Cisco ISE 2.7 Admin Guide: Secure Wired Access

Secure Wired Access

Define Network Devices in Cisco ISE

A network device such as a switch or a router is an authentication, authorization, and accounting (AAA) client through which AAA service requests are sent to Cisco ISE. You must define network devices for Cisco ISE to interact with the network devices. You can configure network devices for RADIUS or TACACS AAA, Simple Network Management Protocol (SNMP) for the Profiling service to collect Cisco Discovery Protocol and Link Layer Discovery Protocol attributes for profiling endpoints, and Trustsec attributes for Trustsec devices. A network device that is not defined in Cisco ISE cannot receive AAA services from Cisco ISE.

In the network device definition:

- You can select the vendor profile that fits the network device . The profile includes pre-defined configurations for the device, such as settings for URL direct and change of authorization.

- You can configure the RADIUS protocol for RADIUS authentications. When Cisco ISE receives a RADIUS request from a network device, it looks for the corresponding device definition to retrieve the shared secret that is configured. If it finds the device definition, it obtains the shared secret that is configured on the device and matches it against the shared secret in the request to authenticate access. If the shared secrets match, the RADIUS server will process the request further based upon the policy and configuration. If they do not match, a reject response is sent to the network device. A failed authentication report is generated, which provides the failure reason.

- You can configure the TACACS+ protocol for TACACS+ authentications. When Cisco ISE receives a TACACS+ request from a network device, it looks for the corresponding device definition to retrieve the shared secret that is configured. If it finds the device definition, it obtains the shared secret that is configured on the device and matches it against the shared secret in the request to authenticate access. If the shared secrets match, the TACACS+ server will process the request further based upon the policy and configuration. If they do not match, a reject response is sent to the network device. A failed authentication report is generated, which provides the failure reason.

- You can configure the Simple Network Management Protocol (SNMP) in the network device definition for the Profiling service to communicate with the network devices and profile endpoints that are connected to the network devices.

- You must define Trustsec-enabled devices in Cisco ISE to process requests from Trustsec-enabled devices that can be part of the Cisco Trustsec solution. Any switch that supports the Trustsec solution is an Trustsec-enabled device.

  Trustsec devices do not use the IP address. Instead, you must define other settings so that Trustsec devices can communicate with Cisco ISE.

  Trustsec-enabled devices use the Trustsec attributes to communicate with Cisco ISE. Trustsec-enabled devices, such as the Nexus 7000 series switches, Catalyst 6000 series switches, Catalyst 4000 series switches, and Catalyst 3000 series switches are authenticated using the Trustsec attributes that you define while adding Trustsec devices.

Note When you configure a network device on Cisco ISE, we recommend that you do not include a backslash (\) in the shared secret. This is because when you upgrade Cisco ISE the backslash will not appear in the shared secret. Note, however, that if you reimage Cisco ISE instead of upgrading it, the backslash appears in the shared secret.

Define a Default Network Device in Cisco ISE

Cisco ISE supports the default device definition for RADIUS and TACACS authentications. You can define a default network device that Cisco ISE can use if it does not find a device definition for a particular IP address. This feature enables you to define a default RADIUS or TACACS shared secret and the level of access for newly provisioned devices.

Note We recommend that you add the default device definition only for basic RADIUS and TACACS authentications. For advanced flows, you must add separate device definition for each network device.

Cisco ISE looks for the corresponding device definition to retrieve the shared secret that is configured in the network device definition when it receives a RADIUS or TACACS request from a network device.

Cisco ISE performs the following procedure when a RADIUS or TACACS request is received:

1. Looks for a specific IP address that matches the one in the request.
2. Looks up the ranges to see if the IP address in the request falls within the range that is specified.
3. If both step 1 and 2 fail, it uses the default device definition (if defined) to process the request.

Cisco ISE obtains the shared secret that is configured in the device definition for that device and matches it against the shared secret in the RADIUS or TACACS request to authenticate access. If no device definitions are found, Cisco ISE obtains the shared secret from the default network device definition and processes the RADIUS or TACACS request.

Add a Network Device in Cisco ISE

You can add a network device in Cisco ISE or use the default network device.

You can also add the network device in the **Work Centers** > **Device Administration** > **Network Resources** > **Network Devices** page.

Before you begin

Make sure that the AAA function is enabled on the network devices. To know more, see the section “Command to Enable AAA Functions” in chapter “Integrations” in the *ISE Admin Guide* .

Procedure

Step 1 Choose **Administration** > **Network Resources** > **Network Devices**.

Step 2 Click **Add**.

Step 3 Enter the **Name** of the network device.

Step 4 Enter the **IP address**.

Step 5 (Optional) Check the **RADIUS Authentication Settings** check box to configure the RADIUS protocol for authentication.

Step 6 (Optional) Check the **TACACS Authentication Settings** check box to configure the TACACS protocol for authentication.

Step 7 (Optional) Check the **SNMP Settings** check box to configure the Simple Network Management Protocol for the Profiling service to collect device information.

Step 8 (Optional) Check the **Advanced Trustsec Settings** check box to configure a Trustsec-enabled device.

Step 9 Click **Submit**.

Import Network Devices into Cisco ISE

You can import a list of device definitions into a Cisco ISE node using a comma-separated value (CSV) file. You must first update the imported template before you can import network devices into Cisco ISE. You cannot run an import of the same resource type at the same time. For example, you cannot concurrently import network devices from two different import files.

You can download the CSV template from the Admin portal, enter your device definition details in the template, and save it as a CSV file, which you can then import this back in to Cisco ISE.

While importing devices, you can create new records or update existing records. Cisco ISE displays the summary of the number of devices that are imported and also reports any errors that were found during the import process. When you import devices, you can also define whether you want Cisco ISE to overwrite the existing device definitions with the new definitions or stop the import process when Cisco ISE encounters the first error.

You cannot import network devices that are exported in previous releases of Cisco ISE, as the import template for these releases are different.

Note You can import the network devices with IP ranges in all the octets.

Procedure

Step 1 Choose **Administration** > **Network Resources** > **Network Devices**.

Step 2 Click **Import**.

Step 3 Click **Browse** to choose the CSV file from the system that is running the client browser.

Step 4 Check the **Overwrite Existing Data with New Data** check box.

Step 5 Check the **Stop Import on First Error** check box.

Step 6 Click **Import**.

Export Network Devices from Cisco ISE

You can export network devices configured in Cisco ISE in the form of a CSV file that you can use to import these network devices into another Cisco ISE node.

Note You can export the network devices with IP ranges in all the octets.

Procedure

Step 1 Choose **Administration** > **Network Resources** > **Network Devices**.

Step 2 Click **Export**.

Step 3 To export network devices, you can do one of the following:

- Check the check boxes next to the devices that you want to export, and choose **Export** > **Export Selected**.
- Choose **Export** > **Export All** to export all the network devices that are defined.

Step 4 Save the export.csv file to your local hard disk.

Troubleshoot Network Device Configuration Issues

Procedure

Step 1 Choose **Operations** > **Troubleshoot** > **Diagnostic Tools** > **General Tools** > **Evaluate Configuration Validator** .

Step 2 Enter the Network Device IP address of the device whose configuration you want to evaluate, and specify other fields as necessary.

Step 3 Select the configuration options to compare against the recommended template.

Step 4 Click **Run**.

Step 5 Click **User Input Required**, and modify the fields as necessary.

Step 6 Check the check boxes next to the interfaces that you want to analyze, and click **Submit**.

Step 7 Click **Show Results Summary**.

Execute Network Device Command Diagnostic Tool

The Execute Network Device Command diagnostic tool allows you to run the **show** command on any network device. The results are exactly what you would see on a console, and can be used to identify problems in the configuration of the device. You can use it when you suspect that the configuration is wrong, you want to validate it, or if you are just curious about how it is configured.

Third-Party Network Device Support in Cisco ISE

Cisco ISE supports third-party network access devices (NADs) through the use of network device profiles. NAD profiles define the capabilities of the third-party device with simplified policy configuration, regardless of the vendor-side implementation. A network device profile contains the following:

- The protocols the network device support, such as RADIUS, TACACS+, and TrustSec. You can import any vendor-specific RADIUS dictionaries that exist for the device into Cisco ISE.
- The attributes and values that the device uses for the various flows such as Wired MAB and 802.1x. This allows Cisco ISE to detect the right flow type for your device according to the attributes it uses.
- The Change of Authorization (CoA) capabilities the device has. While RFC 5176 defines the types of CoA requests, the required attributes in the requests vary depending on the device. Most non-Cisco devices with RFC 5176 support will also support the "Push" and "Disconnect" functions. For devices that do not support the RADIUS CoA type, ISE also supports SNMP CoA. CoA types are described in further detail below.
- The attributes and protocols the device uses for MAB. Network devices from different vendors perform MAB authentication differently.
- The VLAN and ACL permissions used by the device. After the profile is saved, Cisco ISE automatically generates authorization profiles for each configured permission.
- URL redirection is necessary for advanced flows like BYOD, Guest, and Posture. There are two types of URL redirection found on a device: static and dynamic. For static URL redirection, you can copy and paste the ISE portal URL into the configuration. For dynamic URL redirection, ISE uses a RADIUS attribute to tell the network device where to redirect to. In addition, if the device supports neither dynamic nor static URL redirect, ISE provides an Auth VLAN by which it simulates URL redirect. Auth VLAN is based on a DHCP/DNS service running on the ISE box. To create the Auth VLAN, define the DHCP/DNS service settings. For more information, see the DHCP and DNS Services section in *Cisco ISE Admin Guide: Endpoint Profiling* . The URL redirect flow is described in further detail below.

Once you have defined your devices in ISE, configure these device profiles or used the preconfigured device profiles offered by ISE in order to define the capabilities that Cisco ISE uses to enable basic flows, as well as advanced flows such as Profiler, Guest, BYOD, MAB, and Posture.

URL Redirect Mechanism and Auth VLAN

When a third-party device is used in the network and the device does not support dynamic or static URL redirect, ISE simulates the URL redirect flow. The URL redirect simulation flow for such devices is operated by running a DHCP/DNS service on the ISE box (For more information, see the DHCP and DNS Services section in *Cisco ISE Admin Guide: Endpoint Profiling*), and the Auth VLAN flow is as follows:

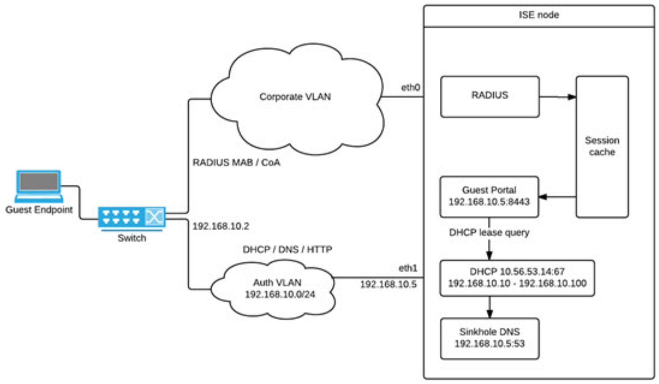
1. A guest endpoint connects to the NAD.
2. The device sends the RADIUS/MAB request to ISE.
3. ISE runs the authentication/authorization policy and stores the user accounting information.
4. ISE sends the RADIUS access/accept message, containing the Auth VLAN ID.
5. The guest endpoint receives network access.

6. The endpoint broadcasts a DHCP request and obtains a client IP address and the ISE sinkhole DNS IP address from the ISE DHCP service.
7. The guest endpoint opens a browser. The browser sends a DNS query and receives the ISE IP address.
8. The endpoint HTTP or HTTPS request is directed to the ISE box.
9. ISE responds with HTTP 301/Moved, providing the guest portal URL. The endpoint browser redirects to the Guest portal page.
10. The guest endpoint user logs in for authentication.
11. Once compliance is validated, ISE responds to the NAD, sending the CoA, authorizing the endpoint and bypassing the sinkhole.
12. Appropriate access is provided to the user based on the CoA, the endpoint receives an IP address from an enterprise DHCP and the user can now use the network.

The Auth VLAN should be separated from the corporate network in order to prevent unauthorized network access by the guest endpoint before the endpoint passes authentication. Configure the Auth VLAN IP helper to point to the ISE machine, or connect one of the ISE network interfaces to the Auth VLAN. For more information about VLAN (DHCP/DNS server) settings,see the DHCP and DNS Services section in *Cisco ISE Admin Guide: Endpoint Profiling* . Multiple VLANs may be connected to one network interface card by configuring a VLAN IP-helper from the NAD configuration. For more information about configuring an IP helper, refer to the administration guide for the device for instructions. In addition, for Guest flows, define a guest portal and select that portal in an Authorization profile that is bound to MAB authorization, similar to regular Guest flows. For more information about guest portals, see the Cisco ISE Guest Services section in *Cisco ISE Admin Guide: Guest and BYOD* .

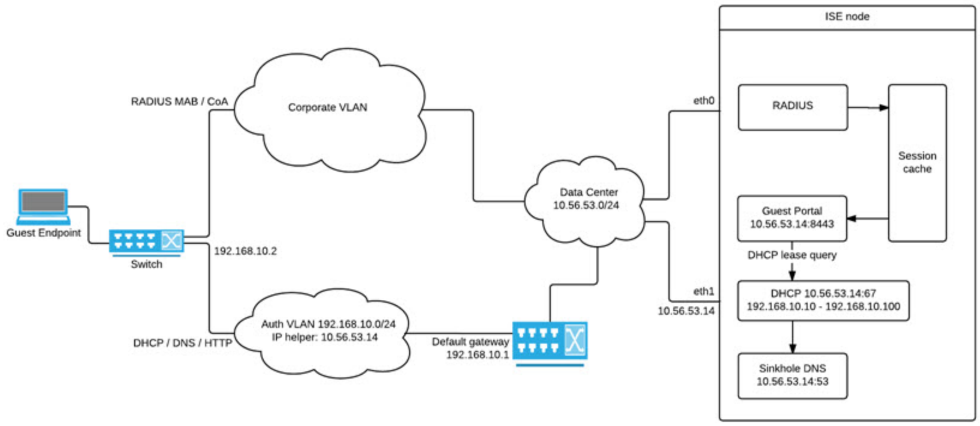
The following diagram displays the basic network setup when an Auth VLAN is defined (the Auth VLAN is connected directly to the Cisco ISE node):

Figure 1: Auth VLAN connect to Cisco ISE Node



The following diagram displays the network with Auth VLAN and an IP helper:

Figure 2: Auth VLAN with IP Helper


ISE node
RADIUS MAB / CoA
Corporate VLAN
eth0
RADIUS
Session cache
Guest Endpoint
Data Center 10.56.53.0/24
Guest Portal 10.56.53.14:8443
Switch
192.168.10.2
DHCP lease query
eth1
10.56.53.14
DHCP 10.56.53.14:67 192.168.10.10 - 192.168.10.100
Auth VLAN 192.168.10.0/24 IP helper: 10.56.53.14
DHCP / DNS / HTTP
Default gateway 192.168.10.1
Sinkhole DNS 10.56.53.14:53

CoA Types

ISE supports both RADIUS and SNMP CoA types. RADIUS or SNMP CoA type support is required in order for the NAD to work in complex flows, while it is not mandatory for basic flows. Define the RADIUS and SNMP settings supported by the device when configuring the NAD from ISE, and indicate the CoA type to be used for a specific flow when configuring the NAD profile. For more information about defining protocols for your NADs, see the Network Devices section in *Cisco ISE Admin Guide: Secure Wired Access* . Check with your third party supplier to verify which type your NAD supports prior to creating the device and NAD profile in ISE.

Network Device Profiles

Cisco ISE supports some third-party network access devices (NADs) through the use of network device profiles. These profiles define the capabilities that Cisco ISE uses to enable basic flows, and advanced flows such as Guest, BYOD, MAB, and Posture.

Cisco ISE includes predefined profiles for network devices from several vendors. Cisco ISE 2.1 has been tested with the vendor devices listed in the following table:

Table 1: Vendor Devices Tested With Cisco ISE 2.1

Device Type	Vendor	CoA Type	URL Redirect Type	Supported/Validated Use Cases				
				802.1X/ MAB	Profiler without CoA	Profiler with CoA	Posture	Guest/BYOD

Wireless	Aruba 7000, InstantAP	RADIUS	Static URL	√	√	√	√	√
	Motorola RFS 4000	RADIUS	Dynamic URL	√	√	√	√	√
	HP 830	RADIUS	Static URL	√	√	√	√	√
	Ruckus ZD 1200	RADIUS	—	√	√	√	√	√
Wired	HP A5500	RADIUS	Auth VLAN provided by ISE	√	√	√	√	√
	HP 3800 and 2920 (ProCurve)	RADIUS	Auth VLAN provided by ISE	√	√	√	√	√
	Alcatel 6850	SNMP	Dynamic URL	√	√	√	√	√
	Brocade ICX 6610	RADIUS	Auth VLAN provided by ISE	√	√	√	√	√
	Juniper EX3300-24p	RADIUS	Auth VLAN provided by ISE	√	√	√	√	√
For additional third-party NADs, you must identify the device properties and capabilities and create custom NAD profiles in Cisco ISE.				√	√	Requires CoA support	Requires CoA support. For URL redirect, if the wired device has no URL redirect, utilizes ISE Auth VLAN. Wireless devices have not been tested with Auth VLAN.	

You can create custom NAD profiles for additional third-party network devices that do not have a predefined profile. For advanced flows such as Guest, BYOD, and Posture, the device needs to support RFC 5176, "Change of Authorization" (CoA) Support for these flows depends on the NAD's capabilities. You may need to refer to the device's administration guide for information on many of the attributes required for a network device profile.

If you have deployed non-Cisco NADs prior to Release 2.0 and created policy rules/RADIUS dictionaries to use them, after upgrade these will continue to work as usual.

ISE Community Resource

For information about third-party NAD profiles, see ISE Third-Party NAD Profiles and Configs.

Configure Third-Party Network Device in Cisco ISE

Cisco ISE supports third-party network access devices (NADs) through the use of network device profiles. These profiles define the capabilities that Cisco ISE uses to enable flows such as Guest, BYOD, MAB, and Posture.

Before you begin

Read the definition for Network Device Profiles, on page 7 in the Cisco Identity Services Engine Administration Guide.

Procedure

Step 1 Ensure your device is configured in ISE. If you are configuring Guest, BYOD, or Posture workflows, ensure Change of Authorization (CoA) is defined and the NAD's URL redirect mechanism is configured to point at the relevant ISE Portal. For the URL redirect, you can copy the ISE portal URL from the portal's landing page. For more information about configuring CoA types and URL redirect for the NAD in ISE, see the Network Devices section in *Cisco ISE Admin Guide: Secure Wired Access* . In addition, refer to the third party device's administration guide for instructions.

Step 2 Ensure an appropriate NAD profile for your device is available in ISE. To view existing profiles, choose **Administration** > **Network Resources** > **Network Device Profiles**. If an appropriate profile does not already exist in ISE, create a custom profile. See Create a Network Device Profile, on page 9 for information on how to create custom profiles.

Step 3 Assign a NAD profile to the NAD that you want to configure. Choose **Administration** > **Network Resources** > **Network Devices**. Open the device to which you would like to assign a profile and from **Device Profile**, select the correct profile from the dropdown list.

Step 4 When you configure your policy rules, the authorization profile should be explicitly set to the NAD profile in step 1, or "Any" if you are just using VLAN or ACL or if you have different devices from different vendors in your network. To set the NAD profile for the authorization profile, choose **Policy** > **Policy Elements** > **Results** > **Authorization** > **Authorization Profiles**. Open the relevant authorization profile and from **Network Device Profile**, select the relevant NAD profile from the dropdown list. When using Auth VLAN for Guest flows, you should also define a guest portal and select that portal in an Authorization profile that is bound to MAB authorization, similar to regular Guest flows. For more information about guest portals, see the Cisco ISE Guest Services section in *Cisco ISE Admin Guide: Guest and BYOD* .

Create a Network Device Profile

Before you begin

- For more information about creating a custom profile, read the Network Access Device Profiles with Cisco Identity Services Engine document.

- Most NADs have a vendor-specific RADIUS dictionary that provides a number of vendor-specific attributes in addition to the standard IETF RADIUS attributes. If the network device has a vendor-specific RADIUS dictionary, import it into Cisco ISE. Refer to the third party device’s administration guide for instructions on which RADIUS dictionary is required. From ISE, choose **Policy Elements** > **Dictionaries** > **System** > **Radius** > **RADIUS Vendors**. For more information about importing RADIUS dictionaries, see the Create RADIUS-Vendor Dictionaries section in *Cisco ISE Admin Guide: Secure Wired Access* .
- For complex flows such as Guest and Posture, the device needs to support RFC 5176, Change of Authorization (CoA)
- For more information about the fields and possible values for creating a network device profile, see the Network Device Profiles Settings section in *Cisco ISE Admin Guide: Secure Wired Access* .

