Managing Cisco® QoS Using eHealth®

Quality of Service (QoS) is a measure of performance that allows you to configure different levels of service for various types of traffic in your infrastructure. QoS techniques can help eliminate problems caused by delay, jitter, packet loss, and echo by prioritizing network traffic. Without implementing a QoS strategy, your network may not guarantee acceptable transmission of data such as Voice over Internet Protocol (VoIP), video conferencing, and mission-critical data. This can result in poor quality voice or video during times of network congestion.

The eHealth® Suite now offers enhanced support for Cisco® routers that are QoS-enabled. eHealth monitors your network to ensure that it delivers expected service levels for your prioritized traffic. When your network performance does not meet expectations, you run reports to help you pinpoint the cause of the problem and to take corrective action.

This support for the material described in this topic is available with eHealth Release 5.7 Service Pack 4.

This focus topic describes how to actively monitor Cisco QoS elements using eHealth reports. It contains the following sections:

- **Overview** introduces QoS, Class of Service (CoS), and Service Level Agreements (SLA).
- **Hardware and License Requirements** lists the system requirements and eHealth licensing information.
- **Creating LAN/WAN and QoS Associations** explains how these associations are created and their role in accessing data, and the use of integrated elements.
- **Discovery** describes the element discovery process and element grouping.
- **Element Overview** describes the QoS element types that eHealth monitors and element naming convention.
- **Reports** describes the reports eHealth supports for Cisco QoS elements, including examples.
- **Reference Information** lists supported At-a-Glance charts and describes how to view a current Element Variable Report, as well as resources for further information.

**Overview: Quality of Service, Class of Service, and Service Level Agreements**

**Quality of Service** - To manage traffic, QoS ensures that the more important traffic gets through before any less-critical traffic. For example, you might want your highest priority or real-time voice and video traffic to have the best service such as the highest bandwidth, lowest latency, and no discards when congestion problems occur. Your lowest priority traffic would have less bandwidth, higher latency times, and be the first traffic to be discarded when congestion problems occur.

**Class of Service** - If you have routers that support QoS, you can configure them to identify different types of network traffic, and to assign a priority level for processing it based on a Class of Service (CoS). A class map defines how Cisco routers identify different types of traffic. A policy map defines what the router should do with the data that matches a certain traffic type (for example, discard it, process it, or delay it in a buffer). This helps detect and avoid network congestion.

Although you can define any number of traffic classifications, Table 1 shows three examples used to mark network traffic.
Along with Traffic Classification, the following traffic management mechanisms help support QoS at network interfaces:

- **Queuing Techniques** - Controls traffic queuing, ensuring room for highest priority traffic. Methods include random early detection (RED) and first-in/first-out (FIFO) queuing.
- **Traffic Policing** - Detects traffic that violates the SLA and controls the rate of traffic across an interface, usually by discarding traffic.
- **Traffic Shaping** - Delays and buffers traffic during times when traffic has reached or exceeded a specific service threshold. When volume exceeds buffer capacity, packets are discarded.

**Service Level Agreement** - An SLA is a contract between a customer and a service provider. A typical SLA contains a set of performance metrics for each CoS that specifies maximum traffic volume and thresholds for packet drops and packet delays. With eHealth, you can prevent SLA violations by monitoring the performance of your QoS elements.

### Hardware and License Requirements

**Hardware** - Your routers must be configured to support IP-based QoS technology. For more information about configuring QoS on your devices, refer to your router documentation.

**Licenses** - Each QoS and CoS element uses the standard eHealth licensing model; each element consumes one poller license.

### Creating LAN/WAN and QoS Associations

Before you discover Cisco QoS-enabled devices, it is recommended that you customize the process by using the NH_DISCOVER_QOS_ASSOCIATIONS environment variable. When NH_DISCOVER_QOS_ASSOCIATIONS is enabled, device associations are created between integrated QoS elements and LAN/WAN interfaces. This improves report functionality, allowing you to navigate between the LAN/WAN interface and QoS elements. To view LAN/WAN and QoS associations, discover your elements using both the LAN/WAN and QoS modes.

