



Configuring Quality of Service

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About EasyQoS

Quality of service (QoS) refers to the ability of a network to provide preferential or deferential service to selected network traffic. The Cisco APIC-EM enables you to configure quality of service on the devices in your network using the EasyQoS feature.

You define the scope of the devices that you want to apply a QoS policy on. Then you define the QoS policy for the scope. The Cisco APIC-EM takes your selections, translates them into the proper device command line interface (CLI) commands, and deploys them onto the devices defined in the scope.

EasyQoS configures quality of service policies on devices based on the QoS feature set available on the device. For more information about a specific device's QoS implementation, see the device product documentation.



Note

To configure QoS on the devices in your network, you must be assigned either administrative permissions (ADMIN_ROLE) or policy administrator permissions (POLICY_ADMIN_ROLE) to use EasyQoS. For information, see [Managing Users](#).

Understanding QoS Policies

A QoS policy defines how network traffic should be handled so that you can make the most efficient use of network resources while still adhering to the objectives of the business (such as guaranteeing voice quality meets enterprise standards or ensuring a high Quality of Experience (QoE) for video). To achieve these goals, a policy comprises the following elements:

- **Policy Scope**—Group of devices that will be configured with a policy.
- **Applications**—Software programs or network signaling protocols that are being used in your network. EasyQoS includes the Cisco Network Based Application Recognition, second generation (NBAR2) application library of approximately 1300 distinct applications. For more information about NBAR2, see the following URL: <http://www.cisco.com/c/en/us/products/ios-nx-os-software/network-based-application-recognition-nbar/index.html>.
- **Business-relevance**—Attribute that classifies a given application according to how relevant it is to your business and operations. The attributes are business relevant, default, and business irrelevant. For information, see [Business-Relevance Groups](#), on page 4.

EasyQoS comes with the Cisco NBAR2 applications preconfigured into application categories and sorted into business-relevancy groups. You can apply this preconfigured policy to your network devices, or you can modify it to meet the needs of your business objectives and your network configuration.

For example, YouTube is set as business-irrelevant (by default), because most customers typically classify this application this way. However, this classification may not be the true for all companies; for example, some businesses may be using YouTube for training purposes. In such cases, an administrator can change this business-relevancy setting to **business-relevant** to align with their business objectives.

The QoS trust and QoS queuing functionality is preconfigured for the current release and cannot be changed. QoS trust and QoS queuing is set per device according to the Cisco Validated Design (CVD) for Enterprise Medianet Quality of Service Design.

The latest validated designs are published in the Cisco Press book, *End-to-End QoS Network Design: Quality of Service for Rich-Media & Cloud Networks*, 2nd Edition, available at: <http://www.ciscopress.com/store/end-to-end-qos-network-design-quality-of-service-for-9781587143694>. For additional information about Cisco Validated Design (CVD) for Enterprise Medianet Quality of Service, see the following Cisco documentation:

- [Cisco Validated Designs](#)
- [Enterprise Medianet Quality of Service Design 4.0](#)
- [Medianet Campus QoS Design 4.0](#)
- [Medianet WAN Aggregation QoS Design 4.0](#)

Policy Scope

A policy scope defines a specific set of devices for the purpose of applying a QoS policy to manage a particular kind of traffic. Up to 2,000 devices can be configured per scope. Scopes cannot overlap. That is, an individual device cannot be a member of more than one scope. Each policy scope can provide one policy for all wired devices in the scope and one policy for each wireless segment in the scope. For each policy (wired or wireless-segment), you can include or exclude any applications (including custom) and customize the treatment of the traffic for that application.

In practice, you should include all devices (wired or wireless) that compose the end-to-end path for a particular kind of traffic. Within the policy scope, you create policies for managing traffic on the entire set of wired devices and on individual wireless segments. This allows you to make tradeoffs as necessary to compensate for differences in the behaviors of various network segments. For example, wireless networks typically have lower bandwidth, lower speed, and increased packet loss in comparison to wired networks. Individual wireless segments may exhibit further variation due to local conditions of RF interference, congestion, and other factors, such as the varying capabilities of network devices. The ability to apply per-segment policies to individual wireless segments enables the adjustment of traffic-handling rules to ensure that the highest-priority traffic is least affected by degradation of the wireless network.

After you define a policy scope, you can configure a QoS policy for it, and apply the policy to the devices in the policy scope. Applying a QoS policy deploys and configures the QoS policy on the devices.

You define policy scopes from the **EasyQoS** window or by applying policy tags to devices in the **Device Inventory** or **Topology** windows. For more information, see the *Cisco Application Policy Infrastructure Controller Enterprise Module Administrator Guide*.

Static and Dynamic QoS Policies

There are two types of QoS policies, named for the way in which the policies are implemented:

- **Static policies**—Deployed to devices and in effect until you change or remove them. Static policies comprise the majority of the deployments.
- **Dynamic policies**—Used on LAN interfaces only. Dynamic policies are applied to the relevant network devices for the duration of an event, for example, during a voice or video call. When the call ends, the policy is removed from the device. For more information, see [Understanding Dynamic QoS Policies, on page 12](#).

Policy Preview

You can preview the command line interface (CLI) commands that EasyQoS will send to a device when you apply the policy. At any time, for example, after a policy change, you can generate the specific commands for a specified device. After reviewing the commands, you can apply the policy to all of the devices in the scope, or you can continue to make changes to the policy.

Policy Versioning

Policies are versioned. You can display previous versions of a policy and select a version to reapply to the devices in a scope.

Editing one version of a policy does not affect other versions of that policy or the components of the policy, such as the applications that the policy manages. For example, deleting an application from a policy does not delete the application from EasyQoS, other versions of that policy, or even other policies. Because policies and applications exist independent of each other, you may reapply a policy version that contains applications in it that no longer exist.

**Note**

Application level modifications like rank, port, and protocol are not captured in policy versioning.

Original Policy Restore

The first time that you apply an EasyQoS policy configuration to devices, EasyQoS detaches the device's original MQC policies (leaving the MQC policy configurations on the device) and stores the device's original NBAR configurations on the Cisco APIC-EM controller. This action allows you to restore the original MQC policies and NBAR configuration onto the devices later, if needed.



Note

Because the MQC policies are detached and not deleted from the device configuration, if you remove these policies, you will not be able to restore them using the EasyQoS original policy restore feature.

When you restore the original policy configuration onto a device, EasyQoS removes the existing EasyQoS policy configuration (except for Multi-Layer Switch (MLS) queuing policies or Physical Layer Interface Module (PLIM) configurations on the Cisco ASR 1000 Series Aggregation Services Routers or MLS switches) that you applied to the devices and reverts to the original configuration that was on the device before you applied any EasyQoS policy configurations.

Any marking and queuing (MQC) policy configurations that existed before any EasyQoS policies were configured are reattached to the interfaces. Queuing policies (MLS configurations) are not restored; instead, the devices retain the MLS configurations that were last applied through EasyQoS.

After you restore the original policy configuration to the device, the EasyQoS policy is deleted from the Cisco APIC-EM, and the status of the devices shows **Policy Restored**.

Note the following additional guidelines and limitations for this feature:

- Original policy restore does not work for policies that were created and applied to devices using the Cisco APIC-EM Release 1.2.x or below, because the Cisco APIC-EM did not store devices' original policy configurations before Cisco APIC-EM Release 1.3.x
- If the first attempt to push an EasyQoS policy to a device fails, EasyQoS automatically attempts to restore the original policy configurations onto the devices.

Understanding Applications

EasyQoS supports all of the applications in the Cisco Next Generation Network-Based Application Recognition (NBAR2) library. If you have additional applications that are not included in EasyQoS, you can add them as custom applications. For information, see [Custom Applications](#), on page 8.

The NBAR2 applications are pre-allocated into the industry standard-based traffic classes, as defined in RFC 4594. The traffic classes define the treatments (such as DSCP marking, queuing and dropping) that are applied to an application's traffic. You cannot change an application's traffic class; however, you can change the business-relevance of an application when you configure QoS policies. For information, see [Understanding QoS Policies](#), on page 2.

Business-Relevance Groups

The EasyQoS feature provides three levels of business-relevance groupings that provide different levels of service to the applications that have been assigned to them. The business-relevance groups essentially map to three types of traffic: high priority, neutral, and low priority. These groups include:

- **Business Relevant**—(High-priority traffic) The applications in this group directly contribute to organizational objectives and, as such, may include a variety of applications, including voice, video, streaming and collaborative multimedia applications, database applications, enterprise resource applications, email, file-transfers, content distribution, and so on. Applications designated as business-relevant are treated according to industry best-practice recommendations, as prescribed in IETF RFC 4594.
- **Default**—(Neutral traffic) This group is intended for applications that may or may not be business-relevant. For example, generic HTTP/HTTPS traffic may contribute to organizational objectives at times, while at other times such traffic may not. You may not have insight into the purpose of some applications (for instance, legacy applications or even newly deployed applications), so the traffic flows for these applications should be treated with the Default Forwarding service, as described in RFC 2747 and 4594.
- **Business Irrelevant**—*Low-priority traffic) This group is intended for applications that have been identified to have no contribution towards achieving organizational objectives. They are primarily consumer- and/or entertainment-oriented in nature. We recommend that this type of traffic be treated as a "Scavenger" service, as described in RFC 3662 and 4594.

Unidirectional and Bidirectional Application Traffic

Some applications are completely symmetrical and require identical bandwidth provisioning on both ends of the connection. Traffic for such applications is described as bidirectional. For example, if 100 kbps of LLQ are assigned to voice in one direction, 100 kbps of LLQ also must be provisioned for voice in the opposite direction (assuming that the same VoIP codecs are being used in both directions, and putting aside for a moment multicast Music-on-Hold [MoH] provisioning). However, certain applications, such as Streaming-Video and multicast MoH, are most often unidirectional. Therefore, it might be unnecessary and even inefficient to provision any bandwidth guarantees for such traffic on a branch router for the branch-to-campus direction of traffic flow.

EasyQoS allows you to specify whether an application is unidirectional or bidirectional for a particular policy.

On switches and wireless controllers, NBAR2 and custom applications are unidirectional by default. However, on routers, because only NBAR applications are supported, NBAR2 applications are bidirectional by default.

Consumers and Producers

You can configure relationships between applications such that when traffic from one application is sent to another application (thus creating a specific a-to-b traffic flow), the traffic is handled in a specific way. The applications in this relationship are called producers and consumers and are defined as follows:

Producer—Sender of the application traffic. For example, in a client/server architecture, the application-server would be considered the producer, as the traffic primarily flows in the server-to-client direction. In the case of a peer-to-peer application, the remote peer is considered the producer.

Consumer—Receiver of the application traffic. The consumer may be a client endpoint in a client/server architecture or it may be the local device in a peer-to-peer application. Consumers may be endpoint devices but may, at times, be specific users of such devices (typically identified by IP Addresses and/or specific subnets). There may also be times when an application is the consumer of another application's traffic flows.

Setting up this relationship allows you to configure specific service levels for traffic matching this scenario.

Marking, Queuing, and Dropping Treatments

Cisco EasyQoS bases its marking, queuing, and dropping treatments on RFC 4594 and the business relevancy category that you have assigned to the application. EasyQoS assigns all of the applications in the Default category to the Default Forwarding application class and all of the applications in the Irrelevant Business category to the Scavenger application class. For applications in the Relevant Business category, EasyQoS assigns traffic classes to applications based on the type of application. See the table below for a list of application classes and their treatments.

Table 1: Marking, Queuing, and Dropping Treatments

Business Relevance	Application Class	Per-Hop Behavior	Queuing and Dropping	Application Description
Relevant	VoIP 1	Expedited Forwarding (EF)	Priority Queuing (PQ)	VoIP telephony (bearer-only) traffic, for example, Cisco IP Phones.
	Broadcast Video	Class Selector (CS) 5	PQ	Broadcast TV, live events, video surveillance flows, and similar inelastic streaming media flows, for example Cisco IP Video Surveillance and Cisco Enterprise TV. (Inelastic flows refer to flows that are highly drop sensitive and have no retransmission and/or flow-control capabilities.)
	Realtime Interactive	CS4	PQ	Inelastic high-definition interactive video applications and audio and video components of these applications, for example, Cisco TelePresence.
	Multimedia Conferencing	Assured Forwarding (AF) 41	Bandwidth (BW) Queue and Differentiated Services Code Point (DSCP) 34 Weighted Random Early Detect (WRED)	Desktop software multimedia collaboration applications and audio and video components of these applications, for example, Cisco Jabber and Cisco WebEx.
	Multimedia Streaming	AF31	BW Queue and DSCP WRED	Video-on-Demand (VoD) streaming video flows and desktop virtualization applications, such as Cisco Digital Media System.
	Network Control	CS6	BW Queue only 2	Network control plane traffic, which is required for reliable operation of the enterprise network, such as EIGRP, OSPF, BGP, HSRP, IKE, and so on.
	Signaling	CS3	BW Queue and DSCP 24	Control-plane traffic for the IP voice and video telephony infrastructure.
	Operations, Administration, and Management (OAM)	CS2	BW Queue and DSCP 16 3	Network operations, administration, and management traffic, such as SSH, SNMP, syslog, and so on.

