Cisco ISE Profiling Service

The profiling service in Cisco Identity Services Engine (ISE) identifies the devices that connect to your network and their location. The endpoints are profiled based on the endpoint profiling policies configured in Cisco ISE. Cisco ISE then grants permission to the endpoints to access the resources in your network based on the result of the policy evaluation.

The profiling service:

- Facilitates an efficient and effective deployment and ongoing management of authentication by using IEEE standard 802.1X port-based authentication access control, MAC Authentication Bypass (MAB) authentication, and Network Admission Control (NAC) for any enterprise network of varying scale and complexity.
- Identifies, locates, and determines the capabilities of all of the attached network endpoints regardless of endpoint types.
- Protects against inadvertently denying access to some endpoints.

ISE Community Resource

ISE Endpoint Profiles

How To: ISE Profiling Design Guide

Profiler Work Center

The Profiler Work Center menu (Work Centers > Profiler) contains all the profiler pages, which acts as a single start point for ISE administrators. The Profiler Work Center menu contains the following options: Overview, Ext ID Stores, Network Devices, Endpoint Classification, Node Config, Feeds, Manual Scans, Policy Elements, Profiling Policies, Authorization Policy, Troubleshoot, Reports, Settings, and Dictionaries.

Profiler Dashboard

The Profiler dashboard (Work Centers > Profiler > Endpoint Classification) is a centralized monitoring tool for the profiles, endpoints, and assets in your network. The dashboard represents data in both graphical and table formats. The Profiles dashlet displays the logical and endpoint profiles that are currently active in the network. The Endpoints dashlet displays the identity group, PSNs, OS types of the endpoints that connect to your network. The Assets dashlet displays flows such as Guest, BYOD, and Corporate. The table displays the various endpoints that are connected and you can also add new endpoints.

Endpoint Inventory Using Profiling Service

You can use the profiling service to discover, locate, and determine the capabilities of all the endpoints connected to your network. You can ensure and maintain appropriate access of endpoints to the enterprise network, regardless of their device types.

The profiling service collects attributes of endpoints from the network devices and the network, classifies endpoints into a specific group according to their profiles, and stores endpoints with their matched profiles in the Cisco ISE database. All the attributes that are handled by the profiling service need to be defined in the profiler dictionaries.

The profiling service identifies each endpoint on your network, and groups those endpoints according to their profiles to an existing endpoint identity group in the system, or to a new group that you can create in the system. By grouping endpoints, and applying endpoint profiling policies to the endpoint identity group, you can determine the mapping of endpoints to the corresponding endpoint profiling policies.

Cisco ISE Profiler Queue Limit Configuration

Cisco ISE profiler collects a significant amount of endpoint data from the network in a short period of time. It causes Java Virtual Machine (JVM) memory utilization to go up due to accumulated backlog when some of the slower Cisco ISE components process the data generated by the profiler, which results in performance degradation and stability issues.

To ensure that the profiler does not increase the JVM memory utilization and prevent JVM to go out of memory and restart, limits are applied to the following internal components of the profiler:

- Endpoint Cache: Internal cache is limited in size that has to be purged periodically (based on least recently used strategy) when the size exceeds the limit.
- Forwarder: The main ingress queue of endpoint information collected by the profiler.
- Event Handler: An internal queue that disconnects a fast component, which feeds data to a slower processing component (typically related to a database query).

Endpoint Cache

- maxEndPointsInLocalDb = 100000 (endpoint objects in cache)
- endPointsPurgeIntervalSec = 300 (endpoint cache purge thread interval in seconds)
- numberOfProfilingThreads = 8 (number of threads)

The limit is applicable to all profiler internal event handlers. A monitoring alarm is triggered when queue size limit is reached.

Cisco ISE Profiler Queue Size Limits

- forwarderQueueSize = 5000 (endpoint collection events)
- eventHandlerQueueSize = 10000 (events)

Event Handlers

- NetworkDeviceEventHandler: For network device events, in addition to filtering duplicate Network Access Device (NAD) IP addresses, which are already cached.
- ARPCacheEventHandler: For ARP Cache events.

Martian IP Addresses

Martian IP addresses are not displayed in **Context Visibility** > **Endpoints** and **Work Centers** > **Profiler** > **Endpoint Classification** windows as the RADIUS parser removes such addresses before they reach the profiling service. Martian IP addresses are a security concern as they are vulnerable to attacks. However, martian IP addresses are displayed in MnT logs for auditing purposes. This behaviour stands true in the case of multicast IP addresses as well. For more information on Martian IP addresses, see https://www.cisco.com/assets/sol/sb/Switches_Emulators_v2_3_5_xx/help/250/index.html#page/tesla_250_olh/martian_addresses.html

Configure Profiling Service in Cisco ISE Nodes

You can configure the profiling service that provides you a contextual inventory of all the endpoints that are using your network resources in any Cisco ISE-enabled network.

You can configure the profiling service to run on a single Cisco ISE node that assumes all Administration, Monitoring, and Policy Service personas by default.

In a distributed deployment, the profiling service runs only on Cisco ISE nodes that assume the Policy Service persona and does not run on other Cisco ISE nodes that assume the Administration and Monitoring personas.

Step 1

Step 2 Choose a Cisco ISE node that assumes the Policy Service persona.

Step 3 Click **Edit** in the Deployment Nodes page.

Step 4 On the **General Settings** tab, check the **Policy Service** check box. If the Policy Service check box is unchecked, both the session services and the profiling service check boxes are disabled.

Step 5 Perform the following tasks:

a) Check the **Enable Session Services** check box to run the Network Access, Posture, Guest, and Client Provisioning session services.
b) Check the **Enable Profiling Services** check box to run the profiling service.
c) Check the **Enable Device Admin Service** check box to run the device administration service to control and audit an enterprise's network devices.

Step 6 Click **Save** to save the node configuration.

Network Probes Used by Profiling Service

Network probe is a method used to collect an attribute or a set of attributes from an endpoint on your network. The probe allows you to create or update endpoints with their matched profile in the Cisco ISE database.

Cisco ISE can profile devices using a number of network probes that analyze the behavior of devices on the network and determine the type of the device. Network probes help you to gain more network visibility.

IP Address and MAC Address Binding

You can create or update endpoints only by using their MAC addresses in an enterprise network. If you do not find an entry in the ARP cache, then you can create or update endpoints by using the L2 MAC address of an HTTP packet and the IN_SRC_MAC of a NetFlow packet in Cisco ISE. The profiling service is dependent on L2 adjacency when endpoints are only a hop away. When endpoints are L2 adjacent, the IP addresses and MAC addresses of endpoints are already mapped, and there is no need for IP-MAC cache mapping.

If endpoints are not L2 adjacent and are multiple hops away, mapping may not be reliable. Some of the known attributes of NetFlow packets that you collect include PROTOCOL, L4_SRC_PORT, IPV4_SRC_ADDR, L4_DST_PORT, IPV4_DST_ADDR, IN_SRC_MAC, OUT_DST_MAC, IN_SRC_MAC, and OUT_SRC_MAC. When endpoints are not L2 adjacent and are multiple L3 hops away, the IN_SRC_MAC attributes carry only the MAC addresses of L3 network devices. When the HTTP probe is enabled in Cisco

ISE, you can create endpoints only by using the MAC addresses of HTTP packets, because the HTTP request messages do not carry IP addresses and MAC addresses of endpoints in the payload data.

Cisco ISE implements an ARP cache in the profiling service, so that you can reliably map the IP addresses and the MAC addresses of endpoints. For the ARP cache to function, you must enable either the DHCP probe or the RADIUS probe. The DHCP and RADIUS probes carry the IP addresses and the MAC addresses of endpoints in the payload data. The dhcp-requested address attribute in the DHCP probe and the Framed-IP-address attribute in the RADIUS probe carry the IP addresses of endpoints, along with their MAC addresses, which can be mapped and stored in the ARP cache.

NetFlow Probe

Cisco ISE profiler implements Cisco IOS NetFlow Version 9. We recommend using NetFlow Version 9, which has additional functionality needed to enhance the profiler to support the Cisco ISE profiling service.

You can collect NetFlow Version 9 attributes from the NetFlow-enabled network access devices to create an endpoint, or update an existing endpoint in the Cisco ISE database. You can configure NetFlow Version 9 to attach the source and destination MAC addresses of endpoints and update them. You can also create a dictionary of NetFlow attributes to support NetFlow-based profiling.

For more information on the NetFlow Version 9 Record Format, see Table 6, “NetFlow Version 9 Field Type Definitions” of the NetFlow Version 9 Flow-Record Format document.

In addition, Cisco ISE supports NetFlow versions earlier than Version 5. If you use NetFlow Version 5 in your network, then you can use Version 5 only on the primary network access device (NAD) at the access layer because it will not work anywhere else.

Cisco IOS NetFlow Version 5 packets do not contain MAC addresses of endpoints. The attributes that are collected from NetFlow Version 5 cannot be directly added to the Cisco ISE database. You can discover endpoints by using their IP addresses, and append the NetFlow Version 5 attributes to endpoints, which can be done by combining IP addresses of the network access devices and IP addresses obtained from the NetFlow Version 5 attributes. However, these endpoints must have been previously discovered with the RADIUS or SNMP probe.

The MAC address is not a part of IP flows in earlier versions of NetFlow Version 5, which requires you to profile endpoints with their IP addresses by correlating the attributes information collected from the network access devices in the endpoints cache.

For more information on the NetFlow Version 5 Record Format, see Table 2, “Cisco IOS NetFlow Flow Record and Export Format Content Information” of the NetFlow Services Solutions Guide.

DHCP Probe

The Dynamic Host Configuration Protocol probe in your Cisco ISE deployment allows the Cisco ISE profiling service to reprofile endpoints based only on new requests of INIT-REBOOT and SELECTING message types. Though other DHCP message types such as RENEWING and REBINDING are processed, they are not used for profiling endpoints. Any attribute parsed out of DHCP packets is mapped to endpoint attributes.

DHCPREQUEST Message Generated During INIT-REBOOT State

If the DHCP client checks to verify a previously allocated and cached configuration, then the client must not fill in the Server identifier (server-ip) option. Instead it should fill in the Requested IP address (requested-ip) option with the previously assigned IP address, and fill in the Client IP Address (ciaddr) field with zero in its

DHCPREQUEST message. The DHCP server will then send a DHCPNAK message to the client if the Requested IP address is incorrect or the client is located in the wrong network.

DHCPREQUEST Message Generated During SELECTING State

The DHCP client inserts the IP address of the selected DHCP server in the Server identifier (server-ip) option, fills in the Requested IP address (requested-ip) option with the value of the Your IP Address (yiaddr) field from the chosen DHCPOFFER by the client, and fills in the “ciaddr” field with zero.

Table 1: DHCP Client Messages from Different States

—	INIT-REBOOT	SELECTING	RENEWING	REBINDING
broadcast/unicast	broadcast	broadcast	unicast	broadcast
server-ip	MUST NOT	MUST	MUST NOT	MUST NOT
requested-ip	MUST	MUST	MUST NOT	MUST NOT
ciaddr	zero	zero	IP address	IP address

Wireless LAN Controller Configuration in DHCP Bridging Mode

We recommend that you configure wireless LAN controllers (WLCs) in Dynamic Host Configuration Protocol (DHCP) bridging mode, where you can forward all the DHCP packets from the wireless clients to Cisco ISE. You must uncheck the Enable DHCP Proxy check box available in the WLC web interface: **Controller** > **Advanced** > **DHCP Master Controller Mode** > **DHCP Parameters**. You must also ensure that the DHCP IP helper command points to the Cisco ISE Policy Service node.

DHCP SPAN Probe

The DHCP Switched Port Analyzer (SPAN) probe, when initialized in a Cisco ISE node, listens to network traffic, which are coming from network access devices on a specific interface. You need to configure network access devices to forward DHCP SPAN packets to the Cisco ISE profiler from the DHCP servers. The profiler receives these DHCP SPAN packets and parses them to capture the attributes of an endpoint, which can be used for profiling endpoints.

For example,

```
switch(config)# monitor session 1 source interface Gi1/0/4
switch(config)# monitor session 1 destination interface Gi1/0/2
```

HTTP Probe

In HTTP probe, the identification string is transmitted in an HTTP request-header field User-Agent, which is an attribute that can be used to create a profiling condition of IP type, and to check the web browser information. The profiler captures the web browser information from the User-Agent attribute along with other HTTP attributes from the request messages, and adds them to the list of endpoint attributes.

Cisco ISE listens to communication from the web browsers on both port 80 and port 8080. Cisco ISE provides many default profiles, which are built in to the system to identify endpoints based on the User-Agent attribute.

HTTP probe is enabled by default. Multiple ISE services such as CWA, Hotspot, BYOD, MDM, and Posture rely on URL-redirection of the client's web browser. The redirected traffic includes the RADIUS session ID of the connected endpoint. When a PSN terminates these URL-redirected flows, it has visibility into the decrypted HTTPS data. Even when the HTTP probe is disabled on the PSN, the node will parse the browser user agent string from the web traffic and correlate the data to the endpoint based on its associated session ID. When browser strings are collected through this method, the source of the data is listed as Guest Portal or CP (Client Provisioning) rather than HTTP Probe.

HTTP SPAN Probe

The HTTP probe in your Cisco ISE deployment, when enabled with the Switched Port Analyzer (SPAN) probe, allows the profiler to capture HTTP packets from the specified interfaces. You can use the SPAN capability on port 80, where the Cisco ISE server listens to communication from the web browsers.

HTTP SPAN collects HTTP attributes of an HTTP request-header message along with the IP addresses in the IP header (L3 header), which can be associated to an endpoint based on the MAC address of an endpoint in the L2 header. This information is useful for identifying different mobile and portable IP-enabled devices such as Apple devices, and computers with different operating systems. Identifying different mobile and portable IP-enabled devices is made more reliable because the Cisco ISE server redirects captures during a guest login or client provisioning download. This allows the profiler to collect the User-Agent attribute and other HTTP attributes, from the request messages and then identify devices such as Apple devices.

Unable to Collect HTTP Attributes in Cisco ISE Running on VMware

If you deploy Cisco ISE on an ESX server (VMware), the Cisco ISE profiler collects the Dynamic Host Configuration Protocol traffic but does not collect the HTTP traffic due to configuration issues on the vSphere client. To collect HTTP traffic on a VMware setup, configure the security settings by changing the Promiscuous Mode to Accept from Reject (by default) of the virtual switch that you create for the Cisco ISE profiler. When the Switched Port Analyzer (SPAN) probe for DHCP and HTTP is enabled, Cisco ISE profiler collects both the DHCP and HTTP traffic.

pxGrid Probe

The pxGrid probe leverages Cisco pxGrid for receiving endpoint context from external sources. Prior to Cisco ISE 2.4, Cisco ISE served only as a publisher and shared various context information such as session identity and group information as well as configuration elements to external subscribers. With the introduction of the pxGrid probe in Cisco ISE 2.4, other solutions serve as the publishers and Cisco ISE Policy Service nodes become the subscribers.

The pxGrid probe is based on pxGrid v2 specification using the Endpoint Asset topic */topic/com.cisco.endpoint.asset* with Service Name *com.cisco.endpoint.asset*. The following table displays the topic attributes all of which are preceded by the prefix *asset*.

Table 2: Endpoint Asset Topic

Attribute Name	Type	Description
assetId	Long	Asset ID
assetName	String	Asset name
assetIpAddress	String	IP address

assetMacAddress	String	MAC address
assetVendor	String	Manufacturer
assetProductId	String	Product Code
assetSerialNumber	String	Serial Number
assetDeviceType	String	Device Type
assetSwRevision	String	S/W Revision number
assetHwRevision	String	H/W Revision number
assetProtocol	String	Protocol
assetConnectedLinks	Array	Array of Network Link objects
assetCustomAttributes	Array	Array of Custom name-value pairs

In addition to the attributes commonly used to track networked assets such as device MAC address (assetMacAddress) and IP address (assetIpAddress), the topic allows vendors to publish unique endpoint information as Custom Attributes (assetCustomAttributes). The use of Endpoint Custom Attributes in Cisco ISE makes the topic extensible to a variety of use cases without requiring schema updates for each new set of unique vendor attributes shared over pxGrid.

RADIUS Probe

You can configure Cisco ISE for authentication with RADIUS, where you can define a shared secret that you can use in client-server transactions. With the RADIUS request and response messages that are received from the RADIUS servers, the profiler can collect RADIUS attributes, which can be used for profiling endpoints.

Cisco ISE can function as a RADIUS server, and a RADIUS proxy client to other RADIUS servers. When it acts as a proxy client, it uses external RADIUS servers to process RADIUS requests and response messages.

The RADIUS probe also collects attributes sent in RADIUS accounting packets by device sensors. For more information, see Attributes Collection from Cisco IOS Sensor-Embedded Switches, on page 21 and Configuration Checklist for Cisco IOS Sensor-Enabled Network Access Devices, on page 21.

The RADIUS probe is running by default, even for systems not configured for Profiling Service to ensure ISE can track endpoint authentication and authorization details for use in Context Visibility Services. The RADIUS probe and Profiling Services are also used to track the creation and update times for registered endpoints for purposes of purge operations.

Table 3: Common Attributes Collected Using the RADIUS Probe

User Name	Calling Station ID	Called Station ID	Framed IP Address
NAS-IP-Address	NAS-Port-Type	NAS-Port-Id	NAS-Identifier
Device Type (NAD)	Location (NAD)	Authentication Policy	Authorization Policy

Note

When an accounting stop is received, it triggers the Cisco ISE to reprofile the corresponding endpoint if it was originally profiled with an IP address. Therefore if you have custom profiles for endpoints profiled with IP addresses, the only way to meet the total certainty factor for these profiles is to match on the corresponding IP address.

Network Scan (NMAP) Probe

Cisco ISE enables you to detect devices in a subnet by using the NMAP security scanner. You enable the NMAP probe on the Policy Service node that is enabled to run the profiling service. You use the results from that probe in an endpoint profiling policy.

Each NMAP manual subnet scan has a unique numeric ID that is used to update an endpoint source information with that scan ID. Upon detection of endpoints, the endpoint source information can also be updated to indicate that it is discovered by the Network Scan probe.

The NMAP manual subnet scan is useful for detecting devices such as printers with a static IP address assigned to them that are connected constantly to the Cisco ISE network, and therefore these devices cannot be discovered by other probes.

NMAP Scan Limitations

Scanning a subnet is highly resource intensive. Scanning a subnet is lengthy process that depends on the size and density of the subnet. Number of active scans is always restricted to one scan, which means that you can scan only a single subnet at a time. You can cancel a subnet scan at any time while the subnet scan is in progress. You can use the **Click** to see latest scan results link to view the most recent network scan results that are stored in **Work Centers** > **Profiler** > **Manual Scans** > **Manual NMAP Scan Results**.

