Engineering Simplicity

Network Configuration Example

Network Segmentation using Device Profiling with EX Series Switches and Aruba ClearPass Policy Manager

Published
2023-10-16

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About This Guide

This network configuration example (NCE) provides an overview and a configuration example for network segmentation using device profiling and colorless port with EX Series switches and Aruba ClearPass policy manager.

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CHAPTER

Device Profiling with EX Series Switches and Aruba ClearPass Policy Manager

About This Network Configuration Example

This Network Configuration Example (NCE) describes how to configure a Juniper Networks EX Series Ethernet Switch and Aruba ClearPass Policy Manager to authenticate wired endpoints that connect to EX Series switches. Specifically, it shows how to configure an EX Series switch and Aruba ClearPass to profile endpoints in authentication process and use the device profiling information to determine access policy.

The colorless port concept rely on device profiling to return the appropriate VLAN/policy. All ports have the same configuration (colorless) and based on the device type connected (AP, IP camera, or printer), NAC (ClearPass) will return the appropriate VLAN/role.

Use Case Overview

Juniper Networks EX Series Ethernet Switches are designed to meet the demands of today's high-performance businesses. They enable companies to grow their networks at their own pace, minimizing large up-front investments. Based on open standards, EX Series switches provides:

- Carrier-class reliability
- Security risk management
- Virtualization
- Application control
- Lower total cost of ownership (TCO
-

Also, allow businesses to scale in an economically sensible way for years to come.

Aruba ClearPass Policy Manager is a policy management platform that provides role-based and device-based network access control (NAC) for any user across any wired, wireless, and VPN infrastructure. Enterprises can deploy EX Series switches can leverage the extensive RADIUS capabilities on EX Series switches to integrate with Aruba ClearPass. This integration enables enterprises to deploy consistent security policies across their wired and wireless infrastructure.

Enterprises typically have a variety of users and endpoints, which results in multiple use cases that need to be addressed by their policy infrastructure. Depending on the type of endpoint and how it is being used, an endpoint might be authenticated by 802.1X authentication, MAC RADIUS authentication, or

captive portal authentication. The policy infrastructure enables any device to be connected to any port on the access switch, and authenticates based on the type of device, the authorization level of the user, or both.

In this network configuration example, we show how to configure Juniper Networks EX Series switches and Aruba ClearPass Policy Manager to use device profiling as part of the authentication process. Device profiling enables Aruba ClearPass to determine the type of endpoint that is being authenticated (for example, whether it is an access point or a VoIP phone or a Windows computer) and then use that information to enforce access policy appropriate to the device type.

Technical Overview

Aruba ClearPass profiling is part of the ClearPass Policy Manager module that performs device profiling. Profiling is enabled by default and automatically collects a variety of data about endpoints, analyzes the data to classify the endpoints, and stores the classifications as device profiles in an endpoint repository. Use the device profiles in enforcement policies to control access to your network. For example, create an enforcement policy that grants endpoints profiled as VoIP phones access to specific servers in your network. Or, create an enforcement policy that places all endpoints profiled as access points in a specific VLAN.

A device profile classifies an endpoint according to the following three hierarchical elements:

- **Category**—This is the broadest classification of a device. It denotes the type of the device. For example: access point, VoIP phone, printer, computer, or smart device.
- **Family**—Devices within a category are organized into families based on type of OS or type of vendor. For example, when the device category is computer, the family might be Windows, Linux, or Mac OS X. When the device category is smart device, the family might be Apple or Android.
- **Name**—Devices within a family are further organized by more granular details, such as version. For example, when the device family is Windows, the device name might be Windows 10 or Windows 2008 server.

In addition to the hierarchical classification above, a device profile contain information such as IP address, hostname, vendor, and time when the device was first discovered or when it was last seen.

To profile devices, Aruba ClearPass Profile uses a number of different types of collectors to collect data on endpoints. For a complete list of the kinds of collectors used. This network configuration example relies on data provided by the DHCP and MAC Organizationally Unique Identifier (OUI) collectors:

- **DHCP collector**—Collects DHCP attributes such as option55 (parameter request list), option60 (vendor class), and options list from DHCPDiscover and DHCPRequest packets. This information can

uniquely fingerprint most endpoints that use DHCP to acquire an IP address on the network. DHCP packets also provide the hostname and IP address of a device.

For the DHCP collector to be able to collect this information, Aruba ClearPass must receive DHCP packets from the endpoints. DHCP relay on EX Series switches allows a switch to send the initial DHCPDiscover and DHCPRequest packets from endpoints to more than one receiver. Configuring ClearPass as one of these receivers allows ClearPass to listen in on the DHCP message exchange between the DHCP servers and client endpoints and to collect the required information from the DHCP packets.

- **MAC OUI collector**—Collects the OUI portion of a device's MAC address. The MAC OUI can be used to better classify some endpoints. For example, DHCP fingerprinting can classify an endpoint as a generic Android device, but it cannot provide information about the vendor. By using the MAC OUI in addition to DHCP fingerprinting, ClearPass Profile can classify an Android device as an HTC Android device, a Samsung Android device, a Motorola Android device, and so on. ClearPass Profile can also use the MAC OUI to profile devices such as printers that might have static IP addresses.

  The MAC OUI collector obtains the MAC OUI from the MAC address information included in the RADIUS request packets sent from the EX Series switch on behalf of the endpoint.

Configuring Device Profiling to provide Dynamic Segmentation with EX Series Switches and Aruba ClearPass Policy Manager

IN THIS SECTION

Dynamic Segmentation provides the flexibility of assigning wired ports on EX switches with dynamic VLAN and policies to segment the internet of things (IOT), access point traffic, and wired user traffic. Aruba ClearPass can centrally manage and enforce network access polices for wired and wireless control.

Micro segmentation is obtained by applying dynamic firewall filters to the wired ports once we successfully authenticate the device to control the east-west traffic. With dynamic filters we can control in a camera network so that it talks only to the secured camera recording server or few dedicated terminals used by security personals. Similarly, we can apply firewall filters on the IP Phone network to allow communication between IP phones and call manager server in the network.

This configuration example illustrates how to use the features of EX Series switches and Aruba ClearPass Policy Manager to perform device profiling as part of the endpoint authentication process.

In this example, an organization has four types of endpoints in its wired infrastructure for which it has defined access policies:

- **Access points**—Endpoints profiled as access points are allowed access to the network and are dynamically assigned to the AP_VLAN VLAN.
- **IP phones**—Endpoints profiled as IP phones are allowed access to the network. The IPPhone_VLAN is dynamically assigned as the VoIP VLAN.
- **Corporate laptops**—Endpoints that have an 802.1X supplicant are authenticated by the user credentials. After the user is successfully authenticated, the laptop is granted access to the network and placed in the Employee_VLAN VLAN.
- **Camera /IOT Devices**—Camera and IOT devices having or not having 802.1x supplicants can be added to the network and granted access to the Camera_IOT_VLAN VLAN.
- **Noncorporate laptops/Tablets**—Endpoints that do not have an 802.1X supplicant and that are profiled as non-corporate devices are provided only internet access

Table 1 on page 5 shows the defines values of the access policies for wired, wireless, and authorization.

Table 1: Access Policies Details

Access Policies	Wired	Wireless	Authorization
AP VLAN	130 (NATIVE)	ALLOWED VLAN = 121,131,151,102	-
IP-Phone	120	121	Between phones and call manager server
Employee	150	151	Access all

Table 1: Access Policies Details *(Continued)*

Access Policies	Wired	Wireless	Authorization
Remediation	101	102	Quarantine
IOT Camera	130	131	DHCP, NTP, and NVR

Requirements

This example the following hardware and software components for the policy infrastructure:

- EX4300, EX2300, EX3400 switch running Junos OS Release 20.2R1 or earlier
- Aruba ClearPass Policy Manager running 6.9.0.130064

Overview and Topology

To implement the endpoint access policies, the policy infrastructure is configured as follows:

- All access interfaces on the switch are initially configured to be in VLAN 100, which serves as a remediation VLAN. If an endpoint is not successfully authenticated or is not successfully profiled as one of the supported endpoints, it remains in the remediation VLAN.

  NOTE: When the endpoints utilize DHCP, avoid changing the VLANs. The endpoint will not send another DHCPRequest until their existing lease expires or a port bounce occurs.

- Endpoints that have an 802.1X supplicant are authenticated by using 802.1X PEAP authentication. For more information on 802.1X PEAP authentication, see *Configuring 802.1X PEAP and MAC RADIUS Authentication with EX Series Switches and Aruba ClearPass Policy Manager*.
- Endpoints that do not have an 802.1X supplicant are authenticated using MAC RADIUS authentication and are profiled to determine what type of device they are. These endpoints undergo a two-step authentication process:

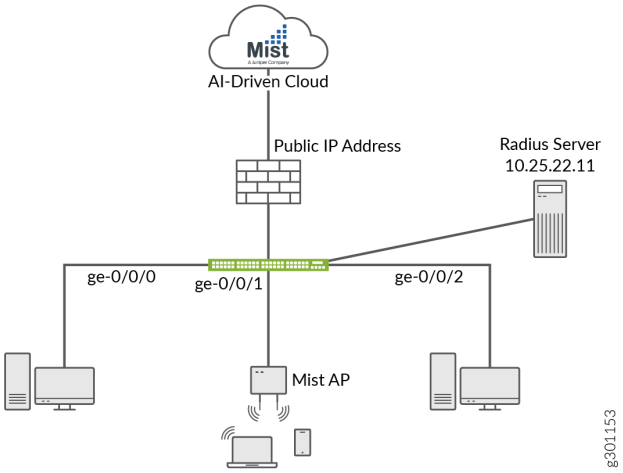
  1. The first step occurs after an endpoint first connects to the switch but before it has been profiled by Aruba ClearPass Profile. After it connects, the endpoint is authenticated using MAC RADIUS

authentication. Aruba ClearPass applies an enforcement policy that instructs the switch to grant the endpoint access to the Internet but prevents it from accessing the internal network.

2. The second step occurs after an endpoint has been successfully profiled. After being authenticated in the first step, the endpoint contacts a DHCP server to request an IP address. The switch relays the DHCP messages sent by the endpoint to the DHCP server to Aruba ClearPass as well, which allows ClearPass to profile the endpoint. After it has profiled the endpoint and added the endpoint to its endpoint repository, ClearPass sends a RADIUS Change of Authorization (CoA) message to the switch, telling it to terminate the session. The switch then attempts reauthentication on behalf of the endpoint. Because the endpoint now exists in the endpoint repository, Aruba ClearPass is able to apply an enforcement policy appropriate to the device type when it authenticates the endpoint. For example, if the endpoint is an access point, ClearPass applies the enforcement policy that dynamically assigns the access point to the AP_VLAN VLAN.

Figure 1 on page 7 shows the topology used in this example.

Figure 1: Topology Used in This Example



Configuration

IN THIS SECTION

This section provides step-by-step instructions for:

Configuring the EX Switch

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them in a text file, remove any line breaks, change any details necessary to match your network configuration, copy and paste the commands into the CLI at the **[edit]** hierarchy level, and then enter commit from configuration mode.

```
[edit]
set access radius-server 10.25.22.11 dynamic-request-port 3799
set access radius-server 10.25.22.11 secret "$9$tqCW01hevLVwgSrwgoJHkp0BISrKM87db"
set access radius-server 10.25.22.11 source-address 10.25.99.11
set access profile ACCESS_PROF_RADIUS accounting-order radius
set access profile ACCESS_PROF_RADIUS authentication-order radius
set access profile ACCESS_PROF_RADIUS radius authentication-server 10.25.22.11
set access profile ACCESS_PROF_RADIUS radius accounting-server 10.25.22.11
set protocols dot1x authenticator authentication-profile-name ACCESS_PROF_RADIUS
set protocols dot1x authenticator interface AUTHC supplicant multiple
set protocols dot1x authenticator interface AUTHC transmit-period 3
set protocols dot1x authenticator interface AUTHC mac-radius
set vlans AP vlan-id 130
set vlans EMPLOYEE-WIRED vlan-id 150
set vlans EMPLOYEE-WIRELESS vlan-id 151
set vlans IOT-WIRED vlan-id 111
set vlans IOT-WIRELESS vlan-id 112
set vlans IP-PHONE-WIRED vlan-id 120
set vlans IP-PHONE-WIRELESS vlan-id 121
set vlans MANAGEMENT vlan-id 99
set vlans MANAGEMENT l3-interface irb.99
set vlans REMEDIATION-WIRED vlan-id 101
```

```
set vlans REMEDIATION-WIRELESS vlan-id 102
set interfaces interface-range AP member ge-0/0/0
set interfaces interface-range AP native-vlan-id 130
set interfaces interface-range AP unit 0 family ethernet-switching interface-mode trunk
set interfaces interface-range AP unit 0 family ethernet-switching vlan members AP
set interfaces interface-range AP unit 0 family ethernet-switching vlan members EMPLOYEE-WIRELESS
set interfaces interface-range AUTHC member ge-0/0/6
set interfaces interface-range AUTHC member ge-0/0/3
set interfaces interface-range AUTHC member ge-0/0/2
set interfaces interface-range AUTHC member ge-0/0/4
set interfaces interface-range AUTHC member ge-0/0/7
set interfaces interface-range AUTHC member ge-0/0/8
set interfaces interface-range AUTHC member ge-0/0/9
set interfaces interface-range AUTHC member ge-0/0/5
set interfaces interface-range AUTHC unit 0 family ethernet-switching interface-mode access
set interfaces interface-range AUTHC unit 0 family ethernet-switching vlan members REMEDIATION-
WIRED
set firewall family ethernet-switching filter Internet_Only_Access term Allow_DHCP from
destination-port 67
set firewall family ethernet-switching filter Internet_Only_Access term Allow_DHCP from
destination-port 68
set firewall family ethernet-switching filter Internet_Only_Access term Allow_DHCP from ip-
protocol udp
set firewall family ethernet-switching filter Internet_Only_Access term Allow_DHCP then accept
set firewall family ethernet-switching filter Internet_Only_Access term Allow_DNS from
destination-port 53
set firewall family ethernet-switching filter Internet_Only_Access term Allow_DNS from ip-
protocol udp
set firewall family ethernet-switching filter Internet_Only_Access term Allow_DNS from ip-
protocol tcp
set firewall family ethernet-switching filter Internet_Only_Access term Block_Internal from ip-
destination-address 192.168.0.0/16
set firewall family ethernet-switching filter Internet_Only_Access term Block_Internal then
discard
set firewall family ethernet-switching filter Internet_Only_Access term Allow_All then accept
```

Step-by-Step Procedure

The general steps to configure the EX switch are:

- Configure the connection to the Aruba ClearPass Policy Manager.

