecting with a disallowed encryption strength receives a Web page describing the problem. Enable this option to prevent a browser with a weak cipher from establishing a connection.
SSL Handshake Timeout option	Determines the time elapse before the SSL handshake timeout. The default is 60 seconds.

Settings	Guidelines
SSL Legacy Renegotiation Support option	SSL and Transport Layer Security (TLS) renegotiations can be subjected to man-in-the-middle (MITM) attacks that can lead to abuse. A new TLS extension (defined in RFC 5746) ties renegotiations to the TLS connections they are being performed over to prevent these kinds of attacks. The SSL Legacy Renegotiation Support option is enabled by default and allows renegotiation between clients and servers even if they do not support the new TLS extension. Disable this option to not allow renegotiations between clients and servers that do not support the new TLS extension. A web server restart is required when you change the value of this option.

Configuring Health Check Options

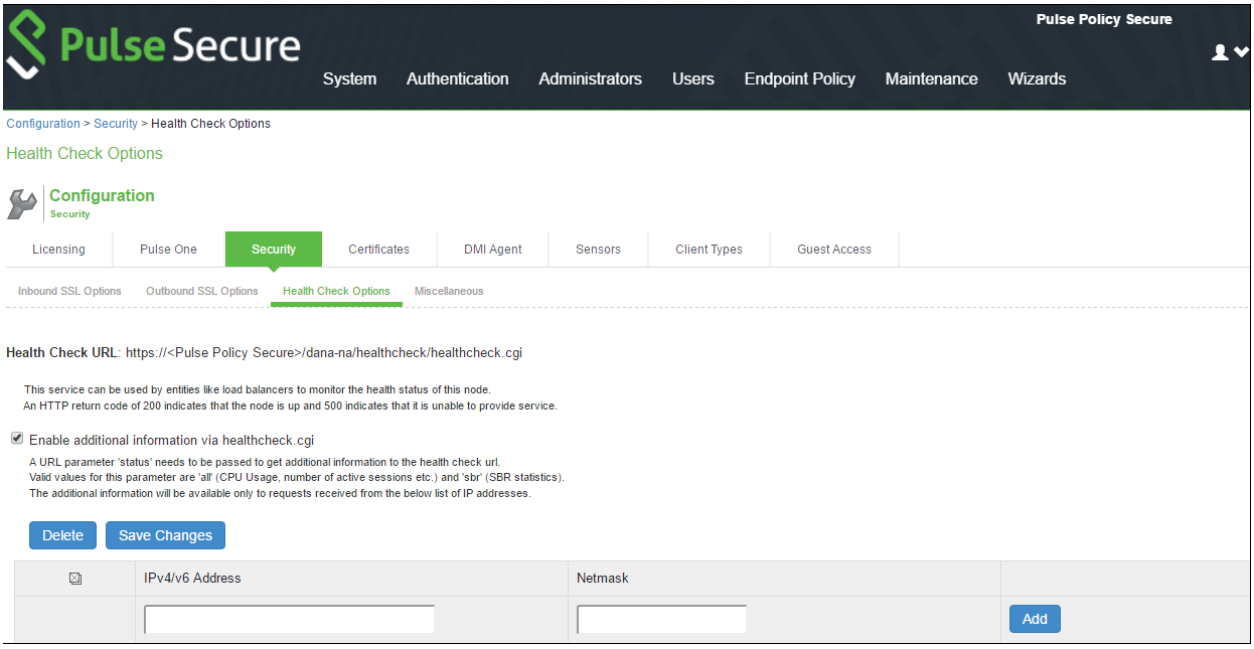
You can use the **System > Configuration > Security > Health Check Options** page to configure the following security options:

- Enable additional information via healthcheck.cgi—This option is used by entities like load balancers to monitor the health status of the node.

To configure health check options:

1. Select **System > Configuration > Security > Health Check Options** to display the configuration page.

Figure 501: Health Check Security Options Configuration Page



2. Select the **Enable additional information via healthcheck.cgi** checkbox and **Save Changes**. A URL parameter 'status' needs to be passed to get additional information to the health check URL.
   For more information about parameters such as CPU usage and number of active sessions use https://<Pulse Policy Secure>/dana-na/healthcheck/healthcheck.cgi?status=all.
   For more information about SBR statistics use https://<Pulse Policy Secure>/dana-na/healthcheck/healthcheck.cgi?status=sbr
3. Enter the IPv4/v6 adress of the load balancer and click **Add**.
4. Click **Save Changes**.

Configuring Miscellaneous Security Options

You can use the System > Configuration > Security > Miscellaneous page to configure the following security options:

- Persistent cookie options—Choose whether to preserve or delete persistent cookies when a session is terminated.
- Lockout options—You can configure lockout options to protect the system from denial of service (DoS), distributed denial of service (DDoS), and password-guessing attacks.

To configure cookie and lockout options:

1. Select **System > Configuration > Security > Miscellaneous** to display the configuration page.
2. Complete the configuration as described below.
3. Save the configuration.

Figure502: Miscellaneous Security Options Configuration Page

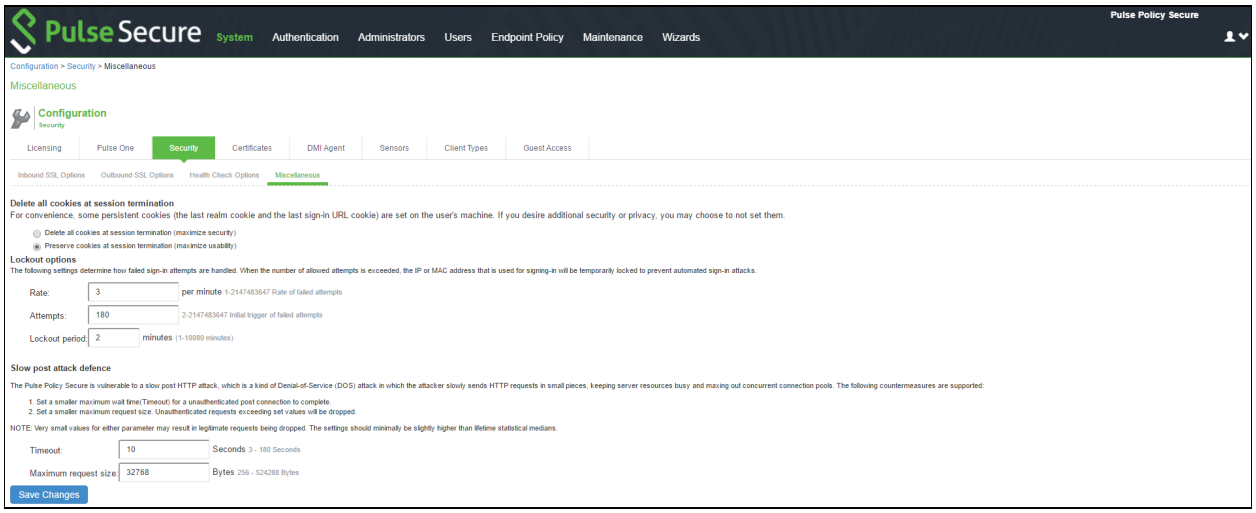


Table90: Miscellaneous Security Options Configuration Guidelines

Settings	Guidelines
Delete all cookies at session termination	For convenience, the system sets persistent cookies on the user's machine to support functions such as multiple sign-in, last associated realm, and the last sign-in URL. For additional security or privacy, you can choose not to set them.
Lockout options	
Rate	Specify the number of failed sign-in attempts to allow per minute.
Attempts	Specify the maximum number of failed sign-in attempts to allow before triggering the initial lockout. The system determines the maximum initial time (in minutes) to allow the failed sign-in attempts to occur by dividing the specified number of attempts by the rate. For example, 180 attempts divided by a rate of 3 results in an initial period of 60 minutes. If 180 or more failed sign-in attempts occur within 60 minutes or less, the system locks out the IP address being used for the failed sign-in attempt.
Lockout period	Specify the length of time (in minutes) the system must lock out the IP address.

The following scenario illustrates how lockout settings work. For example, assume the following settings:

- Rate = 3 failed sign-in attempts per minute
- Attempts = 180 maximum allowed in initial period of 60 minutes (180/3)

- Lockout period = 2 minutes

The following sequence illustrates the effect of these settings:

During a period of 3 minutes, 180 failed sign-in attempts occur from the same IP address. Because the specified value for Attempts occurs in less than the allowed initial period of 60 minutes (180/3), the system locks out the IP address for 2 minutes (fourth and fifth minutes).

In the sixth minute, the system removes the lock on the IP address and begins maintaining the rate of 3 failed sign-in attempts/minute. In the sixth and seventh minutes, the number of failed sign-in attempts is 2 per minute, so the system does not lock the IP address. However, when the number of failed sign-in attempts increases to 5 in the eighth minute, which is a total of 9 failed sign-in attempts within 3 minutes, the system locks out the IP address for 2 minutes again (ninth and tenth minutes).

3. In the eleventh minute, the system removes the lock on the IP address and begins maintaining the rate of 3 failed sign-in attempts per minute again. When the rate remains below an average of 3 per minute for 60 minutes, the system returns to its initial monitoring state.

Configuring Custom HTTP Headers

PPS supports several HTTP headers, which are sent in response to the client request. There are several more headers built to improve security and prevent attacks like XSS. The Custom HTTP Headers configuration enables the administrator to add new headers that they want to enforce.

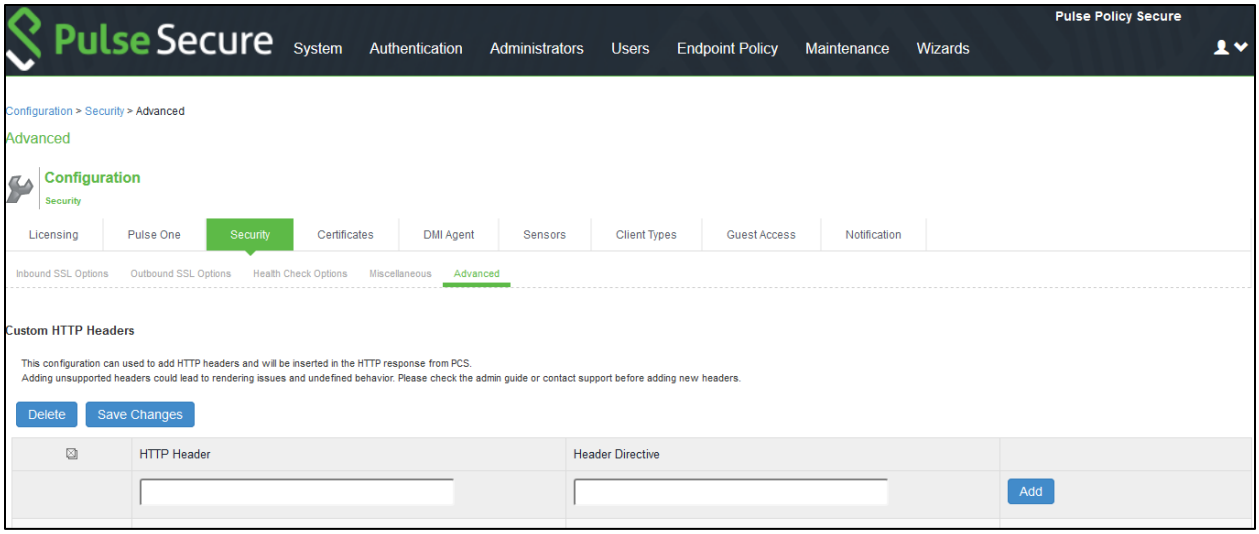
To configure custom HTTP header:

1. Select **System > Configuration > Security > Advanced**.
2. In the Custom HTTP Headers section, enter the HTTP header name and the directives along with the values.
3. Click **Add.**
4. Multiple headers can be added or removed. After adding the headers, click **Save Changes**.

NOTE:

- Administrator should ensure the correctness of the values that they enter, as the system validation on the input values is limited.
- If the administrator configured HTTP header seems to affect the way the page is rendered or is locked out, use the console option to reset the custom HTTP header values.

Figure 503: Custom HTTP Headers Page



The following table lists the OWASP recommended headers.

Header	Need PPS Web Server Changes	Supported Browsers
HPKP	Yes	Firefox, Chrome, Opera
X-XSS-Protection	No	Chrome and IE
X-Content-Type-Options	No	Firefox, Chrome, Opera and IE
Content-Security-Policy	Yes	All major browsers
X-Permitted-Cross-Domain-Policies	Yes	Not supported
Referrer-Policy	No	Chrome, Firefox and Opera
Expect-CT	No	Chrome and Opera
Feature-Policy	No	Not supported
HSTS	No	
X-Frame-Options	No	

Using the Serial Port

This topic describes use of the serial port and serial port console. It includes the following information:

- Connecting to the Serial Port Console
- Using the Serial Console to Roll Back to a Previous OS Version
- Using the Serial Console to Reset the System to the Factory Image

Connecting to the Serial Port Console

In cases where the admin console is unavailable, you can perform network and host configuration tasks and troubleshooting using the serial port console.

To connect to the serial console:

1. Plug a null modem crossover cable from a console terminal or laptop into the device serial port. This cable is provided in the product box. Do not use a straight serial cable.

2. Configure a terminal emulation utility, such as HyperTerminal, with the following serial connection parameters:
   - 9600 bits per second
   - 8-bit No Parity (8N1)
   - 1 Stop Bit
   - No flow control
3. Press Enter until the serial console is displayed.

Figure504: Serial Console Menu

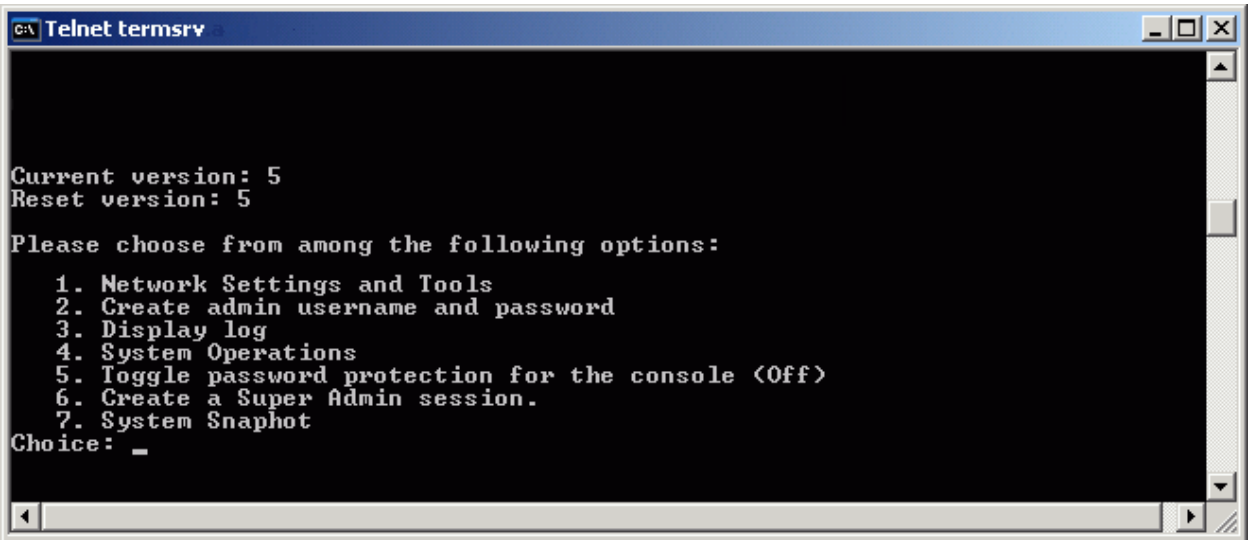


Table91: Serial Console Menu Options

Options	Description
1. Network Settings and Tools	Enables you to change standard network settings; print a routing table; print or clear an ARP cache; run the ping and traceroute commands, remove static routes, and add an ARP entry.
2. Create admin username and password	Enables you to create a new super administrator account.
3. Display log	Enables you to display system configuration, user access logs, or administrator access logs through the serial console. Note that must enter **q** to return to serial console options after viewing the logs.
4. System Operations	Enables you to reboot, shut down, restart, roll back, or factory reset the system without using the admin console.
5. Toggle password protection for the console	Enables you to password protect the serial console. When you toggle this option to “on,” only super administrators are allowed access.
6. Create a Super Admin session	Enables you to create a recovery session to the admin console, even if you have configured the system to block access to all administrators. When you select this option, the system generates a temporary token that is valid for 3 minutes. Enter the following URL into a browser window: `https://<fully-qualified-domain-name>/dana-na/auth/recover.cgi` Then, enter the temporary token when prompted to sign in to the admin console. When you select this option, the system blocks any additional administrators from signing in to the admin console until you sign in to the specified URL and initiate a session using your token. The appliance blocks additional sign-in attempts so that you can fix any configuration problems that the system may have encountered without conflicting with another session.

Options	Description
7. System Snapshot	Enables you to take a system snapshot without using the admin console. When you select this option, the system takes the snapshot immediately. You can then send the snapshot file, by way of SCP, to a remote system. The system prompts you for the destination server port, user ID, password, and the destination path to the remote directory. If you choose not to send the snapshot file to a remote system, the system saves the file locally. The next time you log in to the admin console, the System Snapshot tab contains a link to the snapshot file.

Using the Serial Console to Roll Back to a Previous OS Version

You can use the admin console to roll back the configuration to a previous state. If the rollback option is not available in the admin console, you can use the procedure described in this section to perform the system rollback.

If you have not yet performed an OS service package upgrade, there is no previous state to roll back to, and the rollback option is not available. If you have performed an OS service package upgrade, any system and user configuration data created after the upgrade is lost unless you export the most current configuration files before rolling back the system and then import them afterwards.

To roll back to the previous OS service package:

1. Connect to the serial console.
2. In a browser window, sign in to the admin console.
3. Select **Maintenance > System > Platform**.
4. Click **Reboot Now** and then return to the console utility window. The window displays a message that the system is restarting.
5. After several moments, you are prompted to use the Tab key to select options. Press Tab, and when prompted for the configuration to load, type **rollback** and then press Enter.

After you click **Reboot Now,** the rollback status is output to the screen, and when complete, you are prompted to press Return (Enter) to modify system settings, which returns you to the initial setup options. When you are finished entering data, simply close the serial console window.

If you wait more than 5 seconds to enter your choice, the current system configuration is automatically loaded and you must go back to the admin console and click **Reboot Now** to start the process again. If you have already performed a system rollback, the rollback option is not available again until you upgrade the OS service package again.

Using the Serial Console to Reset the System to the Factory Image

In rare cases, you might need to reset the system to its original factory settings. Before performing this advanced system recovery option, contact PSGSC (http://www.pulsesecure.net/support/). If possible, export the most current system and user configuration data before performing a factory reset.

To perform a factory reset:

1. Connect to the serial console. In a browser window, sign in to the admin console.
2. Select **Maintenance > System > Platform**.
3. Click **Reboot** and then go back to the console utility window. The window displays a message that the system is restarting.
4. After several moments, you are prompted to use the Tab key to select options. Press Tab, and when prompted for the configuration to load, type **factory-reset** and then press Enter. If you wait more than 5 seconds to enter your choice, the current system configuration is automatically loaded, and you must go back to the admin console and click **Reboot Now** to start the process again.

5. When you are prompted to confirm performing a factory reset, type **proceed** and then press Enter. The system begins the process of resetting the machine to its original settings and outputs several screens of data. After several minutes, you are prompted to use the Tab key to select configuration choices.
6. When prompted to press the Tab key, do one of the following:
    - Wait for the default selection (current) to start automatically.
    - Press **Tab**, type **current**, and then press **Enter**.

You are then prompted to enter the initial configuration settings. For details on how to proceed, see the Installation Guide provided in the product packaging or on the Pulse Secure Global Support Center.

After you complete the initialization process, you can upgrade to the latest OS service package and import saved system and user configuration files to return to the last good working state of your system.

You might receive errors from the system during the initial setup or on a factory reset. Before the system starts services, it monitors the network port for a maximum of 120 seconds. The system checks the link status and sends ARP requests to the default gateway. If there is a problem, after 5 seconds, the system displays a message on the serial console that starts with **NIC:.....**. If the link recovers within 120 seconds, the startup process continues. If the link does not recover, the following message is displayed:

```
Internal NIC: ................[Down code=0x1]
```

- **0x1** means that the interface link status reported by the NIC remains off (for example, a disconnected cable or a cable is in the wrong port).
- **0x2** means that the gateway is unreachable. The system boots but is not reachable from IP addresses bound to that network port.

Certificate Security Administration

This chapter describes how to use certificates. It includes the following information:

Understanding Digital Certificate Security

PPS uses Public Key Infrastructure (PKI) to secure the data sent to clients over the Internet. PKI is a security method that uses public and private keys to encrypt and decrypt information. These keys are enabled and stored through digital certificates. A digital certificate is an encrypted electronic file issued by a certificate authority (CA) that establishes credentials for client/server transactions.

In public key cryptography, a public/private key pair is used to encrypt and decrypt data. Data encrypted with a public key, which the owner makes available to the public, can be decrypted with the corresponding private key only, which the owner keeps secret and protected. For example, if User1 wants to send User2 an encrypted message, User1 can encrypt it with User2's public key and send it. User2 then decrypts the message with the private key. The reverse process is also useful: encrypting data with a private key and decrypting it with the corresponding public key. This process is known as creating a digital signature. For example, if User1 wants to present their identity as the sender of a message, they can encrypt the message with her private key and send the message to User2. User2 then decrypts the message with User1's public key, thus verifying that User1 is indeed the sender.

PPS use the following types of digital certificates to establish credentials and secure session transactions:

- Device certificates—A device certificate helps to secure network traffic to and from the Pulse Secure service using elements such as company name, a copy of your company's public key, the digital signature of the CA that issued the certificate, a serial number, and expiration date. In addition, PPS uses a device certificate for communications with the Infranet Enforcers.
- Trusted client CAs—A trusted client CA is a client-side certificate issued by a CA. You can use trusted client CAs in the access management framework realm and role configurations to require certificates or certificates with specific attributes. For example, you may specify that users must present a valid client-side certificate with the OU attribute set to "yourcompany.com" to sign into the Users authentication realm.
- Trusted server CAs—A trusted server CA is the certificate of a Web server that you trust. You can install a trusted server CA to validate the credentials of the web sites that users access through the Pulse Secure client service.
- Code-signing certificates—A code-signing certificate (also called an applet certificate) is a type of server-side certificate that re-signs Java applets that are intermediated by PPS. You can use the self-signed code-signing certificate that comes pre-loaded, or you can install your own code-signing certificate.
- Client Authentication certificates—The client auth certificate is used when backend SSL servers require PPS to present a client certificate.

NOTE:

- The system can verify certificates that use SHA2 as the message digest.

- Only ECDSA certificates are supported other DSA certificates are not supported.

Using Device Certificates

This topic describes how to use device certificates. It includes the following information:

Understanding Device Certificates

A device certificate helps to secure network traffic to and from the Pulse Secure client service using elements such as your company name, a copy of your company's public key, the digital signature of the Certificate Authority (CA) that issued the certificate, a serial number, and an expiration date. The system also uses device certificates for secure communications with the Infranet Enforcer.

When receiving encrypted data from the system, the client's browser first verifies whether the device certificate is valid and whether the user trusts the CA that issued the certificate. If the user has not already indicated that they trust the certificate issuer, the Web browser prompts the user to accept or install the certificate.

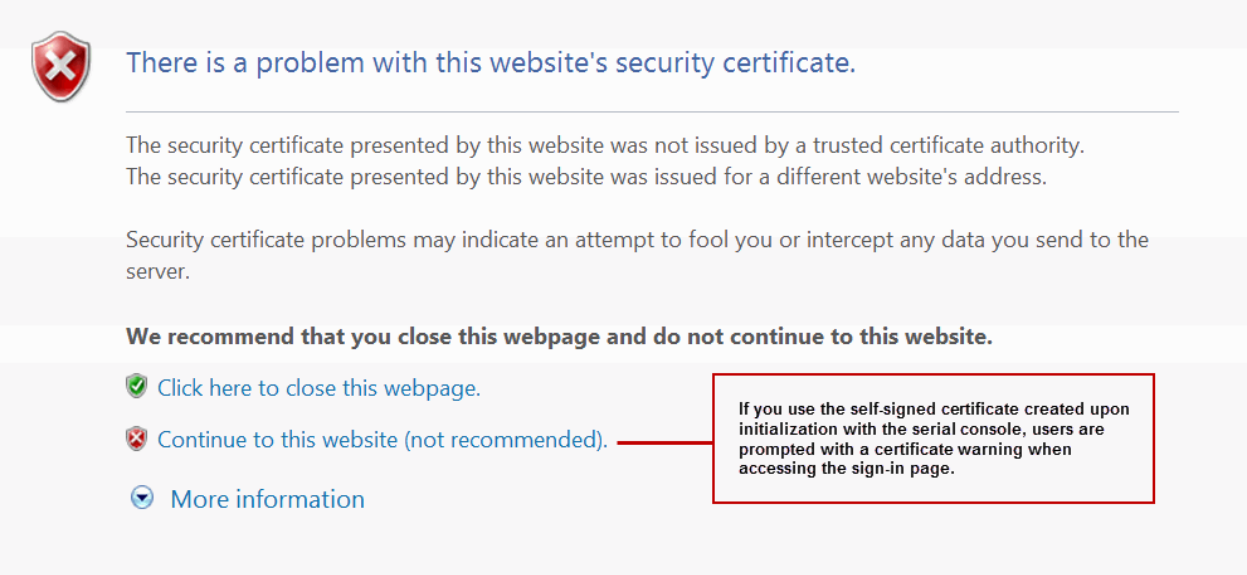
The system supports X.509 device certificates in DER and PEM encode formats (file extensions include .cer, .crt, .der, and .pem) as well as PKCS #12 (file extensions include .pfx and .p12). The system also supports the following features:

- Intermediate device CA certificates—Within a certificate hierarchy, one or more intermediate certificates are branched off a single root certificate.
- Multiple device certificates—When using multiple device certificates, each certificate handles validation for a separate hostname or fully qualified domain name (FQDN) and can be issued by a different CA.

Understanding Self-Signed Certificates

When you initialize the system with the serial console, the system creates a self-signed certificate that enables you to immediately begin setting up the system. Users are prompted with a security alert each time they sign in because the certificate is not issued by a trusted CA.

Figure505: Security Alert When the Device Certificate Is Not Issued by a Trusted CA



Before promoting the system to production use, we recommend you replace the self-signed certificate with a certificate issued by a trusted CA.

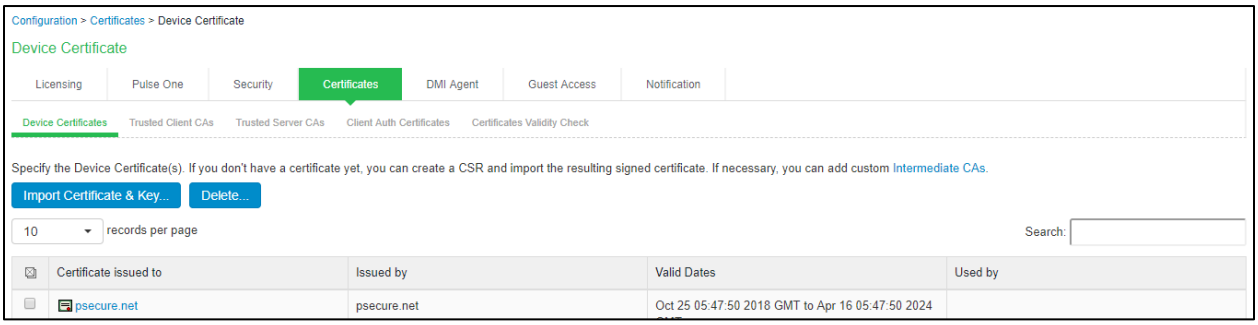
NOTE: In PPS deployments with ScreenOS Enforcers, you must use a CA-signed device certificate. If you use a self-signed certificate, the ScreenOS Enforcer does not allow a connection. Import a CA-signed device certificate into PPS, and then import the certificate of the CA that signed the device certificate into the ScreenOS Enforcer.

Importing a Device Certificate and Private Key

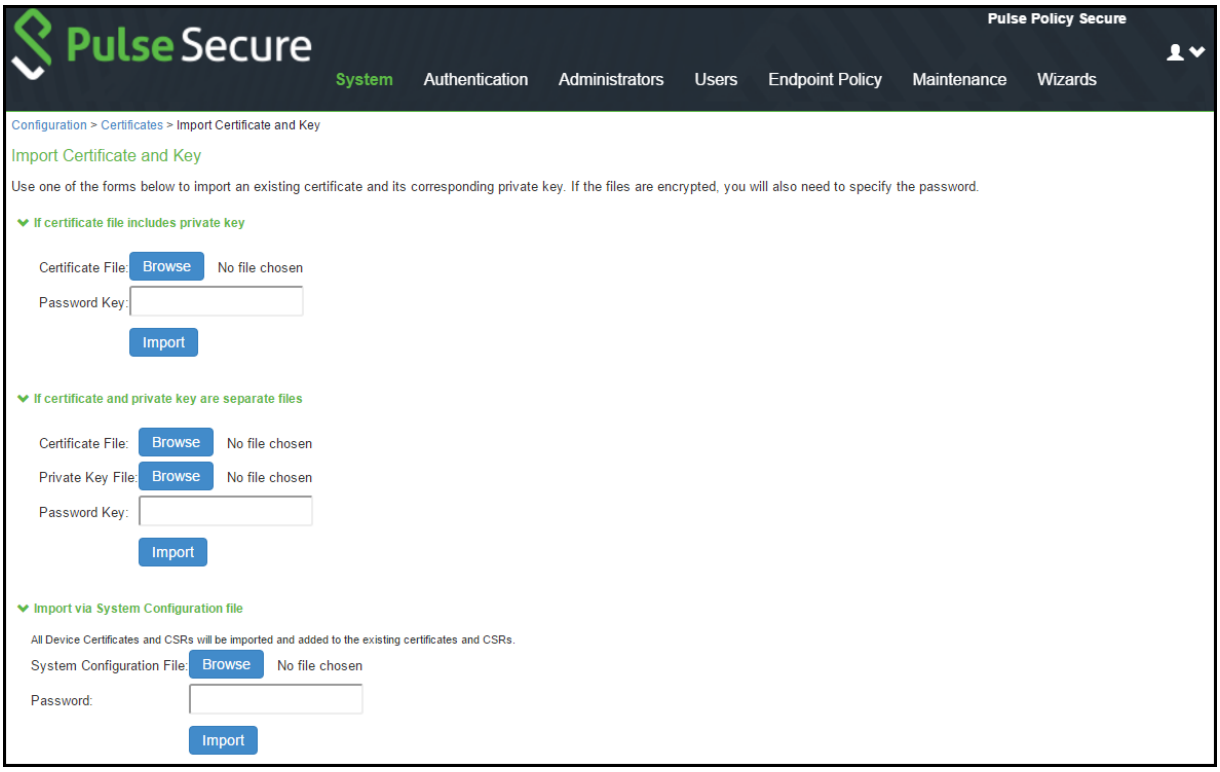
The system uses certificates to verify itself to other network devices. A digital certificate is an electronic means of verifying your identity through a trusted third party, known as a Certificate Authority (CA). Your company might use its own enterprise CA server, or it might use a reputable third-party CA.

To import an enterprise root server certificate and private key:

1. Select **System > Configuration > Device Certificates**.
   Figure506: Device Certificates Management Page



2. Click **Import Certificate & Key** to display the configuration page.
   Figure507: Import Certificate and Key Page



3. Use one of the following options to complete the import procedure:
   - **If certificate file includes private key**—When the certificate and key are contained in one file. The file format is .pfx.
   - **If certificate and private key are separate files**—When the certificate and key are in separate files.
   - **Import via System Configuration file**—When the certificate and key are contained in a system configuration file. With this option, the system imports all the certificates specified (including private keys and pending CSRs, but not the corresponding port mappings).

In the appropriate form, browse to the certificate and key files. If the file is encrypted, enter the password key.

4. Click **Import**.

NOTE: The **Import Certificate and Key** button is disabled on FIPS hardware platforms because importing private keys is not allowed. On a FIPS hardware platform, you must create a CSR and then import a signed certificate from the CA.

Creating a Certificate Signing Request

If your company does not own a digital certificate for its Web servers, you can create a certificate signing request (CSR) and then send the request to a CA for processing. When you create a CSR, a private key is created locally that corresponds to the CSR. If you delete the CSR at any point, this file is also deleted, prohibiting you from installing a signed certificate generated from the CSR.

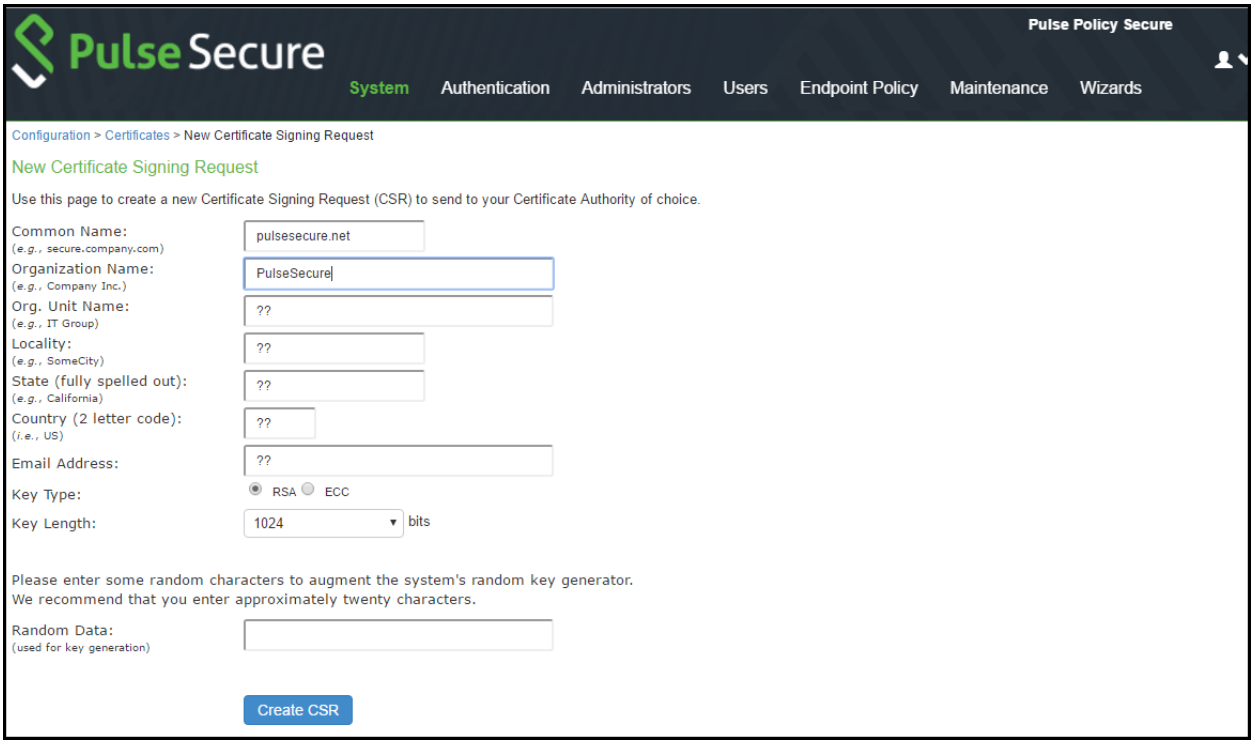
To create a certificate signing request:

1. Select **System > Configuration > Certificates > Device Certificates**.
2. Click **New CSR** to display the configuration page.
3. Complete the required information and click **Create CSR**.
4. Follow the onscreen instructions, which explain what information to send to the CA and how to send it.

When you submit a CSR to a CA authority, you might be asked to specify either the type of Web server on which the certificate was created or the type of Web server the certificate is for. Select **apache** (if more than one option with apache is available, select **any**). If you are prompted for the certificate format to download, select the standard format.

Do not send more than one CSR to a CA at one time. Doing so can result in duplicate charges.

Figure508: New Certificate Signing Request



NOTE: To view details of any pending requests that you previously submitted, click the **Certificate Signing Request Details** link.

Importing a Signed Certificate Created from a CSR

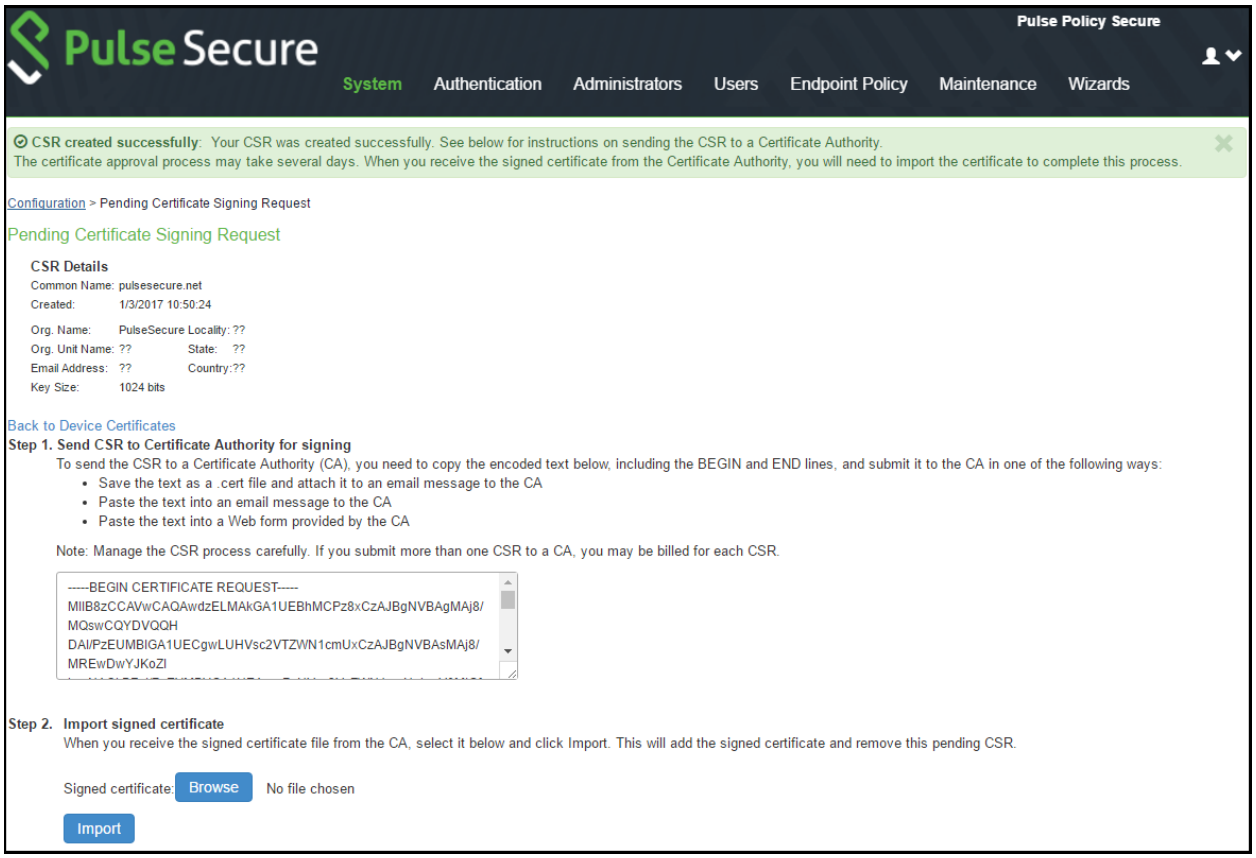
When you receive the signed certificate from the CA, import it.

To import a signed device certificate created from a CSR:

Select **System > Configuration > Certificates > Device Certificates**.

1. Under Certificate Signing Requests, click the Pending CSR link that corresponds to the signed certificate.
2. Under Import signed certificate, browse and select the certificate file you received from the CA, and then click **Import**.

Figure509: Pending Certificate Signing Request



Understanding Intermediate Certificates

Within a certificate hierarchy, one or more intermediate certificates are branched off a single root certificate. The root certificate is issued by a root CA and is self-signed. Each intermediate certificate is issued by the certificate preceding it in the chain.

To use chained certificates in your deployment, you must ensure that the server and client (Web browser) together contain the entire certificate chain. For example, you can secure traffic using a chain that stems from a VeriSign root certificate. If your users' browsers come preloaded with VeriSign root certificates, you need to install only the lower-level certificates in the chain. When your users sign in, the system presents any required certificates within the chain to the browser to secure the transaction. The system creates the proper links in the chain using the root certificate's IssuerDN. If the system and browser together do not contain the entire chain, the user's browser does not recognize or trust the device certificate because it is issued by another certificate instead of by a trusted CA.

You can upload one or more intermediate CAs in a PEM file. The entire chain must be sent to the client in descending order, starting with the root certificate.

Within a certificate hierarchy, one or more intermediate certificates are branched off a single root certificate. The root certificate is issued by a root CA and is self-signed. Each intermediate certificate is issued by the certificate preceding it in the chain.

To use chained certificates in your deployment, you must install the appropriate client-side certificates in each user's Web browser and then upload the corresponding CA certificates to Pulse Secure Client Service Intermediate CA store. Use one of the following methods to upload the certificate chain:

- Import the entire certificate chain in one file. The file must contain the root certificate and any subcertificates whose parents are in the file or already imported. You can include certificates in any order in the import file.

- Import the certificates one at a time in descending order. You must install the root certificate first, and then install the remaining chained certificates in descending order.

If you follow one of these methods, the system automatically chains the certificates together in the correct order and displays them hierarchically in the admin console.

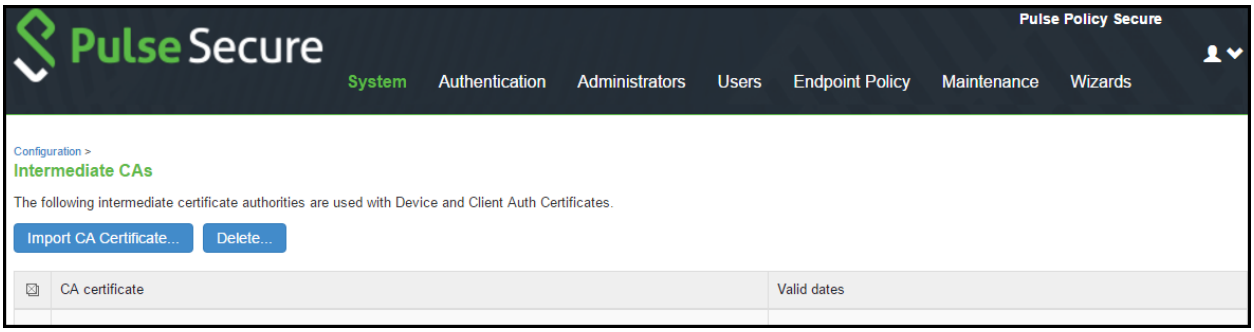
NOTE: If you install multiple certificates in a user's Web browser, the browser prompts the user to choose which certificate to use when signing in.

Importing Intermediate CA Certificates

To import an intermediate CA certificate:

1. Select System > Configuration > Certificates > Device Certificates.
2. Click the Intermediate Device CAs link to display the management page.
3. Click **Import CA certificate**.
4. Browse to the certificate file, select it, and click **Import Certificate** to complete the import operation.

Figure510: Intermediate CAs Management Page



Importing a Renewed Certificate That Uses the Existing Private Key

You can renew a device certificate in two ways:

- Submit a new CSR to a CA—This process is more secure because the CA generates a new certificate and private key and retires the older private key. To use this renewal method, you must first create a CSR through the admin console.
- Request renewal based on the CSR previously submitted to the CA—This process is less secure, because the CA generates a certificate that uses the existing private key.

When you order a renewed certificate, you must either resubmit your original CSR or ensure that the CA has a record of the CSR that you submitted for your current certificate.

To import a renewed device certificate that uses the existing private key:

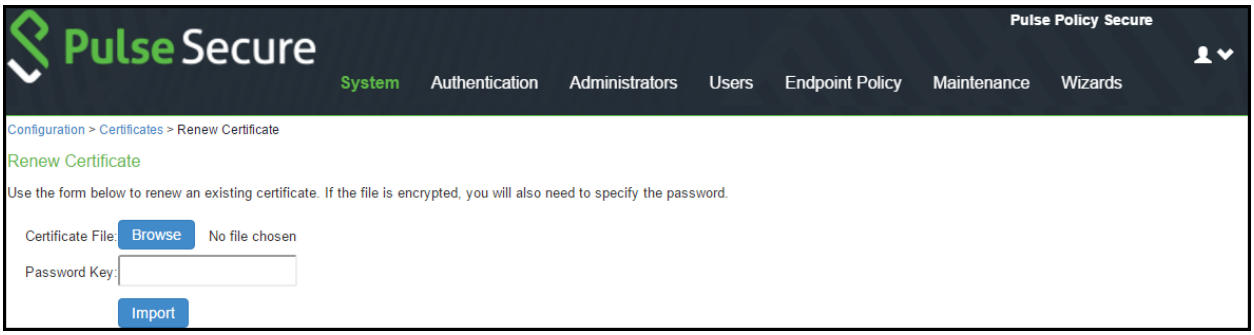
1. Follow your CA's instructions for renewing a certificate that you previously purchased through them. Be sure to specify the same information you used in the original CSR. Your CA uses this information to create a new certificate that corresponds to the existing key.

   NOTE: Even though you specify the same information used in the original CSR, your root CA might have different serial numbers and keys from the original. You might need to support both new client and old client certificates during the transition period, which also requires that you maintain two root CA certificates (your existing certificate and the renewed certificate), at least temporarily

2. Select **System > Configuration > Certificates > Device Certificates**.

3. Click the link that corresponds to the certificate you want to renew.
4. Click **Renew Certificate** to display the page.
5. In the Renew the Certificate form, browse to the renewed certificate file, enter the password for the certificate key, and click **Import**.

Figure511: Renew Certificate Page



Downloading a Device Certificate

You download the device certificate to your local host so that you can import it into other network devices as needed.

To download a device certificate:

1. Select **System > Configuration > Certificates > Device Certificates**.
2. Click the link of the device certificate you want to download to display the configuration page.
3. Click the **Download** link.
4. Save the file to the desired location.

Using Device Certificates with Virtual Ports

Virtual ports can be used to create multiple fully qualified domain names for user sign-in.

When a user tries to sign in using the IP address defined in a virtual port, the system uses the certificate associated with the virtual port to initiate the SSL transaction and for NetScreen Address Change Notification (NACN) communications with the Infranet Enforcer.

You must associate the signed certificate with the port that is connected to the Infranet Enforcer. You can use the same port and certificate for Pulse Client.

You can implement digital certificate security with virtual ports in either of the following ways:

- Associate all hostnames with a single certificate—With this method, you use a single wildcard certificate to validate the identity of all system hostnames, regardless of which hostname is used to sign into. A wildcard certificate includes a variable element in the domain name, making it possible for users who sign in from multiple hosts to map to the “same” domain. For example, if you create a wildcard certificate for *.yourcompany.com, the system uses the same certificate to validate its identity to users who sign in to employees.yourcompany.com as it does to users who sign into partners.yourcompany.com.
- Associate each hostname with its own certificate—With this method, you associate different hostnames with different certificates. Create a virtual port for each hostname. A virtual port activates an IP alias on a physical port. For example, you can create two virtual ports on a single appliance, mapping the first virtual port to the IP address 10.10.10.1 (sales.yourcompany.com) and the second virtual port to the IP address 10.10.10.2 (partners.yourcompany.com). Then you can associate each of these virtual ports with its own certificate, ensuring that users authenticate through different certificates.

To associate certificates with virtual ports:

Create the virtual ports.

Import the device certificates.

Associate the device certificates with the virtual ports:

1. Select **System > Configuration > Certificates > Device Certificates**.
2. Click the link of the device certificate you want to configure to display the configuration page.
3. Use the controls in the “Present certificate on these ports” section to associate ports with the certificate.

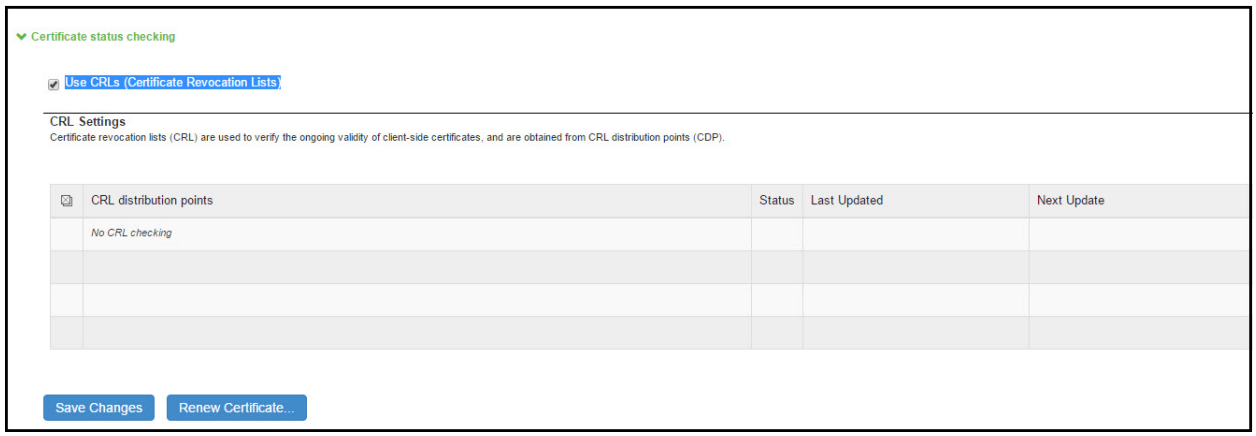
NOTE: You can assign only one device certificate to the Management Port. If you assign a certificate other than the default device certificate to the Management Port, the default device certificate is automatically deselected as the default. If you do not select a device certificate for the Management Port, the system uses the default device certificate that is presented on the Internal port. You cannot assign certificates to Management Port VIPs.

Enabling Certificate Revocation Check for Device Certificate

To enable the CRL for Device Certificates:

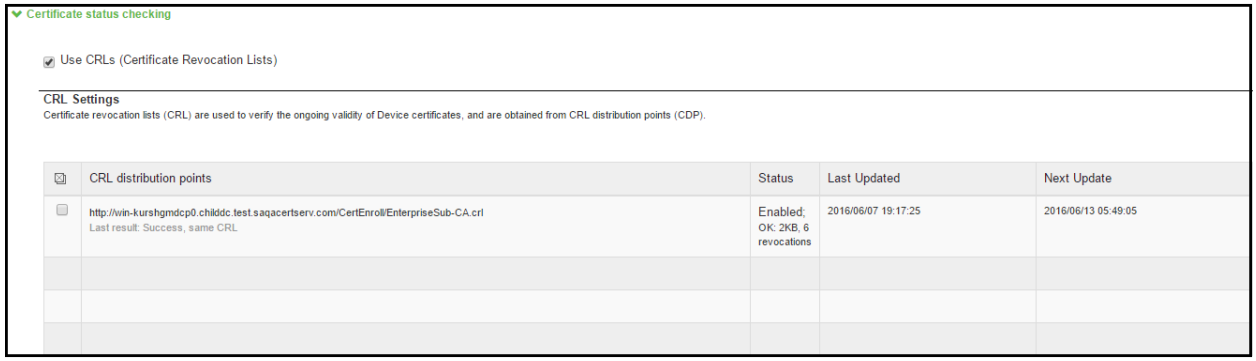
1. Go to **System > Configuration > Certificates > Device Certificates**.
2. Click on the certificate from the list to go to the certificate details.
3. In the **Certificate Details** page, go to **Certificate Status Checking** and enable the **Use CRLs (Certificate Revocation Lists)** checkbox.