Manual NMAP Scan

The following NMAP command scans a subnet and sends the output to nmapSubnet.log:

```
nmap -O -sU -p U:161,162 -oN /opt/CSCOcpm/logs/nmapSubnet.log
    --append-output -oX - <subnet>
```

Table 4: NMAP Commands for a Manual Subnet Scan

-O	Enables OS detection
-sU	UDP scan
-p <port ranges>	Scans only specified ports. For example, U:161, 162
oN	Normal output
oX	XML output

SNMP Read Only Community Strings for NMAP Manual Subnet Scan

The NMAP manual subnet scan is augmented with an SNMP Query whenever the scan discovers that UDP port 161 is open on an endpoint that results in more attributes being collected. During the NMAP manual subnet scan, the Network Scan probe detects whether SNMP port 161 is open on the device. If the port is open, an SNMP Query is triggered with a default community string (public) with SNMP version 2c.

If the device supports SNMP and the default Read Only community string is set to public, you can obtain the MAC address of the device from the MIB value “ifPhysAddress”.

In addition, you can configure additional SNMP Read Only community strings separated by a comma for the NMAP manual network scan in the **Profiler Configuration** window. You can also specify new Read Only community strings for an SNMP MIB walk with SNMP versions 1 and 2c. For information on configuring SNMP Read Only community strings, see Setup CoA, SNMP RO Community, and Endpoint Attribute Filter, on page 15.

Manual NMAP Scan Results

The most recent network scan results are stored in Work Centers > Profiler > Manual Scans > Manual NMAP Scan Results. The Manaul NMAP Scan Results page displays only the most recent endpoints that are detected, along with their associated endpoint profiles, their MAC addresses, and their static assignment status as the result of a manual network scan you perform on any subnet. This page allows you to edit points that are detected from the endpoint subnet for better classification, if required.

Cisco ISE allows you to perform the manual network scan from the Policy Service nodes that are enabled to run the profiling service. You must choose the Policy Service node from the primary Administration ISE node user interface in your deployment to run the manual network scan from the Policy Service node. During the manual network scan on any subnet, the Network Scan probe detects endpoints on the specified subnet, their operating systems, and check UDP ports 161 and 162 for an SNMP service.

Given below is additional information related to the manual NMAP scan results:

- To detect unknown endpoints, NMAP should be able to learn the IP/MAC binding via NMAP or a supporting SNMP scan.
- ISE learns IP/MAC binding of known endpoints via Radius authentication or DHCP profiling.
- The IP/MAC bindings are not replicated across PSN nodes in a deployment. Therefore, you must trigger the manual scan from the PSN, which has the IP/MAC binding in its local database (for example, the PSN against which a mac address was last authenticated with).
- The NMAP scan results do not display any information related to an endpoint that NMAP had previously scanned, manually or automatically.

DNS Probe

The Domain Name Service (DNS) probe in your Cisco ISE deployment allows the profiler to lookup an endpoint and get the fully qualified domain name (FQDN). After an endpoint is detected in your Cisco ISE-enabled network, a list of endpoint attributes is collected from the NetFlow, DHCP, DHCP SPAN, HTTP, RADIUS, or SNMP probes.

When you deploy Cisco ISE in a standalone or in a distributed environment for the first time, you are prompted to run the setup utility to configure the Cisco ISE appliance. When you run the setup utility, you will configure the Domain Name System (DNS) domain and the primary nameserver (primary DNS server), where you can configure one or more nameservers during setup. You can also change or add DNS nameservers later after deploying Cisco ISE using the CLI commands.

DNS FQDN Lookup

Before a DNS lookup can be performed, one of the following probes must be started along with the DNS probe: DHCP, DHCP SPAN, HTTP, RADIUS, or SNMP. This allows the DNS probe in the profiler to do a reverse DNS lookup (FQDN lookup) against specified name servers that you define in your Cisco ISE deployment. A new attribute is added to the attribute list for an endpoint, which can be used for an endpoint profiling policy evaluation. The FQDN is the new attribute that exists in the system IP dictionary. You can create an endpoint profiling condition to validate the FQDN attribute and its value for profiling. The following are the specific endpoint attributes that are required for a DNS lookup and the probe that collects these attributes:

- The dhcp-requested-address attribute—An attribute collected by the DHCP and DHCP SPAN probes.
- The SourceIP attribute—An attribute collected by the HTTP probe
- The Framed-IP-Address attribute—An attribute collected by the RADIUS probe
- The cdpCacheAddress attribute—An attribute collected by the SNMP probe

Configure Call Station ID Type in the WLC Web Interface

You can use the WLC web interface to configure Call Station ID Type information. You can go to the Security tab of the WLC web interface to configure the calling station ID in the RADIUS Authentication Servers page. The MAC Delimiter field is set to Colon by default in the WLC user interface.

For more information on how to configure in the WLC web interface, see Chapter 6, “Configuring Security Solutions” in the Cisco Wireless LAN Controller Configuration Guide, Release 7.2.

For more information on how to configure in the WLC CLI using the config radius callStationIdType command, see Chapter 2, “Controller Commands” in the Cisco Wireless LAN Controller Command Reference Guide, Release 7.2.

Step 1 Log in to your Wireless LAN Controller user interface.

Step 2 Click **Security**.

Step 3 Expand **AAA**, and then choose **RADIUS** > **Authentication**.

Step 4 Choose **System MAC Address** from the Call Station ID Type drop-down list.

Step 5 Check the **AES Key Wrap** check box when you run Cisco ISE in FIPS mode.

Step 6 Choose **Colon** from the MAC Delimeter drop-down list.

SNMP Query Probe

In addition to configuring the SNMP Query probe in the Edit Node page, you must configure other Simple Management Protocol settings in the following location: **Administration** > **Network Resources** > **Network Devices**.

You can configure SNMP settings in the new network access devices (NADs) in the Network Devices list page. The polling interval that you specify in the SNMP query probe or in the SNMP settings in the network access devices query NADs at regular intervals.

You can turn on and turn off SNMP querying for specific NADs based on the following configurations:

- SNMP query on Link up and New MAC notification turned on or turned off
- SNMP query on Link up and New MAC notification turned on or turned off for Cisco Discovery Protocol information

- SNMP query timer for once an hour for each switch by default

For an iDevice, and other mobile devices that do not support SNMP, the MAC address can be discovered by the ARP table, which can be queried from the network access device by an SNMP Query probe.

Cisco Discovery Protocol Support with SNMP Query

When you configure SNMP settings on the network devices, you must ensure that the Cisco Discovery Protocol is enabled (by default) on all the ports of the network devices. If you disable the Cisco Discovery Protocol on any of the ports on the network devices, then you may not be able to profile properly because you will miss the Cisco Discovery Protocol information of all the connected endpoints. You can enable the Cisco Discovery Protocol globally by using the cdp run command on a network device, and enable the Cisco Discovery Protocol by using the cdp enable command on any interface of the network access device. To disable the Cisco Discovery Protocol on the network device and on the interface, use the no keyword at the beginning of the commands.

Link Layer Discovery Protocol Support with SNMP Query

The Cisco ISE profiler uses an SNMP Query to collect LLDP attributes. You can also collect LLDP attributes from a Cisco IOS sensor, which is embedded in the network device, by using the RADIUS probe. The following are the default LLDP configuration settings that you can use to configure LLDP global configuration and LLDP interface configuration commands on the network access devices.

Table 5: Default LLDP Configuration

Attribute	Setting
LLDP global state	Disabled
LLDP holdtime (before discarding)	120 seconds
LLDP timer (packet update frequency)	30 seconds
LLDP reinitialization delay	2 seconds
LLDP tlv-select	Enabled to send and receive all TLVs.
LLDP interface state	Enabled
LLDP receive	Enabled
LLDP transmit	Enabled
LLDP med-tlv-select	Enabled to send all LLDP-MED TLVs

CDP and LLDP Capability Codes Displayed in a Single Character

The Attribute List of an endpoint displays a single character value for the lldpCacheCapabilities and lldpCapabilitiesMapSupported attributes. The values are the Capability Codes that are displayed for the network access device that runs CDP and LLDP.

Example 1

```
lldpCacheCapabilities S
lldpCapabilitiesMapSupported S
```

Example 2

```
lldpCacheCapabilities B;T
lldpCapabilitiesMapSupported B;T
```

Example 3

```
Switch#show cdp neighbors
Capability Codes:
R - Router, T - Trans Bridge, B - Source Route Bridge, S - Switch, H - Host, I - IGMP,
r - Repeater, P - Phone, D - Remote, C - CVTA, M - Two-port Mac Relay
...
Switch#

Switch#show lldp neighbors
Capability codes:
(R) Router, (B) Bridge, (T) Telephone, (C) DOCSIS Cable Device
(W) WLAN Access Point, (P) Repeater, (S) Station, (O) Other
...
Switch#
```

SNMP Trap Probe

The SNMP Trap receives information from the specific network access devices that support MAC notification, linkup, linkdown, and informs. The SNMP Trap probe receives information from the specific network access devices when ports come up or go down and endpoints disconnect from or connect to your network.

For SNMP Trap to be fully functional and create endpoints, you must enable SNMP Query so that the SNMP Query probe triggers a poll event on the particular port of the network access device when a trap is received. To make this feature fully functional, you should configure the network access device and SNMP Trap.

Note Cisco ISE does not support SNMP Traps that are received from the Wireless LAN Controllers (WLCs) and Access Points (APs).

Active Directory Probe

The Active Directory (AD) probe:

- Improves the fidelity of OS information for Windows endpoints. Microsoft AD tracks detailed OS information for AD-joined computers including version and service pack levels. The AD probe retrieves this information directly using the AD Runtime connector to provide a highly reliable source of client OS information.
- Helps distinguish between corporate and non-corporate assets. A basic but important attribute available to the AD probe is whether an endpoint exists in AD. This information can be used to classify an endpoint contained in the AD as a managed device or corporate asset.

You can enable the AD probe under **Administration** > **System** > **Deployment** > **Profiling Configuration**. When this probe is enabled, Cisco ISE fetches the AD attributes for a new endpoint as soon as it receives a hostname. The hostname is typically learned from the DHCP or DNS probes. Once successfully retrieved, ISE does not attempt to query AD again for the same endpoint until a the rescan timer expires. This is to limit the load on AD for attribute queries. The rescan timer is configurable in the **Days Before Rescan** field (**Administration** > **System** > **Deployment** > **Profiling Configuration** > **Active Directory**). If there is additional profiling activity on the endpoint, the AD is queried again.

The following AD probe attributes can be matched in the **Policy** > **Policy Elements** > **Profiling** using the ACTIVEDIRECTORY condition. AD attributes collected using the AD Probe appear with the prefix "AD" in the endpoint details on the **Context Visibility** > **Endpoints** window.

- AD-Host-Exists
- AD-Join-Point
- AD-Operating-System
- AD-OS-Version
- AD-Service-Pack

Configure Probes for Each Cisco ISE Node

You can configure one or more probes on the Profiling Configuration tab per Cisco ISE node in your deployment that assumes the Policy Service persona, which could be:

- A standalone node: If you have deployed Cisco ISE on a single node that assumes all Administration, Monitoring, and Policy Service personas by default.
- Multiple nodes: If you have registered more than one node in your deployment that assume Policy Service persona.

Note Not all probes are enabled by default. Some probes are partially enabled even when they are not explicitly enabled by a check mark. The profiling configuration is currently unique to each PSN. We recommend that each PSN in the deployment should be configured with identical profiler configuration settings.

Before you begin

You can configure the probes per Cisco ISE node only from the Administration node, which is unavailable on the secondary Administration node in a distributed deployment.

Step 1 ChooseIn the Cisco ISE GUI, click the **Menu** icon (☰) and choose **Administration** > **System** > **Deployment**.

Step 2 Choose a Cisco ISE node that assumes the Policy Service persona.

Step 3 Click **Edit** in the Deployment Nodes page.

Step 4 On the **General Settings** tab, check the **Policy Service** check box. If the Policy Service check box is unchecked, both the session services and the profiling service check boxes are disabled.

Step 5 Check the **Enable Profiling Services** check box.

Step 6 Click the **Profiling Configuration** tab.

Step 7 Configure the values for each probe.

Step 8 Click **Save** to save the probe configuration.

Setup CoA, SNMP RO Community, and Endpoint Attribute Filter

Cisco ISE allows a global configuration to issue a Change of Authorization (CoA) in the Profiler Configuration page that enables the profiling service with more control over endpoints that are already authenticated.

In addition, you can configure additional SNMP Read Only community strings separated by a comma for the NMAP manual network scan in the Profiler Configuration page. The SNMP RO community strings are used in the same order as they appear in the Current custom SNMP community strings field.

You can also configure endpoint attribute filtering in the Profiler Configuration page.

Step 1 Choose **Administration** > **System** > **Settings** > **Profiling**.

Step 2 Choose one of the following settings to configure the CoA type:

- **No CoA** (default)—You can use this option to disable the global configuration of CoA. This setting overrides any configured CoA per endpoint profiling policy. If the goal is only visibilility, retain the default value as **No CoA**.
- **Port Bounce**—You can use this option, if the switch port exists with only one session. If the port exists with multiple sessions, then use the Reauth option. If the goal is to immediately update the access policy based on profile changes, select the **Port Bounce** option, this will ensure that any clientless endpoints is reauthorized, and IP address is refreshed, if required.
- **Reauth**—You can use this option to enforce reauthentication of an already authenticated endpoint when it is profiled. Select the **Reauth** option, if no VLAN or address change is expected following the reauthorization of the current session.

  Note If you have multiple active sessions on a single port, the profiling service issues a CoA with the **Reauth** option even though you have configured CoA with the **Port Bounce** option. This function avoids disconnecting other sessions, a situation that might occur with the **Port Bounce** option.

Step 3 Enter new SNMP community strings separated by a comma for the NMAP manual network scan in the **Change Custom SNMP Community Strings** field, and re-enter the strings in the **Confirm Custom SNMP Community Strings** field for confirmation.

The default SNMP community string used is *public*. Click **Show** in the **Current Custom SNMP Community Strings** section to verify this.

Step 4 Check the **Endpoint Attribute Filter** check box to enable endpoint attribute filtering.

On enabling the **EndPoint Attribute Filter**, the Cisco ISE profiler only keeps significant attributes and discards all other attributes. For more information, see Global Setting to Filter Endpoint Attributes, on page 19 and Attribute Filters for ISE Database Persistence and Performance, on page 18 sections. As a best practice, we recommend you to enable **Endpoint Attribute Filter** in production deployments.

Step 5 Check the **Enable Probe Data Publisher** check box if you want Cisco ISE to publish endpoint probe data to pxGrid subscribers that need this data to classify endpoints onboarding on ISE. The pxGrid subscriber can pull the endpoint records from Cisco ISE using bulk download during initial deployment phase. Cisco ISE sends the endpoint records to the pxGrid subscriber whenever they are updated in PAN. This option is disabled by default.

When you enable this option, ensure that the pxGrid persona is enabled in your deployment.

Note This option is available in Cisco ISE 2.4 patch 10 and above.

Step 6 Click **Save**.

Global Configuration of Change of Authorization for Authenticated Endpoints

You can use the global configuration feature to disable change of authorization (CoA) by using the default No CoA option or enable CoA by using port bounce and reauthentication options. If you have configured Port Bounce for CoA in Cisco ISE, the profiling service may still issue other CoAs as described in the "CoA Exemptions" section.

The global configuration chosen dictates the default CoA behavior only in the absense of more specific settings. See Change of Authorization Configuration for Each Endpoint Profiling Policy, on page 49.

You can use the RADIUS probe or the Monitoring persona REST API to authenticate the endpoints. You can enable the RADIUS probe, which allows faster performance. If you have enabled CoA, then we recommend that you enable the RADIUS probe in conjunction with your CoA configuration in the Cisco ISE application for faster performance. The profiling service can then issue an appropriate CoA for endpoints by using the RADIUS attributes that are collected.

If you have disabled the RADIUS probe in the Cisco ISE application, then you can rely on the Monitoring persona REST API to issue CoAs. This allows the profiling service to support a wider range of endpoints. In a distributed deployment, your network must have at least one Cisco ISE node that assumes the Monitoring persona to rely on the Monitoring persona REST API to issue a CoA.

Cisco ISE arbitrarily will designate either the primary or secondary Monitoring node as the default destination for REST queries in your distributed deployment, because both the primary and secondary Monitoring nodes have identical session directory information.

Use Cases for Issuing Change of Authorization

The profiling service issues the change of authorization in the following cases:

- Endpoint deleted: When an endpoint is deleted from the Endpoints page and the endpoint is disconnected or removed from the network.
- An exception action is configured: If you have an exception action configured per profile that leads to an unusual or an unacceptable event from that endpoint. The profiling service moves the endpoint to the corresponding static profile by issuing a CoA.
- An endpoint is profiled for the first time: When an endpoint is not statically assigned and profiled for the first time; for example, the profile changes from an unknown to a known profile.
    - An endpoint identity group has changed: When an endpoint is added or removed from an endpoint identity group that is used by an authorization policy.

      The profiling service issues a CoA when there is any change in an endpoint identity group, and the endpoint identity group is used in the authorization policy for the following:

    - The endpoint identity group changes for endpoints when they are dynamically profiled
    - The endpoint identity group changes when the static assignment flag is set to true for a dynamic endpoint

- An endpoint profiling policy has changed and the policy is used in an authorization policy: When an endpoint profiling policy changes, and the policy is included in a logical profile that is used in an authorization policy. The endpoint profiling policy may change due to the profiling policy match or when an endpoint is statically assigned to an endpoint profiling policy, which is associated to a logical profile. In both the cases, the profiling service issues a CoA, only when the endpoint profiling policy is used in an authorization policy.

Exemptions for Issuing a Change of Authorization

The profiling service does not issue a CoA when there is a change in an endpoint identity group and the static assignment is already true.

Cisco ISE does not issue a CoA for the following reasons:

- An Endpoint disconnected from the network—When an endpoint disconnected from your network is discovered.
- Authenticated wired (Extensible Authentication Protocol) EAP-capable endpoint—When an authenticated wired EAP-capable endpoint is discovered.
- Multiple active sessions per port—When you have multiple active sessions on a single port, the profiling service issues a CoA with the Reauth option even though you have configured CoA with the Port Bounce option.
- Packet-of-Disconnect CoA (Terminate Session) when a wireless endpoint is detected—If an endpoint is discovered as wireless, then a Packet-of-Disconnect CoA (Terminate-Session) is issued instead of the Port Bounce CoA. The benefit of this change is to support the Wireless LAN Controller (WLC) CoA.
- Profiler CoA is suppressed when the **Suppress Profiler CoA for endpoints in Logical Profile** option is used for the configured logical profile in the Authorization Profile. Profiler CoA will be triggered for all other endpoints by default.
- Global No CoA Setting overrides Policy CoA—Global No CoA overrides all configuration settings in endpoint profiling policies as there is no CoA issued in Cisco ISE irrespective of CoA configured per endpoint profiling policy.

Note No CoA and Reauth CoA configurations are not affected, and the profiler service applies the same CoA configuration for wired and wireless endpoints.

Change of Authorization Issued for Each Type of CoA Configuration

Table 6: Change of Authorization Issued for Each Type of CoA Configuration

Scenarios	No CoA Configuration	Port Bounce Configuration	Reauth Configuration	Additional Information
Global CoA configuration in Cisco ISE (typical configuration)	No CoA	Port Bounce	Reauthentication	—
An endpoint is disconnected on your network	No CoA	No CoA	No CoA	Change of authorization is determined by the RADIUS attribute Acct-Status -Type value Stop.
Wired with multiple active sessions on the same switch port	No CoA	Reauthentication	Reauthentication	Reauthentication avoids disconnecting other sessions.
Wireless endpoint	No CoA	Packet-of-Disconnect CoA (Terminate Session)	Reauthentication	Support to Wireless LAN Controller.
Incomplete CoA data	No CoA	No CoA	No CoA	Due to missing RADIUS attributes.

