Use RADIUS for Device Administration with Identity Services Engine

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Introduction

This document describes the compilation of attributes that various Cisco and non-Cisco products expect to receive from an AAA server like a Cisco ISE.

Background Information

Cisco and non-Cisco products expect to receive a compilation of attributes from an authentication, authorization, and accounting (AAA) server. In this case, the server is a Cisco ISE and the ISE would return these attributes along with an Access-Accept as a part of an authorization profile (RADIUS).

This document provides step-by-step instructions on how to add custom attribute authorization profiles and also contains a list of devices and the RADIUS attributes that the devices expect to see returned from the AAA server. All topics include examples.

The list of attributes provided in this document is neither exhaustive nor authoritative and can change at any time without an update to this document.

Device Administration of a network device is generally achieved with TACACS+ protocol but if the

network device does not support TACACS+ or if ISE does not have a device administration license, it can be achieved with RADIUS as well if the network device supports RADIUS device administration. Some devices support both of the protocols and it is up to the users to decide which protocol to use but TACACS+ can be favorable as it has features such as command authorization and command accounting.

Prerequisites

Requirements

Cisco recommends you have the knowledge of these:

- Cisco ISE as a Radius server on the network of interest
- The workflow of the Radius protocol - RFC2865

The ISE deployment will require at least as many Essential licenses as the number of concurrent RADIUS sessions used for device administration managed via RADIUS.

Components Used

The information in this document is based on Cisco Identity Services Engine (ISE) 3.x and higher versions of ISE.

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, ensure that you understand the potential impact of any command.

Configure

Step 1. Create the Vendor-Specific Attributes (VSA).

There can be various dictionaries created for each of the vendors, and attributes can be added to each of these dictionaries. Each dictionary can have multiple attributes that can be used in the authorization profiles. Each attribute, in general, defines the different role of device administration a user could get when he logs in to the network device. However, the attribute can be intended for different purposes of operation or configuration on the network device.

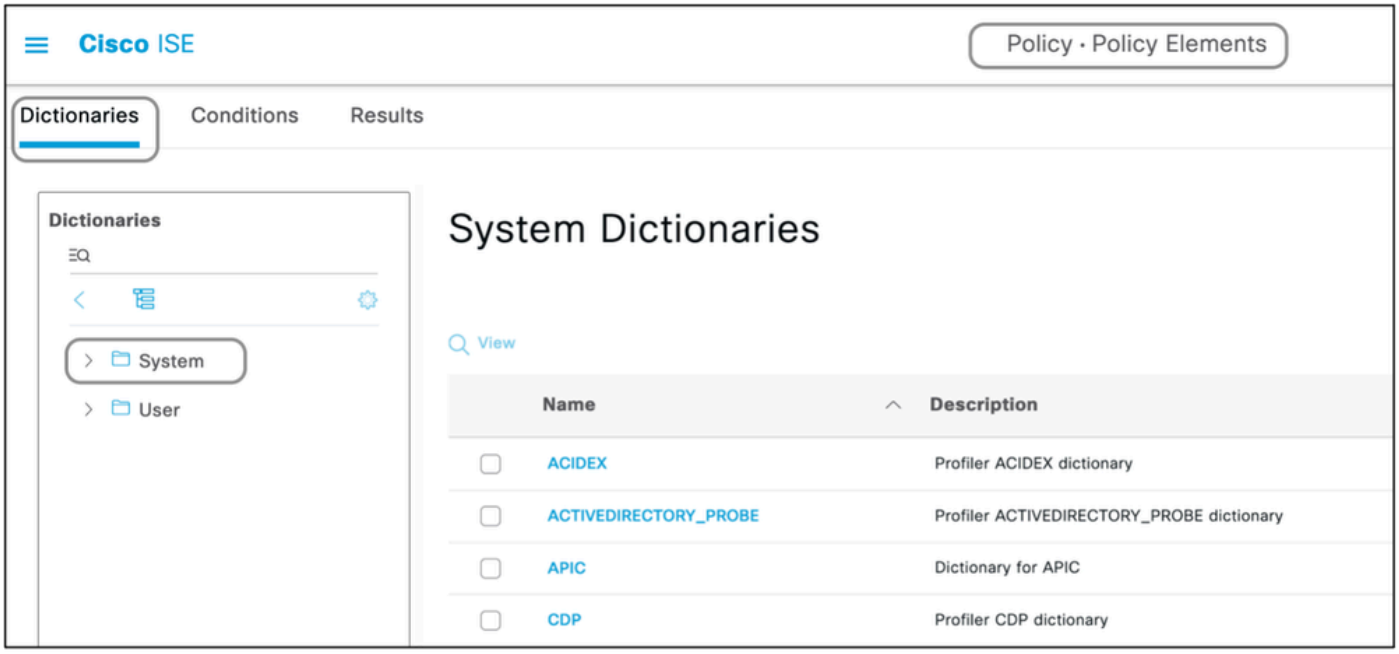
ISE comes with pre-defined attributes for a few vendors. If the vendor is not listed, it can be added as a dictionary with attributes. For some network devices, the attributes are configurable and can be changed for various types of access, if that is the case, ISE has to be configured with attributes the network device expects for different types of access.

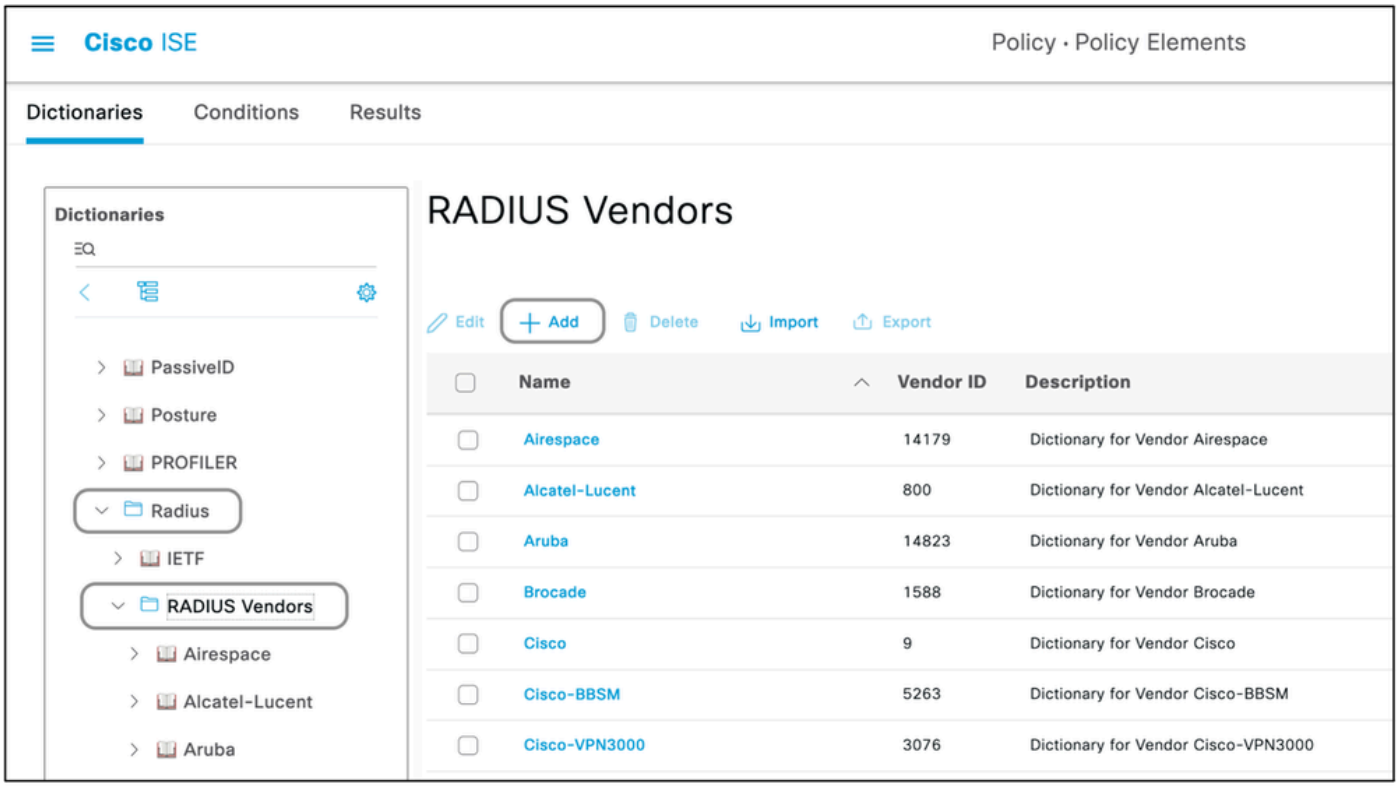
The attributes which are expected to be sent with a Radius Access-Accept are defined as here:

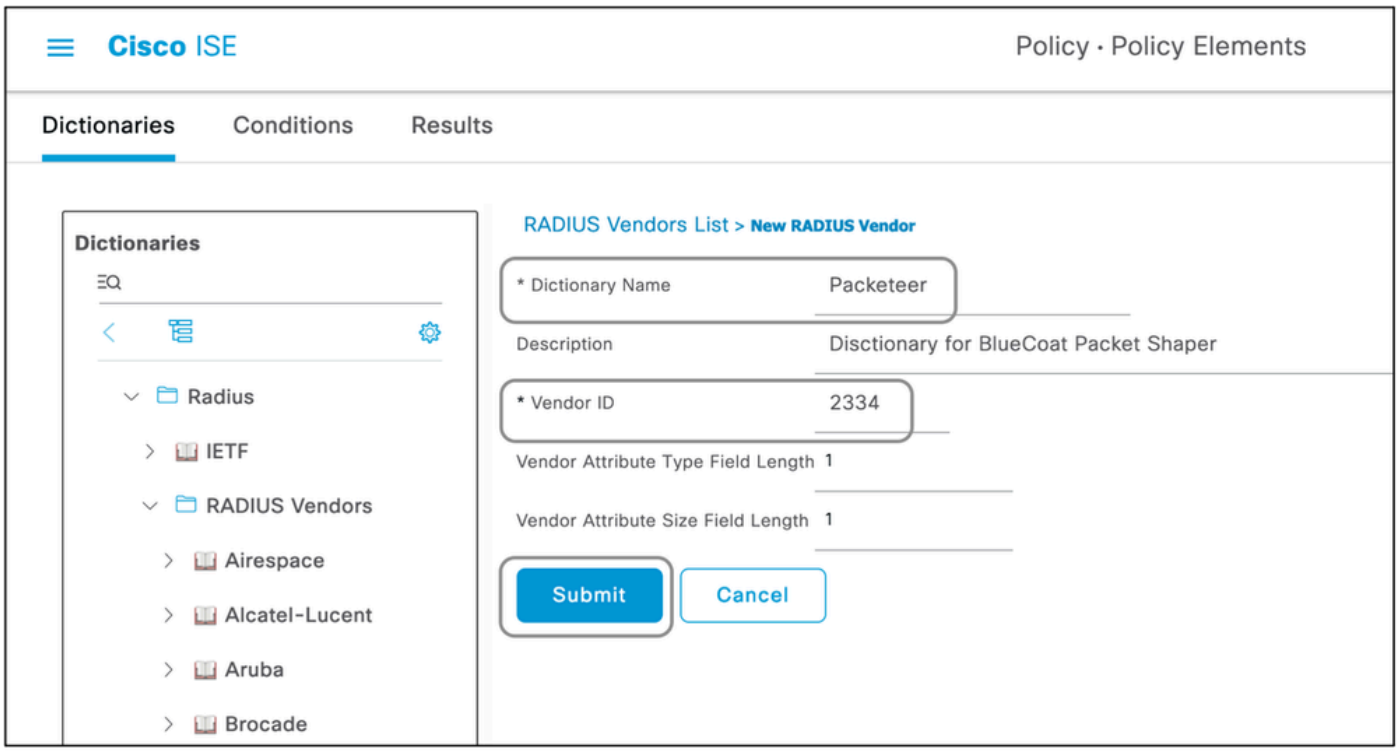
1. Navigate to **Policy > Policy Elements > Dictionaries > System > Radius > Radius Vendors > Add**.
2. The name and the Vendor IDs are to be entered and saved.
3. Click the saved **Radius Vendor** and navigate to **Dictionary Attributes**.
4. Click **Add** and fill out the case sensitive Attribute Name, Data Type, Direction, and ID.
5. **Save** the attribute.

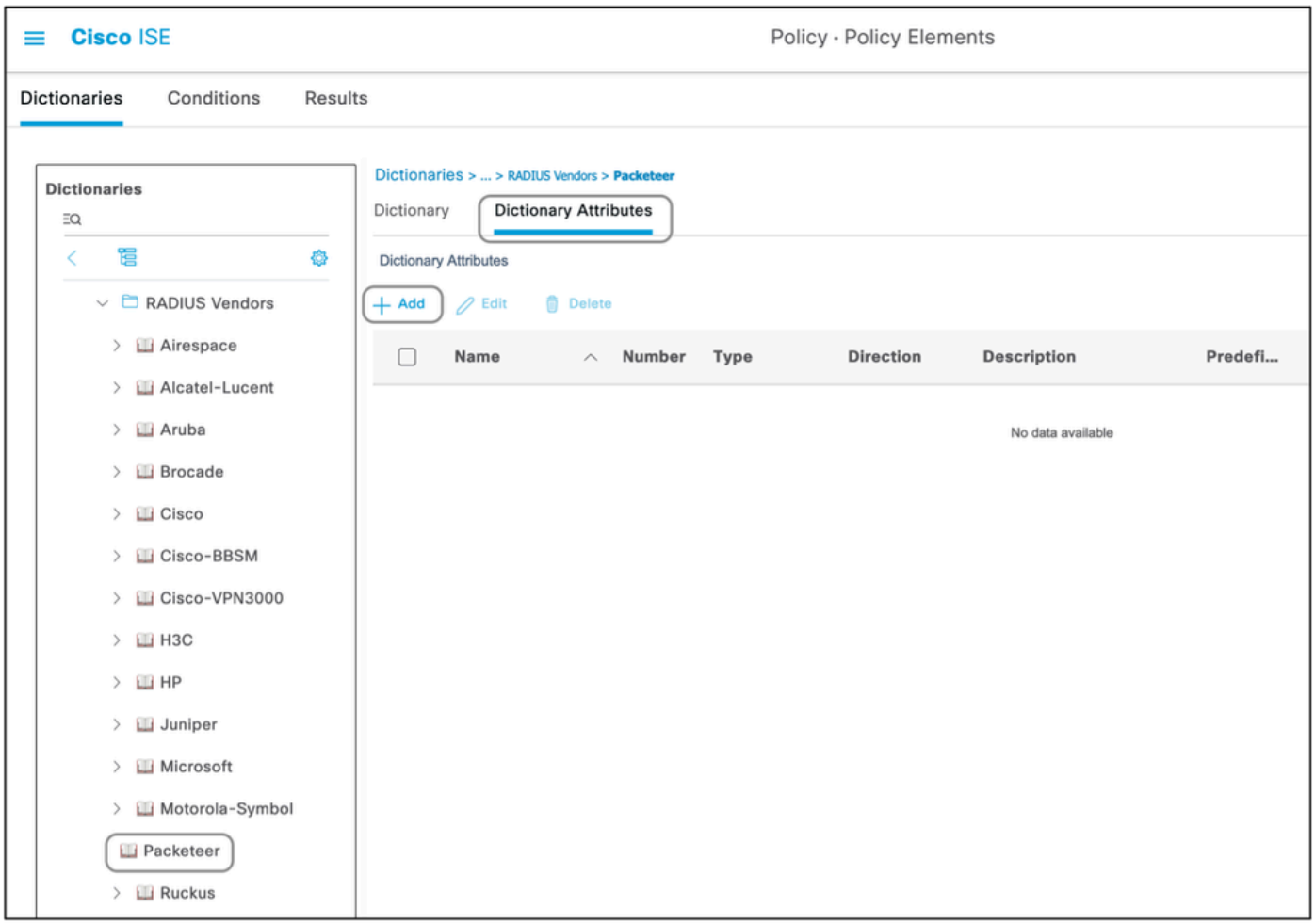
6. Add other Attributes on the same page if there are multiple Attributes to be added to the same Dictionary.

Note: Each of the fields entered as values in this section are to be provided by the vendor themselves. The vendor websites can be visited or vendor support can be contacted in case these are not known.