Figure 512: Enabling Certificate Revocation Check for Device Certificate



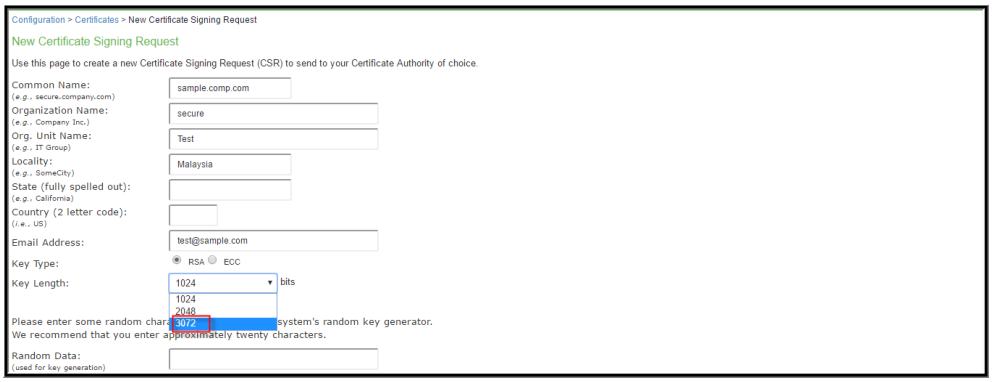
4. Click on Save Changes.
5. Import the CA or CA Chain that issued the Device Certificate to **System > Configuration > Trusted Server CAs**. Once the CRL is successfully downloaded for Device Certificate, it is listed in the CRL distribution points.

Figure 513: Successful CRL Download for Device Certificate



NOTE: PPS supports 3072-bit key length for Device Certificates.

Figure 514: 3072 Bit Key Length for Device Certificates



Using Trusted Client CAs

This topic describes how to use trusted client Certificate Authorities (CAs). It includes the following information:

Understanding Trusted Client CAs

A trusted client CA is a CA that you deem trusted by adding it the trusted client CA store. The system trusts any certificate issued by that CA. To use client CA certificates, you must install and enable the proper certificates. Additionally, you must install the corresponding client-side certificates in your users' Web browsers, or you must use the MMC snap-in in your users' computer accounts (machine certificate). When validating a client-side CA certificate, the system verifies that the certificate is not expired or corrupt and that the certificate is signed by a CA that the system has been configured to recognize. If the CA certificate is chained, the system also follows the chain of issuers until it reaches the root CA, validating each issuer in turn. The system supports X.509 CA certificates in DER and PEM encode formats.

When you install a client-side certificate, you must determine whether to use the certificate to identify individual users or individual machines. To use the certificate to identify individual users, you must install the certificate in each user's individual certificate store. Then you must enable authentication using a certificate server, or you must enable authorization using realm, role, and/or resource policy settings. To use the certificate to identify individual machines, you must install the certificate in each computer's certificate store. Then you must configure a Host Checker policy that checks for the machine certificate and authorizes access to realms, roles, or resource policies based on the certificate's validity.

The system supports using the following additional features with CA certificates:

- Certificate servers—A certificate server is a type of local authentication server that allows you to authenticate users based solely on their certificate attributes rather than authenticating them against a standard authentication server (such as LDAP or RADIUS), and it requires specific certificates or certificate attributes.
- Certificate hierarchies—Within a certificate hierarchy, one or more subordinate certificates (called intermediate certificates) are branched off a root certificate to create a certificate chain. Each intermediate certificate (also called a chained certificate) handles requests for a part of the root CA domain. For example, you can create a root certificate that handles all requests to the yourcompany.com domain and then branch off intermediate certificates that handle requests to partners.yourcompany.com and employees.yourcompany.com. When you install a chained certificate, the system confirms that the chain is valid and allows users to authenticate using the leaf certificate (that is, the lowest certificate in the chain).
- Certificate revocation lists—Certificate revocation is a mechanism by which a CA invalidates a certificate before its expiration date. The CA publishes a certificate revocation list (CRL) which is a list of revoked certificates. Within CRLs, each entry contains the serial number of the revoked certificate, the date that the certificate was revoked, and the reason the certificate was revoked. The CA can invalidate a certificate for various reasons such as when the employee to whom the certificate is issued leaves the company, the certificate's private key is compromised, or the client-side certificate is lost or stolen. When the CA revokes a certificate, the system can appropriately deny access to users who present a revoked certificate.

Trusted Client CA Implementation Notes

Uploading a trusted client CA certificate does not enable client-side SSL authentication or authorization. To do so, you must use a certificate server, or enable certificate restrictions at the realm, role, or resource policy level, or create a Host Checker policy that verifies a machine certificate.

With client-side certificates, we strongly recommend that you advise users to close their Web browsers after signing out. If they do not, other users might be able to use their open browser sessions to access certificate-protected resources without reauthentication. After loading a client-side certificate, Internet Explorer caches the certificate's credentials and private key. The browser keeps this information cached until the user closes the browser (or, in some cases, until the user reboots the workstation). For details, see http://support.microsoft.com/?kbid=290345.) To remind users to close their browsers, you can modify the sign out message on the Sign-in Pages tab.

 NOTE: Certificate authentication does not work on Internet Explorer 8 and 9 if SSL 2.0 is enabled with other SSL and TLS versions. For details, see http://support.microsoft.com/kb/2851628.

Understanding CRLs

A certificate revocation list (CRL) is a mechanism for canceling a client-side certificate. As the name implies, a CRL is a list of revoked certificates published by a CA or a delegated CRL issuer. The system supports base CRLs, which includes the company's revoked certificates in a single, unified list.

The system determines the correct CRL to use by checking the client's certificate. (When it issues a certificate, the CA includes CRL information for the certificate in the certificate itself.) To ensure that it receives the most up-to-date CRL information, the system periodically contacts a CRL distribution point to get an updated list of CRLs. A CRL distribution point (CDP) is a location on an LDAP directory server or Web server where a CA publishes CRLs. The system downloads CRL information from the CDP at the interval specified in the CRL, at the interval that you specify during CRL configuration, and when you manually download the CRL. The system also supports CRL partitioning. CRL partitioning enables you to verify portions of very large CRLs without spending the time and bandwidth necessary to access and validate a very large CRL or collection of large CRLs. CRL partitioning is only enabled when you employ the Specify the CDP(s) in the client certificates method (described below). In this case, the system validates the user by verifying only the CRL specified in the client certificate.

Although CAs include CRL information in client-side certificates, they do not always include CDP information as well. A CA can use any of the following methods to notify the system of a certificate's CDP location:

- Specify the CDP(s) in the CA certificate—When the CA issues a CA certificate, it might include an attribute specifying the location of the CDPs that the system should contact. If more than one CDP is specified, the system chooses the first one listed in the certificate and then fails over to subsequent CDPs, if necessary.
- Specify the CDP(s) in the client certificates—When the CA issues a client-side certificate, it might include an attribute specifying the location of the CDPs that the system must contact. If more than one CDP is specified, it chooses the first one listed in the certificate and then fails over to subsequent CDPs, if necessary. When the system employs CRL partitioning and the client certificate specifies only one CRL, it performs verification using only that CRL.

   NOTE: If you choose this method, the user receives an error on the first sign-in attempt because no CRL information is available. Once the system recognizes the client's certificate and extracts the CRL location, it can start downloading the CRL and subsequently validate the user's certificate. To successfully sign in, the user must try to reconnect after a few seconds.

- Require the administrator to manually enter the CDP location—If the CA does not include the CDP location in the client or CA certificates, you must manually specify how to download the entire CRL object. You can specify a primary and backup CDP. (Manually entering the CDP location provides the greatest flexibility because you do not need to reissue certificates if you change the CDP location.)

The system compares the user's certificate against the appropriate CRL during authentication. If it determines that the user's certificate is valid, the system caches the certificate attributes and applies them, if necessary, during role and resource policy checks. If it determines that the user's certificate is invalid, if it cannot contact the appropriate CRL, or if the CRL is expired, it denies the user access.

NOTE:

- The system supports only CRLs that are in a PEM or DER format and that are signed by the CA for which the revocations apply.
- The system only saves the first CRL in a PEM file.

Understanding OCSP

The Online Certification Status Protocol (OCSP) is a service that enables you to verify client certificates. When OCSP is enabled, the system becomes a client of an OCSP responder and forwards validation requests for users based on client certificates. The OCSP responder maintains a store of CA-published certificate revocation lists (CRLs) and maintains an up-to-date list of valid and invalid client certificates. After the OCSP responder receives a validation request, it validates the status of the certificate using its own authentication database, or it calls upon the OCSP responder that originally issued the certificate to validate the request. After formulating a response, the OCSP responder returns the signed response, and the original certificate is either approved or rejected.

Importing a Trusted Client CA Certificate

If you require users to provide a client-side certificate to sign in, you must upload the corresponding CA certificate. You can upload CA certificates manually, or you can configure the system to upload CA certificates automatically. The system uses the uploaded certificate to verify that the browser-submitted certificate is valid. In addition, you can specify if you want to automatically import CA certificates for validation, and you can specify a CRL or OCSP retrieval method to use to automatically import CA certificates.

To import a trusted client CA certificate:

1. Select **System > Configuration > Certificates > Trusted Client CAs** to display the configuration page.
2. Click **Import CA Certificate** to display the configuration page.
3. Browse to the certificate file, select it, and click **Import Certificate** to complete the import operation.

Renewing a Certificate

To renew a certificate:

1. Select **System > Configuration > Certificates > Trusted Client CAs**.
2. Click the link for the certificate you want to renew.
3. Click **Renew Certificate** to display the import certificate page.
4. Browse to the certificate file, select it, and click **Import Certificate** to complete the import operation.

Configuring Auto-Importing of Client Certificates

To enable auto-importing:

1. Select **System > Configuration > Certificates > Trusted Client CAs**.
2. Click the **Auto-Import Options** button to display the options.

3. Complete the configuration described below.
4. Save your changes.

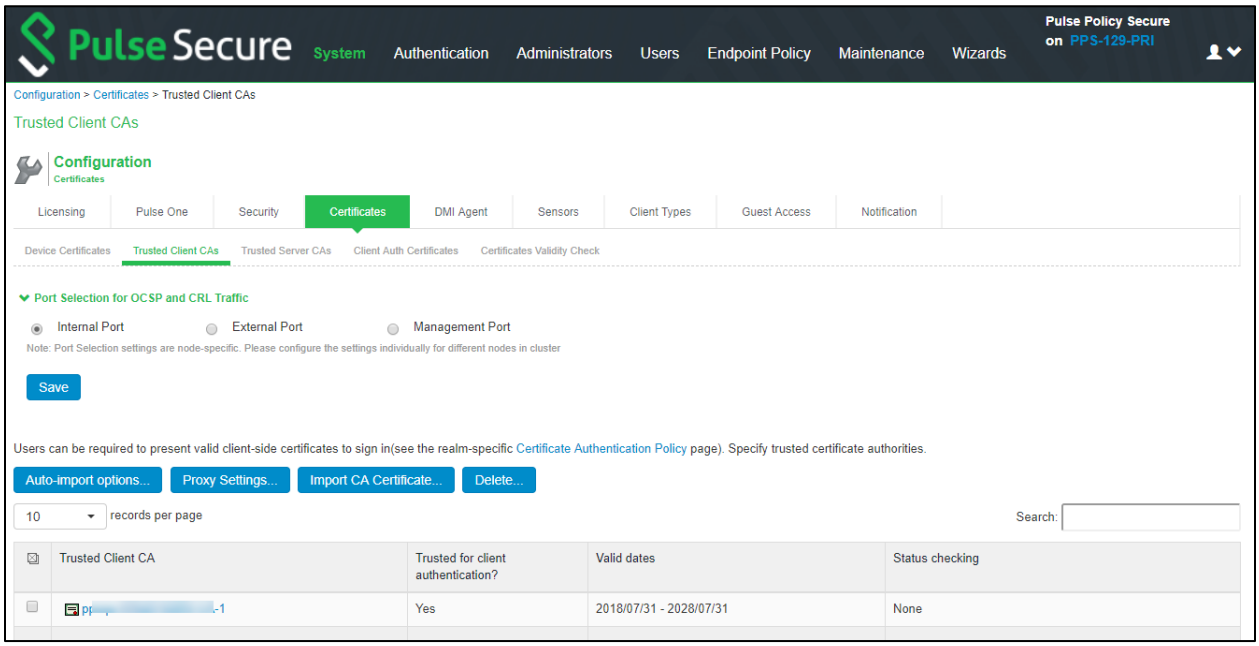
Table92: Auto-Import Options Settings

Settings	Guidelines
Auto-import trusted CAs	Select this option to enable auto-import and display its configuration settings.
Client Certificate Status Checking	Select a method to validate the trusted client certificate: • **None**—Do not validate. • **Use OCSP**—Use the OCSP method, validating the client certificate in real-time, as needed. After you select this option, you can specify options for OCSP. • **Use CRLs**—Use CRLs to validate the client certificate. After you select this option, you can specify options for OCSP. • **Use OCSP with CRL fallback**—Use the OCSP validation method when possible, but attempt to validate client certificates using CRLs if the OCSP method fails (for example, if the link to the OCSP responder fails). After you select this option, you can specify options for OCSP. • **Inherit from root CA**—Use the method configured for the device certificate.
CDP(s)/OCSP responder	Select the location of the responder value: • **None**—Do not use the responder. • **From client certificate**—Use the responder value configured in the client certificate. • **From trusted CA certificate**—Use the responder value configured in the trusted CA certificate that has been uploaded to the system.
Verify imported CA certificates	Select this option to verify that this trusted client CA is valid. Enabling this will check the CRL of this certificate's issuer, and repeat up the chain until reaching the root trusted client CA.
Skip Revocation check when OCSP/CDP server is not available	Select this option to instruct PPS to skip revocation check and accept end user certificates when either OCSP server or CDP server is not accessible over the network. This option is applicable to digital certificates used for end user authentication. PPS skips the revocation check in the following conditions: • Server IP is not reachable • Server Hostname is either not resolvable or resolving to non OCSP/CRL Server IP • Proxy IP is either not reachable or not resolving • Download CRL has expired • OCSP/CRL service in Server is not responding

Configuring Options for Trusted Client CA Certificates

To configure options for the trusted client CA certificate:

1. Select **System > Configuration > Certificates > Trusted Client CAs**.
2. Under **Port Selection for CRL and OCSP Download**, select the port: Internal Port, External Port, or Management Port.



3. Click the certificate you want to configure.
4. Complete the configuration described in table below.

Table93: Trusted Client CA Settings

Settings	Guidelines
Certificate	Use the expander buttons to display the following details: • Issued To—Name and attributes of the entity to whom the certificate is issued. • Issued By—Name and attributes of the entity that issued the certificate. Note that the value of this field must match either the Issued To field (for root certificates) or the Issued To field of the next highest certificate in the chain (for intermediate certificates). • Valid Dates—Time range for which the certificate is valid. • Details—Various certificate details, including its version, serial number, signature algorithm, CRL distribution points, public key algorithm type, and public key.

Settings	Guidelines
Client Certificate Status Checking	Select a method to validate the trusted client certificate: • **None**—Do not validate. • **Use OCSP**—Use the OCSP method, validating the client certificate in real-time, as needed. After you have selected this option and saved the configuration, you can specify options for OCSP. • **Use CRLs**—Use CRLs to validate the client certificate. After you have selected this option and saved the configuration, you can specify options for CRL. • **Use OCSP with CRL fallback**—Use the OCSP validation method when possible, but attempt to validate client certificates using CRLs if the OCSP method fails (for example, if the link to the OCSP responder fails). After you have selected this option and saved the configuration, can specify options for OCSP and CRL.
Verify Trusted Client CA	Select this option to verify that this trusted client CA is valid. Enabling this will check the CRL of this certificate's issuer, and repeat up the chain until reaching the root trusted client CA.
Trusted for Client Authentication	Clear this check box to exclude the CA from being trusted for client certificate authentication. You might want to do this if this CA was added for another trusting purpose, such as SAML signature verification or machine certificate validation.
Skip Revocation check when OCSP/CDP server is not available	Select this option to instruct PPS to skip revocation check and accept end user certificates when either OCSP server or CDP server is not accessible over the network. This option is applicable to digital certificates used for end user authentication. PPS skips the revocation check in the following conditions: •Server IP is not reachable •Server Hostname is either not resolvable or resolving to non OCSP/CRL Server IP •Proxy IP is either not reachable or not resolving •Download CRL has expired •OCSP/CRL service in Server is not responding

5. Save your changes.
6. If you have enabled CRL Checking, click **CRL Checking Options**.
7. If you have enabled OCSP options:
   - Click **OCSP Options**.
   - Complete the configuration described in table below.

Table94: OCSP Options Settings

Settings	Guidelines
Use	Select the type of OCSP responder to validate trusted client CAs: • **None**—The system does not use OCSP to verify the status of certificates issued by this CA. • **Responder(s) specified in the CA certificate**—The system uses OCSP responders specified in the imported client CA to perform verification. When you select this option, the system displays a list of OCSP responders specified in the imported CA (if any) and the last time they were used. • **Responder(s) specified in the client certificates**—The system uses responders specified during client authentication to perform verification. When you select this option, the system displays a list of known OCSP responders (if any) and the last time they were used. • **Manually configured responders**—The system uses primary and secondary OCSP responders at the addresses you specify.
Device Certificate to sign the request	Select the appropriate device certificate or leave the default (unsigned).

Settings	Guidelines
Signature Hash Algorithm	Select **SHA-1** or **SHA-2**.
Use Nonce	A nonce is random data the system includes in an OCSP request and the OCSP responder returns in the OCSP response. The system compares the nonce in the request and response to ensure that the response is generated by the OCSP responder. If the two do not match, the system disregards the response and sends a new request.

8. Save the configuration.
9. After you have added an OCSP responder to the list, you can click its link to display the page.
10. Complete the configuration described below.

Table95: Responder Signer Certificate Settings

Settings	Guidelines
Responder Signer Certificate	Browse to the network path or local directory location of a Responder Signer Certificate. This is the certificate the OCSP responder uses to sign the response. You must specify the Responder Signer Certificate if the signer certificate is not included in the response.
Trust Responder Certificate	Select this option to allow an OCSP responder certificate that matches the responder signer certificate.
Revocation Checking	Select this option to ensure that the certificate has not recently been revoked. This option has implications only if you specified the Use OCSP with CRL fallback option.
Allow clock discrepancy	Use this option to account for possible mismatches in timestamps between the system clock and the OCSP responder clock. If the mismatch is significant, the system disregards the response from the OCSP responder as out of date or expired.

11. Save the configuration.

Configuring a Proxy Server for CRL Downloads and OCSP Status Checks

You can configure the system to send CRL download requests and OCSP status checks to the proxy server and collect the response. You might want to do this if you deploy proxy server to control access to the Internet.

The following types of CRL downloads can use the proxy server:

- CRL distribution points (CDPs) specified in the trusted client CAs
- CDPs specified in client certificates
- Manually configured CDPs

Similarly, the system can send OCSP requests to the OCSP responder through the proxy server. The OCSP responses are also received through the proxy server. This feature is useful when you deploy many PPS systems and the OCSP responders are located outside the network.

To configure a proxy server:

1. Select **System > Configuration > Certificates > Trusted Client CAs**.
2. Click **Proxy Settings** to display the page.
3. Complete the configuration described in table below.
4. Save the configuration.

Table96: Proxy Settings

Settings	Guidelines
Use Proxy Server for HTTP-based CRL download	Select to enable the CRL operations to use a proxy server. NOTE: You can configure a proxy server for web-based URLs, not LDAP URLs.
Use Proxy Server for HTTP-based OCSP status checking	Select to enable the OCSP operations to use a proxy server.
Host Address	Specify either an IP address or a fully qualified domain name.
Port	Enter the proxy server port number if it is different from the default value of 80.
Username/password	If your proxy server required authentication, enter a username and password to log in to the proxy server.

Using Client Auth Certificates

This topic describes how to use client auth certificates. It includes the following information:

- Understanding Client Auth Certificates
- Importing a Client Auth Certificate
- Renewing a Client Auth Certificate
- Configuring Two-Way SSL Authentication
- Enabling Certificate Revocation Check for Client Auth Certificate

Understanding Client Auth Certificates

In certain corporate environments, servers on the LAN are protected with two-way SSL authentication. These servers require the client to authenticate by presenting a valid certificate.

In the remote access scenario, PCS is a client of these servers. You can configure PPS to present client authentication certificates to servers whenever it communicates over SSL.

NOTE: This feature authenticates end users or end-user machines to servers on the corporate LAN.

The SSL protocol provides for mutual authentication of server and client at the time of session initiation. The client part of the authentication is optional. For enhanced security, some deployments may require that the client also authenticate itself with a certificate. Normally, when setting up an SSL connection with a server on behalf of the end user, PCS does not present any certificate to the server. It needs to be explicitly configured to present such certificate. This section explains how such configuration may be performed.

The basic idea is to upload a certificate, private key pair to the Pulse Secure access management framework, and configure a mapping between this pair and a server resource. Subsequently, when an end user attempts to establish a connection with that server, PPS presents the associated certificate to the server. If no certificate is associated with the server in PCS certificate store, then it is assumed that the server does not demand client certificate.

If, during the SSL handshake, the back-end server requests a client certificate but PPS doesn't send a certificate, the end user sees an "access denied" error message. Similarly, if the back-end server rejects the PPS certificate, the end user sees an "access denied" error message. If a certificate is configured, is successfully retrieved and no error is encountered during handshake, the user is granted access to the server.

NOTE: The PPS access management framework allows client authentication certificates to be uploaded to the device in two ways: generate a CSR and upload the signed certificate returned by the CA, or directly import the certificate if one is available.

Importing a Client Auth Certificate

The Pulse Secure access management framework allows certificates that include the private key and for instances where the private key is in a separate file from the certificate. In addition, if your certificates have been exported into a system configuration file, you can import the system configuration file to upload the certificates.

To import the client auth certificates files:

1. Select **System > Configuration > Certificates > Client Auth Certificates**.
2. Click **Import Certificate & Key** to display the configuration page.
3. Complete the configuration described in table below.
4. Click **Import**.

Table 97: Import Certificate and Key Settings

Settings	Guidelines
If certificate file includes private key	
Certificate File	Browse to the network path or local directory location of your private key file.
Password Key	Enter the password key.
If certificate and private file are separate keys	
Certificate File	Browse to the network path or local directory location of your certificate key file.
Private Key File	Browse to the network path or local directory location of your private key file.
Password Key	Enter the password key.
Import via System Configuration file	
System Configuration File	Browse to the network path or local directory location of the system configuration file.
Password	Enter the password.

Renewing a Client Auth Certificate

To renew a certificate:

1. Select **System > Configuration > Certificates > Client Auth Certificates**.
2. Click the link that corresponds to the certificate you want to renew.
3. Click **Renew Certificate** to display the configuration page.
4. In the Renew the Certificate form, browse to the renewed certificate file, enter the password for the certificate key, and click **Import**.

Configuring Two-Way SSL Authentication

To configure two-way SSL authentication:

1. Import the certificates used for two-way SSL handshake in the **System > Configuration > Certificates > Client Auth Certificates** window.
2. Define the back-end resource and assign a certificate to be presented when accessing it using the **Users > Resource Policies > Web > Client Authentication** window.

Enabling Certificate Revocation Check for Client Auth Certificate

Client Auth Certificate Revocation Check is only applicable for TLS Syslog Backend Server. It is not applicable for any other backend server configured to ask Client Certificate.

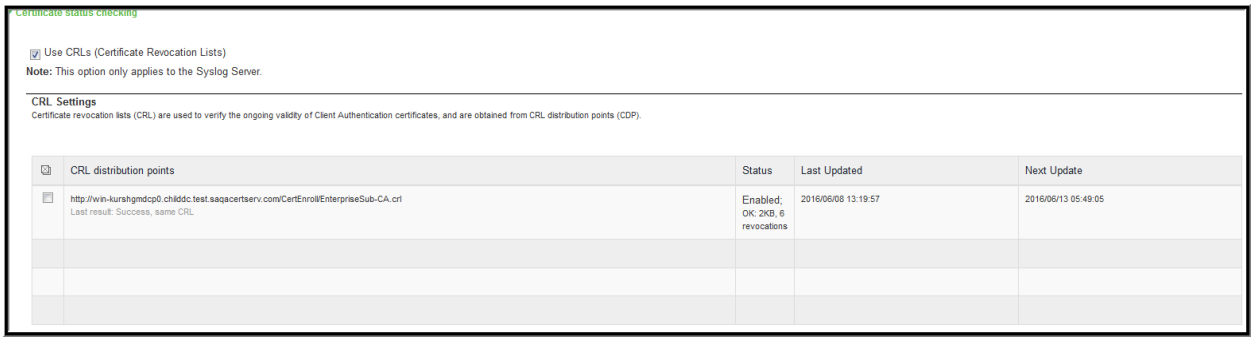
To enable the CRL for Client Auth Certificate:

1. Go to **System > Configuration > Certificates > Client Auth Certificates**.
2. Click on the certificate from the list to go to the certificate details.
3. In the **Certificate Details** page, go to **Certificate Status Checking** and enable the **Use CRLs (Certificate Revocation Lists)** checkbox.

Figure 515: Enabling Certificate Revocation Check for Client Auth Certificate

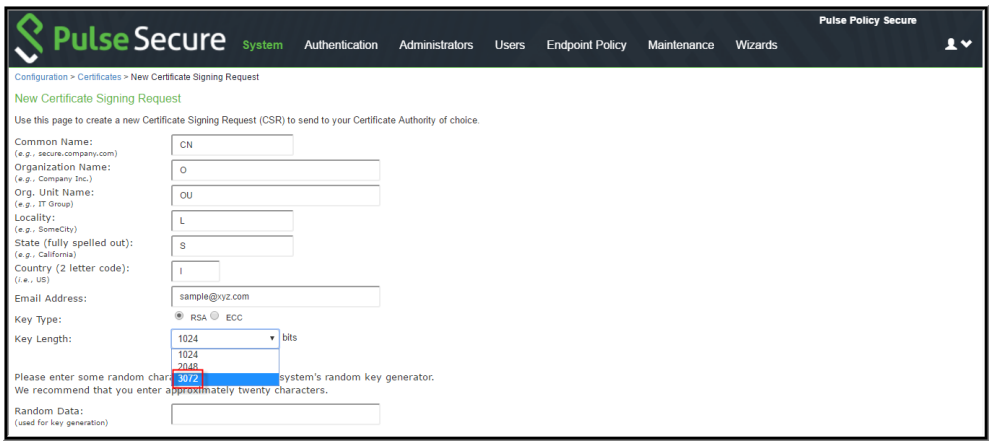
4. Click on **Save Changes**.
5. Import the CA or CA Chain that issued the Client Auth Certificate to **System > Configuration > Trusted Client CAs**.
6. Once the CRL is successfully downloaded for Client Auth Certificate, it is listed in the CRL distribution points.

Figure 516: Successful CRL Download for Client Auth Certificate



NOTE: This version of the PPS supports the 3072 bit key length for Client Auth Certificates.

Figure 517: 3072 Bit Key Length for Client Auth Certificates



NOTE: CRL Download for Device Certificate and Client Auth Certificate using LDAP based URL won't work due to dependency of LDAP Username and Password. In some cases, CDP LDAP URL hostname field is also required which is also not supported.

Using Trusted Server CAs

This topic describes trusted server certificate authorities (CAs). It includes the following information:

- Understanding Trusted Server CAs
- Uploading Trusted Server CA Certificates
- Restoring the Prepopulated Group of Trusted Server CA Certificates
- Renewing a Trusted Server CA Certificate
- Deleting a Trusted Server CA Certificate

Understanding Trusted Server CAs

All the trusted root CAs for the Web certificates installed in Internet Explorer are preinstalled. You might need to install a trusted server CA for additional Web servers in the following situations:

- If you are using third-party integrity measurement verifiers (IMVs) that are installed on a remote server, you must upload the trusted root certificate of the CA that signed the remote server's server certificate.
- If you are using virus signature version monitoring with your own staging site for storing the current virus signatures list, you must upload the trusted root certificate of the CA that signed the staging server certificate.

You can install the trusted root CA certificate on the endpoint in any of the following ways:

- Use a CA certificate that is chained to a root certificate that is already installed on the endpoint, such as VeriSign.
- Upload the CA certificate and any intermediate CA certificates to the Pulse Secure client system. During client installation, the system automatically installs the trusted root device CA certificates on the endpoint. When prompted during installation, the user must allow the installation of the CA certificate(s).
- Prompt users to import the CA certificates on the endpoint using Internet Explorer or other Microsoft Windows tools. In other words, you can use common methods organizations use to distribute root certificates.

NOTE: You cannot use CRL revocation checks for trusted server CA certificates.

Uploading Trusted Server CA Certificates

You can use the Trusted Server CAs page to upload the trusted root certificate of the CA that signed the Pulse Secure client service device certificate. If you upload a certificate chain, you must install the certificates one at a time in descending order starting with the root certificate (DER or PEM files), or you must upload a single file that contains the entire certificate chain (PEM files only). The system supports X.509 CA certificates in PEM (Base 64) and DER (binary) encode formats.

To upload CA certificates:

1. Select **System > Configuration > Certificates > Trusted Server CAs** to display the page.
2. Click **Import Trusted Server CA** to display the page.
3. Browse to the certificate file, select it, and click **Import Certificate** to complete the import operation.

Restoring the Prepopulated Group of Trusted Server CA Certificates

The System > Configuration > Certificates > Trusted Server CAs page is prepopulated with some of the trusted root CAs for the Web certificates installed in Internet Explorer and Windows. You can use the delete functionality on this page to delete CAs and the reset functionality to restore the list to the set that was installed during the upgrade. The reset operation clears all manually imported certificates.

To restore the prepopulated group of trusted CA certificates:

1. Select **System > Configuration > Certificates > Trusted Server CAs**.
2. Click **Reset Trusted Server CAs**.
3. Confirm that you want to restore the set of trusted server CAs that was installed when you upgraded.

Renewing a Trusted Server CA Certificate

If a trusted CA renews its certificate, you must upload the renewed CA certificate.

To import a renewed CA certificate:

1. Select **System > Configuration > Certificates > Trusted Server CAs**.
2. Click the link that corresponds to the certificate that you want to renew to display the page.
3. Click **Renew Certificate**.
4. Browse to the certificate file, select it, and click **Import Certificate** to complete the import operation.

Deleting a Trusted Server CA Certificate

You can delete any trusted server CA certificate, including preinstalled certificates.

To delete a trusted server CA certificate:

1. Select **System > Configuration > Certificates > Trusted Server CAs**.
2. Select the check box for the certificate you want to delete.
3. Click **Delete**, and then confirm that you want to delete the certificate.

Understanding ECC Certificates

Public-key cryptography is a cryptographic system that requires a secret key and a public key that are mathematically linked with each other. One key encrypts the plain text while the other decrypts the cipher text. RSA is the most widely used public-key algorithm.

Elliptic Curve Cryptography (ECC) were introduced as an alternative to RSA in public key cryptography. One advantage of ECC over RSA is key size versus strength. For example, a security strength of 80 bits can be achieved through an ECC key

size of 160 bits, whereas RSA requires a key size of 1024. With a 112-bit strength, the ECC key size is 224 bits and the RSA key size is 2048 bits.

The most popular signature scheme that uses elliptic curves is called the Elliptic Curve Digital Signature Algorithm (ECDSA). The most popular key agreement scheme is called Elliptic Curve Diffie-Hellman (ECDH). An ECDH exchange is a variant of the Diffie-Hellman (DH) protocol and is an integral part of the Suite B cryptography standards proposed by the National Security Agency (NSA) for protecting both classified and unclassified information.

About Suite B

The Advanced Encryption Standard (AES) is a specification for the encryption of electronic data established by the U.S. National Institute of Standards and Technology (NIST) in 2001. Because a single encryption algorithm cannot satisfy all the needs of the national security community, NSA created a larger set of cryptographic algorithms, called Suite B, which can be used along with AES in systems used by national security users. In addition to AES, Suite B includes cryptographic algorithms for hashing, digital signatures, and key exchanges.

Per RFC 6460, to be Suite B TLS 1.2 compliant the server and client should negotiate with the following ciphers:

- TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256
- TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384

RFC 6460 also lists a transitional Suite B profile for TLS 1.0 and TLS 1.1. Clients and servers that do not yet support Suite B TLS 1.2 should negotiate with the following ciphers:

- TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA
- TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA

There is no special configuration to ensure that PPS negotiates Suite B ciphers. However, the following general steps should be performed to enable Suite B compliance:

- An ECC certificate signed by an ECC Root CA is associated with a network port.
    - A P-256 CSR is signed by either a P-256 or P-384 Root CA.
    - A P-384 CSR is signed by a P-384 Root CA.
- Manually enable only AES128 and/or AES256 custom ciphers.

NOTE: PPS cannot be configured to allow only Suite B ciphers.

Using ECC Certificates

ECC certificates are currently supported only on the virtual appliance platforms. As with RSA certificates, ECC certificates are associated with a network port. You can create multiple virtual ports on the server with each port supporting a specific certificate. For example, external virtual port 1 can use a 1024-bit RSA while external virtual port 2 uses ECC P-256 and external virtual port 3 uses ECC P-384. Only clients that support ECC cipher suites can connect to the web server on that network port.

When an Elliptic Curve Cryptography (ECC) certificate is associated with a network port, only clients that support ECC cipher suites can connect to the Web server on that network port.

Except for the key and certificate generation process, the use of ECC certificates is basically the same as using RSA certificates.

FIPS Level 1 Support (Software FIPS)

This chapter covers the following topics:

Understanding Pulse Secure FIPS Level 1 Support

Federal Information Processing Standard (FIPS) are a set of standards that define security requirements for products that implement cryptographic modules used to secure sensitive but unclassified information. The most recent standards are defined in the FIPS Publication 140-2.

The FIPS documents define, among other things, security levels for computer and networking equipment. U.S. Federal Government departments, and other organizations, use FIPS to evaluate the cryptographic capabilities of the equipment they consider for purchase. Cryptographic modules are validated against separate areas of the FIPS specification. An overall certification level is assigned based on the minimum level achieved in any area. Although primarily aimed at environments requiring strict security, FIPS levels are increasingly enforced as qualifying criteria for all U.S. Federal Government contracts. Security-conscious private enterprises might also use FIPS levels as an equipment evaluation benchmark. FIPS levels also serve as a customer-neutral description of vendor requirements. Vendors can engineer security products to FIPS levels and extend the applicability and eligibility of these products across a broad customer base, thereby eliminating exhaustive and time-consuming customer-by-customer product qualification procedures.

Pulse Secure offers FIPS level 1 support for PPS. Both services use a 140-2 level 1 certified cryptographic module to comply with FIPS. When FIPS level 1 support is enabled applications, such as browsers, accessing the web server must support Transport Layer Security (TLS), the latest version of Secure Socket Layer (SSL). If the platform features hardware acceleration, then for SSL processing SSL hardware acceleration is disabled as hardware acceleration does not comply with FIPS validation. Only FIPS approved algorithms are used when in FIPS level 1 support is enabled.

For more information about the Pulse Secure Cryptography Module, see the security policy and the validation certificate. For a complete list of validated FIPS 140-1 and FIPS 140-2 cryptography modules, see http://csrc.nist.gov/groups/STM/cmvp/documents/140-1/140val-all.htm#2018.

FIPS Supported Platforms

The following platforms support FIPS level 1:

- PSA 300/3000/5000/7000
- PPS virtual appliances

Enabling FIPS Level 1 Support

Once you enable FIPS level 1 support, your browser is restricted to specific custom cipher strengths. A list of supported ciphers is shown during the enabling process.

When you enable FIPS level 1 support, the following events occur on the system:

- The Web server restarts and turns on FIPS level 1 support. The Web server now allows only TLSv1.0, TLSv1.1 and TLSv1.2 protocols that include FIPS approved cryptographic algorithms which include Suite B cipher suites.

NOTE: Once FIPS level 1 support is enabled, new client sessions will use FIPS if the client supports FIPS. Existing client sessions may not be using FIPS. To ensure FIPS capable clients are in FIPS level 1 support, all client sessions should be terminated after the FIPS level 1 support is enabled. Administrators can use the **System > Status > Active Users** page to terminate client sessions.

- If the platform features hardware acceleration, when FIPS level 1 support is enabled SSL processing does not utilize the hardware acceleration. IPsec hardware acceleration is not affected.

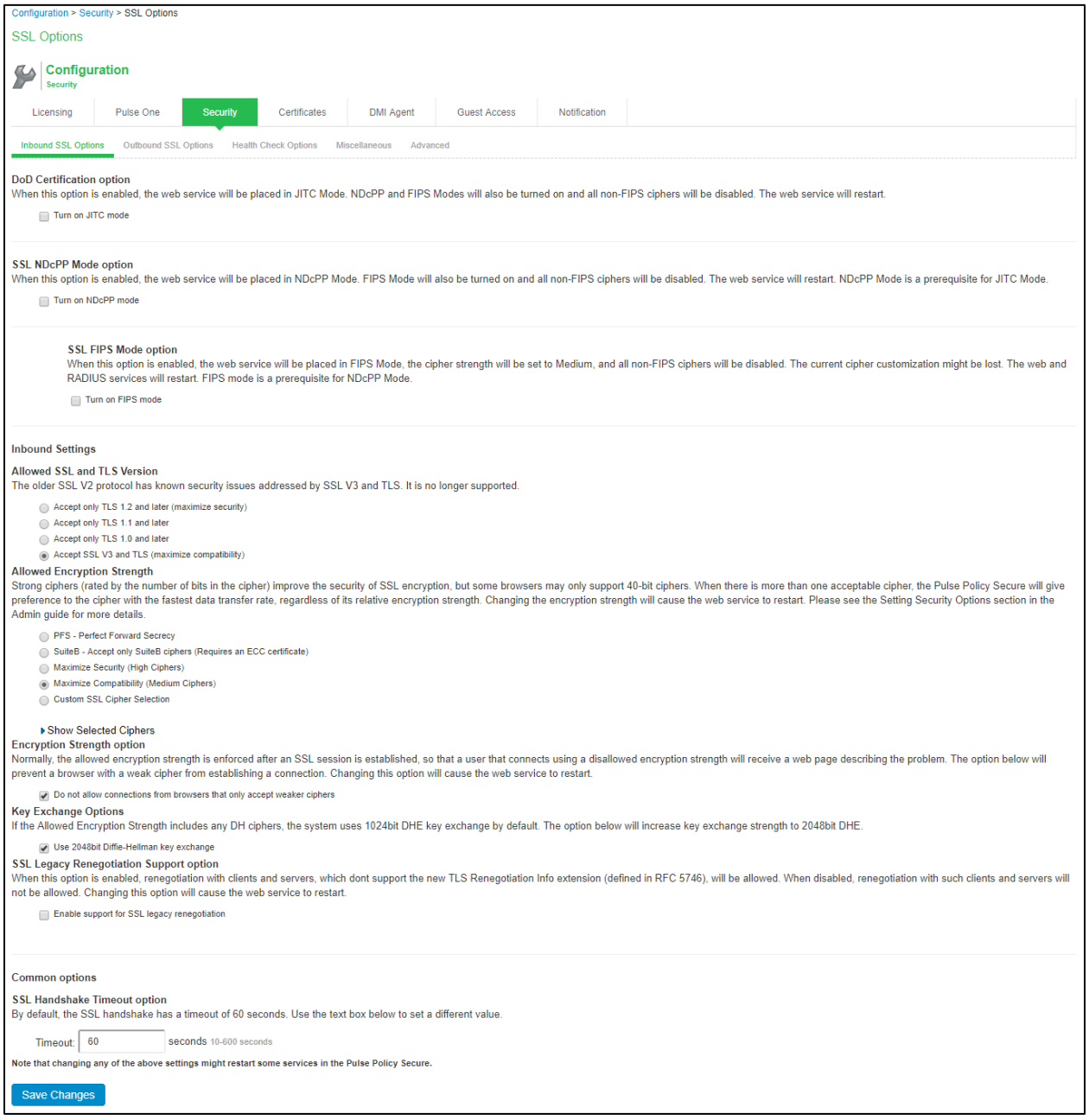
The following event logs are generated for FIPS level 1 support:

- SYS30966 when the web server turns FIPS level 1 support on.
- ADM30965 when the administrator turns FIPS level 1 support on or off.
- ERR30967 when the web server fails to turn on FIPS level 1 support.

To enable FIPS level 1 support:

1. Select **System > Configuration > Inbound SSL Options**.
2. Under SSL FIPS Mode option, select **Turn on FIPS mode**.

Figure518: Enabling FIPS Level 1 Support



Once you turn on FIPS level 1 support, the following changes are made:

- Under Allowed SSL and TLS Version, the **Accept only TLS** option is selected.
- Under Allowed Encryption Strength, Maximize Compatibility (Medium Ciphers) is set. Only FIPS approved ciphers are selected. See "Supported Cipher Suites when FIPS Level 1 Support is Enabled and Disabled"

- Under Encryption Strength, the **Do not allow connections from browsers that only accept weaker ciphers** option is selected.

3. Click **Save Changes**.

FIPS Level 1 support is now enabled on the device. If your browser does not support any of the listed ciphers, you will not be able to log in to the device.

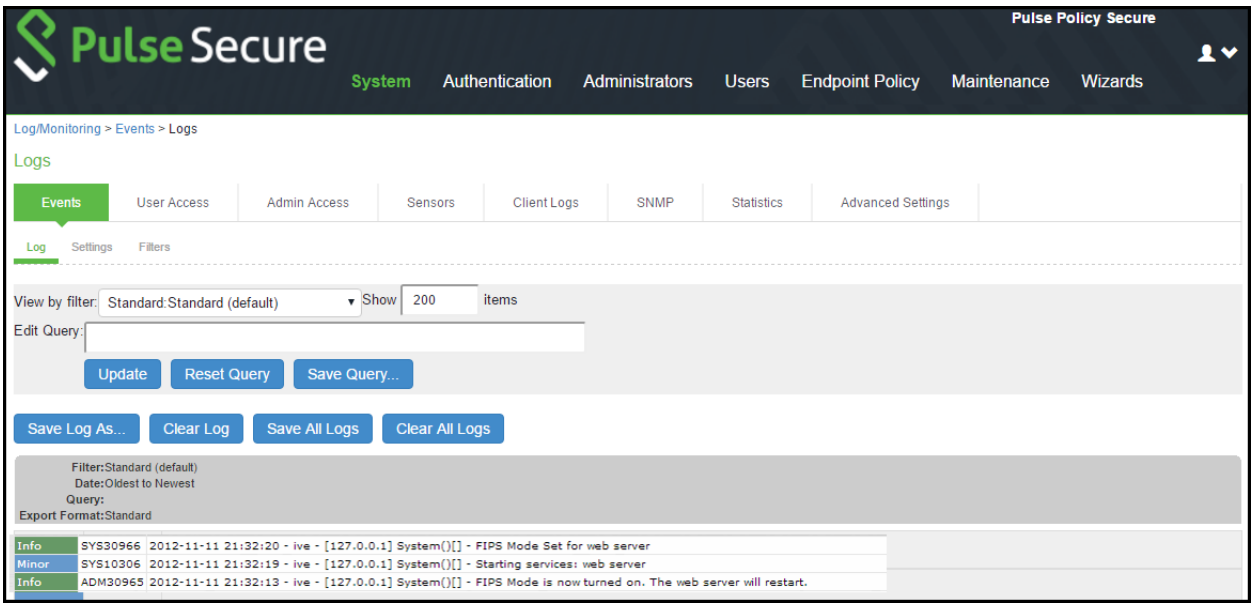
When enabling FIPS mode on PPS, only the following protocols are FIPS compliant:

- EAP-TTLS
- EAP-PEAP
- EAP-TLS

A warning is displayed if non-FIPS protocols are configured on an PPS FIPS enabled device. However, these protocols are not disabled as they may be required for other use cases such as for the MAC authentication bridge.

Entries are made in the Events logs to show that FIPS level 1 support is enabled.

Figure519: Events Log Entries for FIPS Level 1



Turning Off FIPS Level 1 Support from the Serial Console

Problem	**Description:** If you have FIPS level 1 support enabled and your browser does not support the required cipher suites, you cannot access the device. If this happens to an administrator account, you can no longer administer or configure the system.
Solution	You can turn off FIPS level 1 support and reset the encryption strength from the device's serial console. After choosing that option, SSL options are reset to **Accept only TLS 1.0 and later** and to **Maximize Compatibility (Medium Ciphers)**. Open a serial console to your device and select option **8. Turn off FIPS Mode and reset allowed encryption strength for SSL**.

Turning Off FIPS Level 1 and Resetting Encryption Strength from the Serial Console

```
Please choose the operation to perform:
   1. Network Settings and Tools
   2. Create admin username and password
   3. Display log/status
   4. System Operations
   5. Toggle password protection for the console (Off)
   6. Create a Super Admin session.
   7. System Maintenance
   8. Turn off FIPS Mode and reset allowed encryption strength for SSL
Choice: 8
```

NOTE: Once you turn off FIPS level 1 support, option 8 is relabeled "Reset allowed encryption strength for SSL."

Supported Cipher Suites When FIPS Level 1 Support is Enabled

When FIPS level 1 support is enabled, only TLSv1.0, v1.1, v1.2 and AES256, 3DES and AES128 are allowed. The order of the cipher suites is not dependent on the SSL hardware acceleration module since hardware acceleration is not used when FIPS level 1 support is enabled.

When FIPS level 1 support is enabled, the following settings are automatically configured:

- In the SSL Options window:
  - Under Allowed SSL and TLS Version, the **Accept only TLS** option is selected. All other options under this section are disabled.
  - Under Allowed Encryption Strength, the **Maximize Compatibility (Medium Ciphers)** option is selected. Only FIPS approved ciphers are selected.
  - Under Encryption Strength Option, the **Do not allow connections from browsers that only accept weaker ciphers** option is selected.
- SSL hardware acceleration is disabled. IPsec hardware acceleration is not affected by the FIPS level 1 support being enabled.

The first four cipher suites in the below table are given preference due to the requirements in RFC 6460. The first two cipher suites meeting the requirement for Suite B Profile for TLS 1.2. The next two meeting the requirement for Suite B Transitional Profile for TLS 1.0 and 1.1.

Table98: Supported Cipher Suites with FIPS Level 1 Support ON, Hardware Acceleration ON with ECC Server Certificates

Cipher Suite	Protocol
TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256	TLSv1.2
TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384	TLSv1.2
TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA	TLSv1.0 and later
TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA	TLSv1.0 and later
TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA384	TLSv1.2
TLS_ECDH_RSA_WITH_AES_256_GCM_SHA384	TLSv1.2
TLS_ECDH_ECDSA_WITH_AES_256_GCM_SHA384	TLSv1.2
TLS_ECDH_RSA_WITH_AES_256_CBC_SHA384	TLSv1.2
TLS_ECDH_ECDSA_WITH_AES_256_CBC_SHA384	TLSv1.2
TLS_ECDH_RSA_WITH_AES_256_CBC_SHA	TLSv1.0 and later
TLS_ECDH_ECDSA_WITH_AES_256_CBC_SHA	TLSv1.0 and later
TLS_ECDHE_ECDSA_WITH_3DES_EDE_CBC_SHA	TLSv1.0 and later
TLS_ECDH_RSA_WITH_3DES_EDE_CBC_SHA	TLSv1.0 and later
TLS_ECDH_ECDSA_WITH_3DES_EDE_CBC_SHA	TLSv1.0 and later
TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA256	TLSv1.2
TLS_ECDH_RSA_WITH_AES_128_GCM_SHA256	TLSv1.2
TLS_ECDH_ECDSA_WITH_AES_128_GCM_SHA256	TLSv1.2
TLS_ECDH_RSA_WITH_AES_128_CBC_SHA256	TLSv1.2
TLS_ECDH_ECDSA_WITH_AES_128_CBC_SHA256	TLSv1.2
TLS_DHE_RSA_WITH_AES_256_CBC_SHA	TLSv1.0 and later
TLS_DHE_RSA_WITH_AES_128_CBC_SHA	TLSv1.0 and later

Table99: Supported Cipher Suites with FIPS Level 1 Support ON, Hardware Acceleration ON and RSA Server Certificates in Use

Cipher Suite	Protocol
TLS_RSA_WITH_AES_256_CBC_SHA256	TLSv1.2
TLS_RSA_WITH_AES_256_CBC_SHA	TLSv1.0 and later
TLS_RSA_WITH_3DES_EDE_CBC_SHA	TLSv1.0 and later
TLS_RSA_WITH_AES_128_CBC_SHA256	TLSv1.2
TLS_RSA_WITH_AES_128_CBC_SHA	TLSv1.0 and later
TLS_RSA_WITH_AES_256_GCM_SHA384	TLSv1.2
TLS_RSA_WITH_AES_128_GCM_SHA256	TLSv1.2
TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA384	TLSv1.2
TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA	TLSv1.0 and later
TLS_ECDHE_RSA_WITH_3DES_EDE_CBC_SHA	TLSv1.0 and later
TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA256	TLSv1.2

Cipher Suite	Protocol
TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA	TLSv1.0 and later
TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384	TLSv1.2
TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256	TLSv1.2
TLS_DHE_RSA_WITH_AES_256_CBC_SHA	TLS1.0 and later
TLS_DHE_RSA_WITH_AES_128_CBC_SHA	TLS1.0 and later

Table100: Supported Cipher Suites with FIPS Level 1 Support ON, Hardware Acceleration OFF with RSA Device Certificates

Cipher Suite	Protocol
TLS_RSA_WITH_AES_256_CBC_SHA256	TLSv1.2
TLS_RSA_WITH_AES_256_CBC_SHA	TLSv1.0 and later
TLS_RSA_WITH_3DES_EDE_CBC_SHA	TLSv1.0 and later
TLS_RSA_WITH_AES_128_CBC_SHA256	TLSv1.2
TLS_RSA_WITH_AES_128_CBC_SHA	TLSv1.0 and later
TLS_RSA_WITH_AES_256_GCM_SHA384	TLSv1.2
TLS_RSA_WITH_AES_128_GCM_SHA256	TLSv1.2
TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA384	TLSv1.2
TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA	TLSv1.0 and later
TLS_ECDHE_RSA_WITH_3DES_EDE_CBC_SHA	TLSv1.0 and later
TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA256	TLSv1.2
TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA	TLSv1.0 and later
TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384	TLSv1.2
TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256	TLSv1.2
TLS_DHE_RSA_WITH_AES_256_CBC_SHA	TLS1.0 and later
TLS_DHE_RSA_WITH_AES_128_CBC_SHA	TLS1.0 and later

Table101: Supported Cipher Suites with FIPS Level 1 Support ON, Hardware Acceleration OFF with ECC Certificates

Cipher Suite	Protocol
TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256	TLSv1.2
TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384	TLSv1.2
TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA	TLSv1.0 and later
TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA	TLSv1.0 and later
TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA384	TLSv1.2
TLS_ECDH_ECDSA_WITH_AES_256_GCM_SHA384	TLSv1.2

Cipher Suite	Protocol
TLS_ECDH_ECDSA_WITH_AES_256_CBC_SHA384	TLSv1.2
TLS_ECDH_ECDSA_WITH_AES_256_CBC_SHA	TLSv1.0 and later
TLS_ECDHE_ECDSA_WITH_3DES_EDE_CBC_SHA	TLSv1.0 and later
TLS_ECDH_ECDSA_WITH_3DES_EDE_CBC_SHA	TLSv1.0 and later
TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA256	TLSv1.2
TLS_ECDH_ECDSA_WITH_AES_128_GCM_SHA256	TLSv1.2
TLS_ECDH_ECDSA_WITH_AES_128_CBC_SHA256	TLSv1.2
TLS_ECDH_ECDSA_WITH_AES_128_CBC_SHA	TLS1.0 and later

File Management

This chapter describes features for managing configuration files. It includes the following information:

Overview

The system supports multiple administrator capabilities related to configuration and log file management. The below list describes the purpose of the different features:

- Archiving- This feature helps to archive system and user configuration files and user logs on a remote backup server. It also helps in scheduling the archiving jobs. The system allows to import the configurations archived.
- Local backup and restore- This feature helps to create backups on the local system and then recover or restore the data during a disaster or while doing significant configuration changes.
- Binary configuration file import/export- This feature helps to export or import the system (system.cfg) and user configuration (user.cfg) in a binary format to replicate the configuration across multiple systems and across the system upgrades.
- XML configuration file import/export- This feature helps to selectively or fully import or export the configuration in an XML format from one PPS device to another. The XML configurations can be modified for system details such as IP address and so on before importing.
- Push Configuration- This feature helps to push a partial configuration from one PPS device to one or more PPS devices directly.