Business Relevance	Application Class	Per-Hop Behavior	Queuing and Dropping	Application Description
	Transactional Data (Low-Latency Data)	AF21	BW Queue and DSCP 18 WRED	Interactive (foreground) data applications, such as enterprise resource planning (ERP), crew resource management (CRM), and other database applications.
	Bulk Data (High-Throughput Data)	AF11	BW Queue and DSCP 10 WRED	Noninteractive (background) data applications, such as E-mail, file transfer protocol (FTP), and backup applications.
Default	Default Forwarding (Best Effort)	DF	Default Queue and RED	Default applications and applications assigned to the default business-relevant group. Because only a small minority of applications are assigned to priority, guaranteed-bandwidth, or even to deferential service classes, the vast majority of applications continue to default to this best-effort service.
Irrelevant	Scavenger	CS1	Minimum BW Queue (Deferential) and DSCP 8	Nonbusiness related traffic flows and applications assigned to the business-irrelevant group, such as data or media applications that are entertainment-oriented. Examples include YouTube, Netflix, iTunes, and Xbox Live.

- ¹ VoIP signaling traffic is assigned to the Call Signaling class.
- ² WRED is not enabled on this class, as network control traffic should not be dropped.
- ³ WRED is not enabled on this class, as OAM traffic should not be dropped.

Custom Applications

Custom applications are applications that you add to the EasyQoS NBAR2 application library. You can define URL-based applications and server IP address-based applications.

When you define an application according to its server IP address, you can also define a Differentiated Services Code Point (DSCP) value and port classification.

To simplify the configuration process, if you know of an application that has similar traffic and service level needs, you can define a similar application. EasyQoS copies the other application's traffic class, category, and subcategory settings to the application that you are defining.

EasyQoS does not configure Access Control Lists (ACEs) for port numbers 80, 443, and 8080, even if they are defined as part of a custom application. If the custom application has a transport IP defined, EasyQoS configures the application on the devices.

If you are using the IWAN application, and you create a custom application that IWAN does not support, EasyQoS displays a warning, and the new custom application is not visible from the IWAN application.

**Note**

Unless custom applications are assigned to a policy, they are not programmed on the devices.

Favorite Applications

Cisco APIC-EM allows you to flag applications that you want EasyQoS to configure on devices before all other applications, except custom applications. Flagging an application as a favorite helps to ensure that the QoS policies for your favorite applications get configured on devices. For more information, see [Processing Order for Devices with Limited Resources](#), on page 9.

Although there is no limit to the number of favorite applications that you can create, selecting only a small number of favorite applications (for example, less than 25) will help to ensure that these applications are treated correctly from a business-relevance perspective in deployments with network devices that have limited TCAM.

Favorite applications can belong to any business relevancy group or traffic class and are configured system-wide, not on a per-scope basis. For example, if you flag the cisco-jabber-video application as a favorite, the application is flagged as a favorite in all policies.

Keep in mind that not only business-relevant applications may be flagged as favorites, but even business-irrelevant applications may be flagged as such. For example, if an administrator notices a lot of unwanted Netflix traffic on his network, he may choose to flag Netflix as a favorite application (despite its being assigned as business-irrelevant). In this case, Netflix would be programmed into the device policies before other business-irrelevant applications, ensuring that the business-intent of controlling this application is realized.

Processing Order for Devices with Limited Resources

Some network devices have a limited memory (called Ternary Content Addressable Memory or TCAM) for storing network access control lists (ACLs) and access control entries (ACEs). So, as ACLs and ACEs for applications are configured on these devices, the available TCAM space is used. When the TCAM space is depleted, QoS settings for no additional applications can be configured on that device.

To ensure that QoS policies for the most important applications get configured on these devices, EasyQoS allocates TCAM space based on the following order:

- 1 Rank**—Number assigned to custom and favorite applications, but not to existing, default NBAR applications. The lower the rank number, the higher the priority. For example, an application with rank 1 has a higher priority than an application with rank 2, and so on. Having no rank is the lowest priority.
 - Custom applications are assigned rank 1 by default.
 - Default NBAR applications are not assigned a rank until you mark them as favorites, at which point they are assigned rank 10,000.
- 2 Traffic Class**—By traffic class in the following order: Signaling, Bulk Data, Network Control, Operations Administration Management (Ops Admin Mgmt), Transactional Data, Scavenger, Multimedia Streaming, Multimedia Conferencing, Real Time Interactive, Broadcast Video, and VoIP Telephony
- 3 Popularity**—Number (1–10) that is based on Cisco Validated Design (CVD) criteria. The popularity number cannot be changed. An application with a popularity of 10 has a higher priority than an application with a popularity of 9, and so on.

- Custom applications are assigned popularity 10 by default.
- Default NBAR applications are assigned a popularity number (1–10) that is based on Cisco Validated Design (CVD) criteria. When you mark an application as a favorite, this does not change the popularity number (only rank is changed).

4 Alphabetization—If two or more applications have the same rank and/or popularity number, they are sorted alphabetically by the application’s name, and assigned a priority accordingly.

For example, you define a policy that has the following applications:

- Custom application, `custom_realtime`, which has been assigned rank 1 and popularity 10 by default.
- Custom application, `custom_salesforce`, which has been assigned rank 1 and popularity 10 by default.
- Application named `corba-iiop`, which is in the transactional data traffic class, and you have designated as a favorite, giving that application a ranking of 10,000 and popularity of 9 (based on CVD).
- Application named `gss-http`, which is in the Ops Admin Mgmt traffic class, and you have designated as a favorite, giving that application a ranking of 10,000 and popularity of 10 (based on CVD).
- All other, default NBAR applications, which have no rank, but will be processed according to their traffic class and default popularity (based on CVD).

According to the prioritization rules, the applications are configured on the device in this order:

Application Configuration Order	Reason
1. Custom application, <code>custom_realtime</code>	Custom applications are given highest priority. Given that the <code>custom_salesforce</code> and <code>custom_realtime</code> applications have the same rank and popularity, they are sorted alphabetically, <code>custom_realtime</code> before <code>custom_salesforce</code> .
2. Custom application, <code>custom_salesforce</code>	
3. Favorite application, <code>gss-http</code>	Because both of these applications have been designated as favorites, they have the same application ranking. So, then EasyQoS evaluates them according to their traffic class. Because <code>gss-http</code> is in the Ops Admin Mgmt traffic class, it is processed first, followed by the <code>corba-iiop</code> application, which is in the Transactional Data traffic class. Their popularity does not come into play because the processing order has been determined by their traffic class.
4. Favorite application, <code>corba-iiop</code>	
5. All other, default NBAR applications	All other applications are next and are prioritized according to traffic class and then popularity, with any applications having the same popularity being alphabetized according to the application’s name.

In the **QoS Policy Manager** window, you can view the results of the policy configuration that was applied on the devices. With a policy selected, EasyQoS displays the list of the devices in the policy scope and the status of the configuration on each device.

Understanding Service Provider Profiles

Service provider profiles define the Differentiated Services Code Point (DSCP), priority, and bandwidth for traffic that is destined for a service provider. Cisco APIC-EM provides four predefined service provider profiles (SPPs or SP profiles): SPP1, SPP2, SPP3, and SPP4. (See tables below.)

You can use any of the predefined SP profiles, or you can create a customized SP profile for your unique requirements. Creating a customized SP profiles allows you to define the DSCP value and bandwidth for each traffic class in the profile. You can define 4-class, 5-class, 6-class, and 8-class models. To create a customized SP profile, see [Creating a Customized Service Provider Profile](#), on page 27.

After you determine and create, if necessary, the service model that you want to use, you need to configure it on the WAN interfaces. To configure WAN interfaces, see [WAN Interface Configuration for EasyQoS](#).

Table 2: SP Profile 1 (SPP1): 4-Class Model

Class Name	DSCP	Priority Class	SLA	
			Bandwidth (%)	Remaining Bandwidth (%)
Voice	EF	Yes	10	—
Class 1 Data	AF31	—	—	44
Class 2 Data	AF21	—	—	25
Default	0	—	—	31

Table 3: SP Profile 2 (SPP2): 5-Class Model

Class Name	DSCP	Priority Class	SLA	
			Bandwidth (%)	Remaining Bandwidth (%)
Voice	EF	Yes	10	—
Class 1 Data	AF31	—	—	44
Class 2 Data	AF21	—	—	25
Class 3 Data	AF11	—	—	1
Default	Best Effort	—	30%	—

Table 4: SP Profile 3 (SPP3): 6-Class Model

Class Name	DSCP	Priority Class	SLA	
			Bandwidth (%)	Remaining Bandwidth (%)
Class 1 Data	AF31	—	—	10
Class 3 Data	AF11	—	—	1
Video	AF41	—	—	34
Voice	EF	Yes	10	—
Default	0	—	—	30
Class 2 Data	AF21	—	—	25

Table 5: SP Profile 4 (SPP4): 8-Class Model

Class Name	DSCP	Priority Class	SLA	
			Bandwidth (%)	Remaining Bandwidth (%)
Network-Control Management	CS6	—	—	5
Streaming Video	AF31	—	—	10
Call Signalling	CS3	—	—	4
Scavenger	CS1	—	—	1
Interactive Video	AF41	—	—	30
Voice	EF	Yes	10	—
Default	0	—	—	25
Critical Data	AF21	—	—	25

Understanding Dynamic QoS Policies

Dynamic QoS is used on LAN interfaces where you need a specific class of service to be in effect for the duration of some event. You can configure another software application to signal the Cisco APIC-EM (through

REST APIs) when a specified event occurs so that a corresponding QoS policy is applied to the relevant network devices for the duration of the event. When you enable the dynamic policy capability, it is enabled on a per scope basis—not globally.

Dynamic QoS policies are used primarily in business applications, such as voice and video applications. For example, you configure Cisco Unified Call Manager (CUCM) to signal the Cisco APIC-EM of a proceeding call. Cisco APIC-EM responds by setting up QoS policies for the video or voice traffic flow on all of the relevant network devices. When the call is over, CUCM signals the APIC-EM to remove the QoS policies. Note that the call does not wait for the QoS policies to be in effect before proceeding. The call *proceeds* while the Cisco APIC-EM applies the QoS policies to the relevant LAN access interfaces on which hosts (such as, IP phones or telepresence end-points) are connected.

For dynamic QoS to take effect when you enable dynamic QoS on policies, you must apply (or reapply) the policy for each scope. Dynamic QoS is not applied to each scope automatically.

As dynamic policies are applied to interfaces, the **Dynamic QoS** window is updated with information about the policy status (whether the configuration was added successfully or not), source IP address and port, destination IP address and port, flow type (for example, voice or video), and protocol used. In addition, you have the capability to run a path trace on a specific flow. This capability is particularly useful if a policy fails to be successfully applied to an interface. In this case, you can quickly troubleshoot the failure by viewing the path trace of the flow.

EasyQoS Prerequisites

To use EasyQoS to configure QoS policies, make sure that you address the following requirements:

- EasyQoS supports most of the Cisco LAN, WAN, WLAN devices. To verify whether the devices and software versions in your network are supported, see the *Supported Platforms for the Cisco Application Policy Infrastructure Controller Enterprise Module* document.
- Make sure that your Cisco network devices, such as the ISR-G2, the ASR 1000, and Wireless LAN Controller, have the AVC (Application Visibility and Control) feature license installed. For information, see the *NBAR2 (Next Generation NBAR) Protocol Pack FAQ* at the following URL: http://www.cisco.com/c/en/us/products/collateral/ios-nx-os-software/network-based-application-recognition-nbar/qa_C67-723689.html.
- For the Cisco APIC-EM to identify the WAN interfaces that need policies, you must specify the interface type (WAN) and (optionally) its subline rate and service-provider Class-of-Service model. For information about how to configure these settings on WAN interfaces, see [Device Configuration Prerequisites](#).
- From the **Topology** or **Device Inventory** window, verify that the device roles assigned to devices during discovery are appropriate for your network design. If necessary, change any of the device roles that are not appropriate.

EasyQoS Guidelines and Limitations

When configuring policies, be sure to follow these guidelines and limitations:

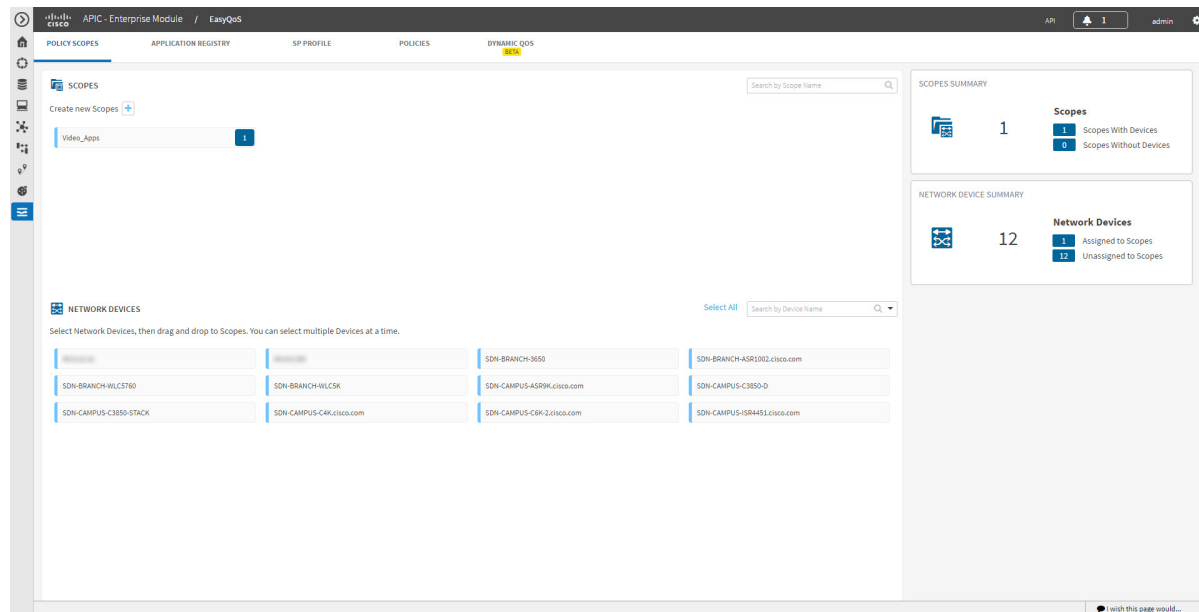
- When you apply a Cisco APIC-EM policy tag to a device, you cannot provision the same device in IWAN. If you want to provision a device using IWAN, you must first remove the APIC-EM policy tag.