- Create the access profile used by the 802.1X protocol. The access profile tells the 802.1X protocol which authentication server and authentication methods to use and the order of the authentication methods.
- Configure the 802.1X protocol.
- Configure the VLANs.
- Configure Ethernet switching on the access ports.
- Configure integrated routing and bridging (IRB) interfaces and assign them to the VLANs.
- Configure DHCP relay to send DHCP packets to Aruba ClearPass so that it can perform device profiling.
- Create the firewall policy that blocks access to the internal network.

To configure the EX switch:

1. Provide the RADIUS server connection information..

```
[edit]
user@Policy-EX-switch# set access radius-server 10.25.22.11 dynamic-request-port 3799
user@Policy-EX-switch# set access radius-server 10.25.22.11 secret password
user@Policy-EX-switch# set access radius-server 10.25.22.11 source-address 10.25.99.11
```

2. Configure the access profile.

```
[edit access]
user@Policy-EX-switch# set access profile ACCESS_PROF_RADIUS accounting-order radius
user@Policy-EX-switch# set access profile ACCESS_PROF_RADIUS authentication-order radius
user@Policy-EX-switch# set access profile ACCESS_PROF_RADIUS radius authentication-server
10.25.22.11
user@Policy-EX-switch# set access profile ACCESS_PROF_RADIUS radius accounting-server
10.25.22.11
```

3. Configure 802.1X to use ACCESS_PROF_RADIUS and enable the protocol on each access interface. In addition, configure the interfaces to support MAC RADIUS authentication and to allow more than one supplicant, each of which must be individually authenticated.

By default, the switch will first attempt 802.1X authentication. If it receives no EAP packets from the endpoint, indicating that the endpoint does not have an 802.1X supplicant, it then tries MAC RADIUS authentication.

```
[edit]
user@Policy-EX-switch# set protocols dot1x authenticator authentication-profile-name
ACCESS_PROF_RADIUS
user@Policy-EX-switch# set protocols dot1x authenticator interface AUTHC supplicant multiple
user@Policy-EX-switch# set protocols dot1x authenticator interface AUTHC transmit-period 3
user@Policy-EX-switch# set protocols dot1x authenticator interface AUTHC mac-radius
user@Policy-EX-switch# set interfaces interface-range AP member ge-0/0/0
user@Policy-EX-switch# set interfaces interface-range AP native-vlan-id 130
user@Policy-EX-switch# set interfaces interface-range AP unit 0 family ethernet-switching
interface-mode trunk
user@Policy-EX-switch# set interfaces interface-range AP unit 0 family ethernet-switching
vlan members AP
user@Policy-EX-switch# set interfaces interface-range AP unit 0 family ethernet-switching
vlan members EMPLOYEE-WIRELESS
user@Policy-EX-switch# set interfaces interface-range AUTHC member ge-0/0/6
user@Policy-EX-switch# set interfaces interface-range AUTHC member ge-0/0/3
user@Policy-EX-switch# set interfaces interface-range AUTHC member ge-0/0/2
user@Policy-EX-switch# set interfaces interface-range AUTHC member ge-0/0/4
user@Policy-EX-switch# set interfaces interface-range AUTHC member ge-0/0/7
user@Policy-EX-switch# set interfaces interface-range AUTHC member ge-0/0/8
user@Policy-EX-switch# set interfaces interface-range AUTHC member ge-0/0/9
user@Policy-EX-switch# set interfaces interface-range AUTHC member ge-0/0/5
```

4. Configure the VLANs used in this example.

```
[edit]
user@Policy-EX-switch# set vlans AP vlan-id 130
user@Policy-EX-switch# set vlans EMPLOYEE-WIRED vlan-id 150
user@Policy-EX-switch# set vlans EMPLOYEE-WIRELESS vlan-id 151
user@Policy-EX-switch# set vlans IOT-WIRED vlan-id 111
user@Policy-EX-switch# set vlans IOT-WIRELESS vlan-id 112
user@Policy-EX-switch# set vlans IP-PHONE-WIRED vlan-id 120
user@Policy-EX-switch# set vlans IP-PHONE-WIRELESS vlan-id 121
user@Policy-EX-switch# set vlans MANAGEMENT vlan-id 99
user@Policy-EX-switch# set vlans MANAGEMENT l3-interface irb.99
```

```
user@Policy-EX-switch# set vlans REMEDIATION-WIRED vlan-id 101
user@Policy-EX-switch# set vlans REMEDIATION-WIRELESS vlan-id 102
```

Note that for dynamic VLAN assignment to work, the VLAN must exist on the switch before authentication is attempted. If the VLAN doesn't exist, authentication fails.

5. Configure DHCP relay to forward DHCP request packets to Aruba ClearPass.

```
[edit]
user@Policy-EX-switch# set dhcp-relay server-group dhcp-dot1x 10.25.22.11
user@Policy-EX-switch# set dhcp-relay active-server-group dhcp-dot1x
```

6. Configure a firewall filter, Internet_Only_Access, to be used for devices that have been authenticated by MAC RADIUS authentication but have not yet been profiled.

   This filter blocks an endpoint from accessing the internal network (192.168.0.0/16).

```
[edit]
user@Policy-EX-switch# set firewall family ethernet-switching filter INTERNET_ACCESS_ONLY
term ALLOW_DHCP from destination-port 67
user@Policy-EX-switch# set firewall family ethernet-switching filter INTERNET_ACCESS_ONLY
term ALLOW_DHCP from destination-port 68
user@Policy-EX-switch# set firewall family ethernet-switching filter INTERNET_ACCESS_ONLY
term ALLOW_DHCP from ip-protocol udp
user@Policy-EX-switch# set firewall family ethernet-switching filter INTERNET_ACCESS_ONLY
term ALLOW_DHCP then accept
user@Policy-EX-switch# set firewall family ethernet-switching filter INTERNET_ACCESS_ONLY
term ALLOW_DNS from destination-port 53
user@Policy-EX-switch# set firewall family ethernet-switching filter INTERNET_ACCESS_ONLY
term ALLOW_DNS from ip-protocol udp
user@Policy-EX-switch# set firewall family ethernet-switching filter INTERNET_ACCESS_ONLY
term ALLOW_DNS from ip-protocol tcp
user@Policy-EX-switch# set firewall family ethernet-switching filter INTERNET_ACCESS_ONLY
term BLOCK_RFC_1918 from ip-destination-address 10.0.0.0/8
user@Policy-EX-switch# set firewall family ethernet-switching filter INTERNET_ACCESS_ONLY
term BLOCK_RFC_1918 from ip-destination-address 172.16.0.0/12
user@Policy-EX-switch# set firewall family ethernet-switching filter INTERNET_ACCESS_ONLY
term BLOCK_RFC_1918 from ip-destination-address 192.168.0.0/16
user@Policy-EX-switch# set firewall family ethernet-switching filter INTERNET_ACCESS_ONLY
term BLOCK_RFC_1918 then discard
```

```
user@Policy-EX-switch# set firewall family ethernet-switching filter INTERNET_ACCESS_ONLY
term ALLOW_ALL then accept
```

Results

From configuration mode, confirm your configuration by entering the following `show` commands.

```
user@Policy-EX-switch# show access
radius-server {
        10.25.22.11 {
            dynamic-request-port 3799;
            secret "$9$tqCW01hevLVwgSrwgoJHkp0BISrKM87db"; ## SECRET-DATA
            source-address 10.25.99.11;
        }
    }
    profile ACCESS_PROF_RADIUS {
        accounting-order radius;
        authentication-order radius;
        radius {
            authentication-server 10.25.22.11;
            accounting-server 10.25.22.11;
        }
    }
}
```

```
user@Policy-EX-switch# show protocols
dot1x {
        authenticator {
            authentication-profile-name ACCESS_PROF_RADIUS;
            interface {
                AUTHC {
                    supplicant multiple;
                    transmit-period 3;
                    mac-radius;
                }
            }
        }
```

```
    }
```

```
user@Policy-EX-switch# show interfaces
  interface-range AP {
        member ge-0/0/0;
        native-vlan-id 130;
        unit 0 {
            family ethernet-switching {
                interface-mode trunk;
                vlan {
                    members [ AP EMPLOYEE-WIRELESS ];
                }
            }
        }
    }
        interface-range AUTHC {
        member ge-0/0/6;
        member ge-0/0/3;
        member ge-0/0/2;
        member ge-0/0/4;
        member ge-0/0/7;
        member ge-0/0/8;
        member ge-0/0/9;
        member ge-0/0/5;
        unit 0 {
            family ethernet-switching {
                interface-mode access;
                vlan {
                    members REMEDIATION-WIRED;
                }
            }
        }
    }
```

```
user@Policy-EX-switch# show vlans
AP {
        vlan-id 130;
    }
    EMPLOYEE-WIRED {
```

```
        vlan-id 150;
    }
    EMPLOYEE-WIRELESS {
        vlan-id 151;
    }
    IOT-WIRED {
        vlan-id 111;
    }
    IOT-WIRELESS {
        vlan-id 112;
    }
    IP-PHONE-WIRED {
        vlan-id 120;
    }
    IP-PHONE-WIRELESS {
        vlan-id 121;
    }
        MANAGEMENT {
        vlan-id 99;
        l3-interface irb.99;
    }
    REMEDIATION-WIRED {
        vlan-id 101;
    }
    REMEDIATION-WIRELESS {
        vlan-id 102;
    }
    }
}
```

```
user@Policy-EX-switch# show forwarding-options
dhcp-relay {
    server-group {
        dhcp-dot1x {
            10.25.22.11;
             }
    }
    helpers {
        bootp {
            server 10.25.22.11;
```

```
        }
}
```

```
user@Policy-EX-switch# show firewall
family ethernet-switching {
        filter INTERNET_ACCESS_ONLY {
            term ALLOW_DHCP {
                from {
                    destination-port [ 67 68 ];
                    ip-protocol udp;
                }
                then accept;
            }
            term ALLOW_DNS {
                from {
                    destination-port 53;
                    ip-protocol [ udp tcp ];
                }
            }
            term BLOCK_RFC_1918 {
                from {
                    ip-destination-address {
                        10.0.0.0/8;
                        172.16.0.0/12;
                        192.168.0.0/16;
                    }
                }
                then discard;
            }
            term ALLOW_ALL {
                then accept;
            }
        }
    }
}
```

If you are done configuring the device, enter `commit` from configuration mode.

Configuring Aruba ClearPass Policy Manager

Step-by-Step Procedure

The general steps for configuring Aruba ClearPass are:

- Verify the Juniper-AV-Pair attribute exists in your RADIUS dictionary.
- Add the EX switch as a network device.
- Ensure that the server certificate used for 802.1X PEAP authentication has been installed.
- Add the local user used in this example for 802.1X authentication.
- Create the following enforcement profiles:
  - VLAN 150 ENF PROF that places endpoints in VLAN 150.
  - JUNIPER VOIP VLAN 120 ENF PROF that defines VLAN 120 as the VoIP VLAN.
  - VLAN 130 ENF PROF that places endpoints in VLAN 130.
  - Internet_Only_Access_Fliter_ID_ENF_Prof that specifies the firewall filter Internet_Only_Access be used for devices that have not yet been profiled.
- Create two enforcement policies:
  - A policy that is invoked when MAC RADIUS authentication is used.
  - A policy that is invoked when 802.1X authentication is used.
- Define the MAC RADIUS authentication service and the 802.1X authentication service.
- Ensure that the MAC RADIUS authentication service is evaluated before the 802.1X authentication service.

To configure Aruba ClearPass:

1. Verify the Juniper-AV-Pair attribute exists in your RADIUS dictionary.

   Go to Administration > Dictionaries > RADIUS and Open the Juniper dictionary.

Vendor Name ▲	Vendor ID	Vendor Prefix	Enabled
Juniper	2636	Juniper	true

NOTE: If the Juniper dictionary is shown in red, open the Juniper dictionary page to enable the dictionary and click the enable button.

RADIUS Attributes

Vendor Name:	Juniper (2636)		
#	**Attribute Name**	**ID**	**Type**
1.	Juniper-AV-Pair	52	String

If the Juniper-AV-Pair attribute is not present, follow these steps to add it:

a. Click the Export button.