Attribute Filters for ISE Database Persistence and Performance

Cisco ISE implements filters for Dynamic Host Configuration Protocol (both DHCP Helper and DHCP SPAN), HTTP, RADIUS, and Simple Network Management Protocol probes except for the NetFlow probe to address performance degradation. Each probe filter contains the list of attributes that are temporal and irrelevant for endpoint profiling and removes those attributes from the attributes collected by the probes.

The isebootstrap log (isebootstrap-yyyymmdd-xxxxxx.log) contains messages that handles the creation of dictionaries and with filtering of attributes from the dictionaries. You can also configure to log a debug message when endpoints go through the filtering phase to indicate that filtering has occurred.

The Cisco ISE profiler invokes the following endpoint attribute filters:

- A DHCP filter for both the DHCP Helper and DHCP SPAN contains all the attributes that are not necessary and they are removed after parsing DHCP packets. The attributes after filtering are merged with existing attributes in the endpoint cache for an endpoint.
- An HTTP filter is used for filtering attributes from HTTP packets, where there is no significant change in the set of attributes after filtering.
- A RADIUS filter is used once the syslog parsing is complete and endpoint attributes are merged into the endpoint cache for profiling.

- SNMP filter for SNMP Query includes separate CDP and LLDP filters, which are all used for SNMP-Query probe.

Global Setting to Filter Endpoint Attributes

You can reduce the number of persistence events and replication events by reducing the number of endpoint attributes that do not change frequently at the collection point. Enabling the **EndPoint Attribute Filter** will have the Cisco ISE profiler only to keep significant attributes and discard all other attributes. Significant attributes are those used by the Cisco ISE system or those used specifically in an endpoint profiling policy or rule.

To enable the **Endpoint Attribute Filter**), see the Setup CoA, SNMP RO Community, and Endpoint Attribute Filter, on page 15 section.

An allowed list is a set of attributes that are used in custom endpoint profiling policies for profiling endpoints, and that are essential for Change of Authorization (CoA), Bring Your Own Device (BYOD), Device Registration WebAuth (DRW), and so on to function in Cisco ISE as expected. The allowed list is always used as a criteria when ownership changes for the endpoint (when attributes are collected by multiple Policy Service nodes) even when disabled.

By default, the allowed list is disabled and the attributes are dropped only when the attribute filter is enabled. The allowed list is dynamically updated when endpoint profiling policies change including from the feed to include new attributes in the profiling policies. Any attribute that is not present in the allowed list is dropped immediately at the time of collection, and the attribute is not used for profiling endpoints. When combined with the buffering, the number of persistence events can be reduced.

You must ensure that the allowed list contains a set of attributes determined from the following two sources:

- A set of attributes that are used in the default profiles so that you can match endpoints to the profiles.
- A set of attributes that are essential for Change of Authorization (CoA), Bring Your Own Device (BYOD), Device Registration WebAuth (DRW), and so on to function as expected.

Note To add an new attribute to the allowed list, the administrator needs to create a new profiler condiion and policy that uses the attribute. This new attribute will be automatically added to the allowed list of stored and replicated attributes.

Table 7: Allowed Attributes

AAA-Server	BYODRegistration
Calling-Station-ID	Certificate Expiration Date
Certificate Issue Date	Certificate Issuer Name
Certificate Serial Number	Description
DestinationIPAddress	Device Identifier
Device Name	DeviceRegistrationStatus
EndPointPolicy	EndPointPolicyID

EndPointProfilerServer	EndPointSource
FQDN	FirstCollection
Framed-IP-Address	IdentityGroup
IdentityGroupID	IdentityStoreGUID
IdentityStoreName	L4_DST_PORT
LastNmapScanTime	MACAddress
MatchedPolicy	MatchedPolicyID
NADAddress	NAS-IP-Address
NAS-Port-Id	NAS-Port-Type
NmapScanCount	NmapSubnetScanID
OS Version	OUI
PolicyVersion	PortalUser
PostureApplicable	Product
RegistrationTimeStamp	—
StaticAssignment	StaticGroupAssignment
TimeToProfile	Total Certainty Factor
User-Agent	cdpCacheAddress
cdpCacheCapabilities	cdpCacheDeviceId
cdpCachePlatform	cdpCacheVersion
ciaddr	dhcp-class-identifier
dhcp-requested-address	host-name
hrDeviceDescr	ifIndex
ip	lldpCacheCapabilities
lldpCapabilitiesMapSupported	lldpSystemDescription
operating-system	sysDescr
161-udp	—

Attributes Collection from Cisco IOS Sensor-Embedded Switches

An Cisco IOS sensor integration allows Cisco ISE run time and the Cisco ISE profiler to collect any or all of the attributes that are sent from the switch. You can collect DHCP, CDP, and LLDP attributes directly from the switch by using the RADIUS protocol. The attributes that are collected for DHCP, CDP, and LLDP are then parsed and mapped to attributes in the profiler dictionaries in the following location: **Policy** > **Policy Elements** > **Dictionaries**.

For information about the supported Catalyst platforms for Device sensors, see https://communities.cisco.com/docs/DOC-72932.

Cisco IOS Sensor-Embedded Network Access Devices

Integrating Cisco IOS sensor embedded network access devices with Cisco ISE involves the following components:

- A Cisco IOS sensor
- Data collector that is embedded in the network access device (switch) for gathering DHCP, CDP, and LLDP data
- Analyzers for processing the data and determining the device-type of endpoints

  There are two ways of deploying an analyzer, but they are not expected to be used in conjunction with each other:

  - An analyzer can be deployed in Cisco ISE
  - Analyzers can be embedded in the switch as the sensor

Configuration Checklist for Cisco IOS Sensor-Enabled Network Access Devices

This section summarizes a list of tasks that you must configure in the Cisco IOS sensor-enabled switches and Cisco ISE to collect DHCP, CDP, and LLDP attributes directly from the switch:

- Ensure that the RADIUS probe is enabled in Cisco ISE.
- Ensure that network access devices support an IOS sensor for collecting DHCP, CDP, and LLDP information.
- Ensure that network access devices run the following CDP and LLDP commands to capture CDP and LLDP information from endpoints:

  ```
  cdp enable
  lldp run
  ```

- Ensure that session accounting is enabled separately by using the standard AAA and RADIUS commands.

  For example, use the following commands:

  ```
  aaa new-model
  aaa accounting dot1x default start-stop group radius
  ```

```
radius-server host <ip> auth-port <port> acct-port <port> key <shared-secret>
radius-server vsa send accounting
```

- Ensure that you run IOS sensor-specific commands.
  - Enabling Accounting Augmentation

    You must enable the network access devices to add Cisco IOS sensor protocol data to the RADIUS accounting messages and to generate additional accounting events when it detects new sensor protocol data. This means that any RADIUS accounting message should include all CDP, LLDP, and DHCP attributes.

    Enter the following global command:

    device-sensor accounting
  - Disabling Accounting Augmentation

    To disable (accounting) network access devices and add Cisco IOS sensor protocol data to the RADIUS accounting messages for sessions that are hosted on a given port (if the accounting feature is globally enabled), enter the following command at the appropriate port:

    no device-sensor accounting
  - TLV Change Tracking

    By default, for each supported peer protocol, client notifications and accounting events are generated only when an incoming packet includes a type, length, and value (TLV) that has not been received previously in the context of a given session.

    You must enable client notifications and accounting events for all TLV changes where there are either new TLVs, or where previously received TLVs have different values. Enter the following command:

    device-sensor notify all-changes
- Be sure that you disable the Cisco IOS Device Classifier (local analyzer) in the network access devices.

  Enter the following command:

```
no macro auto monitor
```

Note This command prevents network access devices from sending two identical RADIUS accounting messages per change.

Support for Cisco IND Controllers by ISE Profiler

Cisco ISE can profile and display the status of devices attached to a Cisco Industrial Network Device (IND). PxGrid connects Cisco ISE and the Cisco Industrial Network Director to communicate endpoint (IoT) data. pxGrid on Cisco ISE consumes Cisco IND events, and queries Cisco IND to update endpoint type.

Cisco ISE profiler has dictionary attributes for IoT devices. Choose **Policy** > **Policy Elements** > **Dictionaries**, and select *IOTASSET* from the list of System Dictionaries to see the dictionary attributes.

Guidelines and Recommendations

If you have several ISE nodes configured for profiling, we recommend that you enable pxGrid for Cisco IND on only one node.

Multiple Cisco IND devices can connect to a single ISE.

If the same endpoint is received from two or more publishers (Cisco IND), Cisco ISE only keeps the last publisher's data for that endpoint.

Cisco ISE gets Cisco IND data from the service names *com.cisco.endpoint.asset* and */topic/com.cisco.endpoint.asset*in pxGrid.

Cisco IND Profiling Process Flow

Cisco IND Asset discovery finds an IoT device and publishes the endpoint data for that device to pxGrid. Cisco ISE sees the event on pxGrid, and gets the endpoint data. Profiler policies in Cisco ISE assign the device data to attributes in the ISE profiler dictionary, and applies those attributes to the endpoint in Cisco ISE.

IoT endpoint data which does not meet the existing attributes in Cisco ISE are not saved. But you can create more attributes in Cisco ISE, and register them with Cisco IND.

Cisco ISE does a bulk download of endpoints when the connection to Cisco IND through pxGrid is first established. If there is a network failure, Cisco ISE does another bulk download of accumulated endpoint changes.

Configure Cisco ISE and Cisco IND for IND Profiling

Note You must install the Cisco ISE certificate in Cisco IND, and install the Cisco IND certificate in ISE, before you activate pxGrid in Cisco IND.

1. Choose **Administration** > **Deployment**. Edit the PSN that you plan to use as pxGrid consumer, and enable pxGrid. This PSN is the one that creates endpoints from pxGrid data published by Cisco IND and profiling.
2. Choose **Administration** > **pxGrid Services** to verify that pxGrid is running. Then click the **Certificates** tab, and fill in the certificate fields. Click **Create** to issue the certificate and download the certificate.
   - For **I want to**, select "**Generate a single certificate (without a certificate signing request), Common Name**, and enter a name for the Cisco IND you are connecting with.
   - For **Certificate Download Format**, choose `PKS12 format`.
   - For **Certificate Password**, create a password.

   Note The ISE internal CA must be enabled. If your browser blocks popups, you won't be able to download the certificate. Unzip the certificate to make the PEM file available for the next step.

3. In Cisco IND, choose **Settings** > **pxGrid**, and click `Download .pem IND certificate`. Keep this window open.

4. In Cisco ISE, choose **Administration** > **pxGrid Services** > **All Clients**. When you see the Cisco IND pxGrid client, approve it.
5. In Cisco IND, move the slider to enable pxGrid. Another screen opens, where you define the location of the ISE node, the name of the certificate that you entered for this pxGrid server in ISE, and the password you provided. Click **Upload Certificate**, and locate the ISE pxGrid PEM file.
6. In ISE, choose **Administration** > **Certificates** > **Trusted Certificates**. Click **Import** and enter the path to the certificate you got from Cisco IND.
7. In Cisco IND, click **Activate**.
8. In Cisco ISE, choose **Adminstration > Deployment**. Select the PSN you are using for the Cisco IND connection, select the Profiling window, and enable the pxGrid probe.
9. The pxGrid connection between ISE and Cisco IND is now active. Verify that by displaying the IoT endpoints that Cisco IND has found.

Add an Attribute for IND Profiling

Cisco IND may return attributes that are not in the ISE dictionary. You can add more attributes to Cisco ISE, so you can more accurately profile that IoT device. To add a new attribute, you create a custom attribute in Cisco ISE, and send that attribute to Cisco IND over pxGrid.

1. Choose **Administration** > **Identity Management** > **Settings**, and select **Endpoint Custom Attributes**. Create an attribute endpoint attribute.
2. You can now use this attribute in a profiler policy to identify assets with the new attribute. Choose **Policy** > **Profiling**, and create a new profiler policy. In the **Rules** section, create a new rule. When you add an **attribute/value**, select the **CUSTOMATTRIBUTE** folder, and the custom attribute you created.

Profiler Conditions

Profiling conditions are policy elements and are similar to other conditions. However unlike authentication, authorization, and guest conditions, the profiling conditions can be based on a limited number of attributes. The Profiler Conditions page lists the attributes that are available in Cisco ISE and their description.

Profiler conditions can be one of the following:

- Cisco Provided: Cisco ISE includes predefined profiling conditions when deployed and they are identified as Cisco Provided in the Profiler Conditions window. You cannot delete Cisco Provided profiling conditions.

  You can also find Cisco Provided conditions in the System profiler dictionaries in the following location: **Policy > Policy Elements > Dictionaries > System**.

  For example, MAC dictionary. For some products, the OUI (Organizationally Unique Identifier) is an unique attribute that you can use it first for identifying the manufacturing organization of devices. It is a component of the device MAC address. The MAC dictionary contains the MACAddress and OUI attributes.

- Administrator Created: Profiler conditions that you create as an administrator of Cisco ISE or predefined profiling conditions that are duplicated are identified as Administrator Created. You can create a profiler condition of DHCP, MAC, SNMP, IP, RADIUS, NetFlow, CDP, LLDP, and NMAP types using the profiler dictionaries in the **Profiler Conditions** window.

Although, the recommended upper limit for the number of profiling policies is 1000, you can stretch up to 2000 profiling policies.

Profiling Network Scan Actions

An endpoint scan action is a configurable action that can be referred to in an endpoint profiling policy, and that is triggered when the conditions that are associated with the network scan action are met.

An endpoint scan is used to scan endpoints in order to limit resources usage in the Cisco ISE system. A network scan action scans a single endpoint, unlike resource-intensive network scans. It improves the overall classification of endpoints, and redefines an endpoint profile for an endpoint. Endpoint scans can be processed only one at a time.

You can associate a single network scan action to an endpoint profiling policy. Cisco ISE predefines three scanning types for a network scan action, which can include one or all three scanning types: for instance, an OS-scan, an SNMPPortsAndOS-scan, and a CommonPortsAndOS-scan. You cannot edit or delete OS-scan, SNMPPortsAndOS-scan, and CommonPortsAndOS-scans, which are predefined network scan actions in Cisco ISE. You can also create a new network scan action of your own.

Once an endpoint is appropriately profiled, the configured network scan action cannot be used against that endpoint. For example, scanning an Apple-Device allows you to classify the scanned endpoint to an Apple device. Once an OS-scan determines the operating system that an endpoint is running, it is no longer matched to an Apple-Device profile, but it is matched to an appropriate profile for an Apple device.

Create a New Network Scan Action

A network scan action that is associated with an endpoint profiling policy scans an endpoint for an operating system, Simple Network Management Protocol (SNMP) ports, and common ports. Cisco provides network scan actions for the most common NMAP scans, but you can also create one of your own.

When you create a new network scan, you define the type of information that the NMAP probe will scan for.

Before you begin

The Network Scan (NMAP) probe must be enabled before you can define a rule to trigger a network scan action. The procedure for that is described in Configure Probes for Each Cisco ISE Node.

Step 1 Choose **Policy** > **Policy Elements** > **Results** > **Profiling** > **Network Scan (NMAP) Actions**. Alternatively, you can choose **Work Centers** > **Profiler** > **Policy Elements** > **NMAP Scan Actions**.

Step 2 Click **Add**.

Step 3 Enter a name and description for the network scan action that you want to create.

Step 4 Check one or more check boxes when you want to scan an endpoint for the following:

- Scan OS: To scan for an operating system
- Scan SNMP Port: To scan SNMP ports (161, 162)
- Scan Common Port: To scan common ports.

- Scan Custom Ports: To scan custom ports.
- Scan Include Service Version Information: To scan the version information, which may contain detailed description of the device.
- Run SMB Discovery Script: To scan SMB ports (445 and 139) to retrieve information such as the OS and computer name.
- Skip NMAP Host Discovery: To skip the initial host discovery stage of the NMAP scan.

Note The Skip NMAP Host Discovery option is selected by default for automatic NMAP scan, however, you must select it to run manual NMAP scan.

Step 5 Click **Submit**.

NMAP Operating System Scan

The operating system scan (OS-scan) type scans for an operating system (and OS version) that an endpoint is running. This is a resource intensive scan.

The NMAP tool has limitations on OS-scan which may cause unreliable results. For example, when scanning an operating system of network devices such as switches and routers, the NMAP OS-scan may provide an incorrect operating-system attribute for those devices. Cisco ISE displays the operating-system attribute, even if the accuracy is not 100%.

You should configure endpoint profiling policies that use the NMAP operating-system attribute in their rules to have low certainty value conditions (Certainty Factor values). We recommend that whenever you create an endpoint profiling policy based on the NMAP:operating-system attribute, include an AND condition to help filter out false results from NMAP.

The following NMAP command scans the operating system when you associate Scan OS with an endpoint profiling policy:

```
nmap -sS -O -F -oN /opt/CSCOcpm/logs/nmap.log -append-output -oX - <IP-address>
```

The following NMAP command scans a subnet and sends the output to nmapSubnet.log:

```
nmap -O -sU -p U:161,162 -oN /opt/CSCOcpm/logs/nmapSubnet.log
    --append-output -oX - <subnet>
```

Table 8: NMAP Commands for a Manual Subnet Scan

-O	Enables OS detection
-sU	UDP scan
-p <port ranges>	Scans only specified ports. For example, U:161, 162
oN	Normal output
oX	XML output

Operating System Ports

The following table lists the TCP ports that NMAP uses for OS scanning. In addition, NMAP uses ICMP and UDP port 51824.