Configuration

The Admin can perform the following configuration procedures:

- Archiving
- Backup and Restore
- Importing/Exporting Binary System Configuration Files
- Importing/Exporting Binary User Configuration Files
- Importing/Exporting XML Configuration Files
- Exporting Universal XML
- Modifying Configuration XML Files
- Pushing the Configuration

Archiving

The Admin must configure the archiving backup server details to transfer the files. You can also schedule the archiving jobs.

NOTE:

- The system does not continue to retry the process if it fails, and log files are not deleted.
- It is recommended to schedule an archive operation when traffic is low to minimize its impact on users. The automatic archiving process compresses files and may lead to performance issues.
- The daylight savings time (DST) must be considered while scheduling the archiving.

To configure log archiving:

1. Select **Maintenance > Archiving > Archiving Servers** to display the configuration page.
2. Complete the configuration as described below.
3. Save the configuration.

Figure520: Archiving Configuration Page

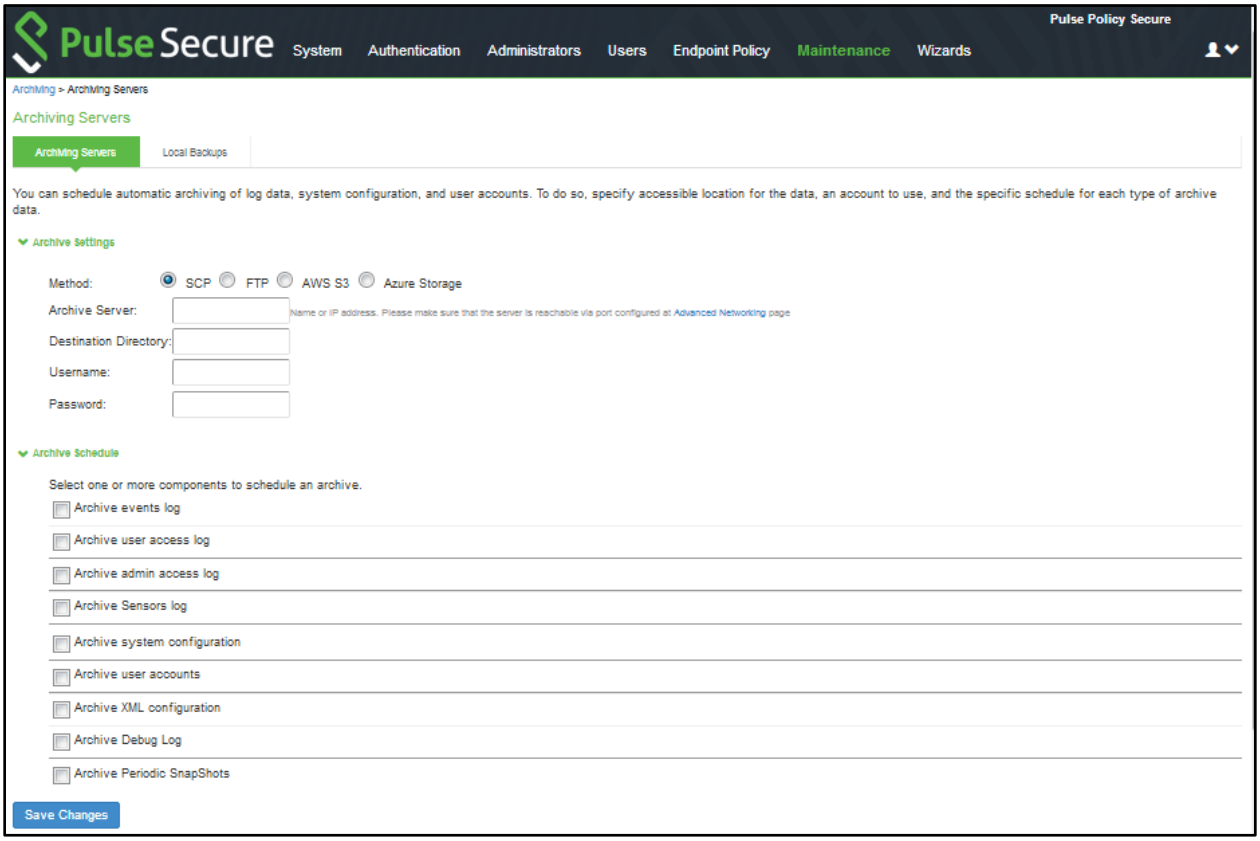


Table102: Archiving Configuration Guidelines

Settings	Guidelines
Archive Settings	
Archive Server	Specify the fully qualified domain name or IP address of the server to which to send the archive files.
Destination Directory	Specify the destination directory. Follow these recommendations: • For UNIX systems, you can specify an absolute or relative path. We recommend you specify a full path. • For Windows systems, specify a path that is relative to the ftp root directory. We recommend you specify a full path. Do not include a drive specification for the destination directory, such as: pulsesecure/log.
Username	Specify a username that has privileges to log into the server and write to the destination directory.
Password	Specify the corresponding password.

Method	Select SCP, FTP, AWS S3 or Azure Storage. SCP is the default method. SCP is a file transfer utility similar to FTP. SCP encrypts all data during transfer. When the data reaches its destination, it is rendered in its original format. SCP is included in most SSH distributions and is available on all major operating system platforms. AWS S3: Push backup configurations and archived logs to Amazon AWS S3 bucket. For more details, refer to Pulse Connect Secure Virtual Appliance on Amazon AWS Cloud Deployment Guide. Azure Storage: Push backup configurations and archived logs to Microsoft Azure storage. For more details, refer to Pulse Connect Secure Virtual Appliance on Microsoft Azure Cloud Deployment Guide.
Archive Schedule	
Archive events log	Schedule archiving for the Events log. The archive file has the following format: **PulseSecureEventsLog-[clustername|standalone]-[nodename|hostname]-[date]-[time]** For example, an archive file for a cluster named Gen has a filename similar to the following: **PulseSecureEventsLog-Gen-node1-Root-20090109-1545.gz**. The archiving schedule configuration includes the following options: • **Use this filter**—Select a log format filter. • Day of week—Select the days of the week on which to run the archiving job. • **Every hour** or a **Specified Time**. Every hour option runs a job every hour on the hour for the selected days. The specified time option runs a job once on the selected days. • **Clear log after archiving**. Select this option to clear the local log file after the archiving job is successfully completed. If an archive job fails, the log files are not deleted.
Archive user access log	Schedule archiving for the User Access log. The archive file has the following format: **PulseSecureAccessLog-[clustername|standalone]- [nodename|hostname]-[date]-[time]** The archiving schedule configuration includes the same options as those described for the Events log.
Archive admin access log	Schedule archiving for the Admin Access log. The archive file has the following format: **PulseSecureAdminLog-[clustername|standalone]- [nodename|hostname]-[date]-[time]** The archiving schedule configuration includes the same options as those described for the Events log.
Archive sensors log	Schedule archiving for the Sensors log. The archive file has the following format: **PulseSecureSensorsLog-[clustername|standalone]- [nodename|hostname]-[date]-[time]** The archiving schedule configuration includes the same options as those described for the Events log.
Archive system configuration	Schedule archiving for the system configuration binary file (system.cfg). The archive file has the following format: **PulseSecureConf-[clustername|standalone]- [nodename|hostname]-[date]-[time]** The archiving schedule configuration includes the same day, time, and password-protection options as those described for the Events log.
Archive user accounts	Schedule archiving for user account configuration binary file (user.cfg). The archive file has the following format: **PulseSecureUserAccounts-[clustername|standalone]- [nodename|hostname]-[date]-[time]** The archiving schedule configuration includes the same day, time, and password-protection options as those described for the Events log.

Archive XML configuration	Schedule archiving for the XML configuration files. The archiving schedule configuration includes the same day and time options as those described for the Events log.
Archive debug log	Enable archiving for collected debug logs. You cannot specify a day and time for archiving debug logs. If you select this option, debug logs are archived periodically and cleared if the **Clear log after archiving** option is selected.
Archive periodic snapshots	Enable archiving for snapshots. You cannot specify a day and time for archiving periodic snapshots. If you select this option, snapshots are archived periodically.

Backup and Restore

Using the backup and restore feature the Administrator can take the system and user account backup and restore it as needed.

NOTE: System allows you to save five system configuration backups and five user account backups on the local server.

To manage configuration file backups:

1. Select **Maintenance > Archiving > Local Backups** to display the configuration page.
2. Use the controls to backup or restore the configuration as described below.
3. Save the configuration.

Figure521: Local Backups Management Page

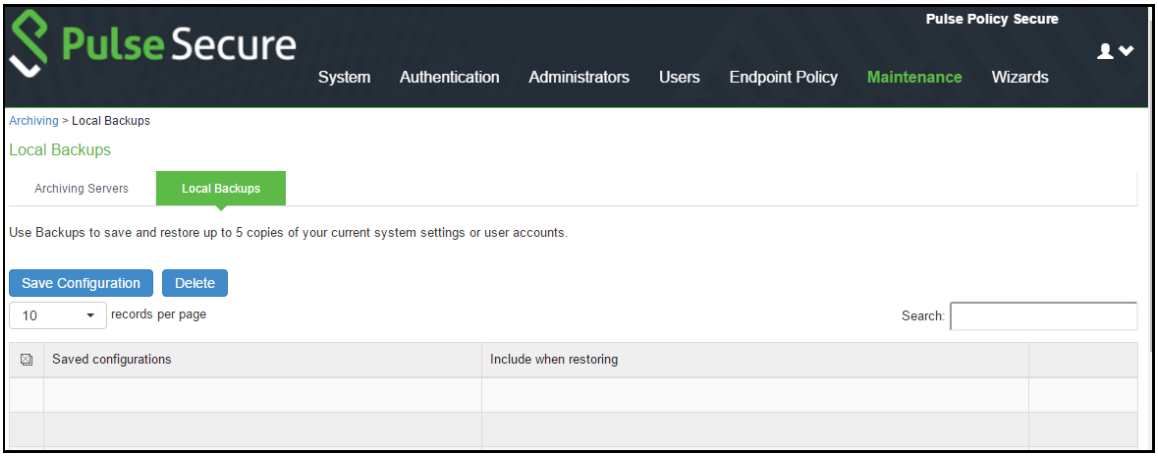


Table103: Local Backups Management Guidelines

Controls	Guidelines
System Configuration	
Save Configuration	Create a backup of the running configuration.
Delete	Select a row in the table and click **Delete** to delete the backup.

Controls	Guidelines
Restore	Select a row in the table and components in the “Include when restoring” column and click **Restore** to replace the running configuration with the archived configuration.
User Configuration	
Save Configuration	Create a backup of the running configuration.
Delete	Select a row in the table and click **Delete** to delete the backup.
Restore	Select a row in the table and click **Restore** to replace the running configuration with the archived configuration.

Importing/Exporting Binary System Configuration Files

PPS enables you to import and export the system and network settings using binary system configuration files. When importing a system configuration file, you can exclude the device certificate and the server’s IP address or network settings from the imported information. For example, to set up multiple PPS systems behind a load balancer, import everything except for the IP address. To set up the system as a backup server, import everything except for the digital certificate and the network settings. The binary system configuration file includes the following settings:

- Network settings
- Certificates. The system imports only device certificates, not the chains that correspond to the device certificates or trusted client CAs.
- Cluster configuration
- Licenses. When you import a configuration file that contains licenses, the system gives precedence to any existing licenses. Licenses are imported only if no licenses are currently installed.
- SNMP settings
- Sensor configuration. Sensor configurations are included in the system configuration file while sensor event policies are included in the user configuration file. To import or export all sensor-related settings, import or export both the system and user configuration files. The user configuration file, not the system configuration file, includes resource profiles, resource policies, and the local user database. To perform a complete backup, export both the system and user configuration files.
- Client-side logs. To import or export client-side logs, import or export both the system and user configuration files. Note:
  - Import of system and user configuration across different hardware platforms is not supported.
  - You can import a FIPS configuration file into a non-FIPS device and vice versa if you do not include the certificate and security world in the import process.

To export a binary system configuration file:

1. Select **Maintenance > Import/Export > Import/Export Configuration** to display the configuration page.
2. Complete the configuration and import/export operation as described below.

Figure522: Export/Import Binary System Configuration File Configuration Page

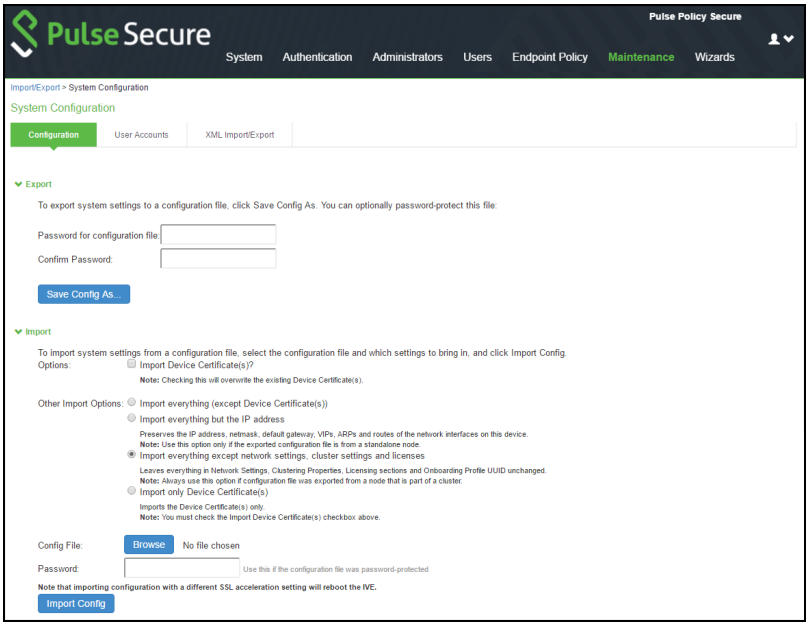


Table104: Configuration and Action Guidelines

Settings	Guidelines
Export	
Password for configuration file	Specify a password to encrypt and secure the configuration file.
Confirm password	Specify the password.
Save Config As	Display a dialog box to save the file to your local host.
Import	
Import Device Certificate(s)?	Overwrite the existing device certificate(s) with the ones in the imported configuration file. NOTE: When importing a device certificate in to a FIPS device, note that you must choose a certificate that uses a FIPS-compliant private key. To ensure FIPS-compliance, select a certificate and corresponding security world private keys were generated on a FIPS device.
Other Import Options	
Import everything (except Device Certificate(s))	Import all settings except the device certificate.
Import everything but the IP address	Do not overwrite the existing configuration for network interface IP addresses, netmask, default gateway, virtual interfaces, ARP tables, and route tables. Use this option only if the exported configuration file is from a standalone node. TIP: To set up multiple nodes in a cluster behind a load balancer, import everything except the IP address.

Settings	Guidelines
Import everything except network settings and licenses	Do not allow the imported configuration to change the existing configuration for settings found in the Network Settings and Licensing sections. With this option, network configurations, licenses, cluster configurations, certificates, defined SNMP settings and syslog configurations are not imported. Always use this option if configuration file was exported from a node that is part of a cluster. TIP: To set up a backup node, import everything except network settings and digital certificates.
Import only Device Certificate(s)	Import the device certificate(s) only.
Config file	Use the browse button to locate and select the file from your local host.
Password	Specify the password (if applicable).
Import Config	Import the configuration file.

Importing/Exporting Binary User Configuration Files

PPS allows you to import/export the system and network settings using binary configuration files. In general, if a menu item falls under the Authentication, Administration, or Users menu, the item is included in the user configuration file (user.cfg). The exception is Sensors event policies, which are under System, but which are exported in the user configuration file. The user configuration file includes the following settings:

- Sign-in settings (includes sign-in policies, sign-in pages, all authentication servers, authentication protocol sets, Pulse Client settings)
- Authentication realms (including admin realms, user realms, and MAC authentication realms)
- Roles
- Network access.
- Infranet Enforcers.
- Host Enforcer.
- Resource policies
- Sensor event policies
- User accounts
- Client-side logs. To export or import client-side logs, export or import both the system and user configuration files.

To export a binary user configuration file:

1. Select **Maintenance > Import/Export > Import/Export Users** to display the configuration page.
2. Complete the configuration and export/import operation as described below.

Figure523: Binary Export/Import User Configuration File Configuration Page

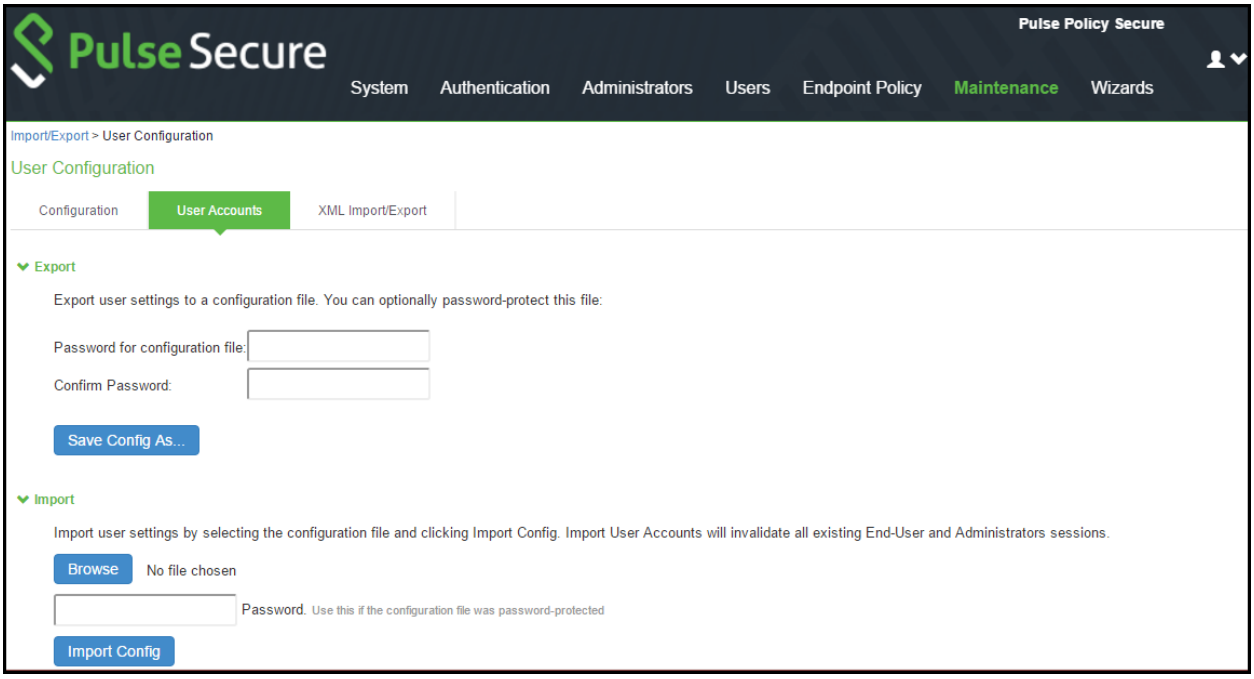


Table105: Binary Export User Configuration File Configuration and Action Guidelines

Settings	Guidelines
Export	
Password for configuration file	(Optional) Specify a password to encrypt and secure the configuration file.
Confirm password	Specify the password.
Save Config As	Display a dialog box to save the file to your local host.
Import	
Browse	Locate and select the file from your local host.
Password	Specify the password (if applicable).
Import Config	Import the configuration file.

Importing/Exporting XML Configuration Files

The Admin can save the system and user configuration in XML format. This enables the system to replicate the configurations.

This will help in the following use cases:

- Adding to the configurations of peer nodes, for example, adding many users.
- Modifying multiple instances of a single setting, for example, an authentication server name.
- Deleting settings, for example, deleting authentication servers that are no longer used.
- Creating a configuration template to use for setting up new nodes.

- Tracking configuration changes by comparing differences on periodic exports.

Guidelines and Limitations

The below table summarizes the guidelines and limitations for using the XML import/export feature.

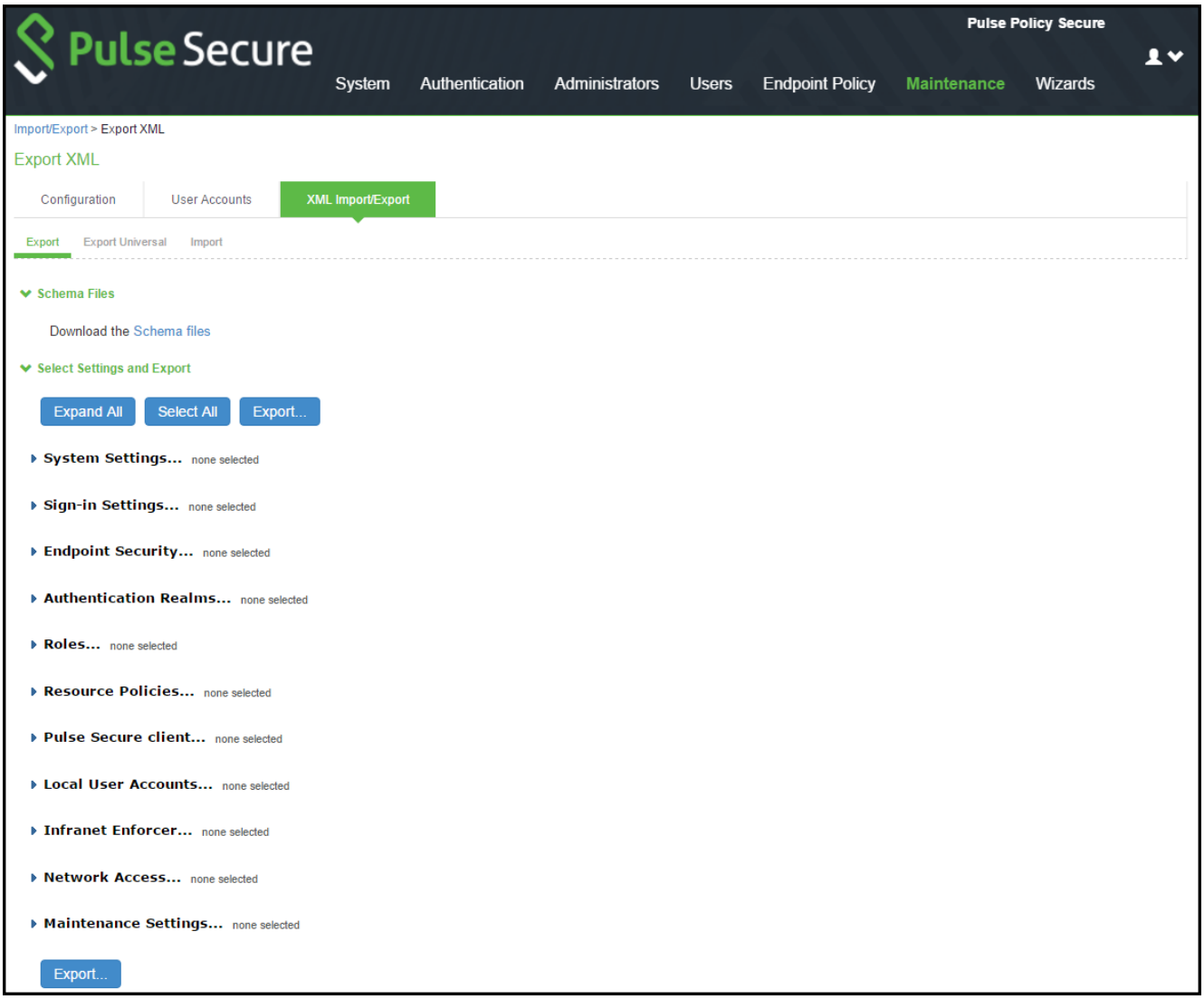
Table106: XML Import/Export Guidelines and Limitations

Category	Guidelines and Limitations
General	The following guidelines and limitations apply: • You can import and export configuration files only between systems running the same software version. • You might find it useful to use a text editor to modify configuration elements that ought to be distinguished, such as configuration object names and descriptions. Never modify the names of the NIC identifiers. The system relies on knowing that each appliance has two interface cards, known as NIC0 and NIC1. • Immediately after importing an Active Directory authentication server configuration, you must edit the configuration to change the Computer Object name. Unexpected problems might arise if two systems join an Active Directory domain using the same Computer Object name.
Licenses	The following rules apply to exported and imported licenses: • You cannot edit the license data that is exported. It is encrypted. • An XML import of licenses is valid only if the system does not currently have a license installed. If a license is installed already, any imported licenses are dropped. If you still intend to import a license, you must perform a factory reset before you perform the import operation. • If you import a license after deleting a temporary license, the imported license is dropped because you might still be able to reactivate the deleted license. The import operation preserves any licensing data.
Clusters	The following guidelines apply to importing a configuration file for nodes that belong to a cluster: • When you perform an import operation on a cluster, all the cluster nodes must be enabled and running. If you attempt to import a configuration into a cluster in which a node is not running, the import operation might hang or your import results might be unpredictable. • The XML configuration that you import must contain the same set of nodes as the original cluster. The signature used to synchronize the cluster when the nodes are reenabled is derived from the IP addresses of the cluster nodes. Therefore, the remaining nodes cannot rejoin the cluster if the imported configuration yields a different signature. • When import occurs, the imported configuration file overwrites the node-specific cluster configuration network settings of the remaining nodes. If you change the node-specific network settings, make sure you do not make the remaining nodes unreachable. • After you have exported the file, do not modify settings that could render the primary node unreachable, such as changes to network settings. • After you have exported the file, do not modify the XML to change the node name, IP address, or IP netmask. • After you have exported the file, do not modify virtual port settings or add new virtual port settings.

To export/import an XML configuration file:

1. Select **Maintenance > Import/Export > Export/Import XML** to display the configuration page.
2. Complete the configuration and export/import operation as described below.

Figure524: Export/Import XML File Configuration Page



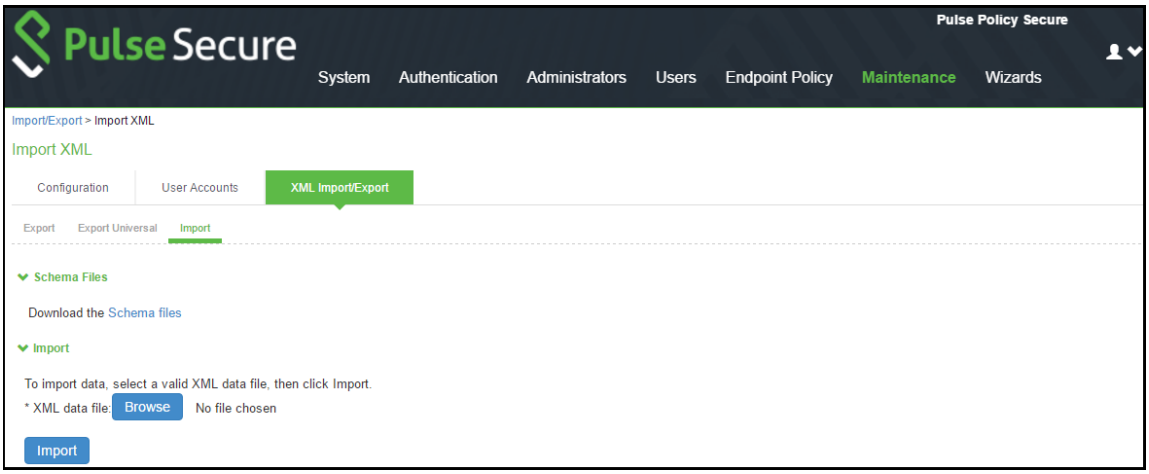


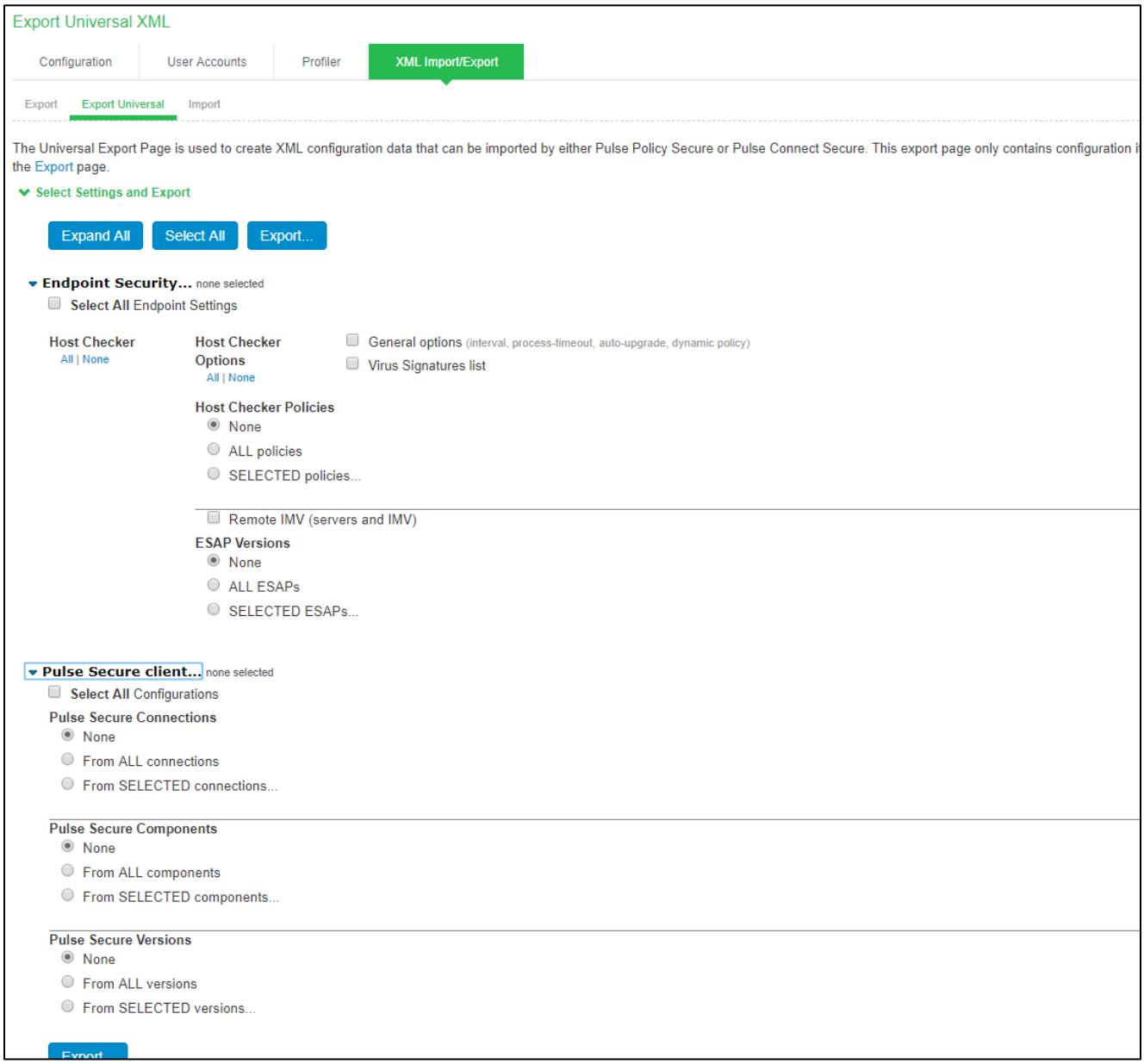
Table107: Export/Import XML File Configuration and Action Guidelines

Settings	Guidelines
Export	
Schema Files	
Schema files	Download the XML schema definition (.xsd) files that describe the XML.
Select Settings and Export	
Expand All	Expand the display of all settings groups.
Select All	Select all settings for all groups.
Export	Export the selected configuration data to an XML file.
Settings	
System	Expand this group and select settings found under the System menu. NOTE: Do not select the DMI Agent unless Technical Support instructs you to do so.
Sign-in	Expand this group and select settings found under the Sign-in menu.
Endpoint Security	Expand this group and select settings found under the Endpoint Security menu. NOTE: ESAP packages are encrypted when exported.
Authentication Realms	Expand this group and select authentication realm settings, including user realms and MAC address authentication realms.
Roles	Expand this group and select settings found under the Roles menu.
Resource Policies	Expand this group and select settings resource policies settings.
Pulse Secure	Expand this group and select settings found under the Pulse Secure menu.
Local User Accounts	Expand this group and select local authentication server settings.
Infranet Enforcer	Expand this group and select settings found under the Infranet Enforcer menu.
Network Access	Policy Secure only.
Maintenance	Expand this group and select settings found under the Maintenance menu.
Export Settings?	

Settings	Guidelines
Export	Export the selected configuration data to an XML file.
Import	
Schema Files	
Schema files	Download the XML schema definition (.xsd) files that describe the XML.
Import	
XML data file	Locate and select the XML file.
Import	Import the file. The Import XML Results page is displayed. This page contains information about the imported network settings, roles, resource policies, and other settings. If there are errors in the XML, the import operation stops and rolls back the configuration to the previous state. Error messages are displayed on the Import XML Results page.

Exporting Universal XML

The Universal Export Page is used to create XML configuration data that can be imported by either PPS or PCS. This export page only contains configuration items that can be imported by either appliance type. To export the entire configuration including appliance specific configuration data use the Export page.



Modifying Configuration XML Files

This topic provides guidelines for modifying an exported configuration file. It includes the following information:

- Understanding the XML Export File
- Comparing Configuration Settings and Values Shown in the User Interface with the Ones in the XML File
- Understanding Referential Integrity Constraints
- Using Operation Attributes

Understanding the XML Export File

When you export a configuration file, the system saves the configuration as an XML file. The data in the exported file is based on the selections you make when you configure the export operation. The file contains all the required XML processing instructions and namespace declarations, which must be included exactly as defined.

The below table provides some basic information and guidelines to help you understand the structured XML used in the export file.

Table108: Structured XML Files: Basic Information and Guidelines

Topic	Guideline
XML schema definition (.xsd) file	The export is based on an XML schema. The schema is a separate file that defines the metadata, and that serves as a model or a template for the exported file. Use the XML schema file to: • Identify the structure and sequence of configuration objects. • Identify optional and required elements, allowable values, default values, and other attributes of the configuration objects. You can download the XML schema definition (.xsd) file in either of the following ways: • From the XML Import/Export pages by clicking a link. • From the URL where the files are stored on the system (you do not need to sign in). To access the .xsd file, access the following URL: https://<*IP-or-hostname*>/dana-na/xml/config.xsd
Elements	An element is a discrete XML unit that defines an object or part of an object. The element typically consists of a pair of tags that may or may not surround string data. Tags are surrounded by angle brackets (< >).
Namespaces	Namespaces allow you to use the same words or labels in your code from different contexts or XML vocabularies. Prefixing elements with namespace qualifiers allows the XML file to include references to different objects that originate in different XML vocabularies and that share the same name. If you do not prefix elements with namespace qualifiers, the namespace is the default XML namespace, and you refer to element type names in that namespace without a prefix. When you see namespace identifiers in your XML files, you do not need to be concerned about them, as long as you do not delete or modify the identifiers.
Element Sequence	You should avoid changing the sequence of elements in the XML file, whenever possible. Although the schema does not enforce sequence in all cases, you gain no benefit from changing the order of elements from the order in which they appear in the exported file, and, in some cases, you might invalidate the XML structure by changing element sequence.

Every XML tag fits into one of the following XML tag types:

- Start tag—Defines the beginning of an element. The start tag consists of an open angle bracket (<), a name, zero or more attributes, and a close angle bracket (>). Every start tag must be followed by an end tag at some point in the document.
- End tag—Defines the end of an element. The end tag consists of an open angle bracket and a forward slash (</), followed by the same name defined in its corresponding start tag, and ends with a close angle bracket (>).
- Empty tag—The empty tag is denoted in two forms. If a tag pair has no data between them, the tag pair is considered an empty tag. Officially, according to the XML specification, an empty tag looks something like this:

  <<empty tag example/>>

  In this form, the empty tag consists of an open angle bracket (<), followed by an element name, a slash and a close angle bracket (/>). When you see an empty tag in your configuration files, it signifies an element that the schema requires to be included in the XML file, but whose data is optional.

Start tags can contain attributes, and tag pairs (elements) can contain additional elements. The following example shows an XML file for the Users object. In this example, you see only the Administrator configuration settings.

```
<configuration xmlns="http://xml.sample.net/x"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
    <authentication>
     <auth-servers>
      <auth-server>
       <local>
        <users>
         <user>
        <username>admin</username>
        <fullname>Platform Administrator</fullname>
        <password-encrypted>3u+U</password-encrypted>
        <one-time-use>false</one-time-use>
        <enabled>true</enabled>
        <change-password-at-signin>false</change-password-at-signin>
         </user>
        </users>
       </local>
         <name>Administrators</name>
      </auth-server>
```

You make changes to the string data that is displayed between start and end tags. For example, using the preceding example, you can add to or change the following elements:

- <username>**admin**</username>
- <fullname>**Platform Administrator**</fullname>
- <password-cleartext>**password**</password-cleartext>
- <change-password-at-signin>**false**</change-password-at-signin>
- <name>**Administrators**</name>

NOTE: The preceding sample displays the password element's data as encrypted data. You can modify the password if you change the element to password-clear text. If you modify the password, the password value is visible until it is imported back into the system. Once imported, the system encrypts the password.

If you enter passwords for new users in clear text format, the passwords are visible in the file, therefore, you might consider setting the Change Password at Next Login option to true.

NOTE:

- Use the password-clear text element and enter a text password when changing passwords through the XML file.

If you change a user for a given authentication server or an authentication server for a given user, you are creating a different user, not updating an existing user or authentication server. User and authentication server together logically define a unique user.

Comparing Configuration Settings

The elements in the XML file are closely related to the objects and their options as you see them in the admin console. The element names in the XML instance file correlate closely with the displayed object and option names.

For example, select **Users > User Roles > [Role] > General > Session Options**. The admin console renders the possible values for a roaming session as an option button group, consisting of the values:

- **Enabled**
- **Limit to subnet**
- **Disabled**

The following snippet from the exported configuration file shows the session options for the Users role. On the bolded line, the roaming session option is disabled:

```
<session-options><SessionOptions>
  <MaxTimeout>60</MaxTimeout>
  <RoamingNetmask />
  <Roaming>disabled</Roaming>
  <PersistentSession>false</PersistentSession>
</SessionOptions>
```

In the schema file, you can locate the allowable values for the roaming session option:

```
<Attribute roaming:START>
<xsd:element name="roaming" minOccurs="0">
...
   <xsd:enumeration value="enabled">
  ...
   <xsd:enumeration value="limit-to-subnet">
  ...
   <xsd:enumeration value="disabled">
...
</xsd:element>
<Attribute roaming:END>
```

To change the value for the roaming session from **Disabled** to **Limit to subnet**, replace **disabled** with **limit-to-subnet**.

This example shows that the admin console often provides all the allowable values, displayed either in an option button group, as check boxes, as list boxes, or as other types of user interface components. The XML file displays only the current state of your configuration. The schema file displays all the actual values for the configuration options that are supported.

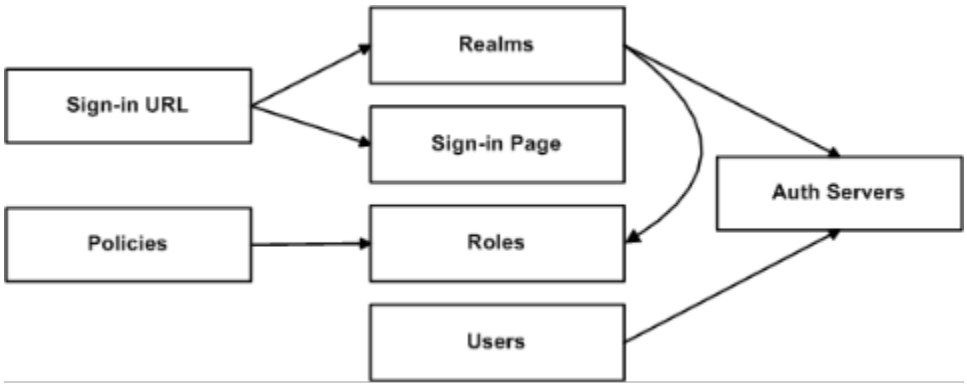
Understanding Referential Integrity Constraints

The system configuration objects are part of a data model that is enforced using referential integrity constraints. You cannot change these constraints, but you should understand them before you attempt to delete objects that maintain dependencies to other objects.

If you violate the referential integrity constraints, your import operation fails.

In the below figure the boxes represent object types and the arrows represent dependent relationships between the object types. Arrows point from dependent objects to objects.

Figure525: Object Referential Integrity Constraints



The system does not allow you to delete an object on which another object depends. Conversely, when you add an object, you must add any other objects on which that object depends.

Sign-in URLs depend upon realms and sign-in pages. Realms depend upon both authentication servers and roles. Policies depend upon roles. Users depend upon authentication servers.

Consider the following scenarios based on the preceding figure:

- If you add sign-in URLs, you must add realms, sign-in pages, roles, and authentication servers. You need to add an authentication server and at least one role to support the realm, and you must add the realm and the sign-in page to support the new sign-in URL.
- If you add a user, you must be able to assign it to an authentication server. If there is no authentication server on the target node yet, you must add one in the XML file.
- If you add a policy, you must be able to assign it to a role. If there is no role on the target system, you must add one in the XML file.
- If you delete an authentication server, you might strand realms and users, therefore, you need to make sure no realms or users depend on the authentication server before you attempt to delete it.
- If you delete a role, you might strand policies and realms. To delete a role, you must first delete any policy that depends upon the role, or reassign associated policies to another role. Also, to delete a role, you must first delete or reassign any realm that depends upon that role.
- If you delete a sign-in page, you might strand one or more sign-in URLs. To delete a sign-in page, you must first delete any associated sign-in URLs or reassign them to other sign-in pages.

Referential integrity checks are performed only during XML import.

Using Operation Attributes

Operation attributes define the positioning or action of XML data within the schema. If you do not specify an operation attribute, the modified data is merged by default.

XML data with an operation attribute has the following format:

```
<object1 xc:operation="operator for object1 and its children unless new operator is defined">
  ….
  <object2>
  …
    <object3 xc:operation="operator for object3">
    …
    </object3>
  …
```

```
    </object2>
    …
</object1>
```

The operation attribute is applied to all children objects unless a different operation attribute is defined in children objects.

The following operation attributes are supported:

- Merge—The configuration data identified by the element that contains this attribute is merged with the configuration at the corresponding level in the configuration datastore identified by the target parameter. This is the default behavior.
- Replace—The configuration data identified by the element that contains this attribute replaces any related configuration in the configuration datastore identified by the target parameter. Only the configuration present in the configuration parameter is affected.
- Create—The configuration data identified by the element that contains this attribute is added to the configuration if and only if the configuration data does not already exist on the device.
- Delete—The configuration data identified by the element that contains this attribute is deleted in the configuration datastore identified by the target parameter.
- Insert before—Changes the position of a configuration element in an ordered set.
- Insert after—Changes the position of a configuration element in an ordered set.
- Rename—Changes the name of one or more of a configuration object's identifiers.

If you are merging a list of objects to an existing list of objects in the configuration store, the results of the merged list might be unexpected. During a merge operation, the order of the objects in the new list is not maintained. If you are importing a list of objects and would like to preserve the order of the new list, you should use the replace operation attribute. You can also use insert before or insert after to ensure that you produce the hierarchy that you intended.

Operation attributes are applied to elements recursively unless new operators are also defined within lower-level elements. There are limitations on the legal operator that can be used in child elements without conflict with the parent operator. The table below shows the legal operator relationships between parent and child elements.

Table109: Legal Operator Attribute Relationships

Child > V-Parent	Create	Merge	Replace	Delete	Insert before	Insert after	Rename
None	OK	OK	OK	OK	OK	OK	OK
Create	OK	OK	Error	Error	OK	OK	Error
Merge	OK	OK	OK	OK	OK	OK	OK
Replace	Error	OK	OK	Error	OK	OK	Error
Delete	Error	OK	Error	OK	Error	Error	Error
Insert Before	OK	OK	OK	OK	OK	OK	OK
Insert After	OK	OK	OK	OK	OK	OK	OK
Rename	OK	OK	OK	OK	OK	OK	OK

The following examples demonstrate the import operation:

Example 1: Set the MTU to 1500 on an interface named "Ethernet0/0" in the running configuration.

```
<interface>
      <name>Ethernet0/0</name>
      <mtu>1500</mtu>
</interface>
```

Example 2: Add an interface named “Ethernet0/0” to the running configuration, replacing any previous interface with that name.

```
<interface xc:operation="replace">
  <name>Ethernet0/0</name>
  <mtu>1500</mtu>
  <address>
   <name>192.0.2.4</name>
   <prefix-length>24</prefix-length>
   </address>
</interface>
```

NOTE:

The default import modes have the following equivalent attributes on the root object of the configuration tree:

- Standard Import is always a merge operation.
- Quick Import is a create operation.
- Full Import is a replace operation.

Example: Importing/Exporting XML file configuration to add Multiple Users

This example shows how to use the configuration XML file import/export feature. The example is illustrative. There are additional ways to use export files.

Assume you have just added a new device to the network, and you want to add your 2,000 users to the system. Instead of adding them one at a time in the admin console, you want to perform a mass import You can export the user accounts, extract the relevant XML that defines users, replicate each element as needed, and then import them. In this situation, your configuration should include the option to force the users to change their passwords the first time they log in to the system.

In this procedure, you only see examples for User 1, User 2, and User 2000. All other users are included in your import file. You set the passwords to numbered instances of the word password, such as password1, password2, and so on. All users in this example are assigned to the same auth server, although you can specify any combination of auth servers that are valid on your system.

To add multiple new users:

1. Select **Maintenance > Import/Export > Export XML**.
2. Follow the instructions to export local user accounts.
3. Save the exported file as users.xml.
4. Open the users.xml file.
5. Copy and paste the User container element repeatedly until you have added the necessary number of users. Although the example shows only three new users, you might add hundreds of new users to the file.
6. Update the appropriate data in each User container element as shown in “Example: Updating the User container”.
7. Save the users.xml file.
8. Select **Maintenance > Import/Export > XML Import/Export > Import**.
9. Click **Browse** to locate and select your users.xml file.

10. Click **Import**.

Example: Updating the User container

```
<configuration xmlns="http://xml.sample.net/x/x"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance">
 <authentication>
  <auth-servers>
   <auth-server>
    <local>
     <users>
        <user>
       <username>user1</username>
       <fullname>User1</fullname>
       <password-cleartext>password1

       </password-cleartext>
       <one-time-use>false</one-time-use>
       <enabled>true</enabled>
       <change-password-at-signin>true

       </change-password-at-signin>
      </user>
        <user>
       <username>user2</username>
      <fullname>User2</fullname>
      <password-cleartext>password2

      </password-cleartext>
      <one-time-use>false</one-time-use>
      <enabled>true</enabled>
      <change-password-at-signin>true

      </change-password-at-signin>
     </user>
     <name>System Local</name>
   </auth-server>
  </auth-servers>
 </authentication>
</configuration>
```

Pushing the Configuration

The push configuration feature supports simple configuration management across an enterprise without requiring you to deploy the systems as a cluster. You push a partial configuration from the running configuration on the source system to the running configuration on one or more target systems.

It is not desirable to push some groups of settings to a running configuration, so the following groups of settings are not supported:

- Network configurations
- Licenses
- Cluster configurations
- Certificates
- SNMP settings

- Syslog server settings
- Push configuration targets

Guidelines and Limitations

The below table summarizes the guidelines and limitations for using the push configuration feature.

Table110: Push Configuration Guidelines and Limitations

Category	Guidelines and Limitations
General	The following guidelines and limitations apply: • You can push a configuration to systems running the same software version (same build number) or higher software version. • The source device pushes data over the management port (if configured) or the internal port. The target device can receive data over the internal or external port or management port. • You can push to a single target or to multiple targets. For example, if you install several new systems, you can push a common configuration to set their initial configuration. • When a configuration push job begins on a target, no warning is displayed, and the administrators are automatically logged out to avoid potential conflicts. • For selected configuration push, if the configuration to be pushed contains one or more JAM packages, we recommend you to push the JAM packages first considering one JAM package per push and then push the remaining configurations. • When the job has completed on a target, the target device restarts its services. Brief interrupts might occur while the service restarts. You must push to targets when they are idle or when you can accommodate brief interruptions. • You must delete the failed push jobs before performing a new push. • For entire configuration push, when pushing settings such as FIPS settings, security settings on a target even though the job has completed on a target, you might see a connection lost message on the source. You can resume the actual job to see the status and even though the source says connection lost the import will be successful.
Licenses	The push configuration job does not push licenses or licensing settings.
Clusters	• You can push a configuration to target that is a member of a cluster, if the target is not a member of the same cluster as the source. • You can push a configuration to multiple targets, if targets are not part of the same cluster. • You must not perform the clustering operations such as adding a cluster, deleting a cluster, and so on when performing a push configuration. If such events occur, then unsuccessful jobs will be aborted and the backup files will be deleted. • You must not use VIPs during push configuration. Instead you must use the internal IP or the management IP of one of the nodes to create the target. • You must delete the backed-up configuration on the target node(s) as soon as possible to free up the disk space.

Configuring Targets

To configure push configuration targets:

1. Select **Maintenance > Push Config > Targets** to display the target list and source options configuration page.
2. Complete the configuration for the source options as described below.
3. Click **New Target** to display the configuration page for targets.
4. Complete the configuration as described below.
5. Save the configuration.

Figure526: Push Configuration Target List and Source Device Settings Page

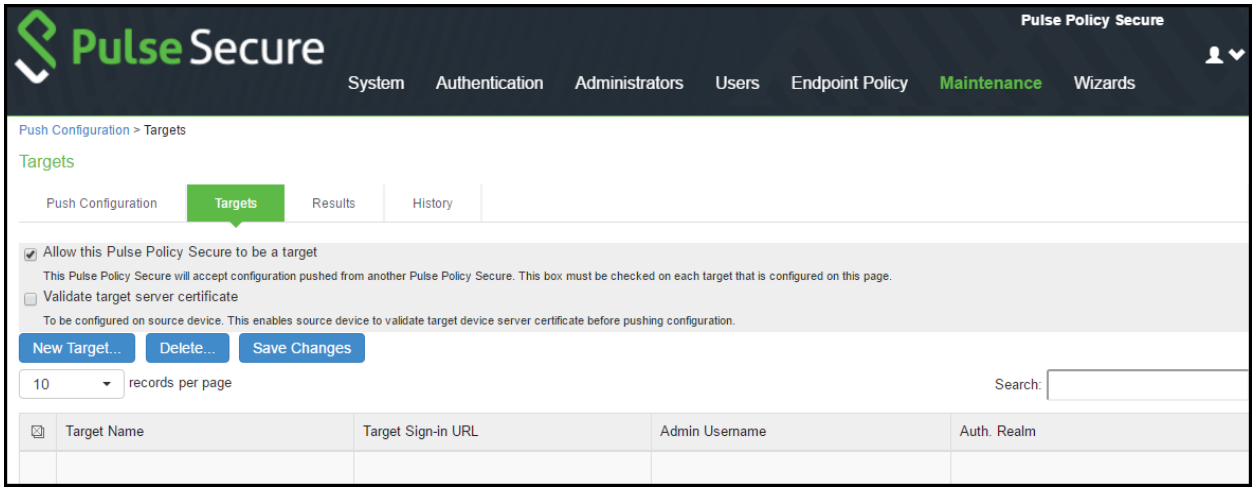


Table111: Push Configuration Target Source Device Configuration Options

Settings	Guidelines
Allow this system to be a target	Select this option to allow the system to accept configuration pushed from another system. This option must be selected on targets, but does not have to be selected on the source system.
Validate target server certificate	Select this option on the source system if you want the source system to validate the target system server certificate before pushing the configuration.
Save Changes	Click this button if you have changed the source device configuration options described above.
Delete	Select a row in the table and click **Delete** to remove the target from the list. You cannot delete a target if it has push configuration results associated with that target.