- When you provision a device using IWAN, you cannot apply a Cisco APIC-EM policy tag to the same device. To apply a Cisco APIC-EM policy tag, you must delete the device from the IWAN device inventory and then rediscover it in the Cisco APIC-EM.
- Changing a policy tag *does not* automatically roll back or change the policy on the device. You must reapply the policy in order for the updated configuration to be deployed to the device.
- Policies are not removed from a device when the policy tag is removed from the device.
- Policies are not reapplied automatically when you change the policy tag on a device to a different policy tag that has already been applied to devices.
- Policies are not reapplied automatically when you enable dynamic QoS. You must reapply the policy to the devices for the change to take effect.
- EasyQoS supports Out Of Band (OOB) changes, that is, changes made to the device configurations from any means other than Cisco APIC-EM. However, after you make the OOB change, you must wait at least 30 minutes until the inventory synchronization occurs and then click **Reapply Policy**.
- EasyQoS supports applications that have names consisting of up to 24 alphanumeric characters, including underscores and hyphens. The underscore and hyphen characters are the only special character allowed in the application name.
- Some network devices have a limited memory (called Ternary Content Addressable Memory or TCAM) for storing network access control lists (ACLs) and access control entries (ACEs). For more information about this limitation and how it is handled, see [Processing Order for Devices with Limited Resources](#), on page 9.
- You cannot create custom applications for wireless devices.
- EasyQoS does not configure ACEs for a custom application that does not define an IP address but does define port number 80, 443, or 8080. However, EasyQoS does configure ACEs for a custom application that does define an IP address and port number 80, 443, or 8080.
- EasyQoS cannot restore an original configuration to a device if the device has a pre-existing EasyQoS configuration that was applied before adding the device to the current policy.

Navigating the EasyQoS Application

You configure QoS policies using the **EasyQoS** window. To access this window, from the **Navigation** pane, click **EasyQoS**.

Figure 1: EasyQoS Window



The **EasyQoS** window has five tabs from which you can create and manage QoS policies:

- **Policy Scopes**—Allows you to define a set of devices to which policies are applied.
- **Application Registry**—Lists all of the applications that EasyQoS supports, including any custom applications that you have added.
- **SP Profile**—Allows you to define the Differentiated Services Code Point (DSCP), priority, and bandwidth for traffic that is destined for a service provider.
- **Policies**—Allows you to configure policies for the selected scope of devices.
- **Dynamic QoS**—Allows you to enable and disable dynamic QoS on policies.

Getting Started with EasyQoS

You can use EasyQoS to apply quality of service (QoS) policies throughout your network. Use the following high-level steps to guide you through the process of setting up a basic EasyQoS policy for your devices.

Before You Begin

EasyQoS supports most of the Cisco LAN, WAN, WLAN devices. To verify whether the devices and software versions in your network are supported, see the *Supported Platforms for the Cisco Application Policy Infrastructure Controller Enterprise Module* document.

Procedure

- Step 1** Define your business objectives.
For example, your business objective might be to improve user productivity by minimizing network response times or to identify and deprioritize non-business applications.
- Step 2** With your business objectives in mind, determine the business relevance of your applications. Decide which category your applications fall into:
- **Relevant**—The application directly contributes to organizational objectives. Such applications include voice, video, streaming and collaborative multimedia applications, database applications, enterprise resource applications, email, file-transfers, content distribution, and so on. These applications are classified, marked, and treated according to industry best-practice recommendations (RFC 4594).
 - **Default**—The application may or may not be business-relevant. For example, generic HTTP/HTTPS traffic may contribute to organizational objectives at times, while at other times such traffic may not. Applications of this type are treated with a Default Forwarding service (RFC 2474).
 - **Irrelevant**—The application has no contribution towards achieving organizational objectives. It is primarily consumer- and/or entertainment-oriented in nature. Applications of this type are treated with a less-than Best Effort service (RFC 3662).
- Step 3** Define the scope (or group) of devices that you will configure with a policy.
- Note** From the **Topology** or **Device Inventory** window, verify that the device roles assigned to devices during discovery are appropriate for your network design. If necessary, change any of the device roles that are not appropriate.
For more information, see [Defining Policy Scopes](#), on page 17.
- Step 4** (Optional) Create custom applications.
If you have applications that are not already defined in EasyQoS, you can add them and define their QoS attributes. For more information, see [Custom Applications](#), on page 8.
- Step 5** (Optional) View the default service provider profiles and, if necessary, create a new service provider profile to fit your needs. For information, see [Creating a Customized Service Provider Profile](#), on page 27.
- Step 6** Create the policy on wired devices or wireless segments. For information, see [Creating or Editing a Policy](#), on page 32.
As part of creating the policy, do the following:
- Configure the business relevance of the applications used in your network. EasyQoS comes with the applications preconfigured into business-relevancy groups. You can keep this configuration or modify it to meet the needs of your business objectives and network configuration. For more information, see [Business-Relevance Groups](#), on page 4.
 - Select favorite applications. Cisco APIC-EM allows you to flag applications that you want EasyQoS to configure on devices before all other applications (except custom applications). This feature increases the chances that favorite applications are configured on network devices that have a limited memory for storing network access control lists (ACLs) and access control entries (ACEs). For more information, see [Favorite Applications](#), on page 9 and [Processing Order for Devices with Limited Resources](#), on page 9.
- Step 7** (Optional) Validate the policy.

You can view the command line interface (CLI) commands that will be applied to a device when the policy is deployed. For more information, see [Policy Preview](#), on page 3.

Step 8 Apply the policy to the scope of devices.

What to Do Next

You can see how the deployed policy is working in your network by performing a path trace on two devices and capturing QoS data. For more information, see [Performing Path Traces](#).

Defining Policy Scopes

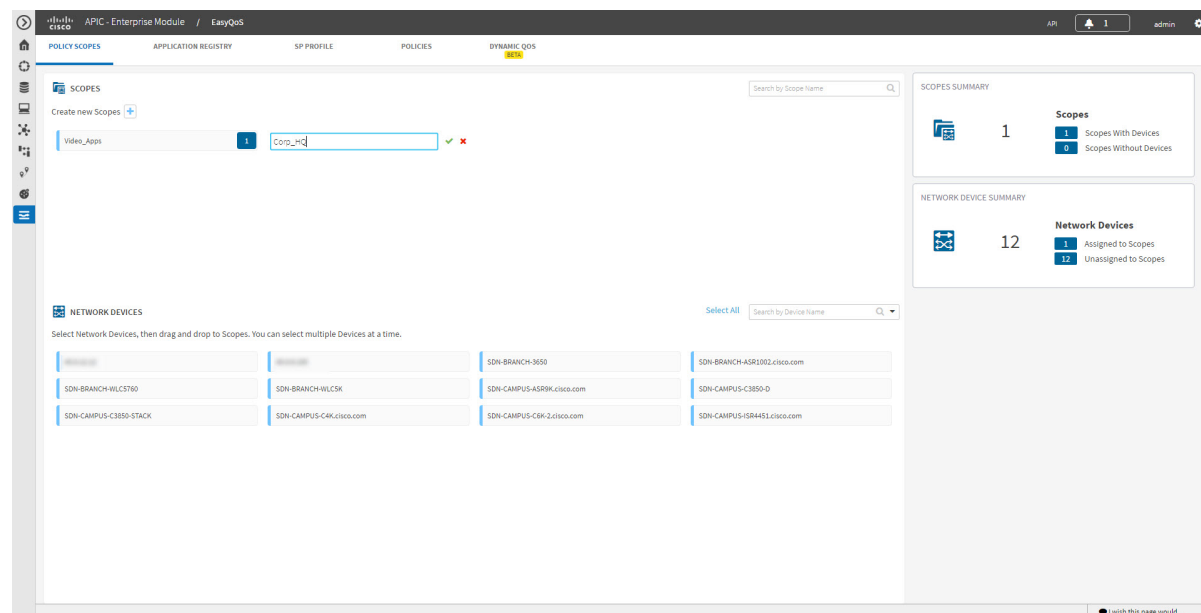
Before you can create a QoS policy, you need to define the policy scope. That is, you need to define the group of devices that will be configured with the same QoS policy. For more information, see [Policy Scope](#), on page 2.



Note

You can also define a policy scope by applying policy tags to devices from the **Device Inventory** window or the **Topology** window. For information, see *Cisco Application Policy Infrastructure Controller Enterprise Module Administrator Guide*.

Figure 2: Policy Scope Window



Before You Begin

Make sure that you have devices in your inventory. If not, discover devices using the Discovery function.

From the **Topology** or **Device Inventory** window, verify that the device roles assigned to devices during discovery are appropriate for your network design. If necessary, change any of the device roles that are not appropriate.

Procedure

- Step 1** From the **Navigation** pane, click **EasyQoS**.
- Step 2** Create new Scopes by clicking the plus (+) icon.
- Step 3** In the **Create Policy Scope** field, enter a name for the policy and click the green check mark icon.
- Step 4** From the **Wired Devices** or **Wireless Segments** lists below, drag and drop the selected device to the field where you named the policy.
EasyQoS adds the device and saves the policy automatically.

The panes on the right show statistics, including how many scopes have and do not have devices, number of wired devices that are assigned and unassigned to scopes, and the number of wireless segments that are assigned and unassigned to scopes.

What to Do Next

You can create policies for wired devices or wireless segments. For information, see [Creating or Editing a Policy](#), on page 32.

Configuring Applications

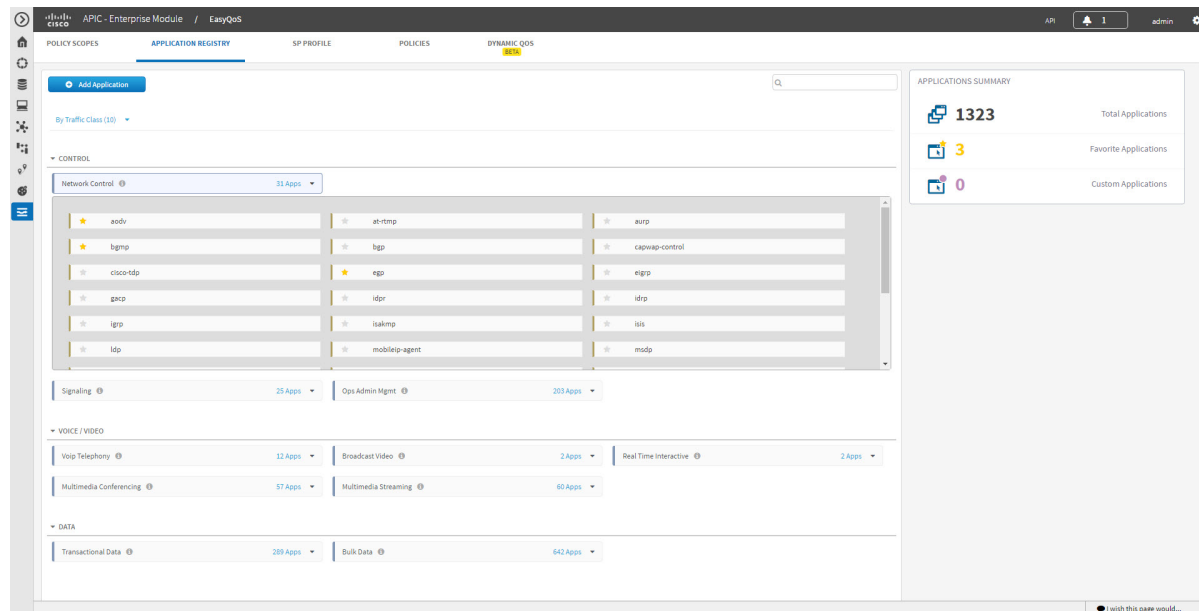
Configuring Favorite Applications

You can designate applications as favorites, which effects the order that the applications are configured on devices. This setting is applied to applications globally, across policies. If you set an application as a favorite, it is set as a favorite in all policies.

You can also configure favorite applications while creating or editing a policy. For more information, see [Creating or Editing a Policy](#), on page 32.

For information about how favorite applications work, see [Favorite Applications](#), on page 9.