Procedure

Step 1 Choose **Administration** > **Network Resources** > **Network Device Profiles**.

Step 2 Click **Add**.

Step 3 Enter a name and description for the network device.

Step 4 Select the vendor of the network device.

Step 5 Check the check boxes for the protocols that the device supports. Check each box if your device supports RADIUS, TACACS+ and/or TrustSec. It is only necessary to check the protocols you want to actually use. If the device supports RADIUS, select the RADIUS dictionary to use with the network device from the dynamic dropdown list in the **RADIUS Dictionaries** field.

Step 6 From the **Templates** section, enter relevant details as follows:

a) From **Authentication/Authorization** configure the device's default settings for flow types, attribute aliasing, and host lookup: From **Flow Type Conditions**, enter the attributes and values that your device uses for the various flows such as Wired MAB, or 802.1x. This enables ISE to detect the correct flow type for your device according to the attributes it uses. There is no IETF standard for MAB and different vendors use different values for Service-Type. Refer to the device's user guide or use a sniffer trace of a MAB authentication to determine the correct settings. From **Attribute Aliasing**, map device specific attribute names to common names to simplify policy rules. Currently, only SSID is defined. If you device has the concept of wireless SSID and then to set this to the attribute it uses. ISE maps this to an attribute called SSID in the Normalised Radius dictionary. This simplifies policy rule configuration as you can refer to SSID in one rule and it will work for multiple devices even if the underlying attributes are different. From **Host Lookup**, enable the **Process Host Lookup** option and select the relevant MAB protocols and attributes for your device, based on the third-party instructions.

b) From **Permissions** configure the network device's default settings for VLAN and ACL. These are automatically mapped based on the authorization profiles you created in ISE.

c) From **Change of Authorization (CoA)** configure the device's CoA capabilities .

d) Expand the **Redirect** section to configure the device's URL redirect capabilities. URL redirection is necessary for Guest, BYOD, and Posture.

Step 7 Click **Submit**.

Export Network Device Profiles from Cisco ISE

Export single or multiple network device profiles configured in Cisco ISE in the form of an XML file in order to edit the XML file and then import the file as new network profiles.

Before you begin

Read the Network Access Device Profiles with Cisco Identity Services Engine document.

Procedure

Step 1 Choose **Administration** > **Network Resources** > **Network Device Profiles**.

Step 2 Click **Export**.

Step 3 Check the check boxes next to the devices that you want to export, and choose **Export** > **Export Selected**

Step 4 Th DeviceProfiles.xml file downloads to your local hard disk.

Import Network Device Profiles into Cisco ISE

You can import a single or multiple network device profiles into ISE using a single XML file with the Cisco ISE XML structure. You cannot concurrently import network device profiles from multiple import files.

Typically, you would first export an existing profile from the Admin portal to use as a template. Enter your device profile details as necessary in the file and save it as an XML file, and then import the edited file back in to Cisco ISE. In order to work with multiple profiles, you can export multiple profiles structured together as a single XML file, edit the file and then import them together, creating multiple files in ISE.

While importing device profiles, you can only create new records. You cannot overwrite an existing profile. In order to edit an existing profile and then overwrite it, export the existing profile, delete the profile from ISE and then import that profile once you have edited it accordingly.

Before you begin

Read the Network Access Device Profiles with Cisco Identity Services Engine document.

Procedure

Step 1 Choose **Administration** > **Network Resources** > **Network Device Profiles**.

Step 2 Click **Import**.

Step 3 Click **Browse** to choose the XML file from the system that is running the client browser.

Step 4 Click **Import**.

Network Device Groups

Cisco ISE allows you to create hierarchical Network Device Groups (NDGs). NDGs can be used to logically group network devices based on various criteria, such as geographic location, device type, or the relative place in the network (Access Layer, Data Center, and so on). For example, to organize your network devices based on geographic location, you can group them by continent, region, or country:

- Africa -> Southern -> Namibia
- Africa -> Southern -> South Africa
- Africa -> Southern -> Botswana

You can also group the network devices based on the device type:

- Africa -> Southern -> Botswana -> Firewalls
- Africa -> Southern -> Botswana -> Routers
- Africa -> Southern -> Botswana -> Switches

Network devices can be assigned to one or more hierarchical NDGs. Thus, when Cisco ISE processes the ordered list of configured NDGs to determine the appropriate group to assign to a particular device, it may find that the same device profile applies to multiple Device Groups, and will apply the first Device Group matched.

There is no limit on the maximum number of NDGs that can be created. You can create up to 6 levels of hierarchy (including the parent group) for the NDGs.

You can view the device group hierarchy in Tree view or Flat Table view. In the Tree view, the root node appears at the top of the tree followed by the child groups in hierarchial order. Click **Expand All** to view all the device groups under each root group. Click **Collapse All** to list only the root groups.

In the Flat Table view, you can view the hierarchy of each device group in the Group Hierarchy column.

You can also view the number of network devices that are assigned to each child group. Click the number link to launch the Network Devices window, which lists all the network devices that are assigned to that device group. You can add additional devices to a device group or move the existing devices to another device group.

While adding a device group, you can specify whether the new group must be added as a root group or select an already existing group as the parent group.

Note You cannot delete a device group if any devices are assigned to that device group. Before deleting a device group you must move all the existing devices to another device group.

Root Network Device Groups

Cisco ISE includes two predefined root NDGs: All Device Types and All Locations. You cannot edit, duplicate, or delete these predefined NDGs, but you can add new device groups under them.

You can create a root Network Device Group (NDG), and then create child NDGs under the root group in the Network Device Groups page.

Network Device Attributes Used By Cisco ISE in Policy Evaluation

When you create a new network device group, a new network device attribute is added to the Device dictionary defined in the system, which you can use in policy definitions. Cisco ISE allows you to configure authentication and authorization policies based on Device dictionary attributes, such as device type, location, model name, and software version that is running on the network device.

Import Network Device Groups in to Cisco ISE

You can import network device groups in to a Cisco ISE node using a comma-separated value (CSV) file. You cannot run import of the same resource type at the same time. For example, you cannot concurrently import network device groups from two different import files.

You can download the CSV template from the Admin portal, enter your device group details in the template, and save the template as a CSV file, which you can then import back into Cisco ISE.

While importing device groups, you can create new records or update existing records. When you import device groups, you can also define whether you want Cisco ISE to overwrite the existing device groups with the new groups or stop the import process when Cisco ISE encounters the first error.

Procedure

Step 1 Choose **Administration** > **Network Resources** > **Network Device Groups** > **Groups**.

Step 2 Click **Import**.

Step 3 Click **Browse** to choose the CSV file from the system that is running the client browser.

Step 4 Check the **Overwrite Existing Data with New Data** check box.

Step 5 Check the **Stop Import on First Error** check box.

Step 6 Click **Import or** click the **Network Device Groups List** link to return to the Network Device Groups list page.

Export Network Device Groups from Cisco ISE

You can export network device groups configured in Cisco ISE in the form of a CSV file that you can use to import these network device groups into another Cisco ISE node.

Procedure

Step 1 Choose **Administration** > **Network Resources** > **Network Device Groups** > **Groups**.

Step 2 To export the network device groups, you can do one of the following:

- Check the check boxes next to the device groups that you want to export, and choose m**Export** > **Export Selected**.
- Choose **Export** > **Export All** to export all the network device groups that are defined.

Step 3 Save the export.csv file to your local hard disk.

Network Device Groups

These pages enable you to configure and manage network device groups.

Network Device Group Settings

The following table describes the fields on the Network Device Groups Page, which you can use to create network device groups. The navigation path for this page is: **Administration** > **Network Resources** > **Network Device Groups** > **Groups**.

You can also create network device groups in the **Work Centers** > **Device Administration** > **Network Device Groups** > **Groups** page.

Table 2: Network Device Group Settings

Fields	Usage Guidelines
Name	Enter the name for the root Network Device Group (NDG). For all subsequent child network device groups under the root NDG, enter the name of the new network device group. You can have a maximum of six nodes in the NDG hierarchy, including the root node. Each NDG name can have a maximum of 32 characters.
Description	Enter the description for the root or the child Network Device Group.
Parent Group	You can select an already existing group as the parent group or add this new group as a root group.

Related Topics

- Network Device Groups, on page 11
- Network Device Attributes Used By Cisco ISE in Policy Evaluation, on page 12
- Add a Network Device in Cisco ISE, on page 2

Network Device Group Import Settings

The following table describes the fields on the Network Device Group Import Page, which you can use to import network device groups into Cisco ISE. The navigation path for this page is: **Administration** > **Network Resources** > **Network Device Groups** > **Groups**.

Table 3: Network Device Groups Import Settings

Fields	Usage Guidelines
Generate a Template	Click this link to create a comma-separated value (.csv) template file. You must update the template with network device groups information in the same format, and save it locally to import those network device groups into any Cisco ISE deployment.

Fields	Usage Guidelines
File	Click **Browse** to the location of the comma-separated value file that you might have created or previously exported from any Cisco ISE deployment. You can import network device groups in another Cisco ISE deployment with new and updated network device groups information using import.
Overwrite Existing Data with New Data	Check this check box if you want Cisco ISE to replace existing network device groups with the device groups in your import file. If you do not check this check box, new network device group that are available in the import file are added to the network device group repository. Duplicate entries are ignored.
Stop Import on First Error	Check this check box if you want Cisco ISE to discontinue import when it encounters an error during import, but Cisco ISE imports network device groups until that time of an error. If this check box is not checked and an error is encountered, the error is reported, and Cisco ISE continues to import device groups.

Related Topics

Network Device Groups, on page 11

Network Device Attributes Used By Cisco ISE in Policy Evaluation, on page 12

Import Network Device Groups in to Cisco ISE, on page 13

Import Templates in Cisco ISE

Cisco ISE allows you to import a large number of network devices and network device groups using comma-separated value (CSV) files. The template contains a header row that defines the format of the fields. The header row should not be edited, and should be used as is.

By default, you can use the Generate a Template link to download a CSV file in the Microsoft Office Excel application and save the file format locally on your system. When you click the Generate a Template link, the Cisco ISE server displays the Opening template.csv dialog. This dialog allows you to open the template.csv file and save the template.csv file locally on your system with an appropriate name for network devices and network device groups. If you choose to open the template.csv file from the dialog, the file opens in the Microsoft Office Excel application by default.

Network Devices Import Template Format

The following table lists the fields in the template header and provides a description of the fields in the Network Device CSV file.

Table 4: CSV Template Fields and Description for Network Devices

Field	Description
Name:String(32):	(Required) This field is the network device name. It is an alphanumeric string, with a maximum of 32 characters in length.
Description:String(256)	This field is an optional description for the network device. A string, with a maximum of 256 characters in length.
IP Address:Subnets(a.b.c.d/m|...)	(Required) This field is the IP address and subnet mask of the network device. (It can take on more than one value separated by a pipe "|" symbol). IPv4 and IPv6 are now supported for network device (TACACS and RADIUS) configuration and for external RADIUS server configuration. When entering an IPv4 address, you can use ranges and subnet masks.
Model Name:String(32):	(Required) This field is the network device model name. It is a string, with a maximum of 32 characters in length.
Software Version:String(32):	(Required) This field is the network device software version. It is a string, with a maximum of 32 characters in length.
Network Device Groups:String(100):	(Required) This field should be an existing network device group. It can be a subgroup, but must include both the parent and subgroup separated by a space. It is a string, with a maximum of 100 characters, for example, Location#All Location#US
Authentication:Protocol:String(6)	This is an optional field. It is the protocol that you want to use for authentication. The only valid value is RADIUS (not case sensitive).
Authentication:Shared Secret:String(128)	(Required, if you enter a value for the Authentication Protocol field) This field is a string, with a maximum of 128 characters in length.
EnableKeyWrap:Boolean(true|false)	This is an optional field. It is enabled only when it is supported on the network device. Valid value is true or false.
EncryptionKey:String(ascii:16|hexa:32)	(Required, if you enable KeyWrap) Indicates the encryption key that is used for session encryption. ASCII—16 characters (bytes) long Hexadecimal—32 characters (bytes) long.

Field	Description
AuthenticationKey:String(ascii:20|hexa:40)	(Required, if you enable KeyWrap). Indicates the keyed Hashed Message Authentication Code (HMAC) calculation over RADIUS messages. ASCII—20 characters (bytes) long Hexadecimal—40 characters (bytes) long.
InputFormat:String(32)	Indicates encryption and authentication keys input format. Valid value is ASCII or Hexadecimal.
SNMP:Version:Enumeration (|2c|3)	This is an optional field, used by the Profiler service. It is the version of the SNMP protocol. Valid value is 1, 2c, or 3.
SNMP:RO Community:String(32)	(Required, if you enter a value for the SNMP Version field) SNMP Read Only community. It is a string, with a maximum of 32 characters in length.
SNMP:RW Community:String(32)	(Required, if you enter a value for the SNMP Version field) SNMP Read Write community. It is a string, with a maximum of 32 characters in length.
SNMP:Username:String(32)	This is an optional field. It is a string, with a maximum of 32 characters in length.
SNMP:Security Level:Enumeration(Auth|No Auth|Priv)	(Required if you choose SNMP version 3) Valid value is Auth, No Auth, or Priv.
SNMP:Authentication Protocol:Enumeration(MD5|SHA)	(Required if you have entered Auth or Priv for the SNMP security level) Valid value is MD5 or SHA.
SNMP:Authentication Password:String(32)	(Required if you have entered Auth for the SNMP security level) It is a string, with a maximum of 32 characters in length.
SNMP:Privacy Protocol:Enumeration(DES|AES128|AES192|AES256|3DES)	(Required if you have entered Priv for the SNMP security level) Valid value is DES, AES128, AES192, AES256, or 3DES.
SNMP:Privacy Password:String(32)	(Required if you have entered Priv for the SNMP security level) It is a string, with a maximum of 32 characters in length.
SNMP:Polling Interval:Integer:600-86400 seconds	This is an optional field to set the SNMP polling interval. Valid value is an integer between 600 and 86400.
SNMP:Is Link Trap Query:Boolean(true|false)	This is an optional field to enable or disable the SNMP link trap. Valid value is true or false.
SNMP:Is MAC Trap Query:Boolean(true|false)	This is an optional field to enable or disable the SNMP MAC trap. Valid value is true or false.

Field	Description
SNMP:Originating Policy Services Node:String(32)	This is an optional field. Indicates which ISE server to be used to poll for SNMP data. By default, it is automatic, but you can overwrite the setting by assigning different values.
Trustsec:Device Id:String(32)	This is an optional field. It is the Trustsec device ID, and is a string, with a maximum of 32 characters in length.
Trustsec:Device Password:String(256)	(Required if you have entered Trustsec device ID) This is the Trustsec device password and is a string, with a maximum of 256 characters in length.
Trustsec:Environment Data Download Interval:Integer:1-2147040000 seconds	This is an optional field. It is the Trustsec environment data download interval. Valid value is an integer between 1 and 24850.
Trustsec:Peer Authorization Policy Download Interval:Integer:1-2147040000 seconds	This is an optional field. It is the Trustsec peer authorization policy download interval. Valid value is an integer between 1 and 24850.
Trustsec:Reauthentication Interval:Integer:1-2147040000 seconds	This is an optional field. It is the Trustsec reauthentication interval. Valid value is an integer between 1 and 24850.
Trustsec:SGACL List Download Interval:Integer:1-2147040000 seconds	This is an optional field. It is the Trustsec SGACL list download interval. Valid value is an integer between 1 and 24850.
Trustsec:Is Other Trustsec Devices Trusted:Boolean(true|false)	This is an optional field. Indicates whether Trustsec is trusted. Valid value is true or false.
Trustsec:Notify this device about Trustsec configuration changes:String(ENABLE_ALL|DISABLE_ALL)	This is an optional field. Notifies Trustsec configuration changes to the Trustsec device. Valid value is ENABLE_ALL or DISABLE_ALL
Trustsec:Include this device when deploying Security Group Tag Mapping Updates:Boolean(true|false)	This is an optional field. It is the Trustsec device included on SGT. Valid value is true or false.
Deployment:Execution Mode Username:String(32)	This is an optional field. It is the username that has privileges to edit the device configuration. It is a string, with a maximum of 32 characters in length.
Deployment:Execution Mode Password:String(32)	This is an optional field. It is the device password and is a string, with a maximum of 32 characters in length.
Deployment:Enable Mode Password:String(32)	This is an optional field. It is the enable password of the device that would allow you to edit its configuration and is a string, with a maximum of 32 characters in length.

Field	Description
Trustsec:PAC issue date:Date	This is the field that displays the issuing date of the last Trustsec PAC that has been generated by Cisco ISE for the Trustsec device.
Trustsec:PAC expiration date:Date	This is the field that displays the expiration date of the last Trustsec PAC that has been generated by Cisco ISE for the Trustsec device.
Trustsec:PAC issued by:String	This is a field that displays the name of the issuer (a Trustsec administrator) of the last Trustsec PAC that has been generated by Cisco ISE for the Trustsec device. It is a string.

Network Device Groups Import Template Format

The following table lists the fields in the template header and provides a description of the fields in the Network Device Group CSV file.

Table 5: CSV Template Fields and Description for Network Device Groups

Field	Description
Name:String(100):	(Required) This field is the network device group name. It is a string with a maximum of 100 characters in length. The full name of an NDG can have a maximum of 100 characters in length. For example, if you are creating a subgroup India under the parent groups Global > Asia, then the full name of the NDG that you are creating would be Global#Asia#India and this full name cannot exceed 100 characters in length. If the full name of the NDG exceeds 100 characters in length, the NDG creation fails.
Description:String(1024)	This is an optional network device group description. It is a string, with a maximum of 1024 characters in length.
Type:String(64):	(Required) This field is the network device group type. It is a string, with a maximum of 64 characters in length.
Is Root:Boolean(true|false):	(Required) This is a field that determines if the specific network device group is a root group. Valid value is true or false.

IPsec Security to Secure Cisco ISE-NAD Communication

Internet Protocol security (IPsec) is a set of protocols that provides security to Internet Protocol. The AAA protocols, RADIUS and TACACS+, use the MD5 hashing algorithm. For greater security, Cisco ISE offers the IPsec feature. IPsec provides secure communication by authenticating the sender, discovering any changes in data during transmission, and encrypting the data that is sent.

Cisco ISE supports IPsec in Tunnel and Transport modes. When you enable IPsec on a Cisco ISE interface and configure the peers, an IPsec tunnel is created between Cisco ISE and the NAD to secure the communication.

You can define a pre-shared key or use X.509 certificates for IPsec authentication. IPsec can be enabled on Gigabit Ethernet 1 through Gigabit Ethernet 5 interfaces. You can configure IPsec on only one Cisco ISE interface per PSN.

IPSec cannot be enabled on Gigabit Ethernet 2 as the smart license is enabled (e0/2—> eth2) by default. However, if you are required to enable IPSec, you have to choose a different interface for smart licensing.

Note Gigabit Ethernet 0 and Bond 0 (when Gigabit Ethernet 0 and Gigabit Ethernet 1 interfaces are bonded) are management interfaces in the Cisco ISE CLI; IPsec is not supported on Gigabit Ethernet 0 and Bond 0.

Required components include:

- Cisco ISE, Release 2.2 and later
- Cisco IOS Software, C5921 ESR (Embedded Services Router) Software (C5921_I86-UNIVERSALK9-M)—The ESR 5921 configuration, by default, supports IPsec in Tunnel and Transport modes. Diffie-Hellman Group 14 and Group 16 are supported.

  Note The C5921 ESR software is bundled with Cisco ISE, Releases 2.2 and later. You need an ESR license to enable it. See Cisco 5921 Embedded Services Router Integration Guide for ESR licensing information.

Configure RADIUS IPsec on Cisco ISE

To configure RADIUS IPsec on Cisco ISE, you must:

Procedure

Step 1 Configure IP address on the interface from the Cisco ISE CLI.

Gigabit Ethernet 1 through Gigabit Ethernet 5 interfaces (Bond 1 and Bond 2) support IPsec. However, IPsec can be configured on only one interface in a Cisco ISE node.

Step 2 Add a directly-connected network device to the IPsec network device group.

Note RADIUS IPsec requires the static route gateway to be directly connected through an interface of the device.

a) Choose **Administration** > **Network Resources** > **Network Devices**.
b) In the Network Devices page, click **Add**.
c) Enter the name and IP address and subnet of the network device that you want to add.
d) From the IPSEC drop-down list, choose **Yes**.
e) Check the **RADIUS Authentication Settings** checkbox.
f) In the Shared Secret field, enter the shared secret key that you have configured on the network device.
g) Click **Submit**.