1	3	4	6	7	9	13	17	19
20	21	22	23	24	25	26	30	32
33	37	42	43	49	53	70	79	80
81	82	83	84	85	88	89	90	99
100	106	109	110	111	113	119	125	135
139	143	144	146	161	163	179	199	211
212	222	254	255	256	259	264	280	301
306	311	340	366	389	406	407	416	417
425	427	443	444	445	458	464	465	481
497	500	512	513	514	515	524	541	543
544	545	548	554	555	563	587	593	616
617	625	631	636	646	648	666	667	668
683	687	691	700	705	711	714	720	722
726	749	765	777	783	787	800	801	808
843	873	880	888	898	900	901	902	903
911	912	981	987	990	992	993	995	999
1000	1001	1002	1007	1009	1010	1011	1021	1022
1023	1024	1025	1026	1027	1028	1029	1030	1031
1032	1033	1034	1035	1036	1037	1038	1039	1040-1100
1102	1104	1105	1106	1107	1108	1110	1111	1112
1113	1114	1117	1119	1121	1122	1123	1124	1126
1130	1131	1132	1137	1138	1141	1145	1147	1148
1149	1151	1152	1154	1163	1164	1165	1166	1169
1174	1175	1183	1185	1186	1187	1192	1198	1199
1201	1213	1216	1217	1218	1233	1234	1236	1244
1247	1248	1259	1271	1272	1277	1287	1296	1300
1301	1309	1310	1311	1322	1328	1334	1352	1417
1433	1434	1443	1455	1461	1494	1500	1501	1503
1521	1524	1533	1556	1580	1583	1594	1600	1641

1658	1666	1687	1688	1700	1717	1718	1719	1720
1721	1723	1755	1761	1782	1783	1801	1805	1812
1839	1840	1862	1863	1864	1875	1900	1914	1935
1947	1971	1972	1974	1984	1998-2010	2013	2020	2021
2022	2030	2033	2034	2035	2038	2040-2043	2045-2049	2065
2068	2099	2100	2103	2105-2107	2111	2119	2121	2126
2135	2144	2160	2161	2170	2179	2190	2191	2196
2200	2222	2251	2260	2288	2301	2323	2366	2381-2383
2393	2394	2399	2401	2492	2500	2522	2525	2557
2601	2602	2604	2605	2607	2608	2638	2701	2702
2710	2717	2718	2725	2800	2809	2811	2869	2875
2909	2910	2920	2967	2968	2998	3000	3001	3003
3005	3006	3007	3011	3013	3017	3030	3031	3052
3071	3077	3128	3168	3211	3221	3260	3261	3268
3269	3283	3300	3301	3306	3322	3323	3324	3325
3333	3351	3367	3369	3370	3371	3372	3389	3390
3404	3476	3493	3517	3527	3546	3551	3580	3659
3689	3690	3703	3737	3766	3784	3800	3801	3809
3814	3826	3827	3828	3851	3869	3871	3878	3880
3889	3905	3914	3918	3920	3945	3971	3986	3995
3998	4000-4006	4045	4111	4125	4126	4129	4224	4242
4279	4321	4343	4443	4444	4445	4446	4449	4550
4567	4662	4848	4899	4900	4998	5000-5004	5009	5030
5033	5050	5051	5054	5060	5061	5080	5087	5100
5101	5102	5120	5190	5200	5214	5221	5222	5225
5226	5269	5280	5298	5357	5405	5414	5431	5432
5440	5500	5510	5544	5550	5555	5560	5566	5631
5633	5666	5678	5679	5718	5730	5800	5801	5802
5810	5811	5815	5822	5825	5850	5859	5862	5877

5900-5907	5910	5911	5915	5922	5925	5950	5952	5959
5960-5963	5987-5989	5998-6007	6009	6025	6059	6100	6101	6106
6112	6123	6129	6156	6346	6389	6502	6510	6543
6547	6565-6567	6580	6646	6666	6667	6668	6669	6689
6692	6699	6779	6788	6789	6792	6839	6881	6901
6969	7000	7001	7002	7004	7007	7019	7025	7070
7100	7103	7106	7200	7201	7402	7435	7443	7496
7512	7625	7627	7676	7741	7777	7778	7800	7911
7920	7921	7937	7938	7999	8000	8001	8002	8007
8008	8009	8010	8011	8021	8022	8031	8042	8045
8080-8090	8093	8099	8100	8180	8181	8192	8193	8194
8200	8222	8254	8290	8291	8292	8300	8333	8383
8400	8402	8443	8500	8600	8649	8651	8652	8654
8701	8800	8873	8888	8899	8994	9000	9001	9002
9003	9009	9010	9011	9040	9050	9071	9080	9081
9090	9091	9099	9100	9101	9102	9103	9110	9111
9200	9207	9220	9290	9415	9418	9485	9500	9502
9503	9535	9575	9593	9594	9595	9618	9666	9876
9877	9878	9898	9900	9917	9929	9943	9944	9968
9998	9999	10000	10001	10002	10003	10004	10009	10010
10012	10024	10025	10082	10180	10215	10243	10566	10616
10617	10621	10626	10628	10629	10778	11110	11111	11967
12000	12174	12265	12345	13456	13722	13782	13783	14000
14238	14441	14442	15000	15002	15003	15004	15660	15742
16000	16001	16012	16016	16018	16080	16113	16992	16993
17877	17988	18040	18101	18988	19101	19283	19315	19350
19780	19801	19842	20000	20005	20031	20221	20222	20828
21571	22939	23502	24444	24800	25734	25735	26214	27000
27352	27353	27355	27356	27715	28201	30000	30718	30951

31038	31337	32768	32769	32770	32771	32772	32773	32774
32775	32776	32777	32778	32779	32780	32781	32782	32783
32784	32785	33354	33899	34571	34572	34573	34601	35500
36869	38292	40193	40911	41511	42510	44176	44442	44443
44501	45100	48080	49152	49153	49154	49155	49156	49157
49158	49159	49160	49161	49163	49165	49167	49175	49176
49400	49999	50000	50001	50002	50003	50006	50300	50389
50500	50636	50800	51103	51493	52673	52822	52848	52869
54045	54328	55055	55056	55555	55600	56737	56738	57294
57797	58080	60020	60443	61532	61900	62078	63331	64623
64680	65000	65129	65389					

NMAP SNMP Port Scan

The SNMPPortsAndOS-scan type scans an operating system (and OS version) that an endpoint is running and triggers an SNMP Query when SNMP ports (161 and 162) are open. It can be used for endpoints that are identified and matched initially with an Unknown profile for better classification.

The following NMAP command scans SNMP ports (UDP 161 and 162) when you associate the Scan SNMP Port with an endpoint profiling policy:

```
nmap -sU -p U:161,162 -oN /opt/CSCOcpm/logs/nmap.log --append-output -oX - <IP-address>
```

Table 9: NMAP Commands for an Endpoint SNMP Port Scan

-sU	UDP scan.
-p <port-ranges>	Scans only specified ports. For example, scans UDP ports 161 and 16.2
oN	Normal output.
oX	XML output.
IP-address	IP-address of an endpoint that is scanned.

NMAP Common Ports Scan

The CommonPortsAndOS-scan type scans an operating system (and OS version) that an endpoint is running and common ports (TCP and UDP), but not SNMP ports. The following NMAP command scans common ports when you associate Scan Common Port with an endpoint profiling policy:nmap -sTU -p T:21,22,23,25,53,80,110,135,139,143,443,445,3306,3389,8080,U:53,67,68,123,135,137,138,139,161,445,500,520,631,1434,1900 -oN /opt/CSCOcpm/logs/nmap.log --append-output -oX - <IP address>

Table 10: NMAP Commands for an Endpoint Common Ports Scan

-sTU	Both TCP connect scan and UDP scan.
-p <port ranges>	Scans TCP ports: 21,22,23,25,53,80,110,135,139,143, 443,445,3306,3389,8080 and UDP ports: 53,67,68,123,135,137, 138,139,161,445,500,520,631,1434,1900
oN	Normal output.
oX	XML output.
IP address	IP address of an endpoint that is scanned.

Common Ports

The following table lists the common ports that NMAP uses for scanning.

Table 11: Common Ports

TCP Ports		**UDP Ports**	
Ports	**Service**	**Ports**	**Service**
21/tcp	ftp	53/udp	domain
22/tcp	ssh	67/udp	dhcps
23/tcp	telnet	68/udp	dhcpc
25/tcp	smtp	123/udp	ntp
53/tcp	domain	135/udp	msrpc
80/tcp	http	137/udp	netbios-ns
110/tcp	pop3	138/udp	netbios-dgm
135/tcp	msrpc	139/udp	netbios-ssn
139/tcp	netbios-ssn	161/udp	snmp
143/tcp	imap	445/udp	microsoft-ds
443/tcp	https	500/udp	isakmp
445/tcp	microsoft-ds	520/udp	route
3389/tcp	ms-term-serv	1434/udp	ms-sql-m
8080/tcp	http-proxy	1900/udp	upnp

NMAP Custom Ports Scan

In addition to the common ports, you can use custom ports (**Work Centers** > **Profiler** > **Policy Elements** > **NMAP Scan Actions** or **Policy** > **Policy Elements** > **Results** > **Profiling** > **Network Scan (NMAP) Actions**) to specify automatic and manual NMAP scan actions. NMAP probes collect the attributes from endpoints via the specified custom ports that are open. These attributes are updated in the endpoint's attribute list in the ISE Identities page (**Work Centers** > **Network Access** > **Identities** > **Endpoints**). You can specify up to 10 UDP and 10 TCP ports for each scan action. You cannot use the same port numbers that you have specified as common ports. See Configure Profiler Policies Using the McAfee ePolicy Orchestrator for more information.

NMAP Include Service Version Information Scan

The Include Service Version Information NMAP probe automatically scans the endpoints to better classify them, by collecting information about services running on the device. The service version option can be combined with common ports or custom ports.

Example:

CLI Command: nmap -sV -p T:8083 172.21.75.217

Output:

Port	State	Service	Version
8083/tcp	open	http	McAfee ePolicy Orchestrator Agent 4.8.0.1500 (ePOServerName: WIN2008EPO, AgentGuid: {1F5ED719-0A22-4F3B-BABA-00FAE756C2FE})

NMAP SMB Discovery Scan

NMAP SMB Discovery scan helps differentiate the Windows versions, and results in a better endpoint profiling. You can configure the NMAP scan action to run the SMB discovery script that is provided by NMAP.

The NMAP scan action is incorporated within the windows default policies and when the endpoint matches the policy and the scanning rule, the endpoint is scanned and the result helps to determine the exact windows version. The policy will be then configured on the feed service and new pre-defined NMAP scan is created with the SMB discovery option.

The NMAP scan action is invoked by the Microsoft-Workstation policies and the result of the scan is saved on the endpoint under the operating system attribute and leveraged to the Windows policies. You can also find the SMB Discovery script option in the manual scan on the subnet.

Note For SMB discovery, be sure to enable the Windows file sharing option in the endpoint.

SMB Discovery Attributes

When the SMB discovery script is executed on the endpoint, new SMB discovery attributes, such as SMB.Operating-system, are added to the endpoint. These attributes are considered for updating the Windows endpoint profiling policies on the feed service. When a SMB discovery script is run, the SMB discovery attribute is prefixed with SMB, such as SMB.operating-system, SMB.lanmanager, SMB.server, SMB.fqdn, SMB.domain, SMB.workgroup, and SMB.cpe.

Skip NMAP Host Discovery

Scanning every port of every single IP address is a time-consuming process. Depending on the purpose of the scan, you can skip the NMAP host discovery of active endpoints.

If a NMAP scan is triggered after the classification of an endpoint, the profiler always skips the host discovery of the endpoint. However, if a manual scan action is triggered after enabling the Skip NMAP Host Discovery Scan, then host discovery is skipped.

NMAP Scan Workflow

Steps to be followed to perform a NMAP scan:

Before you begin

In order to run NMAP SMB discovery script, you must enable the file sharing in your system. Refer to the Enable File Sharing to Run NMAP SMB Discovery Script topic for an example.

Step 1 Create an SMB Scan Action.

Step 2 Configure the Profiler Policy Using the SMB Scan Action.

Step 3 Add a New Condition Using the SMB Attribute.

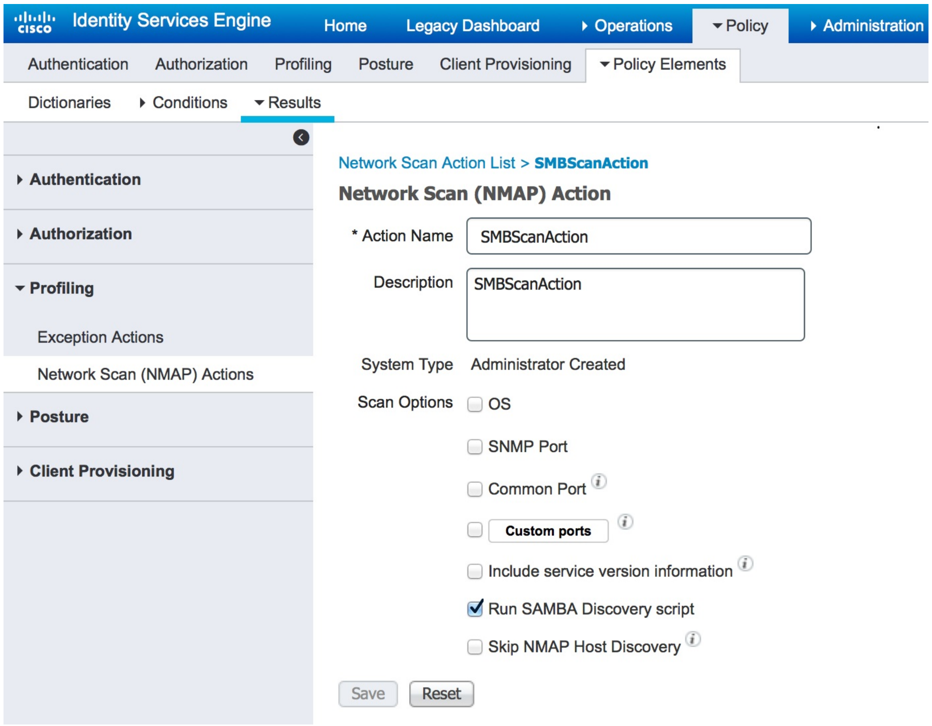
Create an SMB Scan Action

Step 1

Step 2 Enter the **Action Name** and **Description**.

Step 3 Check the **Run SMB Discovery Script** checkbox.

Step 4 Click **Add** to create the network access users.



Network Scan (NMAP) Action

* Action Name: SMBScanAction

Description: SMBScanAction

System Type: Administrator Created

Scan Options:
- □ OS
- □ SNMP Port
- □ Common Port
- □ Custom ports
- □ Include service version information
- ☑ Run SAMBA Discovery script
- □ Skip NMAP Host Discovery

What to do next

You should configure the profiler policy using the SMB scan action.

Configure the Profiler Policy Using the SMB Scan Action

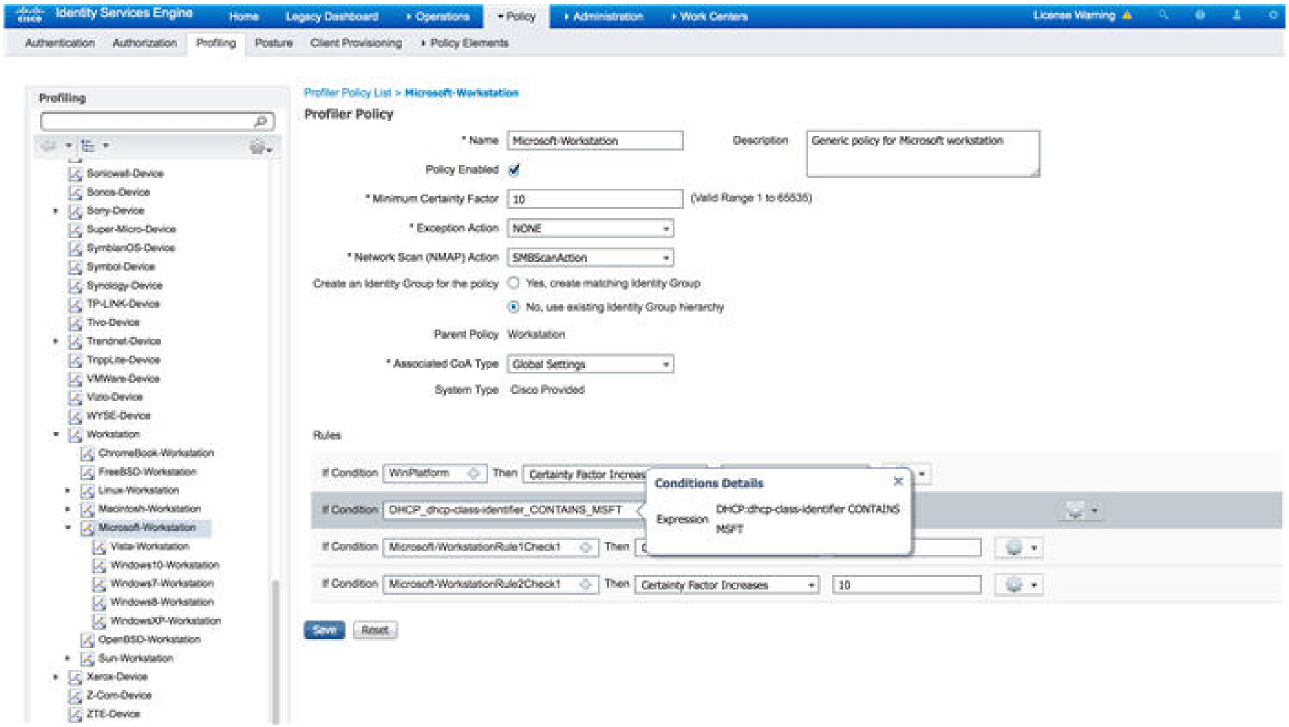
Before you begin

You must create a new profiler policy to scan an endpoint with the SMB scan action. For example, you can scan a Microsoft Workstation by specifying a rule that if the DHCP class identifier contains the MSFT attribute, then a network action should be taken.

Step 1 ChooseIn the Cisco ISE GUI, click the **Menu** icon (☰) and choose **Policy** > **Profiling** > **Add**.

Step 2 Enter the **Name** and **Description**.

Step 3 In the drop-down, select the scan action (for example, SMBScanAction) that you had created. **Network Scan (NMAP) Action**



Profiler Policy List > Microsoft-Workstation

Profiler Policy

* Name: Microsoft-Workstation
Description: Generic policy for Microsoft workstation
Policy Enabled: ☑
* Minimum Certainty Factor: 10 (Valid Range 1 to 65535)
* Exception Action: NONE
* Network Scan (NMAP) Action: SMBScanAction
Create an Identity Group for the policy: ○ Yes, create matching Identity Group
● No, use existing Identity Group hierarchy
Parent Policy: Workstation
* Associated CoA Type: Global Settings
System Type: Cisco Provided

Rules

If Condition WinPlatform Then Certainty Factor Increas
If Condition DHCP_dhcp-class-identifier_CONTAINS_MSFT
If Condition Microsoft-WorkstationRule1Check1 Then C
If Condition Microsoft-WorkstationRule2Check1 Then Certainty Factor Increases 10

Conditions Details
Expression: DHCP:dhcp-class-identifier CONTAINS MSFT

What to do next

You should add a new condition using the SMB attribute.