RADIUS Attributes

Vendor Name:	Juniper (2636)			
#	**Attribute Name**	**ID**	**Type**	**In/Out**
1.	Juniper-Allow-Commands	2	String	in out
2.	Juniper-Allow-Configuration	4	String	in out
3.	Juniper-Authentication-Type	11	String	in out
4.	Juniper-CTP-Group	21	Unsigned32	in out
5.	Juniper-CTPView-APP-Group	22	Unsigned32	in out
6.	Juniper-CTPView-OS-Group	23	Unsigned32	in out
7.	Juniper-CWA-Redirect-URL	50	String	in out
8.	Juniper-CoS-Parameter	39	String	in out
9.	Juniper-CoS-Traffic-Control-Profile	38	String	in out
10.	Juniper-Configuration-Change	9	String	in out

Disable Export Close

b. Save the **RadiusDictionary.xml** file to your computer and then open it with a text editor.

c. Under the **RadiusAttributes** section, add the following line:

<Attribute profile="in out" type="String" name="Juniper-AV-Pair" id="52"/>

d. Save the XML file.

e. Return to your **ClearPass** session and click on the **Import** button in the top right corner of the **RadiusDictionary** page.

f. Click the **Browse** button and find the **RadiusDictionary.xml** file you just saved

g. Click Import.

h. Now open the **Juniper RADIUS dictionary** and verify if the **Juniper-AV-Pair** attribute is present

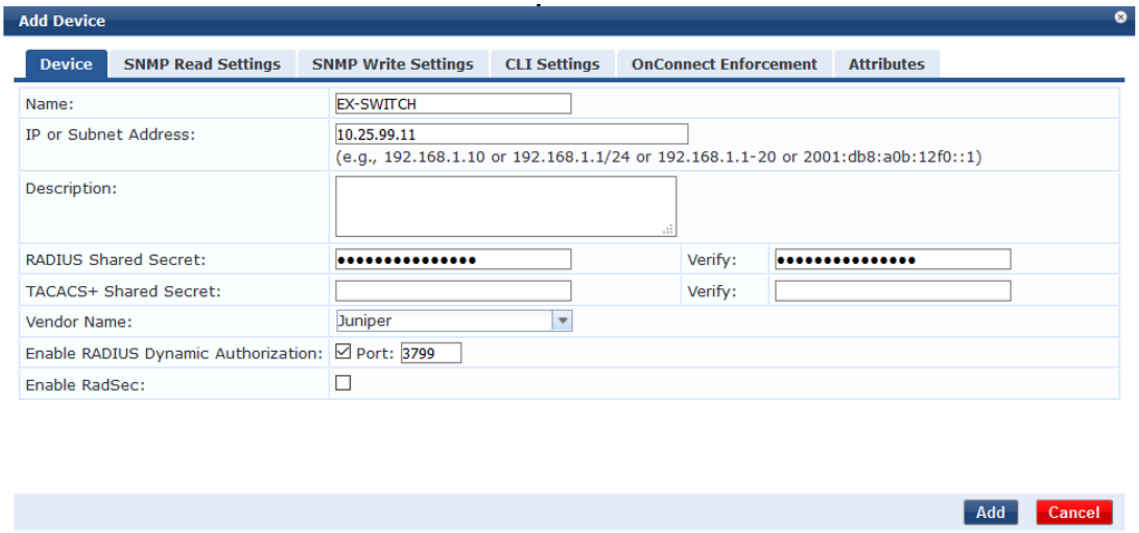
Attribute Name	ID	Type	In/Out
Juniper-AV-Pair	52	String	in out

2. Add the EX switch as a network device.

Step-by-Step Procedure

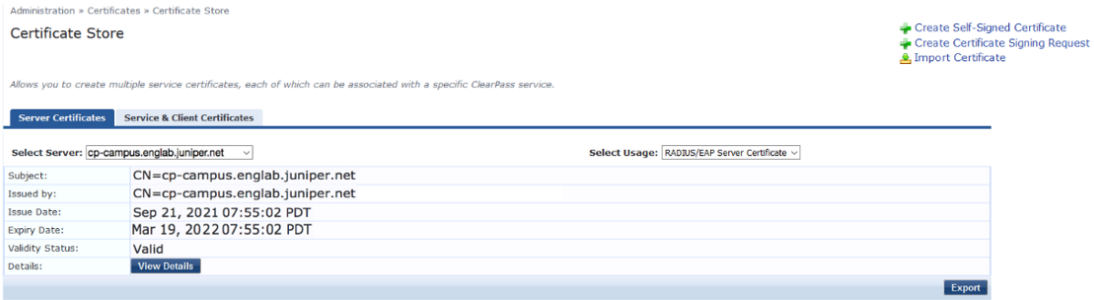
a. Under Configuration > Network > Devices, click **Add**.

b. On the Device tab, enter the hostname and IP address of the switch and the RADIUS shared secret that you configured on the switch. Set the Vendor Name field to **Juniper**.



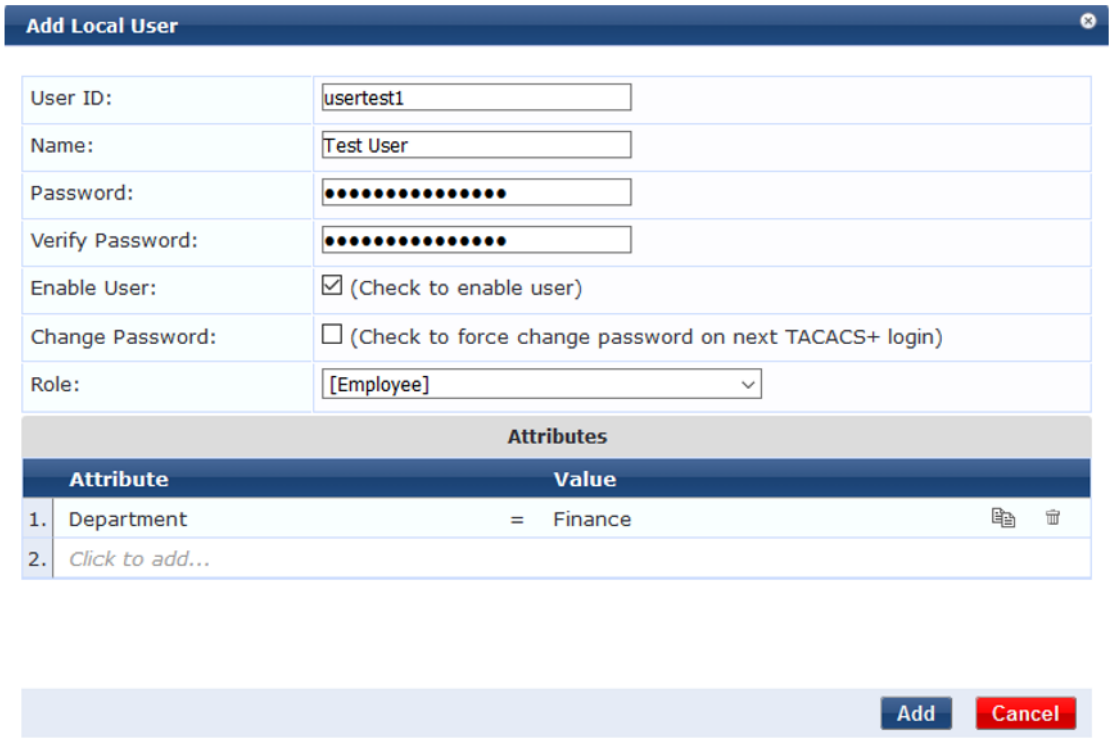
c. Ensure that a trusted server certificate for 802.1X PEAP authentication exists.

- Under Administration > Certificates > Certificate Store, verify that each Aruba ClearPass server has a valid RADIUS/EAP Server Certificate installed. If they do not, add a valid server certificate. The Aruba ClearPass documentation and your Certificate Authority can provide more details on how to obtain certificates and import them into ClearPass.



d. Add a test user to the local user repository. This user will be used to verify 802.1X authentication.

- Under Configuration > Identity > Local Users, click **Add**.
- In the Add Local User window, enter the user ID **(usertest1)**, username **(Test User)**, and password. Then select **Employee** as the user role. Under Attributes, select the **Department** attribute and type **Finance** under value.



> **NOTE**: In this configuration example, the ClearPass Local User Repository is used as the authentication source. In a typical enterprise deployment, however, Microsoft Active Directory is used as the authentication source. For further detail on how to configure Active Directory as an authentication source, search the ClearPass documentation located in Administration » Support » Documentation.

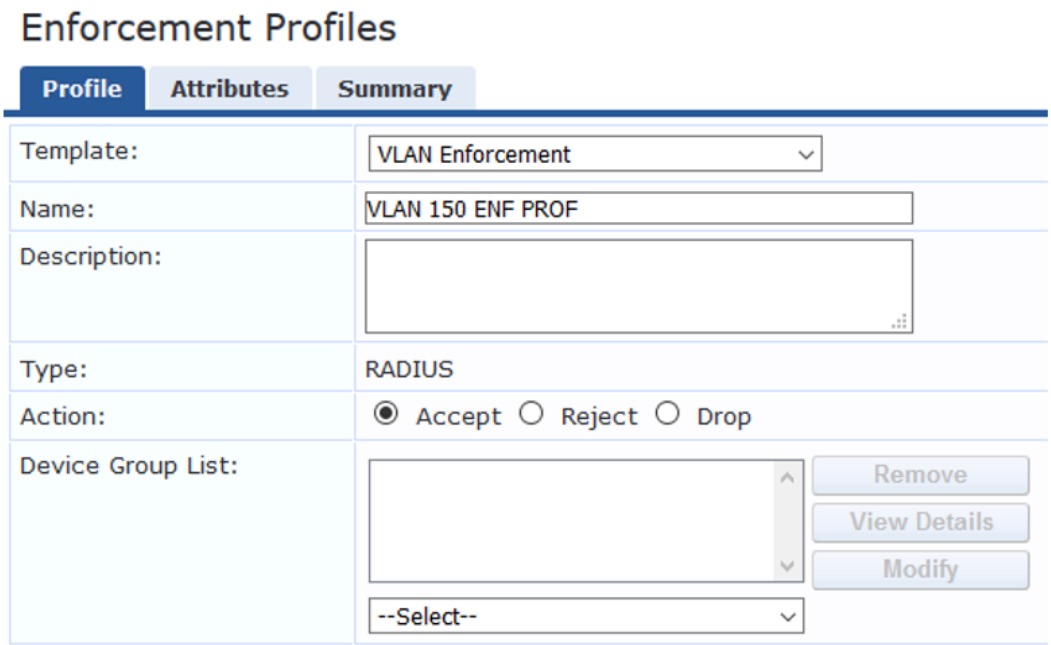
3. Configure an enforcement profile for employee laptops or desktops that authenticate using 802.1X.

   - This profile places the endpoints in VLAN 150.

Step-by-Step Procedure

Under Configuration > Enforcement > Profiles, click **Add**.

a. On the Profile tab, set Template to VLAN Enforcement and type the profile name, VLAN 150 ENF PROF, in the Name field.



b. On the Attributes tab, configure the attributes as shown.

Configuration » Enforcement » Profiles » Add Enforcement Profile

Enforcement Profiles

Profile | Attributes | Summary

	Type	Name		Value
1.	Radius:IETF	Session-Timeout	=	10800
2.	Radius:IETF	Termination-Action	=	RADIUS-Request (1)
3.	Radius:IETF	Tunnel-Type	=	VLAN (13)
4.	Radius:IETF	Tunnel-Medium-Type	=	IEEE-802 (6)
5.	Radius:IETF	Tunnel-Private-Group-Id	=	150
6.	*Click to add...*			

4. Configure an access point enforcement profile, which places access points in VLAN 130.

   - Use the same basic procedure to create this profile as you used in the previous step. After you complete the profile, the information on the Summary tab will appear as shown.

Configuration » Enforcement » Profiles » Edit Enforcement Profile - VLAN 130 ENF PROF

Enforcement Profiles - VLAN 130 ENF PROF

Summary | Profile | Attributes

Profile:

Name:	VLAN 130 ENF PROF
Description:	
Type:	RADIUS
Action:	Accept
Device Group List:	-

Attributes:

	Type	Name		Value
1.	Radius:IETF	Session-Timeout	=	10800
2.	Radius:IETF	Termination-Action	=	RADIUS-Request (1)
3.	Radius:IETF	Tunnel-Type	=	VLAN (13)
4.	Radius:IETF	Tunnel-Medium-Type	=	IEEE-802 (6)
5.	Radius:IETF	Tunnel-Private-Group-Id	=	130

5. Configure an IP phone enforcement profile.

   - This profile instructs Aruba ClearPass to return VLAN 120 as the VLAN that should be used as the VoIP VLAN. The Juniper Networks RADIUS dictionary defines a special RADIUS attribute to use for this purpose. Select **RADIUS-Juniper** for the attribute type and **Juniper-VoIP-Vlan** as the attribute name.

   - After you complete the profile, the information on the **Summary** tab will appear as shown.

Configuration » Enforcement » Profiles » Edit Enforcement Profile - JUNIPER VOIP VLAN 120 ENF PROF

Enforcement Profiles - JUNIPER VOIP VLAN 120 ENF PROF

Summary | Profile | Attributes

Profile:

Name:	JUNIPER VOIP VLAN 120 ENF PROF
Description:	
Type:	RADIUS
Action:	Accept
Device Group List:	-

Attributes:

	Type	Name		Value
1.	Radius:Juniper	Juniper-VoIP-Vlan	=	120

6. Configure an Internet access only enforcement profile.

- This enforcement profile tells Aruba ClearPass to return the name of the firewall filter Internet_Only_Access, which is the firewall filter you configured on the switch that blocks access to the internal network. After you complete this profile, the information on the Summary tab will appear as shown.