Step 3 (Optional; required only for Smart Licensing) Add a separate management interface to interact with the Cisco Smart Software Manager (CSSM). You can also use Smart Software Manager satellite for ESR. To do this, from the Cisco ISE CLI, run the following command to select the corresponding management interface (Gigabit Ethernet 1-5 (or Bond 1 or 2)):

ise/admin# **license esr smart** {*interface*}

This interface must be able to reach Cisco.com to access the Cisco online licensing server.

Step 4 Add a network device to a directly-connected gateway from the Cisco ISE CLI.

ip route [*destination network*] [*network mask*] **gateway** [*next-hop address*]

Step 5 Activate Cisco ISE nodes for IPsec.

a) Choose **Administration** > **System** > **Settings** > **Protocols** > **IPSec**.

   All the Cisco ISE nodes in the deployment are listed in this page.

b) Check the check box next to the Cisco ISE node on which you want to activate IPsec, and then click the **Enable** radio button.
c) Select the interface that you want to use for IPsec communication.
d) Choose an authentication type for the selected ISE node from the following options:

   - Pre-shared Key—If you choose this option, you must enter the pre-shared key and configure the same key on the network device. Use alphanumeric characters for the pre-shared key. Special characters are not supported. For instructions on how to configure the pre-shared key on the network device, see the network device documentation. For an example of the pre-shared key configuration output, see Example: Output of PreShared Key Configuration on Cisco Catalyst 3850, on page 29.

   - X.509 Certificates—If you choose this option, from the Cisco ISE CLI, go to the ESR shell and configure and install X.509 Certificates for ESR 5921. Then, configure the network device for IPsec. For instructions, see Configure and Install X.509 Certificates on ESR-5921, on page 23.

e) Click **Save**.

Note You cannot modify IPsec configuration directly. If you want to modify the tunnel or authentication when IPsec is enabled, disable the current IPsec tunnel, modify the IPsec configuration and then re-enable the IPsec tunnel with a different configuration.

Note If enabled, IPsec removes the IP address from the Cisco ISE interface and shuts down the interface. When the user logs in from Cisco ISE CLI, the interface is displayed with no IP address and in shutdown state. This IP address will be configured on the ESR-5921 interface.

Step 6 Type **esr** to enter into the ESR shell.

```
ise/admin# esr
% Entering ESR 5921 shell
% Cisco IOS Software, C5921 Software (C5921_I86-UNIVERSALK9-M), Version 15.5(2)T2, RELEASE
 SOFTWARE (fc3)
% Technical Support: http://www.cisco.com/techsupport
% Copyright (c) 1986-2015 Cisco Systems, Inc.

Press RETURN to get started, CTRL-C to exit

ise-esr5921>
ise-esr5921>
```

Note For FIPS compliance, you must configure a secret password of at least 8 characters in length. Enter the **Enable secret level 1** command to specify the password:

```
ise-esr5921(config)#enable secret level 1 ?
0 Specifies an UNENCRYPTED password will follow
5 Specifies a MD5 HASHED secret will follow
8 Specifies a PBKDF2 HASHED secret will follow
9 Specifies a SCRYPT HASHED secret will follow
LINE The UNENCRYPTED (cleartext) 'enable' secret
```

Note If you configure customized RADIUS ports from the GUI (other than 1645, 1646, 1812, and 1813), you must enter the following CLI command in the ESR shell to accept the RADIUS port(s) that are configured:

```
ip nat inside source static udp 10.1.1.2 [port_number] interface Ethernet0/0
[port_number]
```

Step 7 (Optional; required only if you have not enabled Smart Licensing in Step 3) Add a Classic license or an Evaluation license (that is valid for 90 days) to Cisco ISE appliances.

- Run the following command from the Cisco ISE CLI to download the license file:

  ```
  ise/admin# license esr classic import esr.lic repository esrrepo
  ```

  For more information on Classic licensing, see the section: Licensing the Software with Classic Licensing in Cisco 5921 Embedded Services Router Integration Guide.

Step 8 Verify IPsec tunnel and RADIUS authentication over IPsec tunnel.

a) Add a user in Cisco ISE and assign to the user group (Administration > Identity Management > Identities > Users).

b) Verify if the IPsec tunnel is established between Cisco ISE and the NAD. To do this:

1. Use the **ping** command to test if the connection between Cisco ISE and the NAD is established.

2. Run the following command from the ESR shell or the NAD CLI to verify if the connection is in Active state: **show crypto isakmp sa**

   ```
   ise-esr5921#show crypto isakmp sa
   IPv4 Crypto ISAKMP SA
   dst             src             state          conn-id status
   192.168.30.1    192.168.30.3    QM_IDLE           1001 ACTIVE
   ```

3. Run the following command from the ESR shell or the NAD CLI to verify if the tunnel is established: **show crypto ipsec sa**

   ```
   ise-esr5921#show crypto ipsec sa

   interface: Ethernet0/0
       Crypto map tag: radius, local addr 192.168.30.1
   ```

```
protected vrf: (none)
local  ident (addr/mask/prot/port): (192.168.30.1/255.255.255.255/0/0)
remote ident (addr/mask/prot/port): (192.168.30.2/255.255.255.255/0/0)
current_peer 192.168.30.2 port 500
  PERMIT, flags={}
 #pkts encaps: 52, #pkts encrypt: 52, #pkts digest: 52
 #pkts decaps: 57, #pkts decrypt: 57, #pkts verify: 57
 #pkts compressed: 0, #pkts decompressed: 0
 #pkts not compressed: 0, #pkts compr. failed: 0
 #pkts not decompressed: 0, #pkts decompress failed: 0
 #send errors 0, #recv errors 0

  local crypto endpt.: 192.168.30.1, remote crypto endpt.: 192.168.30.2
  plaintext mtu 1438, path mtu 1500, ip mtu 1500, ip mtu idb Ethernet0/0
  current outbound spi: 0x393783B6(959939510)
  PFS (Y/N): N, DH group: none

  inbound esp sas:
   spi: 0x8EA0F6EE(2392913646)
     transform: esp-aes esp-sha256-hmac ,
     in use settings ={Tunnel, }
     conn id: 99, flow_id: SW:99, sibling_flags 80000040, crypto map: radius
     sa timing: remaining key lifetime (k/sec): (4237963/2229)
     IV size: 16 bytes
     replay detection support: Y
     Status: ACTIVE(ACTIVE)

  inbound ah sas:

  inbound pcp sas:

  outbound esp sas:
   spi: 0x393783B6(959939510)
     transform: esp-aes esp-sha256-hmac ,
     in use settings ={Tunnel, }
     conn id: 100, flow_id: SW:100, sibling_flags 80000040, crypto map: radius
     sa timing: remaining key lifetime (k/sec): (4237970/2229)
     IV size: 16 bytes
     replay detection support: Y
     Status: ACTIVE(ACTIVE)

  outbound ah sas:

  outbound pcp sas:
```

c) Verify the RADIUS authentication using one of the following methods:

- Log in to the network device using the credentials of the user that you created in Step 8 (a). The RADIUS authentication request is sent to the Cisco ISE node. View the details in the Live Authentications page.
- Connect the end host with the network device and configure 802.1X authentication. Log in to the end host using the credentials of the user that you created in Step 8 (a). The RADIUS authentication request is sent to the Cisco ISE node. View the details in the Live Authentications page.

Configure and Install X.509 Certificates on ESR-5921

To configure and install X.509 Certificates on ESR-5921:

Procedure

Step 1 Type **esr** to enter into the ESR shell.

```
ise/admin# esr
% Entering ESR 5921 shell
% Cisco IOS Software, C5921 Software (C5921_I86-UNIVERSALK9-M), Version 15.5(2)T2, RELEASE
 SOFTWARE (fc3)
% Technical Support: http://www.cisco.com/techsupport
% Copyright (c) 1986-2015 Cisco Systems, Inc.

Press RETURN to get started, CTRL-C to exit

ise-esr5921>
ise-esr5921>
```

Note For FIPS compliance, you must configure a secret password of at least 8 characters in length. Enter the **Enable secret level 1** command to specify the password:

```
ise-esr5921(config)#enable secret level 1 ?
0 Specifies an UNENCRYPTED password will follow
5 Specifies a MD5 HASHED secret will follow
8 Specifies a PBKDF2 HASHED secret will follow
9 Specifies a SCRYPT HASHED secret will follow
LINE The UNENCRYPTED (cleartext) 'enable' secret
```

Note If you configure customized RADIUS ports from the GUI (other than 1645, 1646, 1812, and 1813), you must enter the following CLI command in the ESR shell to accept the RADIUS port(s) that are configured:

```
ip nat inside source static udp 10.1.1.2 [port_number] interface Ethernet0/0
[port_number]
```

Step 2 Generate an RSA key pair using the following command:

Example:

```
crypto key generate rsa label rsa2048 exportable modulus 2048
```

Step 3 Create a trust point using the following command:

Example:

```
crypto pki trustpoint trustpoint-name

enrollment terminal
serial-number none
fqdn none
ip-address none
subject-name cn=networkdevicename.cisco.com
revocation-check none
rsakeypair rsa2048
```

Step 4 Generate a CSR using the following command:

Example:

```
crypto pki enroll rsaca-mytrustpoint

Display Certificate Request to terminal? [yes/no]: yes
```

Step 5 Copy the output of the CSR to a text file, submit it to an external CA for signing, and obtain the signed certificate and the CA certificate.

Step 6 Import the CA using the following command:

Example:

```
crypto pki authenticate rsaca-mytrustpoint
```

Copy and paste the contents of the CA certificate, including the “—BEGIN—“ and “—-End—“ lines.

Step 7 Import the signed certificate using the following command:

Example:

```
crypto pki import rsaca-mytrustpoint
```

Copy and paste the contents of the signed certificate, including the “—BEGIN—“ and “—-End—“ lines.

Following is an example output when you configure and install X.509 Certificates on Cisco 5921 ESR:

```
ise-esr5921#show running-config
!
hostname ise-esr5921
!
boot-start-marker
boot host unix:default-config
boot-end-marker
!
no aaa new-model
bsd-client server url https://cloudsso.cisco.com/as/token.oauth2
mmi polling-interval 60
no mmi auto-configure
no mmi pvc
mmi snmp-timeout 180
call-home
! If contact email address in call-home is configured as sch-smart-licensing@cisco.com
! the email address configured in Cisco Smart License Portal will be used as contact email
 address to send SCH notifications.
contact-email-addr sch-smart-licensing@cisco.com
profile "CiscoTAC-1"
  active
  destination transport-method http
  no destination transport-method email
!
ip cef
no ipv6 cef
!
multilink bundle-name authenticated
!
crypto pki trustpoint SLA-TrustPoint
enrollment pkcs12
revocation-check crl
!
crypto pki trustpoint rsaca-mytrustpoint
enrollment terminal
serial-number none
fqdn none
ip-address none
subject-name cn=ise-5921.cisco.com
revocation-check none
rsakeypair rsa2048
!
crypto pki certificate chain SLA-TrustPoint
certificate ca 01
  30820321 30820209 A0030201 02020101 300D0609 2A864886 F70D0101 0B050030
  32310E30 0C060355 040A1305 43697363 6F312030 1E060355 04031317 43697363
  6F204C69 63656E73 696E6720 526F6F74 20434130 1E170D31 33303533 30313934
  3834375A 170D3338 30353330 31393438 34375A30 32310E30 0C060355 040A1305
  43697363 6F312030 1E060355 04031317 43697363 6F204C69 63656E73 696E6720
  526F6F74 20434130 82012230 0D06092A 864886F7 0D010101 05000382 010F0030
  82010A02 82010100 A6BCBD96 131E05F7 145EA72C 2CD686E6 17222EA1 F1EFF64D
  CBB4C798 212AA147 C655D8D7 9471380D 8711441E 1AAF071A 9CAE6388 8A38E520
  1C394D78 462EF239 C659F715 B98C0A59 5BBB5CBD 0CFEBEA3 700A8BF7 D8F256EE
  4AA4E80D DB6FD1C9 60B1FD18 FFC69C96 6FA68957 A2617DE7 104FDC5F EA2956AC
  7390A3EB 2B5436AD C847A2C5 DAB553EB 69A9A535 58E9F3E3 C0BD23CF 58BD7188
  68E69491 20F320E7 948E71D7 AE3BCC84 F10684C7 4BC8E00F 539BA42B 42C68BB7
  C7479096 B4CB2D62 EA2F505D C7B062A4 6811D95B E8250FC4 5D5D5FB8 8F27D191
  C55F0D76 61F9A4CD 3D992327 A8BB03BD 4E6D7069 7CBADF8B DF5F4368 95135E44
  DFC7C6CF 04DD7FD1 02030100 01A34230 40300E06 03551D0F 0101FF04 04030201
  06300F06 03551D13 0101FF04 05300301 01FF301D 0603551D 0E041604 1449DC85
  4B3D31E5 1B3E6A17 606AF333 3D3B4C73 E8300D06 092A8648 86F70D01 010B0500
  03820101 00507F24 D3932A66 86025D9F E838AE5C 6D4DF6B0 49631C78 240DA905
  604EDCDE FF4FED2B 77FC460E CD636FDB DD44681E 3A5673AB 9093D3B1 6C9E3D8B
  D98987BF E40CBD9E 1AECA0C2 2189BB5C 8FA85686 CD98B646 5575B146 8DFC66A8
  467A3DF4 4D565700 6ADF0F0D CF835015 3C04FF7C 21E878AC 11BA9CD2 55A9232C
  7CA7B7E6 C1AF74F6 152E99B7 B1FCF9BB E973DE7F 5BDDEB86 C71E3B49 1765308B
  5FB0DA06 B92AFE7F 494E8A9E 07B85737 F3A58BE1 1A48A229 C37C1E69 39F08678
  80DDCD16 D6BACECA EEBC7CF9 8428787B 35202CDC 60E4616A B623CDBD 230E3AFB
  418616A9 4093E049 4D10AB75 27E86F73 932E35B5 8862FDAE 0275156F 719BB2F0
  D697DF7F 28
        quit
crypto pki certificate chain rsaca-mytrustpoint
certificate 39
  30820386 3082026E A0030201 02020139 300D0609 2A864886 F70D0101 0B050030
  61310B30 09060355 04061302 5553310B 30090603 5504080C 024E4331 0C300A06
  03550407 0C035254 50310E30 0C060355 040A0C05 43495343 4F310C30 0A060355
  040B0C03 53544F31 19301706 03550403 0C107273 6163612E 65726368 616F2E63
  6F6D301E 170D3136 30393031 32313037 34335A17 0D313730 39303132 31303734
  335A301D 311B3019 06035504 03131269 73652D35 3932312E 63697363 6F2E636F
  6D308201 22300D06 092A8648 86F70D01 01010500 0382010F 00308201 0A028201
  0100EE87 CABFBA18 7E0405A8 ACAAAB23 E7CB6109 2CF98BAE 8EE93536 BF1EBBD3
  73E60BE7 F430B5AF EBF8B0C5 969B2828 A6783BB4 64E333E4 29C8744E 6E783617
  194AF1B0 7F04B4EA B89FD6EB F9C4F2DD 196DC6E0 CAA49B8B 665B6E0D 2FBC1D2F
  8E8181B9 60FAE126 D1B2E4E4 1F321A97 10C1B76A C2BB3174 361B13FA 2CB7BDFE
  22C0C33F 2792D714 C41E2237 00B1AE49 6593DCC3 A799D526 D81F9706 A71DA14E
  5ED76038 7A2C84B4 C668E35C 337BA1DC 9CA56AC2 C8E0059F 660CE39C 925310A0
  F9A21FFB 3C3C507A 20B924F7 E0125D60 6552321C 35736079 42449401 15E68DA6
  B4776DAA FB5AFDF8 59E31373 263175E3 1F14416A 24C21D69 A46173B6 96CC84FB
  5B9D0203 010001A3 818C3081 89300906 03551D13 04023000 302C0609 60864801
  86F84201 0D041F16 1D4F7065 6E53534C 2047656E 65726174 65642043 65727469
  66696361 7465301D 0603551D 0E041604 146DD31C 03690B98 330B67FA 6EDC7B20
  F99FB924 60301F06 03551D23 04183016 8014966A 0C21AF96 3E827690 423599CC
  EE8087A1 2909300E 0603551D 0F0101FF 04040302 05A0300D 06092A86 4886F70D
  01010B05 00038201 0100C0B9 D2845D97 6FFC16DB 01559659 BC1DECA6 E1A01965
  1F6CD459 E03D7ABE 91179FEB 08BF5B9B 84B62C36 236F528E E30C921C 81DA29E1
  EA3DFDC1 B0B0EEBA 14EADAEC 078576E4 D643A0EF 7D8E0880 C5FC3965 811B08C0
  5696DBF5 FADA4092 ACF549B8 2257F508 636D52AA 6CDC9596 AB43313F 6C33C9C1
  2CFDDBE3 EA9D407C 8D1B0F49 BBACD0CD 2832AC12 CD3FEFC8 501E1639 A4EFDC27
  69CA0147 971A1B2D DB2758E6 A84AFC86 4F9A4942 3D7EDBCC 7BDCC1BB 61F69B31
  BF13E39B 10AAC31C 55E73C8B C30BE516 7C506FF4 AC367D94 814A6880 EF201A6D
  CD2E1A95 7BBEC982 01CE867D 931F56E1 1EF1C457 9DC9A0BE 9DB2DC9B 19873585
  89AE82F6 A37E51D6 EECD
        quit
certificate ca 008DD3A81106B14664
  308203A2 3082028A A0030201 02020900 8DD3A811 06B14664 300D0609 2A864886
  F70D0101 05050030 61310B30 09060355 04061302 5553310B 30090603 5504080C
  024E4331 0C300A06 03550407 0C035254 50310E30 0C060355 040A0C05 43495343
  4F310C30 0A060355 040B0C03 53544F31 19301706 03550403 0C107273 6163612E
  65726368 616F2E63 6F6D301E 170D3135 31303231 32313135 34335A17 0D323531
  30313832 31313534 335A3061 310B3009 06035504 06130255 53310B30 09060355
  04080C02 4E43310C 300A0603 5504070C 03525450 310E300C 06035504 0A0C0543
  4953434F 310C300A 06035504 0B0C0353 544F3119 30170603 5504030C 10727361
  63612E65 72636861 6F2E636F 6D308201 22300D06 092A8648 86F70D01 01010500
  0382010F 00308201 0A028201 0100CB82 2AECEE38 1BCB27B9 FA5F2FBD 8609B190
  16A6F741 5BEC18B8 8B260CAF 190EA1CE 063BC558 556DC085 6FAC5425 14AFE225
  0E9E3A12 05F3DA7E D17E03F2 7FFE92FB 38D67027 DBC5C175 EB53E96B 66C20D11
  B4C32D38 AE04385C 8FD4CB74 31A97824 CA1CAFD5 091806C3 6F9CBF8D DC42DD5B
  D985703D F3BB9ED1 7DE99614 422D765C 86AB25CD E80008C5 22049BE8 66D1CA27
  E1EB6D4F 4FD3CC18 E091BBF0 6FE0EB52 B33F231A 6D6B7190 4196C929 D22E2C42
  B9CD2BBD 24550E82 8CD8838F C41B4DAD 2FA1636A 5787BBB2 F21E4718 335B005B
  DFBE6EA7 56EBE30B D52DE85F FFAF0189 E372CBFC 44BFF235 4DA7C9EF DAAC6D0A
  A196DA5A 1B525175 C26B3581 EA4B0203 010001A3 5D305B30 1D060355 1D0E0416
  0414966A 0C21AF96 3E827690 423599CC EE8087A1 2909301F 0603551D 23041830
  16801496 6A0C21AF 963E8276 90423599 CCEE8087 A1290930 0C060355 1D130405
  30030101 FF300B06 03551D0F 04040302 02A4300D 06092A86 4886F70D 01010505
  00038201 01002334 A3F0E5D3 4D229985 67A07754 73EC52E3 05B7D05F 926CC863
  220F849B 861C36B2 EF7C3485 474D4EF0 73895879 CAE08BBB 183B7CFA A20C4354
  86C6D9DF D445DACE C252C608 236F6673 F3F3C329 474B22E8 660BF91E 41054B8D
  43B80E44 AE69C164 2C9F41A2 8284F577 21FFAB8E A6771A5E DD34EBE4 A0DC2EAD
  95702010 02964566 478DA90F 5E134643 81A5F5EA 362D0394 1F9F23D1 DEE50B07
  12938299 1AF11A36 82DAFC6A 164B2F66 8B0AB7CC 9A723EBC B50E740B 0A9270E3
  60E2ED42 7F10D1A6 F6735144 AE93BF86 3D5A0502 6811D2BD 6E694693 28DE84C5
  3747CF0A D2B8D6C9 6CBEBA0A D1137CF8 E31CBF6B 437D82DD D74A4A9F 3557B3D9
  D0BD055F 65A8
        quit
license udi pid CISCO5921-K9 sn 9XG4481W768
username lab password 0 lab
!
redundancy
!
crypto keyring MVPN-spokes
rsa-pubkey address 0.0.0.0
  address 0.0.0.0
  key-string
  quit
!
crypto isakmp policy 10
encr aes
hash sha256
group 16
!
crypto isakmp policy 20
encr aes
hash sha256
group 14
crypto isakmp profile MVPN-profile
   description LAN-to-LAN for spoke router(s) connection
   keyring MVPN-spokes
   match identity address 0.0.0.0
!
crypto ipsec transform-set radius esp-aes esp-sha256-hmac
mode tunnel
crypto ipsec transform-set radius-2 esp-aes esp-sha256-hmac
mode transport
!
crypto dynamic-map MVPN-dynmap 10
set transform-set radius radius-2
!
crypto map radius 10 ipsec-isakmp dynamic MVPN-dynmap
!
interface Ethernet0/0
description e0/0->connection to external NAD
ip address 192.168.20.1 255.255.255.0
ip nat outside
ip virtual-reassembly in
no ip route-cache
crypto map radius
!
interface Ethernet0/1
description e0/1->tap0 internal connection to ISE
ip address 10.1.1.1 255.255.255.252
ip nat inside
ip virtual-reassembly in
no ip route-cache
!
interface Ethernet0/2
no ip address
shutdown
!
interface Ethernet0/3
no ip address
shutdown
!
ip forward-protocol nd
!
no ip http server
no ip http secure-server
ip nat inside source list 1 interface Ethernet0/0 overload
ip nat inside source static udp 10.1.1.2 1645 interface Ethernet0/0 1645
ip nat inside source static udp 10.1.1.2 1646 interface Ethernet0/0 1646
ip nat inside source static udp 10.1.1.2 1812 interface Ethernet0/0 1812
ip nat inside source static udp 10.1.1.2 1813 interface Ethernet0/0 1813
!
access-list 1 permit 10.1.1.0 0.0.0.3
!
control-plane
!
line con 0
logging synchronous
line aux 0
line vty 0 4
login
transport input none
!
end
```