Figure527: Push Configuration Targets Configuration Page

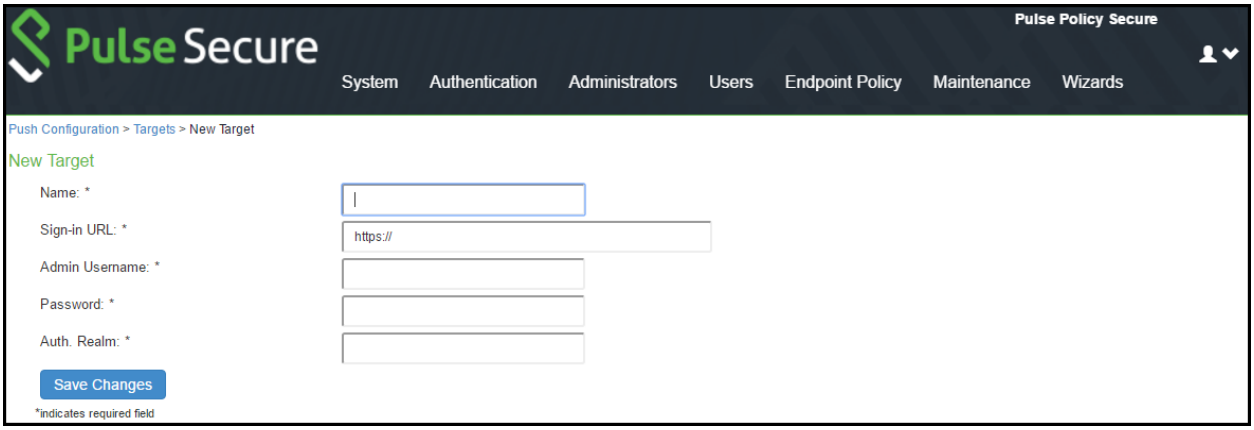


Table112: Push Configuration Targets Configuration Guidelines

Settings	Guidelines
Name	Specify a name to identify the target within the system. Target names and target sign-in URLs cannot be edited after they have been saved.
Sign-in URL	Specify the URL for the administrator sign-in page. Sign-in URLs cannot be edited after they have been saved.
Admin Username	Specify an account on the target system that the push configuration job can use to sign-in and make changes to the configuration. The job can make wide-ranging configuration changes, so the user must have full administrative privileges. In other words, the user must belong to the. Administrators role.
Password	Specify the corresponding password.
Auth. Realm	Specify the administrator authentication realm on the target system. The access management framework must be configured so that the job process (run as the username specified above) can sign in without any human interaction. For example, you cannot have dynamic credentials or multiple roles that are not merged, as these both require manual interaction. We recommend that you create an administrator account on each target that can be used exclusively for push configuration. Configure the administrator realm so that the realm policy and role mapping rules do not result in prompts requiring human interaction. For example, the user must be able to log in with static password authentication or two-factor tokens that do not use challenge-response type authentication. For example, certificates, Soft ID, and Defender Authentication are not supported.

Configuring Push Settings

To configure the settings to be pushed:

1. Select **Maintenance > Push Config > Push Configuration** to display the configuration page.

Complete the configuration and push configuration operation as described below.

Figure528: Push Configuration Selected Settings Page

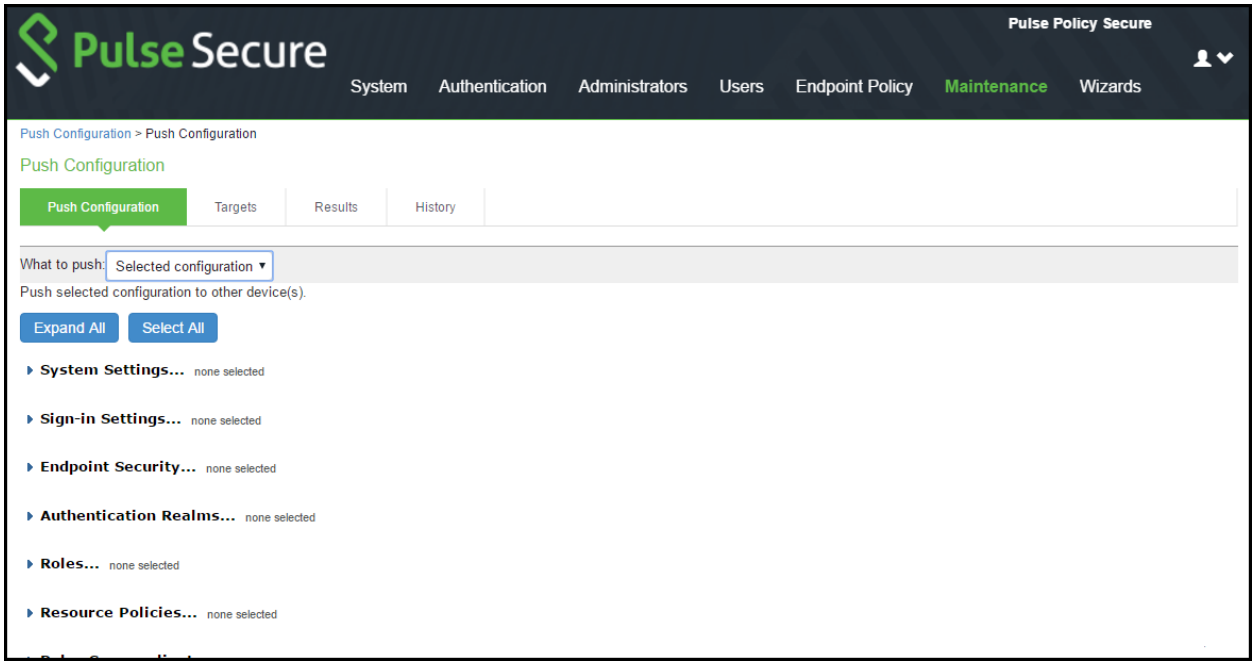


Table113: Push Configuration Selected Settings and Action Guidelines

Settings	Guidelines
Select Settings and Export	
What to push	Select **Selected configuration** or **Entire configuration**. If you select **Selected configuration**, the page displays controls to select settings groups. If you select **Entire configuration**, all settings from the source system are pushed, except for the following: • Network configurations • Licenses • Cluster configurations • Certificates • SNMP settings • Syslog server settings • Push configuration targets
Expand All	Click this button to expand the display of all settings groups.
Select All	Click this button to select all settings for all groups.
Settings	
System	Expand this group and select settings found under the System menu. NOTE: You cannot push host-specific network settings to a target. If you want to copy these settings to another system, use the configuration XML file import/export feature.
Sign-in	Expand this group and select settings found under the Sign-in menu.
Endpoint Security	Expand this group and select settings found under the Endpoint Security menu. NOTE: ESAP packages are encrypted when exported.
Authentication Realms	Expand this group and select authentication realm settings, including user realms and MAC address authentication realms.
Roles	Expand this group and select settings found under the Roles menu.
Resource Policies	Expand this group and select settings resource policies settings.
Pulse Secure	Expand this group and select settings found under the Pulse Secure menu.
Local User Accounts	Expand this group and select local authentication server settings.
Infranet Enforcer	Policy Secure only. Expand this group and select settings found under the Infranet Enforcer menu.
Network Access	Policy Secure only. Expand this group and select settings found under the Network Access menu.
Maintenance	Expand this group and select settings found under the Maintenance menu.
Push Configuration	
Available Targets / Selected Targets	Use the **Add** and **Remove** buttons to select the targets.
Overwrite duplicate settings	Select this option to overwrite settings on the target that have the same name as settings being pushed. If you do not select this option, the push configuration job copies only configuration objects that have names different from the configuration objects on the target.

Settings	Guidelines
Allow Rollback to previous configuration	Select this option to revert to a previous configuration state, effectively rolling back configuration changes. If you select this option, the local configurations on the target node will be backed up before importing the configurations. You can also undo the push configuration if you want to discard the changes and revert to the previous state. We recommend you to delete the backed-up configuration if the import is successful. NOTE: If the target configuration is large the rollback of configurations can take several minutes to complete.
Description	Enter the description for the job. The job description is limited to 100 characters.
Schedule Import on Target	Select this option to allow a delayed import on the target node. If you select this option, the selection applies to all the targets in the job. The import schedule is measured in HH:MM (hours, minutes) format. The schedule is specified according to source's time zone.
Push Configuration	Click this button to push the selected configuration data to the specified targets. You can pause the push for a target during the push process. If errors occur during the push process, the job stops, and the configuration for the target is not imported. However, you can resume the failed push jobs. Error messages are displayed on the Results page. If you have specified multiple targets and a push configuration job to a target fails, the job continues to the next target until specified targets are updated (or fail). The results page displays the status and any problems encountered during the process.

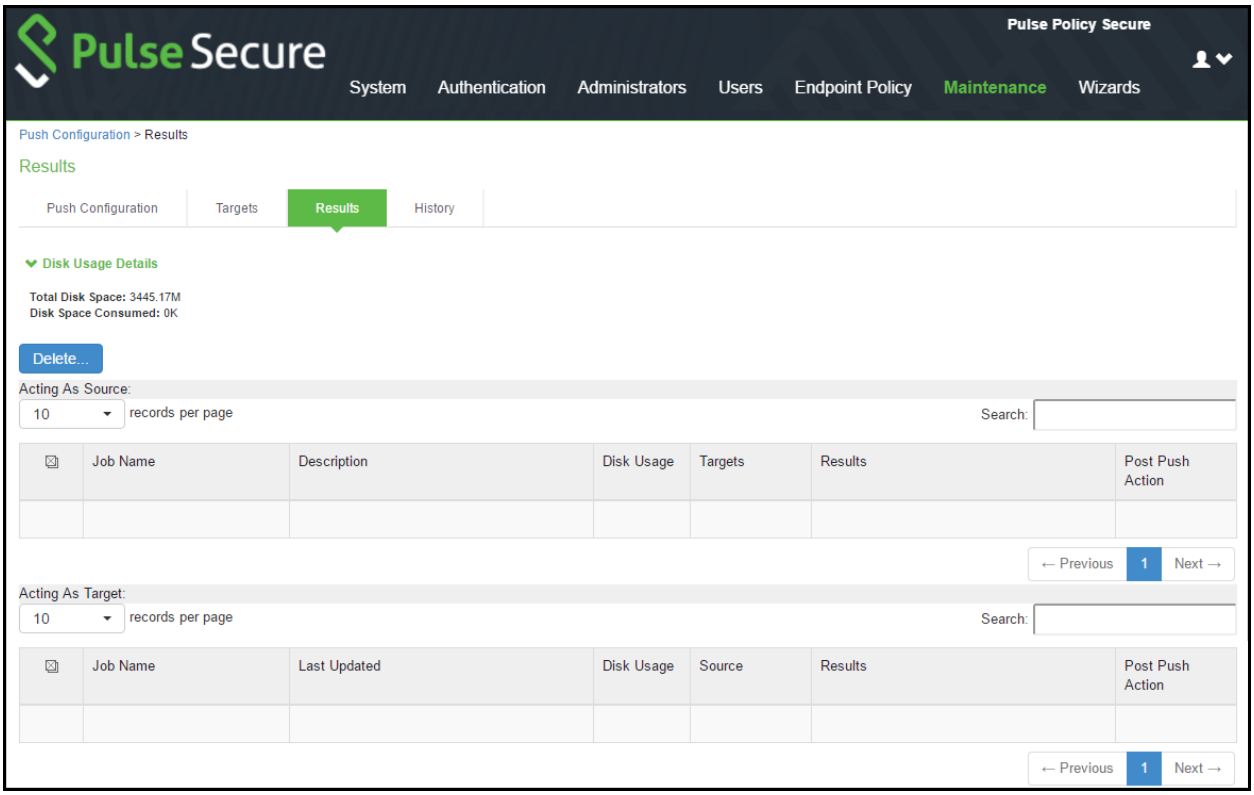
Viewing Configuration Push Results

Purpose The source system saves and displays the push configuration results in the Results tab.

Action To view push configuration job results:

1. Click the Select **Maintenance > Push Config > Results** to display the results page.
2. job name to display additional information about the job.
3. Select a job and click **Delete** to remove it from the results page.

Figure529: Push Configuration Results Page



The below table describes the information displayed on the Results page and the various management tasks you can perform.

Table114: Push Configuration Results

GUI Element	Guidelines
Disk Usage Details	Displays the disk space available for push configuration and the disk space consumed by all the push jobs in the device. The disk space consumed by individual push jobs are also mentioned across each push job under the disk usage column. When total disk space consumed reaches the total disk space push jobs may fail and you can see the results column to see the failure message. You need to monitor the disk space consumed by push configuration to avoid push failures related to disk space limits.
Description Column	Displays the type of the push configuration.

GUI Element	Guidelines
Disk Usage Column	Displays the disk space used by the job.
Results Column	Displays the status of the transfer and result of post push action. It also displays the status of the push such as log in, export, transfer, backup, import and so on. The status result message shows the type of data that is getting transferred. For a paused or failed target the information on the current state of the job when it is paused, or failure reasons if any is displayed. This column also shows the progress of data transfer using a bar chart. For selected push, additional configuration data (additional configuration data refers to configuration that is transferred only if it is modified or not available on the target) includes ESAP package, JAM package, VDI configurations, Terminal services, Host Checker files, Custom sign in pages and notifications, and Applet files. For complete configuration push, additional data includes ESAP and JAM packages.
Post Push Action	Displays the options that the user can perform after the push such as roll back and delete backup. It also displays the post push actions such as rollback done, backup deleted, rollback failed, performing rollback, deleting back up and so on.
Resume	Select this option to resume a paused or a failed push.
Undo	Select this option to rollback to previous configuration that was backed up. Note that you can perform this operation only when the push is successful and Allow Rollback to Previous Configuration is selected. This option is available only if the backup is not deleted or undo is not done yet.
Abort	Select this option to cancel an entire push job or push to target within a job. An aborted push cannot be resumed.
Pause	Select this option to temporarily pause the push operation to a specified target.
Delete Backup	Select this option to delete the backup configuration on the specified target. Note that this option is available only when the users selects the Allow Rollback to Previous Configuration option during the push job.

Viewing Configuration Push History

Purpose

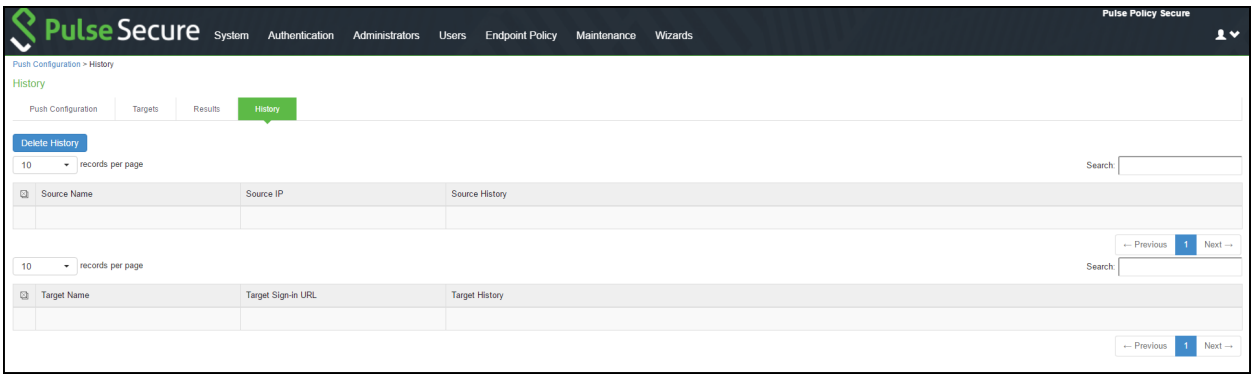
The source/target system saves and displays up to 5 push history results per target/source in the History tab. When the history table reaches 5 entries, the system removes the oldest result data when the next push configuration job is started.

Action

To view push configuration push history:

1. Select **Maintenance > Push Config > History** to display the history page.
2. Examine the history to verify success or learn the reasons the push job failed. The history page displays rollback history however the failure reason is not displayed. You can check the failure reason in the details page for each job. It also displays the timestamp history information of successful, failed push jobs, or if a configuration is undone.
3. Select the source name and click **Delete History** to remove it from the History page.

Figure530: Push Configuration History Page



Dashboard and Reports

Dashboard and Report Overview

A dashboard is an interface used to manage the Pulse Secure access management framework. It provides an integrated view of all devices and users accessing the network, their device profile information, authentication methods used to gain access, device posture compliance and so on.

A report is an element of a dashboard used to convey complex data in simplified formats. Pulse Secure access management framework collects log and configuration data from across your network, and it then aggregates the data into reports for you to view and analyze. It provides a standard set of predefined reports that you can use and customize to fit your needs. The reports are grouped into logical categories for information related to authentication, session traffic, device administration, configuration and administration, and troubleshooting.

You can use the system dashboard and reports to analyze system utilization.

Enabling the Dashboard

You can use the admin console to enable or disable the dashboard.

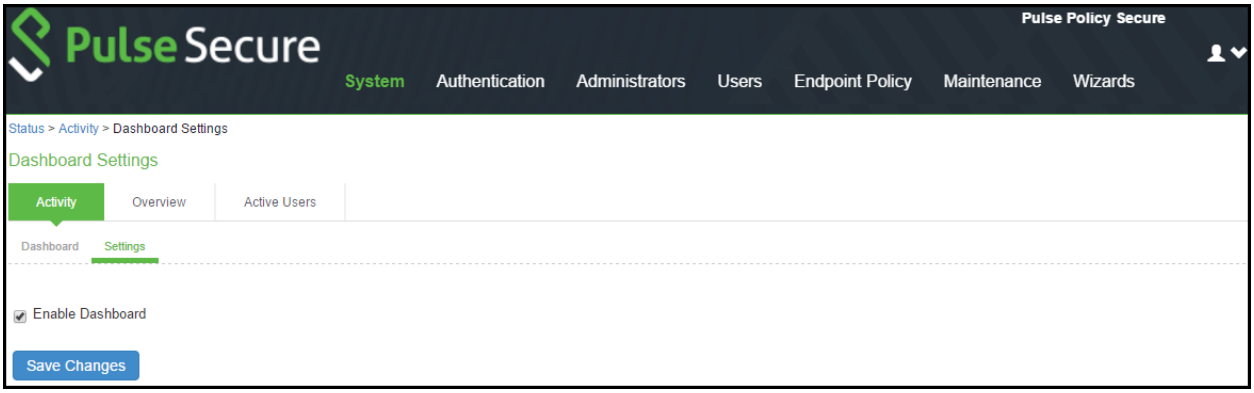
To enable the dashboard.

1. Select System > Status > Activity > Settings.
2. Select Enable **Dashboard**.

NOTE: The dashboard is enabled by default.

The below figure shows the Dashboard Settings for PPS.

Figure531: Dashboard Settings – PPS



Using the Dashboard

This topic describes the dashboard. It includes the following information:

- Dashboard Overview
- Displaying the Dashboard
- Selecting a Data Time Frame
- Refreshing Data
- Drilling Down to Detailed Reports

Dashboard Overview

The dashboard contains six default graphic reports focused on security, network activity, application activity, system monitoring, and compliance.

Table115: Dashboard Status Bar

Metric	Description
Policy Secure	
Total Endpoints	The total number of unique endpoints over a time. If an endpoint provides a unique identifier (mobile device ID, client ID, and so on), then it will be used to identify the endpoint. For a browser-based session where an identifier is not available, each session is considered a unique endpoint.
Active Endpoints	The total number of unique endpoints with active sessions.
Active Guests	The total number of active guest users. A guest user is defined as a user with an expiration date. This includes administrator-created and GUAM-created guest users. This does not include GUAM-created users without expiration dates.
Active MAC Auth Users	The total number of active MAC authentication users.

The below table describes the default dashboard charts.

Table116: Dashboard Charts

Dashboard Chart	Description
Authentication Success	The number of successful authentications over the selected time (1, 7, or 30 days). The 7-day chart is a bar graph. The 1-day and 30-day charts are line graphs.
Authentication Failure	The number of failed authentications over the selected time (1, 7, or 30 days). The 7-day chart is a bar graph. The 1-day and 30-day charts are line graphs.
Session OS Count	Pie chart showing the number of the sessions per operating system.
Top Roles	Pie chart showing the number of top user roles assigned during the selected time.
Compliance Results	Pie chart showing Host Checker posture assessment results: Compliant, Not Compliant, Not Assessed, or Remediated. Compliance results are reported for all instances in which Host Checker is run. The posture assessment chart is clubbed with the compliance results chart for PPS. To view the posture assessment chart, select **Posture Assessment** from the dropdown list.

Dashboard Chart	Description
Posture Assessment	Pie chart showing Host Checker policy violations. Policy violations are reported only for instances in which Host Checker is run at initial sign in.
Auth Mechanism	Pie chart showing the number of sessions per authentication mechanism: 802.1x, Layer 3, MAC address. It applies to PPS only.

Dashboard Database

The dashboard monitoring service collects and stores data in a database for 30 days. The total number of records stored in the database can be up to 300,000 records.

The dashboard database is created only after upgrading to PPS version 5.0 or later and enabling the dashboard option. Note that only new sessions are added to the database and changing the Time Frame filter or clicking refresh sends queries to the database. The data is collected only when the dashboard option is enabled.

The below table describes the different actions and their results.

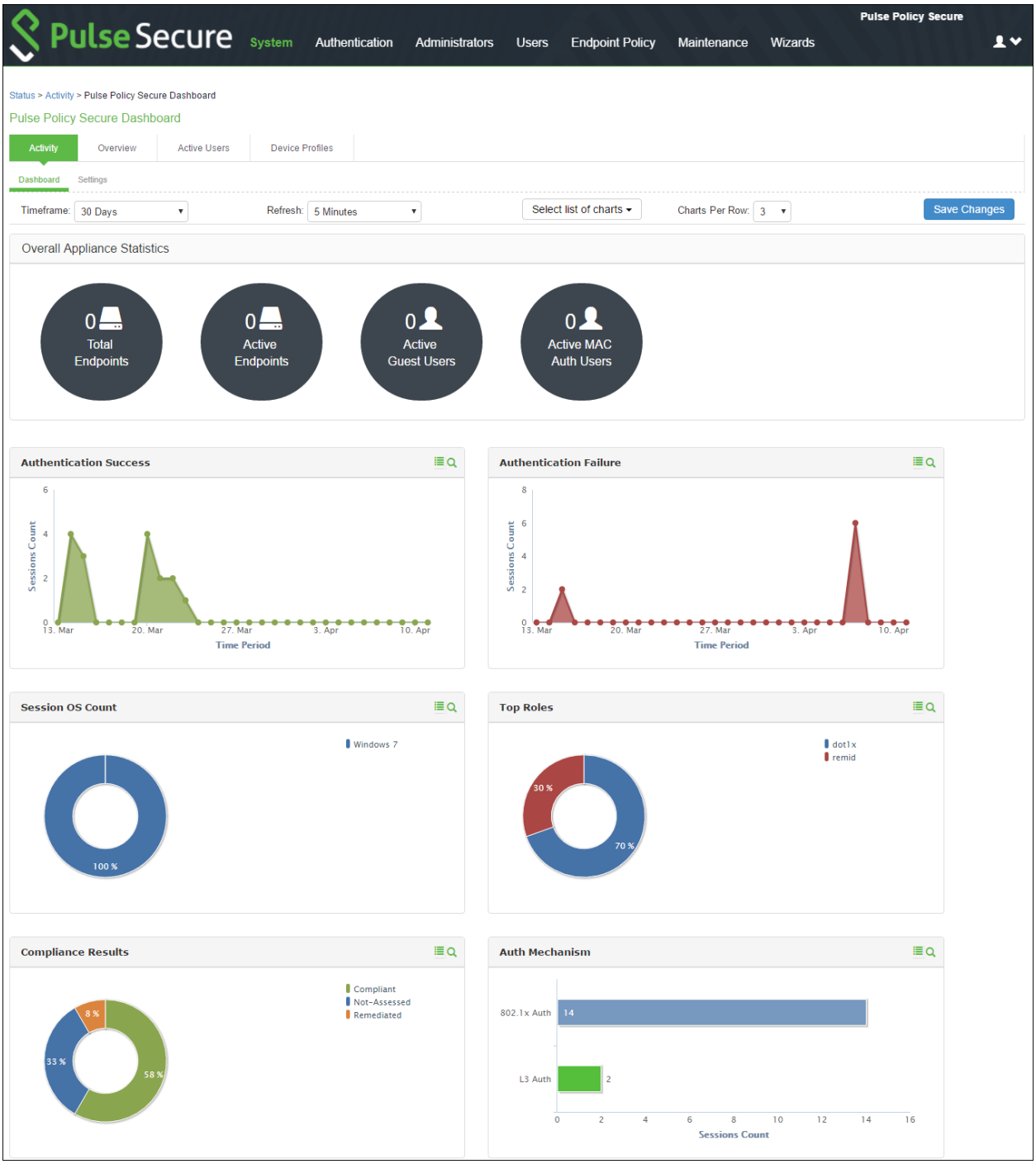
Table117: Dashboard Database

Action	Description
Disable and then reenable the dashboard.	The data collection stops when your dashboard is disabled.
Restore the data from backup, snapshot, or import config.	The data is not exported and the data is retained during upgrades.

Displaying the Dashboard

To display the dashboard, select **System > Status > Activity > Dashboard**.

Figure532: Dashboard



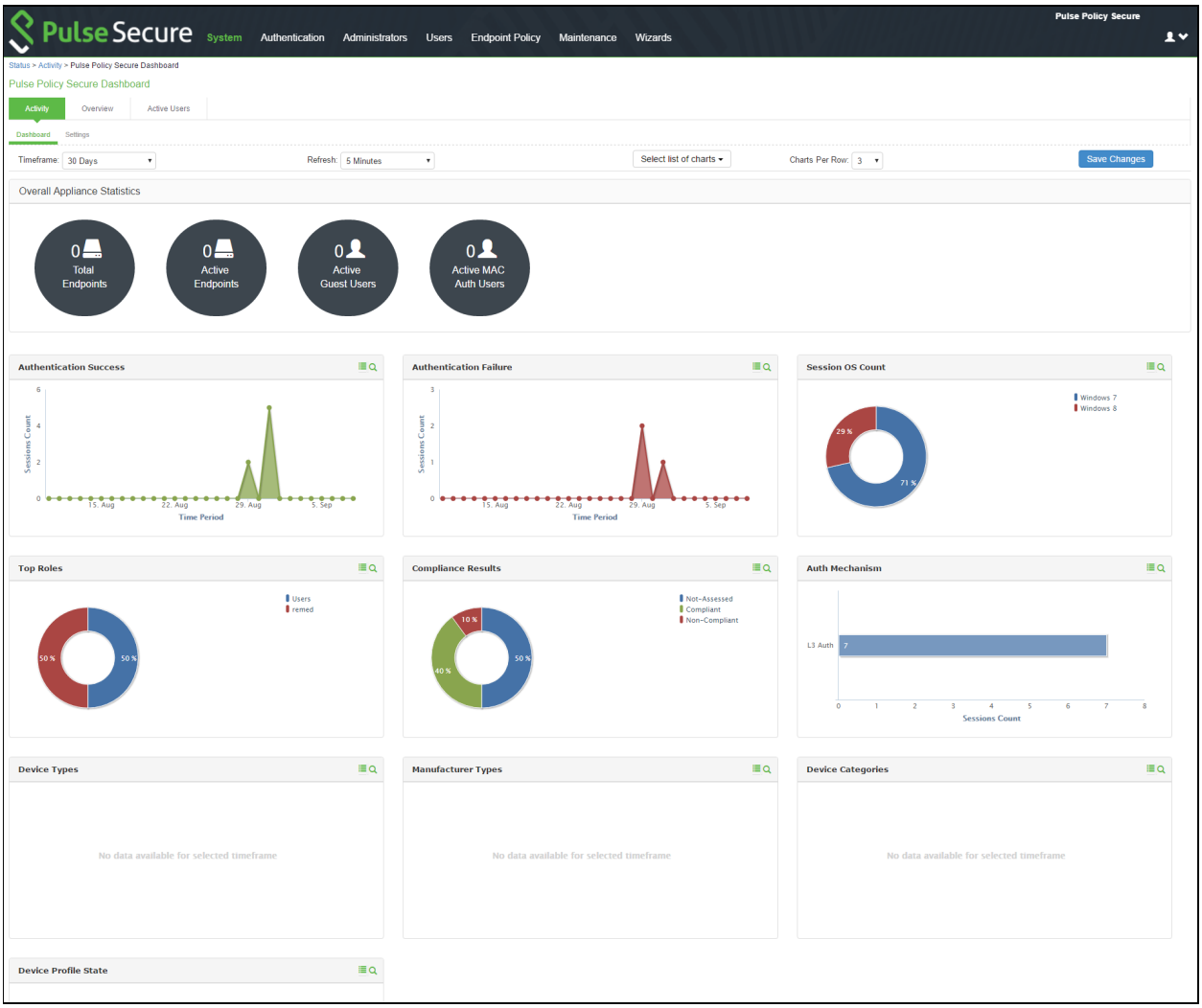
Selecting a Data Time Frame

To select a data timeframe:

1. Select System > Status > Activity > Dashboard.
2. Select one of the following periods from the Time Frame list box:
   - Last 24 Hours– (Default) Refers to the last 24 hours from the current hour.
   - Last 7 Days– Refers to current day and the previous last 6 days.
   - Last 30 Days– Refers to current day and the previous last 29 days.

NOTE: Access records are kept for 30 days. Older records are removed and not included in dashboard charts and reports.

Figure533: Dashboard Showing a 30-Day Time Frame



Refreshing Data

To refresh data:

1. Select **System > Status > Activity > Dashboard**.
2. Select one of the following refresh rates from the Refresh list box:
   - Disabled
   - 5 Minutes
   - 10 Minutes
   - 30 Minutes
   - 60 Minutes

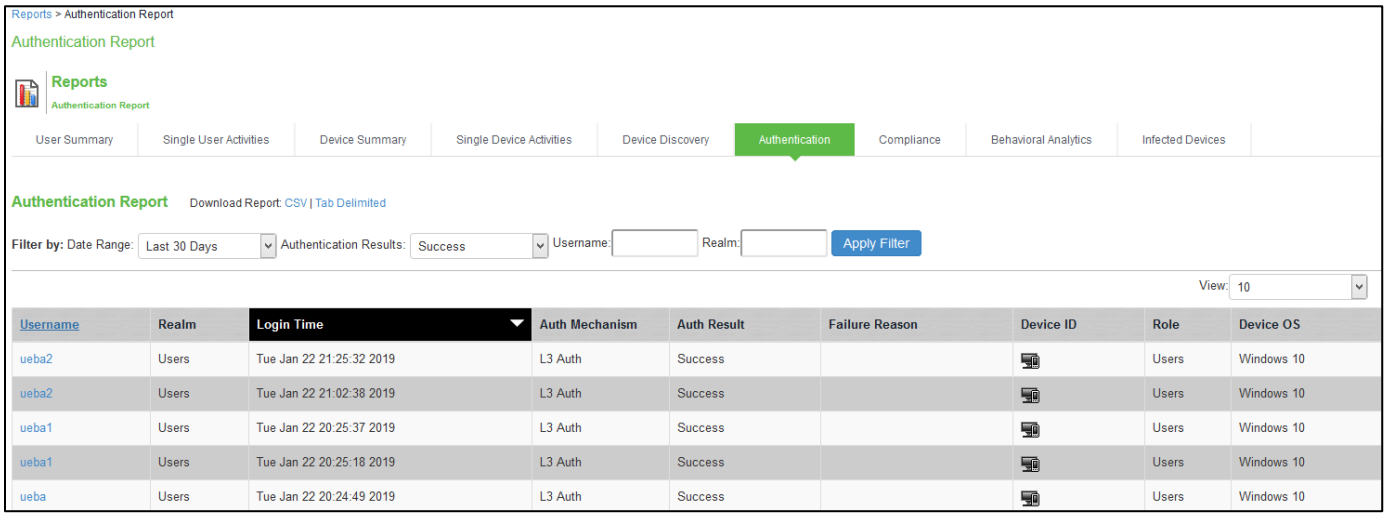
Drilling Down to Detailed Reports

To drill down to view detailed reports:

1. Select **System > Status > Activity > Dashboard**.
2. Click the search icon to display the corresponding tabular report with predefined search filters.

The below figure shows the detailed authentication report. The Authentication Results filter is set to Success.

Figure534: Detailed Authentication Report



Using the User Summary Report

This topic describes the user summary report. It includes the following information:

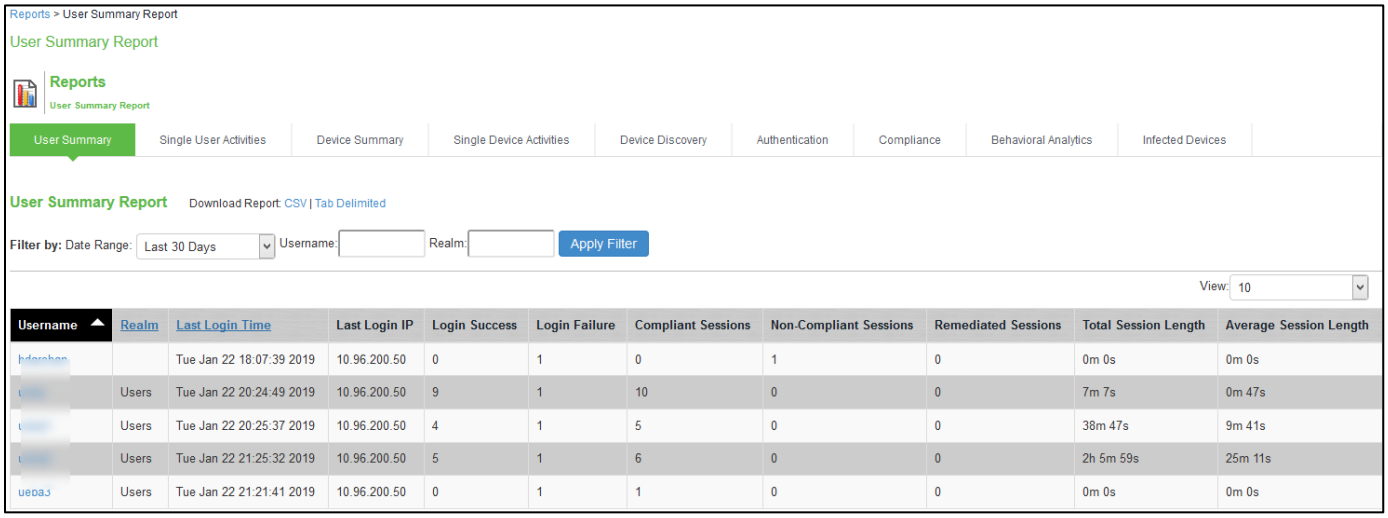
- Overview
- Applying Data Filters
- Sorting Records
- Drilling Down to the Single User Report
- Exporting User Summary Report

Overview

The user summary report displays user statistics such as realm, username, last log in time, last log in IP, successful log in, and so on for each user based on the user activity in the selected time range.

To display the user summary report, select **System > Reports > User Summary**.

Figure535: User Summary Report



The below table describes the columns on the user summary report.

Table118: User Summary Report Columns

Column	Description
Username	Specifies the name of the user.
Realm	Specifies the realm.
Last Login Time	Specifies the last time the user logged in.
Last Login IP	Specifies the last IP that the user logged in with.
Login Success	Specifies the number of successful log ins.
Login Failure	Specifies the number of failed log ins.
Compliant Sessions	Specifies the number of compliant sessions.
Non Compliant Sessions	Specifies the number of non compliant sessions.

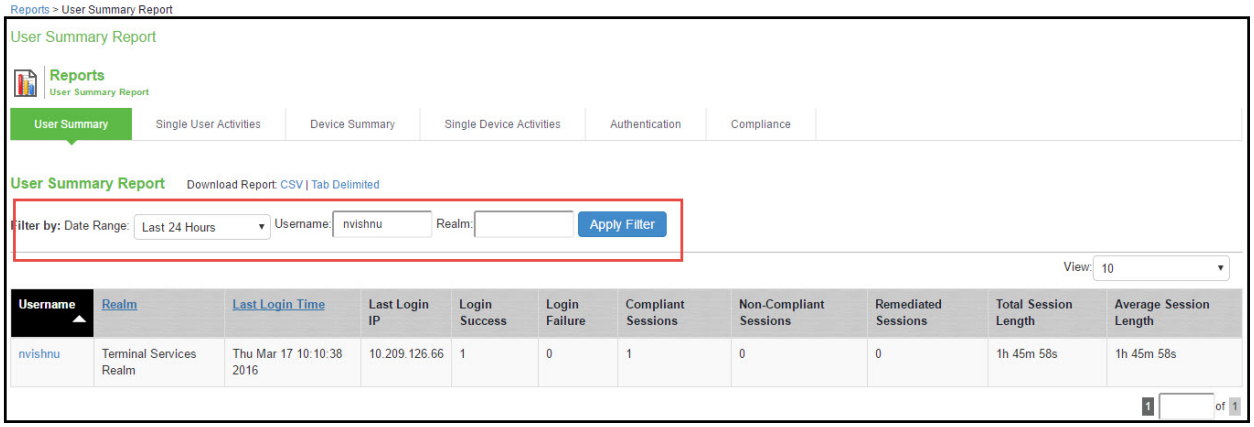
Column	Description
Remediated Sessions	Specifies the number of remediated sessions.
Total Session Length	Specifies the total length of the sessions.
Average Session Length	Specifies the average length of the sessions.

Applying Data Filters

To apply a data filter:

1. Select **System > Reports > User Summary**.
2. Select one of the following periods from the Date Range list box:
   - Last 24 Hours– (Default) Refers to the last 24 hours from the current hour.
   - Last 7 Days– Refers to current day and the previous last 6 days.
   - Last 30 Days– Refers to current day and the previous last 29 days.
3. Enter search criteria in one or more of the following attribute columns:
   - Username
   - Realm
4. Click **Apply Filter**.

Figure536: Filter User Summary Report



Sorting Records

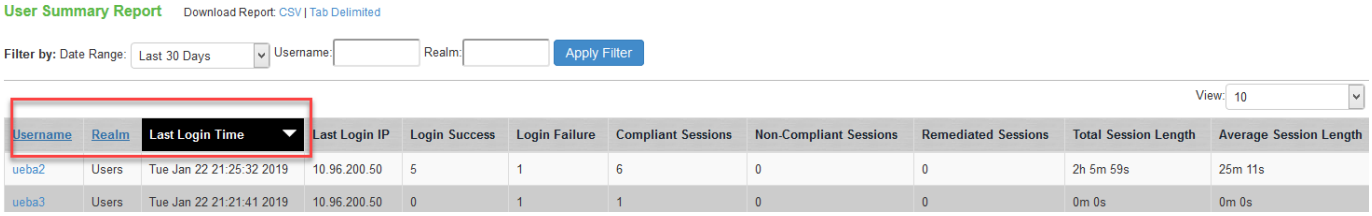
The data source determines the default sort order of the data rows in the report. Typically, data appears randomly, so sorting is an important task in creating a useful report. You can sort single data columns or multiple columns.

To sort the user summary report:

1. Select **System > Reports > User Summary.**
2. Select one of the following columns from the user summary report table, and click either the ascending or descending order icon.
   - Username
   - Realm
   - Last Login Time

   NOTE: The username column is sorted in ascending order by default.

Figure537: Sort User Summary Report

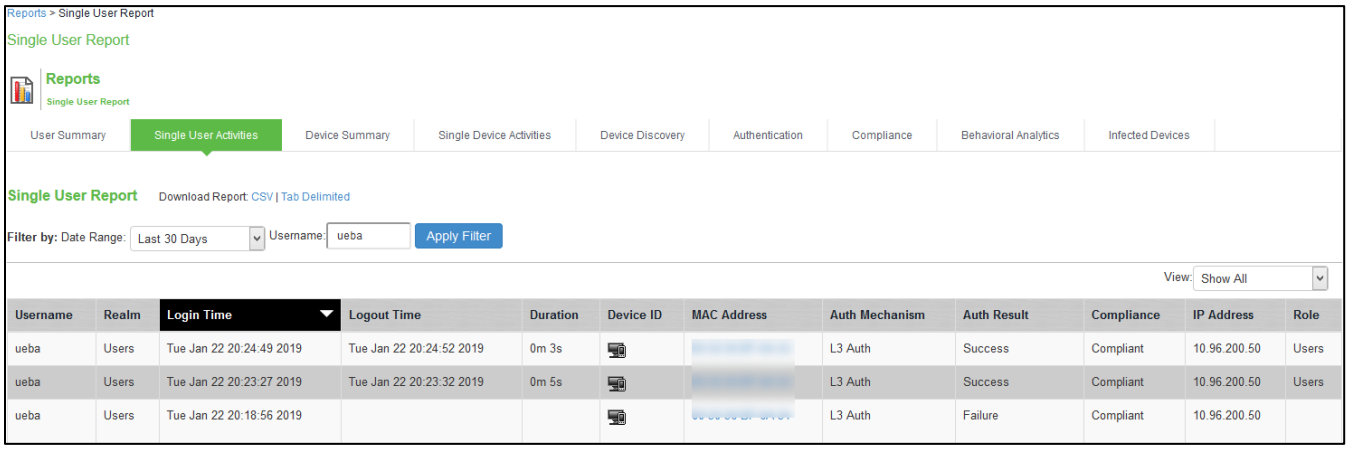


Drilling Down to the Single User Report

To drill down to a single user report:

1. Select **System > Reports > Single User Activities.**
2. Enter the username and specify the data range.
3. Click **Apply Filter.**

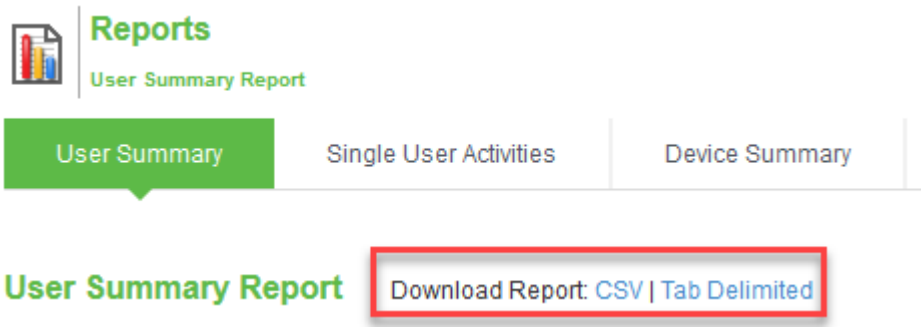
Figure538: Detailed Single User Report



Exporting User Summary Report

To export device summary report:

1. Select **System > Reports > User Summary**.
2. Select a Download Report option.
   - CSV– Exports the report in CSV format.
   - Tab Delimited– Exports the report in tab-delimited format.



Using the Device Summary Report

This topic describes the device summary report. It includes the following information:

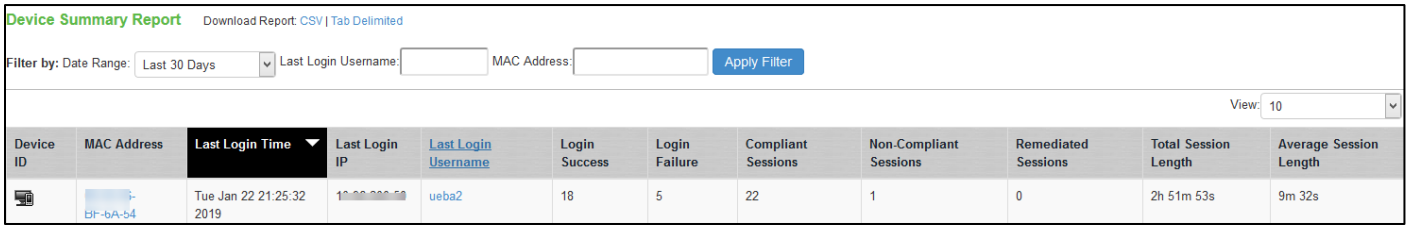
- Overview
- Applying Data Filters
- Sorting Records
- Exporting Device Summary Report

Overview

The device summary report displays device information such as device detail, MAC address, last log in time, last log in IP, log in successful, and so on for each user based on device activity in the selected time range.

To display the device summary report:

1. Select **System > Reports > Device Summary**
2. Select one of the following periods from the Date Range list box:
   - Last 24 Hours– (Default) Refers to the last 24 hours from the current hour.
   - Last 7 Days– Refers to current day and the previous last 6 days.
   - Last 30 Days– Refers to current day and the previous last 29 days.
3. Enter search criteria in one or more of the following columns:
   - Last Login Username
   - MAC Address
4. Click **Apply Filter**.



The below table describes the columns on the device summary report.

Table119: Device Summary Report Columns

Column	Description
Device ID	Specifies a unique identifier to identify the endpoint. Click the device ID icon to view a single device report.
MAC Address	Specifies the MAC address of the device. Click the MAC address to view a single device report.
Last Login Time	Specifies the last time the device was logged in.
Last Login IP	Specifies the last IP that the device logged in with.
Last Login Username	Specifies the username that the user logged in with.
Login Success	Specifies the number of successfully log ins.
Login Failure	Specifies the number of failed log ins.

Column	Description
Compliant Sessions	Specifies the number of compliant sessions.
Non-Compliant Sessions	Specifies the number of non-compliant sessions.
Remediated Sessions	Specifies the number of remediated sessions.
Total Session Length	Specifies the total session length.
Average Session Length	Specifies the average session length.

NOTE: If a device has more than one MAC address in a session, then the value appearing in the MAC Address column will be multiple instead of the actual MAC addresses. Note that the value multiple is not hyperlinked.

Applying Data Filters

To apply a data filter:

1. Select **System > Reports > Device Summary** Select one of the following periods from the Date Range list box:
   - Last 24 Hours– (Default) Refers to the last 24 hours from the current hour.
   - Last 7 Days– Refers to current day and the previous last 6 days.
   - Last 30 Days– Refers to current day and the previous last 29 days.
2. Enter search criteria in one or more of the following columns:
   - Last Login Username
   - Mac Address
3. Click **Apply Filter**.

Sorting Records

The data source determines the default sort order of the data rows in the report. Typically, data appears randomly, so sorting is an important task in creating a useful report. You can sort single data columns or multiple columns.

To sort the device summary report:

1. Select **System > Reports > Device Summary**.
2. Select any one of the following column and click either the ascending or descending order icon.
   - Last Login Time
   - Last Login Username

   NOTE: You can sort the column in either ascending order or descending order.

Exporting Device Summary Report

To export device summary report:

1. Select **System > Reports > Device Summary**.
2. Select a Download Report option.
   - CSV– Exports the report in CSV format.
   - Tab Delimited– Exports the report in tab-delimited format.

Using the Single Device Report

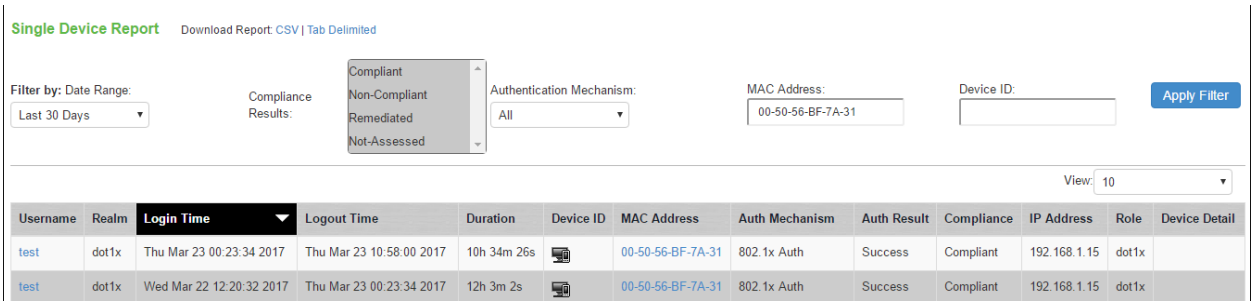
This topic describes the single device report. It includes the following information:

- Overview
- Applying Data Filters
- Sorting Records
- Exporting Single Device Activities Report

Overview

The single device activities report displays the device activity information such as username, realm, log in time, log out time, device detail, MAC address, authentication mechanism, authentication result, compliance, IP address, role and so on for each device.

To display the single device activities report, select **System > Reports > Single Device Activities**.



The below table describes the columns on the single device report.

Table120: Single Device Report Columns

Column	Description
Username	Specifies the name of the user.
Realm	Specifies the realm.
Login Time	Specifies the time the user logged in.
Logout Time	Specifies the time the user logged out.
Duration	Specifies the total duration of the user session.
Device ID	Specifies a unique identifier used to identify an end point. Click the device ID icon to view a single device report.
MAC Address	Specifies the MAC address of the device.
Auth Mechanism	Specifies the authentication mechanism: 802.1x, Layer 3, MAC address.
Auth Result	Specifies the authentication result.
Compliance	Specifies the Host Checker posture assessment results: Compliant, Not Compliant, Not Assessed, or Remediated.
IP Address	Specifies the IP that the user logged in with.
Role	Specifies the role of the user.
Device Detail	Displays the URL that is used for connecting to the MDM server.

Applying Data Filters

To apply a data filter:

1. Select **System > Reports > Single Device Activities**.
2. Select one of the following periods from the **Filter by: Date Range** list box:
   - Last 24 Hours– (Default) Refers to the last 24 hours from the current hour.
   - Last 7 Days– Refers to current day and the previous last 6 days.
   - Last 30 Days– Refers to current day and the previous last 29 days.
3. Enter search criteria in one or more of the following columns:
   - Compliance Results
   - MAC Address
   - Device ID
   - Authentication Mechanism (L3 Auth, 802.1X Auth, MAC auth, all).
4. Click **Apply Filter**.