Configuration » Enforcement » Profiles » Edit Enforcement Profile - INTERNET ONLY ACCESS FILTER ID ENF PROF

Enforcement Profiles - INTERNET ONLY ACCESS FILTER ID ENF PROF

Summary | Profile | Attributes

Profile:

Name:	INTERNET ONLY ACCESS FILTER ID ENF PROF
Description:	
Type:	RADIUS
Action:	Accept
Device Group List:	-

Attributes:

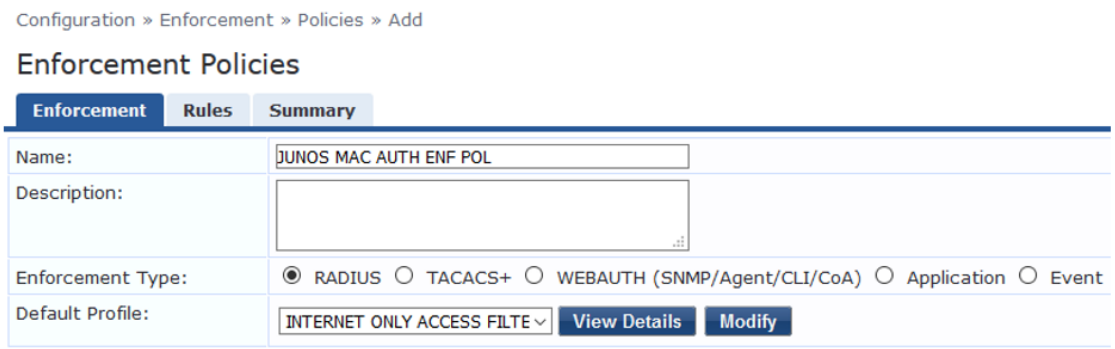
	Type	Name		Value
1.	Radius:IETF	Filter-Id	=	Internet_Only_Access

- Configure the MAC RADIUS authentication enforcement policy.

- For endpoints being authenticated by MAC RADIUS authentication, this policy informs Aruba ClearPass to apply enforcement policies according to the device profile. The VLAN 130 ENF PROF is applied to endpoints profiled as access points, and the JUNIPER VOIP VLAN 120 ENF PROF is applied to endpoints profiled as VoIP phones. The predefined enforcement policy [Deny Access Profile] is applied to endpoints profiled as Windows devices. This enforces the organization access policy that only laptops with an 802.1X supplicant are allowed access to the network. For all other endpoints, including endpoints that have not yet been profiled, the INTERNET ONLY ACCESS FILTER ID ENF PROF profile will be applied.

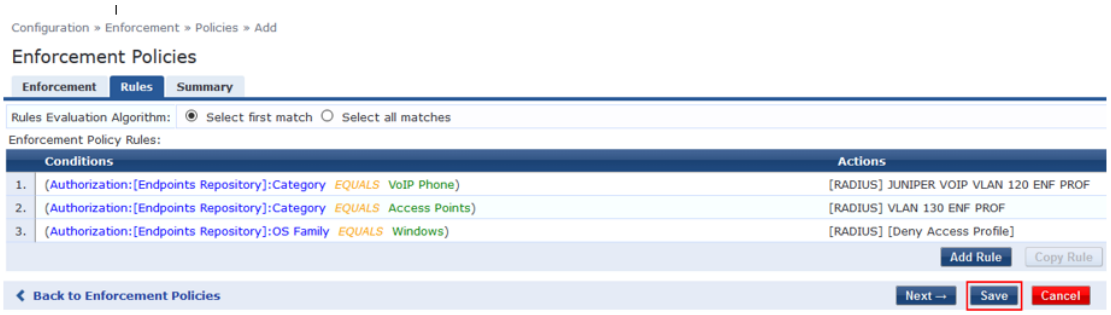
- Under Configuration > Enforcement > Policies, click **Add**.

- On the Enforcement tab, type the name of the policy **(JUNOS MAC AUTH ENF POL)** and set Default Profile to **INTERNET ONLY ACCESS FILTER ID ENF PROF**.



- On the Rules tab, click **Add Rule** and add the rules shown.

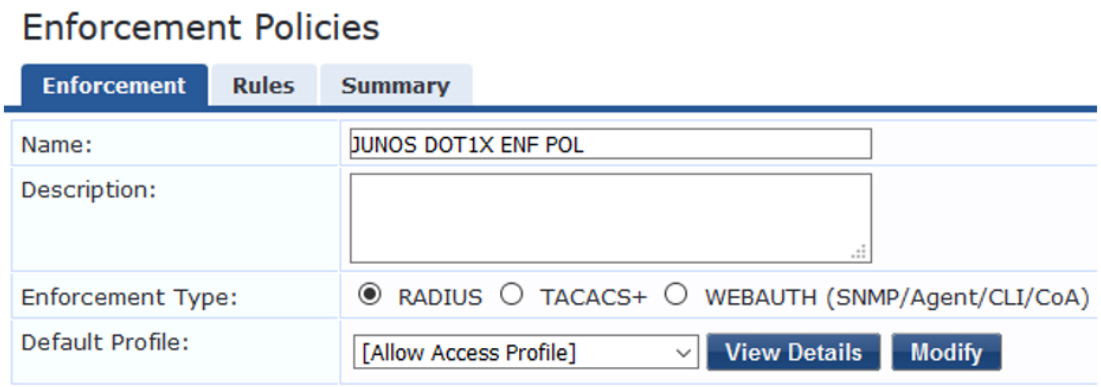
  You must add the rules sequentially by clicking **Save** before you create the next rule.



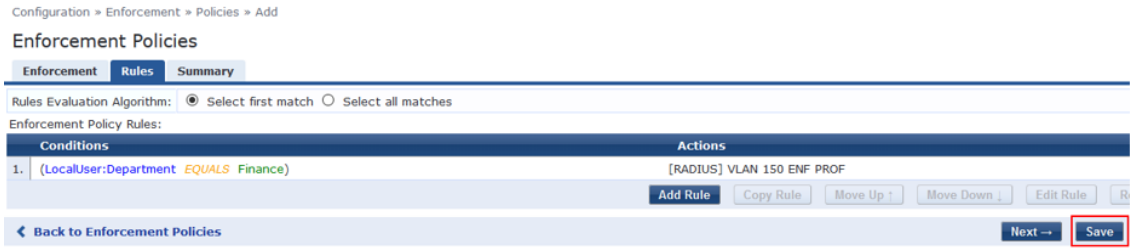
7. Configure the 802.1X enforcement policy.

   This policy tells Aruba ClearPass to use the VLAN 150 ENF PROF enforcement profile if a user is successfully authenticated as a member of the finance department. Any other user authentication will match the Default Profile and the switch will be sent a RADIUS Accept and place the endpoint in the remediation VLAN 100.

   - Under Configuration » Enforcement » Policies, click **Add**.
   - On the Enforcement tab, type the name of the policy **(JUNOS DOT1X ENF POL)** and set Default Profile to **[Allow Access Profile]**.



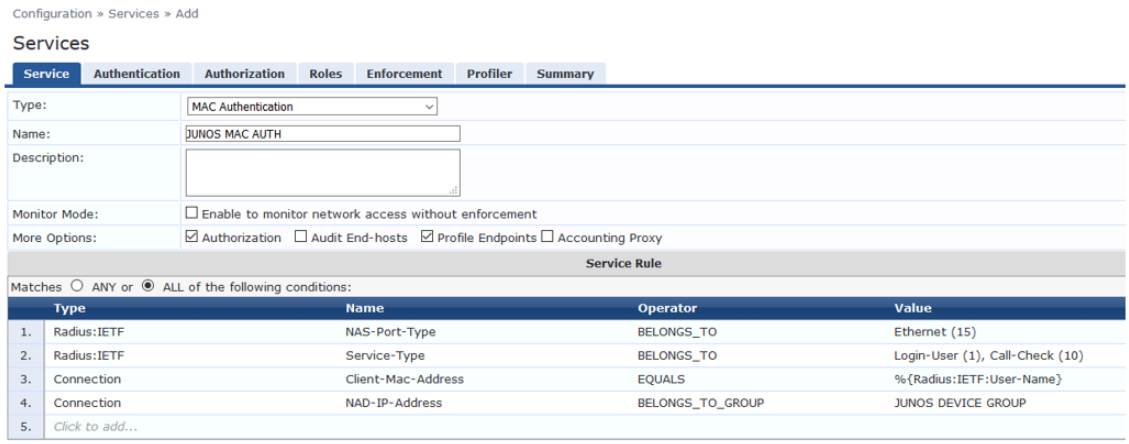
- On the Rules tab, click Add Rule and add the rule shown.



8. Configure the JUNOS MAC AUTH authentication service.

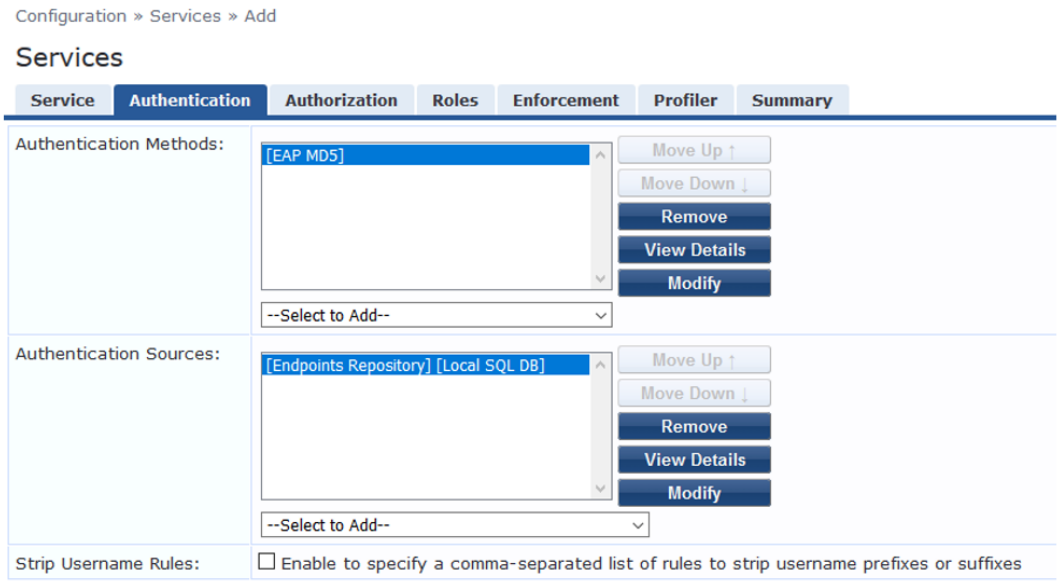
The configuration for this service results in MAC RADIUS authentication being performed when the RADIUS User-Name attribute and the Client-MAC-Address attribute received have the same value.

- Under Configuration » Services, click **Add**.
- On the Services tab, fill out the fields as shown. Be sure to select the **Authorization** and **Profile Endpoints** options.

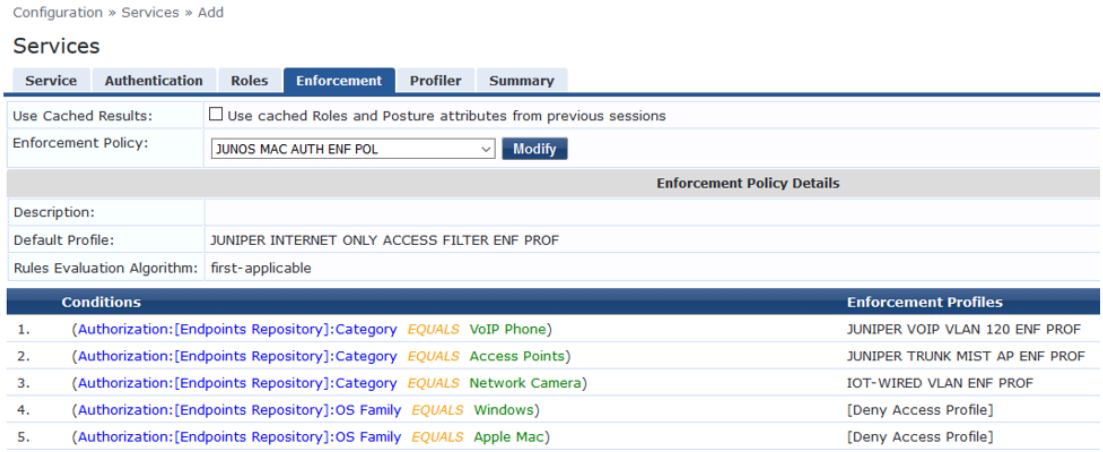


- On the Authentication tab, delete **[Allow All MAC AUTH]** from the Authentication Methods list and add **[EAP MD5]** to the list.

Select **[Endpoints Repository] [Local SQL DB]** in the Authentication Sources list.