Following is an example output when you configure and install X.509 Certificates on Cisco Catalyst 3850:

```
cat3850#show running-config

enable password lab
!
username lab password 0 lab
aaa new-model

!

aaa group server radius ise
server name ise-vm
deadtime 60
!
aaa authentication login default group radius local

aaa authentication enable default group radius enable

!

crypto isakmp policy 10
```

```
encr aes

hash sha256
authentication rsa-sig
group 16
!
crypto ipsec security-association lifetime seconds 86400
!
crypto ipsec transform-set radius esp-aes esp-sha256-hmac
mode tunnel

!

crypto ipsec profile radius-profile

!

crypto map radius 10 ipsec-isakmp
set peer 192.168.20.1
set transform-set radius

match address 100

!

interface GigabitEthernet1/0/1
no switchport
ip address 192.168.20.2 255.255.255.0

crypto map radius

!
access-list 100 permit ip host 192.168.20.2 host 192.168.20.1
!
snmp-server community public RO
snmp-server community private RW
!
radius server rad-ise
address ipv4 192.168.20.1 auth-port 1645 acct-port 1646

key secret
```

Example: Output of PreShared Key Configuration on Cisco Catalyst 3850

Following is an example of the output when you configure the pre-shared key on Cisco Catalyst 3850:

```
cat3850#show running-config

enable password lab
 !
 username lab password 0 lab
 aaa new-model
 !
 aaa group server radius ise
 server name ise-vm
 deadtime 60
 !
 aaa authentication login default group radius local

 aaa authentication enable default group radius enable
```

```
!

crypto isakmp policy 10

 encr aes

 hash sha256
 authentication pre-share
 group 16
 crypto isakmp key 123456789 address 0.0.0.0
 !
 crypto ipsec security-association lifetime seconds 86400
 !
 crypto ipsec transform-set radius esp-aes esp-sha256-hmac
 mode tunnel
 !
 crypto ipsec profile radius-profile
 !
 crypto map radius 10 ipsec-isakmp
 set peer 192.168.20.1
 set transform-set radius
 match address 100
!
interface GigabitEthernet1/0/1
 no switchport
 ip address 192.168.20.2 255.255.255.0

 crypto map radius
!
 access-list 100 permit ip host 192.168.20.2 host 192.168.20.1
 !
 snmp-server community public RO
 snmp-server community private RW
 !
 radius server rad-ise
 address ipv4 192.168.20.1 auth-port 1645 acct-port 1646

 key secret
```

Mobile Device Manager Interoperability with Cisco ISE

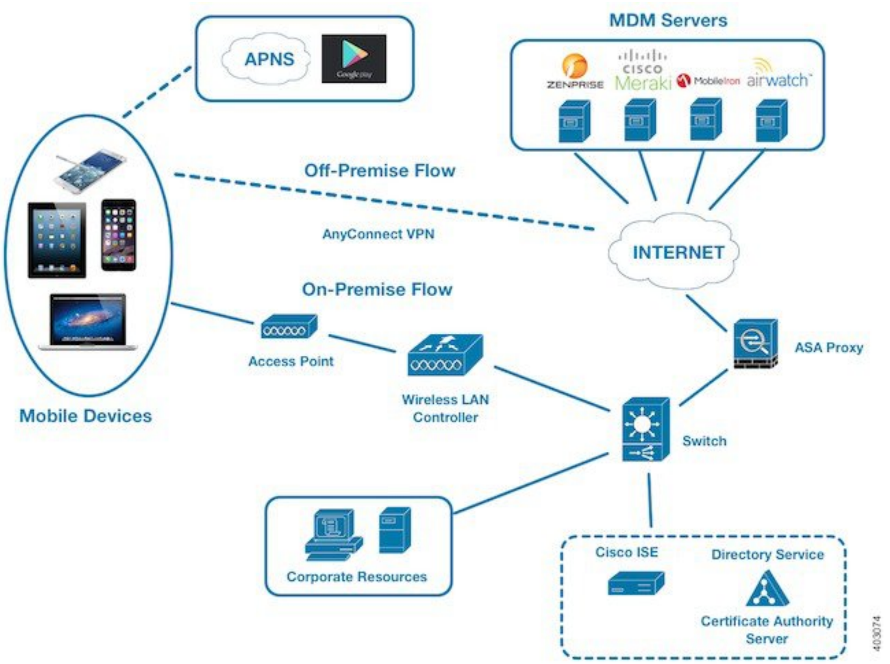
Mobile Device Management (MDM) servers secure, monitor, manage, and support mobile devices deployed across mobile operators, service providers, and enterprises. MDM servers act as a policy server that controls the use of some applications on a mobile device (for example, an e-mail application) in the deployed environment. However, the network is the only entity that can provide granular access to endpoints based on ACLs. Cisco ISE queries the MDM servers for the necessary device attributes to create ACLs that provide network access control for those devices.

You can run multiple active MDM servers on your network, including ones from different vendors. This allows you to route different endpoints to different MDM servers based on device factors such as location or device type.

Cisco ISE also integrates with MDM servers using Cisco's MDM API version 2 to allow devices access the network over VPN via AnyConnect 4.1 and Cisco ASA 9.3.2 or later.

In this illustration, Cisco ISE is the enforcement point and the MDM policy server is the policy information point. Cisco ISE obtains data from the MDM server to provide a complete solution.

Figure 3: MDM Interoperability with Cisco ISE



You can configure Cisco ISE to interoperate with one or more external Mobile Device Manager (MDM) servers. By setting up this type of third-party connection, you can leverage the detailed information available in the MDM database. Cisco ISE uses REST API calls to retrieve information from the external MDM server. Cisco ISE applies appropriate access control policies to switches, access routers, wireless access points, and other network access points to achieve greater control of remote device access to your Cisco ISE network.

The supported MDM vendors are listed here: Supported MDM Servers, on page 32.

Supported MDM Use Cases

The functions Cisco ISE performs with the external MDM server are as follows:

- Managing device registration—Unregistered endpoints accessing the network are redirected to a registration page, which is hosted on the MDM server. Device registration includes user role, device type, and so on.
- Handling device remediation—Endpoints are granted only restricted access during remediation.
- Augmenting endpoint data—Update the endpoint database with information from the MDM server that you cannot gather using the Cisco ISE Profiler. Cisco ISE uses six device attributes you can view using the **Work Centers** > **Network Access** > **Identities** > **Endpoints** page if an endpoint is an MDM monitored device. For example:
  - MDMImei: 99 000100 160803 3
  - MDMManufacturer: Apple
  - MDMModel: iPhone
  - MDMOSVersion: iOS 6.0.0
  - MDMPhoneNumber: 9783148806

  - MDMSerialNumber: DNPGQZGUDTF9

- Cisco ISE polls the MDM server once every 4 hours for device compliance data. This is configurable by the administrator.
- Issuing device instructions through the MDM server—Issues remote actions for users' devices through the MDM server. Administrators initiate remote actions from the ISE console.

Vendor MDM Attributes

When you configure an MDM server in ISE, that vendor's attributes are added to a new entry in the ISE system dictionary, named **mdm**. The following attributes are used for registration status, and are commonly supported by MDM vendors.

- DeviceRegisterStatus
- DeviceCompliantStatus
- DiskEncryptionStatus
- PinLockStatus
- JailBrokenStatus
- Manufacturer
- IMEI
- SerialNumber
- OsVersion
- PhoneNumber
- MDMServerName
- MDMServerReachable
- MEID
- Model
- UDID

Vendor's unique attributes are not supported, but you may be able to use ERS APIs to exchange vendor-specific attributes, if the vendor supports that.

The new MDM dictionary attributes are available to use in authorization policies.

Supported MDM Servers

Supported MDM servers include products from the following vendors:

- Absolute
- AirWatch
- Citrix XenMobile

- Globo
- Good Technology
- IBM MaaS360
- JAMF Software
- Meraki SM/EMM
- MobileIron
- SAP Afaria
- SOTI
- Symantec
- Tangoe
- Microsoft Intune - for mobile devices
- Microsoft SCCM - for desktop devices

ISE Community Resource

How To: Meraki EMM / MDM Integration with ISE

Ports Used by the MDM Server

The following table lists the ports that must be open between the Cisco ISE and the MDM server to enable them to communicate with each other. Refer to the MDM Server Documentation for a list of ports that must be open on the MDM agent and server.

Table 6: Ports Used by the MDM Server

MDM Server	Ports
MobileIron	443
Zenprise	443
Good	19005
Airwatch	443
Afaria	443
Fiberlink MaaS	443
Meraki	443
Microsoft Intune	80 and 443
Microsoft SCCM	80 and 443

MDM Integration Process Flow

This section describes the MDM integration process:

1. The user associates a device to SSID.
2. Cisco ISE makes an API call to the MDM server.
3. This API call returns a list of devices for this user and the posture status for the devices.

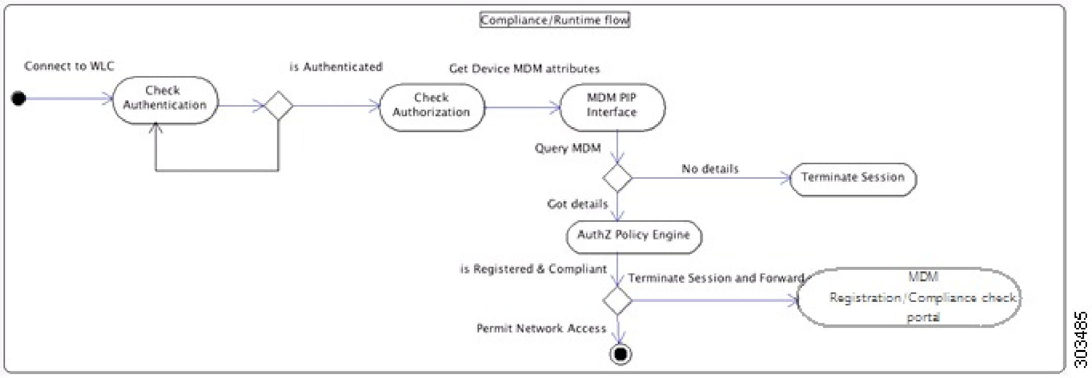
Note The input parameter is the MAC address of the endpoint device. For off-premise Apple iOS devices (any device that connects to Cisco ISE through a VPN), this is the UDID.

4. If the user's device is not in this list, it means the device is not registered. Cisco ISE sends an authorization request to the NAD to redirect to Cisco ISE. The user is presented the MDM server page.

Note You must register a device that is enrolled on the MDM server outside of a Cisco ISE network via the MDM portal. This is applicable for Cisco ISE, Release 1.4 and later. Earlier ISE versions allow devices enrolled outside of a Cisco ISE network to be automatically enrolled if they are compliant with the posture policies.

5. Cisco ISE uses MDM to provision the device and presents an appropriate page for the user to register the device.
6. The user registers the device in the MDM server, and the MDM server redirects the request to Cisco ISE (through automatic redirection or manual browser refresh).
7. Cisco ISE queries the MDM server again for the posture status.
8. If the user's device is not compliant to the posture (compliance) policies configured on the MDM server, the user is notified that the device is out of compliance and must be compliant.
9. After the user's device becomes compliant, the MDM server updates the device state in its internal tables.
10. If the user refreshes the browser now, the control is transferred back to Cisco ISE.
11. Cisco ISE polls the MDM server once every four hours to get compliance information and issues Change of Authorization (CoA) appropriately. This can be configured by the administrator. Cisco ISE also checks the MDM server every 5 minutes to make sure that it is available.

The following figure illustrates the MDM process flow.



Note A device can only be enrolled to a single MDM server at a time. If you want to enroll the same device to an MDM service from another vendor, the previous vendor's profiles must be removed from the device. The MDM service usually offers a "corporate wipe", which only deletes the vendor's configuration from the device (not the whole device). The user can also remove the files. For example, on an IOS device, the user can go to Settings > General >Device management, and click remove management. Or the user can go to the MyDevices portal in ISE, and click corporate wipe.

Set Up MDM Servers with Cisco ISE

To set up MDM servers with Cisco ISE, you must perform the following high-level tasks:

Procedure

Step 1 Import MDM server certificate into Cisco ISE, except for Intune, where you import the PAN's certificate into Azure.

Step 2 Create mobile device manager definitions.

Step 3 Configure ACLs on the Wireless LAN Controllers.

Step 4 Configure an authorization profile that redirects non-registered devices to the MDM server.

Step 5 If there is more than one MDM server on the network, configure separate authorization profiles for each vendor.

Step 6 Configure authorization policy rules for the MDM use cases.

Import MDM Server Certificate into Cisco ISE

For Cisco ISE to connect with the MDM server, you must import the MDM server certificate into the Cisco ISE Certificate Store. If your MDM server has a CA-signed certificate, you must import the root CA into the Cisco ISE Certificate Store.

Note For Microsoft Azure, you import the ISE certificate into Azure. For more information, see Configuring Microsoft Intune as an MDM Server, on page 39.

Procedure

Step 1 Export the MDM server certificate from your MDM server and save it on your local machine.

Step 2 Choose **Administration** > **System** > **Certificates** > **Trusted Certificate** > **Import**.

Step 3 Click **Browse** to select the MDM server certificate that you obtained from the MDM server.

Step 4 Add a friendly name.

Step 5 Check **Trust for authentication within ISE** check box.

Step 6 Click **Submit**.

Step 7 Verify that the Certificate Store list page lists the MDM server certificate.

What to do next

Define Mobile Device Management Servers in ISE, on page 36

.

Define Mobile Device Management Servers in ISE

You can create one or more Mobile Device Management (MDM) and Desktop Device Manager (SCCM) definitions for external MDM servers.

1. Choose **Administration** > **Network Resources** > **External MDM**.
2. Click **Add**.
3. Enter the name and description of the MDM server that you want to add.
4. Choose the **Server Type**, Mobile Device Manager, or Desktop Device Manager. Your choice determines which fields you see next. If you chose Desktop Device Manager, go to Desktop Device Management, on page 38. If you chose Mobile Device Manager, then continue this list of steps.
5. Choose **Authentication Type**, Basic, or OAuth - Client Credentials. If you chose OAuth - Client credentials to configure a Microsoft Intune server, go to Mobile Device Management - OAuth - Client Credentials, on page 37. If you chose Basic, then continue this list of steps.
6. All screens ask for a name and describe this MDM server definition. The following section describes the additional fields and steps, which are based on server and authentication type.

Mobile Device Management - Basic

- **Host Name / IP Address**—Enter the hostname or IP address of the MDM server.
- **Port**—Enter the port to use when connecting to the MDM server, which is usually 443.
- **Instance Name** - If this MDM server has several instances, enter the instance that you want to connect to.
- **Polling Interval**—Enter the polling interval in minutes for Cisco ISE to poll the MDM server for compliance check information. Set this value to match the polling interval on your MDM server. The valid range is from 15 to 1440 minutes. The default value is 240 minutes. We recommend that you set the polling interval below 60 minutes only for testing a few active clients on your network. If you set

this value below 60 minutes for a production environment with many active clients, the system's load increases significantly and may negatively affect performance.

If you set the polling interval to 0, ISE disables communication with the MDM server.

- **Time Interval For Compliance Device ReAuth Query**—When the endpoint is authenticated or re-authenticated, ISE uses a cache to get the MDM variables for that endpoint. If the age of cached value is older than the value of Time Interval For Compliance Device ReAuth Query, then ISE makes a device query to the MDM server to get new values. If the compliance status changed, then ISE triggers a CoA.

  The valid range is from 1 to 1440 minutes. The default value is 1 minute.

Mobile Device Management - OAuth - Client Credentials

Using OAuth requires configuration of the OAuth server, which is described in Configuring Microsoft Intune as an MDM Server, on page 39

- **Auto Discovery URL**—Enter the value of *Microsoft Azure AD Graph API Endpoint* from the Microsoft Azure management portal. This URL is the endpoint at which an application can access directory data in your Microsoft Azure AD directory using the Graph API. The URL is of the form: `https://<hostname>/<tenant id>, for example, https://graph.ppe.windows.net/47f09275-5bc0-4807-8aae-f35cb0341329`. An expanded version of this URL is also in the property file, which is of the form: `https://<Graph_API_Endpoint>/<TenantId_Or_Domain>/servicePrincipalsByAppId/<Microsoft Intune AppId>/serviceEndpoints?api-version=1.6&client-request-id=<Guid.NewGuid()>`.

- **Client ID**—The unique identifier for your application. Use this attribute if your application accesses data in another application, such as the Microsoft Azure AD Graph API, Microsoft Intune API, and so on.

- **Token Issuing URL**—Enter the value of the *Oauth2.0 Authorization Endpoint* from the previous step. This is the endpoint at which your app can obtain an access token using OAuth2.0. After your app is authenticated, Microsoft Azure AD issues your app (ISE) an access token, which allows your app to call the Graph API/ Intune API.

- **Token Audience**—The recipient resource that the token is intended for, which is a public, well-known APP ID URL to the Microsoft Intune API.

- **Polling Interval**—Enter the polling interval in minutes for Cisco ISE to poll the MDM server for compliance check information. Set this value to match the polling interval on your MDM server. The valid range is from 15 to 1440 minutes. The default value is 240 minutes. We recommend that you set the polling interval below 60 minutes only for testing a few active clients on your network. If you set this value below 60 minutes for a production environment with many active clients, the system's load increases significantly and may negatively affect performance.

  If you set the polling interval to 0, ISE disables communication with the MDM server.

- **Time Interval For Compliance Device ReAuth Query**—When the endpoint is authenticated or re-authenticated, ISE uses a cache to get the MDM variables for that endpoint. If the age of cached value is older than the value of Time Interval For Compliance Device ReAuth Query, then ISE makes a device query to the MDM server to get new values. If the compliance status changed, then ISE triggers a CoA.

  The valid range is from 1 to 1440 minutes. The default value is 1 minute.

Desktop Device Management

The following settings require you to configure WMI on the SCCM server, so it can communicate with ISE. See Configure the Microsoft SCCM Server for ISE, on page 42 for more information.

- **Host Name / IP Address**—Enter the hostname or IP address of the MDM server.
- **Site or Instance Name**—Enter the site name, or if the MDM server has several instances, the instance name.