Add a New Condition Using the SMB Attribute

Before you begin

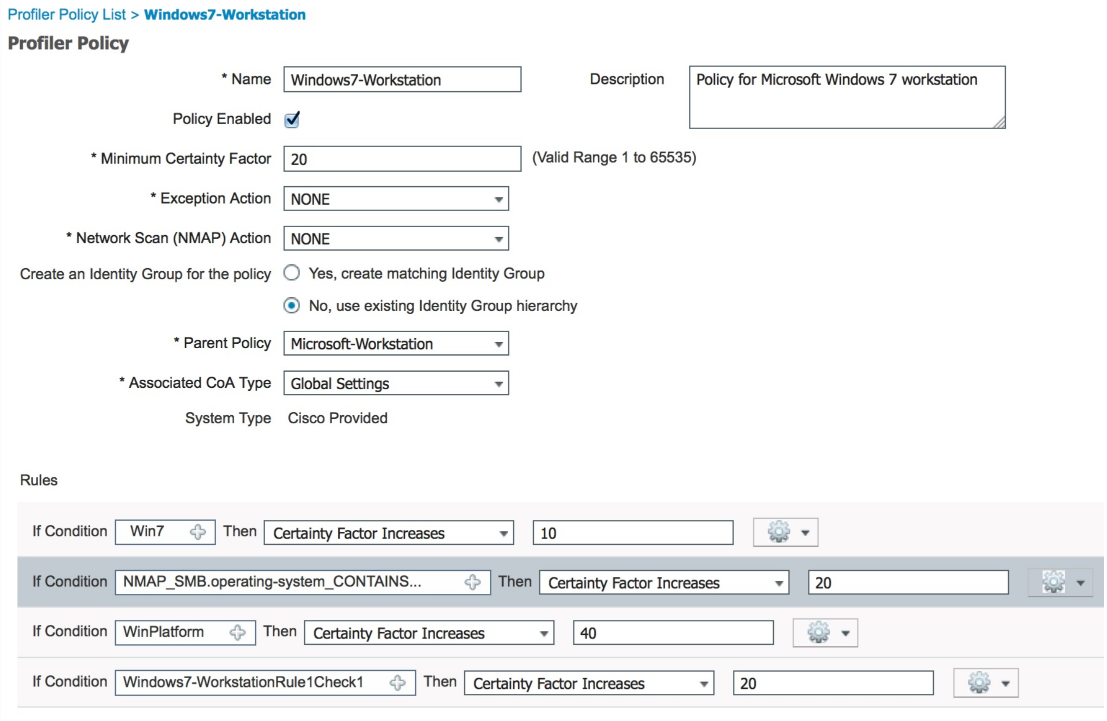
You should create a new profiler policy to scan the version of an endpoint. For example, you can scan for Windows 7 under the Microsoft Workstation parent policy.

Step 1 ChooseIn the Cisco ISE GUI, click the **Menu** icon (☰) and choose **Policy** > **Profiling** > **Add**.

Step 2 Enter the **Name** (for example, Windows-7Workstation) and **Description**.

Step 3 In the **Network Scan (NMAP) Action** drop-down, select **None**.

Step 4 In the **Parent Policy** drop-down choose the Microsoft-Workstation policy.



Profiler Policy List > **Windows7-Workstation**

Profiler Policy

* Name	Windows7-Workstation	Description	Policy for Microsoft Windows 7 workstation
Policy Enabled	☑		
* Minimum Certainty Factor	20	(Valid Range 1 to 65535)	
* Exception Action	NONE		
* Network Scan (NMAP) Action	NONE		
Create an Identity Group for the policy	○ Yes, create matching Identity Group ● No, use existing Identity Group hierarchy		
* Parent Policy	Microsoft-Workstation		
* Associated CoA Type	Global Settings		
System Type	Cisco Provided		

Rules

If Condition	Win7	Then	Certainty Factor Increases	10
If Condition	NMAP_SMB.operating-system_CONTAINS...	Then	Certainty Factor Increases	20
If Condition	WinPlatform	Then	Certainty Factor Increases	40
If Condition	Windows7-WorkstationRule1Check1	Then	Certainty Factor Increases	20

Enable File Sharing to Run NMAP SMB Discovery Script

Given below is an example to enable file sharing in Windows OS version 7, to run the NMAP SMB discovery script.

Step 1 Choose **Control Panel** > **Network and Internet**.

Step 2 Click **Network and Sharing Center**.

Step 3 Click **Change Advanced Sharing Settings**.

Step 4 Click **Turn on File and Printer Sharing**.

Step 5 Enable the following options: **Enable File Sharing for Devices That Use 40- or 56-bit Encryption** and **Turn on Password Protected Sharing**.

Step 6 Click **Save Changes**.

Step 7 Configure the Firewall settings.

a) In the Control Panel, navigate to **System and Security** > **Windows Firewall** > **Allow a Program Through Windows Firewall**.
b) Check the **File and Printer Sharing** check box.
c) Click **OK**.

Step 8 Configure the shared folder.

a) Right-click the destination folder, and select **Properties**.
b) Click the **Sharing** tab, and click **Share**.
c) In the **File Sharing** dialog box, add the required names and click **Share**.
d) Click **Done** after the selected folder is shared.

e) Click **Advanced Sharing** and select the **Share This Folder** check box.
f) Click **Permissions**.
g) In the **Permissions for Scans** dialog box, choose **Everyone** and check the **Full Control** check box.
h) Click **OK**.

Exclude Subnets from NMAP Scan

You can perform an NMAP scan to identify an endpoint's OS or SNMP port.

When performing the NMAP scan, you can exclude a whole subnet or IP range that should not be scanned by NMAP. You can configure the subnet or IP range in the **NMAP Scan Subnet Exclusions** window (**Work Centers > Profiler > Settings > NMAP Scan Subnet Exclusions**). This helps limit the load on your network and saves a considerable amount of time.

For Manual NMAP scan, you can use the **Run Manual NMAP Scan** window (**Work Centers > Profiler > Manual Scans > Manual NMAP Scan > Configure NMAP Scan Subnet Exclusions At**) to specify the subnet or IP range.

Manual NMAP Scan Settings

You can perform a manual NMAP scan (**Work Centers** > **Profiler** > **Manual Scans** > **Manual NMAP Scan**) using the scan options that are available for automatic NMAP scan. You can choose either the scan options or the predefined ones.

Table 12: Manual NMAP Scan Settings

Field Name	Usage Guidelines
Node	Choose the ISE node from which the NMAP scan is run.
Manual Scan Subnet	Enter the range of subnet IP addresses of endpoints for which you want to run the NMAP scan.
Configure NMAP Scan Subnet Exclusions At	You will be directed to the **Work Centers** > **Profiler** > **Settings** > **NMAP Scan Subnet Exclusions** window. Specify the IP address and subnet mask that should be excluded. If there is a match, the NMAP scan is not run.
NMAP Scan Subnet	You can do one of the following: • Specify Scan Options • Select an Existing NMAP Scan
Specify Scan Options	Select the required scan options: OS, SNMP Port, Common Ports, Custom Ports, Include Service Version Information, Run SMB Discovery Script, Skip NMAP Host Discovery. See Create a New Network Scan Action for more information.

Field Name	Usage Guidelines
Select an Existing NMAP Scan	Displays the **Existing NMAP Scan Actions** drop-down list that displays the default profiler NMAP scan actions.
Reset to Default Scan Options	Click this option to restore default settings (all scan options are checked).
Save as NMAP Scan Action	Enter an action name and a description.

Run a Manual NMAP Scan

Step 1

Step 2 In the **Node** drop-down list, select the ISE node from which you intend to run the NMAP scan.

Step 3 In the **Manual Scan Subnet** text box, enter the subnet address whose endpoints you intend to check for open ports.

Step 4 Select one of the following:

a) Choose **Specify Scan Options**, and on the right side of the page, choose the required scan options. Refer to the Create a New Network Scan Action page for more information.

b) Choose **Select An Existing NMAP Scan Action** to select the default NMAP scan action, such as MCAFeeEPOOrchestratorClientScan.

Step 5 Click **Run Scan**.

Configure Profiler Policies Using the McAfee ePolicy Orchestrator

Cisco ISE profiling services can detect if the McAfee ePolicy Orchestrator (McAfee ePO) client is present on the endpoint. This helps in determining if a given endpoint belongs to your organization.

The entities involved in the process are:

- ISE Server
- McAfee ePO Server
- McAfee ePO Agent

Cisco ISE provides an in-built NMAP scan action (MCAFeeEPOOrchestratorClientscan) to check if the McAfee agent is running on an endpoint using NMAP McAfee script on the configured port. You can also create new NMAP scan options using the custom ports (for example, 8082). You can configure a new NMAP scan action using the McAfee ePO software by following the steps below:

Step 1 Configure the McAfee ePo NMAP Scan Action.

Step 2 Configure the McAfee ePO Agent.

Step 3 Configure Profiler Policies Using the McAfee ePO NMAP Scan Action.

Configure the McAfee ePo NMAP Scan Action

Step 1 Choose **Work Centers** > **Profiler** > **Policy Elements** > **Network Scan (NMAP) Actions**.

Step 2 Click **Add**.

Step 3 Enter the **Action Name** and **Description**.

Step 4 In the **Scan Options**, select **Custom Ports**.

Step 5 In the **Custom Ports** dialog box, add the required TCP port. The 8080 TCP port is enabled by default for McAfee ePO.

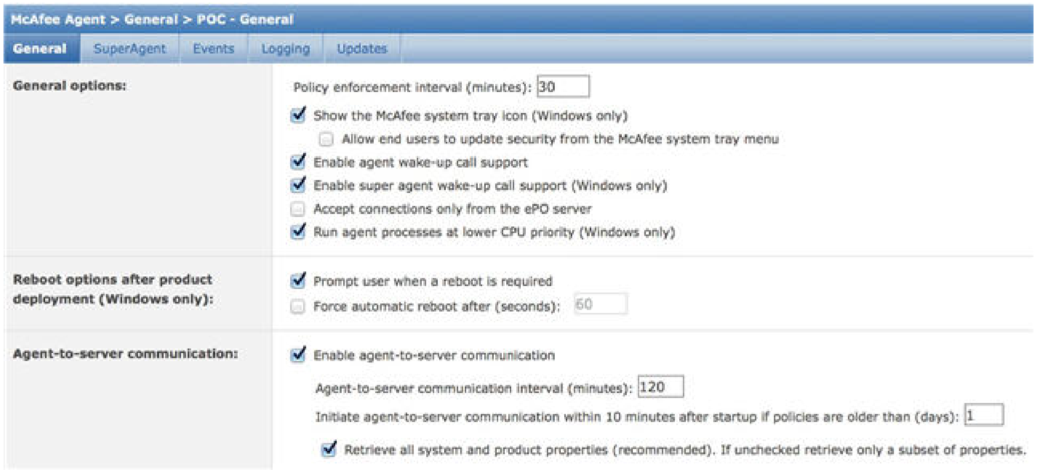
Step 6 Check the **Include Service Version Information** checkbox.

Step 7 Click **Submit**.

Configure the McAfee ePO Agent

Step 1 In your McAfee ePO server, check the recommended settings to facilitate the communication between the McAfee ePO agent and the ISE server.

Figure 1: McAfee ePO Agent Recommended Options



McAfee Agent > General > POC - General

General options:

Policy enforcement interval (minutes): 30

☑ Show the McAfee system tray icon (Windows only)

□ Allow end users to update security from the McAfee system tray menu

☑ Enable agent wake-up call support

☑ Enable super agent wake-up call support (Windows only)

□ Accept connections only from the ePO server

☑ Run agent processes at lower CPU priority (Windows only)

Reboot options after product deployment (Windows only):

☑ Prompt user when a reboot is required

□ Force automatic reboot after (seconds): 60

Agent-to-server communication:

☑ Enable agent-to-server communication

Agent-to-server communication interval (minutes): 120

Initiate agent-to-server communication within 10 minutes after startup if policies are older than (days): 1

☑ Retrieve all system and product properties (recommended). If unchecked retrieve only a subset of properties.

Step 2 Verify that the **Accept Connections Only From The ePO Server** is unchecked.

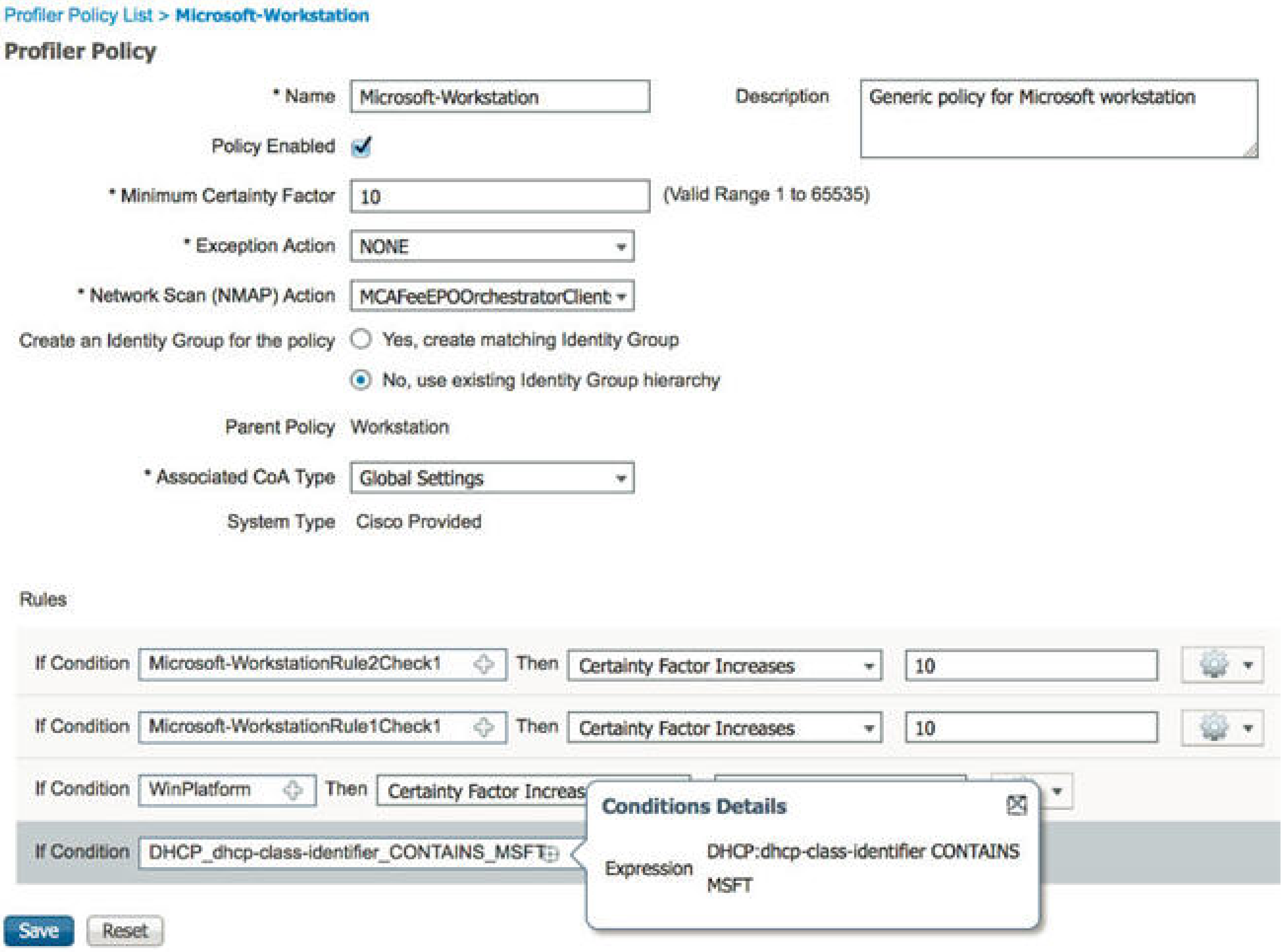
Configure Profiler Policies Using the McAfee ePO NMAP Scan Action

Step 1 Choose **Policy** > **Profiling** > **Add**.

Step 2 Enter the **Name** and **Description**.

Step 3 In the **Network Scan (NMAP) Action** drop-down list, select the required action (for example, MCAFeeEPOOrchestratorClientscan).

Step 4 Create the parent profiler policy (for example, Microsoft-Workstation containing a rule to check if the DHCP class identifier contains the MSFT attribute).


Profiler Policy List > Microsoft-Workstation

Profiler Policy

* Name	Microsoft-Workstation
Description	Generic policy for Microsoft workstation
Policy Enabled	☑
* Minimum Certainty Factor	10 (Valid Range 1 to 65535)
* Exception Action	NONE
* Network Scan (NMAP) Action	MCAFeeEPOOrchestratorClient
Create an Identity Group for the policy	○ Yes, create matching Identity Group ● No, use existing Identity Group hierarchy
Parent Policy	Workstation
* Associated CoA Type	Global Settings
System Type	Cisco Provided

Rules

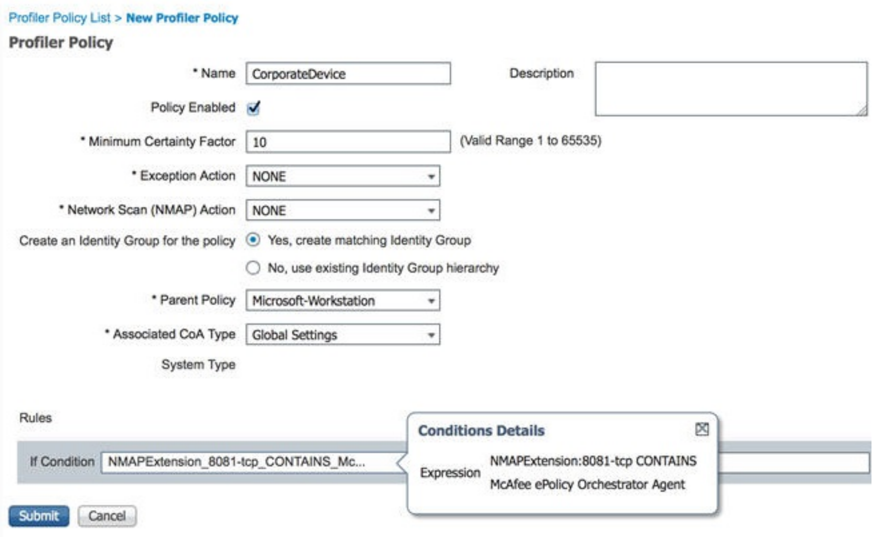
If Condition	Microsoft-WorkstationRule2Check1	Then	Certainty Factor Increases	10
If Condition	Microsoft-WorkstationRule1Check1	Then	Certainty Factor Increases	10
If Condition	WinPlatform	Then	Certainty Factor Increas	
If Condition	DHCP_dhcp-class-identifier_CONTAINS_MSFT			

Conditions Details

Expression DHCP:dhcp-class-identifier CONTAINS MSFT

Step 5 Create a new policy (for example CorporateDevice) within the parent NMAP McAfee ePO policy (for example, Microsoft-Workstation) to check if the McAfee ePO agent is installed on the endpoint.

Endpoints that meet the condition are profiled as corporate devices. You can use the policy to move endpoints profiled with McAfee ePO agent to a new VLAN.



Profiler Policy List > **New Profiler Policy**

Profiler Policy

* Name: CorporateDevice
Description:
Policy Enabled: ☑
* Minimum Certainty Factor: 10 (Valid Range 1 to 65535)
* Exception Action: NONE
* Network Scan (NMAP) Action: NONE
Create an Identity Group for the policy: ● Yes, create matching Identity Group ○ No, use existing Identity Group hierarchy
* Parent Policy: Microsoft-Workstation
* Associated CoA Type: Global Settings
System Type:

Rules

If Condition: NMAPExtension_8081-tcp_CONTAINS_Mc...

Conditions Details
Expression: NMAPExtension:8081-tcp CONTAINS McAfee ePolicy Orchestrator Agent

Profiler Endpoint Custom Attributes

Choose **Administration** > **Identity Management** > **Settings** > **Endpoint Custom Attributes** to assign attributes to endpoints, besides the attributes that the endpoint gathers from the probe. The endpoint custom attributes can be used in authorization policies to profile endpoints.

You can create a maximum of 100 endpoint custom attributes. The types of endpoint custom attributes supported are: Int, String, Long, Boolean, and Float.