**Integrated QoS Elements**. Integrated QoS elements are used by eHealth to aggregate statistics into a single reportable source. This allows you to see the behavior for an entire policy map in one report, making it easier to compare the performance of various class maps.

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### Table 1. Traffic Classification

<table>
<thead>
<tr>
<th>Class</th>
<th>Service</th>
<th>Traffic Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold</td>
<td>Guaranteed latency and bandwidth</td>
<td>Voice and video services</td>
</tr>
<tr>
<td>Silver</td>
<td>Guaranteed minimum bandwidth</td>
<td>Business critical data</td>
</tr>
<tr>
<td>Bronze</td>
<td>Best-effort delivery</td>
<td>Internet, email</td>
</tr>
</tbody>
</table>

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**NOTE**

Integrated QoS elements (discussed in the next section) do not consume poller licenses.

Your eHealth system must have a QoS Health license key to access all the QoS capabilities discussed in this focus topic.

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**eHealth supports many environment variables used to control eHealth processes and operations.**

For a list of QoS-supported environment variables, refer to the eHealth Administration Guide.
Discovery

You use the eHealth discover process to locate devices in your network so eHealth can collect performance data from them and report on their performance and availability. When you run discovery, eHealth queries routers to find elements (interfaces and sub-interfaces) that support the CISCO-CLASS-BASED-QOS-MIB.

An eHealth element is a resource the eHealth system polls for data. After eHealth discovers a QoS element, it is added to the poller configuration. When eHealth detects any changes to an element, it automatically updates the element information in the eHealth database.

QoS element types are further discussed in the Element Overview section.

To discover elements:
1. On the eHealth console, select Setup → Discover.
2. On the Discover dialog box, under Mode, select both LAN/WAN and QoS.
3. Specify one or more community strings that allow read-write or read-only permission to the system elements in the Community Strings field.
4. Select the method through which you want to discover elements under Discover Using and specify the IP addresses to use.
5. Complete any of the remaining fields in the Discover dialog box, then click Discover.

For detailed instructions, refer to the eHealth Administration Guide.

QoS Element Groups

Grouping QoS elements helps organize your elements effectively and pinpoint trends in report data. When elements are discovered, eHealth automatically creates a QoS group per router that collects all integrated elements. You can generate aggregated statistics reports for those element groups.

To organize your groups, you can associate them to group lists.

Element Overview

Figure 1. Cisco QoS Data Model

Figure 1 illustrates the Cisco QoS eHealth data model.

Element Types

The Cisco QoS element types follow:
• Interface - Represents the Cisco QoS-enabled interface and contains statistics associated with the device as a whole.
• QoS CoS Integrated - Comprises all class map statistics as well as mechanics statistics (shaping, classifying, policing).

NOTE

If a discovered Cisco QoS element does not have the latest Cisco MIB installed, QoS CoS Contract elements are discovered instead of QoS CoS Policer elements.

• QoS CoS RED - Created for each QoS CoS that has RED statistics.
• QoS CoS Queue - Created for each QoS CoS that has queuing statistics.
• QoS CoS- Represents all QoS CoS statistics.
Element Naming Convention

eHealth uses the following convention for QoS elements:

\[ \text{sysname-ifDescr-QOS-policyname-configindex-direction-table-classmapname-precedence} \]

Where:

- \text{sysname-ifDescr} identifies the associated interface by the name of the host or router (\text{sysname}) and the interface description in \text{ifTable} (\text{ifDescr}).
- \text{policyname} identifies the QoS policy. This is present when the environment variable \text{EH_CISCO_QOS_POLICYNAME} is enabled.
- \text{configindex} is \text{cbQoSConfigIndex} in the QoS MIB, which identifies the configuration parameters for the QoS element for \text{queueing} and \text{randomDetect} statistics only. If the element does not represent \text{queueing} or \text{randomDetect}, the index is absent.
- \text{direction} represents the direction (IN or OUT) of the element traffic with respect to the router.
- \text{table} identifies the table from which the statistics were taken. This field is absent for \text{classmap}, \text{queueing}, and \text{randomDetect} statistics, but present for \text{policing} (CP) and \text{trafficShaping} (TS) statistics.
- \text{classmapname} is the name of the configured QoS data crossing an interface.
- \text{precedence} is a suffix used only in \text{randomDetect} elements and indicates the associated IP precedence or DSCP.