ISE MDM Support for Microsoft Intune and SCCM

- **Microsoft Intune**- MDM-ISE supports Microsoft's Intune device management as a partner MDM server managing mobile devices.

  You configure ISE as an OAuth 2.0 client application on the Intune server managing mobile devices. ISE gets a token from Azure to establish a session with that ISE Intune application.

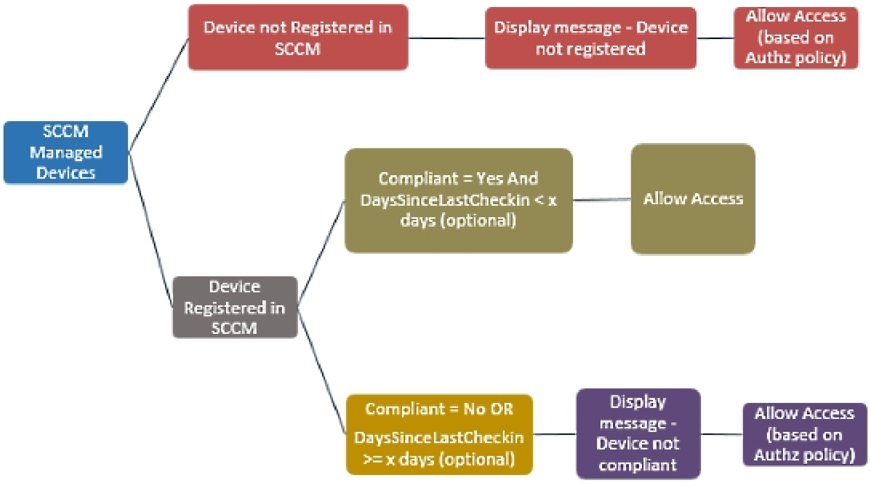
  See https://msdn.microsoft.com/en-us/library/azure/dn645543.aspx for more information about how Intune communicates with a client application.

- **Desktop Device Manager (Microsoft SCCM)** - ISE supports Microsoft's System Center Configuration Manager (SCCM) as a partner MDM server for managing Windows computers. ISE retrieves compliance information from the SCCM server using WMI, and uses that information to grant or deny network access to the user's Windows device.

SCCM Workflow

ISE is able to retrieve information from the SCCM server about whether a device is registered, and if it is registered, is it compliant. The following diagram shows the workflow for devices managed by SCCM.

Figure 4: SCCM Workflow


SCCM Managed Devices
Device not Registered in SCCM
Display message - Device not registered
Allow Access (based on Authz policy)
Compliant = Yes And DaysSinceLastCheckin < x days (optional)
Allow Access
Device Registered in SCCM
Compliant = No OR DaysSinceLastCheckin >= x days (optional)
Display message - Device not compliant
Allow Access (based on Authz policy)

When a device connects and a SCCM policy is matched, ISE queries the SCCM server specified in the authorization policy to retrieve compliance and last logon (check-in) time. With this information, ISE updates the compliance status and lastCheckinTimeStamp of the device in the Endpoint list.

If the device is not compliant or not registered with SCCM, and a redirect profile is used in the authorization policy, a message is displayed to the user that the device is not compliant or not registered with the SCCM. After the user acknowledges the message, ISE can issue a CoA to the SCCM registration site. Users can be granted access based on the authorization policy and profile.

Microsoft SCCM Server Connection Monitoring

Polling is not configurable for SCCM.

ISE runs an MDM HeartBeat job that verifies connection to the SCCM server, and raises alarms if ISE loses the connection to the SCCM server. The HeartBeat job interval is not configurable.

Configuring Microsoft Intune as an MDM Server

Configuring Microsoft Intune as an MDM server for ISE is slightly differently from configuring other MDM servers. Use the following steps to configure ISE's connection to Azure and Azure's connection to ISE.

1. Get the public certificate from the Intune/Azure Active Directory tenant, and import it into ISE to support SSL handshake.
   - **a.** 1. Log on to the Intune Admin Console or Azure Admin console, whichever site has your tenant.
   - **b.** Use the browser to get the certificate details. For, example, with Internet Explorer:
     1. Click on the lock symbol in the browers toolbar, then click View Certficates.
     2. In the Certificate window, select the tab Certification Path.
     3. Find Baltimore Cyber Trust root, and export the root cert.
   - **c.** In ISE, choose **Administration** > **System** > **Certificates** > **Trusted Certificates**, and import the root certificate that you just saved. Give the certificate a meaningful name, such as Azure MDM.

2. Export the ISE self-signed certificate, and prepare it for InTune/Azure.
   - **a.** On the PAN, navigate to **Administration** > **System** > **Certificates** > **System Certificates**, select the Default self-signed server certificate, and click Export.
   - **b.** Select Export Certificate Only (default), and select a place to save it.

   Run the following PowerShell script on the exported certificate file:

```
$cer = New-Object System.Security.Cryptography.X509Certificates.X509Certificate2
$cer.Import(“mycer.cer”)
$bin = $cer.GetRawCertData()
$base64Value = [System.Convert]::ToBase64String($bin)

$bin = $cer.GetCertHash()
$base64Thumbprint = [System.Convert]::ToBase64String($bin)

$keyid = [System.Guid]::NewGuid().ToString()
```

   Keep the values for **$base64Thumbprint, $base64Value** and **$keyid**, which will be used in the next step.

3. Create an ISE application in Intune.
   - **a.** Sign in to your customer domain on the Microsoft Azure management portal, navigate to **Directory** > **Applications** > **Add an Application**, and choose **Add an application my organization is developing**.

b. Configure the ISE application in Azure with the following parameters:

- **Application Name**— enter **`ISE`**.
- Select **WEB APPLICATION AND/OR WEB APP**.
- **SIGN-ON URL and APP ID URL**—Add any valid URL, these values are not used by ISE.

4. Get the manifest file from Azure, add the ISE certificate information, and upload the updated manifest into Azure.

   a. On the Microsoft Azure management portal ((https://manage.windowsazure.com), open the AAD snap-in, and navigate to the ISE application.

   Download the application manifest file from the **Manage Manifest** menu.

5. Update the **keyCredentials** field in Manifest json file as shown in the following example, replacing *Base64 Encoded String of ISE PAN cert* with the exported, edited, certificate file from ISE, which is the $base64Value from the PowerShell script:

```
"keyCredentials": [
                              {
                                “customKeyIdentifier“: “$base64Thumbprint_from_above”,
                                “keyId“: “$keyid_from_above“,
                                "type": "AsymmetricX509Cert",
                                "usage": "Verify",
                                "value": "Base64 Encoded String of ISE PAN cert"
                              }
                           ]
```

Note Do not change the name of the manifest file.

The KeyCredentials complex type is documented here: http://msdn.microsoft.com/en-us/library/azure/dn151681.aspx.

6. Upload the updated manifest file to Azure.

7. On the Microsoft Azure management portal, navigate to the list of App Endpoints. You will use the values of following endpoint attributes to configure ISE:

   - MICROSOFT AZURE AD GRAPH API ENDPOINT
   - OAUTH 2.0 TOKEN ENDPOINT

8. In ISE, configure the Intune server in ISE. For more information about configuring and external MDM server, see Define Mobile Device Management Servers in ISE, on page 36. The fields that are important for Intune are described below:

   - **Auto Discovery URL**—Enter the value of *Microsoft Azure AD Graph API Endpoint* from the Microsoft Azure management portal. This URL is the endpoint at which an application can access directory data in your Microsoft Azure AD directory using the Graph API. The URL is of the form: `https://<hostname>/<tenant id>, for example, https://graph.ppe.windows.net/47f09275-5bc0-4807-8aae-f35cb0341329`. An expanded version of this URL is also in the property file, which is of the form:

```
https://<Graph_API_Endpoint>/<TenantId_Or_Domain>/servicePrincipalsByAppId/<Microsoft
Intune AppId>/serviceEndpoints?api-version=1.6&client-request-id=<Guid.NewGuid()>.
```

- **Client ID**—The unique identifier for your application. Use this attribute if your application accesses data in another application, such as the Microsoft Azure AD Graph API, Microsoft Intune API, and so on.
- **Token Issuing URL**—Enter the value of the *Oauth2.0 Authorization Endpoint* from the previous step. This is the endpoint at which your app can obtain an access token using OAuth2.0. After your app is authenticated, Microsoft Azure AD issues your app (ISE) an access token, which allows your app to call the Graph API/ Intune API.
- **Token Audience**—The recipient resource that the token is intended for, which is a public, well-known APP ID URL to the Microsoft Intune API.

For more information about Intune applications, see the following links:

- https://msdn.microsoft.com/en-us/library/azure/dn645543.aspx
- http://blogs.msdn.com/b/exchangedev/archive/2015/01/22/building-demon-or-service-apps-with-office-365-mail-calendar-and-contacts-apis-oauth2-client-credential-flow.aspx
- https://azure.microsoft.com/en-us/documentation/articles/active-directory-authentication-scenarios
- https://azure.microsoft.com/en-us/documentation/articles/active-directory-integrating-applications
- https://azure.microsoft.com/en-us/documentation/articles/active-directory-application-manifest

Policy Set Example for Microsoft SCCM

The following new dictionary entries can be used in policies to support SCCM.

- MDM.DaysSinceLastCheckin - Number of days since a user last checked in or synched a device with SCCM, from 1 to 365 days.
- MDM.UserNotified - Values are Y or N. Indicates whether the user was notified that they are not registered. You can then allow limited access and redirect to registration portal, or deny access.
- MDM.ServerType - Values are MDM for Mobile Device Manager or DM for Desktop Device Manager.

The following example Policy Set shows a set of policies to support SCCM:

Policy Name	If	Then
SCCM_Comp	Wireless_802.1X AND MDM:MDMServerName EQUALS SccmServer1 AND MDM:DeviceRegisterStatus EQUALS Registered	PermitAccess

Policy Name	If	Then
SCCM_NonComp_Notify	Wireless_802.1X AND MDM:MDMServerName EQUALS SccmServer1 AND MDM:DeviceCompliantStatus EQUALS NonCompliant AND MDM:UserNotified EQUALS 28	PermitAccess
SCCM_NonComp_Days	Wireless_802.1X AND MDM:MDMServerName EQUALS SccmServer1 AND MDM:MDMDeviceCompliantStatus EQUALS Registered AND MDM:DaysSinceLastCheckin EQUALS 28	SCCMRedirect
SCCM_NonComp	Wireless_802.1X AND MDM:MDMServerName EQUALS SccmServer1 AND MDM:DeviceCompliantStatus EQUALS NonCompliant AND MDM:DeviceRegisterStatus EQUALS Registered	SCCMRedirect
SCCM_UnReg_Notify	Wireless_802.1X AND MDM:DeviceRegisterStatus EQUALS Registered AND MDM:UserNotified EQUALS Yes	PermitAccess

Configure the Microsoft SCCM Server for ISE

ISE communicates with the SCCM server using WMI. WMI must be configured on the Windows server running SCCM.

Note The user account that you use for ISE integration must either:

- Be a member of SMS Admins user group.
- Have the same permissions as the SMS object under the WMI namespace

  `root\sms\site_<sitecode>`

  where *sitecode* is the SCCM site.

Set Permissions When AD User in the Domain Admin Group

For Windows 2008 R2,Windows 2012, and Windows 2012 R2, the Domain Admin group does not have full control on certain registry keys in the Windows operating system by default. The Active Directory admin must give the Active Directory user Full Control permissions on the following registry keys:

- **HKEY_CLASSES_ROOT\CLSID\{76A64158-CB41-11D1-8B02-00600806D9B6}**
- **HKLM\Software\Classes\Wow6432Node\CLSID\{76A64158-CB41-11D1-8B02-00600806D9B6}**

No registry changes are required for the following Active Directory versions:

- Windows 2003
- Windows 2003R2
- Windows 2008

To grant full control, the Active Directory admin must first take ownership of the key, as shown below.

Procedure

Step 1 Go to the Owner tab by right clicking the key.

Step 2 Click **Permissions**.

Step 3 Click **Advanced**.

Required Permissions when AD User not in Domain Admin Group

For Windows 2012 R2, give the Active Directory user **Full Control** permissions on the following registry keys:

- `HKEY_CLASSES_ROOT\CLSID\{76A64158-CB41-11D1-8B02-00600806D9B6}`
- `HKLM\Software\Classes\Wow6432Node\CLSID\{76A64158-CB41-11D1-8B02-00600806D9B6}`

The following permissions also are required when an Active Directory user is not in the Domain Admin group, but is in the Domain Users group:

- Add Registry Keys to Allow ISE to Connect to the Domain Controller (see below)
- Permissions to Use DCOM on the Domain Controller, on page 44
- Set Permissions for Access to WMI Root/CIMv2 Name Space, on page 46

These permissions are only required for the following Active Directory versions:

- Windows 2003
- Windows 2003R2
- Windows 2008
- Windows 2008 R2
- Windows 2012

- Windows 2012 R2
- Windows 2016

Add Registry Keys to Allow ISE to Connect to the Domain Controller

You must manually add some registry keys to the domain controller to allow ISE to connect as a Domain User, and retrieve login authentication events. An agent is not required on the domain controllers or on any machine in the domain.

The following registry script shows the keys to add. You can copy and paste this into a text file, save the file with a .reg extension, and double click the file to make the registry changes. To add registry keys, the user must be an owner of the root key.

```
Windows Registry Editor Version 5.00

[HKEY_CLASSES_ROOT\CLSID\{76A64158-CB41-11D1-8B02-00600806D9B6}]
"AppID"="{76A64158-CB41-11D1-8B02-00600806D9B6}"

[HKEY_CLASSES_ROOT\AppID\{76A64158-CB41-11D1-8B02-00600806D9B6}]
"DllSurrogate"="  "

[HKEY_CLASSES_ROOT\Wow6432Node\AppID\{76A64158-CB41-11D1-8B02-00600806D9B6}]
"DllSurrogate"="  "
```

Make sure that you include two spaces in the value of the key **DllSurrogate**.

Keep the empty lines as shown in the script above, including an empty line at the end of the file.

Permissions to Use DCOM on the Domain Controller

The Active Directory user used for ISE Passive Identity services must have permissions to use DCOM (remote COM) on the Domain Controller. You can configure permissions with the **dcomcnfg** command line tool.

Procedure

Step 1 Run the **dcomcnfg** tool from the command line.

Step 2 Expand `Component Services`.

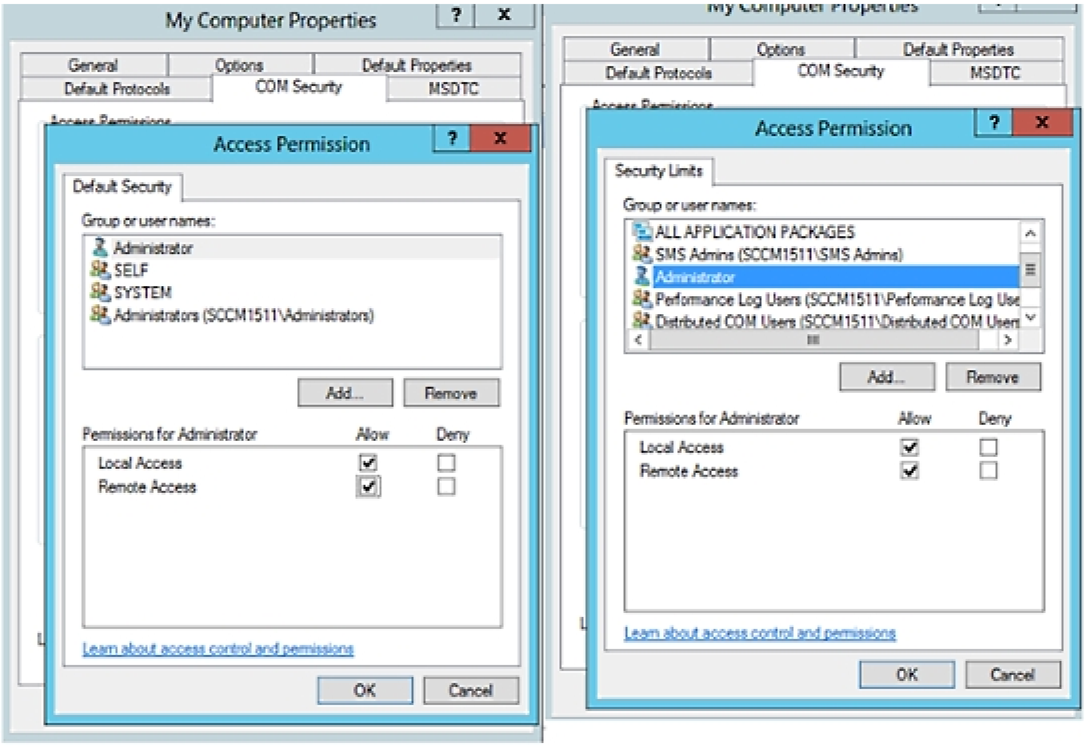
Step 3 Expand **Computers** > **My Computer**.

Step 4 Select Action from the menu bar, click **properties**, and click **COM Security**.

Step 5 Make sure that the account that ISE will use for both Access and Launch has Allow permissions. That Active Directory user should be added to all the four options (Edit Limits and Edit Default for both Access Permissions and Launch and Activation Permissions).

Step 6 Allow all Local and Remote access for both Access Permissions and Launch and Activation Permissions.

Figure 5: Local and Remote Access for Access Permissions



Access Permission — Default Security

Group or user names:

- Administrator
- SELF
- SYSTEM
- Administrators (SCCM1511\Administrators)

Permissions for Administrator	Allow	Deny
Local Access	☑	☐
Remote Access	☑	☐

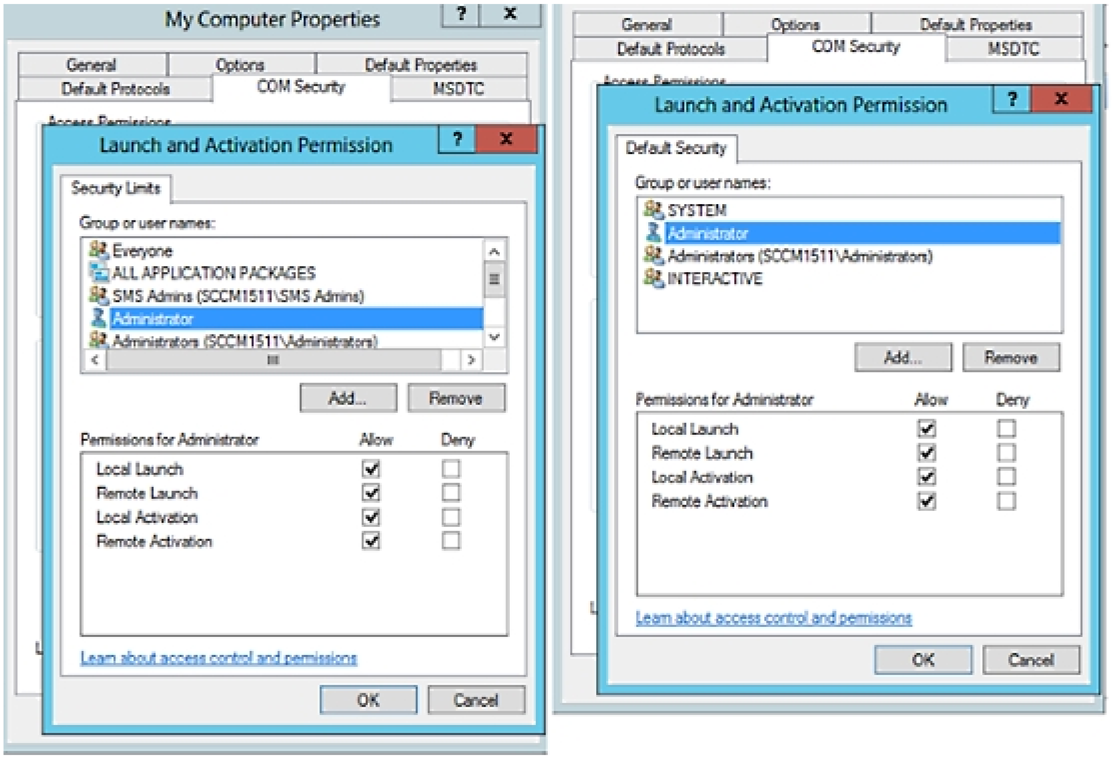
Access Permission — Security Limits

Group or user names:

- ALL APPLICATION PACKAGES
- SMS Admins (SCCM1511\SMS Admins)
- Administrator
- Performance Log Users (SCCM1511\Performance Log Use
- Distributed COM Users (SCCM1511\Distributed COM Users

Permissions for Administrator	Allow	Deny
Local Access	☑	☐
Remote Access	☑	☐

Figure 6: Local and Remote Access for Launch and Activation Permissions



Group or user names:

- Everyone
- ALL APPLICATION PACKAGES
- SMS Admins (SCCM1511\SMS Admins)
- Administrator
- Administrators (SCCM1511\Administrators)

Permissions for Administrator	Allow	Deny
Local Launch	☑	□
Remote Launch	☑	□
Local Activation	☑	□
Remote Activation	☑	□

Group or user names:

- SYSTEM
- Administrator
- Administrators (SCCM1511\Administrators)
- INTERACTIVE

Permissions for Administrator	Allow	Deny
Local Launch	☑	□
Remote Launch	☑	□
Local Activation	☑	□
Remote Activation	☑	□

Set Permissions for Access to WMI Root/CIMv2 Name Space

By default, Active Directory users do not have permissions for the Execute Methods and Remote Enable. You can grant access using the wmimgmt.msc MMC console.