Cisco ISE
Policy · Policy Elements
Dictionaries
Conditions
Results
Dictionaries
Radius
IETF
RADIUS Vendors
Airespace
Alcatel-Lucent
Aruba
Brocade
RADIUS Vendors List > New RADIUS Vendor
* Dictionary Name
Packeteer
Description
Disctionary for BlueCoat Packet Shaper
* Vendor ID
2334
Vendor Attribute Type Field Length
1
Vendor Attribute Size Field Length
1
Submit
Cancel


Cisco ISE
Policy · Policy Elements
Dictionaries
Conditions
Results
Dictionaries
RADIUS Vendors
Airespace
Alcatel-Lucent
Aruba
Brocade
Cisco
Cisco-BBSM
Cisco-VPN3000
H3C
HP
Juniper
Microsoft
Motorola-Symbol
Packeteer
Ruckus
Dictionaries > ... > RADIUS Vendors > Packeteer
Dictionary
Dictionary Attributes
Dictionary Attributes
Add
Edit
Delete
Name
Number
Type
Direction
Description
Predefi...
No data available



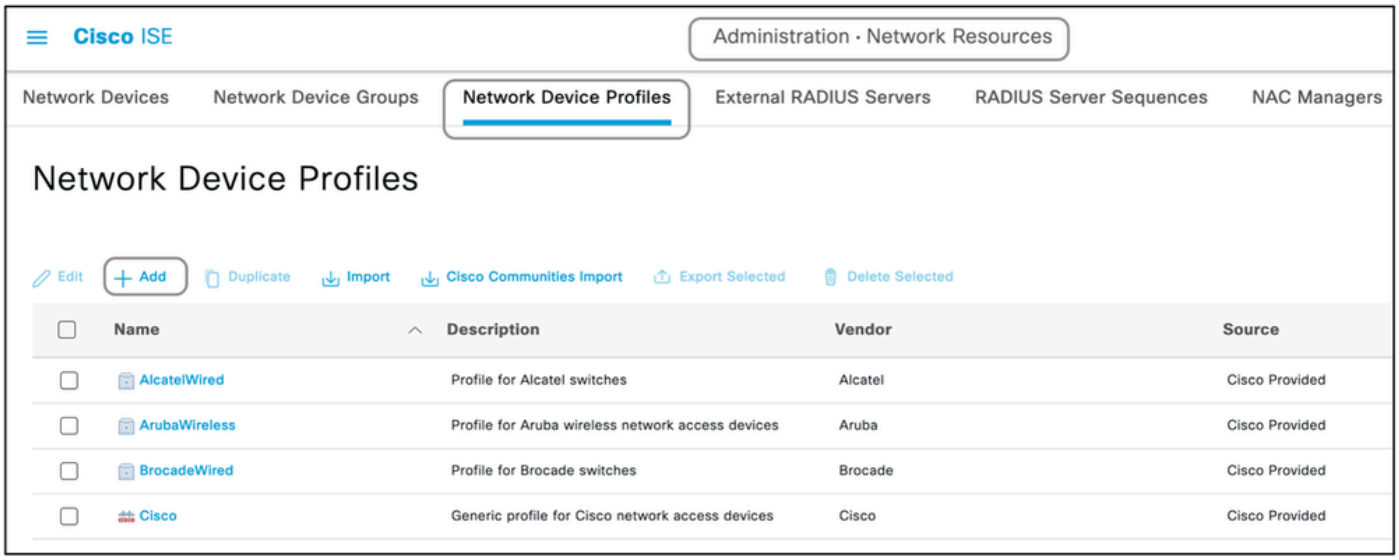
Note: Not all of the vendors require a specific dictionary to be added. If the vendor can use the radius attributes defined by IETF, which exist on ISE already, this step can be skipped.

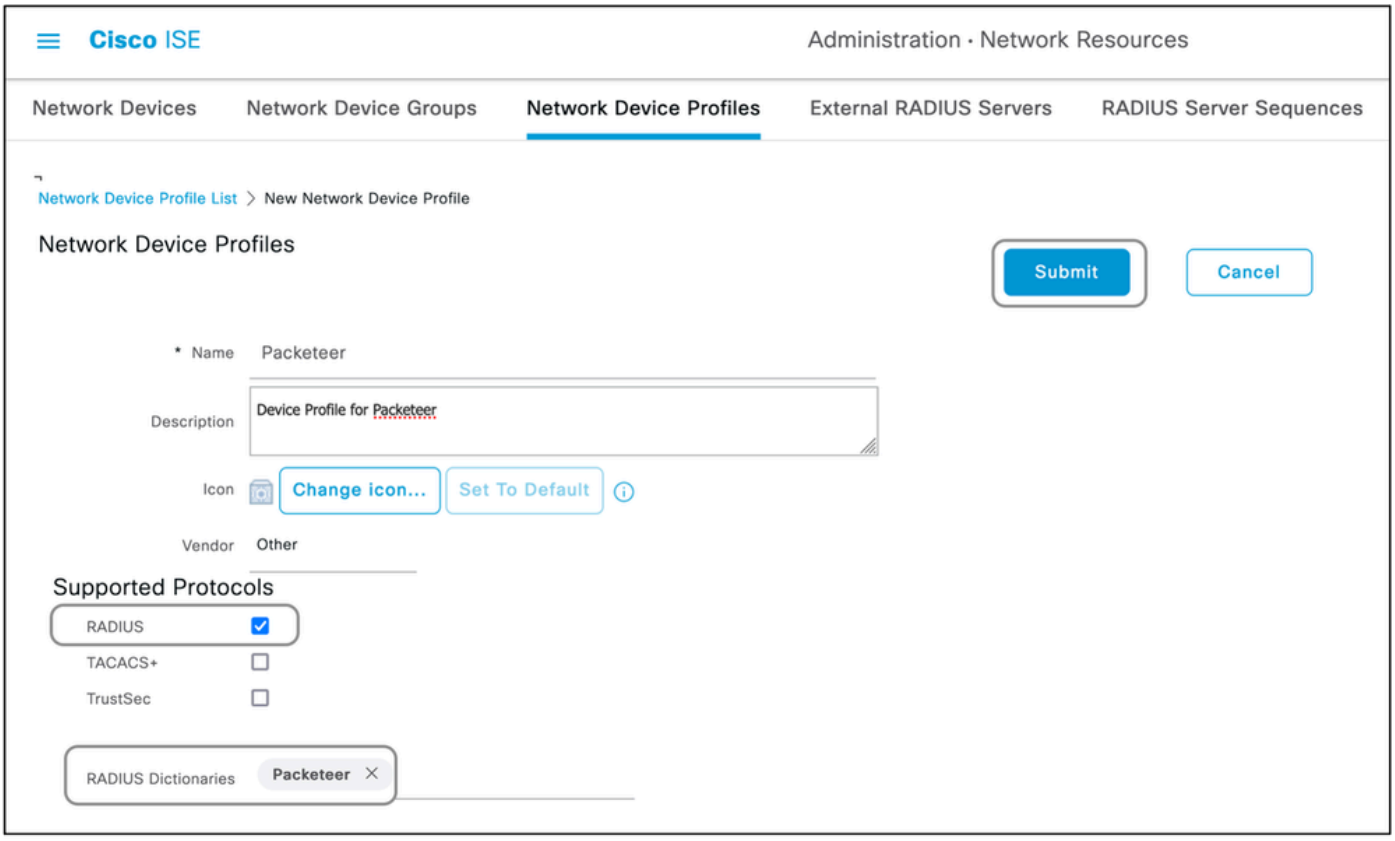
Step 2. Create a Network Device Profile.

This section is not mandatory. A network device profile helps segregate the type of network device which is added and create appropriate authorization profiles for them. Just like radius dictionaries, ISE does have a few pre-defined profiles which can be used. If not already present, a new device profile can be created.

This is the procedure to add a network profile :

1. Navigate to **Administration > Network Resources > Network Device Profiles > Add**.
2. Give a name and check the box for **RADIUS**.
3. Under the **RADIUS Dictionaries**, select the dictionary created in the previous section.
4. If multiple dictionaries were created for the same type of device, all of them can be selected under **RADIUS Dictionaries**.
5. **Save** the profile.





Step 3. Add the Network Device on ISE.

The network device on which device administration is achieved has to be added on ISE along with a key that is defined on the network device. On the network device, ISE is added as a radius AAA server with this key.