Sorting Records

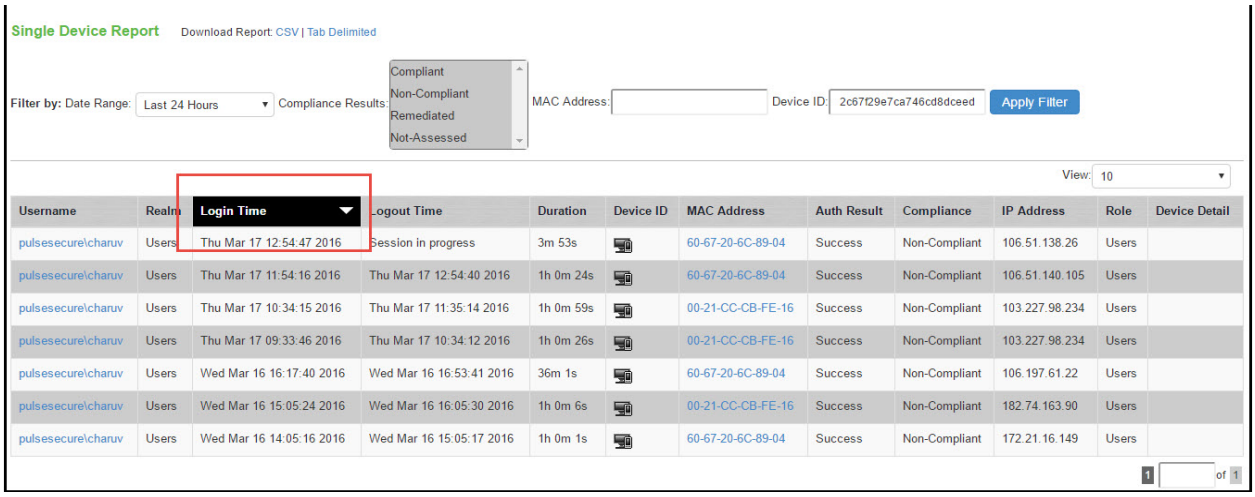
The data source determines the default sort order of the data rows in the report. Typically, data appears randomly, so sorting is an important task in creating a useful report. You can sort single data column.

To sort the single device activities report:

1. Select **System > Reports > Single Device Activities**.
2. Select **Login Time** column and click either the ascending or descending order icon.

NOTE: You can sort the column in either ascending order or descending order.

Figure539: Sort Records in Single Device Activities Report

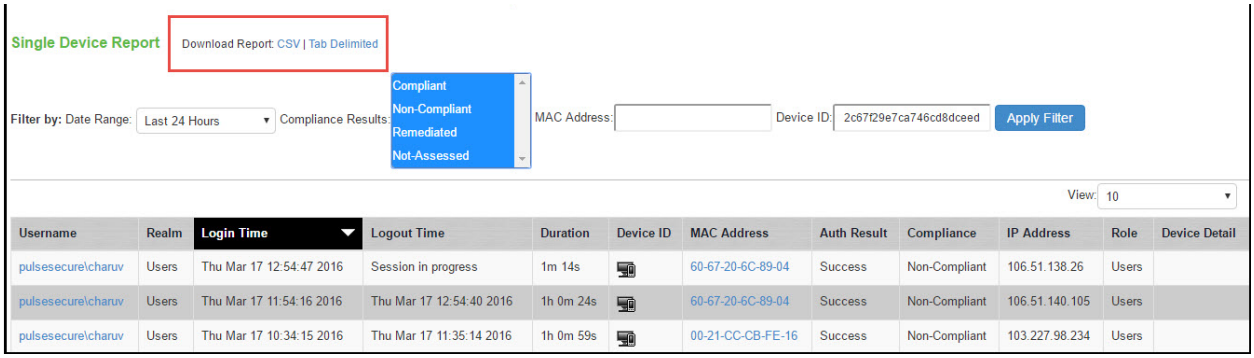


Exporting Single Device Activities Report

To export single device activities report:

1. Select **System > Reports > Single Device Activities**.
2. Select a Download Report option.
   - CSV– Exports the report in CSV format.
   - Tab Delimited– Exports the report in tab-delimited format.

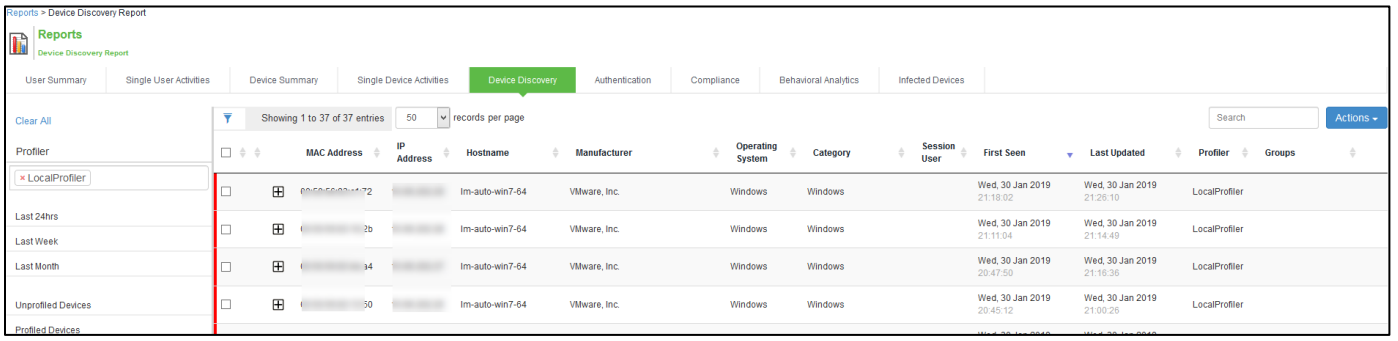
Figure540: Export Single Device Activities Report



Using the Device Discovery Report

You can view the device discovery report if you have integrated Profiler with PPS. The Device Discovery Report contains the list of devices that are discovered in the network. Select **System > Reports > Device Discovery** to view the report.

Figure541: Device Discovery Report



To view more information about a profiled device, click the + icon to the left of the MAC address. See Pulse Secure Profiler Deployment Guide for more information.

Using the Authentication Report

This topic describes the authentication report. It includes the following information:

- Overview
- Displaying the Authentication Report
- Applying Data Filters
- Sorting Records
- Exporting Authentication Report

Overview

The authentication report displays the authentication result for each user based on the device activity in the selected time range.

Displaying the Authentication Report

To display the authentication report, select **System > Reports > Authentication**.

The below table describes the columns on the authentication report.

Table121: Authentication Report Columns

Column	Description
Username	Specifies the name of the user.
Realm	Specifies the realm.
Login Time	Specifies the time the user logged in.
Auth Mechanism	Specifies the authentication mechanism: 802.1x, Layer 3, MAC address.

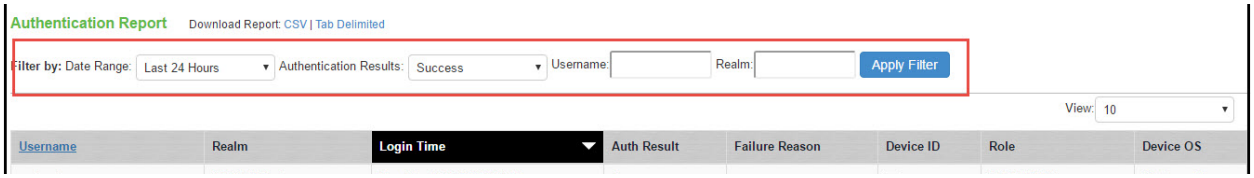
Column	Description
Auth Result	Specifies the authentication result.
Failure Reason	Specifies the host checker failure reason.
Device ID	Specifies a unique identifier used to identify an end point. Click the device ID icon to view a single device report.
Role	Specifies the user role.
Device OS	Specifies the operating system of the device.

Applying Data Filters

To apply a data filter:

1. Select **System > Reports > Authentication**.
2. Select one of the following periods from the Filter by: Date Range list box:
   - Last 24 Hours– (Default) Refers to the last 24 hours from the current hour.
   - Last 7 Days– Refers to current day and the previous last 6 days.
   - Last 30 Days– Refers to current day and the previous last 29 days.
3. Enter search criteria in one or more of the following columns:
   - Authentication Results
   - Username
   - Realm
4. Click **Apply Filter**.

Figure542: Filter Authentication Report



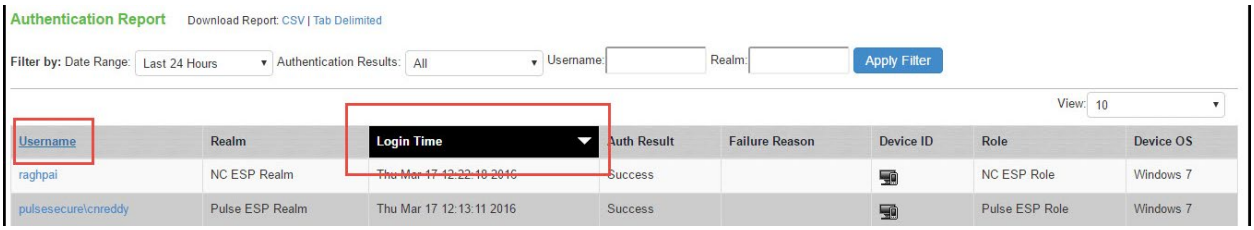
Sorting Records

The data source determines the default sort order of the data rows in the report. Typically, data appears randomly, so sorting is an important task in creating a useful report. You can sort single data column.

To sort the authentication report:

1. Select **System > Reports > Authentication**.
2. Select **Login Time** column and click either the ascending or descending order icon.

Figure543: Sort Records in Authentication Report



Exporting Authentication Report

To export an authentication report:

1. Select **System > Reports > Authentication**.
2. Select a Download Report option.
   - CSV– Exports the report in CSV format.
   - Tab Delimited– Exports the report in tab-delimited format.

Figure544: Export Records in Authentication Report

Using the Compliance Report

This topic describes the compliance report. It includes the following information:

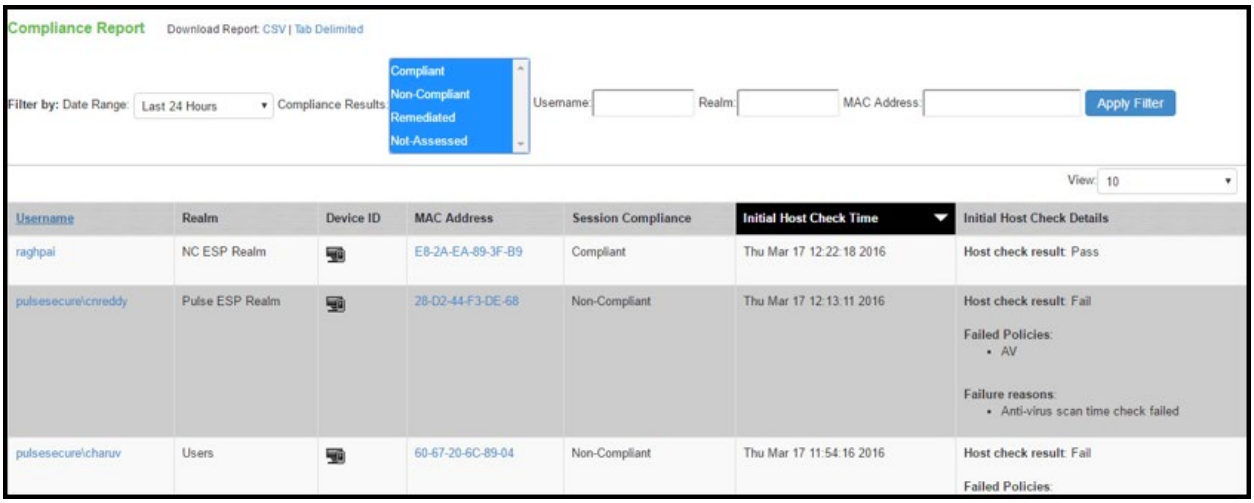
- Overview
- Applying Data Filters
- Sorting Records
- Exporting Compliance Report

Overview

The compliance report displays compliance status such as compliant, not compliant, remediated, not assessed information for each user based on the device activity in the selected time range.

To display the compliance report, select **System > Reports > Compliance**.

Figure545: Compliance Report



The below table describes the different columns on the compliance report.

Table122: Compliance Report Columns

Column	Description
Username	Specifies the name of the user.
Realm	Specifies the realm.
Device ID	Specifies a unique identifier used to identify an end point. Click the device ID icon to view a single device report.
MAC Address	Specifies the MAC address of the device.
Session Compliance	Specifies the Host Checker posture assessment results: Compliant, Not Compliant, Not Assessed, or Remediated.
Initial Host Check Time	Specifies the initial host check time.
Initial Host Check Details	Specifies the host check result.

The posture assessment chart is also a part of compliance report. It is displayed based on Initial Host Checker evaluation details (Login time).

The below table lists the type and the failure reasons for Host Checker.

Table123: Host Checker Failure Reasons– Posture Assessment Chart

Type	Failure Reason
Antivirus	Anti-virus not installed Anti-virus not running Anti-virus not up to date Anti-virus scan time check failed
Firewall	Firewall not installed Firewall not running
Antimalware	Anti-malware not installed
Antispyware	Anti-spyware not installed Anti-spyware not running
OS Checks	Unsupported OS
Port	Restricted ports open Required ports not open
Process	Detected restricted processes Required processes not detected
File	Detected restricted files Required files missing
Registry	Incorrect registry settings
NetBIOS	Detected restricted NetBIOS names Required NetBIOS names not found
MAC Address	Detected restricted MAC address Required MAC address not present
Machine Certificate	Certificate missing
Patch Assessment	Patches missing
Cache Cleaner	Cache cleaner failed
Remote IMV	Remote IMV failure
3rd party	NA (Not considered for reporting)
3rd party sub policy	3rd party sub policy failed
Rooting Detection	Detected rooted devices
Jail Breaking Detection	Detected jail broken devices
Mobile Security Suite (MSS)	Mobile security suite not active
3rd party NHC Check	Generic failure

Table124 Host Checker Failure

Type	Failure Reason
Statement of Health	Generic failure
Connection Control	Generic failure
HC	HDEncryption software not installed
	Detected Unencrypted drives
	Drives are missing
	Unsupported client for HDEncryption check
	Patch Management software not installed
	Detected missing patches
	Unsupported client for PatchMgmt check
	Deprecated patch assessment rule

Applying Data Filters

To apply a data filter:

1. Select **System > Reports > Compliance**.
2. Select one of the following periods from the Filter by: Date Range list box:
   - Last 24 Hours– (Default) Refers to the last 24 hours from the current hour.
   - Last 7 Days– Refers to current day and the previous last 6 days.
   - Last 30 Days– Refers to current day and the previous last 29 days.
3. Enter search criteria in one or more of the following columns:
   - Compliance Results
   - Username
   - Realm
   - MAC Address
4. Click **Apply Filter**.

Figure546: Filter Compliance Report

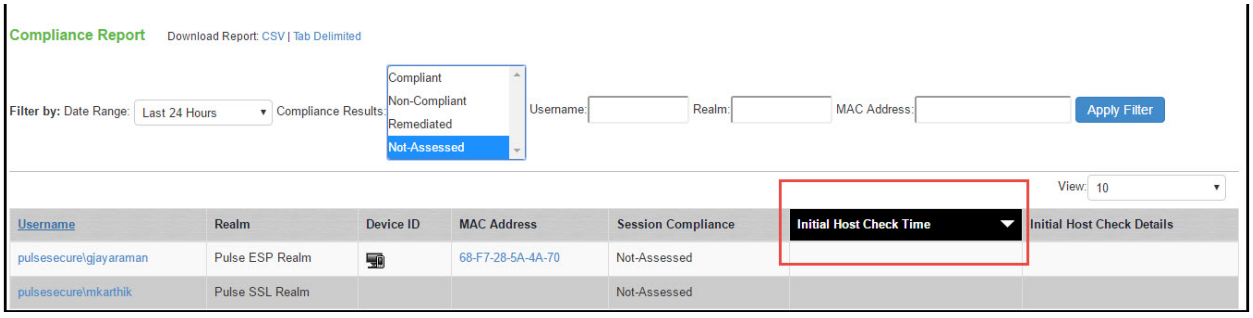
Sorting Records

The data source determines the default sort order of the data rows in the report. Typically, data appears randomly, so sorting is an important task in creating a useful report. You can sort single data column.

To sort the compliance report:

1. Select **System > Reports > Compliance**.
2. Select **Initial Host Check Time** or **Username** column and click either the ascending or descending order icon.

Figure547: Sort Records in Compliance Report

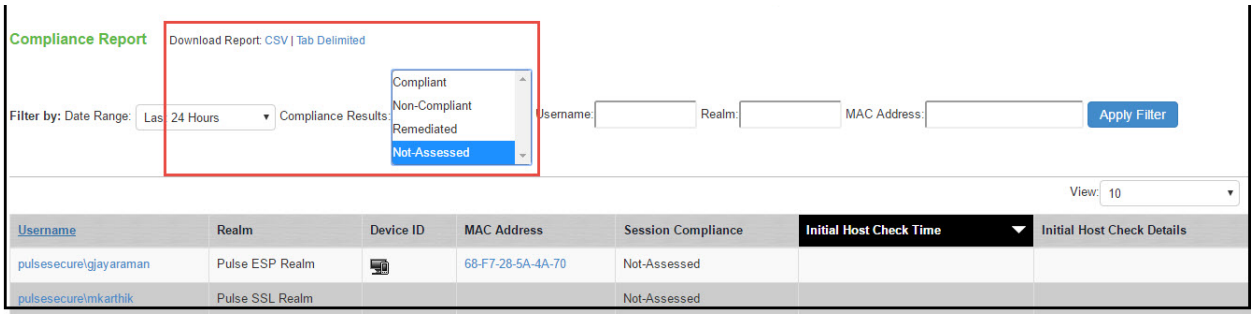


Exporting Compliance Report

To export a compliance report:

1. Select **System > Reports > Compliance**.
2. Select a Download Report option.
   - CSV– Exports the report in CSV format.
   - Tab Delimited– Exports the report in tab-delimited format.

Figure548: Export Compliance Report



System Maintenance

This chapter covers the following information:

Overview

The system maintenance operations must be planned to ensure that your system functions properly and to avoid any network disruptions. You can check the PPS platform information and perform the required tasks, which includes upgrading or downgrading the software, downloading the client installer files, performing disk cleanup operations and so on.

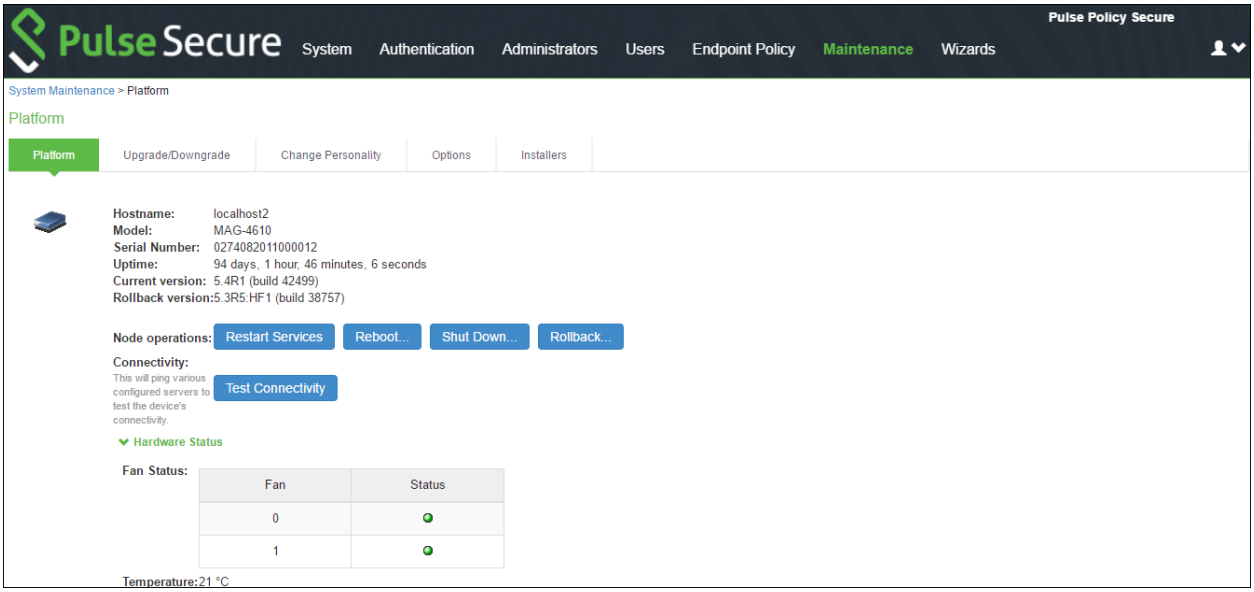
The system maintenance menu includes the following components:

- Platform- Use this option to check the platform information such as model, version, serial number, current version, and the rollback version. This helps the Administrator to perform/plan any routine system maintenance operations.
- Upgrade/Downgrade- Use this option to upgrade/downgrade the PPS software.
- Change Personality- Use this option to change the personality of the PPS device to a PCS device.
- Options- Use this option to check the global system parameters, including hardware settings.
- Installers- Use this option to download the client installer files based on the user platform.

Configuring System Platform

The platform page provides a quick overview of the current state of the system. This gives a quick overview of what Operation System the system has booted, the fallback version, host name, hardware model, serial number, uptime, current version, and the rollback version.

Figure549: System Platform



To restart, reboot, rollback or shut down the system:

1. Select **Maintenance > System > Platform** to display the system maintenance platform page.
2. Click the desired node operation:
   - Restart—Kills all processes and restarts the system. The system is available again after a few minutes.
   - Reboot—Power cycles and reboots the system. The system is available again after a few minutes.
   - Shut Down—Shuts down the system. The system is not available again until the physical power button on the physical device is used to restart the system.
   - Rollback- The system is rollbacked to the previous software version and configuration state. The system is rebooted and unavailable for a few minutes when you rollback.

NOTE:

- The restart, reboot, and shutdown operations are applied to all enabled members of a cluster. If you do not want to apply the operations to all members of the cluster, use the System > Clustering > Status page to disable members; then perform the restart, reboot, or shut down operation.
- If you have enabled logging for Administrator changes (System > Log/Monitoring > Admin Access > Settings page), a log is written to the Admin Access logs page. If you have enabled logging for System Status (System > Log/Monitoring > Events > Settings page), logs are written to the Events logs page.

Configuring System Maintenance Options

You can use the maintenance options page to enable various system maintenance features.

To enable various system maintenance features:

1. Select **Maintenance > System > Options** to display the maintenance options page.
2. Select options as described in the below table.
3. Save the configuration.

Figure550: System options

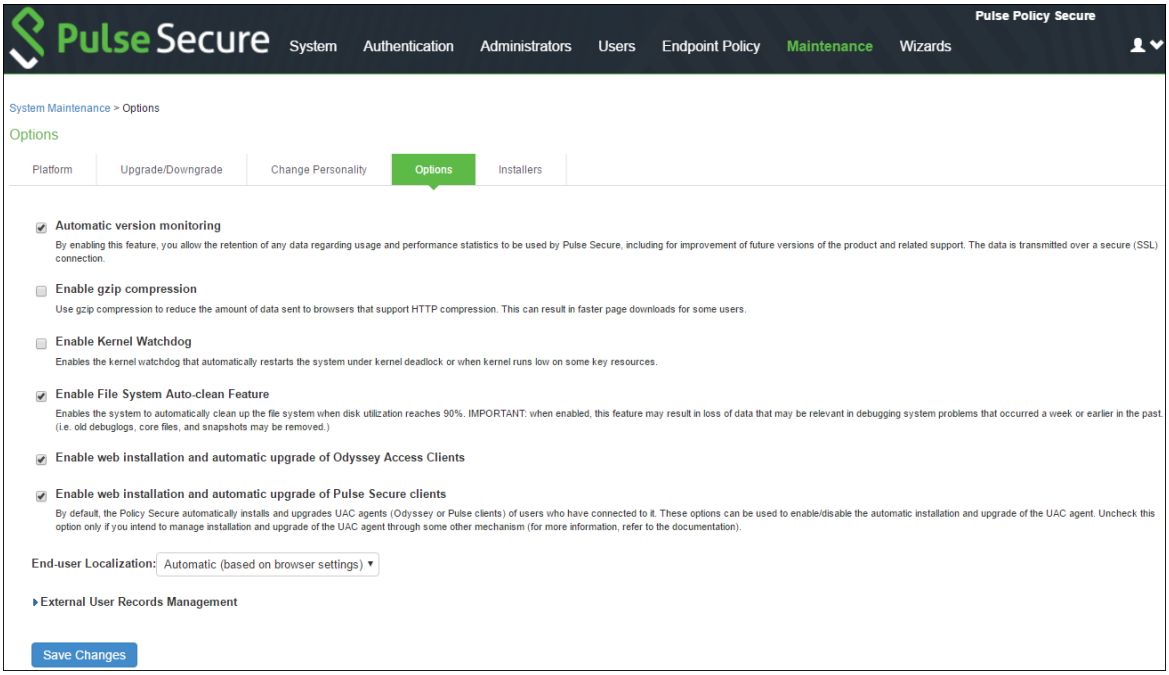


Table125: System Maintenance Options Configuration Guidelines

Options	Guidelines

Automatic version monitoring	If you enable this option, the system reports the following data to PPS:
	• Machine identifier.
	• Information describing your current software, including:
	  • Software build number and build name.
	  • An MD5 hash of your license settings.
	  • An MD5 hash of the internal interface IP address.
	  • If this node is in a cluster, the number of nodes within that cluster.
	  • Current state of the node.
	  • Cluster type (active/active, active/passive).
	  • Total number of unique subnets on the cluster nodes.
	  • Version of Pulse Policy Secure.
	  • Version of ESAP.
	  • Cluster log synchronization status.
	  • Number of Infranet Enforcers configured
	  • Names of RADIUS vendors configured
	• Total number of concurrent users on the device.
	We strongly recommend that you enable this service.

Kernel Watchdog	Enables the kernel watchdog that automatically restarts the system under kernel deadlock or when kernel runs low on some key resources. NOTE: Enable the kernel watchdog only when instructed by Pulse Secure Global Support Center .
File System Auto-clean	Enables the system to automatically clean up the file system when disk utilization reaches 90%. NOTE: The clean-up operation deletes files that might be relevant in debugging—for example, debug logs, core files, and snapshots might be deleted.
Web installation and automatic upgrade of Pulse Secure Clients	After you deploy Pulse Secure client software to endpoints, software updates occur automatically. A Pulse client can receive updates from the server. If you upgrade the Pulse software on your Pulse server, updated software components are pushed to a client the next time it connects. A bound endpoint receives connection set options and connections from its binding server, but it can have its Pulse client software upgraded from any Pulse server that has the automatic upgrade option enabled. During a client software upgrade the client loses connectivity temporarily.
Virtual Terminal console	Enables the virtual terminal on a virtual appliance. Clear this check box to use the serial console. Changing this setting will restart the system.
End-user Localization	Select one of the following options: • Automatic (based on browser settings) • English (U.S.) • Chinese (Simplified) • Chinese (Traditional) • French • German • Japanese • Korean • Spanish

External User Records Management

Options	Guidelines
Persistent user records limit	Specify the maximum number of user records. This feature is useful when system performance is affected due to many user records. We highly recommend you consult Pulse Secure Global Support Center prior to using this feature. Deleting a user record removes all persistent cookies, SSO information, and other resources for that user. It does not remove the user record from the external or internal authentication server. If you delete a user record and that user logs back in to the authentication server, new user records are created. Records are not removed if that user is currently logged in.
Number of records to delete when the limit is exceeded	Specify a number. Older records are removed first. A user record is not deleted if that user is currently logged in.
Delete records now	Check whether the persistent user records limit has been exceeded. If it is, delete the number of user records specified in the option above.
Automatic deletion of user records during new user log ins	Check whether the persistent user records limit will be exceeded whenever a new user record is about to be created. If true, delete the records prior to creating the user new record.

Installing the Service Package

This topic describes how to upgrade, downgrade, and rollback the system software. It includes the following information:

- Downloading and Uploading the Software Package
- Upgrading the System Software
- Downgrading the System Software

Downloading and Uploading the Software Package

To download a software package:

1. Go to http://www.pulsesecure.net/support/downloads/ and browse to the software download page for your product.
2. When prompted, log in with your Pulse Secure customer username and password.
3. Accept the license agreement.
4. When prompted, save the software package to your local host.

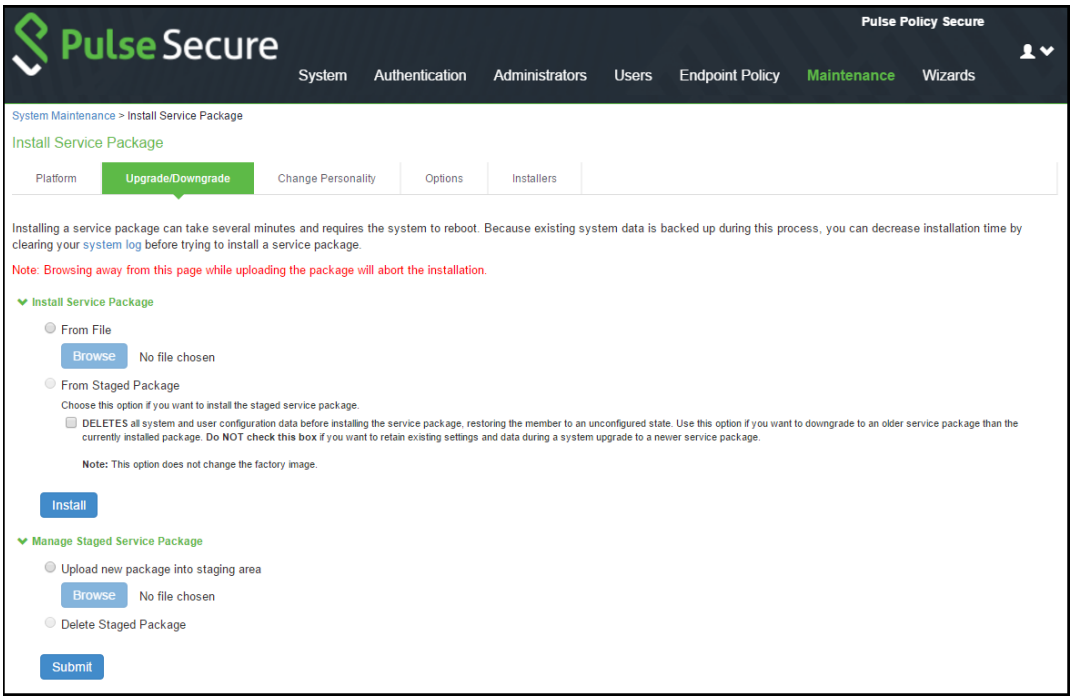
You can upload a software package to the system without immediately initiating the upgrade process. This is known as staging the upgrade. You can stage one package. Uploading a second package overwrites the previous staging.

To upload a software package:

1. Select **Maintenance > System > Upgrade/Downgrade** to display the system software maintenance page.
2. Under Managed Staged Service Package, select **Upload new package into staging area** and use the **Browse** button to locate and select the service package file.
3. Click **Submit** to upload the file.

The Upload Status window shows the progress of the upload operation.

Figure551: Software Upgrade Page



NOTE: If you have enabled logging for Administrator changes (System > Log/Monitoring > Admin Access > Settings page), a log is written to the Admin Access logs page.

Upgrading the System Software

Installing a service package can take several minutes and requires the system to reboot. Because existing system data is backed up during this process, you can decrease installation time by clearing your system log before trying to install a service package.

Note:

- When the system software is upgraded the latest set of updated Trusted Server CAs are uploaded. These new set of Trusted Server CAs can be seen in the **System > Configuration > Certificates > Trusted Server CAs** page. The expired certificates are removed from the system.
- When the system software is upgraded, it automatically upgrades PPS to OpenSSL version 1.0.2n.

To upgrade the operating system:

1. Select **Maintenance > System > Upgrade/Downgrade** to display the system software maintenance page.
2. Under Install Service Package, select one of the following options to proceed:

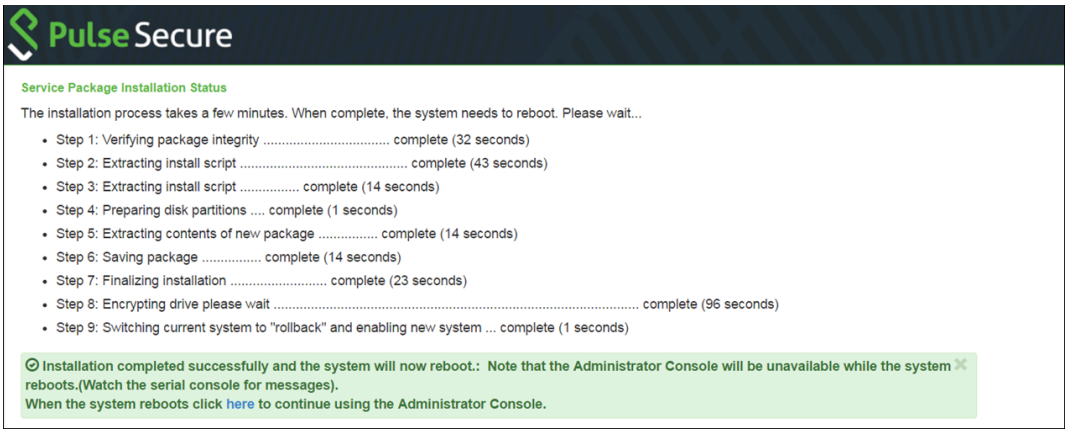
   - **From File**—Use the **Browse** button to locate and select the service package file.
   - **From Staged Package**—Select the service package file that was previously uploaded.

     NOTE: Do not select the **Deletes** ….option when you are upgrading software. The Deletes option is available to support downgrading software.

3. Click **Install**.

The system displays the Service Package Installation Status page, which provides a summary of the integrity checks and compatibility checks and other status indicators.

Figure552: Service Package Installation



NOTE: If you have enabled logging for Administrator changes (System > Log/Monitoring > Admin Access > Settings page), a log is written to the Admin Access logs page. If you have enabled logging for System Status (System > Log/Monitoring > Events > Settings page), logs are written to the Events logs page.

Downgrading the System Software

If necessary, you can downgrade to an earlier version of the system software. When you downgrade, you must clear the system and configuration data to avoid unexpected behavior that can occur when the system has data that relates to the newer software.

If you downgrade the system, you must reestablish network connectivity before you can reconfigure it.

To downgrade the operating system:

1. Select **Maintenance > System > Upgrade/Downgrade** to display the system software maintenance page.
2. Under Install Service Package, select one of the following options to proceed:
   - **From File**—Use the **Browse** button to locate and select the service package file.
   - **From Staged Package**—Select a service package file that was previously uploaded.
3. Select the **Deletes** all system and user configuration date….option to delete all system and user configuration data before installing the service package, restoring the member to an unconfigured state.
4. Click **Install**.

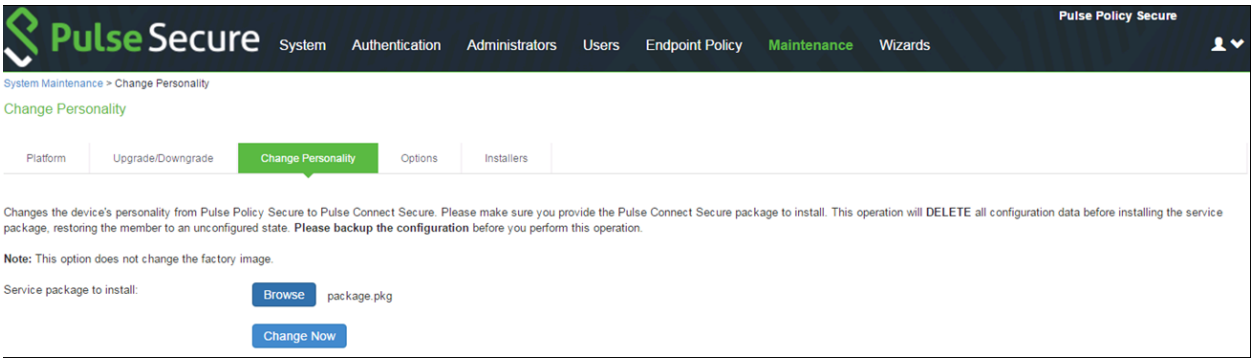
Changing the Device Personality

You can use this page to change the device's personality from PPS to PCS. You must perform a backup operation to avoid losing the configuration data before using this configuration.

To change the device personality:

1. Click **Browse** and select the PCS service package to install.
2. Click **Change Now**.

Figure553: Change Device Personality



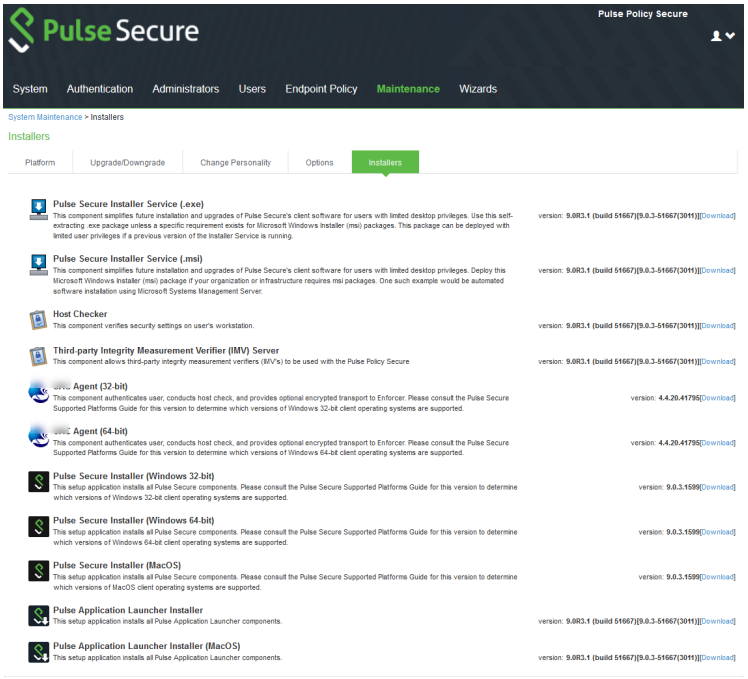
Downloading Client Installer Files

You can use the system maintenance client installers page to download client installer files. The downloadable files include .exe and .msi files for use installing clients on Windows platforms, and .dmg files for installing clients on Macintosh platforms.

To download client installer files:

1. Select **Maintenance > System > Installers** to display the client installer files page.
2. Click **Download** to download the file to your local host.

Figure554: System Maintenance Client Installers Page



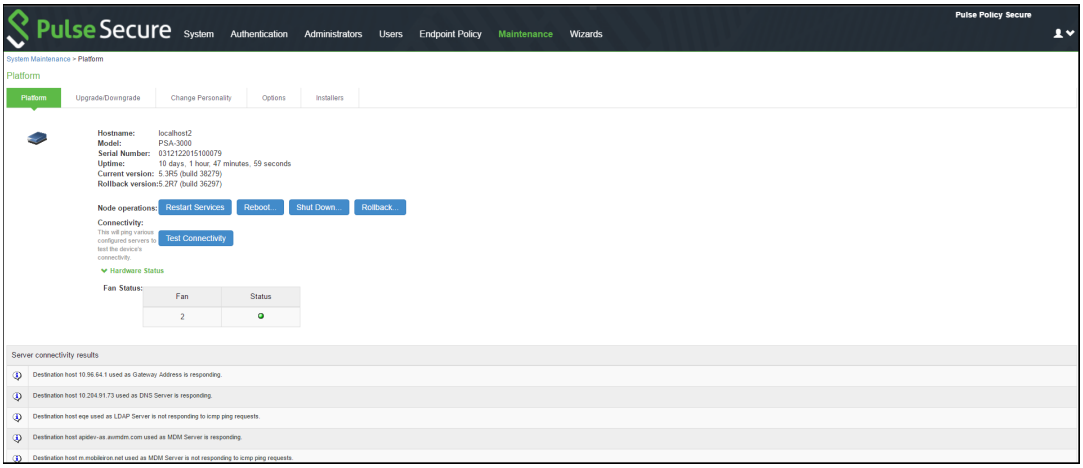
Testing Network Connectivity

You can use the admin console to test network connectivity to all the servers with which the system is configured to communicate, for example network services or AAA servers.

To test network connectivity:

1. Select **Maintenance > System > Platform** to display the system maintenance platform page.
2. Click **Test Connectivity**.

Figure555: System Maintenance Platform Page



Troubleshooting

This part covers the following chapters:

- Logging and Monitoring
- Troubleshooting

Logging and Monitoring

This chapter describes local logging features, SNMP, and syslog. It includes the following information:

- Overview
- Displaying System Logs
- Configuring Log Events Settings
- Log Filtering
- Monitoring using SNMP
- Configuring an External Syslog Server
- Configuring Advanced Settings
- Displaying System Status
- Displaying System Status
- Displaying Hardware Status
- Displaying Active Users
- Displaying User Access Statistics

Logging Overview

PPS provides logging and monitoring capabilities to help you track events and user activities. The system generates event logs related to system performance, administrator actions, network communications, access management framework results, user sessions, and so forth.

The available logs, includes:

- Event Logs- This file contains a variety of system events, such as session timeouts, systems errors and warnings, server restart notifications and connectivity requests.
- User Access Logs- This file contains information about when the user access the appliance, time, number of simultaneous users, user sign-ins and sign-outs.
- Admin Access Logs- This file contains administration information, including administrator changes to user, system and network settings, such as changes to session timeouts, license changes and so on.
- Sensor Log- This file contains information related to IDP sensor.

The system supports the following log collection methods:

- Local log collector and log viewer.
- Reporting to syslog servers.
- Reporting to SNMP servers.

The below table describes the event log severity levels.

Table126: Event Log Severity Levels

Severity Level	Description
Critical	The system cannot serve user and administrator requests or loses functionality to a majority of subsystems.
Major	The system loses functionality in one or more subsystems, but users can still access the system for other access mechanisms.
Minor	The system encounters an error that does not correspond to a major failure in a subsystem. Minor events generally correspond to individual request failures.
Info	The system writes an informational event to the log when a user makes a request or when an administrator makes a modification.

In addition to managing system logs, you can use the admin console to configure collection of client-side logs, including Host Checker logs.

Displaying System Logs

This topic describes how to display local system logs. It includes the following information:

- Displaying System Logs
- Displaying Events Logs
- Displaying User Access Logs
- Displaying Admin Access Logs
- Displaying Sensor Logs

Displaying Events Logs

The Events logs include system events, such as session timeouts, system errors and warnings, requests to check server connectivity, and system restart notifications. The local log viewer displays the most recent 5000 log messages (the display limit).

To display Events logs:

1. Select **System > Log/Monitoring**.
2. Click the **Events** tab.
3. Click the **Log** tab to display the log page.
4. Use the features described in table below to examine log records or manage the log collection.

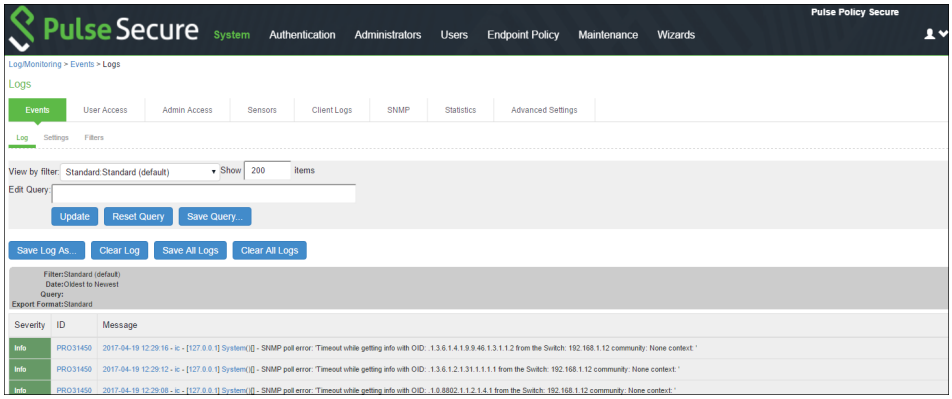


Table127: Log Management Features

Controls	Description
Filter	Select a filter format. Any custom filter formats and the following predefined filter formats are available: • **Standard** (default)—This log filter format logs the date, time, node, source IP address, user, realm, event ID, and message. • **WELF**—This customized WebTrends Enhanced Log Format (WELF) filter combines the standard WELF format with information about the system realms, roles, and messages. • **WELF-SRC-2.0-Access Report**—This filter adds access queries to the customized WELF filter. You can use this filter with NetIQ's SRC to generate reports on user access methods. NOTE: Format filters change only the data displayed (or columns exported), and do not affect the log data that has been collected.

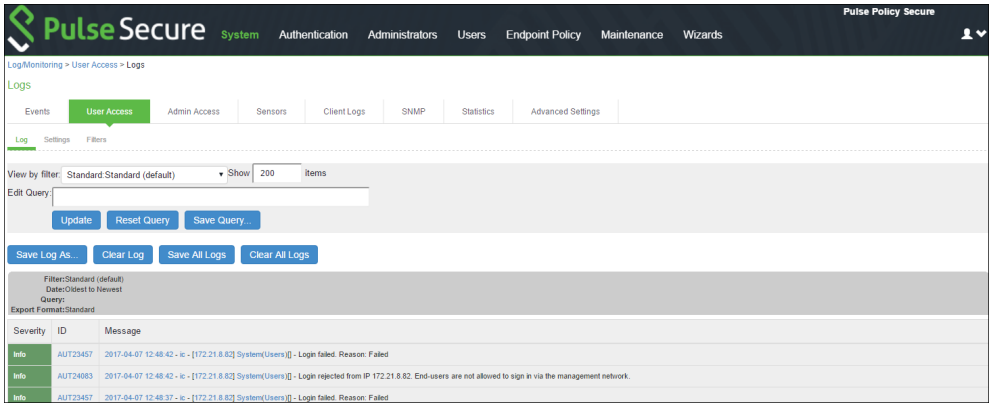
Controls	Description
Query	In the log display, several fields are hyperlinks. The hyperlinks function as dynamic queries on the local log collection. For example, if you click the log ID, the date, or an IP address or username, the log viewer queries the log collection for records that match the value you clicked, and redisplays the log collection. You can apply additional query filters by clicking additional hyperlinked values, essentially creating a Boolean AND query (for example, date AND IP address). Use the **Reset Query** button to clear the query filters and redisplay the unfiltered log collection. Use the **Save Query** button to save the dynamic log query as a custom filter. When you click the Save Query button, the system displays the Filters tab displays with the Query field prepopulated with the variables you selected from the log. NOTE: Query filters change only the display (or rows exported), and do not affect the log data that has been collected.
Save Log As	Save the local log collection to a file. We recommend you retain the system generated log name, which follows a consistent convention: **pulsesecure.logtype.nodename.log**. The local log viewer displays the most recent 5000 log messages (the display limit). If the current log file contains fewer than 5000 log messages, older log messages from the backup log file are displayed, up to a total of 5000 log messages. This makes the log files appear as one, even though they are stored separately. When you save the log messages or use the FTP archive function, the backup log file is appended to the current log file, and is then downloaded as one log file. If the log files are not archived or saved by the time they are rolled over again, the oldest log messages (saved in the backup log file) are lost.
Clear Log	Clear the local **log** and **log.old** file. When you clear the local log, events recorded by the syslog server are not affected. Subsequent events are recorded in a new local log file.
Save All Logs	The Save All Logs button appears on the Events, User Access, Admin Access, and Sensors tabs. When you click **Save All Logs**, the system generates a file that includes event, user access, admin access, sensor logs, and XML data for all of the system statistics and graphs shown on the Status > Overview page. After you click **Save All Logs**, you are prompted to download a file named **pulsesecurelogs-graphs.tar.gz** to your local host.
Clear All Logs	The Clear All Logs button appears on the Events, User Access, Admin Access, and Sensors tabs. It clears event, user access, admin access, sensor logs, and XML data for all of the system statistics and graphs shown on the Status > Overview page. When you clear the local log, events recorded by the syslog server are not affected. Subsequent events are recorded in a new local log file.

Displaying User Access Logs

The User Access logs include information about user access, such as the number of simultaneous users at each one hour interval (logged on the hour) and user sign-ins and sign-outs. The local log viewer displays the most recent 5000 log messages (the display limit).

To display User Access logs:

1. Select **System > Log/Monitoring**.
2. Click the **User Access** tab.
3. Click the **Log** tab.
4. Use the features described in table below to examine log records or manage the log collection.

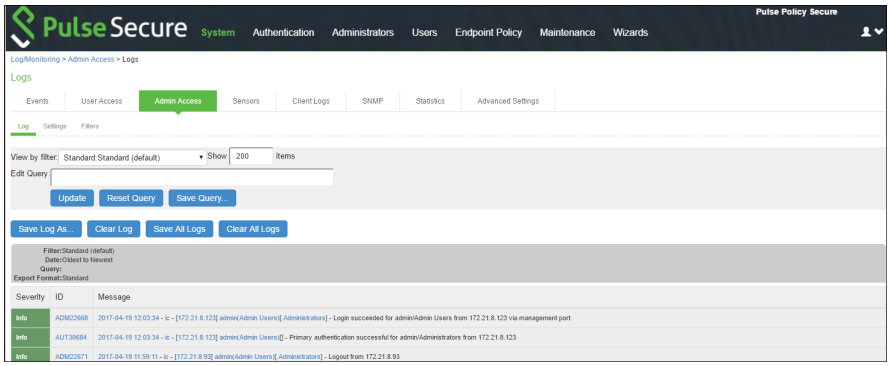


Displaying Admin Access Logs

The Admin Access logs include information about administrator actions, such as administrator changes to user, system, and network settings. It includes a log entry whenever an administrator signs in, signs out, or changes licenses on the appliance. The local log viewer displays the most recent 5000 log messages (the display limit).

To display Admin Access logs:

1. Select **System > Log/Monitoring**.
2. Click the **Admin Access** tab.
3. Click the **Log** tab.
4. Use the features to examine log records or manage the log collection.

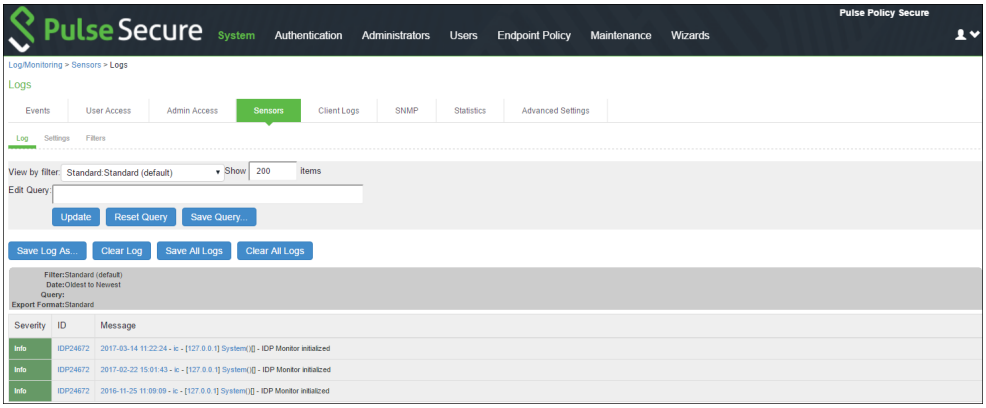


Displaying Sensor Logs

The Sensor logs include information related to communication with an IDP sensor if you have deployed a coordinated threat control solution. The local log viewer displays the most recent 5000 log messages (the display limit).

To display Sensor logs:

1. Select **System > Log/Monitoring**.
2. Click the **Sensor** tab.
3. Click the **Log** tab.
4. Use the features to examine log records or manage the log collection.