Procedure

Step 1 Click Start > Run and type `wmimgmt.msc`.

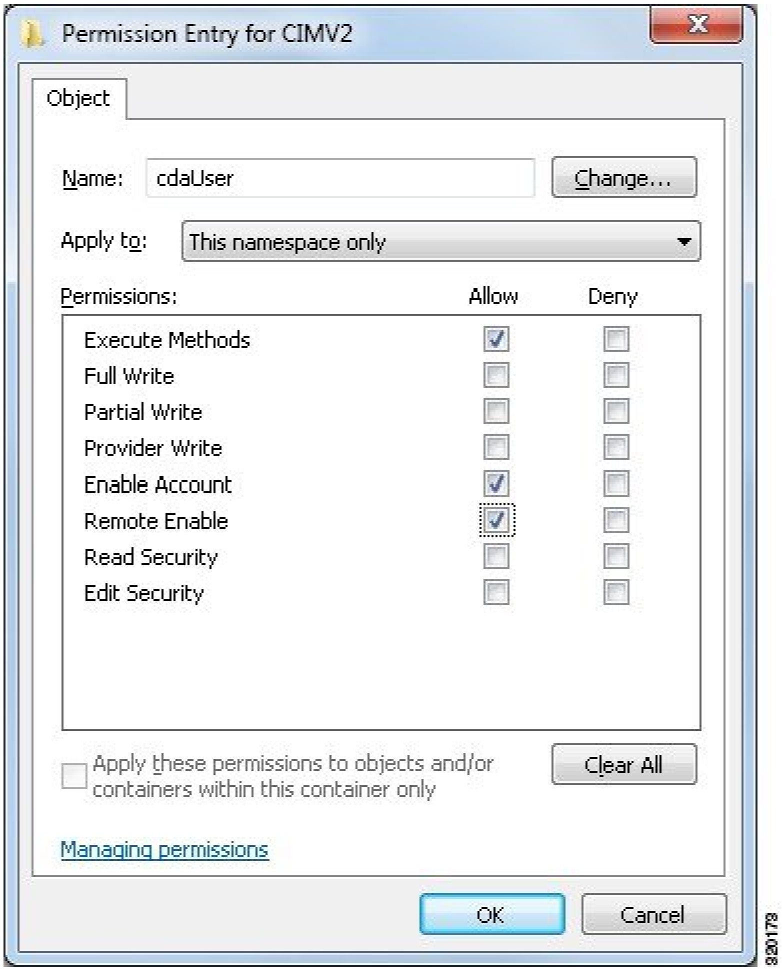
Step 2 Right-click WMI Control and click **Properties**.

Step 3 Under the Security tab, expand Root and choose **CIMV2**.

Step 4 Click **Security**.

Step 5 Add the Active Directory user, and configure the required permissions as shown below.

Figure 7: Required Permissions for WMI Root\CIMv2 Name Space



Permission Entry for CIMV2

Object

Name: cdaUser

Apply to: This namespace only

Permissions:	Allow	Deny
Execute Methods	☑	□
Full Write	□	□
Partial Write	□	□
Provider Write	□	□
Enable Account	☑	□
Remote Enable	☑	□
Read Security	□	□
Edit Security	□	□

□ Apply these permissions to objects and/or containers within this container only

Open Firewall Ports for WMI Access

The firewall software on the Active Directory Domain Controller may block access to WMI. You can either turn the firewall off, or allow access on a specific IP (ISE IP address) to the following ports:

- TCP 135: General RPC Port. When doing asynchronous RPC calls, the service listening on this port tells the client which port the component servicing this request is using.
- UDP 138: Netbios Datagram Service
- TCP 139: Netbios Session Service
- TCP 445: SMB

Note Cisco ISE 1.3 and above support SMB 2.0.

Higher ports are assigned dynamically or you can configure them manually. We recommend that you add %SystemRoot%\System32\dllhost.exe as a target. This program manages ports dynamically.

All firewall rules can be assigned to specific IP (ISE IP).

Configure an Authorization Profile for Redirecting Nonregistered Devices

You must configure an authorization profile in Cisco ISE to redirect nonregistered devices for each external MDM server.

Before you begin

- Ensure that you have created an MDM server definition in Cisco ISE. Only after you successfully integrate ISE with the MDM server does the MDM dictionary gets populated and you can create authorization policy using the MDM dictionary attributes.
- Configure ACLs on the Wireless LAN Controller for redirecting unregistered devices.
- If you are using a proxy for the internet connection and MDM server is part of internal network then you have to put the MDM server name or its IP address in the Proxy-Bypass list. Choose **Administration** > **Settings** > **Proxy Settings** to perform this action.

Procedure

Step 1 Choose **Policy** > **Policy Elements** > **Results** > **Authorization** > **Authorization Profiles** > **Add**.

Step 2 Create an authorization profile for redirecting nonregistered devices that are not compliant or registered.

Step 3 Enter a name for the authorization profile that matches the MDM server name.

Step 4 Choose ACCESS_ACCEPT as the Access Type.

Step 5 Check the **Web Redirection** check box and choose MDM Redirect from the drop-down list.

Step 6 Enter the name of the ACL that you configured on the wireless LAN controller in the ACL field.

Step 7 Select the MDM portal from the **Value** drop-down list.

Step 8 Select the MDM server you want to use from the drop-down list.

Step 9 Click **Submit**.

What to do next

Configure Authorization Policy Rules for the MDM Use Cases.

Configure Authorization Policy Rules for the MDM Use Cases

You must configure authorization policy rules in Cisco ISE to complete the MDM configuration.

Before you begin

- Add the MDM server certificate to the Cisco ISE certificate store.
- Ensure that you have created the MDM server definition in Cisco ISE. Only after you successfully integrate ISE with the MDM server, the MDM dictionary gets populated and you can create authorization policy using the MDM dictionary attributes.
- Configure ACLs on the Wireless LAN Controller for redirecting unregistered or noncompliant devices.

Procedure

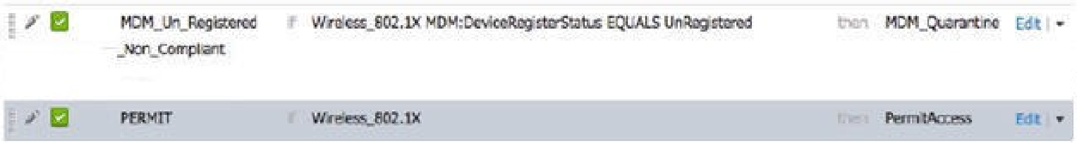
Step 1 Choose **Policy** > **Policy Sets**, and expand the policy set to view the authorization policy rules.

Step 2 Add the following rules:

- MDM_Un_Registered_Non_Compliant—For devices that are not yet registered with an MDM server or compliant with MDM policies. Once a request matches this rule, the ISE MDM page appears with information on registering the device with MDM.
- PERMIT—If the device is registered with Cisco ISE, registered with MDM, and is compliant with Cisco ISE and MDM policies, it will be granted access to the network based on the access control policies configured in Cisco ISE.

The following illustration shows an example of this configuration.

Figure 8: Authorization Policy Rules for the MDM Use Cases



MDM_Un_Registered_Non_Compliant	if	Wireless_802.1X MDM:DeviceRegisterStatus EQUALS UnRegistered	then	MDM_Quarantine	Edit
PERMIT	if	Wireless_802.1X	then	PermitAccess	Edit

Step 3 Click **Save**.

Wipe or Lock a Device

Cisco ISE allows you to wipe or turn on pin lock for a device that is lost. You can do this from the Endpoints page.

Procedure

Step 1 Choose **Work Centers** > **Network Access** > **Identities** > **Endpoints**.

Step 2 Check the check box next to the device that you want to wipe or lock.

Step 3 From the MDM Access drop-down list, choose any one of the following options:

- Full Wipe—Depending on the MDM vendor, this option either removes the corporate apps or resets the device to the factory settings.
- Corporate Wipe—Removes applications that you have configured in the MDM server policies
- PIN Lock—Locks the device

Step 4 Click **Yes** to wipe or lock the device.

View Mobile Device Manager Reports

Cisco ISE records all additions, updates, and deletions of MDM server definitions. You can view these event in the “Change Configuration Audit” report, which provides all the configuration changes from any system administrator for a selected time period.

Choose **Operations** > **Reports** > **Change Configuration Audit** > **MDM**, and specify the period of time to display in the resulting report.

View Mobile Device Manager Logs

You can use the Message Catalog page to view Mobile Device Manager log messages. Choose **Administration** > **System** > **Logging** > **Message Catalog**. The default reporting level for MDM log entries is "INFO." You can change the reporting level to "DEBUG" or "TRACE."

Mobile Device Manager Interoperability with Cisco ISE

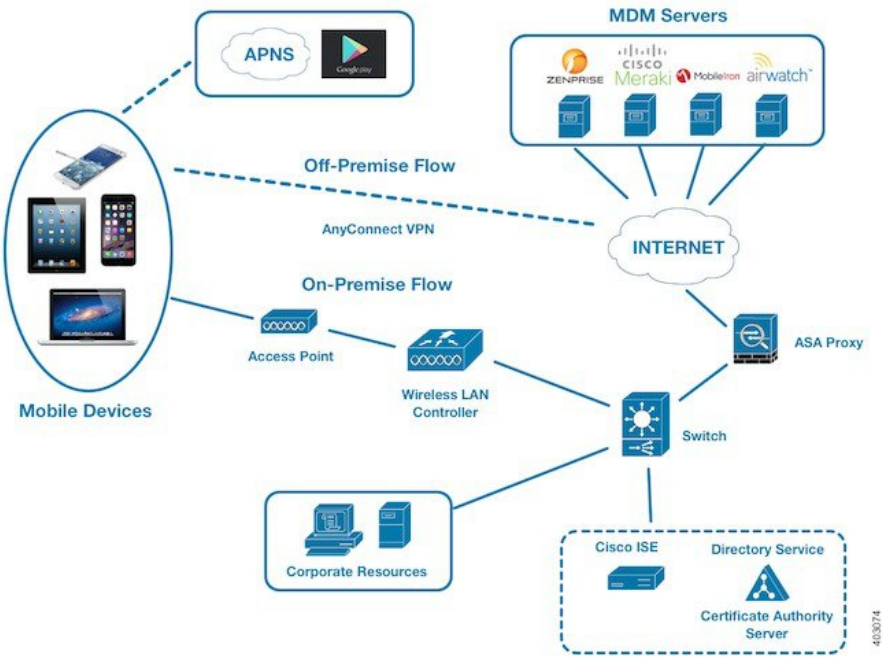
Mobile Device Management (MDM) servers secure, monitor, manage, and support mobile devices deployed across mobile operators, service providers, and enterprises. MDM servers act as a policy server that controls the use of some applications on a mobile device (for example, an e-mail application) in the deployed environment. However, the network is the only entity that can provide granular access to endpoints based on ACLs. Cisco ISE queries the MDM servers for the necessary device attributes to create ACLs that provide network access control for those devices.

You can run multiple active MDM servers on your network, including ones from different vendors. This allows you to route different endpoints to different MDM servers based on device factors such as location or device type.

Cisco ISE also integrates with MDM servers using Cisco's MDM API version 2 to allow devices access the network over VPN via AnyConnect 4.1 and Cisco ASA 9.3.2 or later.

In this illustration, Cisco ISE is the enforcement point and the MDM policy server is the policy information point. Cisco ISE obtains data from the MDM server to provide a complete solution.

Figure 9: MDM Interoperability with Cisco ISE



You can configure Cisco ISE to interoperate with one or more external Mobile Device Manager (MDM) servers. By setting up this type of third-party connection, you can leverage the detailed information available in the MDM database. Cisco ISE uses REST API calls to retrieve information from the external MDM server. Cisco ISE applies appropriate access control policies to switches, access routers, wireless access points, and other network access points to achieve greater control of remote device access to your Cisco ISE network.

The supported MDM vendors are listed here: Supported MDM Servers, on page 32.

Supported MDM Use Cases

The functions Cisco ISE performs with the external MDM server are as follows:

- Managing device registration—Unregistered endpoints accessing the network are redirected to a registration page, which is hosted on the MDM server. Device registration includes user role, device type, and so on.
- Handling device remediation—Endpoints are granted only restricted access during remediation.
- Augmenting endpoint data—Update the endpoint database with information from the MDM server that you cannot gather using the Cisco ISE Profiler. Cisco ISE uses six device attributes you can view using the **Work Centers** > **Network Access** > **Identities** > **Endpoints** page if an endpoint is an MDM monitored device. For example:
  - MDMImei: 99 000100 160803 3
  - MDMManufacturer: Apple
  - MDMModel: iPhone
  - MDMOSVersion: iOS 6.0.0
  - MDMPhoneNumber: 9783148806

  - MDMSerialNumber: DNPGQZGUDTF9

- Cisco ISE polls the MDM server once every 4 hours for device compliance data. This is configurable by the administrator.
- Issuing device instructions through the MDM server—Issues remote actions for users' devices through the MDM server. Administrators initiate remote actions from the ISE console.

Vendor MDM Attributes

When you configure an MDM server in ISE, that vendor's attributes are added to a new entry in the ISE system dictionary, named **mdm**. The following attributes are used for registration status, and are commonly supported by MDM vendors.

- DeviceRegisterStatus
- DeviceCompliantStatus
- DiskEncryptionStatus
- PinLockStatus
- JailBrokenStatus
- Manufacturer
- IMEI
- SerialNumber
- OsVersion
- PhoneNumber
- MDMServerName
- MDMServerReachable
- MEID
- Model
- UDID

Vendor's unique attributes are not supported, but you may be able to use ERS APIs to exchange vendor-specific attributes, if the vendor supports that.

The new MDM dictionary attributes are available to use in authorization policies.

Supported MDM Servers

Supported MDM servers include products from the following vendors:

- Absolute
- AirWatch
- Citrix XenMobile

- Globo
- Good Technology
- IBM MaaS360
- JAMF Software
- Meraki SM/EMM
- MobileIron
- SAP Afaria
- SOTI
- Symantec
- Tangoe
- Microsoft Intune - for mobile devices
- Microsoft SCCM - for desktop devices

ISE Community Resource

How To: Meraki EMM / MDM Integration with ISE

Ports Used by the MDM Server

The following table lists the ports that must be open between the Cisco ISE and the MDM server to enable them to communicate with each other. Refer to the MDM Server Documentation for a list of ports that must be open on the MDM agent and server.

Table 7: Ports Used by the MDM Server

MDM Server	Ports
MobileIron	443
Zenprise	443
Good	19005
Airwatch	443
Afaria	443
Fiberlink MaaS	443
Meraki	443
Microsoft Intune	80 and 443
Microsoft SCCM	80 and 443

MDM Integration Process Flow

This section describes the MDM integration process:

1. The user associates a device to SSID.

2. Cisco ISE makes an API call to the MDM server.

3. This API call returns a list of devices for this user and the posture status for the devices.

Note The input parameter is the MAC address of the endpoint device. For off-premise Apple iOS devices (any device that connects to Cisco ISE through a VPN), this is the UDID.

4. If the user's device is not in this list, it means the device is not registered. Cisco ISE sends an authorization request to the NAD to redirect to Cisco ISE. The user is presented the MDM server page.

Note You must register a device that is enrolled on the MDM server outside of a Cisco ISE network via the MDM portal. This is applicable for Cisco ISE, Release 1.4 and later. Earlier ISE versions allow devices enrolled outside of a Cisco ISE network to be automatically enrolled if they are compliant with the posture policies.

5. Cisco ISE uses MDM to provision the device and presents an appropriate page for the user to register the device.

6. The user registers the device in the MDM server, and the MDM server redirects the request to Cisco ISE (through automatic redirection or manual browser refresh).

7. Cisco ISE queries the MDM server again for the posture status.

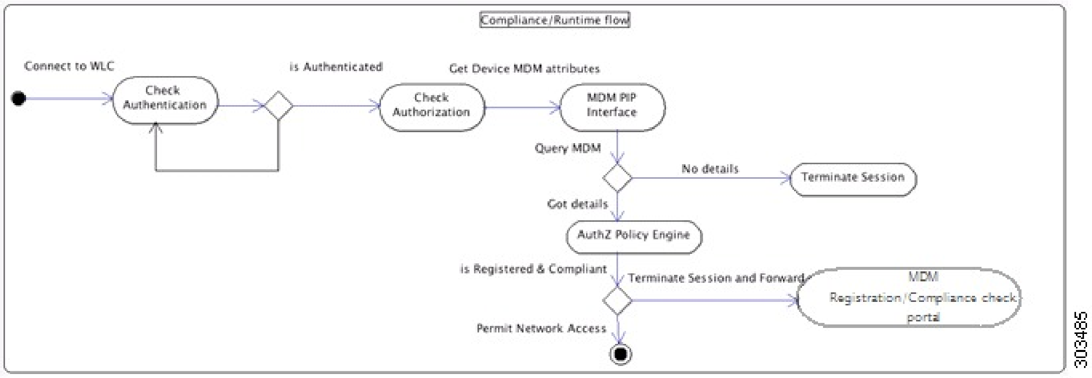
8. If the user's device is not compliant to the posture (compliance) policies configured on the MDM server, the user is notified that the device is out of compliance and must be compliant.

9. After the user's device becomes compliant, the MDM server updates the device state in its internal tables.

10. If the user refreshes the browser now, the control is transferred back to Cisco ISE.

11. Cisco ISE polls the MDM server once every four hours to get compliance information and issues Change of Authorization (CoA) appropriately. This can be configured by the administrator. Cisco ISE also checks the MDM server every 5 minutes to make sure that it is available.

The following figure illustrates the MDM process flow.



Note A device can only be enrolled to a single MDM server at a time. If you want to enroll the same device to an MDM service from another vendor, the previous vendor's profiles must be removed from the device. The MDM service usually offers a "corporate wipe", which only deletes the vendor's configuration from the device (not the whole device). The user can also remove the files. For example, on an IOS device, the user can go to Settings > General >Device management, and click remove management. Or the user can go to the MyDevices portal in ISE, and click corporate wipe.

Set Up MDM Servers with Cisco ISE

To set up MDM servers with Cisco ISE, you must perform the following high-level tasks:

Procedure

Step 1 Import MDM server certificate into Cisco ISE, except for Intune, where you import the PAN's certificate into Azure.

Step 2 Create mobile device manager definitions.

Step 3 Configure ACLs on the Wireless LAN Controllers.

Step 4 Configure an authorization profile that redirects non-registered devices to the MDM server.

Step 5 If there is more than one MDM server on the network, configure separate authorization profiles for each vendor.

Step 6 Configure authorization policy rules for the MDM use cases.

Import MDM Server Certificate into Cisco ISE

For Cisco ISE to connect with the MDM server, you must import the MDM server certificate into the Cisco ISE Certificate Store. If your MDM server has a CA-signed certificate, you must import the root CA into the Cisco ISE Certificate Store.

Note For Microsoft Azure, you import the ISE certificate into Azure. For more information, see Configuring Microsoft Intune as an MDM Server, on page 39.

Procedure

Step 1 Export the MDM server certificate from your MDM server and save it on your local machine.

Step 2 Choose **Administration** > **System** > **Certificates** > **Trusted Certificate** > **Import**.

Step 3 Click **Browse** to select the MDM server certificate that you obtained from the MDM server.

Step 4 Add a friendly name.

Step 5 Check **Trust for authentication within ISE** check box.

Step 6 Click **Submit**.

Step 7 Verify that the Certificate Store list page lists the MDM server certificate.

What to do next

Define Mobile Device Management Servers in ISE, on page 36

.

Define Mobile Device Management Servers in ISE

You can create one or more Mobile Device Management (MDM) and Desktop Device Manager (SCCM) definitions for external MDM servers.