Figure 3: Application Registry Window



Before You Begin

Make sure that you have devices in your inventory. If not, discover devices using the Discovery function.

You must have policy administrator (ROLE_POLICY_ADMIN) permissions and the appropriate resource scope to perform this procedure.

Define the scope of devices that you want to be configured with this QoS policy. You can do this by creating a policy tag in Topology or Device Inventory or by creating a policy scope in EasyQoS.

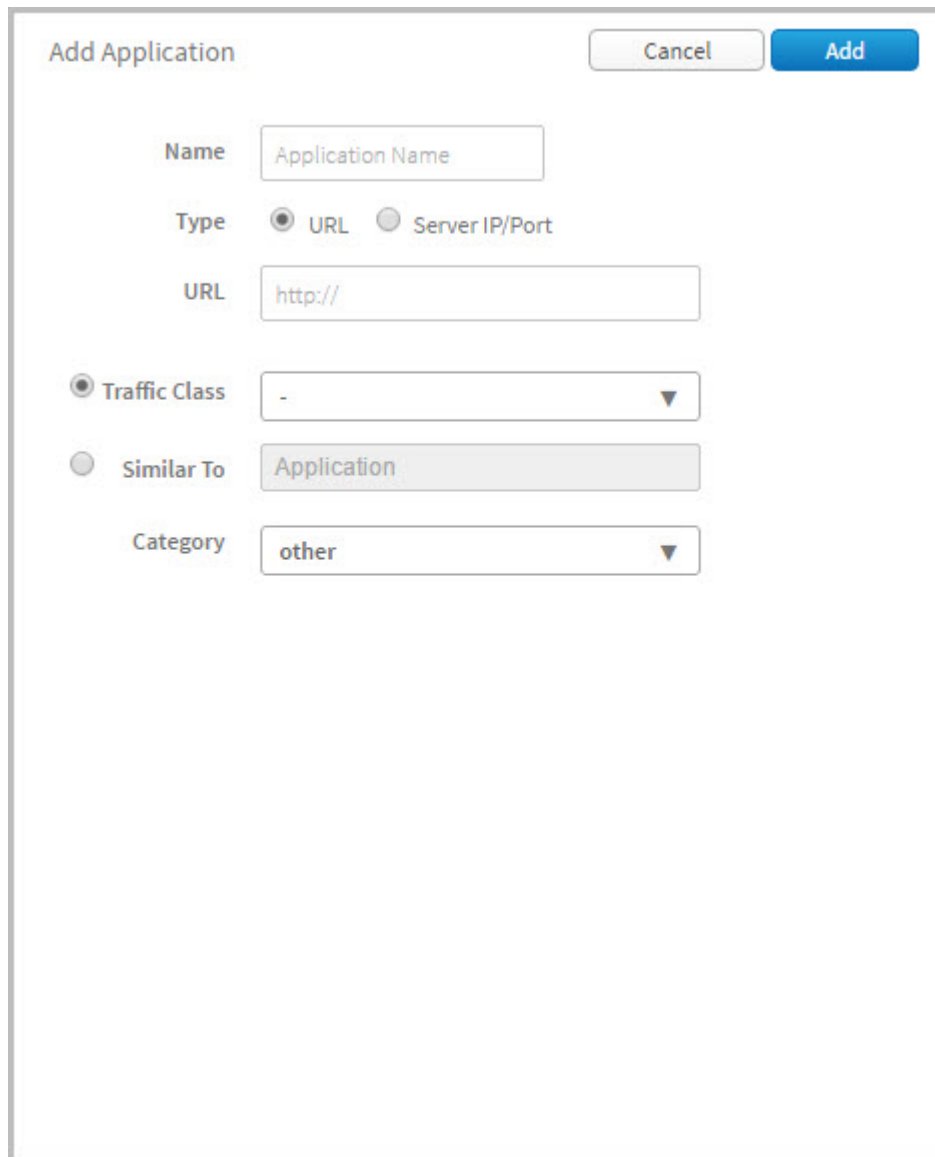
Procedure

- Step 1** From the **Navigation** pane, click **EasyQoS**.
- Step 2** From the **EasyQoS** window, select the **Application Registry** tab.
By default, the applications are listed by traffic class. To change how applications are listed, click the **View By** down arrow at the top of the list and choose **Applications** to view the applications in an alphabetical list or **Application Groups** to view the applications according to their business-relevance group.
- Step 3** Click the star icon next to the applications that you want to set as favorites.
For information about how favorite applications work, see [Favorite Applications](#), on page 9.
- Step 4** For these changes to take effect on the devices, you need to apply (or reapply) the relevant policies.

Creating a URL-Based Custom Application

If you have applications that are not in the the NBAR2 application library, you can add them as custom applications. This procedure shows you how to create a custom application that is accessible through its URL.

Figure 4: Add Application Pane for URL-Based Applications



The screenshot shows a dialog box titled "Add Application" with a "Cancel" button and an "Add" button. The form contains the following fields and options:

- Name:** A text input field containing "Application Name".
- Type:** Two radio buttons: "URL" (selected) and "Server IP/Port".
- URL:** A text input field containing "http://".
- Traffic Class:** A radio button (selected) and a dropdown menu showing "-".
- Similar To:** A radio button and a dropdown menu showing "Application".
- Category:** A dropdown menu showing "other".

Before You Begin

You must have either administrator (ROLE_ADMIN) or policy administrator (ROLE_POLICY_ADMIN) permissions and the appropriate RBAC scope to perform this procedure.

Make sure that you have devices in your inventory. If not, discover devices using the Discovery function.

Define the scope of devices that you want to be configured with this QoS policy. You can do this by creating a policy tag in Topology or Device Inventory or by creating a policy scope in EasyQoS.

Procedure

- Step 1** From the **Navigation** pane, click **EasyQoS**.
- Step 2** From the **EasyQoS** window, select the **Application Registry** tab.
- Step 3** Click **Add Application**.
- Step 4** In the **Add Application** pane, enter information in the following fields:
- **Name**—Name of the application. The name can contain up to 24 alphanumeric characters, including underscores and hyphens. The underscore and hyphen characters are the only special character allowed in the application name.
 - **Type**—Method by which users access the application. Choose **URL** for applications that are accessible through a URL.
 - **URL**—URL used to reach the application.
 - **Traffic Class**—Traffic class to which the application belongs. Valid values are BULK_DATA, TRANSACTIONAL_DATA, OPS_ADMIN_MGMT, NETWORK_CONTROL, VOIP_TELEPHONY, MULTIMEDIA_CONFERENCING, MULTIMEDIA_STREAMING, BROADCAST_VIDEO, REAL_TIME_INTERACTIVE, and SIGNALING.
 - **Similar To**—Application with similar traffic-handling requirements. Click the **Similar To** radio-button and select an application from the drop-down field. EasyQoS copies the other application's traffic class, category, and subcategory settings to the application that you are defining.
- Step 5** Click **Create Application** to save the new application.
- Step 6** When you create a custom applicaiton, it is not assigned to a business-relevancy group. It is placed in a group called Unassigned. To change this setting, see [Creating or Editing a Policy, on page 32](#).
-

What to Do Next

You can now include the custom application to existing or new policies. If you include the custom application in an existing policy that has already been deployed to devices, you need to reapply the policy so that the devices are updated with the class of service settings for the custom application.

Creating a Server-Based Custom Application

If you have applications that are not in the the NBAR2 application library, you can add them as custom applications.

Figure 5: Add Application Pane for Server-Based Applications

The screenshot shows the 'Add Application' configuration pane. At the top right are 'Cancel' and 'Add' buttons. The 'Name' field contains 'Application Name'. The 'Type' section has radio buttons for 'URL' and 'Server IP/Port', with 'Server IP/Port' selected. Below this is a 'DSCP' checkbox and a dropdown menu set to '0 (Best Effort)'. There is also a 'Port Classifiers' checkbox. A table with three columns: 'IP/Subnet', 'Protocol', and 'Port / Range'. The 'Protocol' column has a dropdown menu set to 'TCP'. Below the table are three radio buttons: 'Traffic Class' (selected), 'Similar To', and 'Category'. The 'Traffic Class' dropdown is set to '-'. The 'Similar To' field contains 'Application'. The 'Category' dropdown is set to 'other'.

Before You Begin

You must have either administrator (ROLE_ADMIN) or policy administrator (ROLE_POLICY_ADMIN) permissions and the appropriate RBAC scope to perform this procedure.

Make sure that you have devices in your inventory. If not, discover devices using the Discovery function.

Define the scope of devices that you want to be configured with this QoS policy. You can do this by creating a policy tag in Topology or Device Inventory or by creating a policy scope in EasyQoS.

Procedure

- Step 1** From the **Navigation** pane, click **EasyQoS**.
- Step 2** From the **EasyQoS** window, select the **Application Registry** tab.
- Step 3** Click **Add Application**.
- Step 4** In the **Add Application** pane, complete the following fields:
- **Name**—Name of the custom application. The name can contain up to 24 alphanumeric characters, including underscores and hyphens. The underscore and hyphen characters are the only special character allowed in the application name.
 - **Type**—Method by which users access the application. Choose **Server IP/Port** for applications that are accessible through a server.
 - **DSCP**—Differentiated Services Code Point (DSCP) value identifying the level of service required for the application. Check the **DSCP** check box and define a DSCP value. If you do not define a value, the default value is **Best Effort**. Best-effort service is essentially the default behavior of the network device without any QoS.
 - **Port Classifiers**—Classification of traffic based on IP address, protocol, and port number. Check the **Port Classifiers** check box to define the IP address or subnet, protocol, and port or port range for an application. Valid protocols are **IP**, **TCP**, **UDP**, and **TCP/UDP**. If you select the **IP** protocol, you do not define a port number or range.
 - **Traffic Class**—Traffic class to which the application belongs. Valid values are BULK_DATA, TRANSACTIONAL_DATA, OPS_ADMIN_MGMT, NETWORK_CONTROL, VOIP_TELEPHONY, MULTIMEDIA_CONFERENCING, MULTIMEDIA_STREAMING, BROADCAST_VIDEO, REAL_TIME_INTERACTIVE, and SIGNALING.
 - **Similar To**—Application with the similar traffic-handling requirements. Click the radio-button to select this option, then select an application from the drop-down field. EasyQoS copies the other application's traffic class, category, and subcategory settings to the application that you are defining.
- Step 5** Click **Create Application** to save the application.
- Step 6** When you create a custom applicaiton, it is not assigned to a business-relevancy group. It is placed in a group called Unassigned. To change this setting, see [Creating or Editing a Policy](#), on page 32.
-

What to Do Next

You can now include the custom application in existing or new policies. If you include the custom application in an existing policy that has already been deployed to devices, you need to redeploy the policy so that the devices are updated with the settings for the custom application.

Editing a Custom Application

If you need to change the settings of a custom application, you can edit it.

Before You Begin

You must have either administrator (ROLE_ADMIN) or policy administrator (ROLE_POLICY_ADMIN) permissions and the appropriate RBAC scope to perform this procedure.

Procedure

-
- Step 1** In the **Navigation** pane, click **EasyQoS**.
- Step 2** From the **EasyQoS** window, select the **Application Registry** tab.
- Step 3** Navigate to and select the custom application that you want to edit.
- Note** You can locate the custom application by its application group, traffic class, or by its name in an alphabetical list. You can also enter its name in the search field. Information about the application displays in the right hand pane.
- Note** You can review the policies that use the custom application by clicking **Associated Policies**. **EasyQoS** displays the scope, policy name, and relevance.
- Step 4** Click **Edit**.
- Step 5** Change the desired settings for the custom application:
- **Name**—Name of the application. This value cannot be changed.
 - **Type**—Type of application. Choose either **URL** for applications that are accessible through URL or **Server IP/Port** for applications that are accessible through a server IP address and port number.
 - **Protocol**—Supported protocol for application. Choose either **TCP** or **UDP**. UDP is available only for applications that are accessible through a server IP address and port number.
 - **Value**—The value entered depends on the type of application that is being added. For URL type applications, enter the application URL. For Server IP/Port applications, enter the server IP address and port number through which you access the application.
 - **Traffic Class**—Traffic class to which the application belongs. Valid values are BULK_DATA, TRANSACTIONAL_DATA, OPS_ADMIN_MGMT, NETWORK_CONTROL, VOIP_TELEPHONY, MULTIMEDIA_CONFERENCING, MULTIMEDIA_STREAMING, BROADCAST_VIDEO, REAL_TIME_INTERACTIVE, and SIGNALING.
 - **Similar To**—Application with the similar traffic-handling requirements. Click the radio-button to select this option and select an application from the drop-down field. EasyQoS copies the other application's traffic class, category, and subcategory settings to the application that you are defining.
- Step 6** Click **Save Application**.
-

What to Do Next

You need to reapply the policies that use the custom application for the changes to be configured on the devices.

Deleting a Custom Application

You can delete a custom application, if you no longer need it.

Before You Begin

You must have either administrator (ROLE_ADMIN) or policy administrator (ROLE_POLICY_ADMIN) permissions and the appropriate RBAC scope to perform this procedure.

Make sure that the custom application that you want to delete is not used in any policies.

Procedure

Step 1 In the **Navigation** pane, click **EasyQoS**.

Step 2 From the **EasyQoS** window, select the **Application Registry** tab.