NOTE
When naming elements, keep in mind that eHealth uses a 64-character limit. Exceeding this limit can cause confusion.

Reports

This section describes each report type and helps you determine which reports you need to best monitor your network. eHealth supports the following reports for Cisco QoS elements:

- At-a-Glance
- Trend
- Top N
- Service Level
- Health

In order to manage QoS elements, you must know if the highest priority traffic is receiving the best service and the lowest priority traffic is receiving the least service.

Because QoS technology allows you to implement different levels of service for voice, video, and data network traffic, use these reports to help identify performance trends and service/threshold violations. This capability is especially important to service providers who need to meet customer SLAs for voice service.

Report Benefits. eHealth QoS reports can help you do the following:

- Detect when a threshold is about to be violated, so that you can take corrective action.
- Determine whether a customer has exceeded agreed-on CoS metrics.
- Associate alarm profiles with QoS elements, based on their different classes of service. For example, you can specify alarm thresholds and priorities that are based on SLA parameters, imposing more stringent requirements and higher alarm priorities on higher classes of service. In this way, you can specify that a Gold service will generate an alarm sooner and at a higher alarm priority than a Bronze service.
At-a-Glance Reports

At-a-Glance reports contain a set of pre-defined charts that provide insight into element performance. You can compare several variables on a single page. This helps you find combinations of problems that could indicate problem sources. From At-a-Glance charts you can navigate to Trend reports and review the performance of related elements.

CoS-specific charts for the QoS CoS Integrated element show the traffic shaping and traffic policing applied to each CoS, their effects, the throughput, and the pre- and post-policy packets. You can navigate from an integrated CoS chart to a specific At-a-Glance report for that CoS.

Sample At-a-Glance Report

At-a-Glance reports can be run for varying time periods. This At-a-Glance report displays six charts that detail statistics for a QoS CoS Integrated element. In this example, CoS utilization was between 80-100% for three elements over a 24-hour period. Refer to Table 2 on page 8 to see all available charts for QoS elements.

Trend Reports

Trend reports allow you to view more granular data on a particular performance variable or set of variables for one or more elements, or for a group of elements. You can also view trends over time from both At-a-Glance and Trend reports.

You can run additional Trend reports on individual CoS elements to distinguish between policy-based discards and RED drops, to indicate which variables are affected, and to suggest desired thresholds for those variables.

When you run a Trend report for an element, you can select up to 10 variables. Refer to Trend and Top N Variables on page 8 for directions to access the most current list of available variables to choose for each element.

Sample Trend Report

This sample Trend report shows the rate of packets discarded by a QoS mechanism over one day for element Birmingham-5000-G2/2-QOS-OUT-1331. For most of December 19 the discards for the QoS mechanism were between 2 and 3%. At 9:30 P.M. that rate dropped to 0 indicating that no packets were discarded.
Top N Reports

Top N reports provide information on groups of elements. These reports use the same variables as Trend reports, including such variables as peak values. When you run Top N reports, you select a group of elements and the variables that you want eHealth to compare for each element in that group. Elements are listed in ascending or descending order based on the value of the first variable.

Top N reports enable you to search for the best and worst performing elements within a specific class of service. You can run Top N reports on groups of CoS elements to determine whether an SLA is being violated or is in danger of being violated. If a violation is occurring or is imminent, the reports can help you determine which CoS elements are affected.

You can drill down to associated At-a-Glance and Trend reports to investigate the problem in more detail and to determine whether a service upgrade is warranted.