This is the procedure to add a device on ISE:

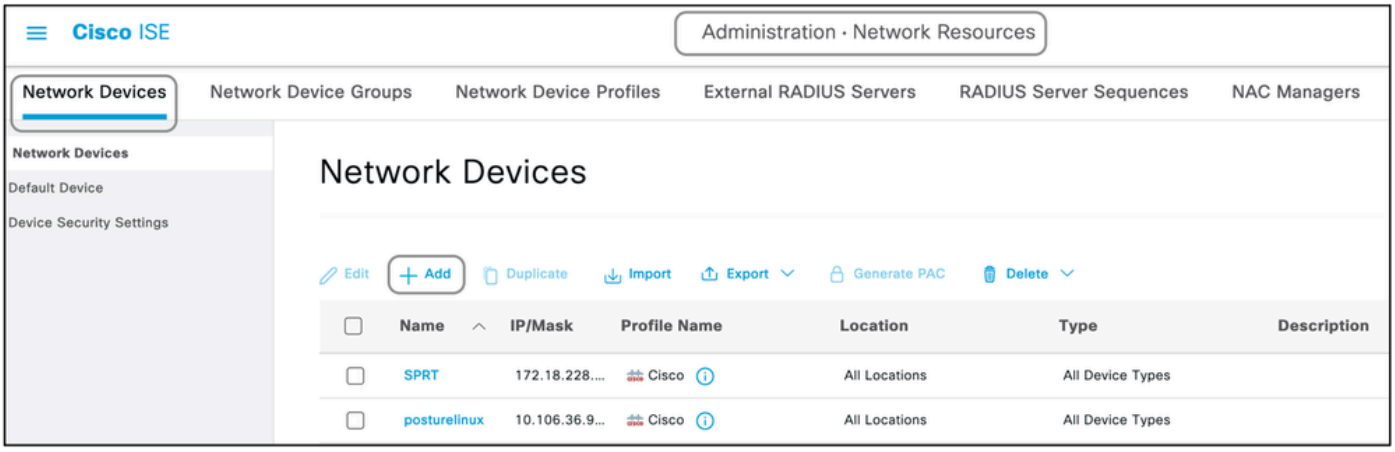
1. Navigate to **Administration > Network Resources > Network Devices > Add**.

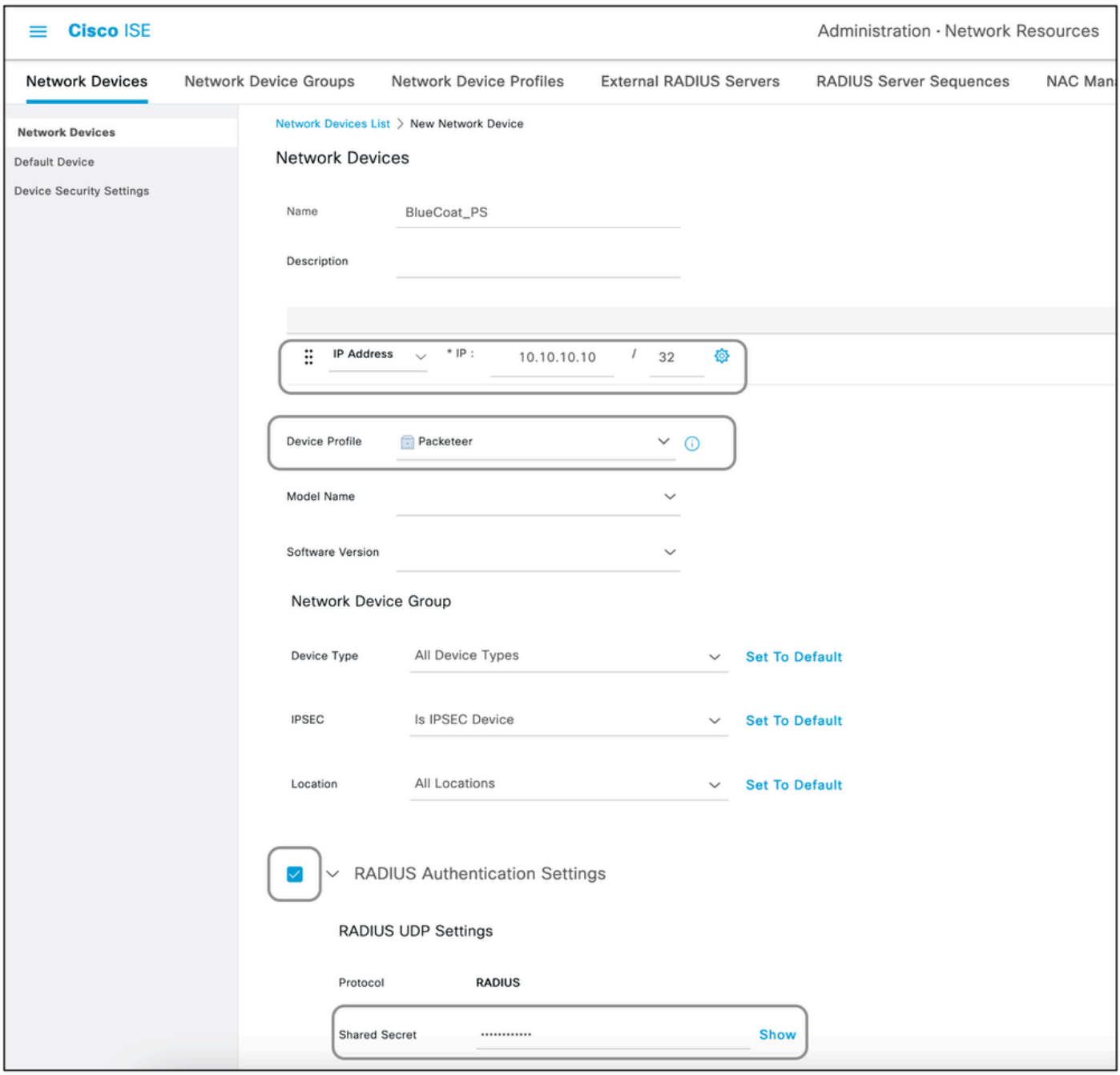
2. Give a name and the IP address.

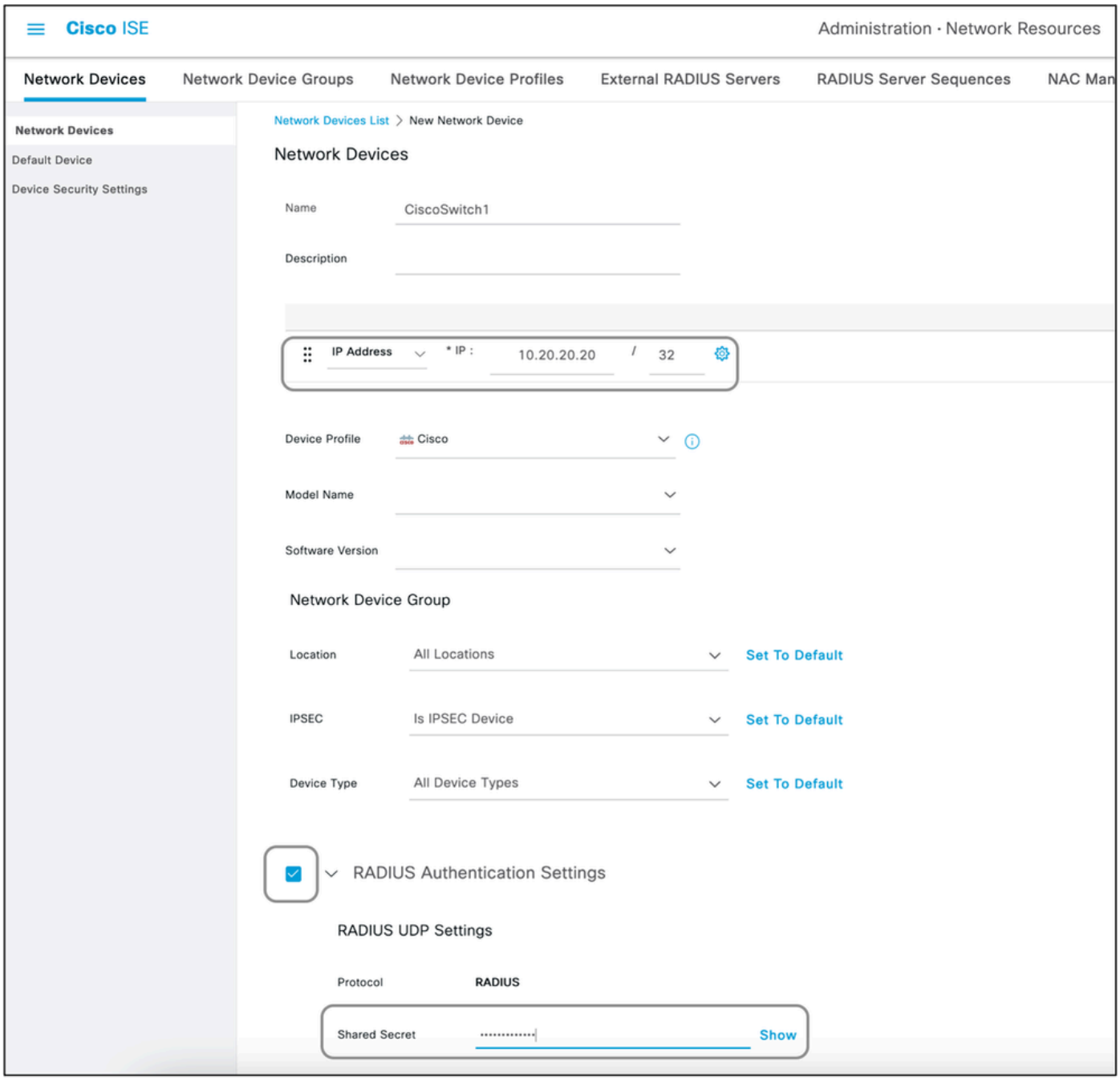
3. The Device Profile can be chosen from the dropdown list to be the one defined in the previous section. If a profile was not created, the default Cisco can be used as it is.