Step 3 Navigate to and select the custom application that you want to delete.

Note You can locate the custom application by its application group, traffic class, or by its name in an alphabetical list. You can also enter its name in the search field.

Information about the application displays in the right hand pane.

Note Verify that no policies use the custom application by clicking **Associated Policies**. The status should indicate that there are no policies associated with the application.

Step 4 Click **Delete**.

Step 5 To confirm the deletion, click **Ok**. Otherwise, click **Cancel**.

Step 6 When the deletion confirmation message appears, click **Ok** again.

What to Do Next

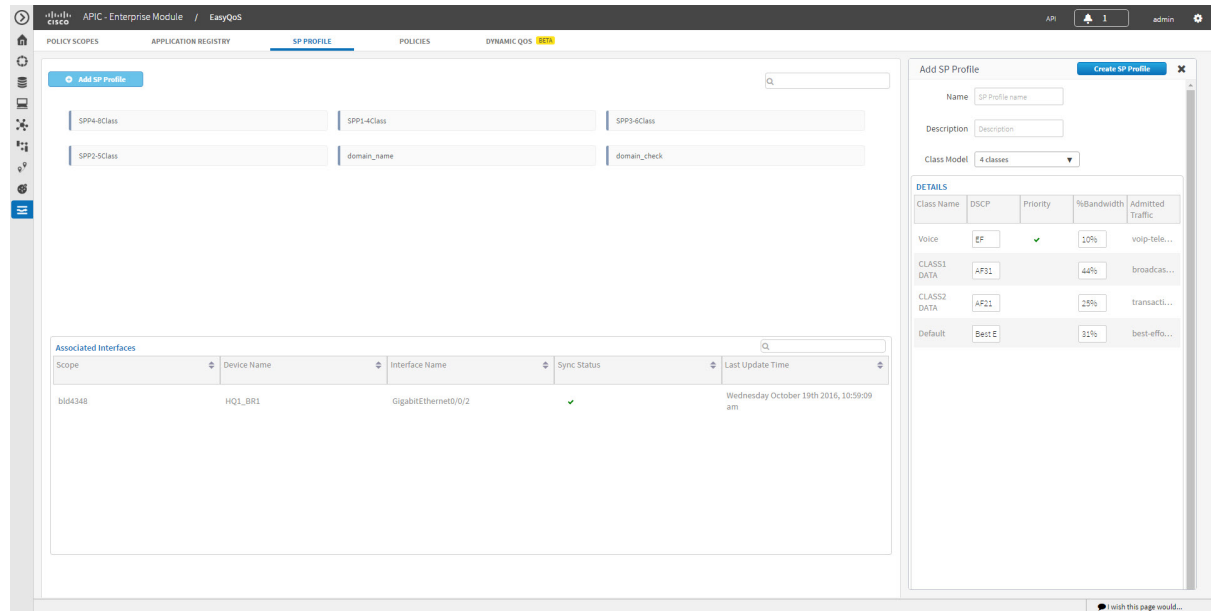
For the changes to be configured on the devices, you need to reapply the policies that used the custom application that you deleted.

Configuring Service Provider Profiles on WAN Interfaces

You can configure your WAN interfaces so that the Cisco APIC-EM can identify them and apply a corresponding service provider (SP) profile to them when a congestion event is triggered on the device (even if the physical WAN interface itself is not congested).

Use the following high-level procedure to configure SP profiles on WAN interfaces.

Figure 6: Service Provider Profile Window Showing Add SP Profile Pane



Before You Begin

You must have either administrator (ROLE_ADMIN) or policy administrator (ROLE_POLICY_ADMIN) permissions and the appropriate RBAC scope to perform this procedure.

Make sure that you have devices in your inventory. If not, discover devices using the Discovery function.

Define the scope of devices that you want to be configured with this QoS policy. You can do this by creating a policy tag in Topology or Device Inventory or by creating a policy scope in EasyQoS.

Procedure

- Step 1** Determine whether you can use any of the preconfigured service provider profiles (SSPs or SP). For information about the preconfigured SP profiles, see [Understanding Service Provider Profiles](#), on page 11.
- Step 2** If you are using one of the preconfigured SP profiles, proceed to Step 3. Otherwise, you can create a custom SP profile. To create a custom SP profile, see [Creating a Customized Service Provider Profile](#), on page 27.
- Step 3** Associate the SP profile with the WAN interface. For information, see [WAN Interface Configuration for EasyQoS](#).
- Step 4** Verify that the Cisco APIC-EM recognizes the SP profile on the WAN interface.

Note You need to wait for next Cisco APIC-EM discovery polling cycle to complete (typically about 30 minutes) before the Cisco APIC-EM and the device will be in synchronization. For information, see [Verifying the WAN Interface Synchronization Status](#), on page 30.

Creating a Customized Service Provider Profile

If you do not want to use any of the preconfigured service provider profiles (SSPs or SP profiles), you can create a customized SP profile to fit your requirements. For information about the preconfigured SP profiles, see [Understanding Service Provider Profiles](#), on page 11.



Note

After creating your custom SP profile, you need to configure the WAN interfaces with the SP profile. For information, see [WAN Interface Configuration for EasyQoS](#).

Figure 7: Service Provider Profile Window Showing Add SP Profile Pane

The screenshot displays the Cisco EasyQoS configuration interface for Service Provider Profiles. The main window is titled 'SP PROFILE' and contains an 'Add SP Profile' button and a search bar. Below this is a table of associated interfaces with the following data:

Scope	Device Name	Interface Name	Sync Status	Last Update Time
bl64348	HQ1_BR1	GigabitEthernet0/0/2	✓	Wednesday October 19th 2016, 10:59:09 am

The right-hand pane, titled 'Add SP Profile', includes a 'Create SP Profile' button and a 'DETAILS' section with the following table:

Class Name	DSCP	Priority	%Bandwidth	Admitted Traffic
Voice	EF	✓	10%	voip-tele...
CLASS1 DATA	AF31		44%	broadcas...
CLASS2 DATA	AF21		25%	transacti...
Default	Best Effort		11%	best-effo...

Before You Begin

You must have either administrator (ROLE_ADMIN) or policy administrator (ROLE_POLICY_ADMIN) permissions and the appropriate RBAC scope to perform this procedure.

Make sure that you have devices in your inventory. If not, discover devices using the Discovery function.

Define the scope of devices that you want to be configured with this QoS policy. You can do this by creating a policy tag in Topology or Device Inventory or by creating a policy scope in EasyQoS.

Procedure

- Step 1** From the **Navigation** pane, click **EasyQoS**.
- Step 2** From the **EasyQoS** window, select the **SP Profiles** tab.
- Step 3** Click **Add SP Profile**.
- Step 4** In the **Add SP Profile** pane, enter information in the following fields:
- **Name**—Name of the SP profile. The name can contain from 3 to 12 alphanumeric characters, including underscores and hyphens. The underscore and hyphen characters are the only special character allowed in the name.

Note You configure the SP profile on WAN interfaces using the name defined in this field.
 - **Description**—Word or phrase that identifies the SP profile.
 - **Class Model**—Choose one of the class models from the drop down list. Valid class models are **4 classes**, **5 classes**, **6 classes**, and **8 classes**.
 - **Class Name**—Name of the QoS class.
 - **DSCP**—Differentiated Services Code Point (DSCP) value. Valid values are as follows:
 - Expedited Forwarding (EF)
 - Class Selector (CS)—CS1, CS2, CS3, CS4, CS5, CS6
 - Assured Forwarding—AF11, AF21, AF41
 - Default Forwarding (DF)

For more information about these DSCP values, see [Marking, Queuing, and Dropping Treatments](#), on page 6.
 - **Priority**—Setting that designates a class of service as a priority service. This is a default setting and cannot be changed.
 - **%Bandwidth**—Percentage of the bandwidth that is allocated to a particular Class of Service.
 - **Admitted Traffic**—Types of application traffic that have a particular Class of Service.
- Step 5** Click **Create SP Profile** to save the new profile.
-

What to Do Next

After creating your customized SP profile, you need to configure the WAN interfaces with the SP profile. For information, see [WAN Interface Configuration for EasyQoS](#).

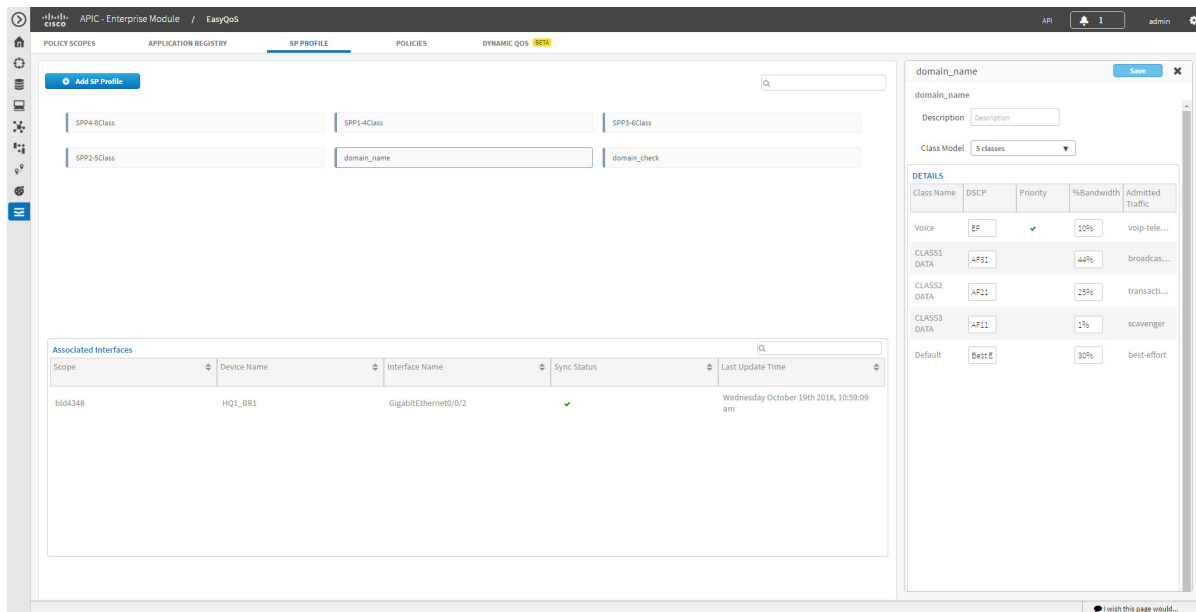
Editing a Custom Service Provider Profile

If you need to change the configuration of a custom service provider profile (SSP or SP profile), you can edit it.

**Note**

If you have not already done so, after configuring your SP profile, you need to configure the WAN interfaces with the new SP profile. For information, see [WAN Interface Configuration for EasyQoS](#).

Figure 8: Service Provider Profile Window Showing Edit SP Profile Pane



Before You Begin

You must have either administrator (ROLE_ADMIN) or policy administrator (ROLE_POLICY_ADMIN) permissions and the appropriate RBAC scope to perform this procedure.

Make sure that you have devices in your inventory. If not, discover devices using the Discovery function.

Define the scope of devices that you want to be configured with this QoS policy. You can do this by creating a policy tag in Topology or Device Inventory or by creating a policy scope in EasyQoS.

Procedure

- Step 1** From the **Navigation** pane, click **EasyQoS**.
- Step 2** From the **EasyQoS** window, select the **SP Profiles** tab.
- Step 3** Select the SP profile that you want to edit.
- Step 4** From the SP profile configuration pane on the left side of the window, click **Edit**.
- Step 5** In the **Edit SP Profile** pane, you can change the values in any of the following fields:
 - Note** If you need to change an SP profile name, you must delete the SP profile and then add it again with the new name.
 - **Description**—Word or phrase that identifies the SP profile.

- **Class Model**—Choose one of the class models from the drop down list. Valid class models are **4 classes**, **5 classes**, **6 classes**, and **8 classes**.
- **Class Name**—Name of the QoS class. The name can contain up to 24 alphanumeric characters, including underscores and hyphens. The underscore and hyphen characters are the only special character allowed in the name.
- **DSCP**—Dynamic Host Configuration Protocol (DHCP) value. Valid values are as follows:
 - Expedited Forwarding (EF)
 - Class Selector (CS)—CS1, CS2, CS3, CS4, CS5, CS6
 - Assured Forwarding—AF11, AF21, AF41
 - Default Forwarding (DF)

For more information about these DHCP values, see [Marking, Queuing, and Dropping Treatments](#), on page 6.

- **Priority**—Setting that designates a class of service as a priority service. This is a default setting and cannot be changed.
- **%Bandwidth**—Percentage of the bandwidth that is allocated to a particular Class of Service.
- **Admitted Traffic**—Types of application traffic that have a particular Class of Service.