You can add values for the endpoint custom attributes in the **Context Directory** > **Endpoints** > **Endpoint Classification** window.

Use cases for endpoint custom attributes include, to allow or block devices based on certain attributes or to assign certain privileges based on the authorization.

Using Endpoint Custom Attributes in Authorization Policy

The endpoint custom attributes section allows you to configure extra attributes. Each definition consists of the attribute and type (String, Int, Boolean, Float, Long). You can profile devices using endpoint custom attributes.

Note You must have a plus or higher license to add custom attributes to the endpoints.

The following steps show how to create an authorization policy using endpoint custom attributes.

Step 1 Create the endpoint custom attributes and assign values.

a) Choose **Administration** > **Identity Management** > **Settings** > **Endpoint Custom Attributes** page.
b) In the **Endpoint Custom Attributes** area, enter the **Attribute Name** (for example, deviceType), Data Type (for example, String) and Parameters.
c) Click **Save**.

d) Choose **Context Visibility** > **Endpoints** > **Summary**.

e) Assign the custom attribute values.

- Check the required MAC address check box, and click **Edit**.
- Or, click the required MAC address, and on the Endpoints page, click **Edit**.

f) In the **Edit Endpoint** dialog box, in the **Custom Attribute** area enter the required attribute values (for example, deviceType = Apple-iPhone).

g) Click **Save**.

Step 2 Create an authorization policy using the custom attributes and values.

a) Choose **Policy** > **Policy Sets**.

b) Create the authorization policy by selecting the custom attributes from the Endpoints dictionary (for example, Rule Name: Corporate Devices, Conditions:EndPoints:deviceType Contains Apple-iPhone, Permissions: then PermitAccess).

c) Click **Save**.

Related Topics

Profiler Endpoint Custom Attributes, on page 41

Create a Profiler Condition

Endpoint profiling policies in Cisco ISE allow you to categorize discovered endpoints on your network, and assign them to specific endpoint identity groups. These endpoint profiling policies are made up of profiling conditions that Cisco ISE evaluates to categorize and group endpoints.

Before you begin

To perform the following task, you must be a Super Admin or Policy Admin.

Step 1 Choose **Policy** > **Policy Elements** > **Conditions** > **Profiling** > **Add**.

Step 2 Enter values for the fields as described in the Endpoint Profiling Policies Settings, on page 43.

Step 3 Click **Submit** to save the profiler condition.

Step 4 Repeat this procedure to create more conditions.

Endpoint Profiling Policy Rules

You can define a rule that allows you to choose one or more profiling conditions from the library that are previously created and saved in the policy elements library, and to associate an integer value for the certainty factor for each condition, or associate either an exception action or a network scan action for that condition. The exception action or the network scan action is used to trigger the configurable action while Cisco ISE is evaluating the profiling policies with respect to the overall classification of endpoints.

When the rules in a given policy are evaluated separately with an OR operator, the certainty metric for each rule contributes to the overall matching of the endpoint profiles into a specific category of endpoints. If the rules of an endpoint profiling policy match, then the profiling policy and the matched policy are the same for that endpoint when they are dynamically discovered on your network.

Logically Grouped Conditions in Rules

An endpoint profiling policy (profile) contains a single condition or a combination of multiple single conditions that are logically combined using an AND or OR operator, against which you can check, categorize, and group endpoints for a given rule in a policy.

A condition is used to check the collected endpoint attribute value against the value specified in the condition for an endpoint. If you map more than one attribute, you can logically group the conditions, which helps you to categorize endpoints on your network. You can check endpoints against one or more such conditions with a corresponding certainty metric (an integer value that you define) associated with it in a rule or trigger an exception action that is associated to the condition or a network scan action that is associated to the condition.

Certainty Factor

The minimum certainty metric in the profiling policy evaluates the matching profile for an endpoint. Each rule in an endpoint profiling policy has a minimum certainty metric (an integer value) associated to the profiling conditions. The certainty metric is a measure that is added for all the valid rules in an endpoint profiling policy, which measures how each condition in an endpoint profiling policy contributes to improve the overall classification of endpoints.

The certainty metric for each rule contributes to the overall matching of the endpoint profiles into a specific category of endpoints. The certainty metric for all the valid rules are added together to form the matching certainty. It must exceed the minimum certainty factor that is defined in an endpoint profiling policy. By default, the minimum certainty factor for all new profiling policy rules and predefined profiling policies is 10.

Endpoint Profiling Policies Settings

Table 13: Endpoint Profiling Policies Settings

Field Name	Usage Guidelines
Name	Enter the name of the endpoint profiling policy that you want to create.
Description	Enter the description of the endpoint profiling policy that you want to create.
Policy Enabled	By default, the **Policy Enabled** check box is checked to associate a matching profiling policy when you profile an endpoint. When unchecked, the endpoint profiling policy is excluded when you profile an endpoint.
Minimum Certainty Factor	Enter the minimum value that you want to associate with the profiling policy. The default value is 10.

Field Name	Usage Guidelines
Exception Action	Choose an exception action, which you want to associate with the conditions when defining a rule in the profiling policy. The default is NONE. The exception actions are defined in the following location: **Policy** > **Policy Elements** > **Results** > **Profiling** > **Exception Actions**.
Network Scan (NMAP) Action	Choose a network scan action from the list, which you want to associate with the conditions when defining a rule in the profiling policy, if required. The default is NONE. The exception actions are defined in the following location: **Policy** > **Policy Elements** > **Results** > **Profiling** > **Network Scan (NMAP) Actions**.
Create an Identity Group for the policy	Check one of the following options to create an endpoint identity group: • **Yes, create matching Identity Group** • **No, use existing Identity Group hierarchy**
Yes, create matching Identity Group	Choose this option to use an existing profiling policy. This option creates a matching identity group for those endpoints and the identity group will be the child of the Profiled endpoint identity group when an endpoint profile matches an existing profiling policy. For example, the Xerox-Device endpoint identity group is created in the Endpoints Identity Groups page when endpoints discovered on your network match the Xerox-Device profile.

Field Name	Usage Guidelines
No, use existing Identity Group hierarchy	Check this check box to assign endpoints to the matching parent endpoint identity group using hierarchical construction of profiling policies and identity groups. This option allows you to make use of the endpoint profiling policies hierarchy to assign endpoints to one of the matching parent endpoint identity groups, as well as to the associated endpoint identity groups to the parent identity group. For example, endpoints that match an existing profile are grouped under the appropriate parent endpoint identity group. Here, endpoints that match the Unknown profile are grouped under Unknown, and endpoints that match an existing profile are grouped under the Profiled endpoint identity group. For example, • If endpoints match the Cisco-IP-Phone profile, then they are grouped under the Cisco-IP-Phone endpoint identity group. • If endpoints match the Workstation profile, then they are grouped under the Workstation endpoint identity group. The Cisco-IP-Phone and Workstation endpoint identity groups are associated to the Profiled endpoint identity group in the system.
Parent Policy	Choose a parent profiling policy that are defined in the system to which you want to associate the new endpoint profiling policy. You can choose a parent profiling policy from which you can inherit rules and conditions to its child.
Associated CoA Type	Choose one of the following CoA types that you want to associate with the endpoint profiling policy: • No CoA • Port Bounce • Reauth • Global Settings that is applied from the profiler configuration set in Administration > System > Settings > Profiling

Field Name	Usage Guidelines
Rules	One or more rules that are defined in endpoint profiling policies determine the matching profiling policy for endpoints, which allows you to group endpoints according to their profiles. One or more profiling conditions from the policy elements library are used in rules for validating endpoint attributes and their values for the overall classification.
Conditions	Click the plus [+] sign to expand the Conditions anchored overlay, and click the minus [-] sign, or click outside the anchored overlay to close it. Click **Select Existing Condition from Library** or **Create New Condition (Advanced Option)** . **Select Existing Condition from Library**: You can define an expression by selecting Cisco predefined conditions from the policy elements library. **Create New Condition (Advanced Option)**: You can define an expression by selecting attributes from various system or user-defined dictionaries. You can associate one of the following with the profiling conditions: • An integer value for the certainty factor for each condition • Either an exception action or a network scan action for that condition Choose one of the following predefined settings to associate with the profiling condition: • Certainty Factor Increases: Enter the certainty value for each rule, which can be added for all the matching rules with respect to the overall classification. • Take Exception Action: Triggers an exception action that is configured in the Exception Action field for this endpoint profiling policy. • Take Network Scan Action: Triggers a network scan action that is configured in the Network Scan (NMAP) Action field for this endpoint profiling policy.

Field Name	Usage Guidelines
Select Existing Condition from Library	You can do the following: • You can choose Cisco predefined conditions that are available in the policy elements library, and then use an AND or OR operator to add multiple conditions. • Click the Action icon to do the following in the subsequent steps: • **Add Attribute or Value**: You can add ad-hoc attribute or value pairs • **Add Condition from Library**: You can add Cisco predefined conditions • **Duplicate**: Create a copy of the selected condition • **Add Condition to Library**: You can save ad-hoc attribute/value pairs that you create to the policy elements library • **Delete**: Delete the selected condition.
Create New Condition (Advance Option)	You can do the following: • You can add ad-hoc attribute/value pairs to your expression, and then use an AND or OR operator to add multiple conditions. • Click the Action icon to do the following in the subsequent steps: • **Add Attribute or Value**: You can add ad-hoc attribute or value pairs • **Add Condition from Library**: You can add Cisco predefined conditions • **Duplicate**: Create a copy of the selected condition • **Add Condition to Library**: You can save ad-hoc attribute/value pairs that you create to the policy elements library • **Delete**: Delete the selected condition. You can use the AND or OR operator

Related Topics

Cisco ISE Profiling Service, on page 1

Create Endpoint Profiling Policies, on page 48

Endpoint Context Visibility Using UDID Attribute

Create Endpoint Profiling Policies

You can create new profiling policies to profile endpoints by using the following options in the New Profiler Policy page:

- Policy Enabled
- Create an Identity Group for the policy to create a matching endpoint identity group or use the endpoint identity group hierarchy
- Parent Policy
- Associated CoA Type

Note When you choose to create an endpoint policy in the **Profiling Policies** window, do not use the Stop button on your web browsers. This action leads to the following: stops loading the **New Profiler Policy** window, loads other list pages and the menus within the list pages when you access them, and prevents you from performing operations on all the menus within the list pages except the Filter menus. You might need to log out of Cisco ISE, and then log in again to perform operations on all the menus within the list pages.

You can create a similar characteristic profiling policy by duplicating an endpoint profiling policy through which you can modify an existing profiling policy instead of creating a new profiling policy by redefining all conditions.

Step 1 Choose **Policy** > **Profiling** > **Profiling Policies**.

Step 2 Click **Add**.

Step 3 Enter a name and description for the new endpoint policy that you want to create. The **Policy Enabled** check box is checked by default to include the endpoint profiling policy for validation when you profile an endpoint.

Step 4 Enter a value for the minimum certainty factor within the valid range 1 to 65535.

Step 5 Click the arrow next to the **Exception Action** drop-down list to associate an exception action or click the arrow next to the **Network Scan (NMAP) Action** drop-down list to associate a network scan action.

Step 6 Choose one of the following options for **Create an Identity Group for the policy**:

- **Yes, create matching Identity Group**
- **No, use existing Identity Group hierarchy**

Step 7 Click the arrow next to the **Parent Policy** drop-down list to associate a parent policy to the new endpoint policy.

Step 8 Choose a CoA type to be associated in the **Associated CoA Type** drop-down list.

Step 9 Click in the rule to add conditions and associate an integer value for the certainty factor for each condition or associate either an exception action or a network scan action for that condition for the overall classification of an endpoint.

Step 10 Click **Submit** to add an endpoint policy or click the **Profiler Policy List** link from the New Profiler Policy page to return to the Profiling Policies page.

Change of Authorization Configuration for Each Endpoint Profiling Policy

In addition to the global configuration of change of authorization (CoA) types in Cisco ISE, you can also configure to issue a specific type of CoA associated for each endpoint profiling policy.

The global No CoA type configuration overrides each CoA type configured in an endpoint profiling policy. If the global CoA type is set other than the No CoA type, then each endpoint profiling policy is allowed to override the global CoA configuration.

When a CoA is triggered, each endpoint profiling policy can determine the actual CoA type, as follows:

- General Setting—This is the default setting for all the endpoint profiling policies that issues a CoA per global configuration.
- No CoA—This setting overrides any global configuration and disables CoA for the profile.
- Port Bounce—This setting overrides the global Port Bounce and Reauth configuration types, and issues port bounce CoA.
- Reauth—This setting overrides the global Port Bounce and Reauth configuration types, and issues reauthentication CoA.

Note If the profiler global CoA configuration is set to Port Bounce (or Reauth), ensure that you configure corresponding endpoint profiling policies with No CoA, the per-policy CoA option so that the BYOD flow does not break for your mobile devices.

See the summary of configuration below combined for all the CoA types and the actual CoA type issued in each case based on the global and endpoint profiling policy settings.

Table 14: CoA Type Issued for Various Combination of Configuration

Global CoA Type	Default CoA Type set per Policy	No coA Type per Policy	Port Bounce Type per Policy	Reauth Type per Policy
No CoA	No CoA	No CoA	No CoA	No CoA
Port Bounce	Port Bounce	No CoA	Port Bounce	Re-Auth
Reauth	Reauth	No CoA	Port Bounce	Re-Auth

Import Endpoint Profiling Policies

You can import endpoint profiling policies from a file in XML by using the same format that you can create in the export function. If you import newly created profiling policies that have parent policies associated, then you must have defined parent policies before you define child policies.

The imported file contains the hierarchy of endpoint profiling policies that contain the parent policy first, then the profile that you imported next along with the rules and checks that are defined in the policy.

Step 1 Choose **Policy** > **Profiling** > **Profiling** > **Profiling Policies**.

Step 2 Click **Import**.

Step 3 Click **Browse** to locate the file that you previously exported and want to import.

Step 4 Click **Submit**.

Step 5 Click the **Profiler Policy List** link to return to the **Profiling Policies** window.

Export Endpoint Profiling Policies

You can export endpoint profiling policies to other Cisco ISE deployments. Or, you can use the XML file as a template for creating your own policies to import. You can also download the file to your system in the default location, which can be used for importing later.

A dialog appears when you want to export endpoint profiling policies, which prompts you to open the profiler_policies.xml with an appropriate application or save it. This is a file in XML format that you can open in a web browser, or in other appropriate applications.

Step 1 Choose **Policy** > **Profiling** > **Profiling** > **Profiling Policies**.

Step 2 Choose **Export**, and choose one of the following:

- **Export Selected**: You can export only the selected endpoint profiling policies in the **Profiling Policies** window.
- **Export Selected with Endpoints**: You can export the selected endpoint profiling policies, and the endpoints that are profiled with the selected endpoint profiling policies.
- **Export All**: By default, you can export all the profiling policies in the **Profiling Policies** window.

Step 3 Click **OK** to export the endpoint profiling policies in the profiler_policies.xml file.

Predefined Endpoint Profiling Policies

Cisco ISE includes predefined default profiling policies when Cisco ISE is deployed, and their hierarchical construction allows you to categorize identified endpoints on your network, and assign them to a matching endpoint identity groups. Because endpoint profiling policies are hierarchical, you can find that the **Profiling Policies** window displays the list of generic (parent) policies for devices and child policies to which their parent policies are associated in the Profiling Policies listing window.

The **Profiling Policies** window displays endpoint profiling policies with their names, type, description and the status, if enabled or not for validation.

The endpoint profiling policy types are classified as follows:

- Cisco Provided: Endpoint profiling policies that are predefined in Cisco ISE are identified as the Cisco Provided type.

  - Administrator Modified: Endpoint profiling policies are identified as the Administrator Modified type when you modify predefined endpoint profiling policies. Cisco ISE overwrites changes that you have made in the predefined endpoint profiling policies during upgrade.

- Administrator Created: Endpoint profiling policies that you create or when you duplicate Cisco-provided endpoint profiling policies are identified as the Administrator Created type.

We recommend that you create a generic policy (a parent) for a set of endpoints from which its children can inherit the rules and conditions. If an endpoint has to be classified, then the endpoint profile has to first match the parent, and then its descendant (child) policies when you are profiling an endpoint.

For example, Cisco-Device is a generic endpoint profiling policy for all Cisco devices, and other policies for Cisco devices are children of Cisco-Device. If an endpoint has to be classified as a Cisco-IP-Phone 7960, then the endpoint profile for this endpoint has to first match the parent Cisco-Device policy, its child Cisco-IP-Phone policy, and then the Cisco-IP-Phone 7960 profiling policy for better classification.

Note Cisco ISE will not overwrite the Administrator Modified policies nor their children policies even if they are still labeled as Cisco Provided. If an Administrator Modified policy is deleted, it reverts back to the previous Cisco Provided policy. Next time when Feed Update happens, all children policies are updated.

Predefined Endpoint Profiling Policies Overwritten During Upgrade

You can edit existing endpoint profiling policies in the Profiling Policies page. You must also save all your configurations in a copy of the predefined endpoint profiles when you want to modify the predefined endpoint profiling policies.

During an upgrade, Cisco ISE overwrites any configuration that you have saved in the predefined endpoint profiles.

Unable to Delete Endpoint Profiling Policies

You can delete selected or all the endpoint profiling policies in the **Profiling Policies** window. By default, you can delete all the endpoint profiling policies from the **Profiling Policies** window. When you select all the endpoint profiling policies and try to delete them in the **Profiling Policies** window, some of them may not be deleted, if the endpoint profiling policies are mapped to other endpoint profiling policies or mapped to an authorization policy.

- You cannot delete Cisco Provided endpoint profiling policies.

- You cannot delete a parent profile in the **Profiling Policies** window when an endpoint profile is defined as a parent to other endpoint profiles. For example, Cisco-Device is a parent to other endpoint profiling policies for Cisco devices.

- You cannot delete an endpoint profile when it is mapped to an authorization policy. For example, Cisco-IP-Phone is mapped to the Profiled Cisco IP Phones authorization policy, and it is a parent to other endpoint profiling policies for Cisco IP Phones.

Predefined Profiling Policies for Draeger Medical Devices

Cisco ISE contains default endpoint profiling policies that include a generic policy for Draeger medical devices, a policy for Draeger-Delta medical device, and a policy for Draeger-M300 medical device. Both the medical devices share ports 2050 and 2150, and therefore you cannot classify the Draeger-Delta and Draeger-M300 medical devices when you are using the default Draeger endpoint profiling policies.

If these Draeger devices share ports 2050 and 2150 in your environment, you must add a rule in addition to checking for the device destination IP address in the default Draeger-Delta and Draeger-M300 endpoint profiling policies so that you can distinquish these medical devices.

Cisco ISE includes the following profiling conditions that are used in the endpoint profiling policies for the Draeger medical devices:

- Draeger-Delta-PortCheck1 that contains port 2000
- Draeger-Delta-PortCheck2 that contains port 2050
- Draeger-Delta-PortCheck3 that contains port 2100
- Draeger-Delta-PortCheck4 that contains port 2150
- Draeger-M300PortCheck1 that contains port 1950
- Draeger-M300PortCheck2 that contains port 2050
- Draeger-M300PortCheck3 that contains port 2150

Endpoint Profiling Policy for Unknown Endpoints

An endpoint that does not match existing profiles and cannot be profiled in Cisco ISE is an unknown endpoint. An unknown profile is the default system profiling policy that is assigned to an endpoint, where an attribute or a set of attributes collected for that endpoint do not match with existing profiles in Cisco ISE.