4. Check Radius Authentication Settings.

5. Enter the **Shared Secret Key** and **save** the device.







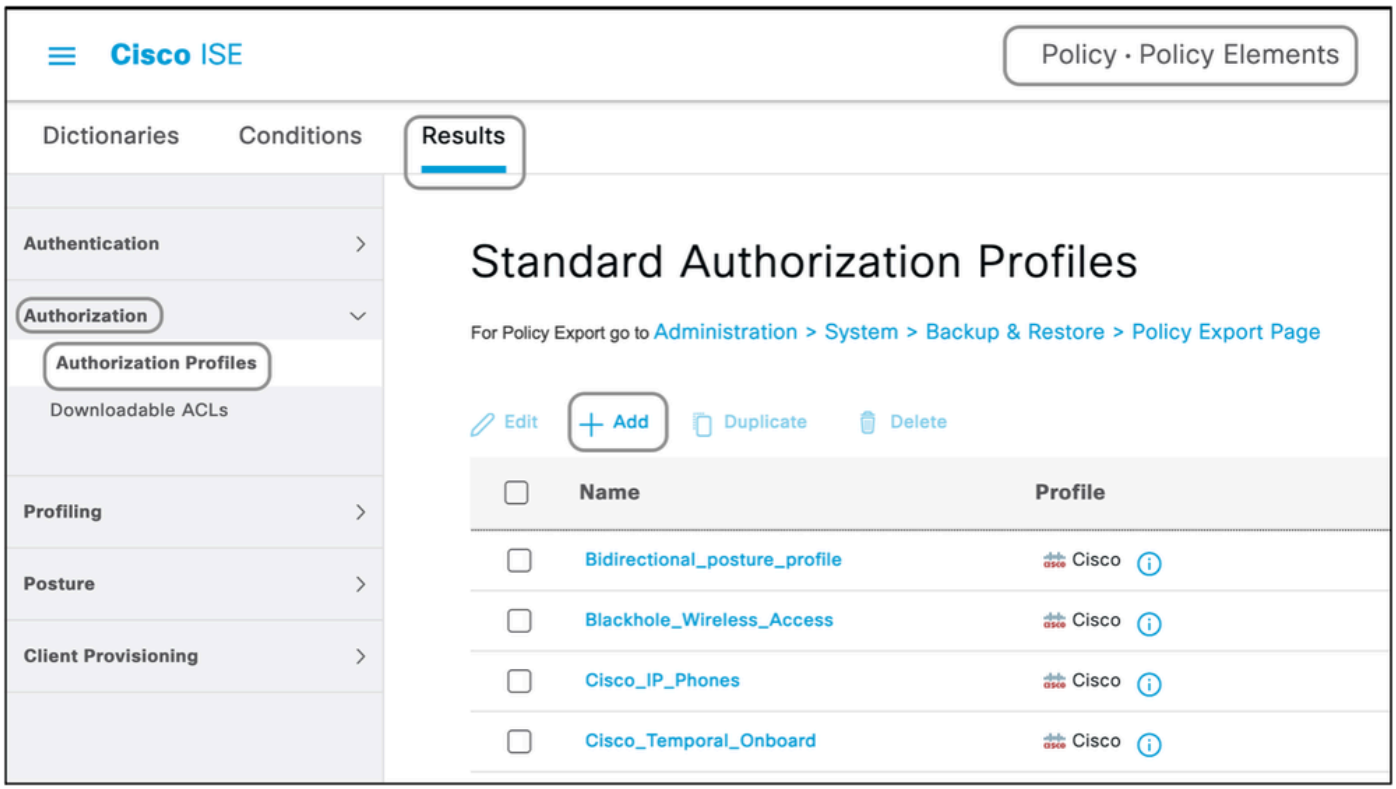
Step 4. Create Authorization Profiles.

The final result that is pushed from ISE as an Access-Accept or Access-Reject is defined in an authorization profile. Each authorization profile can push additional attributes that the network device expects.

This is the procedure to create an authorization profile:

1. Navigate to **Policy > Policy Elements > Results > Authorization > Authorization Profiles**.

2. Under the **Standard Authorization Profiles**, click **Add**.



The types of profiles that can be added are Access-Accept and Access-Reject.