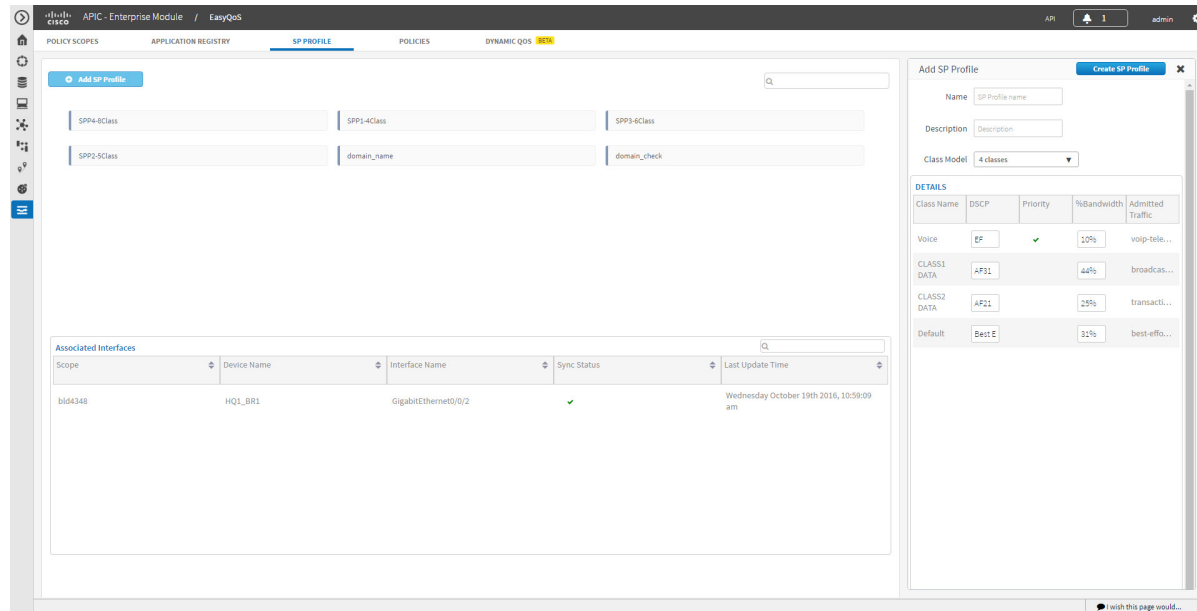
Step 6 Click **Save** to save your changes.

Verifying the WAN Interface Synchronization Status

After you have determined the service provider profile (SP profile) to use or created your custom SP profile (if necessary) and specified the SP profile on your WAN interfaces, you need to make sure that the WAN

interface is properly configured and that the Cisco APIC-EM recognizes it. You can check this configuration on the **SP Profile** window.

Figure 9: SP Profile Tab Showing Associated Interfaces Status



Before You Begin

You must have either administrator (ROLE_ADMIN) or policy administrator (ROLE_POLICY_ADMIN) permissions and the appropriate RBAC scope to perform this procedure.

You must have completed all the steps in [Configuring Service Provider Profiles on WAN Interfaces](#), on page 25.

Procedure

- Step 1** From the **Navigation** pane, click **EasyQoS**.
- Step 2** From the **EasyQoS** window, select the **SP Profiles** tab.
- Step 3** Select the SP profile that you want to verify. The **Associate Interfaces** pane appears, listing the scope, device name, interface name, synchronization status, and last update time.

If the Cisco APIC-EM recognizes the SP profile on the WAN interface, the synchronization status shows a check mark icon (✓). If not, the synchronization status shows a red X icon (✗). You need to troubleshoot the issue. Check that the name that you entered as the description of the interface is exactly as it appears in the Cisco APIC-EM and correct it, if needed.

Configuring QoS Policies

Creating or Editing a Policy

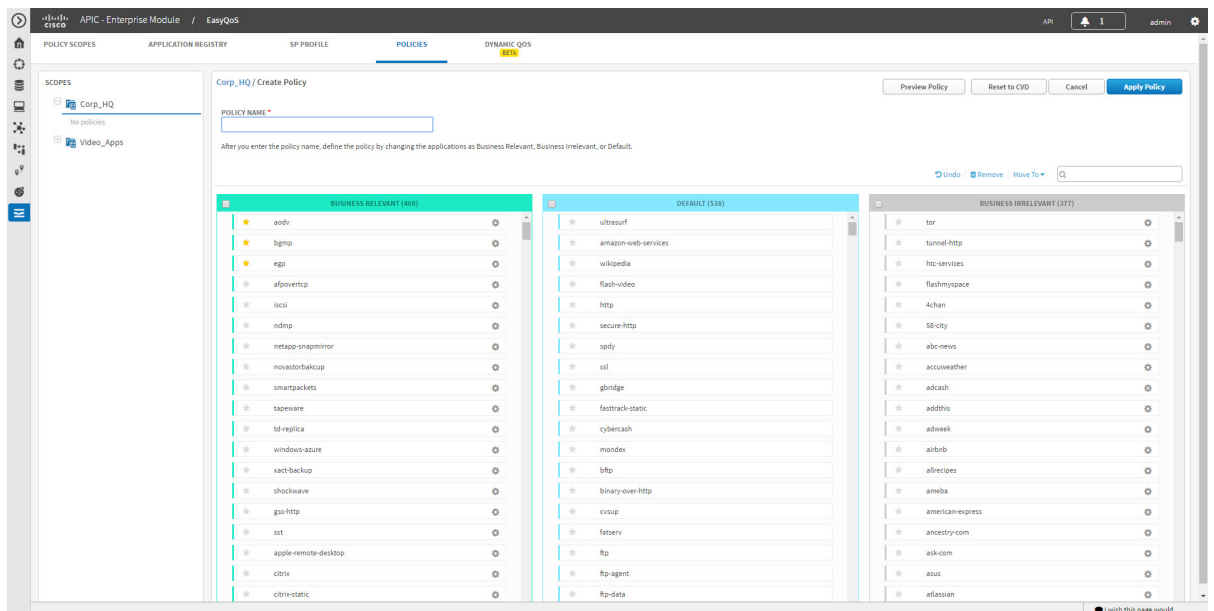
You can create or change a QoS policy for a group of devices that have the same policy scope. When you apply the policy, it is configured on the devices in the scope.



Note

Each policy scope can have a maximum of one wired-devices policy. However, it can have multiple wireless-segment policies (one policy for each wireless segment).

Figure 10: Policies Tab



Before You Begin

You must have either administrator (ROLE_ADMIN) or policy administrator (ROLE_POLICY_ADMIN) permissions and the appropriate RBAC scope to perform this procedure.

Make sure that you have discovered your complete network topology.

From the **Topology** or **Device Inventory** window, verify that the device roles assigned to devices during discovery are appropriate for your network design. If necessary, change any of the device roles that are not appropriate.

Define the scope of devices that you want to be configured with this QoS policy. You can do this by creating a policy tag in Topology or Device Inventory or by creating a policy scope in EasyQoS.

Procedure

-
- Step 1** From the **Navigation** pane, click **EasyQoS**.
- Step 2** Click the **Policies** tab.
- Step 3** From the **Scopes** pane, select a policy scope.
- Step 4** Do one of the following:
- To create a policy for the wired devices, click the **Create Policy** button and enter a name for the policy in the **Policy Name** field.
 - To create a policy for a wireless-device segment, click the plus sign (+) icon next to the chosen wireless segment and enter a name for the policy in the **Policy Name** field..
 - To edit a policy, select the policy from the **Scopes** pane.
- Step 5** If you want to change the business relevance of an application, proceed to the next step. Otherwise, click **Apply Policy** to configure the current application settings to the devices.
- Step 6** To change an application's business relevance, drag and drop the application from the current business relevance group to the chosen business relevance group.
- Note** To change an application's business relevance, you can also select the application and use the **Move To** drop down list to select the chosen business relevancy group. If you make a mistake, you can click the **Undo** button.
- Step 7** (Optional) You can designate applications as favorites by clicking the star icon next to the application name. For information about how favorite applications work, see [Favorite Applications](#), on page 9.
- Step 8** (Optional) You can change some of an application's settings by clicking the **Edit** icon next to the application name.
- Note** You cannot edit applications that have not been assigned a business relevance. If there are unassigned applications, the **Unassigned** link indicates the number of unassigned applications. To assign an unassigned application to a business relevance group, click **Unassigned**, then drag and drop the application into the appropriate business relevance group.
- Complete the following fields in the **Edit Application Details** dialog box and click **Save** when you are done:
- **Application Name**—Name of the application. This field is not editable.
 - **Show Details** and **Hide Details** toggle—Displays and hides the application's settings, for example, the application's URL or TCP and UDP port assignments. These settings are not editable.
 - **Advanced Policy Settings**—You can configure these advanced settings:
 - **Traffic Direction**—Indicates whether the policy is applied to unidirectional or bidirectional application traffic. For more information, see [Unidirectional and Bidirectional Application Traffic](#), on page 5
 - **Consumer**—Application that receives traffic from the application that you are editing. Use this setting to apply a policy to traffic that flows between these applications. For more information, see [Consumers and Producers](#), on page 5.
 - **Associated Policies**—If present, lists the policies that include the application that you are editing.
- Step 9** Do one of the following:

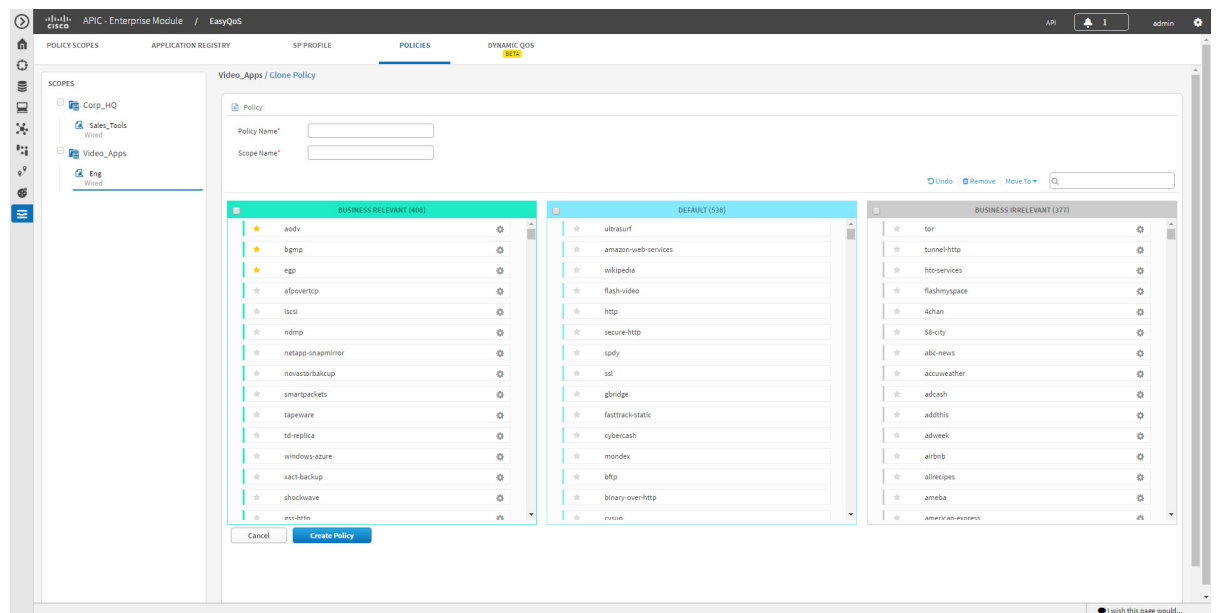
- To save and apply a new policy, click **Apply Policy**.
- To save your changes and reapply the policy, click **Reapply Policy**.

The policy is configured on the devices in the scope.

Cloning a Policy

If a policy exists that has most of the settings that you want in a new policy, you can clone the existing policy, change it, and apply it to specific scope of devices.

Figure 11: Policies Tab



Before You Begin

You must have either administrator (ROLE_ADMIN) or policy administrator (ROLE_POLICY_ADMIN) permissions and the appropriate RBAC scope to perform this procedure.

From the **Device Inventory** window, verify that the device roles (assigned during discovery) are appropriate for your network design. If necessary, change any of the device roles that are not appropriate. For information, see the *Cisco Application Policy Infrastructure Controller Enterprise Module Administrator Guide*.

Define the scope of devices that you want to be configured with this QoS policy. You can do this by creating a policy tag in Topology or Device Inventory or by creating a policy scope in EasyQoS.

You must have created at least one policy.

Procedure

- Step 1** From the **Navigation** pane, click **EasyQoS**.
 - Step 2** Click the **Policies** tab.
 - Step 3** From the **Scopes** pane, select a policy scope and then the policy that you want to clone.
 - Step 4** Click **Clone**.
 - Step 5** Enter a name for the policy in the **Policy Name** field.
 - Step 6** Enter the name of the policy scope in the **Scope Name** field.
 - Step 7** If you want to change the business relevancy groups to which applications belong, proceed to the next step. Otherwise, click **Create Policy** to configure the same policy settings as the policy that you are cloning.
 - Step 8** To change an application's business relevancy group, drag and drop the application to the chosen business relevancy group.
 - Step 9** (Optional) If desired, designate applications as favorites by clicking the star icon next to the application name. For information about how favorite applications work, see [Favorite Applications](#), on page 9.
 - Step 10** Click **Create Policy**.
The policy is configured on the devices in the scope.
-

Deleting a Policy

You can delete a QoS policy if it is no longer needed.

Before You Begin

You must have either administrator (ROLE_ADMIN) or policy administrator (ROLE_POLICY_ADMIN) permissions and the appropriate RBAC scope to perform this procedure.