An Unknown profile is assigned in the following scenarios:

- When an endpoint is dynamically discovered in Cisco ISE, and there is no matching endpoint profiling policy for that endpoint, it is assigned to the unknown profile.
- When an endpoint is statically added in Cisco ISE, and there is no matching endpoint profiling policy for a statically added endpoint, it is assigned to the unknown profile.

  If you have statically added an endpoint to your network, the statically added endpoint is not profiled by the profiling service in Cisco ISE. You can change the unknown profile later to an appropriate profile and Cisco ISE will not reassign the profiling policy that you have assigned.

Endpoint Profiling Policy for Statically Added Endpoints

For the endpoint that is statically added to be profiled, the profiling service computes a profile for the endpoint by adding a new MATCHEDPROFILE attribute to the endpoint. The computed profile is the actual profile of an endpoint if that endpoint is dynamically profiled. This allows you to find the mismatch between the computed profile for statically added endpoints and the matching profile for dynamically profiled endpoints.

Endpoint Profiling Policy for Static IP Devices

If you have an endpoint with a statically assigned IP address, you can create a profile for such static IP devices.

You must enable the RADIUS probe or SNMP Query and SNMP Trap probes to profile an endpoint that has a static IP address.

Endpoint Profiling Policy Matching

Cisco ISE always considers a chosen policy for an endpoint that is the matched policy rather than an evaluated policy when the profiling conditions that are defined in one or more rules are met in a profiling policy. Here, the status of static assignment for that endpoint is set to false in the system. But, this can be set to true after it is statically reassigned to an existing profiling policy in the system, by using the static assignment feature during an endpoint editing.

The following apply to the matched policies of endpoints:

- For statically assigned endpoint, the profiling service computes the MATCHEDPROFILE.
- For dynamically assigned endpoints, the MATCHEDPROFILEs are identical to the matching endpoint profiles.

You can determine a matching profiling policy for dynamic endpoints using one or more rules that are defined in a profiling policy and assign appropriately an endpoint identity group for categorization.

When an endpoint is mapped to an existing policy, the profiling service searches the hierarchy of profiling policies for the closest parent profile that has a matching group of policies and assigns the endpoint to the appropriate endpoint policy.

Endpoint Profiling Policies Used for Authorization

You can use an endpoint profiling policy in authorization rules, where you can create a new condition to include a check for an endpoint profiling policy as an attribute, and the attribute value assumes the name of the endpoint profiling policy. You can select an endpoint profiling policy from the endpoints dictionary, which includes the following attributes: PostureApplicable, EndPointPolicy, LogicalProfile, and BYODRegistration.

The attribute value for PostureApplicable is auto set based on the operating system. It is set to *No* for IOS and Android devices because AnyConnect support is not available on those platforms to perform Posture. The value is set as *Yes* for Mac OSX and Windows devices.

You can define an authorization rule that includes a combination of EndPointPolicy, BYODRegistration, and identity groups.

Endpoint Profiling Policies Grouped into Logical Profiles

A logical profile is a container for a category of profiles or associated profiles, irrespective of Cisco-provided or administrator-created endpoint profiling policies. An endpoint profiling policy can be associated to multiple logical profiles.

You can use the logical profile in an authorization policy condition to help create an overall network access policy for a category of profiles. You can create a simple condition for authorization, which can be included in the authorization rule. The attribute-value pair that you can use in the authorization condition is the logical profile (attribute) and the name of the logical profile (value), which can be found in the EndPoints systems dictionary.

For example, you can create a logical profile for all mobile devices like Android, Apple iPhone, or Blackberry by assigning matching endpoint profiling policies for that category to the logical profile. Cisco ISE contains IP-Phone, a default logical profile for all the IP phones, which includes IP-Phone, Cisco-IP-Phone, Nortel-IP-Phone-2000-Series, and Avaya-IP-Phone profiles.

Create Logical Profiles

You can create a logical profile that you can use to group a category of endpoint profiling policies, which allows you to create an overall category of profiles or associated profiles. You can also remove the endpoint profiling policies from the assigned set moving them back to the available set. For more information about Logical Profiles, see Endpoint Profiling Policies Grouped into Logical Profiles, on page 53.

Step 1 Choose **Policy** > **Profiling** > **Profiling** > **Logical Profiles**.

Step 2 Click **Add**.

Step 3 Enter a name and description for the new logical profile in the text boxes for **Name** and **Description**.

Step 4 Choose endpoint profiling policies from the **Available Policies** to assign them in a logical profile.

Step 5 Click the right arrow to move the selected endpoint profiling policies to the **Assigned Policies**.

Step 6 Click **Submit**.

Profiling Exception Actions

An exception action is a single configurable action that can be referred to in an endpoint profiling policy, and that is triggered when the exception conditions that are associated with the action are met.

Exception Actions can be any one of the following types:

- Cisco-provided—You can not delete Cisco-provided exception actions. Cisco ISE triggers the following noneditable profiling exception actions from the system when you want to profile endpoints in Cisco ISE:
  - Authorization Change—The profiling service issues a change of authorization when an endpoint is added or removed from an endpoint identity group that is used by an authorization policy.
  - Endpoint Delete—An exception action is triggered in Cisco ISE and a CoA is issued when an endpoint is deleted from the system in the Endpoints page, or reassigned to the unknown profile from the edit page on a Cisco ISE network.
  - FirstTimeProfiled—An exception action is triggered in Cisco ISE and a CoA is issued when an endpoint is profiled in Cisco ISE for the first time, where the profile of that endpoint changes from an unknown profile to an existing profile but that endpoint is not successfully authenticated on a Cisco ISE network.
- Administrator-created—Cisco ISE triggers profiling exception actions that you create.

Create Exception Actions

You can define and associate one or more exception rules to a single profiling policy. This association triggers an exception action (a single configurable action) when the profiling policy matches and at least one of the exception rules matches in the profiling endpoints in Cisco ISE.

Step 1 Choose **Policy** > **Policy Elements** > **Results** > **Profiling** > **Exception Actions**.

Step 2 Click **Add**.

Step 3 Enter a name and description for the exception action in the text boxes for **Name** and **Description**.

Step 4 Check the **CoA Action** check box.

Step 5 Click the **Policy Assignment** drop-down list to choose an endpoint policy.

Step 6 Click **Submit**.

Create Endpoints with Static Assignments of Policies and Identity Groups

You can create a new endpoint statically by using the MAC address of an endpoint in the Endpoints page. You can also choose an endpoint profiling policy and an identity group in the Endpoints page for static assignment.

The regular and mobile device (MDM) endpoints are displayed in the Endpoints Identities list. In the listing page, columns for attributes like Hostname, Device Type, Device Identifier for MDM endpoints are displayed. Other columns like Static Assignment and Static Group Assignment are not displayed by default.

Note You cannot add, edit, delete, import, or export MDM Endpoints using this page.

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

Step 2 Click **Add**.

Step 3 Enter the MAC address of an endpoint in hexadecimal format and separated by a colon.

Step 4 Choose a matching endpoint policy from the **Policy Assignment** drop-down list to change the static assignment status from dynamic to static.

Step 5 Check the **Static Assignment** check box to change the status of static assignment that is assigned to the endpoint from dynamic to static.

Step 6 Choose an endpoint identity group to which you want to assign the newly created endpoint from the **Identity Group Assignment** drop-down list.

Step 7 Check the **Static Group Assignment** check box to change the dynamic assignment of an endpoint identity group to static.

Step 8 Click **Submit**.

Import Endpoints Using a CSV File

You can import endpoints from a CSV file that you have created from a Cisco ISE template and update it with endpoint details. Endpoints exported from Cisco ISE contains around 90 attributes and therefore cannot be imported directly into another ISE deployment. If columns that are not allowed for import are present in the CSV file, a message with the list of attributes that cannot be imported is displayed. You must delete the specified columns before trying to import the file again.

There are about 31 attributes that can be imported. The list includes MACAddress, EndPointPolicy, and IdentityGroup. Optional attributes are:

Description	PortalUser	LastName
PortalUser.GuestType	PortalUser.FirstName	EmailAddress
PortalUser.Location	Device Type	host-name
PortalUser.GuestStatus	StaticAssignment	Location
PortalUser.CreationType	StaticGroupAssignment	MDMEnrolled
PortalUser.EmailAddress	User-Name	MDMOSVersion
PortalUser.PhoneNumber	DeviceRegistrationStatus	MDMServerName
PortalUser.LastName	AUPAccepted	MDMServerID
PortalUser.GuestSponsor	FirstName	BYODRegistration
CUSTOM.<custom attribute name>	—	—

The file header has to be in the format as specified in the default import template so that the list of endpoints appear in this order: MACAddress, EndpointPolicy, IdentityGroup <List of attributes listed above as optional attributes>. You can create the following file templates:

- MACAddress
- MACAddress, EndPointPolicy
- MACAddress, EndPointPolicy, IdentityGroup
- MACAddress, EndPointPolicy, IdentityGroup, <List of attributes listed above as optional attributes>

All attribute values, except MAC address, are optional for importing endpoints from a CSV file. If you want to import endpoints without certain values, the values are still separated by a comma. For example,

- MAC1, Endpoint Policy1, Endpoint Identity Group1
- MAC2
- MAC3, Endpoint Policy3
- MAC4, , Endpoint Identity Group4
- MAC5, , Endpoint Identity Group5, MyDescription, MyPortalUser, and so on

To import the endpoints using a CSV file:

Step 1 Choose **Context Visibility** > **Endpoints** > **Import** .

Step 2 Click **Import From File**.

Step 3 Click **Browse** to locate the CSV file that you have already created.

Step 4 Click **Submit**.

To import endpoint custom attributes, you have to create the same custom attributes as in the CSV file in the **Administration** > **Identity Management** > **Settings** > **Endpoint Custom Attributes** window using the correct data types. These attributes have to be prefixed with CUSTOM to differentiate them from endpoint attributes.

Default Import Template Available for Endpoints

You can generate a template in which you can update endpoints that can be used to import endpoints. By default, you can use the Generate a Template link to create a CSV file in the Microsoft Office Excel application and save the file locally on your system. The file can be found in **Context Visibility** > **Endpoints** > **Import** > **Import From File**. You can use the Generate a Template link to create a template, and the Cisco ISE server will display the Opening template.csv dialog. This dialog allows you to open the default template.csv file, or save the template.csv file locally on your system. If you choose to open the template.csv file from the dialog, the file opens in the Microsoft Office Excel application. The default template.csv file contains a header row that displays the MAC address, Endpoint Policy, and Endpoint Identity Group, and other optional attributes.

You must update the MAC addresses of endpoints, endpoint profiling policies, endpoint identity groups along with any of the optional attribute values you wish to import, and save the file with a new file name. This file can be used to import endpoints. See the header row in the template.csv file that is created when you use the Generate a Template link.

Table 15: CSV Template File

MAC	EndpointPolicy	IdentityGroup	Other Optional Attributes
11:11:11:11:11:11	Android	Profiled	<Empty>/<Value>

Unknown Endpoints Reprofiled During Import

If the file used for import contains endpoints that have their MAC addresses, and their assigned endpoint profiling policies is the Unknown profile, then those endpoints are immediately reprofiled in Cisco ISE to the matching endpoint profiling policies during import. However, they are not statically assigned to the Unknown profile. If endpoints do not have endpoint profiling policies assigned to them in the CSV file, then they are assigned to the Unknown profile, and then reprofiled to the matching endpoint profiling policies. See below how Cisco ISE reprofiles Unknown profiles that match the Xerox_Device profile during import and also how Cisco ISE reprofiles an endpoint that is unassigned.

Table 16: Unknown Profiles: Import from a File

MAC Address	Endpoint Profiling Policy Assigned Before Import in Cisco ISE	Endpoint Profiling Policy Assigned After Import in Cisco ISE
00:00:00:00:01:02	Unknown	Xerox-Device
00:00:00:00:01:03	Unknown	Xerox-Device

MAC Address	Endpoint Profiling Policy Assigned Before Import in Cisco ISE	Endpoint Profiling Policy Assigned After Import in Cisco ISE
00:00:00:00:01:04	Unknown	Xerox-Device
00:00:00:00:01:05	If no profile is assigned to an endpoint, then it is assigned to the Unknown profile, and also reprofiled to the matching profile.	Xerox-Device

Endpoints with Invalid Attributes Not Imported

If any of the endpoints present in the CSV file have invalid attributes, then the endpoints are not imported and an error message is displayed.

For example, if endpoints are assigned to invalid profiles in the file used for import, then they are not imported because there are no matching profiles in Cisco ISE. See below how endpoints are not imported when they are assigned to invalid profiles in the CSV file.

Table 17: Invalid Profiles: Import from a File

MAC Address	Endpoint Profiling Policy Assigned Before Import in Cisco ISE	Endpoint Profiling Policy Assigned After Import in Cisco ISE
00:00:00:00:01:02	Unknown	Xerox-Device
00:00:00:00:01:05	If an endpoint such as 00:00:00:00:01:05 is assigned to an invalid profile other than the profiles that are available in Cisco ISE, then Cisco ISE displays a warning message that the policy name is invalid and the endpoint will not be imported.	The endpoint is not imported because there is no matching profile in Cisco ISE.

Import Endpoints from LDAP Server

You can import the MAC addresses, the associated profiles, and the endpoint identity groups of endpoints securely from an LDAP server.

Before you begin

Before you begin to import endpoints, ensure that you have installed the LDAP server.

You have to configure the connection settings and query settings before you can import from an LDAP server. If the connection settings or query settings are configured incorrectly in Cisco ISE, then the “LDAP import failed:” error message appears.

Step 1 Choose **Context Visibility** > **Endpoints** > **Import** > **Import from LDAP**.

Step 2 Enter the values for the connection settings.

Step 3 Enter the values for the query settings.

Step 4 Click **Submit**.

Export Endpoints Using CSV File

You can export all the endpoints or only the selected endpoints using a CSV file. The endpoints are listed with around 90 attributes along with their MAC addresses, endpoint profiling policies, and endpoint identity groups. The custom attributes are also exported to the CSV file and are prefixed with CUSTOM to differentiate them from other endpoint attributes.

Note To import endpoint custom attributes that are exported from one deployment to another, you must create the same custom attributes in the **Administration** > **Identity Management** > **Settings** > **Endpoint Custom Attributes** window and use the same data type as specified in the original deployment.

Export All exports all the endpoints in Cisco ISE, whereas **Export Selected** exports only the endpoints selected by the user. By default, the profiler_endpoints.csv is the CSV file and Microsoft Office Excel is the default application to open the CSV file.

To export the endpoints using a CSV file:

Step 1 Choose **Context Visibility** > **Endpoints**.

Step 2 From the **Export** drop-down list, choose one of the following options:

Step 3 Click **OK** to save the CSV file.

Most of the attributes in the exported spreadsheet are simple. The following attributes require an explanation:

- *UpdateTime*: The last time that the profiler updated the endpoint, due to a change to an endpoint attribute. The value is 0 if there have been no updates since the endpoint session started. It will be blank briefly, during an update
- *InactivityTime*: Time since the endpoint was active.

Identified Endpoints

Cisco ISE displays identified endpoints that connect to your network and use resources on your network in the **Endpoints** window. An endpoint is typically a network-capable device that connect to your network through wired and wireless network access devices and VPN. Endpoints can be personal computers, laptops, IP phones, smart phones, gaming consoles, printers, fax machines, and so on.

The MAC address of an endpoint, expressed in hexadecimal form, is always the unique representation of an endpoint, but you can also identify an endpoint with a varying set of attributes and the values associated to them, called an attribute-value pair. You can collect a varying set of attributes for endpoints based on the endpoint capability, the capability and configuration of the network access devices and the methods (probes) that you use to collect these attributes.

Dynamically Profiled Endpoints

When endpoints are discovered on your network, they can be profiled dynamically based on the configured profiling endpoint profiling policies, and assigned to the matching endpoint identity groups depending on their profiles.

Statically Profiled Endpoints

An endpoint can be profiled statically when you create an endpoint with its MAC address and associate a profile to it along with an endpoint identity group in Cisco ISE. Cisco ISE does not reassign the profiling policy and the identity group for statically assigned endpoints.

Unknown Endpoints

If you do not have a matching profiling policy for an endpoint, you can assign an unknown profiling policy (Unknown) and the endpoint therefore will be profiled as Unknown. The endpoint profiled to the Unknown endpoint policy requires that you create a profile with an attribute or a set of attributes collected for that endpoint. The endpoint that does not match any profile is grouped within the Unknown endpoint identity group.

Identified Endpoints Locally Stored in Policy Service Nodes Database

Cisco ISE writes identified endpoints locally in the Policy Service node database. After storing endpoints locally in the database, these endpoints are then made available (remote write) in the Administration node database only when significant attributes change in the endpoints, and replicated to the other Policy Service nodes database.

The following are the significant attributes:

- ip
- EndPointPolicy
- MatchedValue
- StaticAssignment
- StaticGroupAssignment
- MatchedPolicyID
- NmapSubnetScanID
- PortalUser
- DeviceRegistrationStatus
- BYODRegistration

When you change endpoint profile definitions in Cisco ISE, all endpoints have to be reprofiled. A Policy Service node that collects the attributes of endpoints is responsible for reprofiling of those endpoints.

When a Policy Service node starts collecting attributes about an endpoint for which attributes were initially collected by a different Policy Service node, then the endpoint ownership changes to the current Policy Service node. The new Policy Service node will retrieve the latest attributes from the previous Policy Service node and reconcile the collected attributes with those attributes that were already collected.

When a significant attribute changes in the endpoint, attributes of the endpoint are automatically saved in the Administration node database so that you have the latest significant change in the endpoint. If the Policy Service node that owns an endpoint is not available for some reasons, then the Administrator ISE node will reprofile an endpoint that lost the owner and you have to configure a new Policy Service node for such endpoints.

Policy Service Nodes in Cluster

Cisco ISE uses Policy Service node group as a cluster that allows to exchange endpoint attributes when two or more nodes in the cluster collect attributes for the same endpoint. We recommend to create clusters for all Policy Service nodes that reside behind a load balancer.

If a different node other than the current owner receives attributes for the same endpoint, it sends a message across the cluster requesting the latest attributes from the current owner to merge attributes and determine if a change of ownership is needed. If you have not defined a node group in Cisco ISE, it is assumed that all nodes are within one cluster.

There are no changes made to endpoint creation and replication in Cisco ISE. Only the change of ownership for endpoints is decided based on an allowed list of attributes used for profiling that are built from static attributes and dynamic attributes.

Upon subsequent attributes collection, the endpoint is updated on the Administration node, if anyone of the following attributes changes:

- ip
- EndPointPolicy
- MatchedValue
- StaticAssignment
- StaticGroupAssignment
- MatchedPolicyID
- NmapSubnetScanID
- PortalUser
- DeviceRegistrationStatus
- BYODRegistration

When an endpoint is edited and saved in the Administration node, the attributes are retrieved from the current owner of the endpoint.