Sample Top N Report

When you run a Top N report, select a group of elements for which you want to compare common values. You can select up to six variables for comparison.

This sample Top N report shows the comparison of six elements on network (bandwidth) utilization percentage, minimum, and maximum. Up to 1,000 elements can appear for comparison.

<table>
<thead>
<tr>
<th>Element</th>
<th>BW Util % All</th>
<th>BW Util % Min</th>
<th>BW Util % Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>F002-8000-500-QOS-OUT-TCP assumes default</td>
<td>2.02</td>
<td>2.01</td>
<td>2.03</td>
</tr>
<tr>
<td>F002-8000-500-QOS-OUT-SHRINK</td>
<td>2.02</td>
<td>2.01</td>
<td>2.03</td>
</tr>
<tr>
<td>F002-8000-500-QOS-108T-OUT-VOICE-CORE</td>
<td>2.50</td>
<td>2.50</td>
<td>2.51</td>
</tr>
<tr>
<td>F002-8000-500-QOS-108T-OUT-EGP</td>
<td>0.69</td>
<td>0.61</td>
<td>0.69</td>
</tr>
<tr>
<td>F002-8000-500-QOS-OUT-TCP</td>
<td>0.40</td>
<td>0.42</td>
<td>0.40</td>
</tr>
<tr>
<td>R2-7000-QOS-IP-To93-O-3PP5S-IN</td>
<td>0.06</td>
<td>0.06</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Service Level Reports

When you use QoS on a VoIP-based network, Service Level reports summarize the performance of your network with three types of reports:

- **VoIP-Executive.** Provides high-level views of your network and can help you determine how workloads, availability, and latency vary with time across the network and from group to group within the network.

- **VoIP-IT Manager.** Summarizes the service levels across an IT environment and provides information about the network volume, utilization, and Health exceptions, as well as a summary of important variables for each element in the group or group list.

- **VoIP-Service Customer.** Provides information on volume, Health exceptions, utilization, Health Index, and availability for the elements in the group or group list.

Service Level reports help manage SLAs by summarizing the historical performance of resources in an enterprise, region, department, or business unit for an element group or group list based on analysis ranges and pre-defined thresholds.

Sample Service Level Report

This sample Network vs. Voice CoS Volume chart displays the total network volume and the total VoIP CoS traffic on WAN links for all the WAN and CoS elements in the group or group list during the report period. This chart is part of the VoIP IT Manager, VoIP Executive, and VoIP Service Customer Service Level reports.
Health Reports

Health reports contain information about the performance of a group of elements for a report period and alerts you to situations that may require attention.

When Health reports indicate trouble, drill down to At-a-Glance, Trend, and Top N reports to investigate problems. Health reports also identify situations to investigate because of errors, unusual utilization rates, or excessive volume.

Health reports display SLA metrics for your CoS elements on network utilization, packet drops, and packet delays. It compares performance variables to QoS parameters and indicates when a QoS SLA has been violated.

You can use a Health report to:

- Check on the performance of your Gold, Silver, and Bronze QoS service classes.
- Identify normal and exceptional network behavior.
- Compare the performance of a group of elements during a report period to their performance over a baseline period.
- Detect changes in behavior that indicate that problems are about to happen or are currently happening.
- Identify trends in volume.
- Verify Capacity Projection and Provisioning Leadtime through supplemental capacity reports.

Sample Health Report

The Health report can be run on data representing a report period of up to a month and can compare that data to baseline data compiled up to a year or more.

The default baseline period is 6 weeks for a daily Health report, 13 weeks for a weekly report, and 12 months for a monthly report.

The sample Health report is a daily report that focuses on network volume leaders from the selected group of elements. The volume leaders chart makes it easy to see the heaviest users. A table follows the volume leaders panels with the number of bytes versus the baseline data for the same period. Drilling down from the bars in the chart to At-a-Glance and Trend reports provides more detail on the element.
**Reference Information**

This section describes the following:

- How to access Trend and Top N variables for the Cisco QoS elements.
- Supported At-a-Glance charts that gauge the performance of each Cisco QoS element over a specified time period.
- Resources for further information.