Procedure

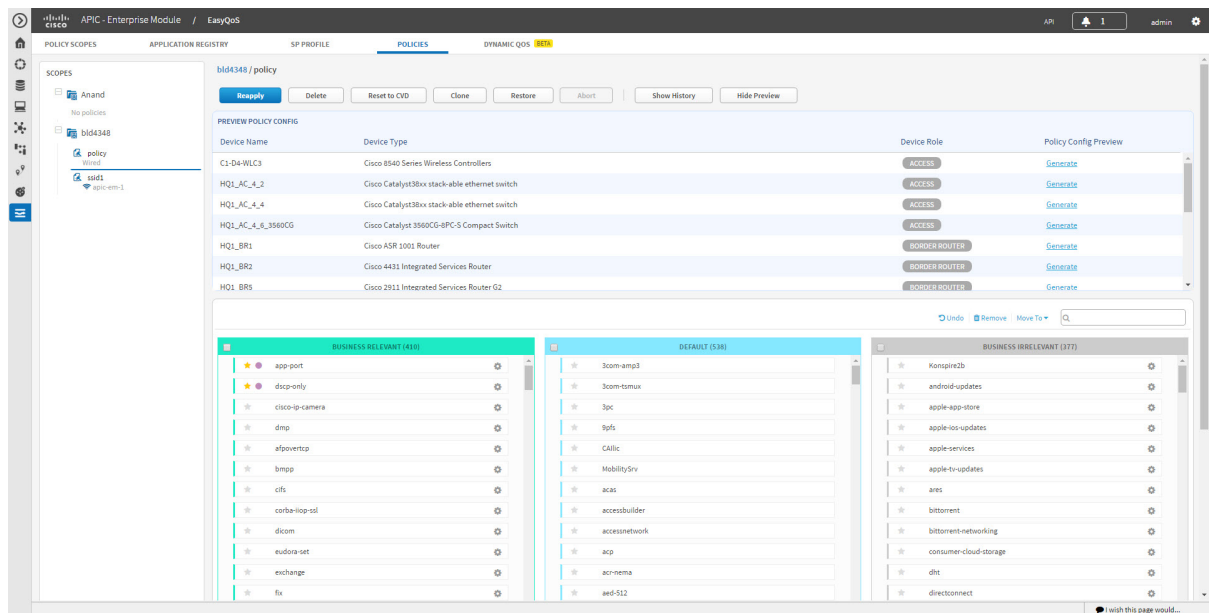
- Step 1** From the **Navigation** pane, click **EasyQoS**.
 - Step 2** Click the **Policies** tab.
 - Step 3** From the **Scopes** pane, select a policy scope.
 - Step 4** Under the policy scope name, select a policy.
 - Step 5** Click **Delete**.
 - Step 6** To confirm the deletion, click **Ok**. Otherwise, click **Cancel**.
 - Step 7** When the deletion confirmation message appears, click **Ok** again.
-

Managing QoS Policies

Previewing a Device's Policy Configuration

You can preview the EasyQoS policy configuration that will be applied to a device.

Figure 12: Policies Tab Showing Policy Preview Configuration



Before You Begin

You must have either administrator (ROLE_ADMIN) or policy administrator (ROLE_POLICY_ADMIN) permissions and the appropriate RBAC scope to perform this procedure.

You must have created an EasyQoS policy.

Procedure

- Step 1** From the **Navigation** pane, click **EasyQoS**.
- Step 2** Click the **Policies** tab.
- Step 3** Click **Show** next to the **Preview Policy** option.
The **Preview Policy Config** table displays, listing all of the devices in the scope along with their device type, device role, option to generate the configuration.
- Step 4** Click **Ok**.
- Step 5** Click **Generate** to produce the configuration for the corresponding device.
- Step 6** Click **View** to display the policy configuration for the corresponding device.

EasyQoS displays the command line interface (CLI) commands that comprise the policy configuration for the corresponding device in a separate dialog box.

Step 7 To generate additional configurations for other devices, repeat Steps 5 and 6.

Cancelling a Policy Configuration Process

After you click **Apply** or **Reapply**, EasyQoS begins to configure the policy on the devices in the policy scope. If you realize that you have made a mistake, you can cancel the policy configuration process.

The policy configuration process is performed as a bulk process in that it configures 40 devices at a time. So, if you have fewer than 40 devices, cancelling the process has no real effect. However, if you have hundreds of devices, cancelling the policy configuration process can be useful when needed.

When you click **Abort**, EasyQoS cancels the configuration process on devices that have not started to be configured and changes the device status to **Policy Aborted**. EasyQoS does not cancel configurations that are in the process of being completed or have been completed. These devices retain the updated policy configuration and reflect the state of the policy configuration, whether it is configuring, successful, or failed.

Before You Begin

You must have either administrator (ROLE_ADMIN) or policy administrator (ROLE_POLICY_ADMIN) permissions and the appropriate RBAC scope to perform this procedure.

Procedure

Click **Abort** to cancel the policy configuration process.

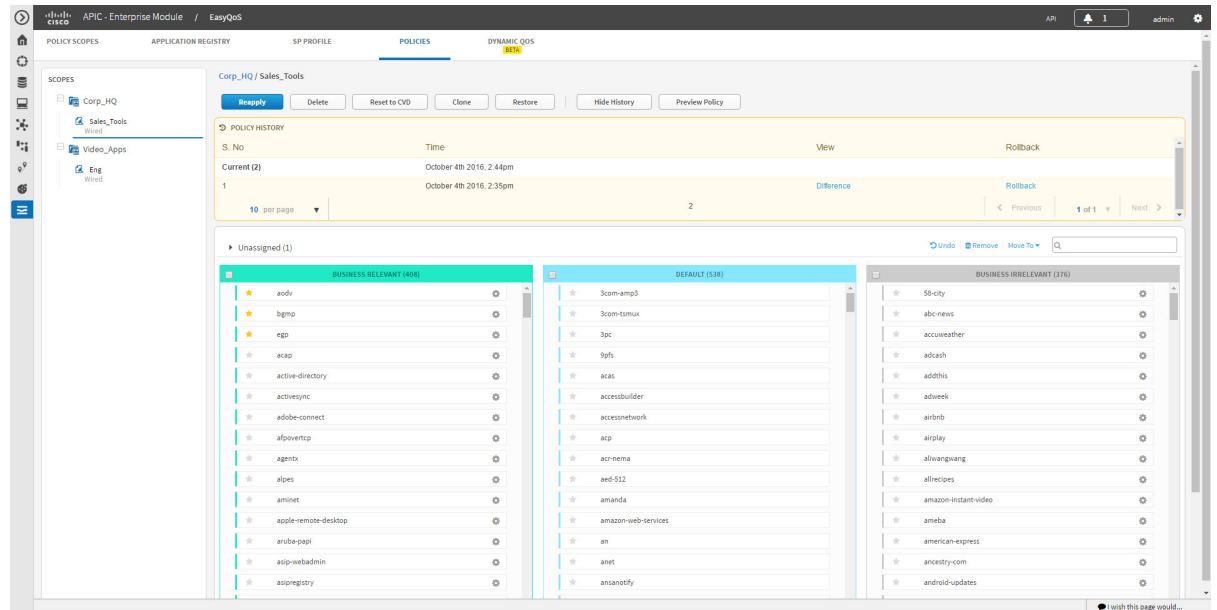
Displaying the Version History of Policies

You can display the version history of QoS policies. The version history includes the series number (iteration) of the policy and the date and time that the version was saved. In addition, the version history allows you to perform the following actions:

- Display the differences between a selected policy and the current one. For information, see [Comparing Policy Versions](#), on page 39.

- Roll back to a previous version of a policy. For information, see [Rolling Back to a Previous Policy Version](#), on page 40.

Figure 13: Policies Tab Showing Version History of Policies



Before You Begin

You must have either administrator (ROLE_ADMIN) or policy administrator (ROLE_POLICY_ADMIN) permissions and the appropriate RBAC scope to perform this procedure.

Procedure

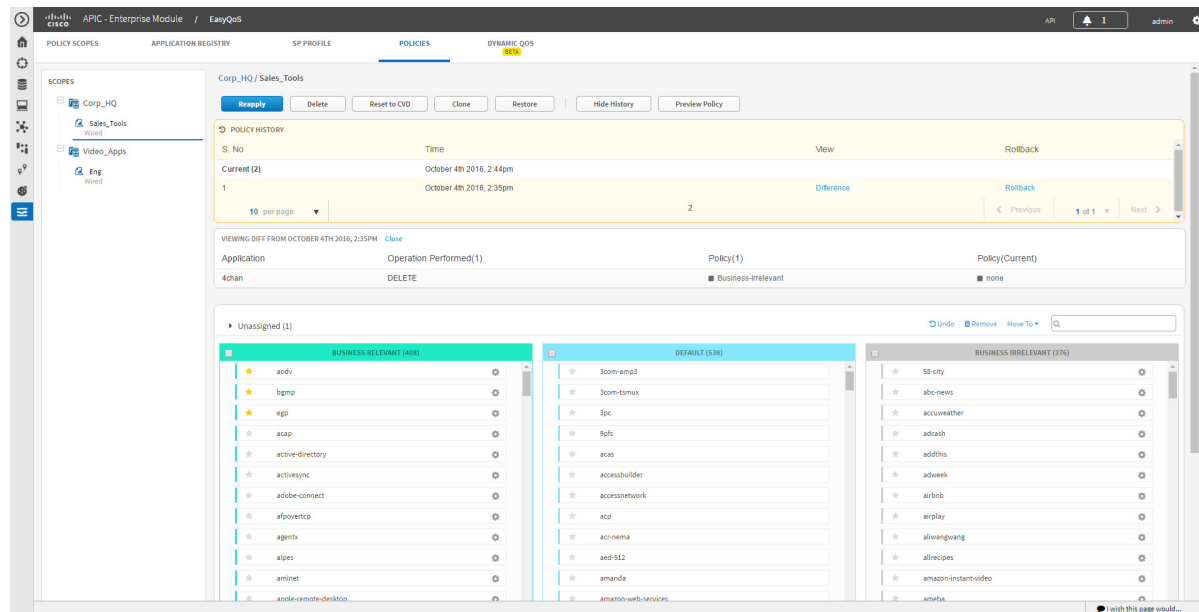
- Step 1** From the **Navigation** pane, click **EasyQoS**.
- Step 2** Click the **Policies** tab.
- Step 3** From the **Scopes** pane, select a policy scope.
- Step 4** Click **Show History**.

EasyQoS displays the version history of the selected policy in the **Policy History** area.

Comparing Policy Versions

You can view the differences between the selected version and the current version.

Figure 14: Policies Tab Showing Policy Versions



Before You Begin

You must have either administrator (ROLE_ADMIN) or policy administrator (ROLE_POLICY_ADMIN) permissions and the appropriate RBAC scope to perform this procedure.

Procedure

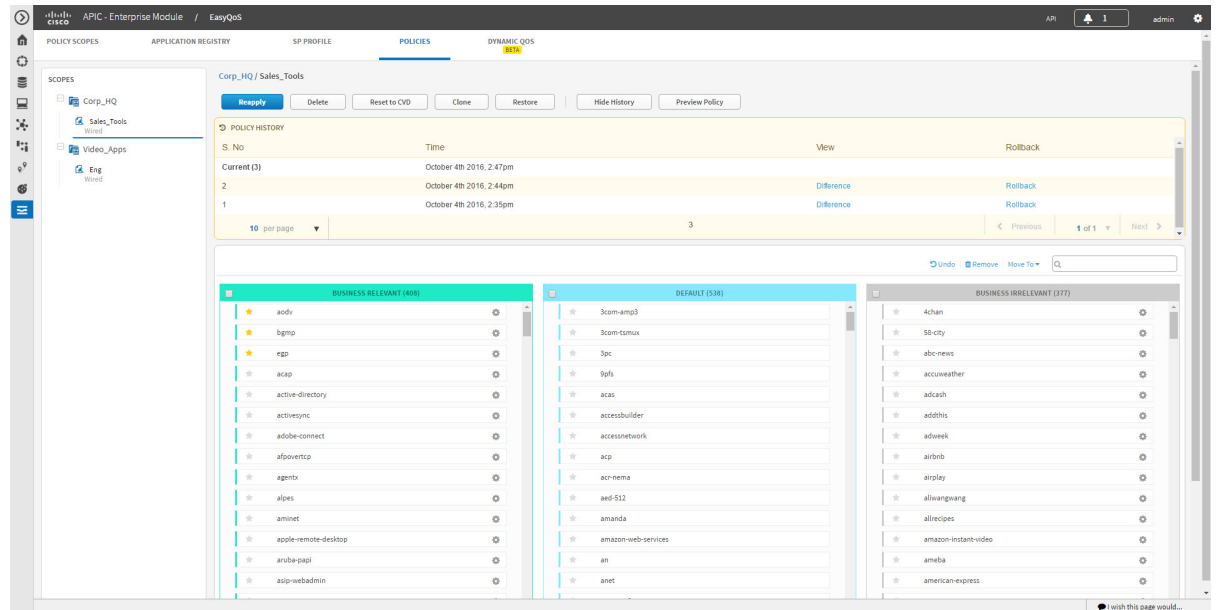
- Step 1** From the **Navigation** pane, click **EasyQoS**.
- Step 2** Click the **Policies** tab.
- Step 3** From the **Scopes** pane, select a policy scope.
- Step 4** Click **Show History**.
- Step 5** Click **Difference** corresponding to the version that you want to compare with the current version.