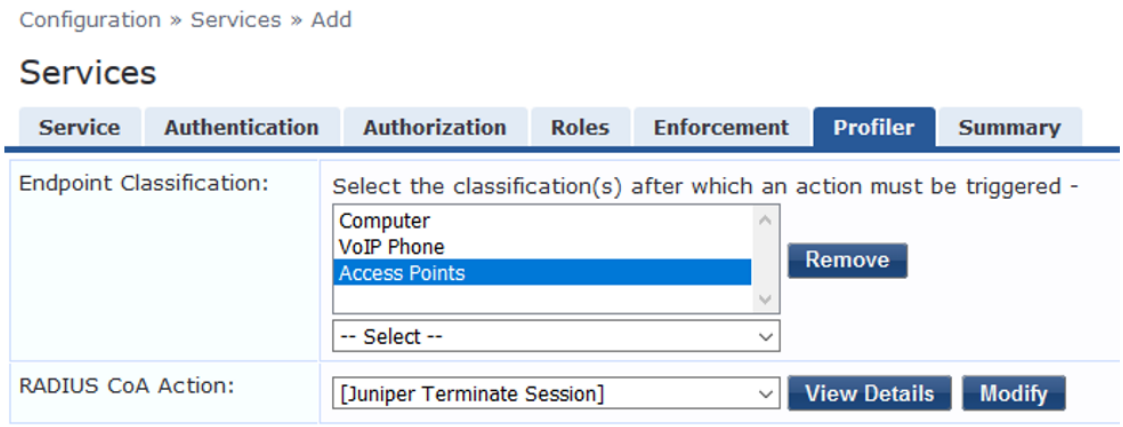


- On the Enforcement tab, select **JUNOS MAC AUTH ENF POL**.



- On the Profiler tab, add Computer, VoIP Phone, Access Points to the Endpoint Classification list.

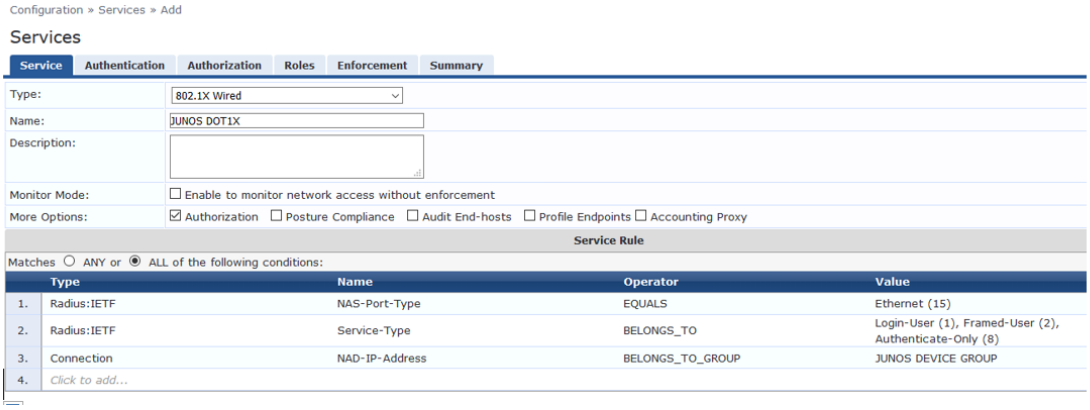
  Select **[Juniper Terminate Session]** from the RADIUS CoA Action list.
  This configuration causes endpoints to go through reauthentication after they are profiled and added to the endpoint repository. Before an endpoint is profiled, the INTERNET ONLY ACCESS FILTER ID ENF PROF enforcement profile is in effect for the authenticated user session. (This profile is the default profile for the MAC authentication policy configured in Step 7.) After Aruba ClearPass successfully classifies a device, it sends a RADIUS CoA to the switch, which causes the switch to terminate the session. The switch then attempts to reauthenticate the endpoint. Because the endpoint's device profile is now in the endpoint repository, the appropriate device enforcement profile will be applied when the endpoint is authenticated.



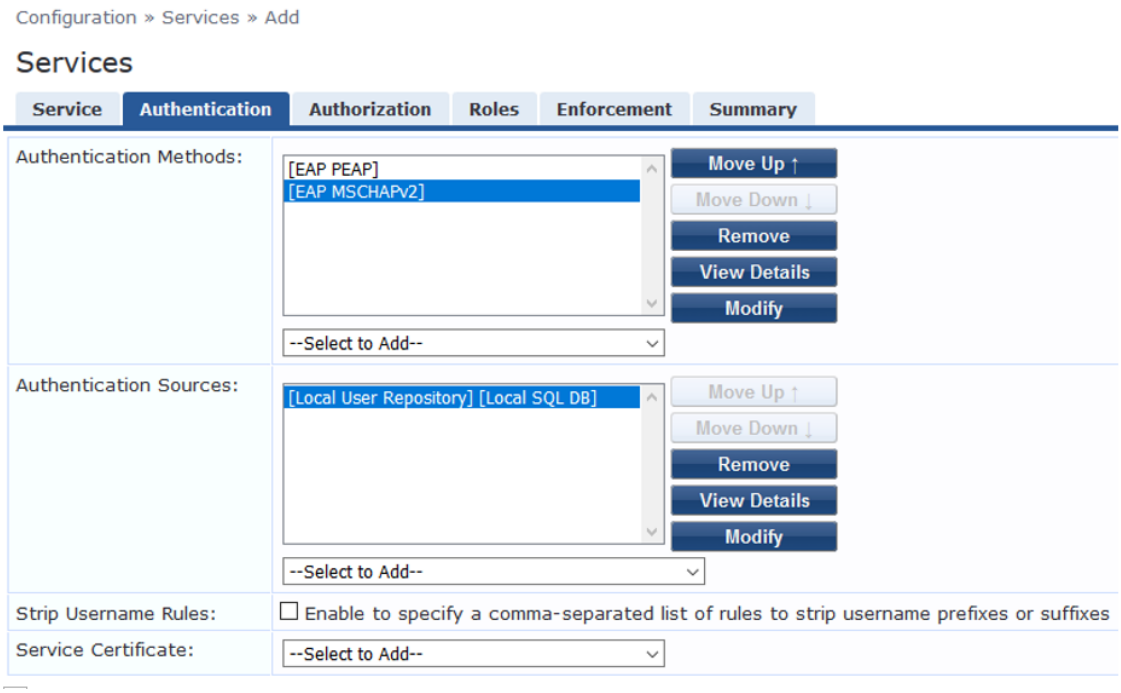
- Click Save.

9. Configure the 802.1X authentication service.

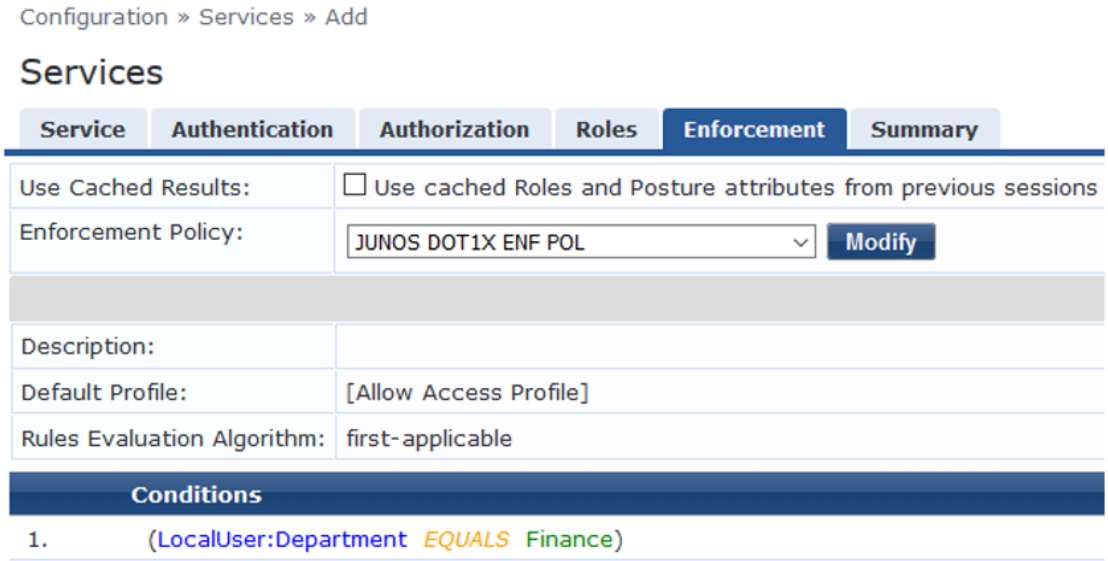
- Under Configuration > Services, click **Add**.
- On the Service tab, fill out the fields as shown.



- On the Authentication tab:
  - Set Authentication Sources to **[Local User Repository][Local SQL DB]**.
  - Remove the **[EAP FAST], [EAP-TLS]** and **[EAP-TTLS]** Authentication Methods.

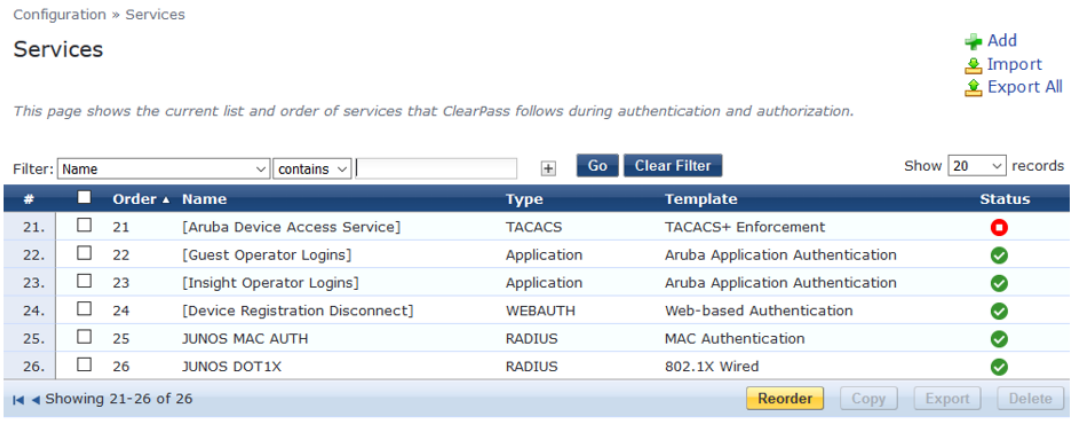


- On the Enforcement tab, set Enforcement Policy to **Juniper_Dot1X_Policy**.



- Verify that the MAC RADIUS authentication service policy is evaluated before the 802.1X authentication service policy.
    - Because Aruba ClearPass is configured to recognize MAC RADIUS authentication requests by the RADIUS User-Name attribute and the Client-MAC-Address attribute having the same value, it is more efficient to have the MAC RADIUS service policy evaluated first.

- In the Services main window, verify that **JUNOS MAC AUTH** appears before **JUNOS DOT1X** in the services list, as shown. If it does not, click **Reorder** and move **JUNOS MAC AUTH** above **JUNOS DOT1X**.



Verification

Confirm that the configuration is working properly.

Verifying 802.1X Authentication on the EX Switch

Purpose

Verify that the test user, usertest1, is being authenticated and placed in the correct VLAN.

To perform this procedure, you must have a Windows device with an active 802.1X supplicant that passes the authentication information for usertest1. For information on how to configure a Windows 7 supplicant for 802.1X PEAP authentication, see *Configuring 802.1X PEAP and MAC RADIUS Authentication with EX Series Switches and Aruba ClearPass Policy Manager*

Action

1. Connect the Windows 7 laptop to ge-0/0/22 on the EX switch.
2. On the switch, type the following command:

```
user@Policy-EX-switch-01> show dot1x interface ge-0/0/8
802.1X Information:
Interface      Role           State          MAC address        User
ge-0/0/8.0     Authenticator  Authenticated  98:90:96:D8:70:19  usertest1
```

3. For more details, including the dynamic VLAN assignment, type:

```
user@Policy-EX-switch-01> show dot1x interface ge-0/0/8 detail
ge-0/0/8.0
  Role: Authenticator
  Administrative state: Auto
  Supplicant mode: Multiple
  Number of retries: 3
  Quiet period: 60 seconds
  Transmit period: 3 seconds
  Mac Radius: Enabled
  Mac Radius Restrict: Disabled
  Mac Radius Authentication Protocol: EAP-MD5
  Reauthentication: Enabled
  Reauthentication interval: 3600 seconds
  Supplicant timeout: 30 seconds
  Server timeout: 30 seconds
  Maximum EAPOL requests: 2
  Guest VLAN member: not configured
  Number of connected supplicants: 1
    Supplicant: usertest1, 98:90:96:D8:70:19
      Operational state: Authenticated
      Backend Authentication state: Idle
      Authentication method: Radius
      Authenticated VLAN: EMPLOYEE-WIRED
      Session Reauth interval: 10800 seconds
      Reauthentication due in 10772 seconds
      Eapol-Block: Not In Effect
      Domain: Data
```

The output shows that usertest1 has been successfully authenticated and placed in the EMPLOYEE-WIRED VLAN.

Verifying the Access Point Authentication on the EX Switch

Purpose

Verify that the access point has been successfully authenticated and placed in the correct VLAN.

Action

1. Connect an access point to ge-0/0/6 on the EX switch.

2. On the switch, type the following command:

```
user@Policy-EX-switch-01> show dot1x interface ge-0/0/6
ge-0/0/6.0
  Role: Authenticator
  Administrative state: Auto
  Supplicant mode: Multiple
  Number of retries: 3
  Quiet period: 60 seconds
  Transmit period: 3 seconds
  Mac Radius: Enabled
  Mac Radius Restrict: Disabled
  Mac Radius Authentication Protocol: EAP-MD5
  Reauthentication: Enabled
  Reauthentication interval: 3600 seconds
  Supplicant timeout: 30 seconds
  Server timeout: 30 seconds
  Maximum EAPOL requests: 2
  Guest VLAN member: not configured
  Number of connected supplicants: 1
    Supplicant: 5c5b352e2d19, 5C:5B:35:2E:2D:19
      Operational state: Authenticated
      Backend Authentication state: Idle
      Authentication method: Mac Radius
      Authenticated VLAN: AP
      Session Reauth interval: 3600 seconds
      Reauthentication due in 3549 seconds
Egress Vlan: 102, 121, 130, 131, 151

    Operational supplicant mode: Single
   Eapol-Block: Not In Effect
   Domain: Data
```

The output shows that the access point has been authenticated and placed in the AP_VLAN VLAN.