**Trend and Top N Variables**

You can use the eHealth Element Variable Report (available from the eHealth Web interface Organization Page) to obtain details about supported Trend and Top N variables for each element.

Figure 2 shows an Element Variable Report with the Trend variables for a Cisco QoS element. It illustrates how eHealth combines and evaluates the MIB variables to obtain the data for each Trend variable.

**At-a-Glance Charts**

Table 2. At-a-Glance Charts for the Cisco QoS Elements

<table>
<thead>
<tr>
<th>Element</th>
<th>Charts</th>
</tr>
</thead>
<tbody>
<tr>
<td>QoS CoS</td>
<td>CoS Packets/Sec</td>
</tr>
<tr>
<td></td>
<td>CoS Bytes/Sec</td>
</tr>
<tr>
<td></td>
<td>Utilization by CoS</td>
</tr>
<tr>
<td>QoS CoS</td>
<td>Bytes Discarded</td>
</tr>
<tr>
<td></td>
<td>Congestion Discarded</td>
</tr>
<tr>
<td></td>
<td>CoS Utilization</td>
</tr>
<tr>
<td></td>
<td>Frames</td>
</tr>
<tr>
<td></td>
<td>Mechanism Discarded</td>
</tr>
<tr>
<td></td>
<td>Throughput</td>
</tr>
<tr>
<td></td>
<td>Utilization</td>
</tr>
<tr>
<td>QoS CoS</td>
<td>RED Packets/Sec</td>
</tr>
<tr>
<td></td>
<td>RED Bytes/Sec</td>
</tr>
<tr>
<td></td>
<td>RED Bytes/Sec</td>
</tr>
<tr>
<td></td>
<td>Utilization by CoS</td>
</tr>
<tr>
<td>QoS CoS Policer</td>
<td>Policing Packets/sec (violated, exceeded, conformed)</td>
</tr>
<tr>
<td></td>
<td>Policing Bytes/Sec (violated, exceeded, conformed)</td>
</tr>
<tr>
<td></td>
<td>Policing Packets/sec (in-contract, out-of-contract)</td>
</tr>
<tr>
<td></td>
<td>Policing Bytes/Sec (in-contract, out-of-contract)</td>
</tr>
<tr>
<td>QoS CoS RED</td>
<td>CoS Packets/Sec</td>
</tr>
<tr>
<td></td>
<td>CoS Bytes/Sec</td>
</tr>
<tr>
<td></td>
<td>Utilization by CoS</td>
</tr>
</tbody>
</table>
## Further Information

To learn more about QoS and CoS, refer to the following resources:

<table>
<thead>
<tr>
<th>To learn more about:</th>
<th>Refer to:</th>
</tr>
</thead>
<tbody>
<tr>
<td>QoS and CoS Basics</td>
<td>eHealth Web Help</td>
</tr>
<tr>
<td></td>
<td><em>Introduction to eHealth</em></td>
</tr>
<tr>
<td>Discovering QoS Elements</td>
<td>eHealth Administration Guide</td>
</tr>
<tr>
<td>Polling Licenses</td>
<td>eHealth Web Help</td>
</tr>
<tr>
<td></td>
<td><em>eHealth Administration Guide</em></td>
</tr>
<tr>
<td>Using QoS Environment Variables</td>
<td>eHealth Web Help</td>
</tr>
<tr>
<td>Creating QoS Element Groups</td>
<td>eHealth Web Help</td>
</tr>
<tr>
<td></td>
<td><em>eHealth Administration Guide</em></td>
</tr>
<tr>
<td>Importing and Exporting QoS Data from an NMS</td>
<td>eHealth Integration Guide</td>
</tr>
<tr>
<td>Storing Custom QoS Variables in the Database</td>
<td>eHealth Customizing Variables Guide</td>
</tr>
</tbody>
</table>