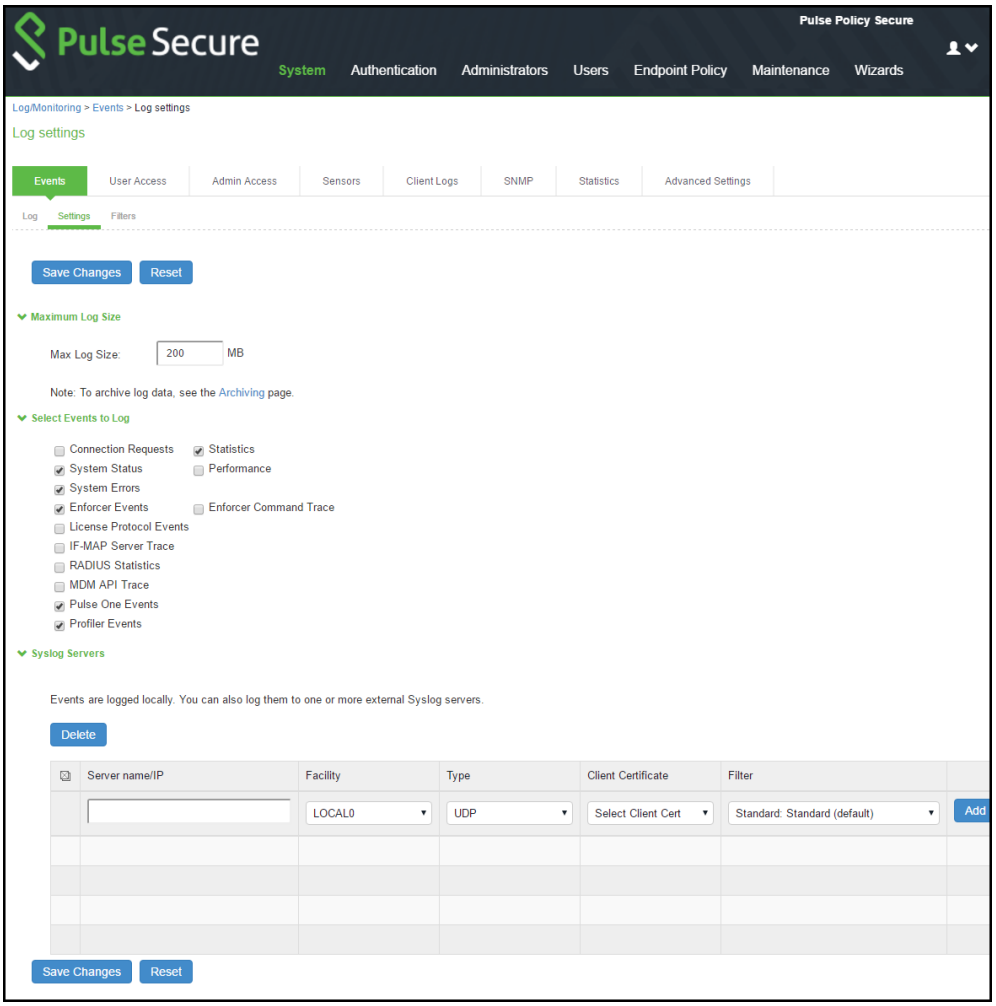
Configuring Log Events Settings

The log type has its own settings that allow you to specify which events are logged, the maximum file size, and whether to log events to system log server in addition to logging them locally.

To configure log event categories:

1. Select **System > Log/Monitoring**.
2. Click the **Settings** tab to display the configuration page.
3. Complete the configuration as described below.
4. Save the configuration.

Figure556: Log Events Settings Configuration Page



NOTE: To configure log events for each local log category, you must perform this procedure on each local log tab: Events, User Access, Admin Access, and Sensors.

Table128: Log Events Settings

Settings	Guidelines
Maximum Log Size	
Max Log Size	Specify the maximum size of the local log. The default is 200 MB. The maximum is 500 MB. The default is a good choice for logs formatted with the Standard format. If you use a more verbose format, such as WELF, specify a larger value. When the local log reaches the maximum log size, the current data is rolled over to a backup log file. A new, empty, file is then created for all subsequent (new) log messages. The log viewer displays the most recent 5000 log messages (the display limit). If the current log file contains fewer than 5000 log messages, older log messages from the backup log file can be displayed, up to a total of 5000 log messages. This makes the log files appear as one, even though they are stored separately. When you save the log messages or use the FTP archive function, the backup log file is appended to the current log file and is then downloaded as one log file. If the log files are not archived or saved by the time they are rolled over again, the oldest log messages (saved in the backup log file) are lost.
Archiving	Click the **Archiving** link to display the configuration page for Archiving jobs, including log archiving.
Select Events to Log – Events Tab	
Connection Requests	Log events related to connection requests.
System Status	Log events related to changes in system status.
System Errors	Log events related to system errors.
Enforcer Events	Log events related to Infranet Enforcer communication.
Enforcer Command Trace	Log events related to Infranet Enforcer command execution.
Statistics	Log user access statistics reported on the System > Log/Monitoring > Statistics tab. If you unselect the Statistics option, the statistics are not written to the log file, but are still reported on the statistics page.
Performance	Log events related to performance, such as CPU utilization.
License Protocol Events	Log events related to licensing.
IF-MAP Server Trace	Log events related to IF-MAP.
RADIUS Statistics	Logs events related to RADIUS.
Select Events to Log – User Access Tab	
Login/log out	Log events related to sign in and sign out.
User Settings	Log events related to changes to user settings.
Client Certificate	Log events related to certificate security.
Enforcer Deny Messages	Log events related to Infranet Enforcer.
IF-MAP Client User Messages	Log events related to IF-MAP.
RADIUS Accounting Messages	Log events related to RADIUS.

Settings	Guidelines
Endpoint Heartbeat Messages	Log events related to endpoint heartbeat messages.
Pulse Client Messages	Log events related to Pulse clients.
Select Events to Log – Admin Access Tab	
Administrator changes	Log events related to configuration changes.
Administrator log ins	Log events related to administrator access.
License changes	Log events related to licensing.
Select Events to Log – Sensor Tab	
None	If you have configured communication with an IDP sensor for coordinated threat control, communication between the network nodes is logged. There is no way to select less than the whole set of sensor event logs.

Log Filtering

PPS allows you to filter and format the data in your events, user access, and administrator access log files. When you filter log files, PPS displays only those messages specified within the filter query. For example, you can create a query that logs only entries for a particular range of IP addresses, or users who are signed into a specific realm. This topic describes how to use log filters. It includes the following information:

- Creating a Custom Log Collection Filter
- Reviewing the Configuration of Predefined Log Format Filters
- Example: Using the Source IP Address Filter
- Displaying User Access Statistics

Creating a Custom Log Collection Filter

If desired, you can create custom log collection filters to change the records displayed or exported. For example, it is common to see administrators use a filter for RADIUS accounting logs. This filter allows only the accounting log message, and it puts the entire message in a comma separated list. The order of the filtered message is: Date, Time, User, Realm, "List of Roles", NAS-ID, Acct-Status, Auth-Type, Attr-Value1, Attr-Value2, Attr-Value3.

Accounting attribute messages are different from authentication attribute messages in that the attribute name is not printed in the log message, but a comma is inserted for every attribute to be logged, even if it is not present.

To create a custom log collection filter:

1. Select **System > Log/Monitoring**.
2. Click the **Events** tab.
3. Click the **Filter** tab.
4. Click **New Filter** to display the configuration page.
5. Complete the configuration as described below.
6. Save the configuration.

Figure557: New Filter Page

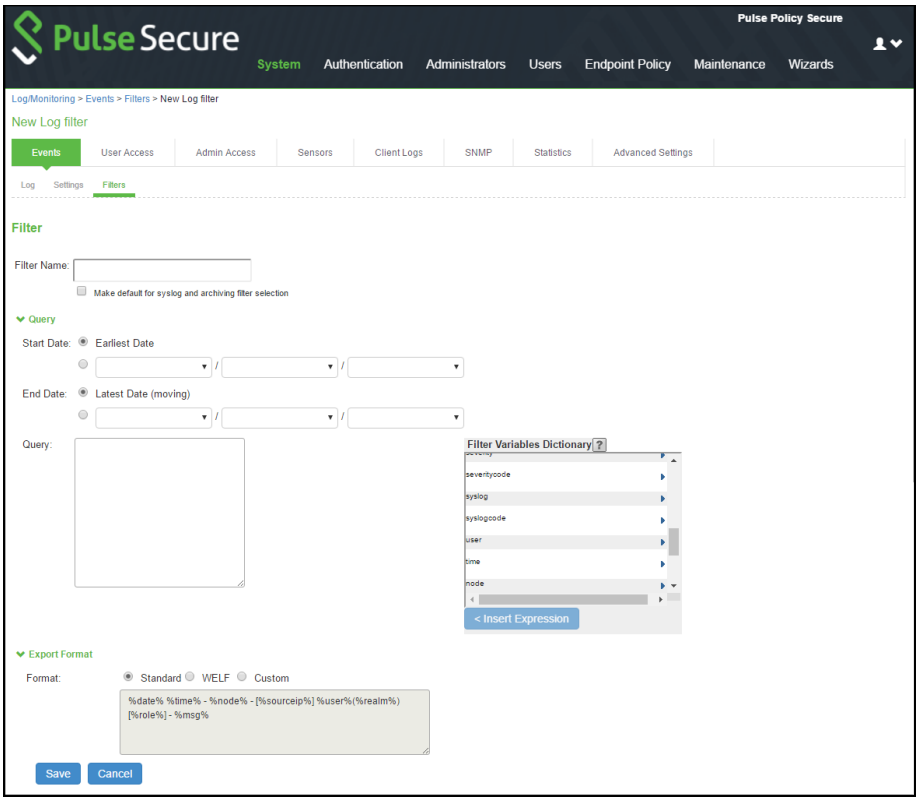


Table129: Filter Settings

Settings	Guidelines
Filter Name	Specify a name that is helpful to you and other administrators in understanding usage for your customer filter.
Make default	Make the filter the default on syslog and archiving configuration pages.
Query	
Start Date	Enter a start date. Click **Earliest Date** to write all logs from the first available date stored in the log file.
End Date	Enter an end date. Click **Latest Date** to write all logs up to the last available date stored in the log file.
Query	Use the Filter Variables Dictionary to insert query expressions in the Query box. Enclose the query value in single quotes. For example, insert the query expression **sourceip=**. Then complete the expression by adding the value **'192.168.0.1'**.
Export Format	Select an export format: • **Standard** (default)—This log filter format logs the date, time, node, source IP address, user, realm, event ID, and message. • **WELF**—This customized WebTrends Enhanced Log Format (WELF) filter combines the standard WELF format with information about the system realms, roles, and messages. • **Custom**—Use the Standard as a template for your custom selection of columns to be included in exports (when log collections are saved to files).

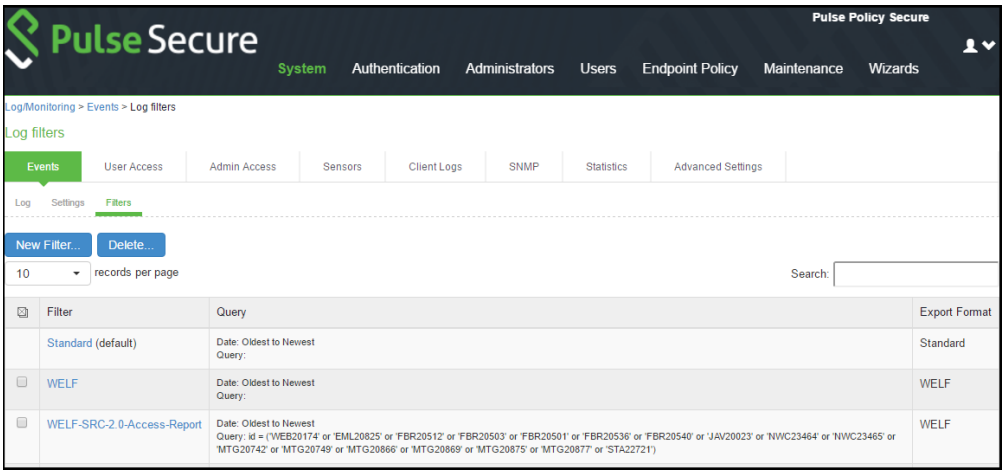
NOTE: Log query filters change only the data displayed (or rows exported). Log format filters change only the data displayed (or columns exported). Use of filters does not affect the log data that has been collected.

Reviewing the Configuration of Predefined Log Format Filters

To view the configuration of predefined log format filters:

1. Select **System > Log/Monitoring**.
2. Click the **Events** tab.
3. Click the **Filter** tab to display the log filters page.
4. Click the hyperlinked name of the filter to display its configuration page. You cannot edit the predefined filter named Standard, but you may edit the predefined WELF filters and any other custom filters that appear in the list.

Figure558: Log Filters Page



Example: Using the Source IP Address Filter

When drilling into logs to verify behavior or troubleshoot an issue with a dual-stack device, it is helpful to redisplay the log collection filtered on the IP address.

To filter on an IP address:

1. Select **System > Log/Monitoring**.
2. Create the filter:
3. Select **User Access** and then **Filter**.
4. Define the filter expression, name the filter, and click **Save**. In this example, we create a filter based on source IP address and name it IPv6_Address_Filter:Standard.
5. Use the filter:
6. Select **Logs** to display the user logs table.
7. Under View by filter, select **IPv6_Address_Filter:Standard**.
8. If desired, under Edit Query, edit the value of the **sourceip=** variable expression to filter on different source IP addresses.
9. Click **Update** to apply the filter and redisplay the log collection.

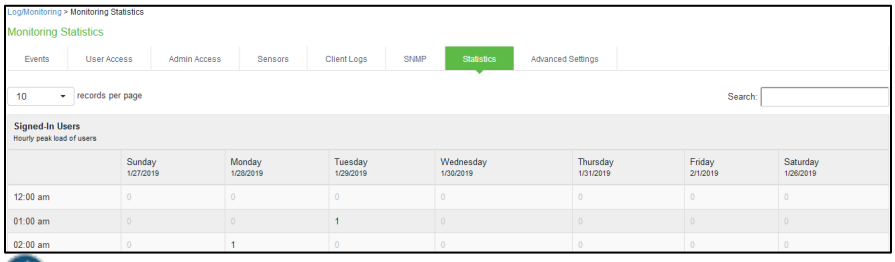
Displaying User Access Statistics

Every hour, the system logs the peak count of Web users in the previous hour. It displays the hourly counts for the past week on the Statistics page. It writes the report to the system log once a week.

To display user statistics:

1. In the admin console, select **System > Log/Monitoring**.
2. Click the **Statistics** tab to display the page.
3. Scroll the page to view the data.

Figure559: User Statistics Page



NOTE: Upgrading software clears all statistics. If you configure the system to log statistics hourly, however, older statistics are still available in the log file after an upgrade.

Monitoring using SNMP

You can use a third-party SNMP manager, such as HP OpenView, to monitor PPS system health. PPS supports SNMP version 2 (v2) and SNMPv3. PPS implements a private MIB, and defines its own traps. Download the PPS MIB file and specify the appropriate information to receive the traps.

To configure the SNMP agent:

1. Select **System > Log/Monitoring**.
2. Click the **SNMP** tab to display the SNMP configuration page.
3. Complete the configuration as described below.
4. Save the configuration.

Figure560: SNMP Configuration Page

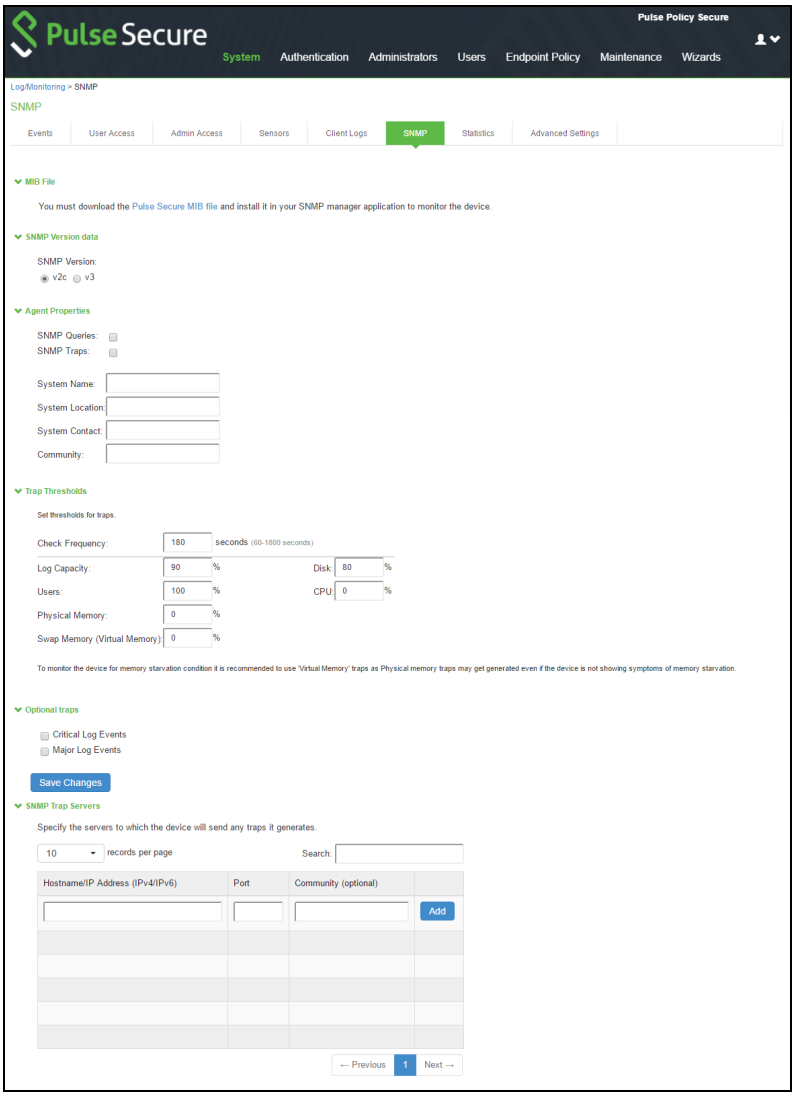


Table130: SNMP Configuration Settings

Settings	Guidelines				
MIB File	Use the **Pulse Secure MIB file** link to download the device management information base MIB file. You add this file to your SNMP manager configuration.				
SNMP Version	Select your SNMP server version: • **v2c** • **v3**				
Agent Properties					
SNMP Queries	Select to support SNMP queries.				
SNMP Traps	Select to send SNMP traps.				
System Name	Specify a system name.				
System Location	Specify a location.				
System Contact	Specify a system contact.				
Community String	• Required only for SNMPv2c. • To query the system, your network management station must send it the community string. • To stop the SNMP system, clear the community field.				
SNMPv3 Configuration					
Username	Specify the SNMPv3 username. The User-Based Security Model (USM) is the default Security Module for SNMPv3. The system supports only one user at a time to be registered with an SNMP engine. Editing the SNMPv3 user attributes overwrite any already registered SNMPv3 user. The SNMPv3 user must have read-only access on all MIBs supported by the system. SNMPv3 user configuration attributes can also be used for SNMP traps.				
Security Level	**Selection**	**Auth Protocol**	**Auth Password**	**Priv Protocol**	**Priv Password**
	No Auth, NoPriv	—	—	—	—
	Auth, NoPriv	Select MD5 (HMAC-MD5-96) or SHA (HMAC-SHA-96).	Enter an authentication password. The password can contain any ASCII characters and must be at least 8 characters in length.	—	—
	Auth, Priv	Select MD5 (HMAC-MD5-96) or SHA (HMAC-SHA-96).	Enter an authentication password. The password can contain any ASCII characters and must be at least 8 characters in length.	Select either CBC-DES or CFB-AES-128.	Enter a privacy password. The password can contain any ASCII characters and must be at least 8 characters in length.
Trap Thresholds	NOTE: Setting a threshold value to 0 disables that respective trap.				
Check Frequency	Specify the frequency in seconds for sending traps. The default is 180 seconds.				
Log Capacity	Specify the percent of log space used. The default is 90%.				
Users	Specify the percent of user capacity used. The default is 100%.				
Physical Memory	Specify the percent of physical memory used. The default is 0 (not reported).				

Settings	Guidelines
Swap Memory (Virtual Memory)	Specify the percent of swap memory used. The default is 0 (not reported). NOTE: We recommend you monitor swap memory to alert you to potential memory issues. The threshold for traps for physical memory usage might be reached even if the system is not experiencing any difficulties.
Disk	Specify the percent of disk utilization. The default is 80%.
CPU	Specify the percent of CPU utilization. The default is 0 (not reported).
Meeting Users	Specify the percent of meeting users. The default is 100%.
Optional Traps	
Critical Log Events	Send traps when the system logs critical events.
Major Log Events	Send traps when the system logs major events.
Save SNMP Settings?	Click **Save Changes** to update the SNMP agent configuration. The page is refreshed and displays the SNMP engine ID. If the configuration is changed to move from SNMP v2c to SNMP v3, the system generates and displays two engine IDs.
SNMP Servers	
Hostname / IP address	Specify the hostname or IP address for the SNMP servers to which the system will send any traps it generates.
Port	Specify the port for the SNMP server. Typically, SNMP uses port 162.
Community	Specify the community string (if necessary).

Keep the following configuration tips in mind when you configure your SNMP manager to listen for this SNMP agent:

- Add the Pulse Secure MIB file to the SNMP manager configuration.
- If using SNMPv2c, the community string configuration for the SNMP manager and SNMP agent must match.
- If using SNMPv3, the SNMPv3 user configuration for the SNMP manager and the SNMP agent must match.
- If using SNMPv3, you must specify the Authoritative Engine ID for SNMPv3 traps that was generated when you saved the SNMP agent configuration.

The table below is a reference of MIB objects for the system.

Table131: MIB Objects

Object	Description
logFullPercent	Returns the percentage of available file size filled by the current log as a parameter of the logNearlyFull trap.
signedInWebUsers	Returns the number of users signed in through a Web browser.
signedInMailUsers	Returns the number of users signed in to the e-mail client.
blockedIP	Returns the IP address—blocked due to consecutive failed log in attempts—sent by the iveToomanyFailedLoginAttempts trap. The system adds the blocked IP address to the blockedIPList table.
authServerName	Returns the name of an external authentication server sent by the externalAuthServerUnreachable trap.
productName	Returns the licensed product name.
productVersion	Returns the software version.

Object	Description
fileName	Returns the file name sent by the archiveFileTransferFailed trap.
meetingUserCount	Returns the number of concurrent meeting users sent by the meetingUserLimit trap.
iveCpuUtil	Returns the percentage of CPU used during the interval between two SNMP polls. This value is calculated by dividing the amount of CPU used by the amount of CPU available during the current and previous SNMP polls. If no previous poll is available, the calculation is based on the interval between the current poll and system boot.
iveMemoryUtil	Returns the percentage of memory utilized by the system at the time of an SNMP poll. The system calculates this value by dividing the number of used memory pages by the number of available memory pages.
iveConcurrentUsers	Returns the total number of users logged in.
clusterConcurrentUsers	Returns the total number of users logged in for the cluster.
iveTotalHits	Returns the total number of hits to the system since last reboot. Includes total values from iveFileHits, iveAppletHits, meetingHits, and iveWebHits.
iveFileHits	Returns the total number of file hits to the system since last reboot.Incremented by the Web server with each GET/POST corresponding to a file browser request.
iveWebHits	Returns the total number of hits by means of the Web interface since last reboot. Incremented by the Web server for each http request received by the system, excluding file hits, applet hits, and meeting hits.
iveAppletHits	Returns the total number of applet hits to the system since last reboot.Incremented by the Web server for each GET request for a Java applet.
ivetermHits	Returns the total number of terminal hits to the system since last reboot.
logName	Returns the name of the log (admin/user/event) for the logNearlyFull and iveLogFull traps.
iveSwapUtil	Returns the percentage of swap memory pages used by the system at the time of an SNMP poll. The system calculates this value by dividing the number of swap memory pages used, by the number of available swap memory pages.
diskFullPercent	Returns the percentage of disk space used in the system for the iveDiskNearlyFull trap. The system calculates this value by dividing the number of used disk space blocks by the number of total disk space blocks.
blockedIPList	Returns a table with the 10 most recently blocked IP addresses. The blockedIP MIB adds blocked IP addresses to this table
ipEntry	An entry in the blockedListIP table containing a blocked IP address and its index (see IPEntry).
IPEntry	The index (ipIndex) and IP address (ipValue) for an entry in the blockedIPList table.
ipIndex	Returns the index for the blockedIPList table.
ipValue	A blocked IP address entry in the blockedIPList table.
logID	Returns the unique ID of the log message sent by the logMessageTrap trap.
logType	Returns a string sent by the logMessageTrap trap stating whether a log message is major or critical.
logDescription	Returns a string sent by the logMessageTrap trap stating whether a log message is major or critical.
Name	Returns the name of a virtual system.
ocspResponderURL	Returns the name of an OCSP responder.
fanDescription	Returns the status of the system fans.
psDescription	Returns the status of the system power supplies.

Object	Description
raidDescription	Returns the status of the system RAID device.
iveLogNearlyFull	The log file (system, user access, or administrator access) specified by the logName parameter is nearly full. When this trap is sent, the logFullPercent (%of log file full) parameter is also sent. You can configure this trap to be sent at any percentage. To disable this trap, set the Log Capacity trap threshold to 0%. The trap's default value is 90%. NOTE: When SNMP traps are enabled, the iveLogNearlyFull and iveLogFull traps are sent when the log files are 90% full and 100% full respectively, even if the threshold is set to 0 (disabled).
iveLogFull	The log file (system, user access, or administrator access) specified by the logName parameter is completely full. NOTE: When SNMP traps are enabled, the iveLogNearlyFull and iveLogFull traps are sent when the log files are 90% full and 100% full respectively, even if the threshold is set to 0 (disabled).
iveMaxConcurrentUsersSignedIn	Maximum number or allowed concurrent users are currently signed in. You can configure this trap to be sent at any percentage. To disable this trap, set the Users trap threshold to 0%. The trap's default value is 100%.
iveTooManyFailedLoginAttempts	A user with a specific IP address has too many failed sign-in attempts. Triggered when a user fails to authenticate according to the settings for the Lockout options on the Security Options tab. When the system triggers this trap, the system also triggers the blockedIP (source IP of log in attempts) parameter.
externalAuthServerUnreachable	An external authentication server is not responding to authentication requests. When the system sends this trap, it also sends the authServerName (name of unreachable server) parameter.
iveStart	The system has just been turned on.
iveShutdown	The system has just been shut down.
iveReboot	The system has just been rebooted.
archiveServerUnreachable	The system is unable to reach the configured archive server.
archiveServerLoginFailed	The system is unable to log into the configured archive server.
archiveFileTransferFailed	The system is unable to successfully transfer files to the configured archive server. When the system sends this trap, it also sends the fileName parameter.
iveRestart	Supplies notification that the system has restarted according to the administrator's instruction.
iveDiskNearlyFull	Supplies notification that the system disk drive is nearly full. When the system sends this trap, it also sends the diskFullPercent parameter. You can configure this trap to be sent at any percentage. To disable this trap, set the Disk trap threshold to 0%. This trap's default value is 80%.
iveDiskFull	Supplies notification that the system disk drive is full.
logMessageTrap	The trap generated from a log message. When the system sends this trap, it also sends the logID, logType, and logDescription parameters.
memUtilNotify	Supplies notification that the system has met the configured threshold for memory utilization. To disable this trap, set the Physical Memory trap threshold to 0. The threshold is 0%, by default.
cpuUtilNotify	Supplies notification that the system has met the configured threshold for CPU utilization. To disable this trap, set the CPU trap threshold to 0. The threshold is 0%, by default.

Object	Description
swapUtilNotify	Supplies notification that the system has met the configured threshold for swap file memory utilization. To disable this trap, set the Swap Memory trap threshold to 0. The threshold is 0%, by default.
iveFanNotify	Supplies notification that the status of the fans has changed.
ivePowerSupplyNotify	Supplies notification that the status of the power supplies has changed.
iveRaidNotify	Supplies notification that the status of the RAID device has changed.
iveNetExternalInterfaceDownTrap (nicEvent)	Supplies the type of event that brought down the external interface. The nicEvent parameter can contain values of “external” for an external event and “admin” for an administrative action.
iveNetInternalInterfaceDownTrap (nicEvent)	Supplies the type of event that brought down the internal interface. The nicEvent parameter can contain values of “external” for an external event and “admin” for an administrative action.
iveClusterDisableNodeTrap (clusterName,nodeList)	Supplies the name of the cluster that contains disabled nodes, as well as a string containing the names of all disabled nodes. Node names are separated by white space in the string.
iveClusterChangedVIPTrap(vipType, currentVIP, newVIP)	Supplies the status of a virtual IP for the cluster. The vipType indicates whether the changed VIP was external or internal. The currentVIP contains the VIP prior to the change, and newVIP contains the VIP after the change.
iveNetManagementInterfaceDownTrap (nicEvent)	Supplies the type of event that brought down the management port. The nicEvent parameter can contain values of “external” for an external event and “admin” for an administrative action.
iveClusterDelete(nodeName)	Supplies the name of the node on which the cluster delete event was initiated.
pclsRemainingGracePeriod	Number of days remaining in grace period for contacting PCLS
iveMaxConcurrentUsersLicenseCapacity	Total licensed concurrent users capacity

Configuring an External Syslog Server

PPS allows you to send the log data to an external syslog server. You should use syslog if your enterprise has any long-term record-keeping or accounting requirements.

To configure reporting to a syslog server:

1. Select **System > Log/Monitoring**.
2. Click the **Settings** tab.
3. Specify the maximum log size and select the events to be logged.
4. Specify the server configuration as described below and click **Add**. You can specify multiple syslog servers.
5. Save the configuration.

NOTE: To enable syslog reporting for each local log category, you must perform this procedure on each local log tab: Events, User Access, Admin Access, and Sensors.

Figure561: Syslog Server Configuration Page

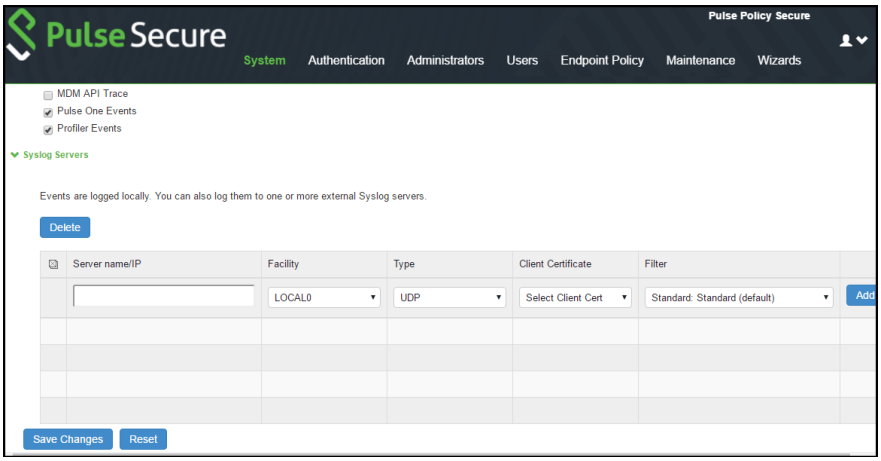


Table132: Syslog Server Configuration Guidelines

Settings	Guidelines
Server name/IP	Specify the fully qualified domain name or IP address for the syslog server. NOTE: If you select **TLS** from the Type list, the server name must match the CN in the subjectDN in the certificate obtained from the server.
Facility	Select a syslog server facility level (LOCAL0-LOCAL7). Your syslog server must accept messages with the following settings: facility = LOG_USER and level = LOG_INFO.
Type	Select the connection type to the syslog server. You can select: • UDP (User Datagram Protocol) - A simple non-secure transport model. • TCP (Transmission Control Protocol) - A core protocol of the Internet Protocol suite (IP), but lacks strong security. • TLS (Transport Layer Security) - Uses cryptographic protocols to provide a secure communication.
Client Certificate	(optional) If you select TLS from the Type menu and your remote syslog server requires client certificates, select the installed client certificate to use to authenticate to the syslog server. Client certificates are defined in the Configuration > Certificates > Client Auth Certificates page. Client certificates must be installed on the device before they can be used. NOTE: There is no fallback if a connection type fails.
Filter	Select a filter format. Any custom filter format and the following predefined filter formats are available: • **Standard** (default)—This log filter format logs the date, time, node, source IP address, user, realm, event ID, and message. • **WELF**—This customized WebTrends Enhanced Log Format (WELF) filter combines the standard WELF format with information about the system realms, roles, and messages. • **WELF-SRC-2.0-Access Report**—This filter adds access queries to the customized WELF filter. You can use this filter with NetIQ's SRC to generate reports on user access methods.

Configuring Advanced Settings

This option helps to configure fault tolerance on each configured TCP and TLS syslog server available. Fault tolerance is supported only for TCP and TLS syslog servers. UDP syslog servers cannot be configured for fault-tolerance. This functionality helps the syslog server to recover the logs lost during a disconnect. The administrator can configure fault-tolerance on syslog servers by enabling this option from the admin UI. PPS/PCS reads the lost pending logs during a disconnect from the log disk and transports them to the syslog server on a reconnect. Fault tolerance is supported only for the syslog servers configured under the following log-types:

- Events

- User Access
- Admin Access

NOTE: Fault tolerance is node-specific. In case of clusters, the setting needs to be enabled/disabled by logging into each of the cluster members.

To configure advance settings to a TCP and TLS syslog server:

1. Select **System > Log/Monitoring**.
2. Click the **Advance Settings** tab to display the configuration page.
3. Complete the configuration as described in below table.
4. Save the configuration.

NOTE: This feature is limited to configuring fault tolerance settings of an existing syslog server; and cannot be used to create or delete a new syslog server.

Figure 562: Log Events Settings Configuration Page

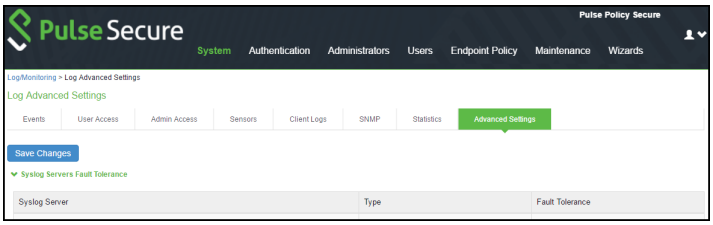


Table 133: Advanced Settings

Settings	Guidelines
Syslog Server Fault Tolerance	
Syslog Server	Lists the existing Syslog servers.
Type	Specifies if the Syslog server is a TLS or TCP type.
Fault Tolerance	Tolerates the loss of network connection to a TCP/TLS syslog server for a brief period (maximum of 4 hours) by sending the logs missed during the disconnect time. Click the checkbox to enable this option. Fault-tolerance is disabled by default on any syslog server.

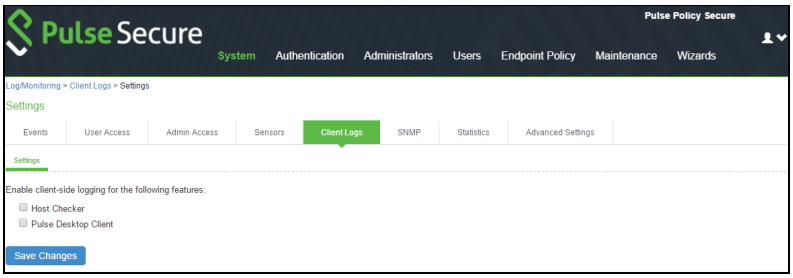
Enabling Client-Side Logging

Client-side logging is not enabled by default. You can enable client-side logging for Host Checker. PPS writes a client side log to endpoints when client side logging is enabled.

To enable client-side logging:

1. Select **System > Log/Monitoring**.
2. Click the **Client Logs** tab to display the configuration page.
3. Select the **Host Checker** option to enable client-side logging when Host Checker is run on the endpoint.
4. Save the configuration.

Figure563: Client Logs Configuration Page

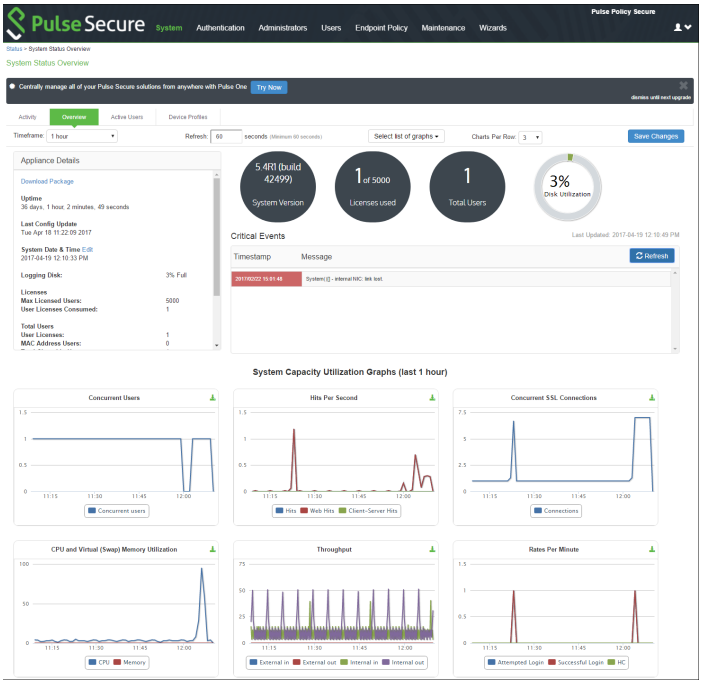


Displaying System Status

The System Status page is a dashboard of system version information, system capacity utilization, uptime, and summary user information. The System Status page is the “home” page that is displayed when you log into the admin console as an administrator. To navigate to the System Status page from other admin console pages, select **System > Status**.

The following figure shows the System Status page for PPS. The table that follows describes the various options available.

Figure564: System Status Page



Item	Description
1	Click the **Critical Events** link to display a new window with a table of the last 10 critical system events.
2	Click the **Page Settings** link to display a new window with the System Status Settings page.
3	Click the System Version **Download Package** link to download the software version running on the system. You might do this when you need to synchronize software on another node to the software version running on this system.
4	Click the System Date and Time **Edit** link to display the System Date and Time configuration page.
5	Click a System Capacity Utilization report **Edit** link to display a new window with controls to customize the appearance of the report graphs.
6	Click a System Capacity Utilization report **Download** link to download graph data in XML format.
7	Click an Enforcer Status link to navigate to its configuration page.

Table134: Licenses and Total Users

Item	Description
Licenses	

Item	Description
Max Licensed Users	Displays the maximum number of licensed users by supported platform type.
User Licenses Consumed	Displays how user licenses are being used. Pulse Secure client connections and agentless connections count as user licenses.
Total Users	
User Licenses	Displays the number of Pulse Secure client connections and agentless connections. These types of connections count as user licenses. The maximum number of licenses is the sum of the capacity provisioned by the licenses that have been added to the system.
MAC Address Users	Displays the number of connections through MAC Address authentication realms. This number is reported only if a MAC Address realm has been configured. These connections do not count as user licenses, and there is no maximum number of licenses set by rule.
RADIUS Users	Displays the number of RADIUS user connections. These connections do not count as user licenses, and there is no maximum number of licenses set by rule.
Total Signed-In Users	Displays the sum of user licenses in use. • User Licenses count • Odyssey Users count • MAC Address Users count • RADIUS Users count

You can use this page to select the reports displayed on the System Status page, as well as data properties, such as the time dimension and refresh rate.

The following reports are available:

- Concurrent Users—Shows a count of users signed into the system. In clustered environments, the graph includes two lines. The first line displays the number of local users signed into the node selected from the list, and the second line displays the number of concurrent users signed into the entire cluster.
- Hits per Second—Shows a count of hits currently being processed by the system. In a clustered environment, you may select a node from the list to determine which node's data is displayed in the graph. The graph includes three lines: total number of hits, number of Web hits, and number of client/server hits.
- CPU and Memory Usage—Shows the percentage of the CPU and memory being used. In a clustered environment, you may select a node from the list to determine which node's data is displayed in the graph.
- Throughput—Shows the amount of data (in KB) being processed. In a clustered environment, you may select a node from the list to determine which node's data is displayed in the graph. The graph includes four lines: external in, external out, internal in, and internal out.
- Connections—Shows a count of concurrent SSL connections.
- Rates—Shows the rate of attempted log ins, successful log ins, and Host Checker updates.

Displaying Hardware Status

You can use the Maintenance > System > Platform page to display the hardware health status, including information about hard drives, fans, and power supplies.

To display hardware health status:

1. Select **Maintenance > System > Platform** to display the System Maintenance page.
2. Review the hardware status information described below.

Figure565: System Maintenance Page

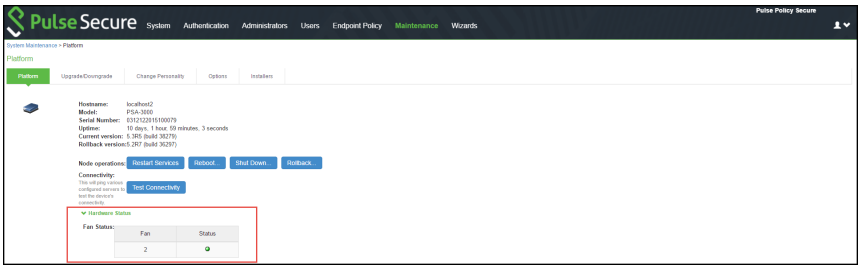


Table135: Hardware Status Information

Hardware Component	Status Message
Hard Disk Status	Displays a health statement for the device disk drive.
Fan Status	Displays a health statement for the device fan(s).
Power Supply	Displays a health statement for the device power supply.

The below table lists the RAID status and hard drive status. Depending on your system, you may or may not see all these possible statuses.

Table136: RAID and Hard Drive Status

RAID Status	Drive 1	Drive 2
Hard Disk RAID is operational	Active	Active
Hard Disk RAID is in single drive mode	Missing	Active
Hard Disk RAID is in single drive mode	Active	Missing
Hard Disk RAID has failed	Failed	Active
Hard Disk RAID has failed	Active	Failed
Hard Disk RAID is in the process of recovering	Active	Reconstructing
Hard Disk RAID is in the process of recovering	Reconstructing	Active
Hard Disk RAID is in the process of recovering	Active	Verifying
Hard Disk RAID is in the process of recovering	Verifying	Active
Hard Disk RAID status is unknown	Unknown	Active
Hard Disk RAID status is unknown	Active	Unknown

RAID Status	Drive 1	Drive 2
Hard Disk RAID status is unknown	Unknown	Unknown
Not available	n/a	n/a

Using Software RAID on PSA7000

NOTE: All hard disks are encrypted with AES128 using a random generated key.

This section describes the use of software RAID. It includes the following information:

- Overview of Software RAID
- Configuring RAID Controller
- Checking RAID Statuses

Overview of Software RAID

The PSA7000 device has two hard disks. However, there is no hardware RAID controller. In PPS 5.4R1, RAID functionality is enabled through the software RAID available in Linux. Software is used to create RAID devices in the RAID 1 layer. These individual disk partitions can also be used as regular partitions. All partitions, which include boot, root, data, var, tmp, swap, and so on are created out of the software RAID. Software RAID does not affect any of the other hardware models except PSA7000. It works the same way either with hardware RAID or no RAID at all.

Configuring RAID Controller

To configure a RAID controller on the PSA7000, disks are hot plugged on the PSA7000. Configuring RAID on the PSA7000 also involves some manual configuration steps in the admin console. RAID configuration is carried out by the following steps:

To remove a disk from the second slot in the system:

1. Select Menu option: **4. System Operations**
2. Select Menu option: **20. Manage RAID**
3. A prompt appears: **Are you sure you want to manage RAID? (y/n)**
4. Enter **y** for the prompt.
5. Choose Menu option: **2. Remove Disk2**. This will detach the disk in the second slot from software RAID.
6. Physically unplug the disk from the second slot.

To insert a disk to the second slot in the system:

1. Physically plug in the disk in the second slot.
2. Select Menu option: 4. System Operations
3. Select Menu option: 20. Manage RAID
4. A prompt appears: Are you sure you want to manage RAID? (y/n)
5. Enter y for the prompt.
6. Choose Menu option: 4. Add Disk2. This will attach the disk in the second slot to the software RAID.

Checking RAID Statuses

To check the status of RAID and individual disks:

1. Go to **system > platform** page of the web interface.
2. Status of RAID and individual disks are displayed. The below table shows the hard disk status and the hard disk RAID status.

Table 137: Hard Disk and Hard Disk RAID Statuses

	Status	Guidelines
Hard Disk	Active	A disk that is present and part of RAID
	Inactive	A disk that is present but not part of RAID
	Missing	A disk that is removed.
Hard Disk RAID	Operation	Both disks are active and part of the software RAID
	Recovering	Both disks are active and syncing with each other
	Failed	Both disks are active but one of them is not part of RAID

NOTE: In the single drive mode, only one disk is active. The other disk is either missing or inactive.

LCD Display

This section describes the addition of LCD to PPS devices. It includes the following information:

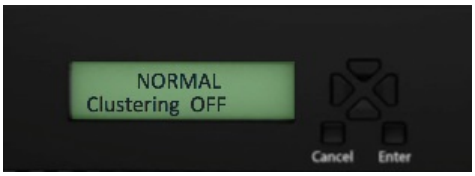
- Overview of adding LCD for PPS
- Modes Supported by the LCD

Overview of adding LCD for PPS

The addition of a LCD screen allows field technicians to quickly gauge the health of the system without logging into the device. The buttons on the LCD panel allow navigation through the display menus. The directional buttons are used to access the menu modes and find device information. The LCD can display two line of text. The below figure shows the LCD screen with navigation buttons.

NOTE: LCD display is available for the PSA-7000 platform model only.

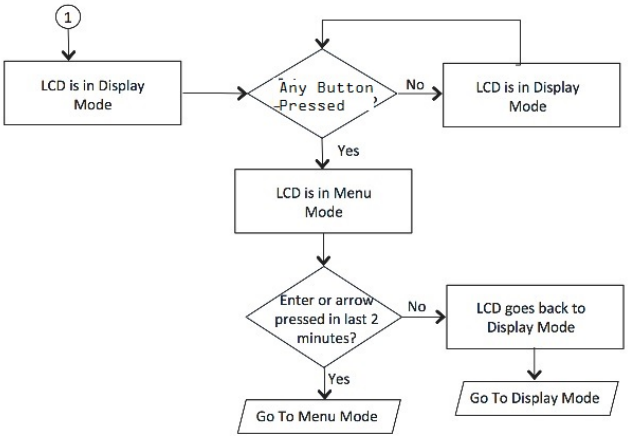
Figure 566: LCD with Navigation Buttons



Modes Supported by the LCD

The LCD supports two modes namely the display mode (default) and the menu mode. Pressing any button in the display mode will change the mode to menu mode. If a user presses the cancel button, the LCD immediately changes back to display mode and shows the appropriate state. The LCD remains in display mode. If the LCD is in menu mode and the user does not press any button for more than two minutes, then the LCD changes back to display mode. The below figure shows the two modes supported by the LCD

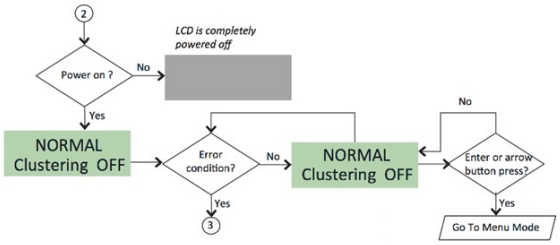
Figure 567: Two Modes Supported by the LCD



Display Mode

The display mode describes the current state of the system, such as normal state or error conditions (e.g., fan speed and overheat). It represents the default status. The LCD goes into display mode after boot-up is complete. In display mode, the LCD is either set to NORMAL or shows a label that describes an error condition. If all systems are functioning normally, then the LCD shows NORMAL. The second line in the NORMAL state is used to show whether the appliance is configured as part of a cluster. The valid states in the display mode are Clustering OFF and Clustering ON. Figure *568* below figure shows the two valid states in display mode.

Figure 568: Valid States in Display Mode



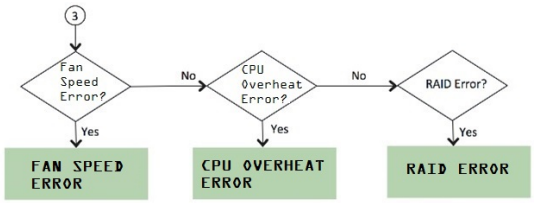
Detecting Error Conditions in Display Mode

If more than one error condition is detected, all error conditions will be displayed in sequence with a 2 second pause before switching to the next one. All error conditions need to be cleared before the status returns back to the NORMAL state. Error conditions include:

- Overheat
- Fan Failure
- RAID Errors

The below figure shows the various error conditions that are detected.

Figure 569: Error Conditions



To detect the error conditions in the display mode:
If there are any error conditions, they are automatically shown on the LCD screen when it is in the display mode. The types of errors displayed are: Fan Failures, CPU overheating and RAID errors. If there are multiple errors they would be displayed in the order shown in the abpve figure with a two second pause between successive displays.
The error message is automatically cleared when the underlying error condition is resolved. For example: the CPU overheat message disappears when CPU temperature is lowered. The user can enter the Menu mode at any point, even if an error message is being displayed.

Menu Mode

The menu mode is activated when the user presses any button. A single press of the button changes to menu mode and loads the last selected menu selection.

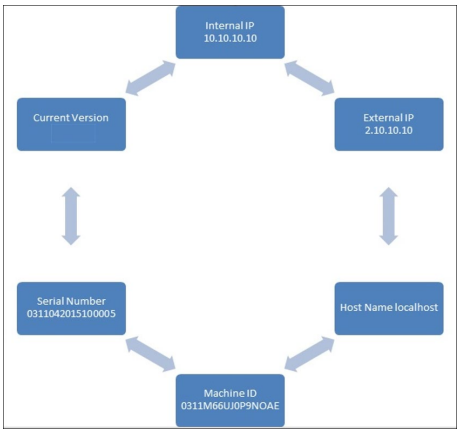
To view information in the menu mode:

1. Press any button. This puts the LCD into menu mode.
2. Press the right and left arrows keys to obtain the available system configuration data.
3. View information starting with the Internal IP and moving in a clockwise direction.
4. The menu screens loop back in a cycle.
5. Press Cancel at any point to exit to display mode.

NOTE: Any button, even cancel will put the user in the menu mode.

The below figure show the available system configuration data available in menu mode.

Figure 570: System Configuration Data Available in Menu Mode



Displaying Active Users

You can use the Active Users page to display the system active users table and to perform administrative actions pertaining to active sessions.

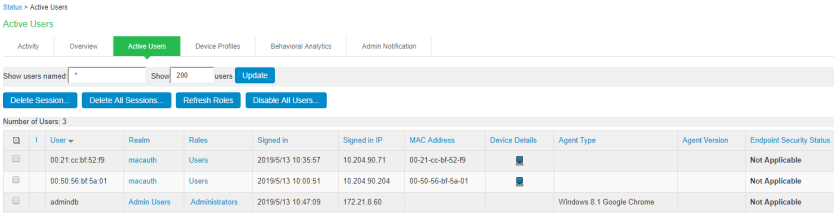
The system active users table displays all users who have an active session (in contrast to the users tables that appear on the authentication server configuration pages, which display session records for active and inactive sessions that were authenticated by the particular authentication server).

If a user signs in and is placed in a VLAN without an IP address, the table does not display an IP address under Signed in IP.

If there is a NAT device between the user's computer and the Infranet Enforcer, the table displays both the NAT device's IP address and the endpoint's virtual source IP address under Signed in IP. For example, if the NAT device's IP address is 10.64.9.26, and the endpoint's virtual source IP address is 192.168.80.128, the following information is displayed under Signed in IP: **10.64.9.26 (192.168.80.128 behind NAT)**.

To display the system Active Users page:

1. Select **System > Status**.
2. Click the **Active Users** tab to display the system active users page.
3. Use the controls described in table below to perform administrative actions pertaining to active sessions.



Note: Profiler publishes signed in IP address in Active users page only if RADIUS Accounting is disabled and signed in IP is not available for the user session.