EasyQoS displays the results of the comparison below the **Policy History** area. The results include applications that were changed, and the operations performed to them.

Rolling Back to a Previous Policy Version

If you change a policy configuration, and then realize that it is incorrect, or it is not having the desired affect in your network, you can revert to a policy that is up to five versions back.

Figure 15: Policies Tab Showing Rollback Option



Before You Begin

You must have either administrator (ROLE_ADMIN) or policy administrator (ROLE_POLICY_ADMIN) permissions and the appropriate RBAC scope to perform this procedure.

Define the scope of devices that you want to be configured with this QoS policy. You can do this by creating a policy tag in Topology or Device Inventory or by creating a policy scope in EasyQoS.

You must have created at least two versions of the policy to roll back to a previous policy version.

Procedure

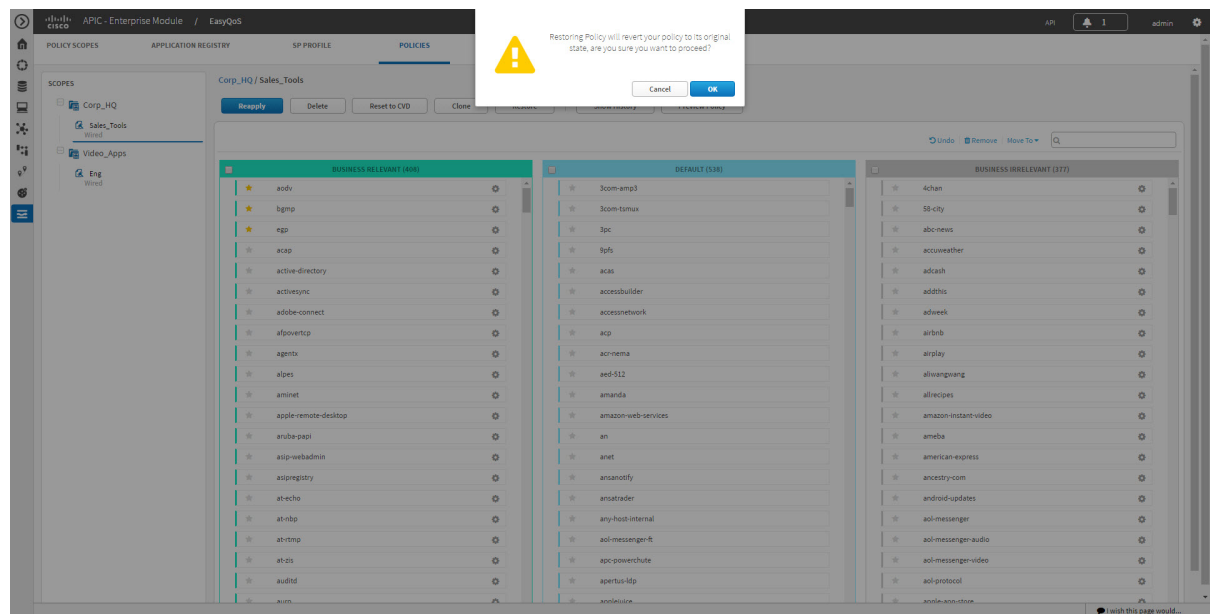
- Step 1** From the **Navigation** pane, click **EasyQoS**.
- Step 2** Click the **Policies** tab.
- Step 3** From the **Scopes** pane, select a policy scope and then the policy that you want to rollback.
- Step 4** Click **Show History**.
Previous versions of the selected policy are listed in descending order with the newest version (highest number) at the top of the list and the oldest version (lowest number) at the bottom.

- Step 5** (Optional) To view the differences between the selected version and the latest version of a policy, click **Difference** in the **View** column.
- Step 6** When you determine the policy version that you want to rollback to, click **Rollback** for that policy version.
- Step 7** Click **Ok** to confirm the rollback procedure.
The rolled back version becomes the newest version.
- Step 8** Click **Reapply**.
The newest policy version is configured on the devices in the scope.

Restoring the Original Device Configuration

After you apply policies to devices, you can restore the original policies (MQC policies and NBAR configuration) onto devices. For detailed information, see [Original Policy Restore, on page 4](#).

Figure 16: Policy Tab Showing Confirmation to Restore Original Device Configuration Dialog Box



Before You Begin

You must have either administrator (ROLE_ADMIN) or policy administrator (ROLE_POLICY_ADMIN) permissions and the appropriate RBAC scope to perform this procedure.

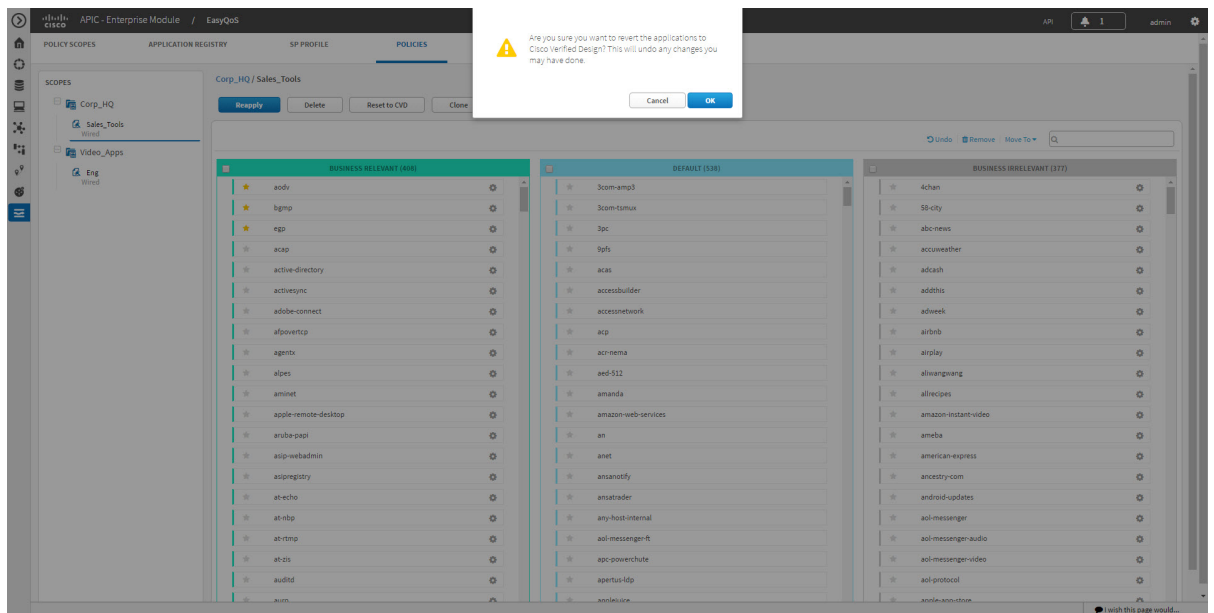
Procedure

- Step 1** From the **Navigation** pane, click **EasyQoS**.
- Step 2** Click the **Policies** tab.
- Step 3** From the **Scopes** pane, select a policy scope.
- Step 4** Click **Restore**.
- Step 5** Click **OK** to confirm the procedure.

Resetting Applications to the Cisco Validated Design Configuration

The Cisco Validated Design (CVD) configuration is the default configuration for the applications in EasyQoS. If you create or make changes to a policy and then decide that you want to start over, you can reset the applications to the Cisco Validated Design (CVD) configuration. For more information about the CVD configuration, see [Understanding QoS Policies](#), on page 2.

Figure 17: Policy Tab Showing Reset to CVD Confirmation Dialog Box



Before You Begin

You must have either administrator (ROLE_ADMIN) or policy administrator (ROLE_POLICY_ADMIN) permissions and the appropriate RBAC scope to perform this procedure.

Procedure

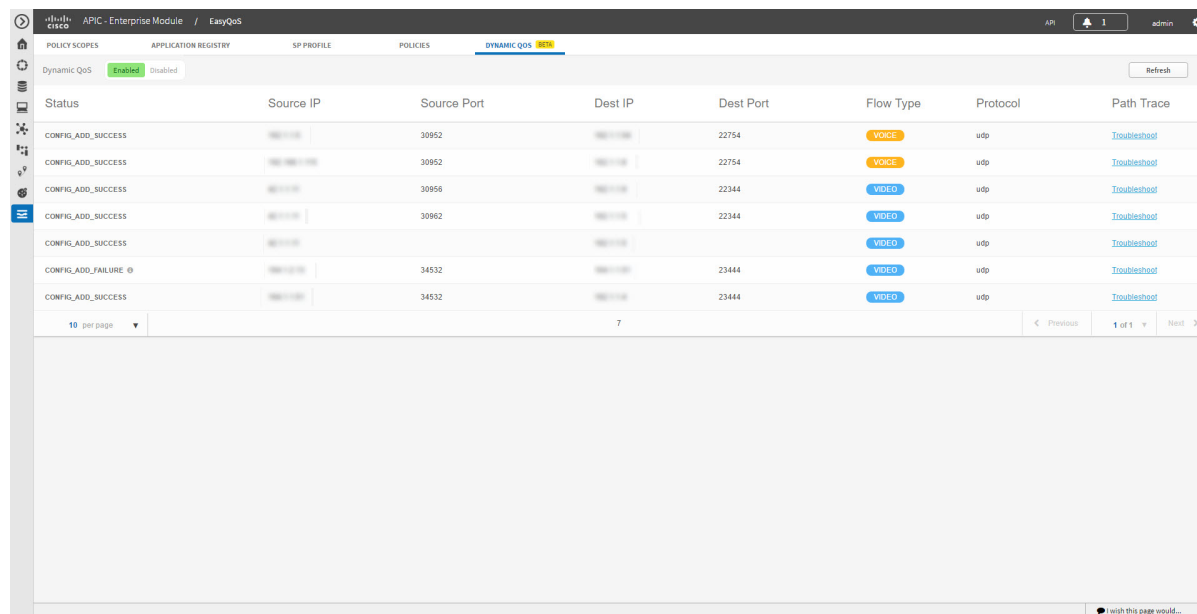
- Step 1** From the **Navigation** pane, click **EasyQoS**.
- Step 2** Click the **Policies** tab.
- Step 3** From the **Scopes** pane, select a policy scope.
- Step 4** Click **Reset to CVD**.
- Step 5** Click **Ok** to confirm this change.

Configuring Dynamic QoS

Enabling and Disabling Dynamic QoS

You can enable a policy to be dynamically applied to devices. For more information, see [Static and Dynamic QoS Policies](#), on page 3.

Figure 18: Dynamic QoS Tab



Before You Begin

You must have either administrator (ROLE_ADMIN) or policy administrator (ROLE_POLICY_ADMIN) permissions and the appropriate RBAC scope to perform this procedure.

You must have created a QoS policy with the appropriate configuration. For information, see [Creating or Editing a Policy](#), on page 32.

Procedure

- Step 1** From the **Navigation** pane, click **EasyQoS**.
- Step 2** From the **EasyQoS** window, click the **Dynamic QoS** tab.
- Step 3** In the **Dynamic QoS** field, click **Enabled** to turn on dynamic policy creation or **Disabled** to turn off dynamic policy creation.
- Step 4** To apply these configuration changes to the devices, you must reapply the policy to each scope.

Troubleshooting Dynamic QoS

You can use Path Trace to help you troubleshoot your dynamic QoS implementation.

Figure 19: Dynamic QoS Tab Showing Troubleshooting Link in Path Trace Column

Status	Source IP	Source Port	Dest IP	Dest Port	Flow Type	Protocol	Path Trace
CONFIG_ADD_SUCCESS	192.168.1.1	30952	192.168.1.2	22754	VOICE	udp	Troubleshoot
CONFIG_ADD_SUCCESS	192.168.1.1	30952	192.168.1.2	22754	VOICE	udp	Troubleshoot
CONFIG_ADD_SUCCESS	192.168.1.1	30956	192.168.1.2	22344	VIDEO	udp	Troubleshoot
CONFIG_ADD_SUCCESS	192.168.1.1	30962	192.168.1.2	22344	VIDEO	udp	Troubleshoot
CONFIG_ADD_SUCCESS	192.168.1.1	30962	192.168.1.2	22344	VIDEO	udp	Troubleshoot
CONFIG_ADD_FAILURE	192.168.1.1	34532	192.168.1.2	23444	VIDEO	udp	Troubleshoot
CONFIG_ADD_SUCCESS	192.168.1.1	34532	192.168.1.2	23444	VIDEO	udp	Troubleshoot

Before You Begin

You must have either administrator (ROLE_ADMIN) or policy administrator (ROLE_POLICY_ADMIN) permissions and the appropriate RBAC scope to perform this procedure.

You must have enabled Dynamic QoS and applied or reapplied policies for Dynamic QoS to be in effect. For information, see [Enabling and Disabling Dynamic QoS](#), on page 43.

Procedure

- Step 1** From the **Navigation** pane, click **EasyQoS**.
- Step 2** From the **EasyQoS** window, click the **Dynamic QoS** tab.
- Step 3** Locate the flow that you want to troubleshoot.
- Step 4** For that flow, click **Troubleshoot** in the **Path Trace** column.
A path trace is conducted on the selected flow, and the results are displayed in **Path Trace** in a separate browser window. For information about interpreting path trace results, see the *Cisco Path Trace Solution Guide*.