Verifying the VoIP Phone and Non-corporate Laptop Authentication on the EX Switch

Purpose

Verify that the VoIP phone has been successfully authenticated and that the non-corporate laptop has not been authenticated.

Action

1. Connect a VoIP phone to ge-0/0/8 on the EX switch, and connect a laptop that does not have an enabled 802.1X supplicant to the Ethernet port on the phone.

2. To verify the authentication state of the devices, type the following command on the switch:

```
user@Policy-EX-switch-01> show dot1x interface ge-0/0/8
ge-0/0/8.0
  Role: Authenticator
  Administrative state: Auto
  Supplicant mode: Multiple
  Number of retries: 3
  Quiet period: 60 seconds
  Transmit period: 30 seconds
  Mac Radius: Enabled
  Mac Radius Restrict: Disabled
  Mac Radius Authentication Protocol: EAP-MD5
  Reauthentication: Enabled
  Configured Reauthentication interval: 3600 seconds
  Supplicant timeout: 30 seconds
  Server timeout: 30 seconds
  Maximum EAPOL requests: 2
  Guest VLAN member: not configured
  Number of connected supplicants: 2
    Supplicant: 08173515ec53, 08:17:35:15:EC:53
      Operational state: Authenticated
      Backend Authentication state: Idle
      Authentication method: Mac Radius
      Authenticated VLAN: IPPhone_VLAN
      Session Reauth interval: 3600 seconds
      Reauthentication due in 3591 seconds
      Session Accounting Interim  Interval: 600 seconds
      Accounting Update  due in 591 seconds
    Supplicant: No User, D0:67:E5:50:E3:DD
      Operational state: Connecting
      Backend Authentication state: Idle
      Authentication method: None
      Session Reauth interval: 0 seconds
      Reauthentication due in 0 seconds
      Session Accounting Interim  Interval: 600 seconds
      Accounting Update  due in 0 seconds
```

The output shows that two supplicants are attached to the port, each identified by MAC address. The VoIP phone has been successfully authenticated and placed in IPPhone_VLAN. The laptop is in a connecting state, not authenticated state, indicating that it has failed to be authenticated.

3. To verify that IPPhone_VLAN VLAN has been assigned as the VoIP VLAN, type the following command:

```
user@Policy-EX-switch-01> show ethernet-switching interface ge-0/0/8
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down,
                         MMAS - Mac-move action shutdown,
                         SCTL - shutdown by Storm-control )

Logical     Vlan         TAG  MAC    STP       Logical         Tagging
interface   members           limit  state     interface flags
ge-0/0/8.0                    65535                             tagged,untagged
            default      1    65535  Forwarding                untagged
            IPPhone_VLAN 120  65535  Forwarding                tagged
```

IPPhone_VLAN is shown as a tagged VLAN, indicating that it is the VoIP VLAN.

Verifying the Status of Authentication Requests on Aruba ClearPass Policy Manager

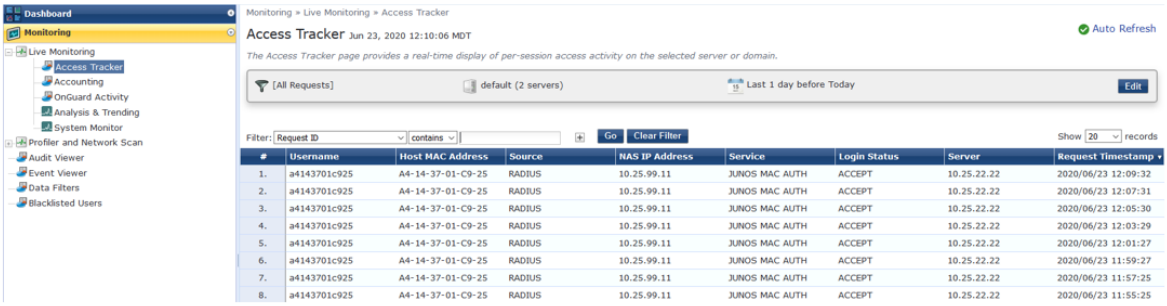
Purpose

Verify that the endpoints are being correctly authenticated and that the correct RADIUS attributes are being exchanged between the switch and Aruba ClearPass.

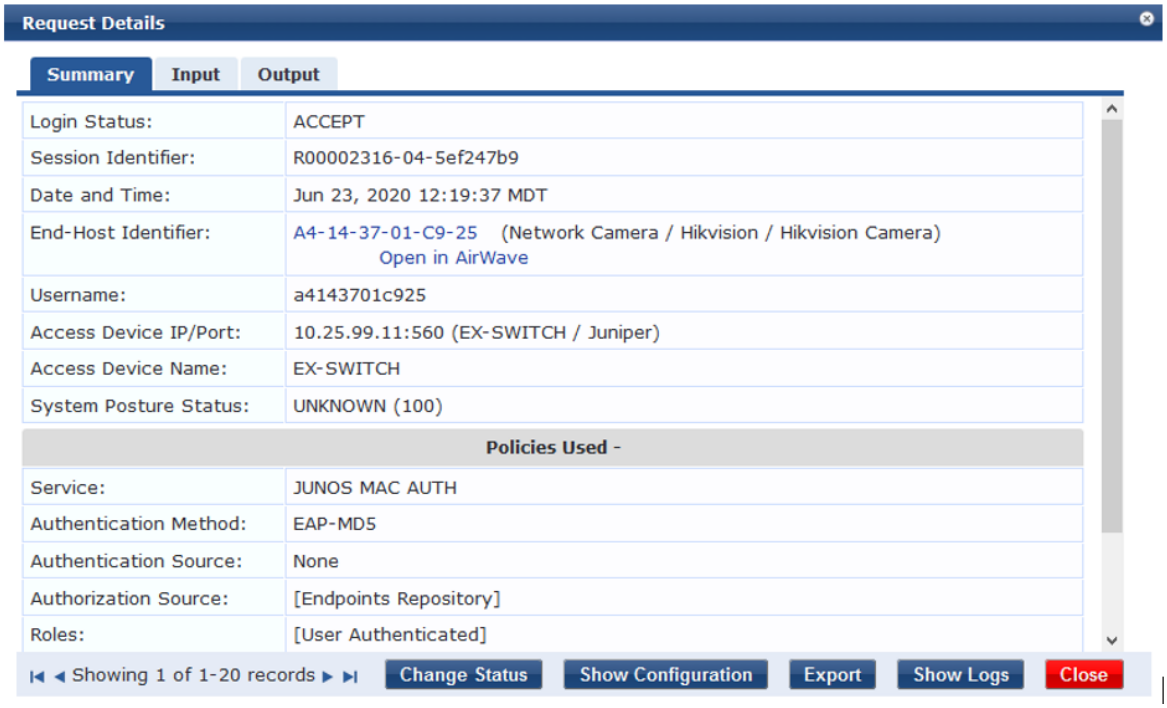
Action

1. Go to Monitoring > Live Monitoring > Access Tracker to display the status of the authentication requests.

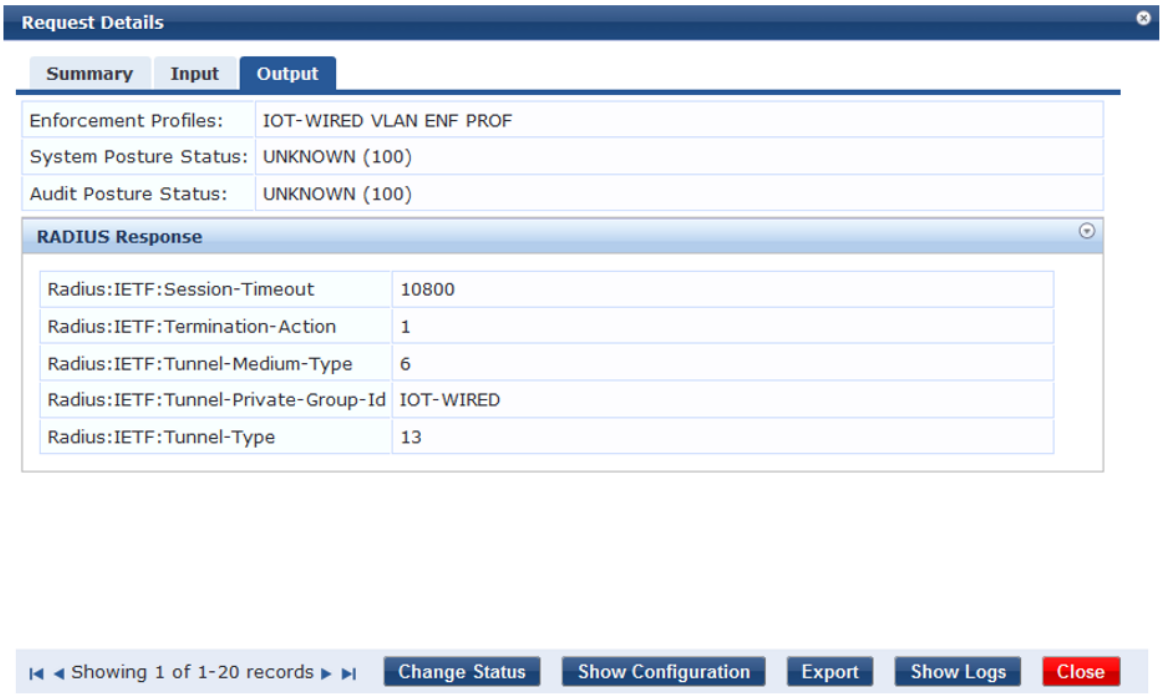
   The Access Tracker monitors authentication requests as they occur and reports on their status.



2. To get more details on a particular authentication request, click on the request.



3. To verify the RADIUS attributes that Aruba ClearPass sent back to the switch for this request, click the **Output** tab.



Meaning

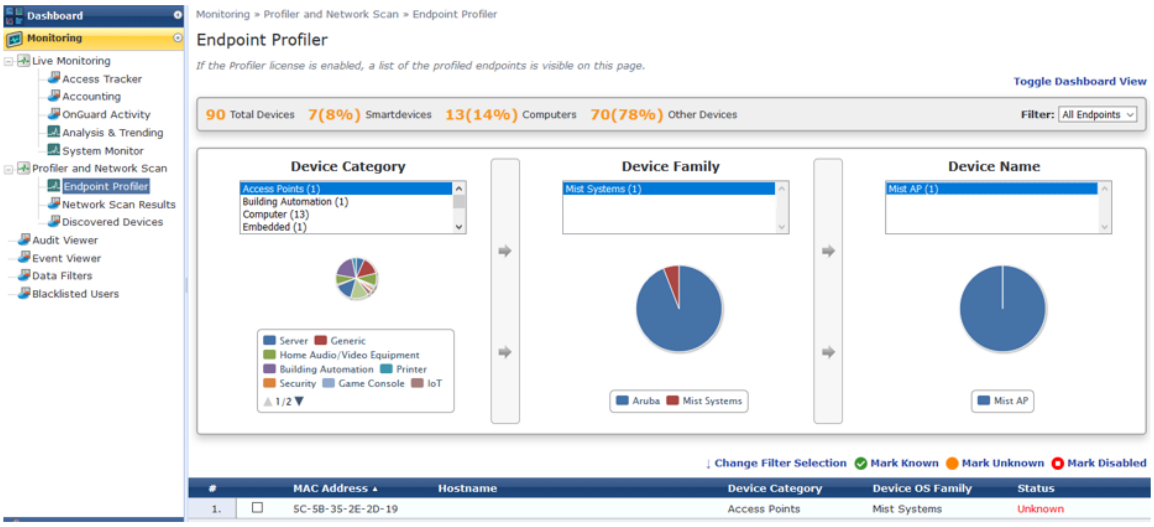
The authentication request from the IOT Device (Camera) was successful and the correct information about the IOT VLAN was returned to the switch.

Monitoring Device Profiling

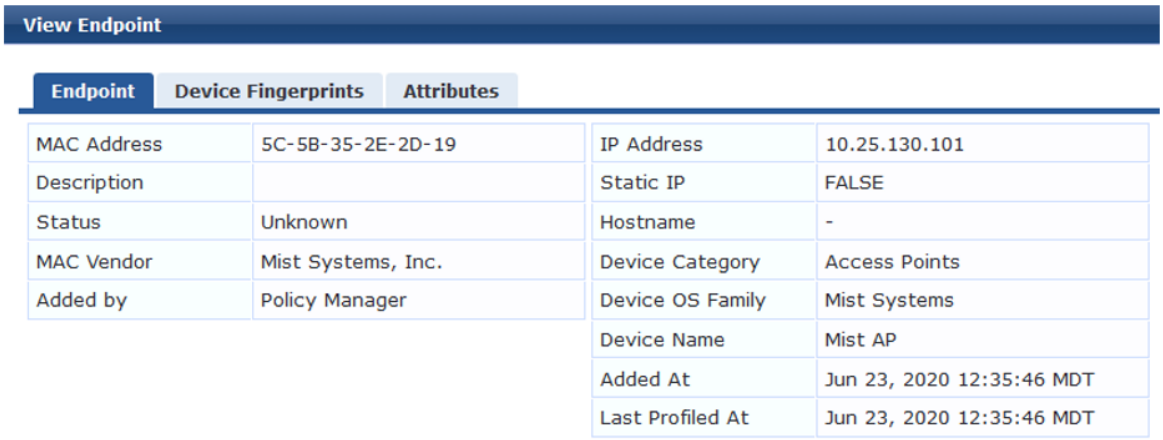
Step-by-Step Procedure

You can view the devices that Aruba ClearPass Profile has discovered and maintains in its endpoint repository, obtaining information on the total number of devices profiled, the kinds of devices, and device-specific data, such as the device vendor, device hostname, and timestamp when the device was added to the repository.