Table138: Active Users Page

Buttons	Administrative Actions
Update	Refresh records displayed on the page: • To refresh the page, click **Update**. • To display a specific user, enter the username in the Show Users Named box and click **Update**. If you do not know the exact username, use the asterisks (*) as a wildcard character. • To change the table size, enter a number in the Show N users box and click **Update**. TIP: To sort the table of currently signed-in users and administrators, click a column header.
Delete Session	Select the check box next to the appropriate names and then click **Delete Session** to immediately delete the session. The user is signed out by your action.
Delete All Sessions	Use this option to immediately delete all sessions. Users are signed out by your action. NOTE: If you want to sign out administrators, you must choose them individually and use the Delete Session button.
Refresh Roles	Manually evaluate all authentication policies, role-mapping rules, role restrictions, user roles, and resource policies for all currently signed-in users. Use this button if you make changes to an authentication policy, role-mapping rules, role restrictions, or resource policies and you want to immediately refresh the roles of all users.
Disable All Users	Sign out all end users who are currently signed-in and also prevent any other users from signing in. To allow users to sign in again after you disable all users, click **Enable All Users**.

Troubleshooting

This chapter describes admin console troubleshooting tools. It includes the following information:

Overview

You can use the admin console troubleshooting tools to investigate user access issues and system issues. The following tools are available through the Maintenance > Troubleshooting pages:

- Policy tracing—Diagnose user access issues.
- Debug logs—Work with PSGSC to diagnose system issues.
- RADIUS diagnostic log—Diagnose issues with PPS RADIUS server.
- tcpdump—Sniff packet headers to diagnose networking issues.
- Network troubleshooting commands—Use standard network commands, such as ping, traceroute, NSlookup, and other commands to diagnose networking issues.
- Kerberos debugging—Diagnose issues with Kerberos communication.
- System snapshots—Work with PSGSC to reproduce and diagnose system issues.
- Remote debugging—Enable PSGSC to access your system directly to help you diagnose system issues.

If the admin console is unavailable, you can use the serial port console to perform some troubleshooting operations, such as use ping and traceroute commands, view logs, create system snapshots, and perform configuration rollbacks and factory resets.

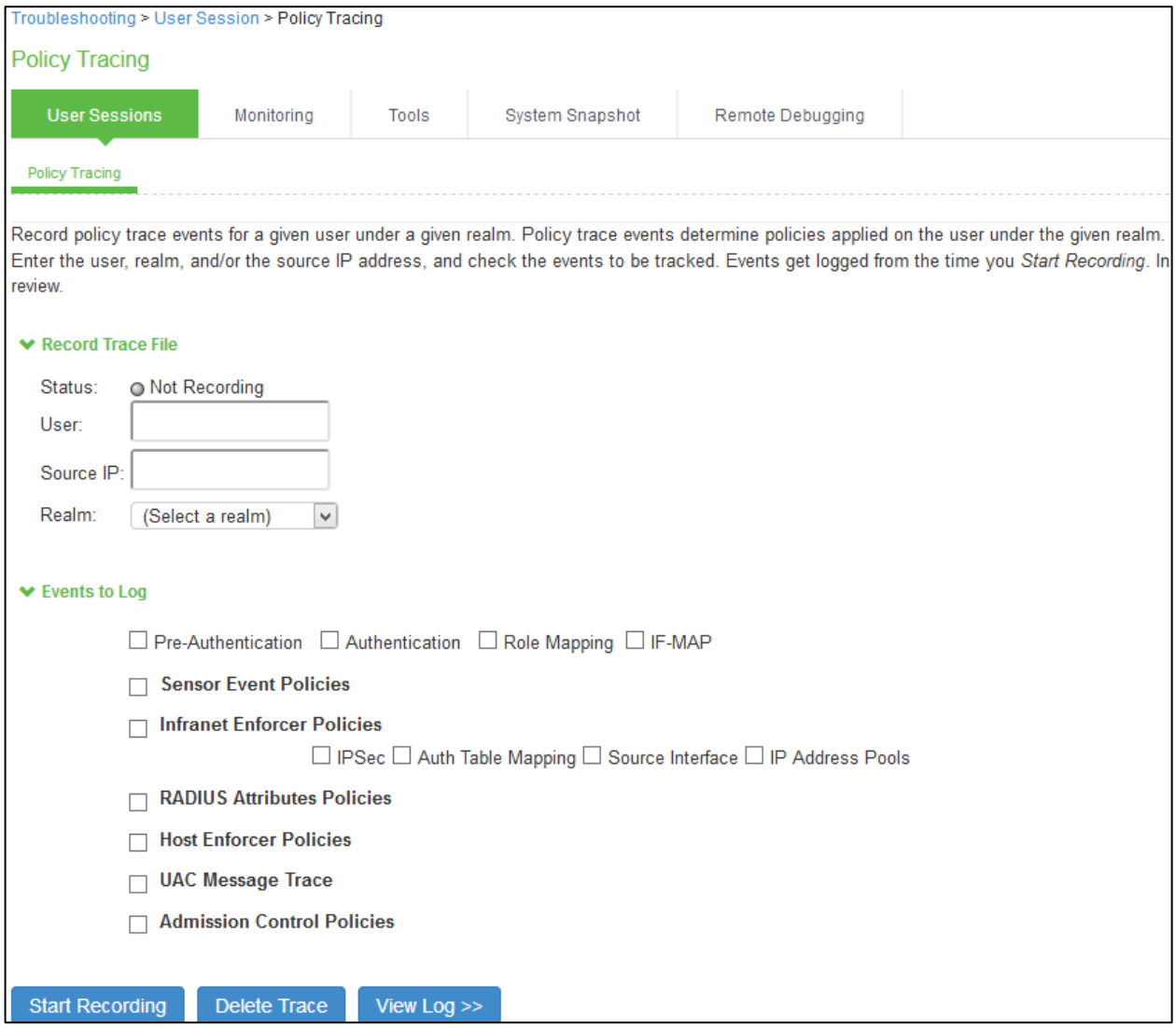
Policy Tracing

It is common to encounter a situation where the system denies a user access to the network or to resources, and the user logs a trouble ticket. You can use the policy tracing utility and log to determine whether the system is working as expected and properly restricting access, or whether the user configuration or policy configuration needs to be updated to enable access in the user's case.

To create a policy trace log:

1. Select **Maintenance > Troubleshooting > Policy Tracing** to display the configuration page.

Figure571: Policy Tracing Configuration Page



2. Complete the configuration as described below.

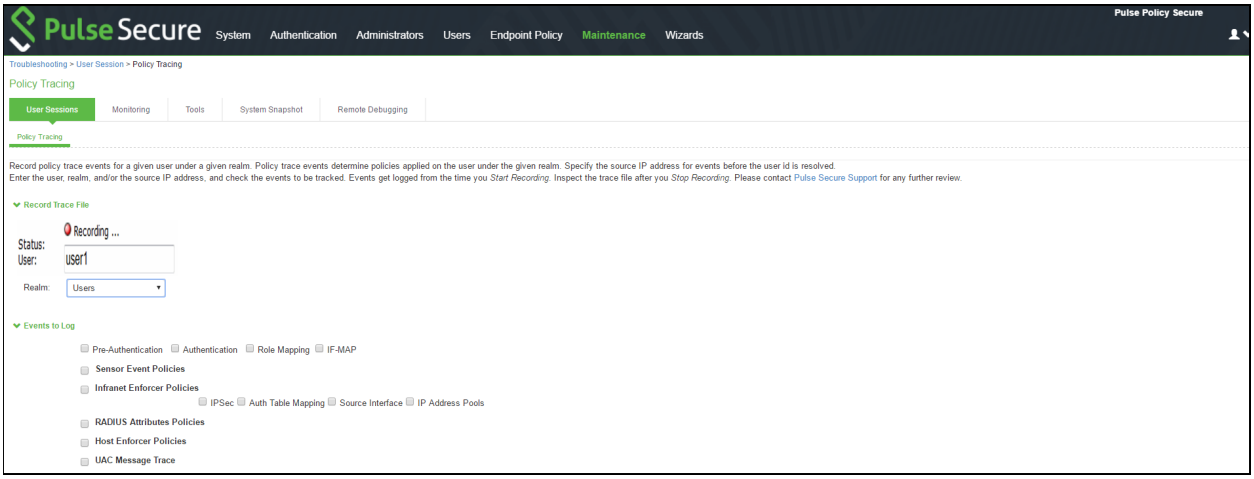
Table139: Policy Trace Configuration Guidelines

Settings	Guidelines
Record Trace File	
User	Specify the username to trace. If you are tracing anonymous access, you can use the asterisks wildcard character (*) because you might not know the internal username the system assigns to the next anonymous session.
Source IP	Specify the source IP address if you know it. If you are able to provide the source IP address, the policy trace log can include events that occur before the user ID is entered into the system.
Realm	Select the realm to trace.
Events to Log	
Pre-Authentication	Logs events related to evaluation of realm rules.
Authentication	Logs events related to authentication.
Role Mapping	Logs events related to role mapping.
IF-MAP	Logs events related to IF-MAP queries related to the session.
Sensor Event Policies	Logs events related to sensor policies.
Infranet Enforcer Policies	Logs events related to Layer 3 Infranet Enforcer policies.
RADIUS Attributes Policies	Logs events related to Layer 2 802.1X access.
PPS Message Trace	Logs PPS messages.
Admission Control Policies	Logs events related to admission control policies.

3. Click **Start Recording**.

The following figure shows the policy tracing page with the recording indicator.

Figure572: Policy Tracing Page During Recording



4. Initiate the action you want to trace, such as a user sign in.
5. Click **View Log** to display the policy trace results log.
6. Click **Stop Recording** when you have enough information.

The below table describes options for managing the policy trace results log file.

Table140: Post-Trace Options

Control	Guidelines
Delete Trace	Under Events to Log, click **Delete Trace** to clear the results displayed on this page.
Update	Specify a number of rows to display and click **Update** to change the number of rows that are displayed.
Save Log As	Click this button to save the trace results log to a file. This is useful particularly when you are working with the Pulse Secure Global Support Center (PSGSC) to troubleshoot a case.
Clear Log	Click this button to clear the log file from the system.

Debug Logs

The Pulse Secure Global Support Center (PSGSC) might direct you to create a debug log to assist them in helping you debug an issue with the system. The debug log is used only by PSGSC.

To use debug logging:

1. Select **Maintenance > Troubleshooting > Debug Log** to display the configuration page.
2. Complete the configuration as described below.
3. Click **Save Changes**. When you save changes with Debug Logging On selected, the system begins generating debug log entries.
4. Initiate the action you want to debug, such as a user sign in. You can reset the debug log file to restart debug logging if it takes you too long to initiate the action.
5. Click **Save Debug Log** to save the debug log to a file that you can send to PSGSC. You can clear the log after you have saved it to a file.
6. Unselect **Debug Logging On** and click **Save Changes** to turn off debug logging.

Figure573: Debug Logging Configuration Page

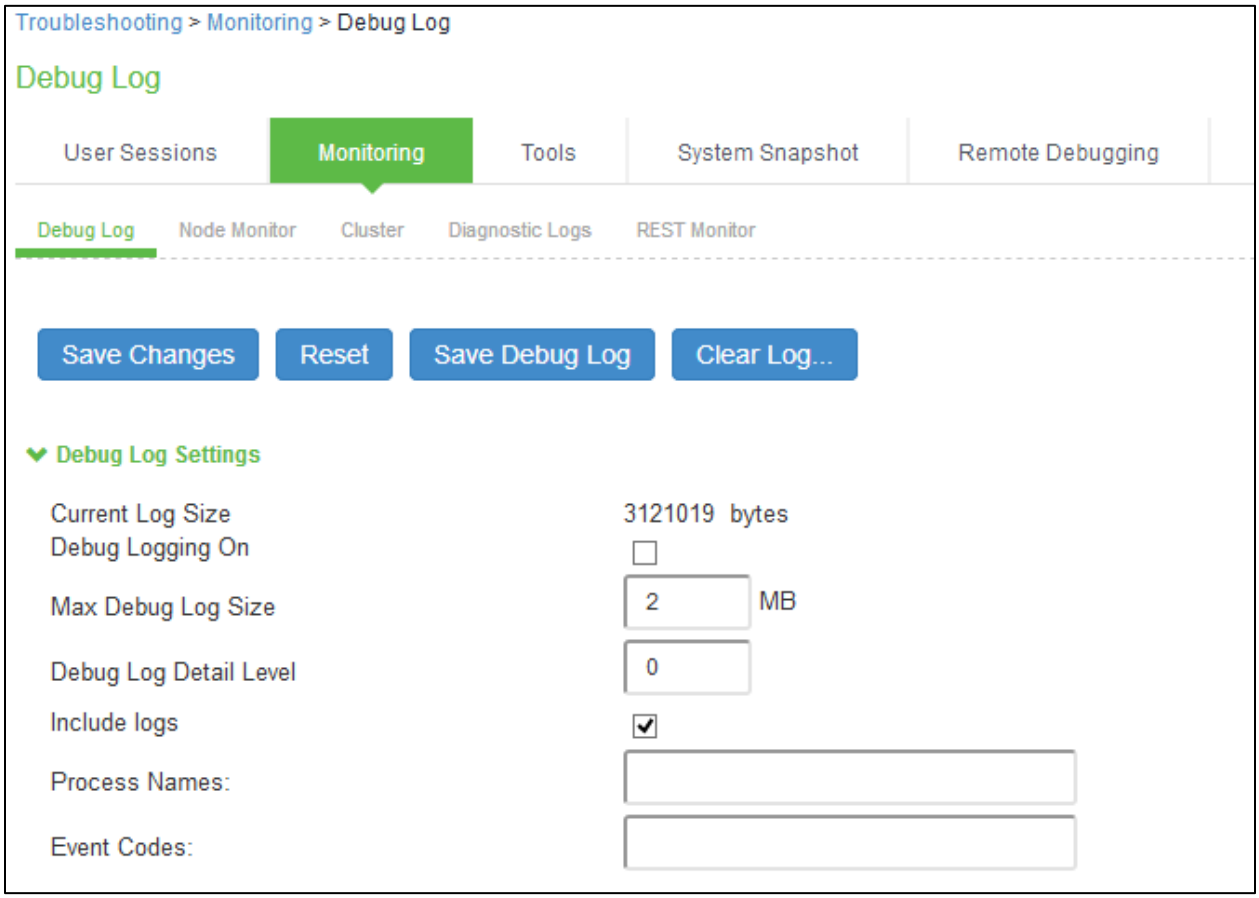


Table141: Debug Log Configuration Guidelines

Settings	Guidelines
Current Log Size	Displays the size of the current log file. If it is large, use the controls to save, reset, or clear the log file.
Debug Logging On	Select to turn on debug logging.
Debug Log Size	Specify a maximum debug log file size. The default is 2 MB. The maximum is 250 MB.
Debug Log Detail Level	Specify the debug log detail level. Obtain this from PSGSC.
Include logs	Select this option to include system logs in the debug log file. Recommended.
Process Names	Specify the process name. Obtain this from PSGSC.
Event Codes	Specify the event code. Obtain this from PSGSC.

RADIUS Diagnostic Logs

The RADIUS diagnostic log utility allows you to view trace and debug-level RADIUS messages. When RADIUS diagnostic logging is enabled, the diagnostic tool logs all requests that PPS receives from RADIUS clients. RADIUS requests initiated by PPS do not appear in the log.

Observe the following guidelines:

- Diagnostic logging affects system performance.
- All events that appear in the log have an ID code, and all messages in a thread are tagged with the same ID. This allows you to track individual log ins or log in attempts.
- Source IP addresses are represented as 127.0.0.1 (the loopback address).
- For Layer 2 connections, the calling station ID is the MAC address of the endpoint.
- Passwords are suppressed and do not appear in the logs.
- When the log fills up, logging stops. You can clear the log to restart logging.
- Raw traffic is not available in the log. To view raw traffic, use the tcpdump feature.

To use RADIUS diagnostic logging:

1. Select **Maintenance > Troubleshooting > Diagnostics Logs** to display the configuration page.
2. Complete the configuration as described below.
3. Click **Save Changes**. When you save changes with RADIUS Diagnostic Logging On selected, the system begins generating diagnostic log entries.
4. Initiate the action you want to debug, such as a user sign in. You can clear the debug log file to restart diagnostic logging if it takes you too long to initiate the action.
5. Manage the resulting log:
   - Click **Save Log** to save the log files in a zipped format.
   - Click **Clear Log** to remove previous logs and start diagnostic logging with a fresh file.
   - Click **Save And Clear Log** to save the diagnostic log to a file that you can send to PSGSC. The existing logs in the device will be cleared after saving.
6. Unselect **RADIUS Diagnostic Logging On** and click **Save Changes** to turn off diagnostic logging.

Figure574: RADIUS Diagnostic Logging Configuration Page

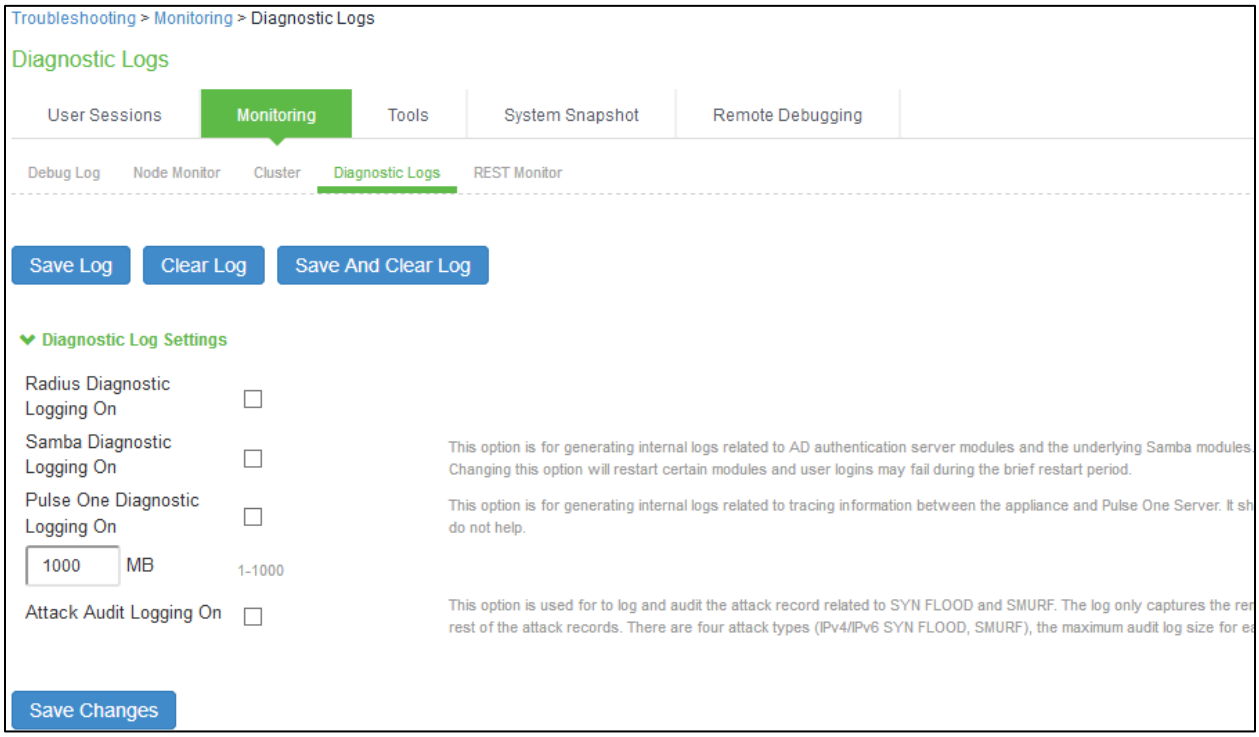


Table142: RADIUS Debug Log Configuration Guidelines

Settings	Guidelines
RADIUS Diagnostic Logging On	Specify the source IP address if you know it. If you are able to provide the source IP address, the policy trace log can include events that occur before the user ID is entered into the system.
Max Diagnostic Log Size	Specify a maximum logfile size. The default is 1000 MB.

Samba Diagnostic Logs

The Samba diagnostic log utility allows you to view trace and debug the samba troubleshooting messages on the new AD authentication server. When samba diagnostic logging is enabled, the internal logs related to AD authentication server is generated.

Observe the following guidelines:

- Diagnostic logging affects system performance.
- Must be used only when the admin UI error messages, event logs and admin logs are not very useful.
- Enabling/Disabling samba logs will restart certain modules and user log ins may fail during the restart.
- The default debug log setting will generate minimal logs. Enabling debug log with event AAA or AAA::samba along with this feature can generate more logs based on the debug log level.
- Enabling samba logs will cause logs to be generated from all configured AD authentication servers. Logs from multiple AD servers are interleaved and can be identified by the header in each line of the logs.

To use samba diagnostic logging:

1. Select **Troubleshooting > Monitoring > Diagnostic Logs** to display the configuration page.
2. Complete the configuration as described below.
3. Click **Save Changes**. When you save changes with Samba Diagnostic Logging On selected, the system begins generating diagnostic log entries.
4. Initiate the action you want to debug, such as a user sign in.
5. Manage the resulting log:
   - Click **Save Log** to save the log files in a zipped format.
   - Click **Clear Log** to remove previous logs and start diagnostic logging with a fresh file.
   - Click **Save And Clear Log** to save the diagnostic log to a file that you can send to PSGSC. The existing logs in the device will be cleared after saving.
6. Unselect **Samba Diagnostic Logging On** and click **Save Changes** to turn off diagnostic logging.

Table143: Samba Debug Log Configuration Guidelines

Settings	Guidelines
Samba Diagnostic Logging On	Select this option to generate logs related to AD server.
Max Diagnostic Log Size	Specify a maximum log file size. PPS • Default (MB)- 10 • Maximum (MB)-100

TCP Dump

This is a tool to sniff the packet, when you want to examine that the expected packet really reached a node. You can run the tcpdump utility to sniff the packet headers on the network and save them on a dump file.

To use tcpdump:

1. Select **Maintenance > Troubleshooting > TCP Dump** to display the configuration page.

2. Complete the configuration as described below.
3. Click **Start Sniffing** to start the tcpdump process.
4. Initiate the action you want to debug, such as a user sign in.
5. Click **Stop Sniffing** to write the tcpdump output to the screen.
6. Click **Get** to save the output to a file, or click **Delete** to clear the output.

Figure575: TCP Dump Configuration Page

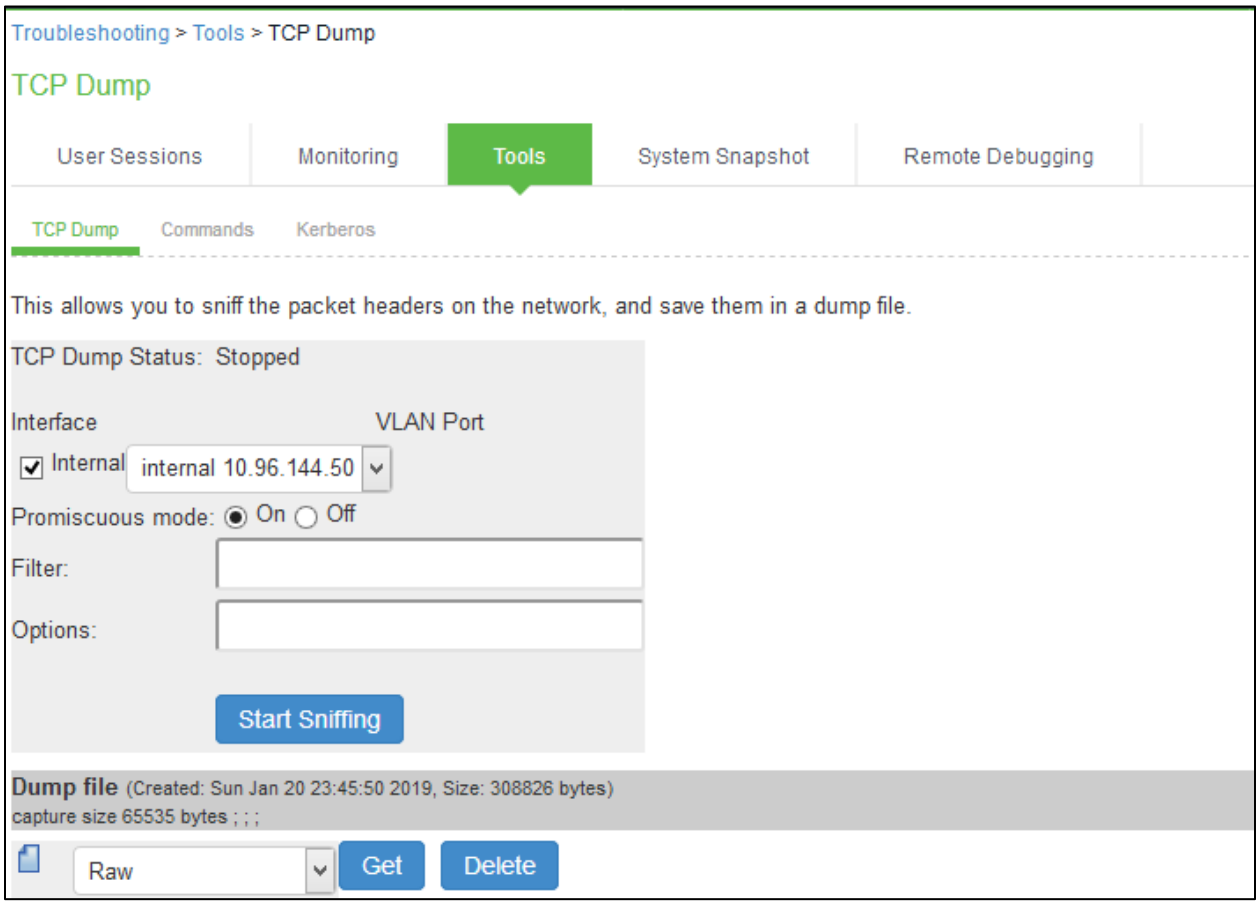


Table144: Debug Log Configuration Guidelines

Settings	Guidelines
TCP Dump Status	Displays whether the utility is stopped or running.
Interface	Select the ports on which to sniff.
VLAN Port	Select the VLAN port.
Promiscuous mode	Select a promiscuous mode option.
Filter	Specify a filter expression. For information about TCP dump filter expressions, see the UNIX man page.

Settings	Guidelines	
	Example	**Result**
	tcp port 80	Sniffs packets on TCP port 80.
	port 80	Sniffs packets on TCP or UDP port 80.
	ip	Sniffs the IP protocol.
	tcp	Sniffs the TCP protocol.
	dst #.#.#.#	Sniffs the destination IP address specified, where #.#.#.# is a valid IP address.
	src #.#.#.#	Sniffs the source IP address specified, where #.#.#.# is a valid IP address.
	port 80 or port 443	Sniffs on port 80 or port 443.
	src #.#.#.# and dst #.#.#.#	Sniffs the source and destination IP addresses or hosts specified, where each #.#.#.# represents a valid IP address.
	tcp port 80 or port 443 and dst #.#.#.# and src #.#.#.#	This example shows how to specify multiple parameters to create a filter that sniffs on TCP port 80, or on TCP or UDP port 443, and on the destination and source ports, where each #.#.#.# represents a valid IP address.

Network Troubleshooting Commands

You can run common network troubleshooting commands such as arp, ping, ping6, traceroute, traceroute6, NSlookup, and AvgRTTs from the admin console. You can use these connectivity tools to see the network path from the system to a specified server. If a client can ping or traceroute to the access system, and the access system can ping the target server, any remote users should be able to access the server through the access system.

To run network troubleshooting commands:

1. Select **Maintenance > Troubleshooting > Commands** to display the configuration page.
2. Complete the configuration as described below.
3. Click **OK** to run the command and write the output to the screen.
4. Click **Clear** to clear the output.

Figure576: Network Troubleshooting Commands Configuration Page

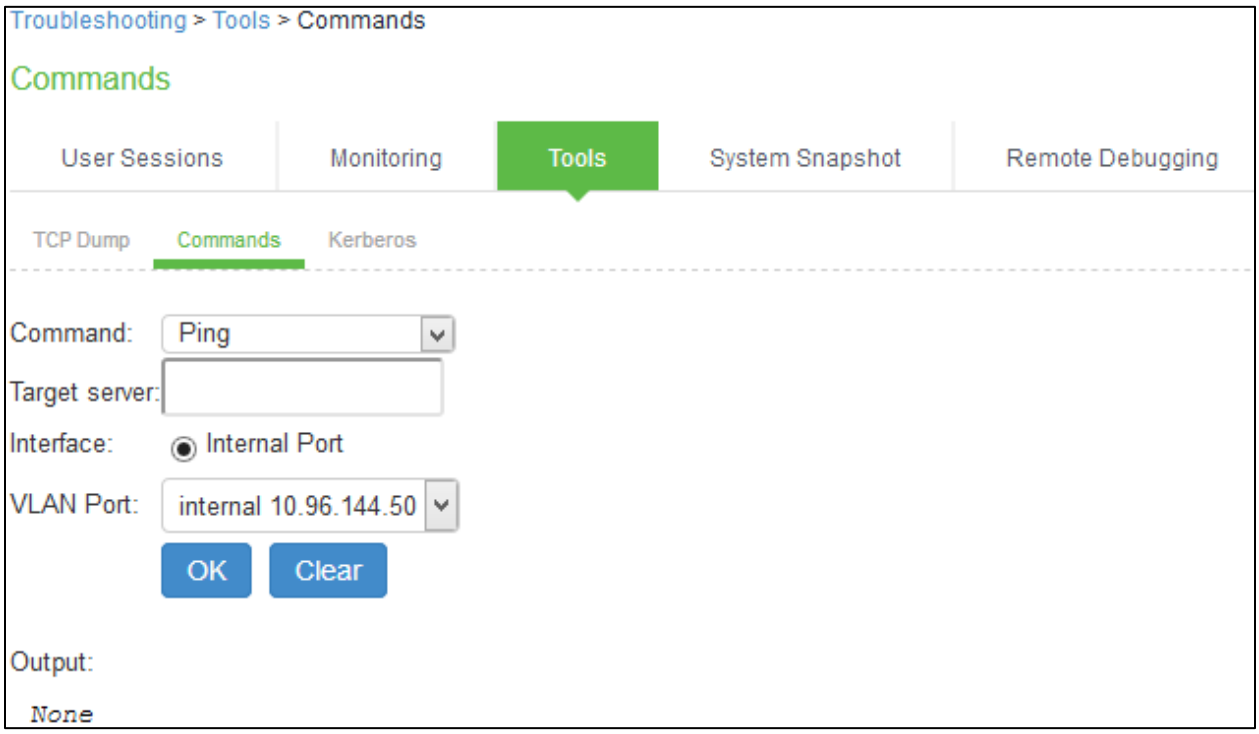


Table145: Network Troubleshooting Commands Configuration Guidelines

Settings	Guidelines
Command	Select a network troubleshooting command: • **Ping/Ping6**—Use the ping command to verify that the system can connect to other systems on the network. In the event of a network failure between the local and remote nodes, you do not receive a reply from a pinged device. In that case, contact your LAN administrator for help. The ping command sends packets to a server and returns the server response, typically a set of statistics including the target server's IP address, the time spent sending packets and receiving the response, and other data. You can ping unicast or multicast addresses, and you must include the target server name in the request. Select **ping** to ping an IPv4 address or hostname. Select **ping6** to ping an IPv6 address. We do not support DNS resolution for hosts with IPv6 addresses. Hence, ping6 does not support pings to hostnames. • **Traceroute/Traceroute6**—Use the traceroute command to discover the path that a packet takes from PPS to another host. Traceroute sends a packet to a destination server and receives an ICMP TIME_EXCEEDED response from each gateway along its path. The TIME_EXCEEDED responses and other data are recorded and displayed in the output, showing the path of the packet round-trip. Select **traceroute** to target an IPv4 address or hostname. Select **traceroute6** to target an IPv6 address. We do not support DNS resolution for hosts with IPv6 addresses. Hence, traceroute6 does not support traceroute to hostnames. • **NSLookup**—Use NSlookup to get detailed information about a name server on the network. You can query on several different types of information, including a server's IP address, alias IP address, start-of-authority record, mail exchange record, user information, well-known services information, and other types of information. • **ARP**—Use the arp command to map IP network addresses to the hardware addresses. The Address Resolution Protocol (ARP) allows you to resolve hardware addresses. To resolve the address of a server in your network, a system sends information about its unique identifier to a server process executed on a server in the intranet. The server process then returns the required address to the client process. • **AvgRTTs**—Use AvgRTTs to display the average round-trip time (RTT) to the localhost. • **Portprobe**—Display the Transmission Control Protocol (TCP) or the User Datagram Protocol (UDP) port status (open or closed).
Target server	Specify the IP address or hostname for the target server.
Interface	Select the interface from which to send the command.
VLAN Port	Select a VLAN port, to test connectivity to a subscriber intranet.
Output	Displays command output.

Troubleshooting TCP and UDP Port Status

Problem	**Description:** The system makes several connections to back-end servers using various port numbers. If communication between the system and the back-end servers stops, it can be difficult to determine the source of the problem.
Solution	You can use the Portprobe command to display the Transmission Control Protocol (TCP) or the User Datagram Protocol (UDP) port status (open or closed).

NOTE: Only the system internal ports, management port and internal VLAN ports support the Portprobe command.

A TCP port can be closed under two conditions:

- The system sends a connection request to the back-end server port and the back-end server closes the connection (sends an RST packet).
- The connection request times out because the back-end server is not found or the back-end server is too busy to respond to the connection request.

If either of these conditions occurs, the system sends a ping command to the back-end server. If the ping command is successful, the back-end server is considered reachable but the back-end server port is closed. If the ping command fails, the back-end server is considered unreachable.

For UDP ports, the system sends a UDP datagram with a ping to the back-end server port. If the back-end server responds with Internet Control Message Protocol (ICMP) port unreachable or ICMP unreachable, the back-end port is considered unreachable. If the back-end server responds with ICMP host unreachable then the back-end server is considered unreachable.

To troubleshoot the TCP or UDP port:

1. Select **Maintenance > Troubleshooting > Tools > Commands**.
2. Select the **Portprobe** command.
3. Select either **TCP** or **UDP**.
4. Enter the target server and port number. You can enter an IP address, hostname or FQDN for the target server.
5. Enter the probe count. This is the number of times the system attempts to communicate with the back-end server port. The default for TCP is one; the default for UDP is five.
6. Enter the probe timeout. This is the number of seconds the system waits for a response from the back-end server port.
7. Select either the internal port or the management port. If the management port is not configured, it is not displayed.
8. If using an internal port, select the internal VLAN port from the list.
9. Click **OK**.

The following figure shows an example of a successful and an unsuccessful port probe.

Figure577: Successful TCP Port Probe

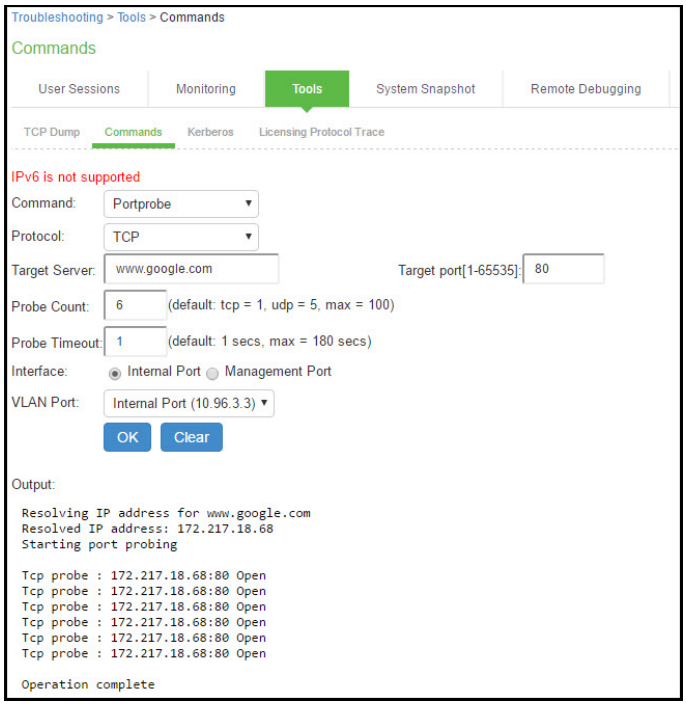
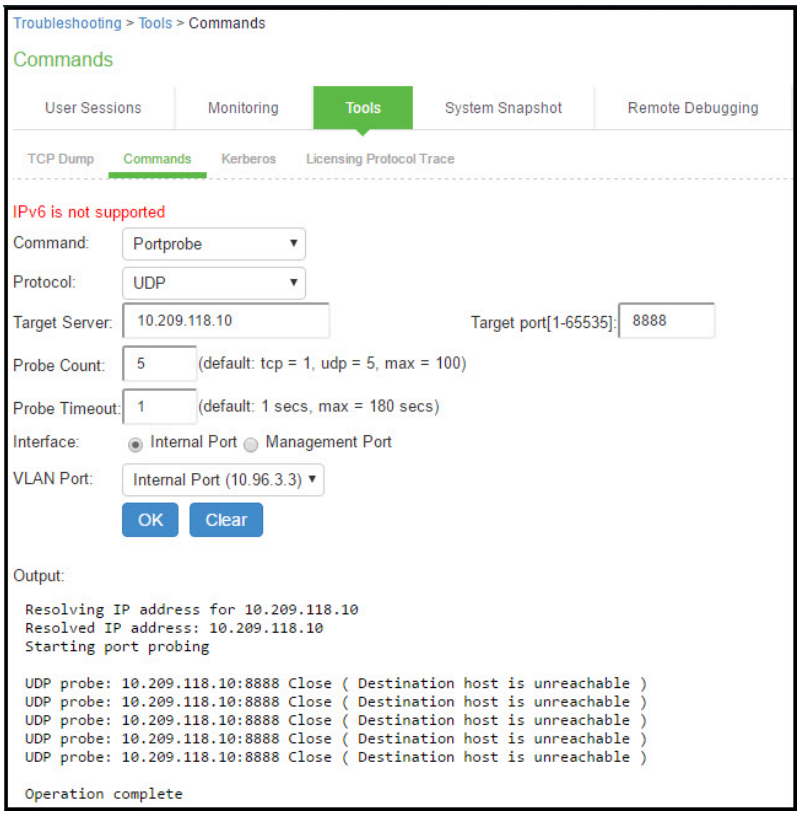


Figure578: Unsuccessful UDP Port Probe

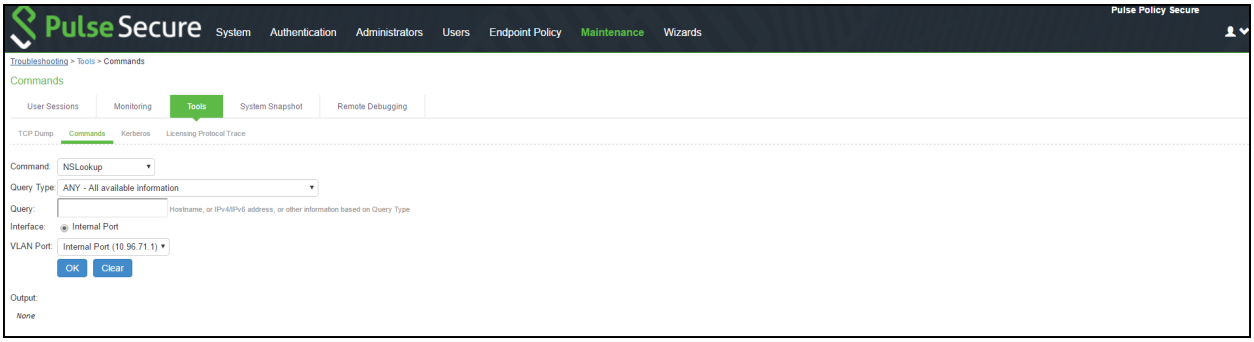


Testing Server Connectivity

To run NSLookup to test name server connectivity:

1. In the admin console, choose **Maintenance > Troubleshooting >Tools > Commands**.
2. From the Command list, select **NSLookup**.
3. Select the type of query to use from the Query Type drop down menu.
4. Enter the query, which is a hostname, an IP address, or other information, depending on your selection of query type.
5. Enter the VLAN port.
6. Click **OK** to run the command.

Figure579: Network Troubleshooting Commands Configuration Page



Kerberos Debugging

You can run the Kerberos debugging utility from the admin console. The utility checks the DNS infrastructure for validity of the Kerberos realms and defined credentials.

To use the Kerberos debugging utility:

1. Select **Maintenance > Troubleshooting > Tools > Kerberos** to display the configuration page.
2. Complete the configuration as described below.
3. Click **Run** to start the debugging process.
4. Click **Get** to save the output to a file, or click **Delete** to clear the output.

Figure580: Kerberos Debugging Utility Configuration Page

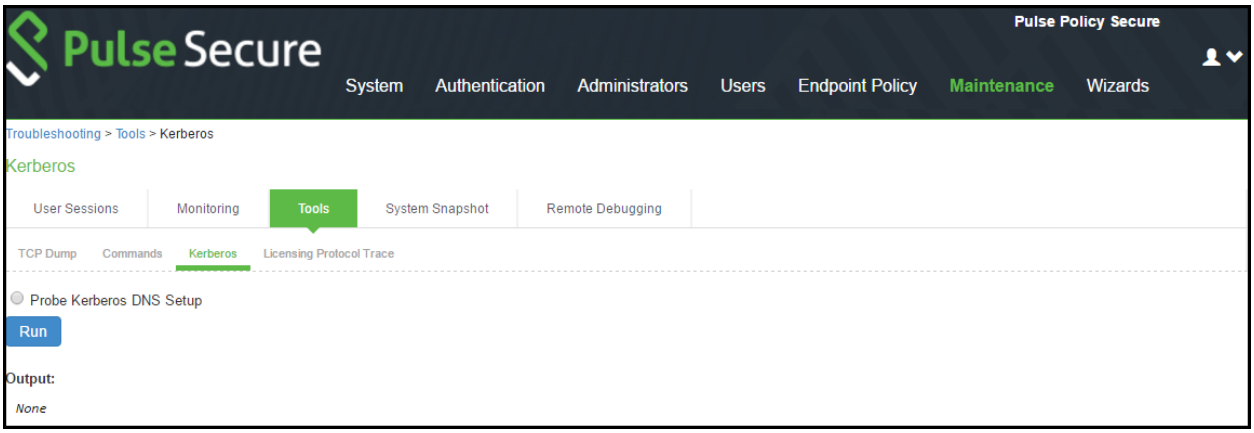


Table146: Kerberos Debugging Utility Configuration Guidelines

Settings	Guidelines
Probe Kerberos DNS Setup	Select this option to display the configuration elements for the Kerberos DNS test.
Kerberos Realm	Specify the realm name.
Site	Specify the fully qualified domain name.

Output	Displays results of the probe, for example:
	
	`KDCs for realm matrix.net:`
	`top.matrix.net,top.matrix.net`
	`Operation complete`

Remote Debugging

Remote debugging allows Pulse Secure Global Support Center (PSGSC) to directly access this system over a secure connection. You should enable this feature only if you have been requested to do so by PSGSC in response to an issue that you have reported.

To enable remote debugging:

1. Select **Maintenance > Troubleshooting > Remote Debugging** to display the configuration page.
2. Complete the configuration and actions as described below.

Figure581: Remote Debugging Configuration Page

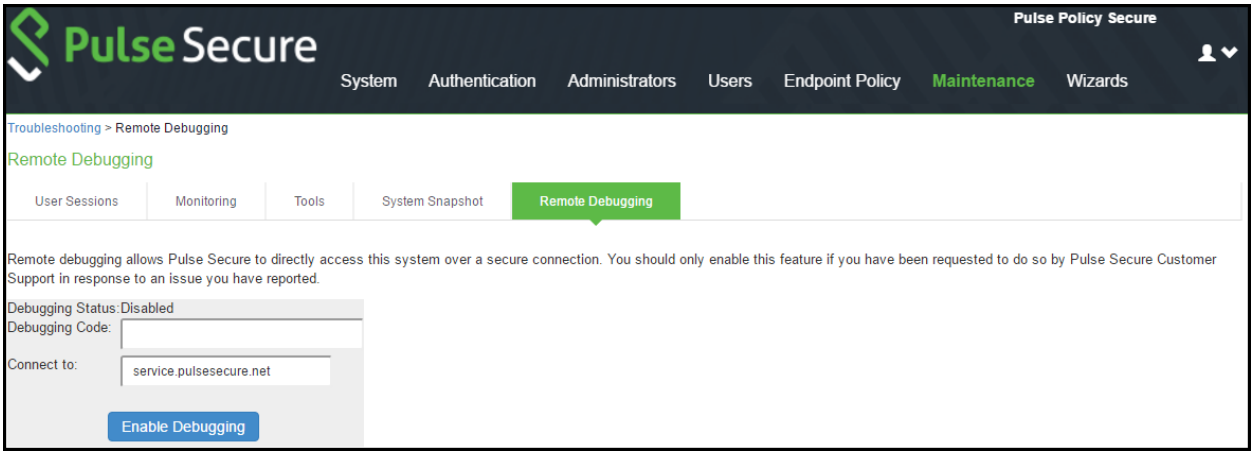


Table147: Remote Debugging Configuration and Action Guidelines

Settings	Guidelines
Debugging Status	Displays whether remote debugging is enabled or disabled.
Debugging Code	Specify a code as instructed by PSGSC.
Connect to	Specify the fully qualified domain name as instructed by PSGSC.
Enable Debugging	Click this option to allow remote debugging.

Troubleshooting the Common Issues with PPS

The below table describes the common issues with PPS and provides the possible resolution.

Table148: Troubleshooting

Category	Description	Resolution/KB docs
Installation	Integrating Cisco IP phone 7941 or 7911G for 802.1x authentication with the PPS solution	For more information, see KB 13668.
	Configuring Odyssey Client for Wired 802.1x	For problem resolution, see KB 10654.
	Pulse Secure Desktop Client prompts for certificate validation even though the Trusted Root certificate is installed	For problem resolution, see KB 23479.
	Communication Ports that are open by default on PPS device	For more information, see KB 24280.
Layer 2 (802.1X, MAC Auth, SNMP, RADIUS)	802.1X- "TLS handshake failed" posted to the PPS user access log	For problem resolution, see KB 13716.
	MAC Auth- Does PPS count MAC authentication against the concurrent user license?	For more information, see KB 24574.
	SNMP monitoring of PPS devices	For more information, see KB 26207.
	RADIUS dropped new Radius authentication request	For resolution, see KB 30167.
Layer 3 (SRX, SOS, PAN, Fortinet)	Juniper SRX firewalls disconnect and reconnect at random times causing loss of access to protected resources	For resolution, see KB KB 40024.
	Delay in removal of user session from Palo Alto Firewall after termination of session on PPS	For resolution, see KB 40165.
Host Checker	Upgrading ESAP in an L2 authentication environment	For resolution, see KB 28732.
	How to enforce domain membership with Host Checker Policy	For resolution, see KB 17389.
IF-MAP	Information on IF-Map Server and IF-Map Client	For more information, see KB 22006.
	Cannot find an option to enable IF-MAP server in admin GUI	For more information, see KB 23043.

Category	Description	Resolution/KB docs
Cluster	Cluster VIP flapping between both of the nodes in Active/Passive cluster	For resolution, see KB 21584.
	Cluster Licensing Best Practices	For more information, see KB 40093.
	Do the active nodes monitor the state of their own interface? Each node monitors both of it's interfaces by sending an ARP to the default gateway. This ARP message is sent every 5 seconds. The PPS waits up to 5 seconds for a response. If there is no response the PPS begins a wait period of 45 seconds. If there is still no response, the PPS marks the interface as down. Note: The ARP timeout value is configurable from the network settings page for each interface. Additionally, you can configure how many ARP ping timeouts are received before marking the interface as down. This applies to both interfaces and all nodes in the cluster. On the cluster properties page, there is an option to have each PPS disable their external interface in the event their internal interface goes down. This is a cluster-wide setting.	
	How big is the Synchronization Packet? This depends on how much data is synchronized. It is observed that approximately 1MB of data is transferred for 1000 users when a node is added to the cluster and synchronized. After the nodes are synchronized, data is sent only upon a status change. For example, user session status, user properties (bookmarks), or a change to the system configuration.	
	How does the PPS inform the local nodes if the passive becomes the Master? When one PPS fails, the other PPS detects the outage and assumes the VIP. It then issues a gratuitous ARP so that all local nodes (switches and routers included) will know the new MAC address for the VIP.	
	Explanation on LEADER cluster status and Sync Rank	For more information, see KB 13295.
	I have received my replacement PPS; how do I join it to my existing cluster?	For more information, see KB 13727.
	Procedure for replacing a device in an Active/Passive or Active/Active cluster	For more information, see KB 16146.
	Procedure to collect logs	For more information, see KB 21714.
AAA (AD, LADAP, RADIUS)	Users intermittently fail auth to Active Directory; NT_STATUS_IO_TIMEOUT seen in logs	For resolution, see KB 40179.
	Does the PPS server support, multiple instances of Active Directory/Windows NT, for the same domain?	For resolution, see KB 21702.
	What permissions are needed on the service account used within PCS/PPS Active Directory standard mode authentication server and	For resolution, see KB 40401.

Category	Description	Resolution/KB docs
	how to set it up using Delegate Control Wizard	
	Mapping based on Primary Group by using LDAP Authorization Server.	For more information, see KB 2527.
Guest	500 Internal Error, when attempting to sign into the GUAM portal Note: The customization for GUAM is no more supported from the PPS 5.2 release.	For resolution, see KB 40296.

Appendix

Custom Expressions and System Variables Reference

Using Custom Expressions in Rule Configuration

This topic describes custom expressions. It is intended for advanced users. It includes the following information:

Custom Expressions

Many system rules, such as role mapping rules or resource policy rules, support custom expressions. A custom expression is a combination of variables that the system evaluates as a Boolean object. The expression returns true, false, or error.

You can write custom expressions in the following formats. Note that elements of these formats are described in greater detail in the table that follows:

- *variable comparisonOperator variable*
- *variable comparisonOperator simpleValue*
- *variable comparisonOperator* (*simpleValue*)
- *variable comparisonOperator* (OR *Values*)
- *variable comparisonOperator* (AND *Values*)
- *variable comparisonOperator* (*time* TO *time*)

- *variable comparisonOperator* (*day* TO *day*)
- isEmtpy (*variable*)
- isUnknown (*variable*)
- (*customExpr*)
- NOT *customExpr*
- ! *customExpr*
- *customExpr* OR *customExpr*
- *customExpr* || *customExpr*
- *customExpr* AND *customExpr*
- *customExpr* && *customExpr*

Custom Expression Elements

Table 149: Custom Expression Elements

Element	Description
variable	Represents a system variable. A variable name is a dot-separated string, and each component can contain characters from the set [a-z A-Z 0-9_] but cannot start with a digit [0-9]. Variable names are case-insensitive. For system variables that you may use in role mapping rules and resource policies. When writing a custom expression in a log query field, you need to use system log variables. These variables are described in the **Filter Variables Dictionary** on the Filter page (**System > Log/Monitoring > Events | User Access | Admin Access > Filters** > *Select Filter* tab).
	Quoting syntax for variables: The system supports a quoting syntax for custom expression variables that allows you to use any character except '.' (period) in a user attribute name. To escape characters in an attribute name, quote some or all of the variable name using { } (curly-braces). For example, these expressions are equivalent: • userAttr.{Login-Name} = 'xyz' • userAttr.Login{-}Name = 'xyz' • {userAttr.Login-Name} = 'xyz' • userA{ttr.L}{ogin-}Name = 'xyz'
	• Escape characters supported within quotes: • ****—Escape a backslash (\). • **\{**—Escape a left curly brace ({). • **\}**—Escape a right curly brace (}). • **\hh**—Escape a hexadecimal value where hh is two characters from [0-9A-Fa-f].
	Examples: • userAttr.{Tree Frog} = 'kermit' • userAttr.{Tree\20Frog} = 'kermit'
	Notes: • There is no limit to the number of quotes you can use in a variable name. • You can use the quoting syntax with any variable, not just userAttr.* variables. • You need to use curly-brace quotes only when writing custom expressions.