1. Choose **Administration** > **Network Resources** > **External MDM**.

2. Click **Add**.

3. Enter the name and description of the MDM server that you want to add.

4. Choose the **Server Type**, Mobile Device Manager, or Desktop Device Manager. Your choice determines which fields you see next. If you chose Desktop Device Manager, go to Desktop Device Management, on page 58. If you chose Mobile Device Manager, then continue this list of steps.

5. Choose **Authentication Type**, Basic, or OAuth - Client Credentials. If you chose OAuth - Client credentials to configure a Microsoft Intune server, go to Mobile Device Management - OAuth - Client Credentials, on page 57. If you chose Basic, then continue this list of steps.

6. All screens ask for a name and describe this MDM server definition. The following section describes the additional fields and steps, which are based on server and authentication type.

Mobile Device Management - Basic

- **Host Name / IP Address**—Enter the hostname or IP address of the MDM server.

- **Port**—Enter the port to use when connecting to the MDM server, which is usually 443.

- **Instance Name** - If this MDM server has several instances, enter the instance that you want to connect to.
- **Polling Interval**—Enter the polling interval in minutes for Cisco ISE to poll the MDM server for compliance check information. Set this value to match the polling interval on your MDM server. The valid range is from 15 to 1440 minutes. The default value is 240 minutes. We recommend that you set the polling interval below 60 minutes only for testing a few active clients on your network. If you set this value below 60 minutes for a production environment with many active clients, the system's load increases significantly and may negatively affect performance.

  If you set the polling interval to 0, ISE disables communication with the MDM server.
- **Time Interval For Compliance Device ReAuth Query**—When the endpoint is authenticated or re-authenticated, ISE uses a cache to get the MDM variables for that endpoint. If the age of cached value is older than the value of Time Interval For Compliance Device ReAuth Query, then ISE makes a device query to the MDM server to get new values. If the compliance status changed, then ISE triggers a CoA.

  The valid range is from 1 to 1440 minutes. The default value is 1 minute.

Mobile Device Management - OAuth - Client Credentials

Using OAuth requires configuration of the OAuth server, which is described in Configuring Microsoft Intune as an MDM Server, on page 39

- **Auto Discovery URL**—Enter the value of *Microsoft Azure AD Graph API Endpoint* from the Microsoft Azure management portal. This URL is the endpoint at which an application can access directory data in your Microsoft Azure AD directory using the Graph API. The URL is of the form: `https://<hostname>/<tenant id>, for example, https://graph.ppe.windows.net/47f09275-5bc0-4807-8aae-f35cb0341329`. An expanded version of this URL is also in the property file, which is of the form: `https://<Graph_API_Endpoint>/<TenantId_Or_Domain>/servicePrincipalsByAppId/<Microsoft Intune AppId>/serviceEndpoints?api-version=1.6&client-request-id=<Guid.NewGuid()>.`
- **Client ID**—The unique identifier for your application. Use this attribute if your application accesses data in another application, such as the Microsoft Azure AD Graph API, Microsoft Intune API, and so on.
- **Token Issuing URL**—Enter the value of the *Oauth2.0 Authorization Endpoint* from the previous step. This is the endpoint at which your app can obtain an access token using OAuth2.0. After your app is authenticated, Microsoft Azure AD issues your app (ISE) an access token, which allows your app to call the Graph API/ Intune API.
- **Token Audience**—The recipient resource that the token is intended for, which is a public, well-known APP ID URL to the Microsoft Intune API.
- **Polling Interval**—Enter the polling interval in minutes for Cisco ISE to poll the MDM server for compliance check information. Set this value to match the polling interval on your MDM server. The valid range is from 15 to 1440 minutes. The default value is 240 minutes. We recommend that you set the polling interval below 60 minutes only for testing a few active clients on your network. If you set this value below 60 minutes for a production environment with many active clients, the system's load increases significantly and may negatively affect performance.

  If you set the polling interval to 0, ISE disables communication with the MDM server.
- **Time Interval For Compliance Device ReAuth Query**—When the endpoint is authenticated or re-authenticated, ISE uses a cache to get the MDM variables for that endpoint. If the age of cached value

is older than the value of Time Interval For Compliance Device ReAuth Query, then ISE makes a device query to the MDM server to get new values. If the compliance status changed, then ISE triggers a CoA.

The valid range is from 1 to 1440 minutes. The default value is 1 minute.

Desktop Device Management

The following settings require you to configure WMI on the SCCM server, so it can communicate with ISE. See Configure the Microsoft SCCM Server for ISE, on page 42 for more information.

- **Host Name / IP Address**—Enter the hostname or IP address of the MDM server.
- **Site or Instance Name**—Enter the site name, or if the MDM server has several instances, the instance name.

ISE MDM Support for Microsoft Intune and SCCM

- **Microsoft Intune**- MDM-ISE supports Microsoft's Intune device management as a partner MDM server managing mobile devices.

  You configure ISE as an OAuth 2.0 client application on the Intune server managing mobile devices. ISE gets a token from Azure to establish a session with that ISE Intune application.

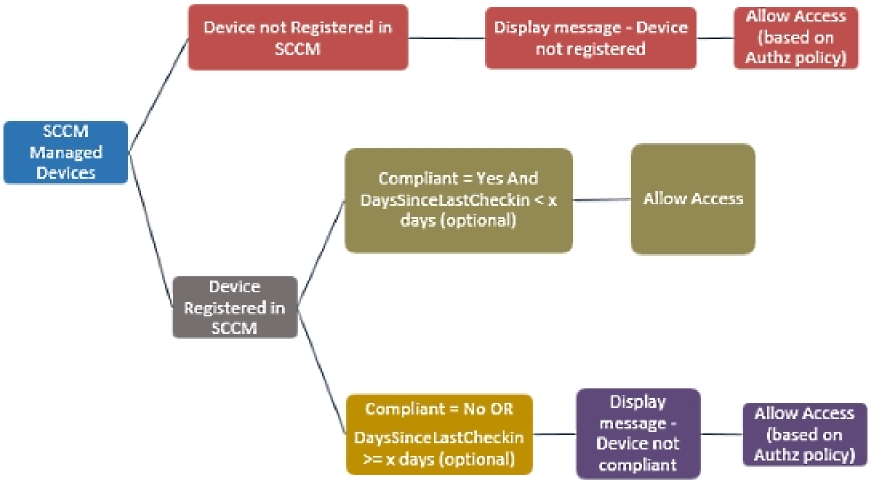
  See https://msdn.microsoft.com/en-us/library/azure/dn645543.aspx for more information about how Intune communicates with a client application.

- **Desktop Device Manager (Microsoft SCCM)** - ISE supports Microsoft's System Center Configuration Manager (SCCM) as a partner MDM server for managing Windows computers. ISE retrieves compliance information from the SCCM server using WMI, and uses that information to grant or deny network access to the user's Windows device.

SCCM Workflow

ISE is able to retrieve information from the SCCM server about whether a device is registered, and if it is registered, is it compliant. The following diagram shows the workflow for devices managed by SCCM.

Figure 10: SCCM Workflow


Device not Registered in SCCM
Display message - Device not registered
Allow Access (based on Authz policy)
SCCM Managed Devices
Compliant = Yes And DaysSinceLastCheckin < x days (optional)
Allow Access
Device Registered in SCCM
Compliant = No OR DaysSinceLastCheckin >= x days (optional)
Display message - Device not compliant
Allow Access (based on Authz policy)

When a device connects and a SCCM policy is matched, ISE queries the SCCM server specified in the authorization policy to retrieve compliance and last logon (check-in) time. With this information, ISE updates the compliance status and lastCheckinTimeStamp of the device in the Endpoint list.

If the device is not compliant or not registered with SCCM, and a redirect profile is used in the authorization policy, a message is displayed to the user that the device is not compliant or not registered with the SCCM. After the user acknowledges the message, ISE can issue a CoA to the SCCM registration site. Users can be granted access based on the authorization policy and profile.

Microsoft SCCM Server Connection Monitoring

Polling is not configurable for SCCM.

ISE runs an MDM HeartBeat job that verifies connection to the SCCM server, and raises alarms if ISE loses the connection to the SCCM server. The HeartBeat job interval is not configurable.

Configuring Microsoft Intune as an MDM Server

Configuring Microsoft Intune as an MDM server for ISE is slightly differently from configuring other MDM servers. Use the following steps to configure ISE's connection to Azure and Azure's connection to ISE.

1. Get the public certificate from the Intune/Azure Active Directory tenant, and import it into ISE to support SSL handshake.
   a. 1. Log on to the Intune Admin Console or Azure Admin console, whichever site has your tenant.
   b. Use the browser to get the certificate details. For, example, with Internet Explorer:
      1. Click on the lock symbol in the browers toolbar, then click View Certficates.
      2. In the Certificate window, select the tab Certification Path.
      3. Find Baltimore Cyber Trust root, and export the root cert.
   c. In ISE, choose **Administration** > **System** > **Certificates** > **Trusted Certificates**, and import the root certificate that you just saved. Give the certificate a meaningful name, such as Azure MDM.
2. Export the ISE self-signed certificate, and prepare it for InTune/Azure.
   a. On the PAN, navigate to **Administration** > **System** > **Certificates** > **System Certificates**, select the Default self-signed server certificate, and click Export.
   b. Select Export Certificate Only (default), and select a place to save it.

   Run the following PowerShell script on the exported certificate file:

```
$cer = New-Object System.Security.Cryptography.X509Certificates.X509Certificate2
$cer.Import(“mycer.cer”)
$bin = $cer.GetRawCertData()
$base64Value = [System.Convert]::ToBase64String($bin)

$bin = $cer.GetCertHash()
$base64Thumbprint = [System.Convert]::ToBase64String($bin)

$keyid = [System.Guid]::NewGuid().ToString()
```

   Keep the values for **$base64Thumbprint, $base64Value** and **$keyid**, which will be used in the next step.

3. Create an ISE application in Intune.
   a. Sign in to your customer domain on the Microsoft Azure management portal, navigate to **Directory** > **Applications** > **Add an Application**, and choose **Add an application my organization is developing**.
   b. Configure the ISE application in Azure with the following parameters:
      - **Application Name**— enter **`ISE`**.
      - Select **WEB APPLICATION AND/OR WEB APP**.
      - **SIGN-ON URL and APP ID URL**—Add any valid URL, these values are not used by ISE.

4. Get the manifest file from Azure, add the ISE certificate information, and upload the updated manifest into Azure.
   a. On the Microsoft Azure management portal ((https://manage.windowsazure.com), open the AAD snap-in, and navigate to the ISE application.

   Download the application manifest file from the **Manage Manifest** menu.

5. Update the **keyCredentials** field in Manifest json file as shown in the following example, replacing *Base64 Encoded String of ISE PAN cert* with the exported, edited, certificate file from ISE, which is the $base64Value from the PowerShell script:

```
"keyCredentials": [
                                {
                                  "customKeyIdentifier": "$base64Thumbprint_from_above",
                                  "keyId": "$keyid_from_above",
                                  "type": "AsymmetricX509Cert",
                                  "usage": "Verify",
                                  "value": "Base64 Encoded String of ISE PAN cert"
                                }
                             ]
```

Note Do not change the name of the manifest file.

   The KeyCredentials complex type is documented here: http://msdn.microsoft.com/en-us/library/azure/dn151681.aspx.

6. Upload the updated manifest file to Azure.

7. On the Microsoft Azure management portal, navigate to the list of App Endpoints. You will use the values of following endpoint attributes to configure ISE:
   - MICROSOFT AZURE AD GRAPH API ENDPOINT
   - OAUTH 2.0 TOKEN ENDPOINT

8. In ISE, configure the Intune server in ISE. For more information about configuring and external MDM server, see Define Mobile Device Management Servers in ISE, on page 36. The fields that are important for Intune are described below:
   - **Auto Discovery URL**—Enter the value of *Microsoft Azure AD Graph API Endpoint* from the Microsoft Azure management portal. This URL is the endpoint at which an application can access directory data in your Microsoft Azure AD directory using the Graph API. The URL is of the form:

`https://<hostname>/<tenant id>, for example, https://graph.ppe.windows.net/47f09275-5bc0-4807-8aae-f35cb0341329`. An expanded version of this URL is also in the property file, which is of the form: `https://<Graph_API_Endpoint>/<TenantId_Or_Domain>/servicePrincipalsByAppId/<Microsoft Intune AppId>/serviceEndpoints?api-version=1.6&client-request-id=<Guid.NewGuid()>`.

- **Client ID**—The unique identifier for your application. Use this attribute if your application accesses data in another application, such as the Microsoft Azure AD Graph API, Microsoft Intune API, and so on.
- **Token Issuing URL**—Enter the value of the *Oauth2.0 Authorization Endpoint* from the previous step. This is the endpoint at which your app can obtain an access token using OAuth2.0. After your app is authenticated, Microsoft Azure AD issues your app (ISE) an access token, which allows your app to call the Graph API/ Intune API.
- **Token Audience**—The recipient resource that the token is intended for, which is a public, well-known APP ID URL to the Microsoft Intune API.

For more information about Intune applications, see the following links:

- https://msdn.microsoft.com/en-us/library/azure/dn645543.aspx
- http://blogs.msdn.com/b/exchangedev/archive/2015/01/22/building-demon-or-service-apps-with-office-365-mail-calendar-and-contacts-apis-oauth2-client-credential-flow.aspx
- https://azure.microsoft.com/en-us/documentation/articles/active-directory-authentication-scenarios
- https://azure.microsoft.com/en-us/documentation/articles/active-directory-integrating-applications
- https://azure.microsoft.com/en-us/documentation/articles/active-directory-application-manifest

Policy Set Example for Microsoft SCCM

The following new dictionary entries can be used in policies to support SCCM.

- MDM.DaysSinceLastCheckin - Number of days since a user last checked in or synched a device with SCCM, from 1 to 365 days.
- MDM.UserNotified - Values are Y or N. Indicates whether the user was notified that they are not registered. You can then allow limited access and redirect to registration portal, or deny access.
- MDM.ServerType - Values are MDM for Mobile Device Manager or DM for Desktop Device Manager.

The following example Policy Set shows a set of policies to support SCCM:

Policy Name	If	Then
SCCM_Comp	Wireless_802.1X AND MDM:MDMServerName EQUALS SccmServer1 AND MDM:DeviceRegisterStatus EQUALS Registered	PermitAccess

Policy Name	If	Then
SCCM_NonComp_Notify	Wireless_802.1X AND MDM:MDMServerName EQUALS SccmServer1 AND MDM:DeviceCompliantStatus EQUALS NonCompliant AND MDM:UserNotified EQUALS 28	PermitAccess
SCCM_NonComp_Days	Wireless_802.1X AND MDM:MDMServerName EQUALS SccmServer1 AND MDM:MDMDeviceCompliantStatus EQUALS Registered AND MDM:DaysSinceLastCheckin EQUALS 28	SCCMRedirect
SCCM_NonComp	Wireless_802.1X AND MDM:MDMServerName EQUALS SccmServer1 AND MDM:DeviceCompliantStatus EQUALS NonCompliant AND MDM:DeviceRegisterStatus EQUALS Registered	SCCMRedirect
SCCM_UnReg_Notify	Wireless_802.1X AND MDM:DeviceRegisterStatus EQUALS Registered AND MDM:UserNotified EQUALS Yes	PermitAccess

Configure the Microsoft SCCM Server for ISE

ISE communicates with the SCCM server using WMI. WMI must be configured on the Windows server running SCCM.

Note The user account that you use for ISE integration must either:

- Be a member of SMS Admins user group.
- Have the same permissions as the SMS object under the WMI namespace

  ```
  root\sms\site_<sitecode>
  ```

  where *sitecode* is the SCCM site.

Set Permissions When AD User in the Domain Admin Group

For Windows 2008 R2,Windows 2012, and Windows 2012 R2, the Domain Admin group does not have full control on certain registry keys in the Windows operating system by default. The Active Directory admin must give the Active Directory user Full Control permissions on the following registry keys:

- **HKEY_CLASSES_ROOT\CLSID\{76A64158-CB41-11D1-8B02-00600806D9B6}**
- **HKLM\Software\Classes\Wow6432Node\CLSID\{76A64158-CB41-11D1-8B02-00600806D9B6}**

No registry changes are required for the following Active Directory versions:

- Windows 2003
- Windows 2003R2
- Windows 2008

To grant full control, the Active Directory admin must first take ownership of the key, as shown below.

Procedure

Step 1 Go to the Owner tab by right clicking the key.

Step 2 Click **Permissions**.

Step 3 Click **Advanced**.

Required Permissions when AD User not in Domain Admin Group

For Windows 2012 R2, give the Active Directory user **Full Control** permissions on the following registry keys:

- `HKEY_CLASSES_ROOT\CLSID\{76A64158-CB41-11D1-8B02-00600806D9B6}`
- `HKLM\Software\Classes\Wow6432Node\CLSID\{76A64158-CB41-11D1-8B02-00600806D9B6}`

The following permissions also are required when an Active Directory user is not in the Domain Admin group, but is in the Domain Users group:

- Add Registry Keys to Allow ISE to Connect to the Domain Controller (see below)
- Permissions to Use DCOM on the Domain Controller, on page 44
- Set Permissions for Access to WMI Root/CIMv2 Name Space, on page 46

These permissions are only required for the following Active Directory versions:

- Windows 2003
- Windows 2003R2
- Windows 2008
- Windows 2008 R2
- Windows 2012

- Windows 2012 R2
- Windows 2016

Add Registry Keys to Allow ISE to Connect to the Domain Controller

You must manually add some registry keys to the domain controller to allow ISE to connect as a Domain User, and retrieve login authentication events. An agent is not required on the domain controllers or on any machine in the domain.

The following registry script shows the keys to add. You can copy and paste this into a text file, save the file with a .reg extension, and double click the file to make the registry changes. To add registry keys, the user must be an owner of the root key.

```
Windows Registry Editor Version 5.00

[HKEY_CLASSES_ROOT\CLSID\{76A64158-CB41-11D1-8B02-00600806D9B6}]
"AppID"="{76A64158-CB41-11D1-8B02-00600806D9B6}"

[HKEY_CLASSES_ROOT\AppID\{76A64158-CB41-11D1-8B02-00600806D9B6}]
"DllSurrogate"="  "

[HKEY_CLASSES_ROOT\Wow6432Node\AppID\{76A64158-CB41-11D1-8B02-00600806D9B6}]
"DllSurrogate"="  "
```

Make sure that you include two spaces in the value of the key **DllSurrogate**.

Keep the empty lines as shown in the script above, including an empty line at the end of the file.

Permissions to Use DCOM on the Domain Controller

The Active Directory user used for ISE Passive Identity services must have permissions to use DCOM (remote COM) on the Domain Controller. You can configure permissions with the **dcomcnfg** command line tool.

Procedure

Step 1 Run the **dcomcnfg** tool from the command line.

Step 2 Expand **`Component Services`**.

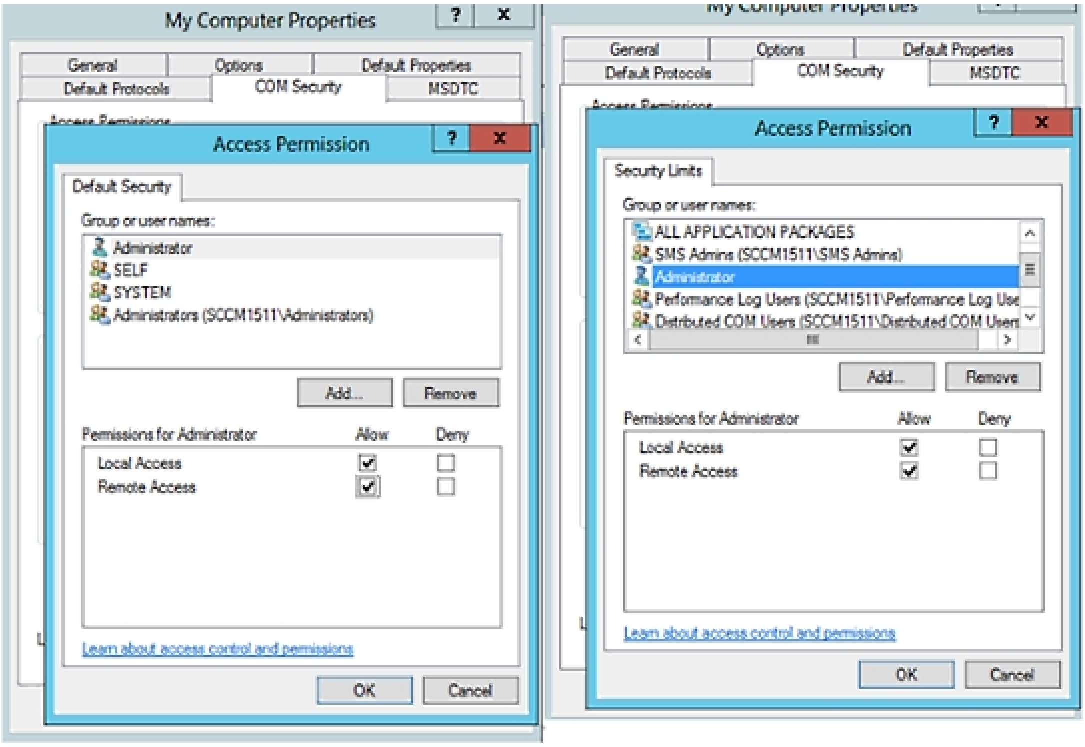
Step 3 Expand **Computers** > **My Computer**.