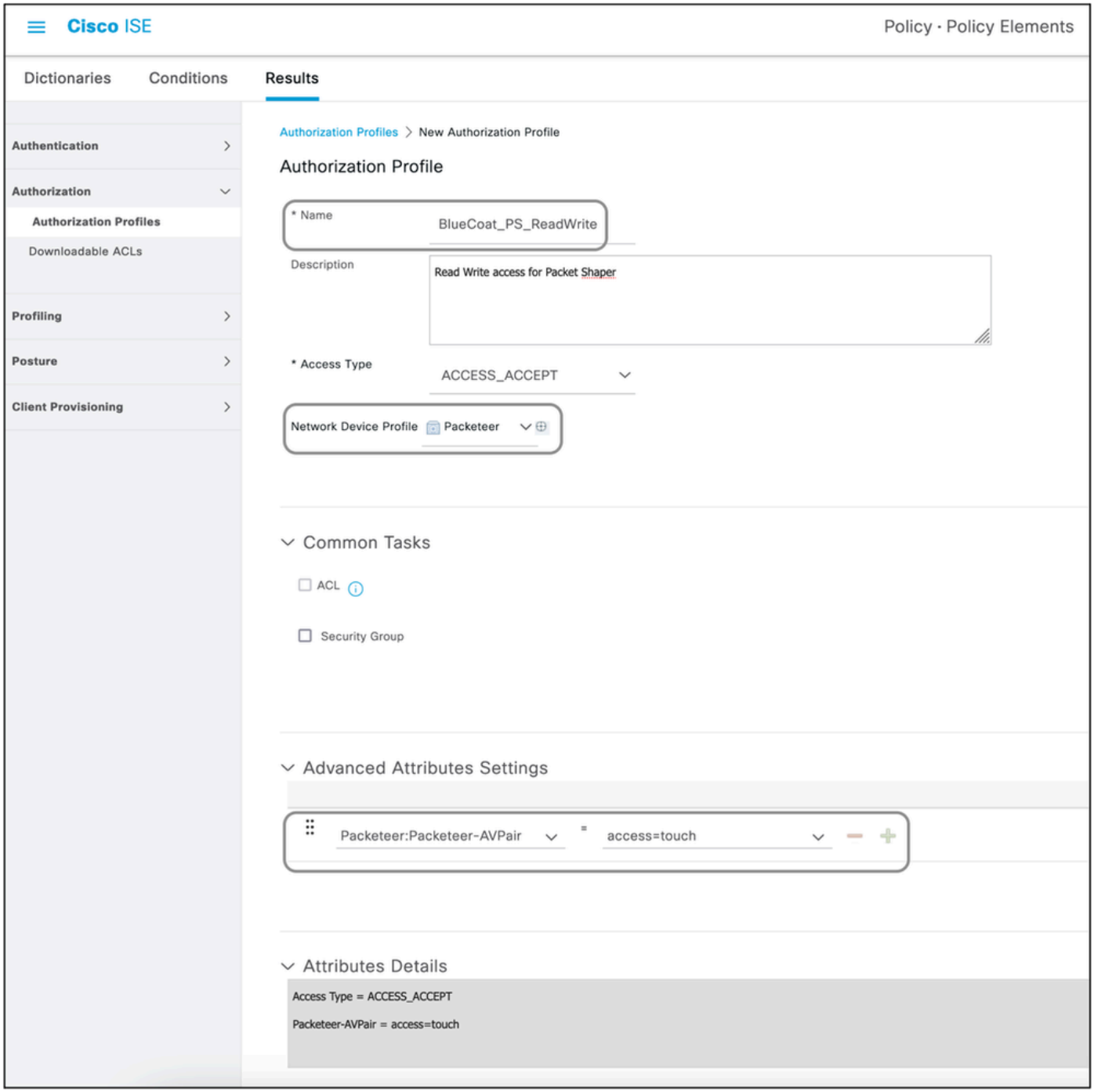
Create an Access-Accept Profile

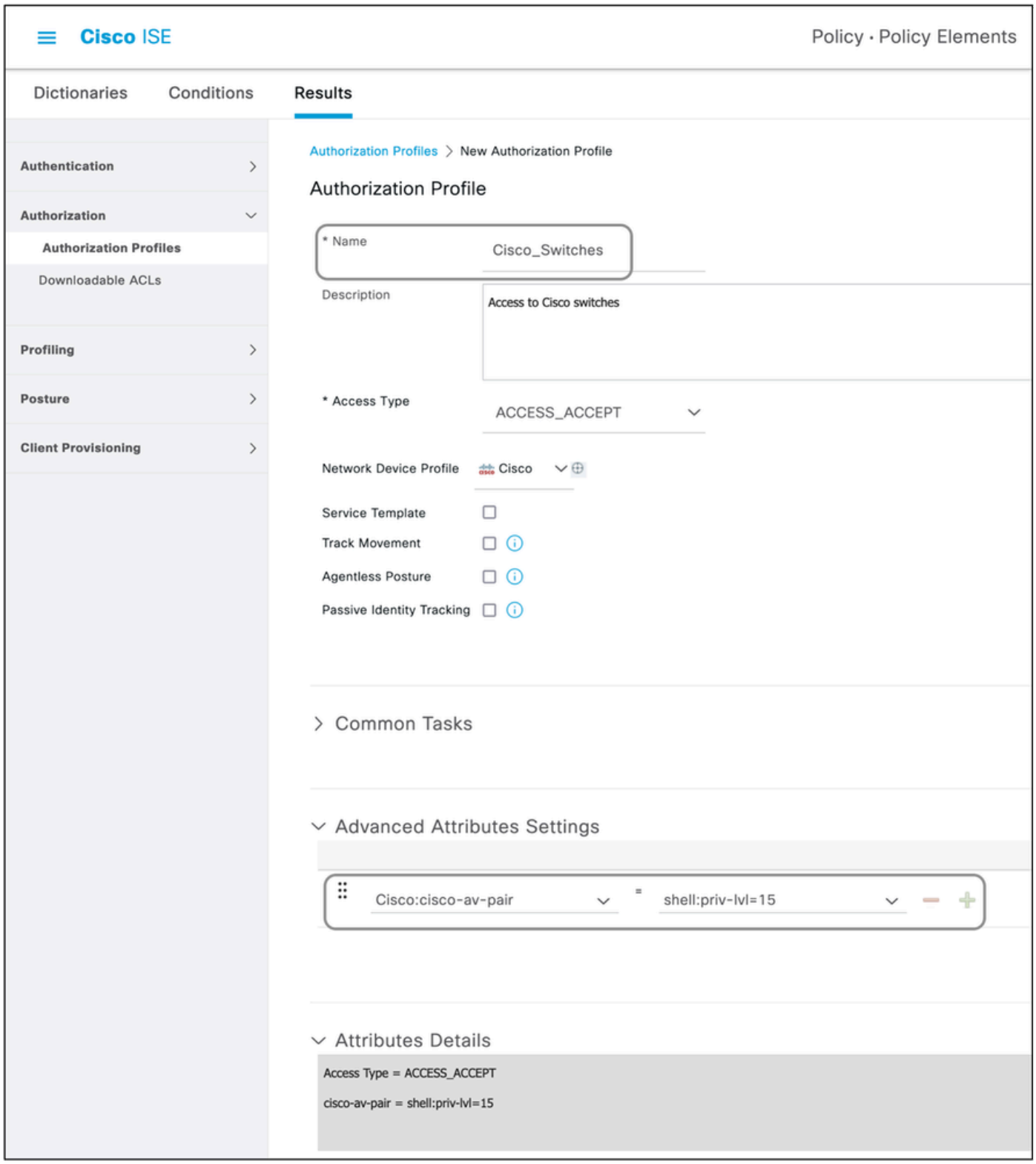
This profile is used for some kind of access to the network device. This profile can have multiple attributes passed along with it. Here are the steps:

1. Give a sensible name and choose Access Type to be Access-Accept.
2. Choose the network device profile which was created in one of the previous sections. If no profile was created, the default Cisco can be used.
3. With different types of profiles chosen, the page here limits the options of configuration.
4. Under **Advanced Attributes Settings**, choose the dictionary and the applicable attribute (LHS).
5. Assign a value (RHS) to the attribute either from the dropdown if available or type out the value expected.
6. If there are more attributes to be sent as part of the same result, click the + icon and repeat steps 4 and 5.

Create multiple Authorization Profiles for each of the results/roles/authorizations ISE is expected to send.

Note: The consolidated attributes can be verified under the Attribute Details field.


Cisco ISE
Policy · Policy Elements
Dictionaries
Conditions
Results
Authentication
Authorization
Authorization Profiles
Downloadable ACLs
Profiling
Posture
Client Provisioning
Authorization Profiles > New Authorization Profile
Authorization Profile
* Name
BlueCoat_PS_ReadWrite
Description
Read Write access for Packet Shaper
* Access Type
ACCESS_ACCEPT
Network Device Profile
Packeteer
Common Tasks
ACL
Security Group
Advanced Attributes Settings
Packeteer:Packeteer-AVPair
=
access=touch
Attributes Details
Access Type = ACCESS_ACCEPT
Packeteer-AVPair = access=touch



Create an Access-Reject Profile

This profile is used to send a rejection for device administration but can still be used to send attributes along with it. This is used to send a Radius Access-Reject packet. The steps remain the same except step one where Access-Reject has to be chosen instead of Access-Accept for the Access Type.

Step 5. Create a Policy Set.

Policy sets on ISE are evaluated top to down and the first one which satisfies the condition set in the policy sets is responsible for the ISE response to the Radius Access-Request packet sent by the network device.

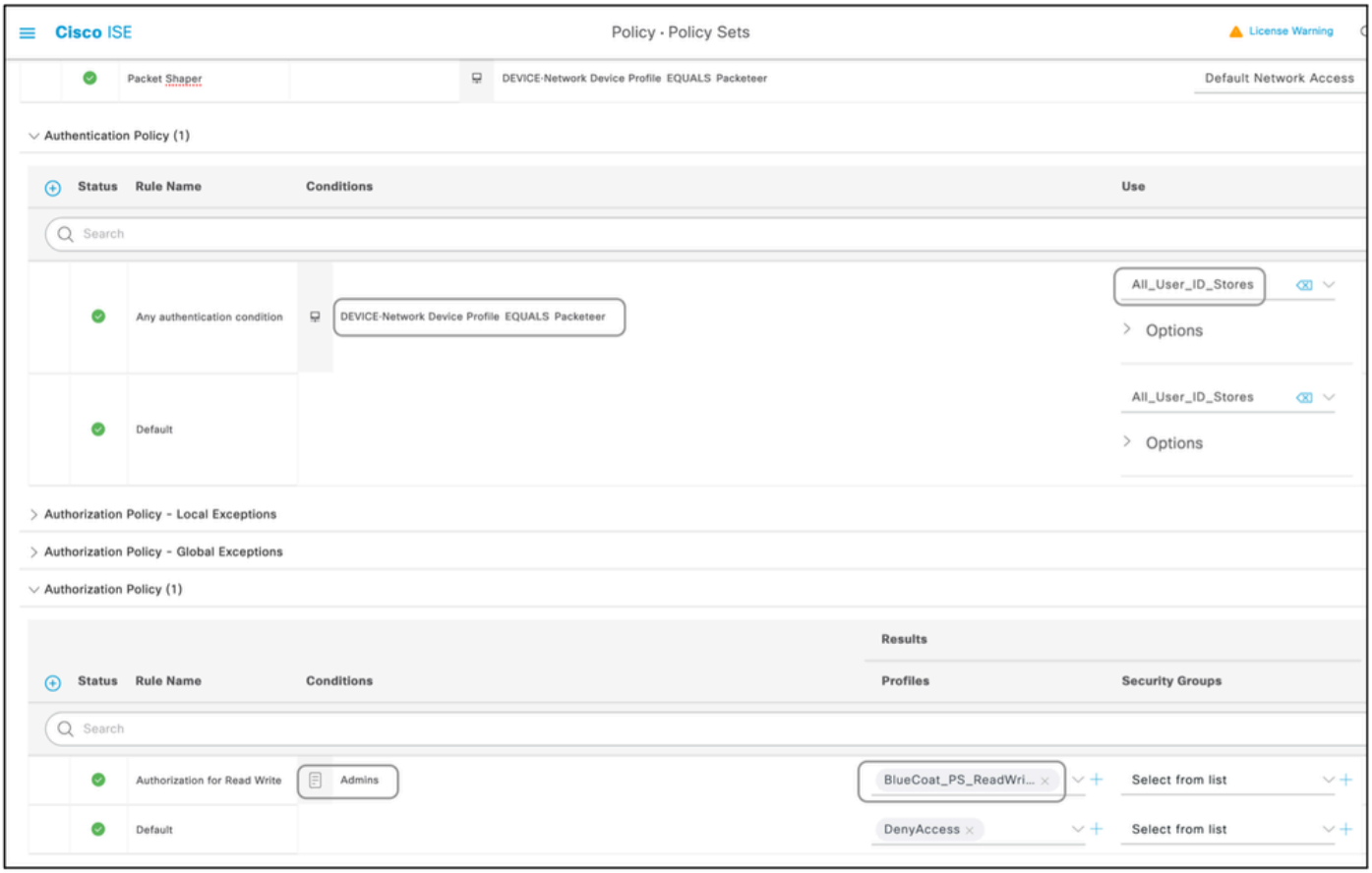
Cisco recommends a unique policy set for each type of device. The condition to evaluate the user authentication and authorization happen at evaluation. If ISE has external identity sources, it can be used for the type of authorization.