Element	Description
comparisonOperator	One of the following: • **=**—Equal to. Use with strings, numbers, and DNs. • **!=**—Not equal to. Use with strings, numbers, and DNs. • **<**—Less than. Use with numbers. • **<=**—Less than or equal to. Use with numbers. • **>**—Greater than. Use with numbers. • **>=**—Greater than or equal to. Use with numbers.
simpleValue	One of the following: • *string* — quoted string that may contain wildcards. • *IP Address*—a.b.c.d • *subnet*—a.b.c.d/subnetBitCount or a.b.c.d/netmask • *number*—Positive or negative integer • *day*—SUN MON TUE WED THU FRI SAT Notes about strings: • A string may contain all characters except <nl> (newline) and <cr> (carriage return). • Strings can be any length. • String comparisons are case-insensitive. • Strings can be quoted with single- or double-quotes. A quoted string may contain wildcards, including star(*), question mark (?), and square brackets ([ ]). • *variable comparisonOperator variable* comparisons are evaluated without wildcard matching. • Use a backslash to escape these characters: single-quote (') — \' double-quote (") — \" backslash (\) — \\ hexadecimal — \hh [0-9a-fA-F] Note about *day*: Day and time comparisons are evaluated in the system's time zone. Day range (*day* TO *day*) calculations start with the first day and step forward until the second day is reached. In time range (*time* TO *time*) calculations, the first value must be earlier than the second value. Only time variables can be compared to day and time values. The time variables are: time.* and log inTime.*.
time	Time of day in one of the following formats: • *HH:MM* — 24-hour • *HH:MMam* — 12-hour • *HH:MMpm* — 12-hour • *H:MM* — 24-hour • *H:MMam* — 12-hour • *H:MMpm* — 12-hour Day and time comparisons are evaluated in the system's time zone. Day range (day TO day) calculations start with the first day and step forward until the second day is reached. In time range (time TO time) calculations, the first value must be earlier than the second value. Only time variables can be compared to day and time values. The time variables are: time.* and log inTime.*.
OR *Value*	String containing one or more OR comparisons: Examples: *variable comparisonOperator* (*number* OR *number* ...) *variable comparisonOperator* (*string* OR *string* ...)

Element	Description
AND *Value*	String containing one or more AND comparisons. Examples: *variable comparisonOperator* (*number* AND *number* ...) *variable comparisonOperator* (*string* AND *string* ...)
isEmpty	Function that takes a single variable name (*variable*) argument and returns a boolean value. isEmpty() is true if the variable is unknown or has a zero-length value, zero-length strings, and empty lists. Example: isEmpty(userAttr.terminationDate)
isUnknown	Function that takes a single variable name (*variable*) argument and returns a boolean value. isUnknown() is true if the variable is not defined. User attributes (userAttr.* *variables*) are unknown if the attribute is not defined in LDAP or if the attribute lookup failed (such as if the LDAP server is down). Example: isUnknown(userAttr.bonusProgram)
NOT, !	Logical negation *comparisonOperator*. The negated expression evaluates to true if the *customExpr* is false and evaluates to false if the *customExpr* is true. The operators NOT, AND, and OR are evaluated from highest to lowest precedence in this order: NOT (from right), AND (from left), OR (from left).
OR, ||	Logical operator OR ||, which are equivalent. The operators NOT, AND, and OR are evaluated from highest to lowest precedence in this order: NOT (from right), AND (from left), OR (from left).
AND, &&	Logical AND or &&, which are equivalent. The operators NOT, AND, and OR are evaluated from highest to lowest precedence in this order: NOT (from right), AND (from left), OR (from left).
customExpr	Expression written in the Custom Expression Syntax (see above).

Wildcard Matching

In a quoted string, supported wildcards include:

- star (*)—A star matches any sequence of zero or more characters.
- question mark (?)—A question mark matches any single character.
- square brackets ([ ])—Square brackets match one character from a range of possible characters specified between the brackets. Two characters separated by a dash (-) match the two characters in the specified range and the lexically intervening characters. For example, ‘dept[0-9]’ matches strings "dept0", "dept1", and up to "dept9".

To escape wildcard characters, place them inside square brackets. For example, the expression ' userAttr.x = " *value* [*]" ' evaluates to true if attribute x is exactly "*value**".

Using Multivalued Attributes

Multivalued attributes—attributes that contain two or more values—provide you with a convenient method for defining resources that expand into multiple individual bookmarks on the users’ bookmarks page.

For example, assume that the user’s LDAP directory contains the multivalued attribute HomeShares: \\Srv1\Sales;\\Srv2\Marketing. When you configure the Windows File share resource definition using the HomeShares multivalued attribute, \\<userAttr.HomeShares>, the user sees two bookmarks:

- \\Srv1\Sales

- \\Srv2\Marketing

Now let's assume the user's LDAP directory contains a second multivalued attribute defined as HomeFolders: Folder1;Folder2;Folder3. When you configure the Windows File share resource using both of the multivalued attributes, \\<userAttr.HomeShares>\<userAttr.HomeFolders>, the user sees the following six bookmarks:

- \\Srv1\Sales\Folder1
- \\Srv1\Sales\Folder2
- \\Srv1\Sales\Folder3
- \\Srv2\Marketing\Folder1
- \\Srv2\Marketing\Folder2
- \\Srv2\Marketing\Folder3

The only exception to this functionality is when the variable includes an explicit separator string. In this case, only one bookmark containing multiple resources displays on the users' bookmark page.

You specify the separator string in the variable definition using the syntax sep='string' where string equals the separator you want to use. For example, to specify a semi-colon as the separator, use the syntax <variable.Attr sep=';'>.

Use the following syntax for multivalued attributes handling. Note that <variable> refers to a session variable such as <userAttr.name> or <CertAttr.name>:

- <variable[Index]>—You specify indexes in a variety of ways. If, for example, the total number of values for a given index is 5, and you want to specify the entire range of values you use <variable[ALL]>. If you want to specify only the fourth value, you use <variable[4]>.
- <variable> is the same as <variable[ALL]>.
- <variable> is the same as <variable[ALL]>.
- <variable sep='str'> and <variable[All] sep='str'> — These variable definitions always refer to a single string value with all the tokens expanded out with separator strings between the values.

NOTE: Variable names cannot contain spaces.

Specifying Multivalued Attributes in a Bookmark Name

Another common case of using multivalued attributes occurs when you include a variable in a bookmark name and in a URL or file server/share field.

For example, again assume that the user's LDAP directory contains the multivalued attribute HomeShares: \\Srv1\Sales;\\Srv2\Marketing. When you configure the Windows File share resource definition using the HomeShares multivalued attribute, \\<userAttr.HomeShares>, and you use the same attribute in the bookmark name field, <userAttr.HomeShares>, the system creates two bookmarks:

- Srv1\Sales bookmark pointing to \\Srv1\Sales
- Srv2\Marketing bookmark pointing to \\Srv2\Marketing

This does not create a situation in which you end up with the following set of conditions:

- Srv1\Sales bookmark pointing to \\Srv1\Sales
- Srv1\Marketing bookmark pointing to \\Srv1\Marketing (error)
- Srv2\Sales bookmark pointing to \\Srv1\Sales (error)

- Srv2\Marketing bookmark pointing to \\Srv2\Marketing

Distinguished Name Variables

You can compare a distinguished name (DN) to another DN or to a string, but the system ignores wildcards, white space, and case. Note, however, that the system takes the order of DN keys into consideration.

When the system compares an expression to a DN to a string, it converts the string to a distinguished name before evaluating the expression. If the system cannot convert the string due to bad syntax, the comparison fails. The DN variables are:

- userDN
- certDN
- certIssuerDN

The system also supports DN suffix comparisons using the **matchDNSuffix** function. For example:

matchDNSuffix(certDn, "dc=danastreet,dc=net")

Within the parenthesis, the first parameter is the “ full” DN and the second is the suffix DN. You can use a variable or string for each parameter. Note that this first parameter should have more keys than the second (suffix parameter). Otherwise, if they are equal, it is the same as <*firstparam*> = <*secondparam*>. If the second parameter has more keys, **matchDNsuffix** returns false.

System Variables

The below table lists and defines system variables, gives an example for each system variable, and provides a guide as to where you may use system variables.

Table 150: System Variables and Examples

Variable	Description	Usage	Examples
authMethod	Type of authentication method used to authenticates a user.	role mapping rules, resource policy rules	authMethod = 'ACE Server'
cacheCleanerStatus	The status of Cache Cleaner. Possible values: 1 - if it is running 0 - if otherwise		cacheCleanerStatus = 1 cacheCleanerStatus = 0
certAttr.<cert-attr>	Attributes from a client-side certificate. Examples of certAttr attributes include: • C - country • CN - common name • description - description • e-mailAddress - e-mail address • GN - given name • initials - initials • L - locality name • O - organization • OU - organizational unit • SN - surname • serialNumber- serial number • ST - state or province • title - title • UI - unique identifier Use this variable to check that the user's client has a client-side certificate with the value(s) specified.	• role mapping rules • resource policy rules • SSO parameter fields • LDAP configuration	certAttr.OU = 'Retail Products Group'

Variable	Description	Usage	Examples
certAttr.altName.<Alt-attr>	Subject alternative name value from a client-side certificate where <Alt-attr> may be: • Email • EmailId • EmailDomain • DNS • registeredId • ipAddress • UPN • UPNid • UPNDomain • fascn • fascnAC • fascnSC • fascnCN • fascnCS • fascnICI • fascnPI • fascnOC • fascnOI • fascnPOA • fascnLRC	• role mapping rules • resource policy rules • SSO parameter fields • LDAP configuration	• certAttr.altName.email = "joe@company.com" • certAttr.altName.ipAddress = 10.10.83.2
certAttr.serialNumber	Client certificate serial number. Note that all characters other than [0-9 a-f A-F] are stripped out of a string before comparison with certAttr.SN. Wildcards are not supported.	• role mapping rules • resource policy rules • SSO parameter fields • LDAP configuration	• certAttr.SerialNumber = userAttr.certSerial • certAttr.SerialNumber = "6f:05:45:ab"
certDN	Client certificate subject DN. Wildcards are not permitted.	role mapping rules, resource policy rules	• certDN = 'cn=John Harding,ou=eng,c=Company' • certDN = userDN (match the certificate subject DN with the LDAP user DN) • certDN = userAttr.x509SubjectName • certDN = ('cn=John Harding,ou=eng,c=Company' or 'cn=Julia Yount,ou=eng,c=Company')

Variable	Description	Usage	Examples
certDN.<subject-attr>	Any variable from the client certificate subject DN, where subject-attr is the name of the RDN key. Use to test the various subject DN attributes in a standard x.509 certificate.	• role mapping rules • resource policy rules • SSO parameter fields • LDAP configuration	• certDN.OU = 'company' • certDN.E = 'joe@company.com' • certDN.ST = 'CA'
certDNText	Client certificate user DN stored as a string. Only string comparisons to this value are allowed.	• role mapping rules • resource policy rules • SSO parameter fields	certDNText = 'cn=John Harding,ou=eng,c=Company'
certIssuerDN	Client certificate-issuer subject DN. This variable works like a standard DN attribute such as CertDN. Wildcards are not permitted.	• role mapping rules • resource policy rules • SSO parameter fields	• certIssuerDN = 'cn=John Harding,ou=eng,c=Company' • certIssuerDN = userAttr.x509Issuer • certIssuerDN = ('ou=eng,c=Company' or 'ou=operations,c=Company')
certIssuerDN.<issuer-attr>	Any variable from the client certificate-issuer subject DN, where issuer-attr is the name of the RDN key.	• role mapping rules • resource policy rules • SSO parameter fields	• certIssuerDN.OU = 'company' • certIssuerDN.ST = 'CA'
certIssuerDNText	Client certificate-issuer subject DN stored as a string. Only string comparisons to this value are allowed.	• role mapping rules • resource policy rules • SSO parameter fields	certIssuerDNText = 'cn=John Harding,ou=eng,c=Company'
defaultNTDomain	Contains the Domain value set in the authentication server configuration when you use AD/NT authentication.	• role mapping rules • resource policy rules • SSO parameter fields	defaultNTDomain=” CORP”

Variable	Description	Usage	Examples
group.<group-name>	User's group membership as provided by the realm authentication or directory server.	• role mapping rules • resource policy rules Only those groups evaluated for role mapping rules are available in the detailed rules (conditions) in the resource policies. We recommend that you use the **groups** variable instead of **group.<group-name>**, which is supported only for backwards compatibility.	• group.preferredPartner • group.goldPartner or group.silverPartner • group.employees and time.month = 9 Combination examples: Allow all partners with active status from Monday to Friday but preferred partners Monday through Saturday: ((group.partners and time = (Mon to Fri)) or (group.preferredPartners and time = (Mon to Sat))) and userAttr.partnerStatus = 'active' NOTE: Spaces are not supported, such as, group.sales managers
Groups	List of groups as provided by the realm authentication or directory server. NOTE: You can enter any characters in the groupname, although wildcard characters are not supported.	• role mapping rules • resource policy rules • SSO parameter fields	groups=('sales managers')
hostCheckerPolicy	Host Checker polices that the client has met.	• role mapping rules • resource policy rules • SSO parameter fields	hostCheckerPolicy = ('Norton' and 'Sygate') and cacheCleanerStatus = 1hostCheckerPolicy = ('Norton' and 'Sygate')
log inHost	Hostname or IP address that the browser uses to contact the Pulse Secure service.	• role mapping rules • resource policy rules • SSO parameter fields • LDAP configuratio n	log inHost = 10.10.10.10

Variable	Description	Usage	Examples
log inTime	The time of day at which the user submits his credentials. The time is based on system time. NOTE: When using this variable in an SSO parameter field, the variable returns the UNIX string time.	• role mapping rules • resource policy rules • SSO parameter fields	• log inTime = (8:00am) • log inTime= (Mon to Fri)
log inTime.day	The day of month on which the user submits his credentials, where day is 1-31. The time is based on the system time. You cannot use the TO operator with this variable.	• role mapping rules • resource policy rules	log inTime.day = 3
log inTime.dayOfWeek	The day of the week on which the user submits his credentials, where dayOfWeek is in the range [0-6] where 0 = Sunday. The system does not support the **TO** operator with time.dayOfWeek expressions if you use numbers instead of strings. In other words, " log inTime.dayOfWeek = (2 TO 6)" does not work, but " log inTime.dayOfWeek = (mon to fri)" does work.	• role mapping rules • resource policy rules	• log inTime.dayOfWeek = (0 OR 6) • log inTime.dayOfWeek = (mon TO fri) • log inTime.dayOfWeek = (1) • log inTime.dayOfWeek = 5
log inTime.dayOfYear	The numeric day of the year on which the user submits his credentials, where dayOfYear can be set to [0-365]. You cannot use the TO operator with this variable.	• role mapping rules • resource policy rules	log inTime.dayOfYear = 100
log inTime.month	The month in which the user submits his credentials, where month can be set to [1-12] where 1 = January. You cannot use the TO operator with this variable.	• role mapping rules • resource policy rules	log inTime.month >= 4 AND log inTime.month <=9
log inTime.year	The year in which the user submits his credentials, where year can be set to [1900-2999]. You cannot use the TO operator with this variable.	• role mapping rules • resource policy rules	log inTime.year = 2005
log inURL	URL of the page that the user accessed to sign in. The system gets this value from the Administrator URLs|User URLs column on the **Authentication > Signing In > Sign-in Policies** page of the admin console.	• role mapping rules • resource policy rules • SSO parameter fields • LDAP configuration	log inURL = */admin

Variable	Description	Usage	Examples
networkIf	The network interface on which the user request is received. Possible values: internal, external	• role mapping rules • resource policy rules • SSO parameter fields	sourceIp = 192.168.1.0/24 and networkIf = internal
Ntdomain	The NetBIOS NT domain used in NT4 and Active Directory authentication.	• role mapping rules • SSO parameter fields	ntdomain = jnpr
Ntuser	The NT username used in Active Directory authentication	• role mapping rules • SSO parameter fields	ntuser = jdoe
password password[1] password[2]	The password entered by the user for the primary authentication server (password and password[1]) or the secondary authentication server (password[2]).	• role mapping rules • resource policy rules • SSO parameter fields	**password = A1defo2z**
Realm	The name of the authentication realm to which the user is signed in.	• role mapping rules • resource policy rules • SSO parameter fields	Realm = ('GoldPartners' or 'SilverPartners') NOTE: AND condition will always fail as a user is only allowed to sign in to a single realm in a session.
Role	List of all the user roles for the session. In SSO, if you want to send all the roles to back-end applications, use <role sep = ";"> - where sep is the separator string for multiple values. The system supports all separators except “ and >.	• resource policy rules • SSO parameter fields	• Role = ('sales' or 'engineering') • Role = ('Sales' AND 'Support')

Variable	Description	Usage	Examples
radius.requestAttributes.<reqAttrs>	Allows the user to filter the roles based on the incoming RADIUS request attributes. The list of default value are as follows: • radius.requestAttributes.Calling-Station-Id = <ANY> • radius.requestAttributes.NAS-IP-Address = <ANY> • radius.requestAttributes.NAS-Identifier = <ANY> • radius.requestAttributes.NAS-Port-Type = <ANY> • radius.requestAttributes.Called-Station-Id = <ANY> • radius.requestAttributes.Aruba-Essid-Name = <ANY> • radius.requestAttributes.User-Name = <ANY>	role mapping rules	radius.requestAttributes.Calling-Station-Id = "00:aa:3f:*"
locationGroup	Allows the user to filter the roles based on the location group.	role mapping rules	locationGroup = "bangalore"
eapProtocol.<protocolLayer>	Allows the user to filter the roles based on EAP protocol. <protocolLayer> indicates whether the variable matches the inner protocol or outer protocol. • The values for the outerProtocol variable are EAP-PEAP and EAP-TTLS. • The values for the innerProtocol are PAP, CHAP, MS-CHAP, MS-CHAP-V2, EAP-MD5, EAP-TLS, EAP-MSCHAP-V2, EAP-GTC, and EAP-JUAC.	role mapping rules	eap-protocol.outerProtocol != "EAP-PEAP"
sourceIP	The IP address of the machine on which the user authenticates. You can specify the netmask using the bit number or in the netmask format: '255.255.0.0'. Note that you can evaluate the sourceIP expression against a string variable such as an LDAP attribute.	• role mapping rules • resource policy rules • SSO parameter fields	• sourceIP = 192.168.10.20 • sourceIP = 192.168.1.0/24 and networkIf internal • userAttr.dept = ('eng' or 'it') and sourceIP = 10.11.0.0/16 • sourceIP = 192.168.10.0/24 (Class C) is the same as: sourceIP = 192.168.10.0/255.255.255.0 • sourceIP=userAttr.sourceip

Variable	Description	Usage	Examples
Time	The time of day at which the role mapping rule or resource policy rule is evaluated. The time of the day can be in 12-hour or 24-hour format.	• role mapping rules • resource policy rules	• time = (9:00am to 5:00pm) • time = (09:00 to 17:00) • time = (Mon to Fri) Combination examples: Allow executive managers and their assistants access from Monday to Friday: userAttr.employeeType = ('*manager*' or '*assistant*') and group.executiveStaff and time = (Mon to Fri)
time.day	The day of month on which the user submits his credentials to, where day is 1-31. The time is based on the system time.	• role mapping rules • resource policy rules	log inTime.day = 3
time.dayOfWeek	The day of the week on which the role mapping rule or resource policy rule is evaluated, where dayOfWeek is in the range [0-6] where 0 = Sunday.	• role mapping rules • resource policy rules	• log inTime.dayOfWeek = (0 OR 6) • log inTime.dayOfWeek = (1 to 5) • log inTime.dayOfWeek = 5
time.dayOfYear	The day of the year on which the role mapping rule or resource policy rule is evaluated. Possible values include: 1-365.	• role mapping rules • resource policy rules	time.dayOfYear = 100
time.month	The month in which the role mapping rule or resource policy rule is evaluated. Possible values include: 1-12	• role mapping rules • resource policy rules	• time.month >= 9 and time.month <= 12 and time.year = 2004 • group.employees and time.month = 9
time.year	The year in which the role mapping rule or resource policy rule is evaluated, where year can be set to [1900-2999].	• role mapping rules • resource policy rules	time.year = 2005

Variable	Description	Usage	Examples
user user@primary_auth_server_name user@secondary_auth_server_name	Pulse Secure username for the user's primary authentication server (user and user@primary_auth_server_name) or secondary authentication server (user@secondary_auth_server_name). Use when authenticating against an Active Directory server, domain and username. primary_auth_server_name is the name of the primary auth server. If there are spaces or special characters in the name, it can be enclosed in curly brackets. For example user@{My Primary Auth Server} secondary_auth_server_name is the name of the secondary auth server. If there are spaces or special characters in the name, it can be enclosed in curly brackets. For example user@{My Secondary Auth Server} NOTE: When including a domain as part of a username, you must include two slashes between the domain and user. For example: user='yourcompany.net\\joeuser'.	• role mapping rules • resource policy rules • SSO parameter fields	• user = 'steve' • user = 'domain\\steve'
username username@primary_auth_server_name username@secondary_auth_server_ name	Pulse Secure system username for the user's primary authentication server (username and username@primary_auth_server_name) or secondary authentication server (username@secondary_auth_server_name). If the user is signing in to a certificate authentication server, then the user's Pulse Secure system username is the same as CertDN.cn. primary_auth_server_name is the name of the primary auth server. If there are spaces or special characters in the name, it can be enclosed in curly brackets. For example user@{My Primary Auth Server} secondary_auth_server_name is the name of the secondary auth server. If there are spaces or special characters in the name, it can be enclosed in curly brackets. For example user@{My Secondary Auth Server}	• role mapping rules • resource policy rules • SSO parameter fields	• username = 'steve' and time = mon • username = 'steve' • username = 'steve*' • username = ('steve' or '*jankowski')
userAgent	The browser's user agent string.	• role mapping rules • resource policy rules • SSO parameter fields	The browser's user agent string.

Variable	Description	Usage	Examples
userAttr.<auth-attr>	User attributes retrieved from an LDAP, RADIUS, or SiteMinder authentication or directory server.	• role mapping rules • resource policy rules • SSO parameter fields	• userAttr.building = ('HQ*' or 'MtView[1-3]') • userAttr.dept = ('sales' and 'eng') • userAttr.dept = ('eng' or 'it' or 'custsupport') • userAttr.division = 'sales' • userAttr.employeeType != 'contractor' • userAttr.salaryGrade > 10 • userAttr.salesConfirmed >= userAttr.salesQuota *Negative examples:* • userAttr.company != "Acme Inc" or not group.contractors • not (user = 'guest' or group.demo) *Combination examples:* Allow executive managers and their assistants access from Monday to Friday: userAttr.employeeType = ('*manager*' or '*assistant*') and group.executiveStaff and time = (Mon to Fri) Allow all partners with active status from Monday to Friday but preferred partners Monday through Saturday: ((group.partners and time = (Mon to Fri)) or (group.preferredPartners and time = (Mon to Sat))) and userAttr.partnerStatus = 'active'
userDN	The user DN from an LDAP server. If the user is authenticated by the LDAP server, then this DN is from the authentication server; otherwise, the DN comes from the realm's Directory/Attribute server. Wildcards are not permitted.	• role mapping rules • resource policy rules	• userDN = 'cn=John Harding,ou=eng,c=Company' • userDN = certDN

Variable	Description	Usage	Examples
userDN.<user-attr>	Any variable from the user DN, where user-attr is the name of the RDN key.	• role mapping rules • resource policy rules • SSO parameter fields	Any variable from the user DN, where user-attr is the name of the RDN key.
userDNText	User DN stored as a string. Only string comparisons to this value are allowed.	• role mapping rules • resource policy rules • SSO parameter fields	userDNText = 'cn=John Harding,ou=eng,c=Company'

Custom Variables and Macros

Custom variables, like system variables, are name-value pair tags that you can use when defining role mapping rules, resource policy rules and SSO parameter fields.

Custom variables are created in the Server Catalog (for example, Authentication > Auth Server > *Name* > Settings) by using a predefined macro on a system variable. Available macros are:

- REGMATCH – Matches a regular expression pattern against a string text.
- APPEND – Appends a text string to another text string.
- DAYSDIFF – Calculates the difference between two dates.

NOTE: These macros are located under Variable Operators in the Variables tab of the Server Catalog window.

A custom variable name is a dot-separated string. Each component can contain characters from the set [a-z A-Z 0-9 _] but cannot start with a digit [0-9]. Custom variable names are case-insensitive.

Custom variables are referenced as **customVar.<variableName>** . For example, if you create a custom variable with the name **check-prefix**, you reference this custom variable as **customVar.check-prefix**.

append

Syntax APPEND (attr, TextString)

APPEND (attr, attr2)

Description Append a text string to an attribute or append an attribute to another attribute and store the resulting string in the custom variable.

Options **attr**—System variable of type string.

TextString—Quoted ASCII string.

attr2—System variable of type string.

Output Fields Returns a String value. If no match is found, returns an empty string.

If the system variable is multivalued, the custom variable is also multivalued and uses the same order as the system variable.

Sample Output

```
APPEND (userName, “@sample.net”)
```

In this example, the string “@sample.net” is appended to the userName value.

daysdiff

Syntax DAYSDIFF (attr, timeformat)

Description Calculates the number of days between the attribute and the current time.

Options **attr**—System variable of type string.

timeformat—Output time format. Valid values are: UTC, TIMET, MMDDYYYY

Output Fields Returns an Integer value.

Sample Output

```
DAYSDIFF ( certAttr.validUpto, UTC)
```

In this example, calculate the difference in days between the current time and the value of certAttr.validUpto and express the time in UTC (Coordinated Universal Time).

regmatch

Syntax REGMATCH (attr, regex, groupingNumber)

Description Match the regular expression pattern against an attribute and store the result in the custom variable.

Options **attr—**System variable of type string.

regex—Quoted string containing the regular expression to be applied to the attr option.

groupingNumber—The group value to assign to the custom variable.

Additional Information The regular expression supports the Perl Compatible Regular Expressions (PCRE) syntax. A grouping (capture buffer) in the regex pattern can also be used to define a custom variable.

Output Fields Returns a String value. If no match is found, returns an empty string.

If the system variable is multivalued, the custom variable is also multivalued and uses the same order as the system variable.

Sample Output

```
REGMATCH (mailId, “^(.*)@sample.net$”, 1)
```

In this example, a mailId of myName@sample.net creates a custom variable with value “myName”.

Specifying Fetch Attributes in a Realm

To facilitate the support for various parameterized settings in user roles and resource policies, you have the ability to specify additional fetch attributes. The system stores the fetch attributes when users log in so that you can use them in parameterized role or resource policy definitions.

The system pulls all the attributes that are currently stored in the Sever Catalog for the user's authentication or authorization LDAP server. So, make sure to add the LDAP user attributes that are used in role or resource policy definitions in the LDAP Server Catalog first.

When a user logs in, the system retrieves user attributes that are referenced in the role mapping rules plus all of the additional attributes referenced in the Server Catalog and stores all these values. Note that this should not incur a significant performance overhead because all the user attributes are retrieved in one single LDAP query.

 NOTE: When you substitute variables, such as in IP/Netmasks or hostnames, the values in the session are appropriately converted into the data type that is required by the particular application definition.

Specifying the homeDirectory Attribute for LDAP

You can create a bookmark that automatically maps to a user’s LDAP home directory. You can accomplish this using the LDAP attribute homeDirectory. You need to configure a realm that specifies the LDAP server instance as its auth server, and you need to configure role-mapping rules and a bookmark that points to the LDAP homeDirectory attribute.

REST API Support

- Overview
- Sample GET/POST/PUT/DELETE Request and Responses

Overview

The REST API provides a standardized method for Next-Gen firewalls and third-party systems to interact with PPS. **Representational state transfer (REST)** or RESTful Web services are one way of providing interoperability between computer systems on the Internet. REST-compliant Web services allow requesting systems to access and manipulate textual representations of Web resources using a uniform and predefined set of stateless operations. In a RESTful Web service, requests made to a resource's URI will elicit a response that may be in XML, HTML, JSON or some other defined format. PPS supports JSON format only.

REST methods determine the HTTP method for manipulating the resources defined in the service operation. The kind of operations available include those predefined by the HTTP verbs GET, POST, PUT, DELETE and so on. The response may confirm that some alteration has been made to the stored resource, and it may provide hypertext links to other related resources or collections of resources. By making use of a stateless protocol and standard operations, REST systems aim for fast performance, reliability, and the ability to grow, by re-using components that can be managed and updated without affecting the system as a whole, even while it is running.

Note: REST API Support for PPS involves only Configuration APIs. Also, PPS supports only the GET, POST, PUT and DELETE APIs.

The valid and supported values are described in the Table 151.

Table 151: Valid and Supported Values

HTTP Verb	Definition
DELETE	Delete an existing resource.
GET	Retrieve a representation of a resource.
POST	Create a new resource
PUT	Create a new resource to a new URL, or modify an existing resource to an existing URL.

The error codes supported are described in the Table 152.

Table 152: Error Codes Supported

HTTP Verb	Definition
200 OK	Requesting for resource information successful using GET Resource updation successful using PUT

HTTP Verb	Definition
201 Created	Resource creation successful using POST
204 No Content	Deletion of resource successful with no body. Even PUT, POST may return 204 if no errors or warnings seen
400 – Bad Request	Any Request (GET/PUT/POST/DELETE, and so on) is invalid. Example : Incorrect JSON format
401 – Unauthorized	Any REST Call with invalid credentials
403 – Forbidden	REST Call with valid credentials but no permission.
404 – Not found	Requested resource in URI does not exists
422 – Unprocessable Entity	Any validation/referential integrity errors that would result in failure of PUT/POST/DELETE request
500 Server Error	When PPS rest server is not responding

Authentication for REST APIs

Basic authentication using the HTTP authorization header is used to authenticate username/password on the Administrators authserver. It is expected that the user is already configured in the Administrators authserver. On a successful login, a random token (api_key) is generated and sent back as a JSON response. Further access to APIs can use this api_key in their Authorization header for access. The entire communication is over TLS. An example is explained below:

```
REQUEST

GET /api/v1/auth HTTP/1.1

Host: xx.xx.xx.xx

Authorization: Basic YWRtaW5kYjpkYW5hMTIz

Content-Type: application/json


RESPONSE

HTTP/1.1 200 OK

Cache-Control: no-store

Connection: Keep-Alive

Content-Type: application/json

Expires: -1

Keep-Alive: timeout=15

{ "api_key": "p5mMlc7RQu81R2NvssLCCZhP05kf0N2ONFeYeLXX6aU=" }
```

Authorization header for all future request should perform Basic Auth using above api_key value as username and password as

empty.

```
REQUEST

GET /api/v1/configuration HTTP/1.1

Host: xx.xx.xx.xx

Authorization: Basic
cDVtTWxjN1JRdTgxUjJOdnNzTENDWmhQMDVrZjBOMk9ORmVZZUxYWDZhVT06



RESPONSE

HTTP/1.1 200 OK

Content-Length →283

Content-Type →application/json

{

"administrators":

{ "href": "/api/v1/configuration/administrators" }

,

"authentication":

{ "href": "/api/v1/configuration/authentication" }

,

"system":

{ "href": "/api/v1/configuration/system" }

,

"users":

{ "href": "/api/v1/configuration/users" }

}
```

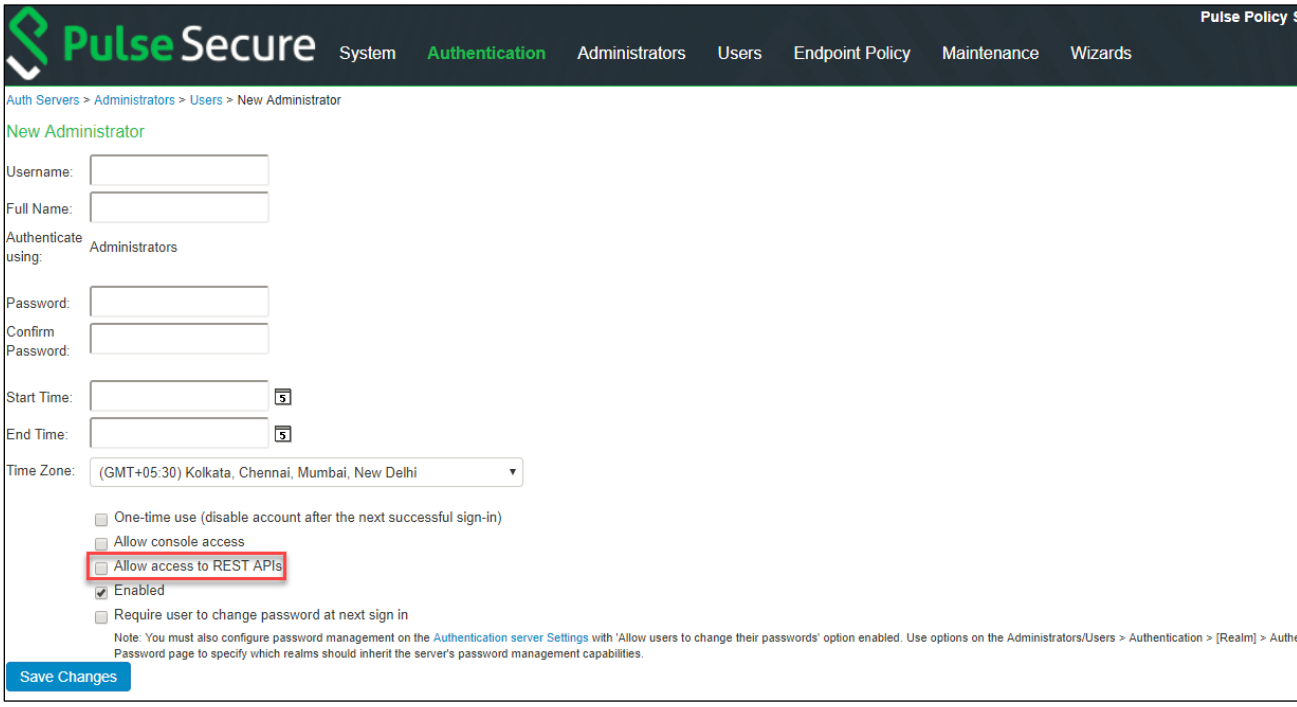
Enabling REST API Configuration

The configuration of PPS can be accessed using REST APIs. The PPS configuration is represented in a JSON form when accessed using REST APIs. The structure of the JSON representation is very similar to the structure of PPS XML configuration.

A new admin UI option for users under "Administrators" authserver has been added. REST API authentication would be successful only for those users who have this option enabled.

To enable this checkbox:

1. Go to Authentication > Auth. Servers >Administrators > Users > New/Update.
2. Select the Allow access to REST APIs checkbox.
3. Click on **Save Changes**.



Sample GET/POST/PUT/DELETE Request and Responses

Below is a sample of GET/POST/PUT/DELETE request and responses:

GET API call: It will fetch the details under Endpoint Policy in PPS

```
REQUEST
GET /api/v1/configuration/uac HTTP/1.1

Host xx.xx.xx.xx

Authorization : Basic
VU9qSTlGTzNrYVk5d0t2aXpBN1dPZ0FyZlN1S3FmTkNnQUh0R0ZuR0xSbz06

Content-Type: application/json

{
    "admissionControl": {
        "href": "/api/v1/configuration/uac/admissionControl"
    },
    "host-enforcer": {
        "href": "/api/v1/configuration/uac/host-enforcer"
    },
    "infranet-enforcer": {
        "href": "/api/v1/configuration/uac/infranet-
enforcer"
    },
    "mac-address-realms": {
        "href": "/api/v1/configuration/uac/mac-address-
realms"
    },
    "network-access": {
        "href": "/api/v1/configuration/uac/network-access"
    },
    "snmpEnforcement": {
        "href": "/api/v1/configuration/uac/snmpEnforcement"
    }
}
RESPONSE

HTTP/1.1 200 OK

Content-Length: 340

Content-Type: application/json
```

POST API call : It will create SRX Enforcer in Infranet Enforcer connection

```
REQUEST

POST /api/v1/configuration/uac/infranet-
enforcer/connections/infranet-enforcer/ HTTP/1.1
```

```
Host xx.xx.xx.xx

Authorization : Basic
VU9qSTlGTzNrYVk5d0t2aXpBN1dPZ0FyZlN1S3FmTkNnQUh0R0ZuR0xSbz06


Content-Type: application/json


{
    "idp-for-local-sessions-only": "true",
    "junos": {
        "location-group": "- No 802.1X -",
        "password-encrypted":
"3u+UR6n8AgABAAAAofSnIBrU19vdwUslG5LG4cg1QH6CbXDSmY4ZW0x85HY
="
    },
    "name": "SRX",
    "serial-number": [
        "SJFIOQJI4KNM"
    ],
    "severity-filter": "medium",
    "use-idp": "false"
}


RESPONSE

HTTP/1.1 201 OK


Content-Length: 122


Content-Type: application/json

{
    "result": {
        "info": [
            {
                "message": "Operation succeed without
warning or error!"
            }
        ]
    }
}
```

PUT API call: It will update the existing configuration. Configured Location Group as "Guest" and updated to "Default" Location group.

Before Updating the Location Group

```
REQUEST
GET api/v1/configuration/uac/network-access/radius-
clients/radius-client/Radius%20Client HTTP/1.1

Host xx.xx.xx.xx
```

```
Authorization : Basic
VU9qSTlGTzNrYVk5d0t2aXpBN1dPZ0FyZlN1S3FmTkNnQUh0R0ZuR0xSbz06


Content-Type: application/json


{
    "coa-support": "true",
    "description": "",
    "disconnect-support": "true",
    "dynamic-auth-port": "3799",
    "enable": "true",
    "gatewayid": "",
    "ip-address": "10.204.88.12",
    "ip-address-range": "1",
    "kek-encrypted": "",
    "key-wrap-format": "HEX",
    "key-wrap-support": "false",
    "location-group": "Guest",
    "mack-encrypted": "",
    "make-model": "Ruckus Wireless",
    "name": "Radius Client",
    "ruckus-certificate-verification": "false",
    "ruckus-password-encrypted": "",
    "shared-secret-encrypted":
"3u+UR6n8AgABAAAAofSnIBrU19vdwUslG5LG4cg1QH6CbXDSmY4ZW0x85HY
="
}

RESPONSE

HTTP/1.1 200 OK

Content-Length: 122

Content-Type: application/json
```

After Updating the Location Group

```
REQUEST


PUT api/v1/configuration/uac/network-access/radius-
clients/radius-client/Radius%20Client HTTP/1.1


Host xx.xx.xx.xx


Authorization : Basic
VU9qSTlGTzNrYVk5d0t2aXpBN1dPZ0FyZlN1S3FmTkNnQUh0R0ZuR0xSbz06


Content-Type: application/json


{
```

```
    "coa-support": "true",
    "description": "",
    "disconnect-support": "true",
    "dynamic-auth-port": "3799",
    "enable": "true",
    "gatewayid": "",
    "ip-address": "xx.xxx.xx.xx",
    "ip-address-range": "1",
    "kek-encrypted": "",
    "key-wrap-format": "HEX",
    "key-wrap-support": "false",
    "location-group": "Default",
    "mack-encrypted": "",
    "make-model": "Ruckus Wireless",
    "name": "Radius Client",
    "ruckus-certificate-verification": "false",
    "ruckus-password-encrypted": "",
    "shared-secret-encrypted":
"3u+UR6n8AgABAAAAofSnIBrU19vdwUslG5LG4cg1QH6CbXDSmY4ZW0x85HY="
}

RESPONSE

HTTP/1.1 200 OK


Content-Length: 122


Content-Type: application/json

{
    "result": {
        "info": [
            {
                "message": "Operation succeed without warning
or error!"
            }
        ]
    }
}
```

DELETE API Call: Deleting SNMP device from PPS

```
REQUEST

DELETE
api/v1/configuration/uac/snmpEnforcement/clients/client/ruckus
HTTP/1.1


Host 10.96.73.37


Authorization : Basic
VU9qSTlGTzNrYVk5d0t2aXpBN1dPZ0FyZlN1S3FmTkNnQUh0R0ZuR0xSbz06
```

```
Content-Type: application/json


{
    "default-vlan": "0",
    "description": "",
    "enable": "true",
    "ip-address": "10.204.88.12",
    "location-group": "none",
    "model": "Ruckus Wireless",
    "name": "ruckus",
    "read-auth-password-encrypted": "",
    "read-auth-protocol": "md5",
    "read-priv-password-encrypted": "",
    "read-priv-protocol": "",
    "read-security-level": "auth",
    "read-username": "public",
    "snmp-enforcement": "false",
    "snmp-version": "V2",
    "sys-contact":
"https://support.ruckuswireless.com/contact_us",
    "sys-description": "Ruckus Wireless ZD1200",
    "sys-location": "350 West Java Dr. Sunnyvale, CA 94089
US",
    "sys-name": "ruckus",
    "trap-auth-password-encrypted": "",
    "trap-auth-protocol": "md5",
    "trap-priv-password-encrypted": "",
    "trap-priv-protocol": "",
    "trap-security-level": "auth",
    "trap-username": "public",
    "use-samecredential": "true",
    "write-auth-password-encrypted": "",
    "write-auth-protocol": "md5",
    "write-priv-password-encrypted": "",
    "write-priv-protocol": "",
    "write-security-level": "auth",
    "write-username": "public"
}
RESPONSE

HTTP/1.1 204 NO CONTENT

Content-Length: 0
Content-Type: application/json
```

Event Types supported by Nozomi Networks

The following table describes the detailed description about events supported by Nozomi Networks.

Category	Type ID	Name	Definition
Custom Checks	PROC:STALE-VARIABLE	Stale variable	A variable configured with :check_last_update N does not have its value updated for more than N seconds.
Learned Behavior/Custom Checks	PROC:CRITICAL-STATE-ON	Critical state on	The system has entered in a Process Critical State that has either been learned or inserted as a custom check
Custom Checks	PROC:INVALID-VARIABLE-QUALITY	Invalid variable quality	A variable configured with :check_quality N keeps its value with an invalid quality for more than N seconds.
Built-in Checks	NET:RST-FROM-SLAVE	Slave sent RST on Link	A slave closed the connection to the master. This can be due to the device restarting or behaving in a strange manner.
Custom Checks	NET:INACTIVE-PROTOCOL	Inactive protocol	A link configured with :check_last_activity N stays inactive for more than N seconds.
Built-in Checks	SIGN:TCP-SYN-FLOOD	TCP SYN flood	This kind of alert occurs when either one or many hosts send a great amount of TCP SYN packets to a single host.
Built-in Checks	SIGN:MALICIOUS-PROTOCOL	Malicious Protocol detected	Malicious Protocol detected
Built-in Checks	SIGN:FIRMWARE-CHANGE	Firmware change requested	Firmware change requested
Built-in Checks	SIGN:MAN-IN-THE-MIDDLE	Man-In-the-middle attack	This kind of alert is raised when a Man-In-the-middle attack is detected.
Protocol Validation	SIGN:DHCP-OPERATION	DHCP operation	A DHCP request from an unknown device has been found in the network, as a sign of a new device which is trying to obtain an address.
Built-in Checks	SIGN:CPE:CHANGE	Installed software change detected	This kind of alert is raised after the detection of an installed software change.
Built-in Checks	SIGN:PROTOCOL-ERROR	Protocol error	A generic protocol error occurred, this usually relates to a state machine, option or other general violation of the protocol.
Built-in Checks	SIGN:ILLEGAL-PARAMETERS	A request with illegal parameters was asked	A request with illegal parameters was asked
Built-in Checks	SIGN:UNSUPPORTED-FUNC	Unsupported function was asked	An unsupported function has been called on the remote peer. It might me because of a malfunctioning software is trying to perform an operation without success or that a malicious attacker is trying to understand the functionalities of the device.

Category	Type ID	Name	Definition
Built-in Checks	SIGN:MALICIOUS-DOMAIN	Malicious domain	Malicious domain
Built-in Checks	SIGN:NETWORK-SCAN	Network Scan	Network Scan
Protocol Validation	SIGN:NETWORK-MALFORMED	Malformed network packet	A malformed packet is detected during the Deep Packet Inspection phase.
Built-in Checks	SIGN:PROGRAM:CHANGE	Program change detected	The program on the OT device has been uploaded and changed. This can be a legitimate operation during maintenance and upgrade of the software or an unauthorized tentative to read the program logic.
Built-in Checks	SIGN:CONFIGURATION-CHANGE	Configuration change requested	The configuration on the device has been uploaded and changed. This can be a legitimate operation during maintenance or an unauthorized tentative to modify the behaviour of the device.
Learned Behavior	VI:NEW-NODE:MALICIOUS-IP	Bad reputation ip	Bad reputation ip
Built-in Checks	SIGN:OT_DEVICE-REBOOT	OT device reboot requested	The OT device has been requested to reboot by the sender host. This event may be something correct during Engineering operations on the OT device, for instance the maintenance. However, it may indicate suspicious activity of an attacker trying to disrupt the process being controlled by the OT device.
Custom Checks	PROC:NOT-ALLOWED-INVALID- VARIABLE	(Variable quality is not allowed)	A variable that has been configured with a specific check has been detected to have a not allowed quality.
Built-in Checks	SIGN:MULTIPLE-UNSUCCESSFUL-LOGINS	Multiple unsuccessful logins	This kind of alert occurs when a host is repeatedly trying to login to a service without success.
Custom Checks	PROC:SYNC-ASKED-AGAIN	Slave sync asked	A new general interrogation command is issued, this can be an anomaly since this command should be performed once per OT device.
Built-in Checks	SIGN:OT_DEVICE-STOP	OT device stop requested	The OT device program has been requested to stop by the sender host. This event may be something correct during Engineering operations on the OT device, for instance the maintenance of the program itself. However, it may indicate suspicious activity of an attacker trying to halt the process being controlled by the OT device.
Built-in Checks	SIGN:OT_DEVICE-START	OT device start requested	The OT device program has been requested to start again by the sender host. This event may be something correct during Engineering operations on the OT device, for instance the maintenance of the program itself or a reboot of the system for updates. However, it may indicate

Category	Type ID	Name	Definition
			suspicious activity of an attacker trying to manipulate the state of the OT device.
Learned Behavior	VI:PROC:PROTOCOL-FLOW-ANOMALY	Protocol flow anomaly	This kind of alert is raised when the Process-related behavior of a protocol changes in a suspicious manner.
Built-in Checks	SIGN:DEV-STATE-CHANGE	Device state change	This kind of alert is raised when a change of the state of a device is detected, for example when an OT device is asked to enter in a new mode or a factory reset is issued.
Built-in Checks	SIGN:PROGRAM:UPLOAD	Program uploaded to device	The program of the OT device has been uploaded. This can be a legitimate operation during maintenance and upgrade of the software or an unauthorized tentative to disrupt the normal behavior of the system.
Built-in Checks	SIGN:CLEARTEXT-PASSWORD	Cleartext password	Cleartext password
Built-in Checks	SIGN:TCP-SYN-FLOOD	TCP SYN flood	This kind of alert occurs when one or many host send a great amount of TCP SYN packets to a single host.
Built-in Checks	PROC:WRONG-TIME	Process time issue detected	A slave reported a wrong time regarding Process data. This may be due to incorrect time synchronization of the slave, a misbehavior or a sign of compromise of the device.
Protocol Validation	SIGN:SCADA-INJECTION	SCADA packet Injection4	A traffic injection of SCADA packets has been detected in the network.
Built-in Checks	SIGN:ARP:DUP	Duplicate IP	This kind of alert occurs when a duplicated IP is spotted on the network by analyzing the ARP protocol.
Built-in Checks	SIGN:PACKET-RULE	Packet rule match	A packet rule has matching a specific security check has matched. This Alert requires to thoroughly check what happened to verify if an attacker is trying to compromise one or more host.
Learned Behavior	VI:NEW-PROTOCOL:CONFIRMED	New protocol confirmed	A protocol between two nodes has been confirmed at Layer 4 (the endpoint has accepted the connection).
Custom Checks	NET:LINK-RECONNECTION	Link reconnection	A link configured as persistent has a new TCP handshake.
Built-in Checks	SIGN:MALICIOUS-IP	Bad ip reputation	Bad ip reputation
Learned Behavior	VI:PROC:VARIABLE-FLOW-ANOMALY	Variable flow anomaly	The access over time to a variable has changed in a unexpected manner.
Built-in Checks	SIGN:PROC:MISSING-VAR	Missing Variable Requested	A tentative to access a nonexistent variable has been performed. This can be due to a reconnaissance activity or configuration change.
Learned Behavior	VI:NEW-NET-DEV	New network device detected	A new unseen network device, such as a switch, router or firewall has appeared in the network.

Category	Type ID	Name	Definition
Protocol Validation	SIGN:SCADA-MALFORMED	Malformed SCADA packet	A malformed packet is detected during the Deep Packet Inspection phase.
Learned Behavior	VI:PROC:NEW-VAR	New SCADA variable appeard	A new variable has been detected in a SCADA slave.
Learned Behavior	VI:NEW-FUNC-CODE	New function code detected	A node starts using a function code as never seen earlier.
Learned Behavior	VI:NEW-PROTOCOL:APPLICATION	New application detected	A Layer 7 protocol has been detected in a Layer 4 protocol.
Built-in Checks	SIGN:MALWARE-DETECTED	Malware detected	A malicious payload has been transferred over the network.
Learned Behavior	VI:NEW-PROTOCOL	New protocol used	A new protocol has been tried between two nodes.
Learned Behavior	VI:NEW-LINK	New target used	A node tries to communicate with a node not contacted before.
Learned Behavior	VI:NEW-ARP	New ARP from unknown MAC addresses	A new unseen node appeared through ARP traffic. This Alert is useful to detect also devices that are connected near the sniff interfaces of SCADAguardian but are not sending relevant application-level packets through the network.
Learned Behavior	VI:NEW-NODE:TARGET	New target node appeared	A new unseen node starts to send packets in the network.
Built-in Checks	SIGN:PASSWORD:WEAK	Weak password used	Weak password used
	SIGN:DDOS	DDOS attack	DDOS attack
	SIGN:MULTIPLE-OT_DEVICE-RESERVATIONS	Multiple OT device reservations	Multiple OT device reservations
Learned Behavior	VI:NEW-NODE	New node appeared	A new unseen node starts to send packets in the network.
Built-in Checks	SIGN:PROGRAM:DOWNLOAD	Program downloaded from device	The program of the OT device has been downloaded from another host. This can be a legitimate operation during maintenance and upgrade of the software or an unauthorized tentative to read the program logic.
Learned Behavior	VI:PROC:NEW-VALUE	New SCADA variable value	A new variable value or behavior has been detected in a SCADA slave.
Learned Behavior/Custom Checks	PROC:CRITICAL-STATE-OFF	Critical state off	The system has exited from a Process Critical State.
Protocol Validation	SIGN:INVALID-IP	Invalid IP	A packet with invalid IP packets reserved for special purposes (e.g. loopback addresses). Packets with such addresses can originate from misconfiguration or spoofing/denial of service attacks.

Category	Type ID	Name	Definition
Learned Behavior	VI:NEW-SCADA-NODE	New SCADA node appeared	A new unseen node speaking SCADA protocols starts to send packets in the network.
Learned Behavior	VI:NEW-MAC	New Mac address	A new unseen MAC address has appeared in the network.
Built-in Checks	SIGN:UNSUPPORTED-FUNC	Unknown RTU ID requested	An unsupported function has been called on the remote peer. This may mean that a malfunctioning software is trying to perform an operation without success or that a malicious attacker is trying to understand the functionalities of the device.