Create Endpoint Identity Groups

Cisco ISE groups endpoints that it discovers in to the corresponding endpoint identity groups. Cisco ISE comes with several system-defined endpoint identity groups. You can also create additional endpoint identity groups from the **Endpoint Identity Groups** window. You can edit or delete the endpoint identity groups that you have created. You can only edit the description of the system-defined endpoint identity groups. You cannot edit the name of these groups or delete them.

Step 1 Choose **Administration** > **Identity Management** > **Groups** > **Endpoint Identity Groups**.

Step 2 Click **Add**.

Step 3 Enter the **Name** for the endpoint identity group that you want to create (do not include spaces in the name of the endpoint identity group).

Step 4 Enter the **Description** for the endpoint identity group that you want to create.

Step 5 Click the **Parent Group** drop-down list to choose an endpoint identity group to which you want to associate the newly created endpoint identity group.

Step 6 Click **Submit**.

Identified Endpoints Grouped in Endpoint Identity Groups

Cisco ISE groups discovered endpoints into their corresponding endpoint identity groups based on the endpoint profiling policies. Profiling policies are hierarchical, and they are applied at the endpoint identify groups level in Cisco ISE. By grouping endpoints to endpoint identity groups, and applying profiling policies to endpoint identity groups, Cisco ISE enables you to determine the mapping of endpoints to the endpoint profiles by checking corresponding endpoint profiling policies.

Cisco ISE creates a set of endpoint identity groups by default, and allows you to create your own identity groups to which endpoints can be assigned dynamically or statically. You can create an endpoint identity group and associate the identity group to one of the system-created identity groups. You can also assign an endpoint that you create statically to any one of the identity groups that exists in the system, and the profiling service cannot reassign the identity group.

Default Endpoint Identity Groups Created for Endpoints

Cisco ISE creates the following endpoint identity groups:

- blacklist: This endpoint identity group includes endpoints that are statically assigned to this group in Cisco ISE and endpoints that are blocked in the device registration portal. An authorization profile can be defined in Cisco ISE to permit, or deny network access to endpoints in this group.
- GuestEndpoints: This endpoint identity group includes endpoints that are used by guest users.
- Profiled: This endpoint identity group includes endpoints that match endpoint profiling policies except Cisco IP phones and workstations in Cisco ISE.
- RegisteredDevices: This endpoint identity group includes endpoints, which are registered devices that are added by an employee through the devices registration portal. The profiling service continues to profile these devices normally when they are assigned to this group. Endpoints are statically assigned to this group in Cisco ISE, and the profiling service cannot reassign them to any other identity group. These devices will appear like any other endpoint in the endpoints list. You can edit, delete, and block these devices that you added through the device registration portal from the endpoints list in the Endpoints window in Cisco ISE. Devices that you have blocked in the device registration portal are assigned to the blacklist endpoint identity group, and an authorization profile that exists in Cisco ISE redirects blocked devices to a URL, which displays “Unauthorised Network Access”, a default portal page to the blocked devices.
- Unknown: This endpoint identity group includes endpoints that do not match any profile in Cisco ISE.

In addition to the above system created endpoint identity groups, Cisco ISE creates the following endpoint identity groups, which are associated to the Profiled (parent) identity group. A parent group is the default identity group that exists in the system:

- Cisco-IP-Phone: An identity group that contains all the profiled Cisco IP phones on your network.
- Workstation: An identity group that contains all the profiled workstations on your network.

Endpoint Identity Groups Created for Matched Endpoint Profiling Policies

If you have an endpoint policy that matches an existing policy, then the profiling service can create a matching endpoint identity group. This identity group becomes the child of the Profiled endpoint identity group. When you create an endpoint policy, you can check the Create Matching Identity Group check box in the Profiling Policies page to create a matching endpoint identity group. You cannot delete the matching identity group unless the mapping of the profile is removed.

Add Static Endpoints in Endpoint Identity Groups

You can add or remove statically added endpoints in any endpoint identity group.

You can add endpoints from the Endpoints widget only to a specific identity group. If you add an endpoint to the specific endpoint identity group, then the endpoint is moved from the endpoint identity group where it was dynamically grouped earlier.

Upon removal from the endpoint identity group where you recently added an endpoint, the endpoint is reprofiled back to the appropriate identity group. You do not delete endpoints from the system but only remove them from the endpoint identity group.

Step 1 Choose **Administration** > **Identity Management** > **Groups** > **Endpoint Identity Groups**.

Step 2 Choose an endpoint identity group, and click **Edit**.

Step 3 Click **Add**.

Step 4 Choose an endpoint in the Endpoints widget to add the selected endpoint in the endpoint identity group.

Step 5 Click the **Endpoint Group List** link to return to the Endpoint Identity Groups page.

Dynamic Endpoints Reprofiled After Adding or Removing in Identity Groups

If an endpoint identity group assignment is not static, then endpoints are reprofiled after you add or remove them from an endpoint identity group. Endpoints that are identified dynamically by the ISE profiler appear in appropriate endpoint identity groups. If you remove dynamically added endpoints from an endpoint identity group, Cisco ISE displays a message that you have successfully removed endpoints from the identity group but reprofiles them back in the endpoint identity group.

Endpoint Identity Groups Used in Authorization Rules

You can effectively use endpoint identity groups in the authorization policies to provide appropriate network access privileges to the discovered endpoints. For example, an authorization rule for all types of Cisco IP

Phones is available by default in Cisco ISE in the following location: **Policy** > **Policy Sets** > **Default** > **Authorization Policy** .

You must ensure that the endpoint profiling policies are either standalone policies (not a parent to other endpoint profiling policies), or their parent policies of the endpoint profiling policies are not disabled.

Anycast and Profiler Services

Anycast is a networking technique where the same IP address is assigned to two or more hosts and routing is allowed to determine the most appropriate target to receive the data. Similar to the load balancer use cases to provide a single target for profiling data (RADIUS, DHCP relay, SNMP traps, and NetFlow), Anycast allows the sources to be configured with a single IP target to avoid sending the same data to multiple destinations.

The Anycast IP address can be assigned to a real PSN interface IP address or a load balancer virtual IP address to support redundancy across data centers. You must not assign the Anycast IP address to ISE Gigabit Ethernet 0 management interface.

The interface used for Anycast must be a dedicated interface used by the Profiler probe. The same requirement does not apply when the Anycast IP address is assigned to a load balancer virtual IP address.

When using Anycast, it is critical that any node failure be automatically detected and the corresponding route to the failed node be removed from the routing table. If an Anycast target is the only host on the link or VLAN, then failure may result in route being automatically removed.

When IP Anycast is deployed, it is very important to ensure that the route metrics to each target have significant weighting or bias. If the routes to Anycast targets flap or result in an Equal-Cost Multi-Path Routing (ECMP) scenario, then traffic for a given service (RADIUS AAA, DHCP or SNMP Trap Profiling, HTTPS portals) may be distributed to each target resulting in excessive traffic and service failures (RADIUS AAA and HTTPS portals) or suboptimal profiling and database replication (profiling services).

The key advantage of IP Anycast is that it greatly simplifies the configuration on access devices, profile data sources, and DNS. It can also optimize ISE profiling by ensuring that the data for a given endpoint is sent only to a single PSN. Additional route configuration must be carefully planned and managed with appropriate monitors. However, troubleshooting might be difficult because distinct subnetworks and IP addresses are not used.

Profiler Feed Service

Profiler conditions, exception actions, and NMAP scan actions are classified as Cisco-provided or administrator-created, as shown in the System Type attribute. Endpoint profiling policies are classified as Cisco-provided, administrator-created, or administrator- modified. These classifications are shown in the System Type attribute.

You can perform different operations on the profiler conditions, exception actions, NMAP scan actions, and endpoint profiling policies depending on the System Type attribute. You cannot edit or delete Cisco-provided conditions, exception actions, and nmap scan actions. You can not delete Endpoint policies that are provided by Cisco. When you edit policies, they are called administrator-modified. When the feed service updates policies, the administrator-modified policies are replaced by the up-to-date version of the Cisco-provided policy that it was based on.

You can retrieve new and updated endpoint profiling policies and the updated OUI database from the Cisco feed server. You must have a subscription to Cisco ISE. You can also receive e-mail notifications about applied, success, and failure messages. You can send the anonymous information back to Cisco about feed service actions, which helps Cisco improve the feed service.

The OUI database contains the MAC OUIs assigned to vendors. The OUI list is available here: http://standards.ieee.org/develop/regauth/oui/oui.txt

Cisco ISE downloads policies and OUI database updates every day at 1:00 A.M of the local Cisco ISE server time zone. Cisco ISE automatically applies these downloaded feed server policies, and stores the the changes so that you can revert to the previous state. When you revert to a previous state, the new endpoint profiling policies are removed and updated endpoint profiling policies are reverted to the previous state. In addition, the profiler feed service is automatically disabled.

You can also update the feed services manually in offline mode. You can download the updates manually by using this option if you cannot connect your ISE deployments to Cisco feed service.

Note Updates from the Feed Service are not allowed after the license goes Out of Compliance (OOC) for 45 days within a 60-day window period. The license is out of compliance when it has expired, or when the usage exceeds the allowed number of sessions.

Configure Profiler Feed Service

The Profiler Feed Service retrieves new and updated endpoint profiling policies and MAC OUI database updates from the Cisco Feed server. If the Feed Service is unavailable or other errors have occurred, it is reported in the Operations Audit report.

You can configure Cisco ISE to send anonymous feed service usage report back to Cisco, which sends the following information to Cisco:

- Hostname: Cisco ISE hostname
- MaxCount: Total number of endpoints
- ProfiledCount: Profiled endpoints count
- UnknownCount: Unknown endpoints count
- MatchSystemProfilesCount: Cisco Provided profiles count
- UserCreatedProfiles: User created profiles count

You can change the CoA type in a Cisco-provided profiling policy. When the feed service updates that policy, the CoA type will not be changed, but the rest of that policy's attributes will be still be updated.

Before you begin

The Profiler feed service can only be configured from the Cisco ISE Admin portal in a distributed deployment or in a standalone ISE node.

Set up a Simple Mail Transfer Protocol (SMTP) server if you plan to send e-mail notifications from the Admin portal about feed updates (**Administration** > **System** > **Settings**).

To update the Feed Services online:

Step 1 Choose **Administration** > **System** > **Certificates** > **Trusted Certificates**, and check if **QuoVadis Root CA 2** is enabled.

Step 2 Choose **Work Centers** > **Profiler** > **Feeds**.
You can also access the option in the **Administration** > **FeedService** > **Profiler** page.

Step 3 Click the **Online Subscription Update** tab.

Step 4 Click the **Test Feed Service Connection** button to verify that there is a connection to the Cisco Feed Service, and that the certificate is valid.

Step 5 Check the **Enable Online Subscription Update** check box.

Step 6 Enter time in HH:MM format (local time zone of the Cisco ISE server). By default, Cisco ISE feed service is scheduled at 1.00 AM every day.

Step 7 Check the **Notify administrator when download occurs** check box and enter your e-mail address in the **Administrator email address** text box. Check the **Provide Cisco anonymous information to help improve profiling accuracy** check box, if you want to allow Cisco ISE to collect non-sensitive information (that will be used to provide better services and additional features in forthcoming releases).

Step 8 Click **Save**.

Step 9 Click **Update Now**.

Instructs Cisco ISE to contact Cisco feed server for new and updated profiles created since the last feed service update. This re-profiles all endpoints in the system, which may cause an increase the load on the system. Due to updated endpoint profiling policies, there may be changes in the authorization policy for some endpoints that are currently connected to Cisco ISE.

The **Update Now** button is disabled when you update new and updated profiles created since the last feed service and enabled only after the download is completed. You must navigate away from the profiler feed service configuration window and return to this window.

Related Topics

Configure Profiler Feed Services Offline, on page 66

Configure Profiler Feed Services Offline

You can update the feed services offline when Cisco ISE is not directly connected to the Cisco feed server. You can download the offline update package from the Cisco feed server and upload it to Cisco ISE using the offline feed update. You can also set email notifications about new policies that are added to the feed server.

Configuring the profiler feed services offline involves the following tasks:

1. Download Offline Update Package
2. Apply Offline Feed Updates

Download Offline Update Package

Step 1 Choose **Work Centers** > **Profiler** > **Feeds**.
You can also access the option in the **Administration** > **FeedService** > **Profiler** page.

Step 2 Click the **Offline Manual Update** tab.

Step 3 Click **Download Updated Profile Policies** link. You will be redirected to Feed Service Partner Portal.
You can also go to https://ise.cisco.com/partner/ from your browser, to go to the feed service partner portal directly.

Step 4 If you are a first time user, accept the terms and agreements.
An email will be triggered to Feed Services administrator to approve your request. Upon approval, you will receive a confirmation email.

Step 5 Login to the partner portal using your Cisco.com credentials.

Step 6 Choose **Offline Feed** > **Download Package** .

Step 7 Click **Generate Package** .

Step 8 Click the **Click to View the Offline Update Package contents** link to view all the profiles and OUIs that are included in the generated package.

- The policies under Feed Profiler 1 and Feed OUI will be downloaded to all versions of Cisco ISE.
- The policies under Feed Profiler 2 will be downloaded only to Cisco ISE Release 1.3 and later.
- The policies under Feed Profiler 3 will be downloaded only to Cisco ISE Release 2.1 and later.

Step 9 Click **Download Package** and save the file to your local system.
You can upload the saved file to Cisco ISE server to apply the feed updates in the downloaded package.

Apply Offline Feed Updates

Before you begin

You must have downloaded the offline update package before applying the feed updates.

Step 1 Choose **Work Centers** > **Profiler** > **Feeds** .
You can also access the option in the **Administration** > **FeedService** > **Profiler** window.

Step 2 Click the **Offline Manual Update** tab.

Step 3 Click **Browse** and choose the downloaded profiler feed package.

Step 4 Click **Apply Update** .

Configure Email Notifications for Profile and OUI Updates

You can configure your email address to receive notifications on profile and OUI updates.

Step 1 Perform **Step 1** through **Step 5** in the Download Offline Update Package section to go to the Feed Service Partner Portal.

Step 2 Choose **Offline Feed** > **Email Preferences**.

Step 3 Check the **Enable Notifications** checkbox to receive notifications.

Step 4 Choose the number of days from the **days** drop-down list to set the frequency in which you want to receive the notifications on new updates.

Step 5 Enter the e-mail address/addresses and click **Save** .

Undo Feed Updates

You can revert endpoint profiling policies that were updated in the previous update and remove endpoint profiling policies and OUIs that are newly added through the previous update of the profiler feed service .

An endpoint profiling policy, if modified after an update from the feed server is not changed in the system.

Step 1 Choose **Work Centers** > **Profiler** > **Feeds**.

Step 2 Click **Go to Update Report Page** if you want to view the configuration changes made in the Change Configuration Audit report.

Step 3 Click **Undo Latest**.

Profiler Reports

Cisco ISE provides you with various reports on endpoint profiling, and troubleshooting tools that you can use to manage your network. You can generate reports for historical as well as current data. You may be able to drill down on a part of the report to view more details. For large reports, you can also schedule reports and download them in various formats.

You can run the following reports for endpoints from **Operations > Reports > Endpoints and Users**:

- Endpoint Session History
- Profiled Endpoint Summary
- Endpoint Profile Changes
- Top Authorizations by Endpoint
- Registered Endpoints

Detect Anomalous Behavior of Endpoints

Cisco ISE protects your network from the illegitimate use of a MAC address. Cisco ISE detects the endpoints involved in MAC address spoofing and allows you to restrict the permission of the suspicious endpoints.

The following are the two options in the profiler configuration page for Anomalous Behavior:

- Enable Anomalous Behavior Detection
- Enable Anomalous Behavior Enforcement

If you enable Anomalous Behavior detection, Cisco ISE probes for data, and checks for any contradiction to the existing data with respect to changes in attributes related to NAS-Port-Type, DHCP Class Identifier, and Endpoint Policy. If so, an attribute called **AnomalousBehavior** set to true is added to the endpoint which helps you to filter and view the endpoints in the Visibility Context page. Audit logs are also generated for the respective MAC address.

When anomalous behavior detection is enabled, Cisco ISE checks if the following attributes of existing endpoints have changed:

1. Port-Type—Determines if the access method of an endpoint has changed. This only applies when the same MAC address that is connected via Wired Dot1x has been used for Wireless Dot1x and visa-versa.
2. DHCP Class Identifier—Determines whether the type of client or vendor of an endpoint has changed. This only applies when DHCP Class identifier attribute is populated with a certain value and is then changed to another value. If an endpoint is configured with a static IP, the DHCP Class Identifier attribute is empty in Cisco ISE. Later on, if another device spoofs the MAC address of this endpoint and uses DHCP, the Class Identifier changes from an empty value to a specific string. This will not trigger anomalous behavior detection.
3. Endpoint Policy—Determines if there are significant profile changes. This only applies when the profile of an endpoint changes from a “Phone” or “Printer” to a “Workstation”.

If you enable Anomalous Behavior Enforcement, a CoA is issued upon detection of the anomalous Behavior, which can be used to re-authorize the suspicious endpoints, based on the authorization rules configured in the **Profiler Configuration** window.

Set Authorization Policy Rules for Endpoints with Anomalous Behavior

You can choose the action to be taken against any endpoint with anomalous Behavior by setting the corresponding rules on the Authorization Policy page.

Step 1 Choose **Policy** > **Policy Sets**.

Step 2 Click the arrow icon › from the **View** column corresponding to the Default Policy to open the Set view screen and view and manage the default authorization policy.

Step 3 From the **Actions** column on any row, click the cog icon and then from the drop-down list, insert a new authorization rule by selecting any of the insert or duplicate options, as necessary.
A new row appears in the Policy Sets table.

Step 4 Enter the Rule Name.

Step 5 From the **Conditions** column, click the (+) symbol.

Step 6 Create the required conditions in the **Conditions Studio Page**. In the **Editor** section, click the **Click To Add an Attribute** text box, and select the required Dictionary and Attribute (for example, Endpoints.AnomalousBehaviorEqualsTrue).

You can also drag and drop a Library condition to the **Click To Add An Attribute** text box.

Step 7 Click **Use** to set the authorization policy rules for endpoints with anomalous behavior.

Step 8 Click **Done**.

View Endpoints with Anomalous Behavior

You can view the endpoints with anomalous behavior by using any of the following options:

- Click Anomalous Behavior from **Home** > **Summary** > **Metrics**. This action opens a new tab with Anomalous Behaviour column in the lower pane of the window.
- Choose **Context Visibility** > **Endpoints** > **Endpoint Classification**. You can view the Anomalous Behaviour column in the lower pane of the window.

- You can create a new Anomalous Behavior column in Authentication view or Compromised Endpoints view in the Context Visibility window as explained in the following steps:

Step 1 Choose **Context Visibility** > **Endpoints** > **Authentication** or **Context Visibility** > **Endpoints** > **Compromised Endpoints**.

Step 2 Click the Settings icon in the lower pane of the window and check **Anomalous Behavior** check box..

Step 3 Click **Go**.

You can view the Anomalous Behavior column in the Authentication or Compromised Endpoints View.