A typical policy set is created this way:

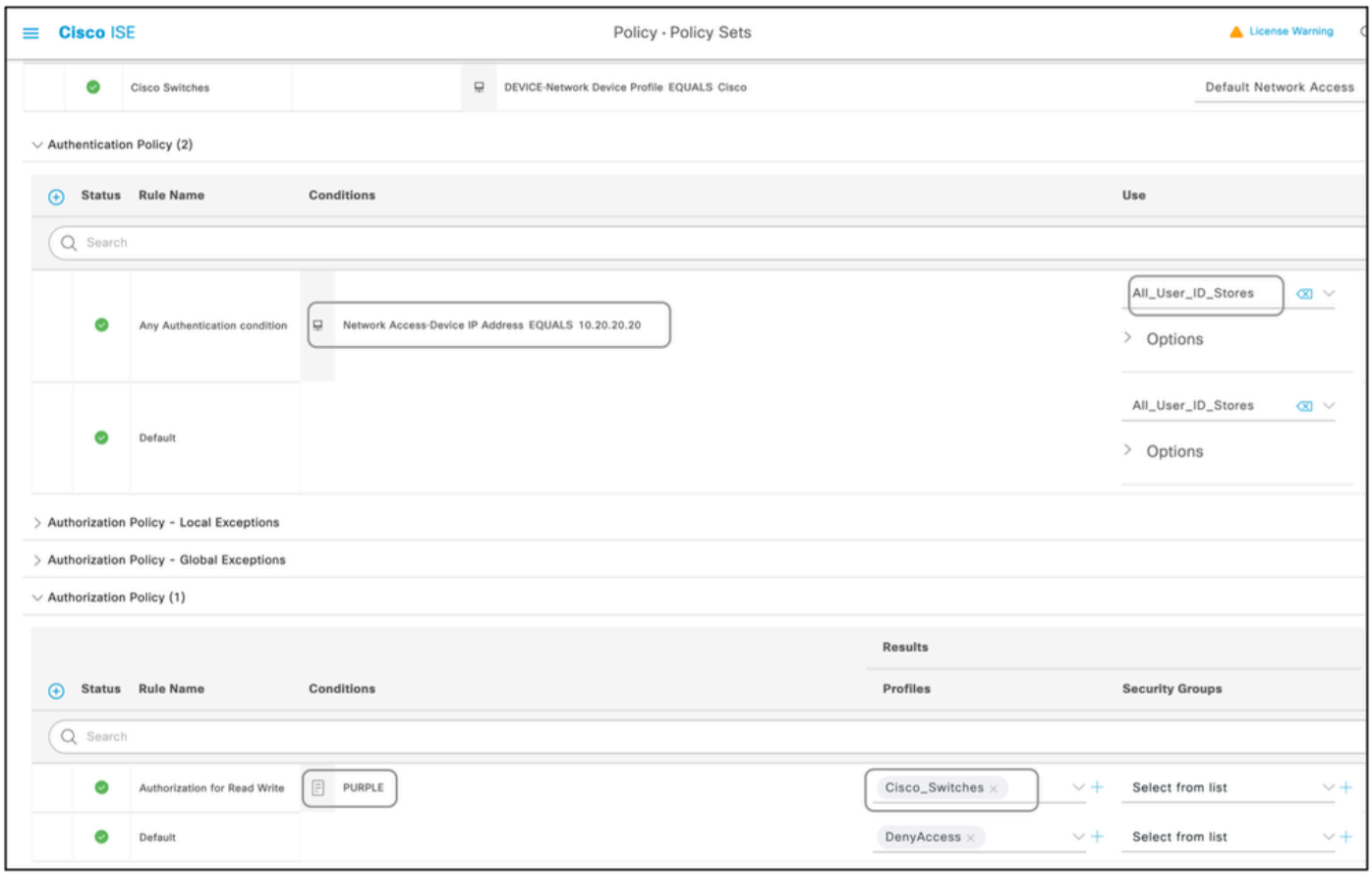
1. Navigate to **Policy > Policy Sets > +**.
2. Rename the **New Policy Set 1**.
3. Set the condition to be unique for this device.
4. Expand the **Policy Set**.
5. Expand the **Authentication Policy** to set an authentication rule. The external source or the internal users are examples that can be used as an identity source sequence against which ISE would check for the user.
6. The authentication policy is all set. The policy can be saved at this point.
7. Expand the **Authorization Policy** to add the authorization conditions for the users. An example is to check for a particular AD group or ISE internal identity group. Name the rule likewise.
8. The result for the authorization rule can be selected from the drop-down.
9. Create multiple authorization rules for different types of access the vendor supports.






Cisco ISE
Policy · Policy Sets
License Warning
Packet Shaper
DEVICE-Network Device Profile EQUALS Packeteer
Default Network Access
Authentication Policy (1)
Status
Rule Name
Conditions
Use
Search
Any authentication condition
DEVICE-Network Device Profile EQUALS Packeteer
All_User_ID_Stores
Options
Default
All_User_ID_Stores
Options
Authorization Policy - Local Exceptions
Authorization Policy - Global Exceptions
Authorization Policy (1)
Results
Status
Rule Name
Conditions
Profiles
Security Groups
Search
Authorization for Read Write
Admins
BlueCoat_PS_ReadWri...
Select from list
Default
DenyAccess
Select from list


Cisco ISE
Policy · Policy Sets
License Warning
Policy Sets
Reset
Reset Policyset Hitcounts
Save
Status
Policy Set Name
Description
Conditions
Allowed Protocols / Server Sequence
Hits
Actions
View
Search
Cisco Switches
DEVICE-Network Device Profile EQUALS Cisco
Default Network Access
0



Device List

Any device that supports device administration with Radius can be added on ISE with a few modifications to all the steps mentioned in the previous section. Hence, this document has a list of devices that work with the information provided in this section. The list of attributes and values provided in this document is neither exhaustive nor authoritative and can change at any time without an update to this document. Please consult the vendor websites and vendor support for validation.

Aggregation Services Routers (ASR)

Separate dictionary and VSAs need not be created for this as it uses Cisco AV pairs which are already present on ISE.

Attribute(s): **cisco-av-pair**

Value(s): **shell:tasks="#<role-name>,<permission>:<process>"**

Usage:Set the values of<role-name>to the name of a role locally defined on the router. The role hierarchy can be described in terms of a tree, where the role#rootis at the top of the tree, and the role#leafadds additional commands. These two roles can be combined and passed back if:**shell:tasks="#root,#leaf"**.

Permissions can also be passed back on an individual process basis, so that a user can be granted read, write, and execute privileges for certain processes. For example, in order to grant a user read and write privileges for the BGP process, set the value to:**shell:tasks="#root,rw:bgp"**. The order of the attributes does not matter; the result is the same whether the value is set to**shell:tasks="#root,rw:bgp"**or to**shell:tasks="rw:bgp,#root"**.

Example: Add the Attribute to an Authorization Profile.

Dictionary Type	RADIUS Attribute	Attribute Type	Attribute Value
RADIUS-Cisco	cisco-av-pair	String	shell:tasks="#root,#leaf,rwx:bgp,r:ospf"

Cisco Switches IOS® and Cisco IOS® XE

Separate dictionary and VSAs need not be created for this as it uses RADIUS attributes that are already present on ISE.

Attribute(s):**cisco-av-pair**

Value(s):**shell:priv-lvl=<level>**

Usage:Set the values of<level>to the numbers which are basically the number of privileges to be sent. Typically, if 15 is sent, it means read-write, if 7 is sent it means read-only.

Example: Add the Attribute to an Authorization Profile.

Dictionary Type	RADIUS Attribute	Attribute Type	Attribute Value
RADIUS-Cisco	cisco-av-pair	String	shell:priv-lvl=15

BlueCoat Packet Shaper

Attribute(s):**Packeteer-AVPair**

Value(s):**access=<level>**

Usage:<level>is the level of access to grant. Touch access is equivalent to read-write, while look access is equivalent to read-only.