1. In Aruba ClearPass, select **Monitoring** » **Profiler and Network Scan** » **Endpoint Profiler** . The initial Endpoint Profiler window provides an overview of the endpoints in its repository, grouping devices within the device category, device family, and device name hierarchies. The table at the bottom of the window lists the endpoints that are in the currently selected device name group.



2. To display more information about an individual endpoint, click on the endpoint in the table.

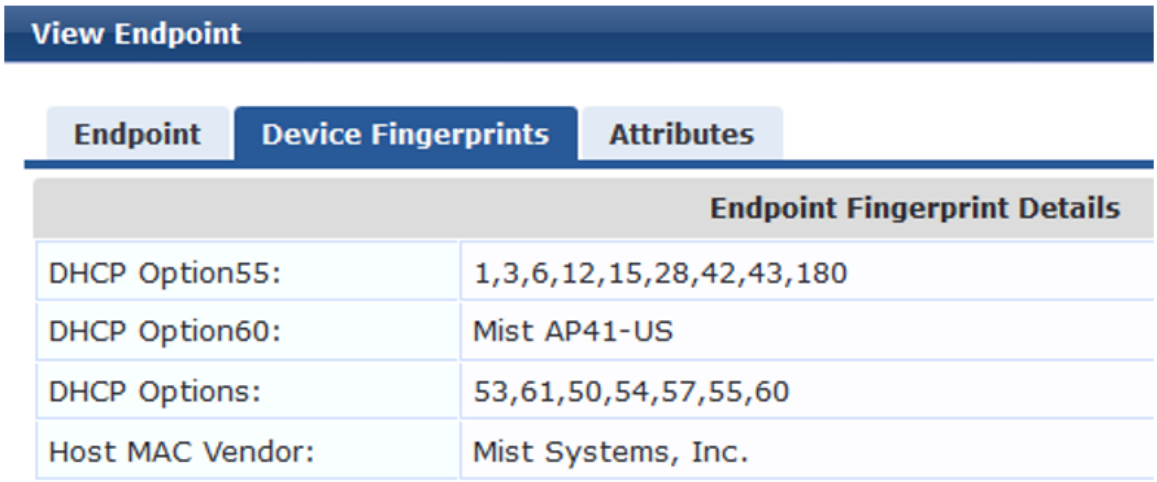


View Endpoint

Endpoint | **Device Fingerprints** | **Attributes**

MAC Address	5C-5B-35-2E-2D-19	IP Address	10.25.130.101
Description		Static IP	FALSE
Status	Unknown	Hostname	-
MAC Vendor	Mist Systems, Inc.	Device Category	Access Points
Added by	Policy Manager	Device OS Family	Mist Systems
		Device Name	Mist AP
		Added At	Jun 23, 2020 12:35:46 MDT
		Last Profiled At	Jun 23, 2020 12:35:46 MDT

In the View Endpoint window, you can display the information ClearPass Profile used to profile the device by clicking the Device Fingerprints tab. In the following example, ClearPass Profile used information obtained from various DHCP options in the DHCP messages to profile the device.



Troubleshooting Authentication

Step-by-Step Procedure

This topic describes how you get detailed diagnostic information by enabling tracing of authentication operations on the EX Series switch.

Aruba ClearPass Policy Manager provides additional detailed diagnostic information.

You can enable trace options for the 802.1X protocol.

1. The following set of commands enables the writing of trace logs to a file named do1x.

```
root@EX-switch-1# set protocols dot1x traceoptions file dot1x
root@EX-switch-1# set protocols dot1x traceoptions file size 5m
root@EX-switch-1# set protocols dot1x traceoptions flag all
```

2. Use the show log CLI command to display the contents of the trace log file. For example:

```
root@EX-switch-1> show log dot1x
root@EX-switch-1> set protocols dot1x traceoptions file size 5m
```

3. You can also display the contents of the trace log file from the UNIX-level shell. For example:

```
root@EX-switch-1> start shell
root@EX-switch-1: RE:0% tail -f /var/log/dot1x
```

Configuring Colorless Ports on EX Series Switches with Aruba ClearPass Policy Manager and Cisco ISE

IN THIS SECTION

Starting from Junos OS Release 20.4R1, EX switches support Colorless ports. Colorless ports are used in conjunction with device profiling with any standards-based radius server, and convert an access port to a trunk port and allow the necessary VLANs with necessary tagging. In the case that some of the VLAN's are missing on the switch, this feature helps in creating those missing VLANs dynamically on the switch.

MAC Auth Bypass (MAB), is commonly used as a fail-through for headless, non-802.1X capable and legacy devices as well as guest users. MAB is often combined with 802.1X and Captive Portal as part of a colorless port configuration supporting every user and device type with a single port configuration.

Aruba ClearPass is a multi-vendor product that leverages standards-based protocols and technologies along with the flexibility to support vendor-specific switch features for policy enforcement.

Radius IETF Attribute **Egress-VLANID** is used for vlans with tag functionality. Any standards based Radius server can send multiple tagged vlans using radius attribute **Egress-VLANID** or **Egress-VLAN-Name** for tagged packets as per RFC 4675.

The Egress-VLANID or Egress-VLAN-Name attribute contains two parts; the first part indicates if frames on the VLAN for this port are to be represented in tagged or untagged format, the second part is the VLAN name.
For Example:

```
Egress-VLANID = 0x3100012D, here 0x31 represents tagged.
       Egress-VLANID = 0x3200012D, here 0x32 represents untagged.
```

NOTE: Egress-VLAN-Name 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.

Examples:

- For attribute Egress-VLANID:

```
001094001177 Cleartext-Password := "001094001177“
    Tunnel-Type = VLAN,
    Tunnel-Medium-Type = IEEE-802,
    Egress-VLANID += 0x3100033,    <<= Here 0x31 for tagged vlan
    Egress-VLANID += 0x3200034,     <<= Here 0x32 for untagged vlan
```

- For attribute Egress-VLAN-Name:

```
001094001144 Cleartext-Password := "001094001144“
    Tunnel-Type = VLAN,
    Tunnel-Medium-Type = IEEE-802,
    Egress-VLAN-Name += 1vlan-2,    <<= Here 1 for tagged vlan
    Egress-VLAN-Name += 2vlan-3,    <<= Here 2 for untagged vlan
    Egress-VLAN-Name += 1vlan-4,
    Egress-VLAN-Name += 1vlan-5,
```

- For sample radius profile:

```
001094001177 Auth-Type = EAP, Cleartext-Password := "001094001177 “
  Tunnel-Type = VLAN,
  Tunnel-Medium-Type = IEEE-802,
  Juniper-AV-Pair = Supplicant-Mode-Single-Secure,
  Egress-VLANID += 0x3100065,
  Egress-VLANID += 0x3100066
```

With Junos OS Release 20.3R1, we have added new VSA Supplicant-Mode-Single or Supplicant-Mode-Single-secure with attribute Juniper-AV-Pair. Which will be used to set the supplicant mode of dot1x.

Requirements

This example uses the following hardware and software components for the policy infrastructure:

- EX4300, EX2300, EX3400 switch running Junos OS Release 20.4R1 or earlier
- Aruba ClearPass Policy Manager running 6.9.0.130064

Overview and Topology

IN THIS SECTION

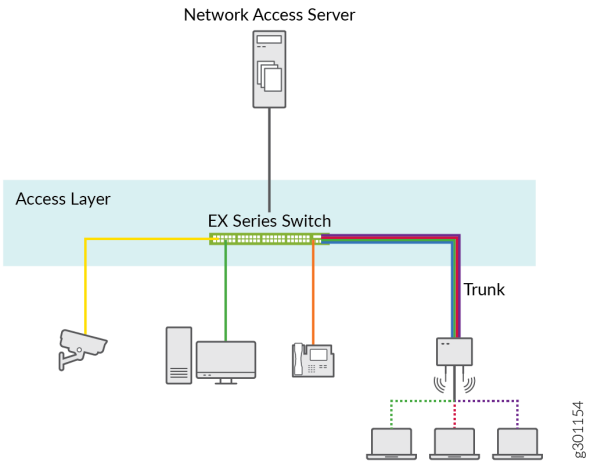
VLAN name is highly recommended in a colorless port deployment as it removes the need for radius server to maintain a VLAN to function mapping for each switch. This simplifies policy creation, management and troubleshooting.

For example, each switch might use a different VLAN-ID for “secure access”. Instead of having to write complex policy in radius to return the correct VLAN-ID for each switch, we just give the appropriate VLAN-ID a name on each switch; “SECURE” for example. Now in your radius server, you simply return a VLAN enforcement with “SECURE” as the VLAN-ID and each switch will use the appropriate VLAN-ID mapped locally on the switch.

> **NOTE**: In ClearPass 6.6.X and earlier, the pre-defined Juniper dynamic authorization enforcement profiles need to be used with Juniper switches.

Figure 2 on page 41 shows the topology used in this example.

Figure 2: Topology Used in This Example



Here is the sample profile in a radius server to convert the port once device profiling is enabled and we detect a MIST AP to a trunk port with VLAN 130 as native VLAN and allow the rest of the VLAN's (121,131,151,102).

```
001094001177 Auth-Type = EAP, Cleartext-Password := "001094001177 "
      Tunnel-Type = VLAN,
      Tunnel-Medium-Type = IEEE-802,
      Juniper-AV-Pair = Supplicant-Mode-Single-Secure,

      Egress-VLANID += 0x3200082,     130 hex value is 82, 0x32 is used to designate untagged

      Egress-VLANID += 0x3100079,     121 hex value is 79, 0x31 is used to designate tagged

      Egress-VLANID += 0x3100083,     for vlan 131

      Egress-VLANID += 0x3100097,     for vlan 151

      Egress-VLANID += 0x3100066,     for vlan 102
```

Procedure

Step-by-Step Procedure

To configure colorless ports on EX Series switches with Aruba ClearPass policy manager and Cisco ISE, follow the below steps:

1. **Example of an Enforcement Profile in Aruba ClearPass / ISE**—When using the Egress-VLANID attribute, ClearPass requires a decimal value to be entered for the Egress-VLANID value, so you must

convert your desired hexadecimal values into decimal values. For example, see entry 4 in the Enforcement Profiles on page 21, for VLAN 130 to be untagged. The hexadecimal value for this is 0x3200082. Converting the hexadecimal value to decimal gives 52428930.

> **NOTE**: To quickly convert hexadecimal value to decimal value, use the conversion application tool that is available on websites.

Figure 3: Enforcement Profiles

Summary | Profile | Attributes

	Type	Name		Value
1.	Radius:IETF	Tunnel-Type	=	VLAN (13)
2.	Radius:IETF	Tunnel-Medium-Type	=	IEEE-802 (6)
3.	Radius:Juniper	Juniper-AV-Pair	=	Supplicant-Mode-Single
4.	Radius:IETF	Egress-VLANID	=	52428930
5.	Radius:IETF	Egress-VLANID	=	51380345
6.	Radius:IETF	Egress-VLANID	=	51380355
7.	Radius:IETF	Egress-VLANID	=	51380375
8.	Radius:IETF	Egress-VLANID	=	51380326

If the switchport is configured for Supplicant Mode Multiple, you must also return the **Juniper-AV-Pair of Supplicant-Mode-Single or Supplicant-Mode-Single-Secure** in your RADIUS response. The **Egress-VLANID** and **Egress-VLAN-NAME** attributes are not able to be used with the supplicant mode of Multiple.

2. In the Enforcement Profiles - Egress-VLAN-NAME on page 22 you can see how to use the Egress-VLAN-NAME attribute instead of the Egress-VLANID attribute.

Figure 4: Enforcement Profiles - Egress-VLAN-NAME

Summary | Profile | Attributes

	Type	Name		Value
1.	Radius:IETF	Tunnel-Type	=	VLAN (13)
2.	Radius:IETF	Tunnel-Medium-Type	=	IEEE-802 (6)
3.	Radius:Juniper	Juniper-AV-Pair	=	Supplicant-Mode-Single
4.	Radius:IETF	Egress-VLAN-Name	=	2AP
5.	Radius:IETF	Egress-VLAN-Name	=	1IP-PHONE-WIRELESS
6.	Radius:IETF	Egress-VLAN-Name	=	1IOT-WIRELESS
7.	Radius:IETF	Egress-VLAN-Name	=	1REMEDIATION-WIRELESS
8.	Radius:IETF	Egress-VLAN-Name	=	1EMPLOYEE-WIRELESS

NOTE: You must assign 1 to the VLAN Name to indicate tagged or 2 to indicate untagged. The values are case sensitive.