Step 4 Select Action from the menu bar, click **properties**, and click **COM Security**.

Step 5 Make sure that the account that ISE will use for both Access and Launch has Allow permissions. That Active Directory user should be added to all the four options (Edit Limits and Edit Default for both Access Permissions and Launch and Activation Permissions).

Step 6 Allow all Local and Remote access for both Access Permissions and Launch and Activation Permissions.

Figure 11: Local and Remote Access for Access Permissions



Access Permission — Default Security

Group or user names:

- Administrator
- SELF
- SYSTEM
- Administrators (SCCM1511\Administrators)

Permissions for Administrator	Allow	Deny
Local Access	☑	□
Remote Access	☑	□

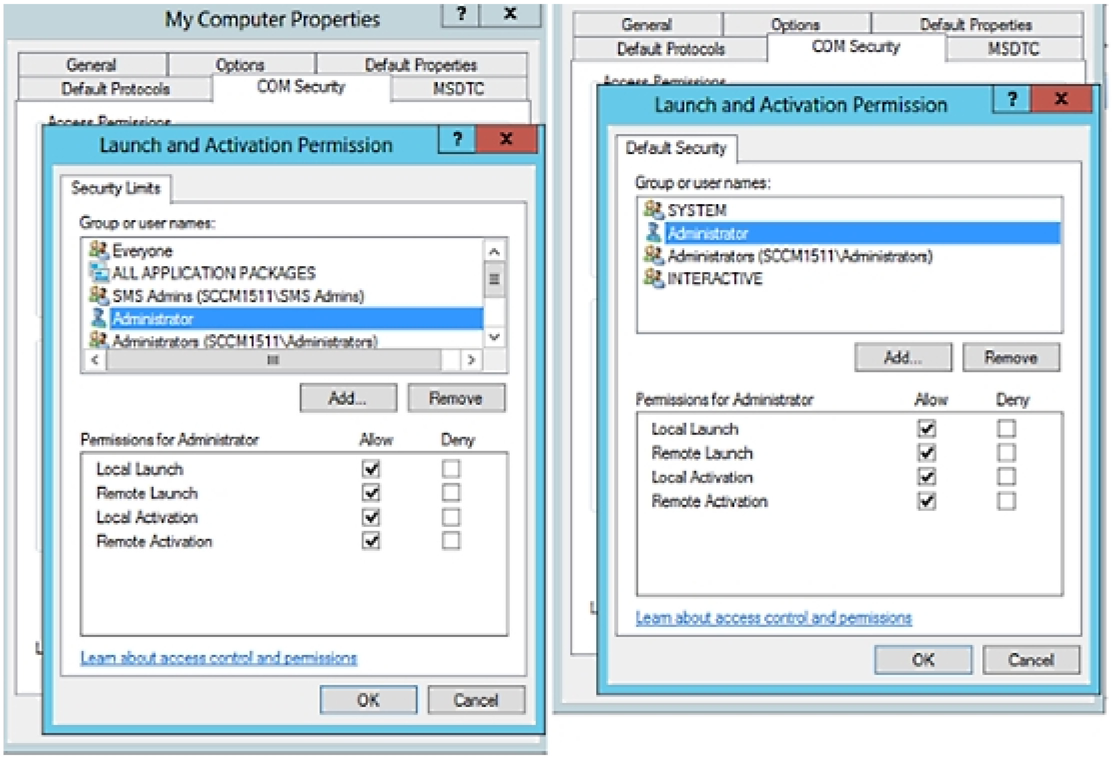
Access Permission — Security Limits

Group or user names:

- ALL APPLICATION PACKAGES
- SMS Admins (SCCM1511\SMS Admins)
- Administrator
- Performance Log Users (SCCM1511\Performance Log Use
- Distributed COM Users (SCCM1511\Distributed COM Users

Permissions for Administrator	Allow	Deny
Local Access	☑	□
Remote Access	☑	□

Figure 12: Local and Remote Access for Launch and Activation Permissions



Security Limits — Group or user names:

- Everyone
- ALL APPLICATION PACKAGES
- SMS Admins (SCCM1511\SMS Admins)
- Administrator
- Administrators (SCCM1511\Administrators)

Permissions for Administrator	Allow	Deny
Local Launch	☑	□
Remote Launch	☑	□
Local Activation	☑	□
Remote Activation	☑	□

Default Security — Group or user names:

- SYSTEM
- Administrator
- Administrators (SCCM1511\Administrators)
- INTERACTIVE

Permissions for Administrator	Allow	Deny
Local Launch	☑	□
Remote Launch	☑	□
Local Activation	☑	□
Remote Activation	☑	□

Set Permissions for Access to WMI Root/CIMv2 Name Space

By default, Active Directory users do not have permissions for the Execute Methods and Remote Enable. You can grant access using the wmimgmt.msc MMC console.

Procedure

Step 1 Click Start > Run and type `wmimgmt.msc`.

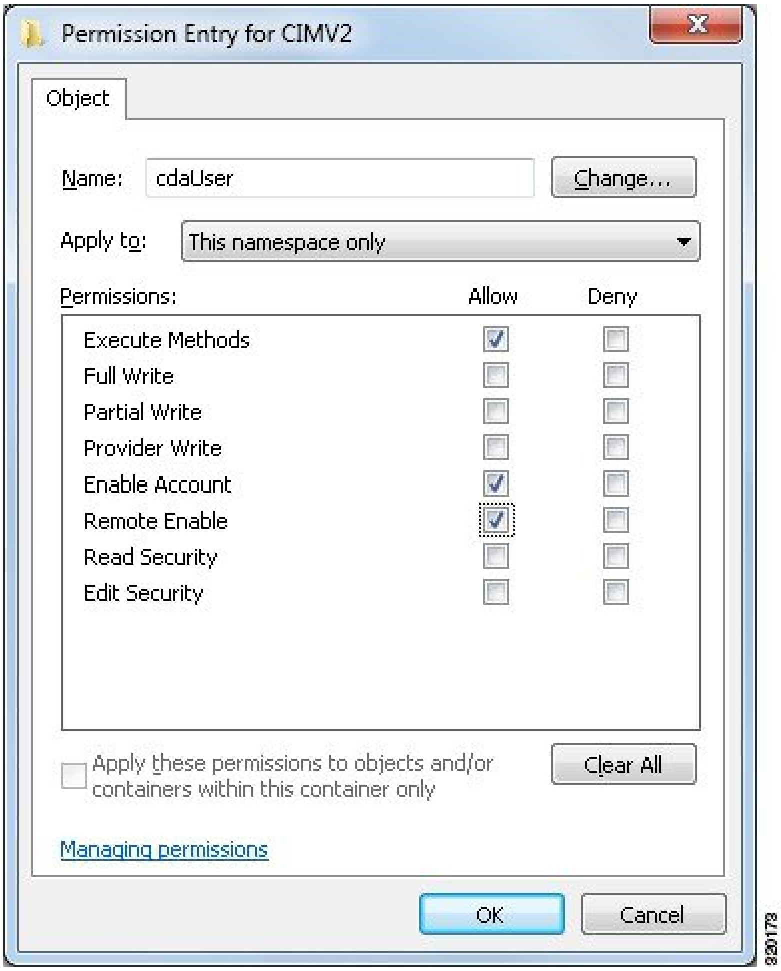
Step 2 Right-click WMI Control and click **Properties**.

Step 3 Under the Security tab, expand Root and choose **CIMV2**.

Step 4 Click **Security**.

Step 5 Add the Active Directory user, and configure the required permissions as shown below.

Figure 13: Required Permissions for WMI Root\CIMv2 Name Space



Permission Entry for CIMV2

Object

Name: cdaUser

Apply to: This namespace only

Permissions:	Allow	Deny
Execute Methods	☑	□
Full Write	□	□
Partial Write	□	□
Provider Write	□	□
Enable Account	☑	□
Remote Enable	☑	□
Read Security	□	□
Edit Security	□	□

□ Apply these permissions to objects and/or containers within this container only

Open Firewall Ports for WMI Access

The firewall software on the Active Directory Domain Controller may block access to WMI. You can either turn the firewall off, or allow access on a specific IP (ISE IP address) to the following ports:

- TCP 135: General RPC Port. When doing asynchronous RPC calls, the service listening on this port tells the client which port the component servicing this request is using.
- UDP 138: Netbios Datagram Service
- TCP 139: Netbios Session Service
- TCP 445: SMB

Note Cisco ISE 1.3 and above support SMB 2.0.

Higher ports are assigned dynamically or you can configure them manually. We recommend that you add %SystemRoot%\System32\dllhost.exe as a target. This program manages ports dynamically.

All firewall rules can be assigned to specific IP (ISE IP).

Configure an Authorization Profile for Redirecting Nonregistered Devices

You must configure an authorization profile in Cisco ISE to redirect nonregistered devices for each external MDM server.

Before you begin

- Ensure that you have created an MDM server definition in Cisco ISE. Only after you successfully integrate ISE with the MDM server does the MDM dictionary gets populated and you can create authorization policy using the MDM dictionary attributes.
- Configure ACLs on the Wireless LAN Controller for redirecting unregistered devices.
- If you are using a proxy for the internet connection and MDM server is part of internal network then you have to put the MDM server name or its IP address in the Proxy-Bypass list. Choose **Administration** > **Settings** > **Proxy Settings** to perform this action.

Procedure

Step 1 Choose **Policy** > **Policy Elements** > **Results** > **Authorization** > **Authorization Profiles** > **Add**.

Step 2 Create an authorization profile for redirecting nonregistered devices that are not compliant or registered.

Step 3 Enter a name for the authorization profile that matches the MDM server name.

Step 4 Choose ACCESS_ACCEPT as the Access Type.

Step 5 Check the **Web Redirection** check box and choose MDM Redirect from the drop-down list.

Step 6 Enter the name of the ACL that you configured on the wireless LAN controller in the ACL field.

Step 7 Select the MDM portal from the **Value** drop-down list.

Step 8 Select the MDM server you want to use from the drop-down list.

Step 9 Click **Submit**.

What to do next

Configure Authorization Policy Rules for the MDM Use Cases.

Configure Authorization Policy Rules for the MDM Use Cases

You must configure authorization policy rules in Cisco ISE to complete the MDM configuration.

Before you begin

- Add the MDM server certificate to the Cisco ISE certificate store.
- Ensure that you have created the MDM server definition in Cisco ISE. Only after you successfully integrate ISE with the MDM server, the MDM dictionary gets populated and you can create authorization policy using the MDM dictionary attributes.

- Configure ACLs on the Wireless LAN Controller for redirecting unregistered or noncompliant devices.

Procedure

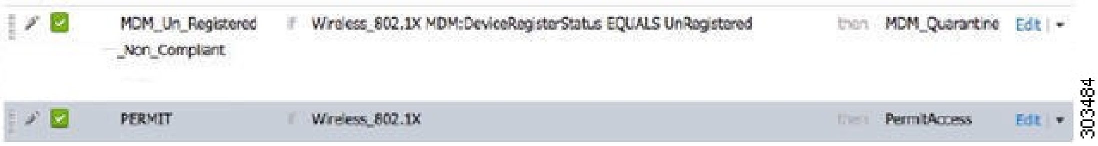
Step 1 Choose **Policy** > **Policy Sets**, and expand the policy set to view the authorization policy rules.

Step 2 Add the following rules:

- MDM_Un_Registered_Non_Compliant—For devices that are not yet registered with an MDM server or compliant with MDM policies. Once a request matches this rule, the ISE MDM page appears with information on registering the device with MDM.
- PERMIT—If the device is registered with Cisco ISE, registered with MDM, and is compliant with Cisco ISE and MDM policies, it will be granted access to the network based on the access control policies configured in Cisco ISE.

The following illustration shows an example of this configuration.

Figure 14: Authorization Policy Rules for the MDM Use Cases



✓	MDM_Un_Registered_Non_Compliant	if	Wireless_802.1X MDM:DeviceRegisterStatus EQUALS UnRegistered	then	MDM_Quarantine
✓	PERMIT	if	Wireless_802.1X	then	PermitAccess

Step 3 Click **Save**.

Configuring ACLs on the Wireless LAN Controller for MDM Interoperability

You must configure ACLs on the wireless LAN controller for use in authorization policy to redirect nonregistered devices and certificate provisioning. Your ACLs should be in the following sequence.

Procedure

Step 1 Allow all outbound traffic from server to client.

Step 2 (Optional) Allow ICMP inbound traffic from client to server for troubleshooting.

Step 3 Allow access to MDM server for unregistered and noncompliant devices to download the MDM agent and proceed with compliance checks.

Step 4 Allow all inbound traffic from client to server to ISE for Web Portal and supplicant, and certificate provisioning flows.

Step 5 Allow inbound DNS traffic from client to server for name resolution.

Step 6 Allow inbound DHCP traffic from client to server for IP addresses.

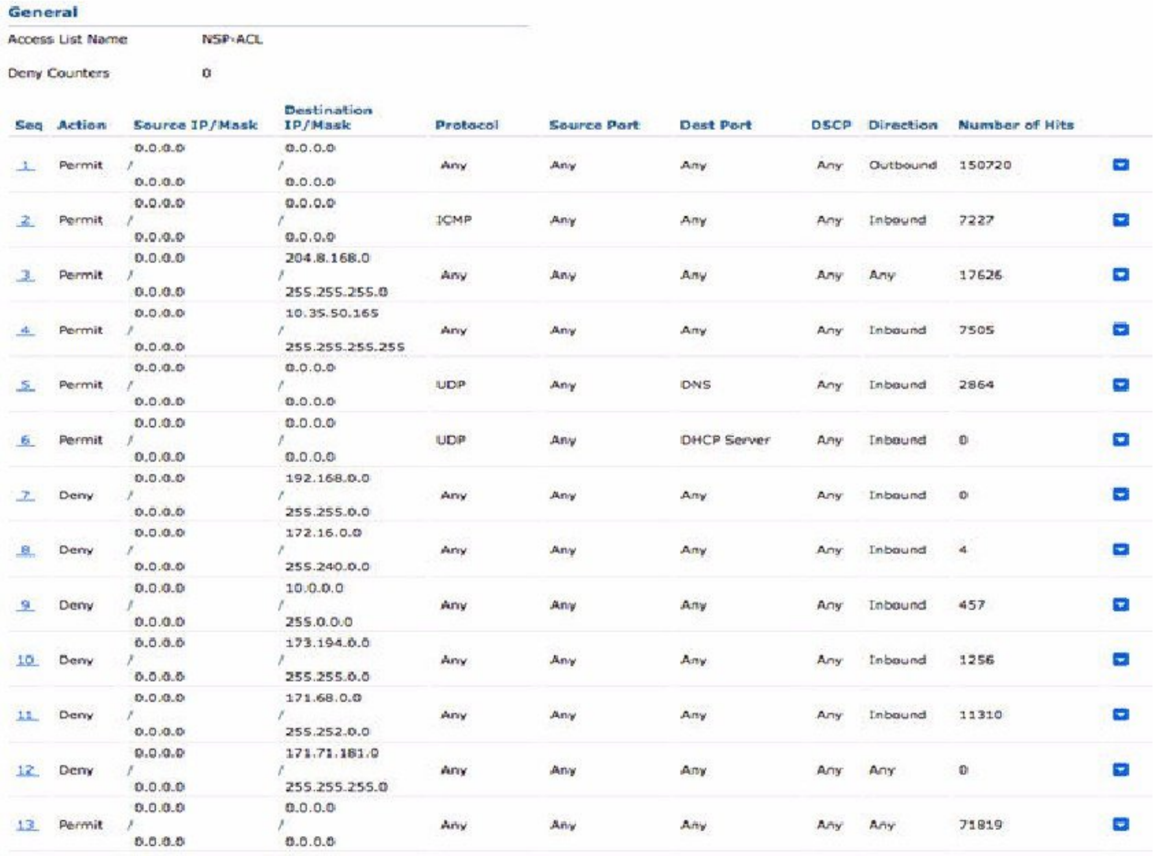
Step 7 Deny all inbound traffic from client to server to corporate resources for redirection to ISE (as per your company policy).

Step 8 (Optional) Permit the rest of the traffic.

Example

The following example shows the ACLs for redirecting a nonregistered device to the BYOD flow. In this example, the Cisco ISE ip address is 10.35.50.165, the internal corporate network ip address is 192.168.0.0 and 172.16.0.0 (to redirect), and the MDM server subnet is 204.8.168.0.

Figure 15: ACLs for Redirecting Nonregistered Device



General

Access List Name	NSP-ACL
Deny Counters	0

Seq	Action	Source IP/Mask	Destination IP/Mask	Protocol	Source Port	Dest Port	DSCP	Direction	Number of Hits	
1	Permit	0.0.0.0 / 0.0.0.0	0.0.0.0 / 0.0.0.0	Any	Any	Any	Any	Outbound	150720	▾
2	Permit	0.0.0.0 / 0.0.0.0	0.0.0.0 / 0.0.0.0	ICMP	Any	Any	Any	Inbound	7227	▾
3	Permit	0.0.0.0 / 0.0.0.0	204.8.168.0 / 255.255.255.0	Any	Any	Any	Any	Any	17626	▾
4	Permit	0.0.0.0 / 0.0.0.0	10.35.50.165 / 255.255.255.255	Any	Any	Any	Any	Inbound	7505	▾
5	Permit	0.0.0.0 / 0.0.0.0	0.0.0.0 / 0.0.0.0	UDP	Any	DNS	Any	Inbound	2864	▾
6	Permit	0.0.0.0 / 0.0.0.0	0.0.0.0 / 0.0.0.0	UDP	Any	DHCP Server	Any	Inbound	0	▾
7	Deny	0.0.0.0 / 0.0.0.0	192.168.0.0 / 255.255.0.0	Any	Any	Any	Any	Inbound	0	▾
8	Deny	0.0.0.0 / 0.0.0.0	172.16.0.0 / 255.240.0.0	Any	Any	Any	Any	Inbound	4	▾
9	Deny	0.0.0.0 / 0.0.0.0	10.0.0.0 / 255.0.0.0	Any	Any	Any	Any	Inbound	457	▾
10	Deny	0.0.0.0 / 0.0.0.0	173.194.0.0 / 255.255.0.0	Any	Any	Any	Any	Inbound	1256	▾
11	Deny	0.0.0.0 / 0.0.0.0	171.68.0.0 / 255.252.0.0	Any	Any	Any	Any	Inbound	11310	▾
12	Deny	0.0.0.0 / 0.0.0.0	171.71.181.0 / 255.255.255.0	Any	Any	Any	Any	Any	0	▾
13	Permit	0.0.0.0 / 0.0.0.0	0.0.0.0 / 0.0.0.0	Any	Any	Any	Any	Any	71819	▾

Wipe or Lock a Device

Cisco ISE allows you to wipe or turn on pin lock for a device that is lost. You can do this from the Endpoints page.

Procedure

Step 1 Choose **Work Centers** > **Network Access** > **Identities** > **Endpoints**.

Step 2 Check the check box next to the device that you want to wipe or lock.

Step 3 From the MDM Access drop-down list, choose any one of the following options:

- Full Wipe—Depending on the MDM vendor, this option either removes the corporate apps or resets the device to the factory settings.

- Corporate Wipe—Removes applications that you have configured in the MDM server policies
- PIN Lock—Locks the device

Step 4 Click **Yes** to wipe or lock the device.

View Mobile Device Manager Reports

Cisco ISE records all additions, updates, and deletions of MDM server definitions. You can view these event in the “Change Configuration Audit” report, which provides all the configuration changes from any system administrator for a selected time period.

Choose **Operations** > **Reports** > **Change Configuration Audit** > **MDM**, and specify the period of time to display in the resulting report.

View Mobile Device Manager Logs

You can use the Message Catalog page to view Mobile Device Manager log messages. Choose **Administration** > **System** > **Logging** > **Message Catalog**. The default reporting level for MDM log entries is "INFO." You can change the reporting level to "DEBUG" or "TRACE."