Create a Dictionary as shown in this document with these values:

- Name: Packeteer
- Vendor ID: 2334
- Vendor Length Field Size: 1
- Vendor Type Field Size: 1

Enter the details of the attribute:

- Attribute:Packeteer-AVPair
- Description: Used in order to specify the access level
- Vendor Attribute ID: 1
- Direction: OUT
- Multiple Allowed: False
- Allow Tagging: Unchecked
- Attribute Type: String

Example: Add the Attribute to an Authorization Profile (for read-only access).

Dictionary Type	RADIUS Attribute	Attribute Type	Attribute Value
RADIUS-Packeteer	Packeteer-AVPair	String	access=look

Example: Add the Attribute to an Authorization Profile (for read-write access).

Dictionary Type	RADIUS Attribute	Attribute Type	Attribute Value
RADIUS-Packeteer	Packeteer-AVPair	String	access=touch

BlueCoat Proxy Server (AV/SG)

Attribute(s): **Blue-Coat-Authorization**

Value(s): **<level>**

Usage:<level>is the level of access to grant. 0 means no access, 1 means read-only access while 2 means read-write access. Blue-Coat-Authorization attribute is the one responsible for the level of access.

Create a Dictionary as shown in this document with these values:

- Name: BlueCoat
- Vendor ID: 14501
- Vendor Length Field Size: 1
- Vendor Type Field Size: 1

Enter the details of the attribute:

- Attribute: Blue-Coat-Group
- Vendor Attribute ID: 1
- Direction: BOTH
- Multiple Allowed: False
- Allow Tagging: Unchecked
- Attribute Type: Unsigned Integer 32 (UINT32)

Enter the details of the second attribute:

- Attribute: Blue-Coat-Authorization
- Description: Used in order to specify the access level
- Vendor Attribute ID: 2
- Direction: BOTH
- Multiple Allowed: False
- Allow Tagging: Unchecked
- Attribute Type: Unsigned Integer 32 (UINT32)

Example: Add the Attribute to an Authorization Profile (for no access).

Dictionary Type	RADIUS Attribute	Attribute Type	Attribute Value
RADIUS-BlueCoat	Blue-Coat-Group	UINT32	0

Example: Add the Attribute to an Authorization Profile (for read-only access).

Dictionary Type	RADIUS Attribute	Attribute Type	Attribute Value
RADIUS-BlueCoat	Blue-Coat-Group	UINT32	1

Example: Add the Attribute to an Authorization Profile (for read-write access).

Dictionary Type	RADIUS Attribute	Attribute Type	Attribute Value

RADIUS-BlueCoat	Blue-Coat-Group	UINT32	2

Brocade Switches

Separate dictionary and VSAs need not be created for this as it uses RADIUS attributes that are already present on ISE.

Attribute(s): **Tunnel-Private-Group-ID**

Value(s):**U:<VLAN1>; T:<VLAN2>**

Usage:Set<VLAN1>to the value of the data VLAN. Set<VLAN2>to the value of the voice VLAN. In this example, the data VLAN is VLAN 10, and the voice VLAN is VLAN 21.

Example: Add the Attribute to an Authorization Profile.

Dictionary Type	RADIUS Attribute	Attribute Type	Attribute Value
RADIUS-IETF	Tunnel-Private-Group-ID	Tagged String	U:10;T:21

Infoblox

Attribute(s):**Infoblox-Group-Info**

Value(s):**<group-name>**

Usage:<group-name>is the name of the group with the privileges that the user is granted. This group must be configured on the Infoblox device. In this configuration example, the group name is MyGroup.

Create a Dictionary as shown in this document with these values:

- Name: Infoblox
- Vendor ID: 7779
- Vendor Length Field Size: 1
- Vendor Type Field Size: 1

Enter the details of the attribute:

- Attribute:Infoblox-Group-Info
- Vendor Attribute ID: 009
- Direction: OUT
- Multiple Allowed: False
- Allow Tagging: Unchecked
- Attribute Type: String

Example: Add the Attribute to an Authorization Profile.

Dictionary Type	RADIUS Attribute	Attribute Type	Attribute Value
RADIUS-Infoblox	Infoblox-Group-Info	String	MyGroup

Cisco Firepower Management Center

Separate dictionary and VSAs need not be created for this as it uses RADIUS attributes that are already

present on ISE.

Attribute(s):**cisco-av-pair**

Value(s): **Class–[25]=<role>**

Usage:Set the values of<role>to the names of roles locally defined on the FMC. Create multiple roles such as admin and read-only user on the FMC and assign the values to the attributes on ISE to be received by the FMC likewise.

Example: Add the Attribute to an Authorization Profile.

Dictionary Type	RADIUS Attribute	Attribute Type	Attribute Value
RADIUS-Cisco	cisco-av-pair	String	Class–[25]=NetAdmins

Nexus Switches

Separate dictionary and VSAs need not be created for this as it uses RADIUS attributes that are already present on ISE.

Attribute(s):**cisco-av-pair**

Value(s):**shell:roles="<role1> <role2>"**

Usage:Set the values of<role1>and<role2>to the names of roles locally defined on the switch. When multiple roles are created, separate them with a space character. When multiple roles are passed back from the AAA server to the Nexus switch, the result is that the user has access to commands defined by the union of all three roles.

The built-in roles are defined inConfigure User Accounts and RBAC.

Example: Add the Attribute to an Authorization Profile.

Dictionary Type	RADIUS Attribute	Attribute Type	Attribute Value
RADIUS-Cisco	cisco-av-pair	String	shell:roles="network-admin vdc-admin vdc-operator"

Wireless LAN Controller (WLC)

Separate dictionary and VSAs need not be created for this as it uses RADIUS attributes that are already present on ISE.

Attribute(s):**Service-Type**

Value(s):**Administrative (6) / NAS-Prompt (7)**

Usage:In order to grant the user read/write access to the Wireless LAN Controller (WLC), the value must be Administrative; for read-only access, the value must be NAS-Prompt.

For details, seeRADIUS Server Authentication of Management Users on Wireless LAN Controller (WLC) Configuration Example

Example: Add the Attribute to an Authorization Profile (for read-only access).

Dictionary Type	RADIUS Attribute	Attribute Type	Attribute Value
RADIUS-IETF	Service-Type	Enumeration	NAS-Prompt

Example: Add the Attribute to an Authorization Profile (for read-write access).

Dictionary Type	RADIUS Attribute	Attribute Type	Attribute Value
RADIUS-IETF	Service-Type	Enumeration	Administrative

Data Center Network Manager (DCNM)

DCNM must be restarted after the authentication method is changed. Otherwise, it can assign network-operator privilege instead of network-admin.

Separate dictionary and VSAs need not be created for this as it uses RADIUS attributes that are already present on ISE.

Attribute(s):**cisco-av-pair**

Value(s):**shell:roles=<role>**

DCNM Role	RADIUS Cisco-AV-Pair
User	shell:roles = "network-operator"
Administrator	shell:roles = "network-admin"

AudioCodes

Attribute(s): **ACL-Auth-Level**

Value(s): **ACL-Auth-Level = "<integer>"**

Usage:<integer>is the level of access to grant. A value of ACL-Auth-Level attribute with name ACL-Auth-UserLevel of 50 for the user, a value of ACL-Auth-Level attribute with name ACL-Auth-AdminLevel of value100 for admin and value of ACL-Auth-Level with name ACL-Auth-SecurityAdminLevel of value 200 for security admin. The names can be skipped and the values for attributes can be given directly as value for the authorization profile advanced AV pair.

Create a Dictionary as shown in this document with these values:

- Name: AudioCodes
- Vendor ID: 5003
- Vendor Length Field Size: 1
- Vendor Type Field Size: 1

Enter the details of the attribute:

- Attribute: ACL-Auth-Level
- Description: Used in order to specify the access level
- Vendor Attribute ID: 35
- Direction: OUT
- Multiple Allowed: False
- Allow Tagging: Unchecked
- Attribute Type: Integer

Example: Add the Attribute to an Authorization Profile (for user).

Dictionary Type	RADIUS Attribute	Attribute Type	Attribute Value
RADIUS-AudioCodes	ACL-Auth-Level	Integer	50

Example: Add the Attribute to an Authorization Profile (for admin).

Dictionary Type	RADIUS Attribute	Attribute Type	Attribute Value
RADIUS-AudioCodes	ACL-Auth-Level	Integer	100

Example: Add the Attribute to an Authorization Profile (for security admin).

Dictionary Type	RADIUS Attribute	Attribute Type	Attribute Value
RADIUS-AudioCodes	ACL-Auth-Level	Integer	200