3. **Example for Cisco ISE**

Figure 5: Cisco ISE

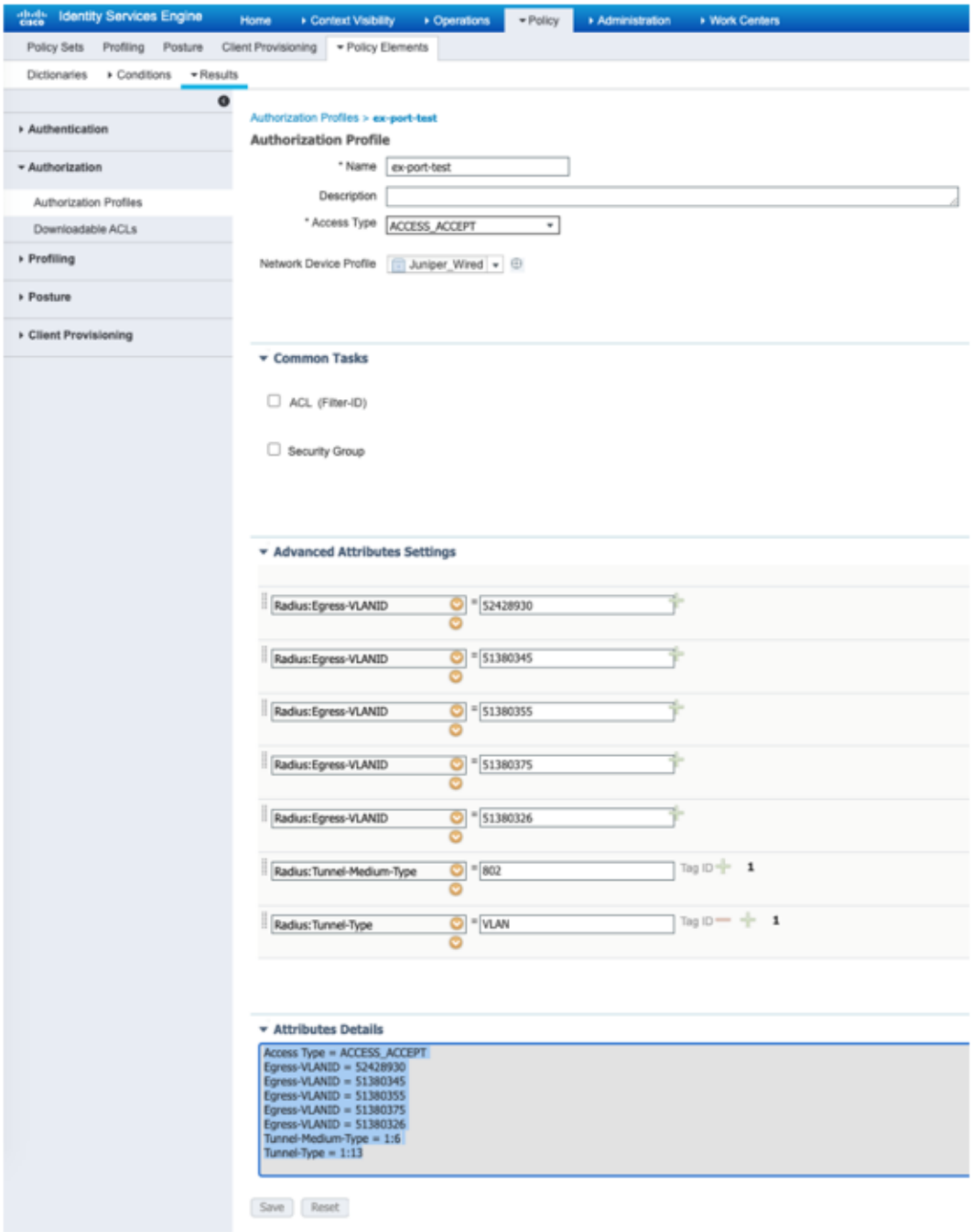
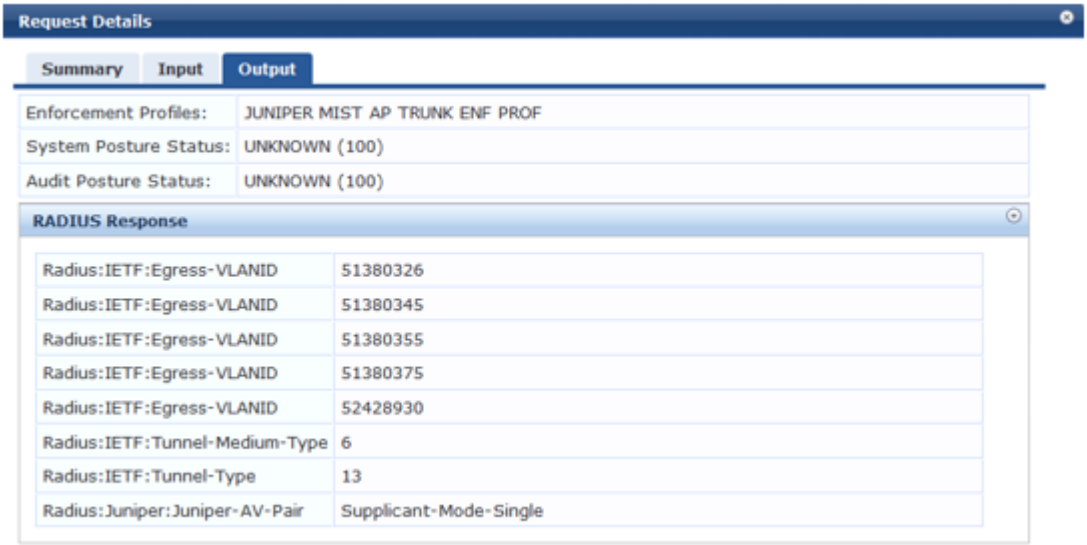


Figure 6: Aruba ClearPass Profiling



Request Details

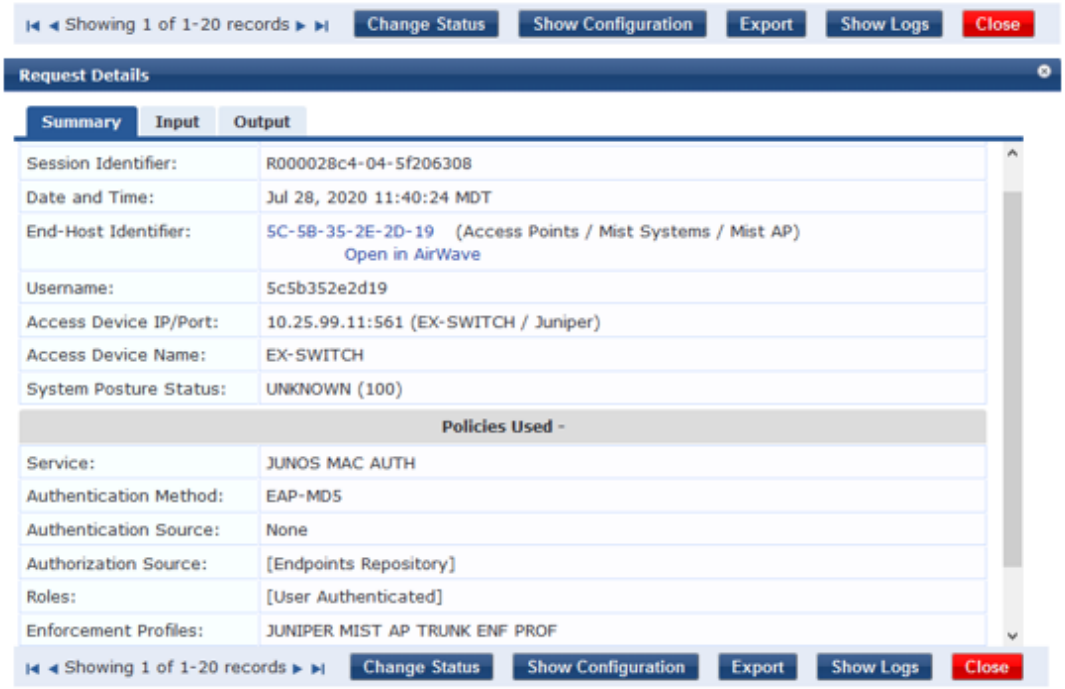
Summary | Input | Output

Enforcement Profiles:	JUNIPER MIST AP TRUNK ENF PROF
System Posture Status:	UNKNOWN (100)
Audit Posture Status:	UNKNOWN (100)

RADIUS Response

Radius:IETF:Egress-VLANID	51380326
Radius:IETF:Egress-VLANID	51380345
Radius:IETF:Egress-VLANID	51380355
Radius:IETF:Egress-VLANID	51380375
Radius:IETF:Egress-VLANID	52428930
Radius:IETF:Tunnel-Medium-Type	6
Radius:IETF:Tunnel-Type	13
Radius:Juniper:Juniper-AV-Pair	Supplicant-Mode-Single

Figure 7: Configuring VLANs and Port



Showing 1 of 1-20 records | Change Status | Show Configuration | Export | Show Logs | Close

Request Details

Summary | Input | Output

Session Identifier:	R000028c4-04-5f206308
Date and Time:	Jul 28, 2020 11:40:24 MDT
End-Host Identifier:	5C-5B-35-2E-2D-19 (Access Points / Mist Systems / Mist AP) Open in AirWave
Username:	5c5b352e2d19
Access Device IP/Port:	10.25.99.11:561 (EX-SWITCH / Juniper)
Access Device Name:	EX-SWITCH
System Posture Status:	UNKNOWN (100)
Policies Used -	
Service:	JUNOS MAC AUTH
Authentication Method:	EAP-MD5
Authentication Source:	None
Authorization Source:	[Endpoints Repository]
Roles:	[User Authenticated]
Enforcement Profiles:	JUNIPER MIST AP TRUNK ENF PROF

Showing 1 of 1-20 records | Change Status | Show Configuration | Export | Show Logs | Close

Verification

IN THIS SECTION

Verification on the switch port

Purpose

To verify the configuration on the switch port, use the `show dot1x interface ge-0/0/6 detail` command.

Action

```
root@EX2300-1> show dot1x interface ge-0/0/6 detail
ge-0/0/6.0
  Role: Authenticator
Administrative state: Auto
Supplicant mode: Single
  Number of retries: 3
  Quiet period: 60 seconds
  Transmit period: 30 seconds
  Mac Radius: Disabled
  Mac Radius Restrict: Disabled
  Reauthentication: Enabled
  Reauthentication interval: 3600 seconds
  Supplicant timeout: 30 seconds
  Server timeout: 30 seconds
  Maximum EAPOL requests: 2
  Guest VLAN member: not configured
  Number of connected supplicants: 1
    Supplicant: sujitghosh, AC:87:A3:12:E3:A8
      Operational state: Authenticated
      Backend Authentication state: Idle
      Authentication method: Radius
```

```
    Authenticated VLAN: __dynamic_vlan-0130__
    Session Reauth interval: 3600 seconds
    Reauthentication due in 3593 seconds
    Egress Vlan: 102, 121, 130, 131, 151
    Eapol-Block: Not In Effect
    Domain: Data
```

Verification of the VLANs created on the switch port

Purpose

To verify the VLANs created on the switch port, use the `show vlans` command.

Action

```
root@EX2300-1> show vlans
Routing instance        VLAN name             Tag          Interfaces
default-switch          __dynamic_vlan-0102__ 102
                                                           ae0.0*
                                                           ge-0/0/6.0*
default-switch          __dynamic_vlan-0121__ 121
                                                           ae0.0*
                                                           ge-0/0/6.0*
default-switch          __dynamic_vlan-0130__ 130
                                                           ae0.0*
                                                           ge-0/0/6.0*
default-switch          __dynamic_vlan-0131__ 131
                                                           ae0.0*
                                                           ge-0/0/6.0*
default-switch          __dynamic_vlan-0151__ 151
                                                           ae0.0*
                                                           ge-0/0/6.0*
default-switch          default               1
                                                           ae0.0*
                                                           ge-0/0/0.0
                                                           ge-0/0/1.0*
                                                           ge-0/0/11.0
                                                           ge-0/0/2.0*
                                                           ge-0/0/3.0
                                                           ge-0/0/8.0
default-switch          vlan10                10
```

```
                                                        ae0.0*
                                                        ge-0/0/4.0
default-switch          vlan11                11
                                                        ae0.0*
                                                        ge-0/0/4.0
default-switch          vlan12                12
                                                        ae0.0*
                                                        ge-0/0/4.0
default-switch          vlan20                20
                                                        ae0.0*
                                                        ge-0/0/5.0
default-switch          vlan30                30
                                                        ae0.0*
                                                        ge-0/0/7.0
default-switch          vlan40                40
                                                        ae0.0*
```

Ethernet Switching for Egress VLAN

Purpose

To verify the ethernet-switching table for Egress vlan list, use the `show ethernet-switching interface ge-0/0/6.0` command.

Action

```
root@EX2300-1> show ethernet-switching interface ge-0/0/6.0
Routing Instance Name : default-switch
Logical Interface flags (DL - disable learning, AD - packet action drop,
                         LH - MAC limit hit, DN - interface down,
                         MMAS - Mac-move action shutdown,  AS - Autostate-exclude enabled,
                         SCTL - shutdown by Storm-control, MI - MAC+IP limit hit)
Logical         Vlan                  TAG   MAC    MAC+IP STP         Logical          Tagging
interface       members                     limit  limit  state       interface flags
ge-0/0/6.0                                  16384  0
tagged,untagged
                __dynamic_vlan-0130__  130   16384  0      Forwarding                   untagged
                __dynamic_vlan-0102__  102   16384  0      Forwarding                   tagged
                __dynamic_vlan-0121__  121   16384  0      Forwarding                   tagged
                __dynamic_vlan-0131__  131   16384  0      Forwarding                   tagged
```

```
                __dynamic_vlan-0151__  151   16384  0      Forwarding                   tagged
```