QoS for IP Voice and Video
How Cisco IT Uses QoS for Critical Applications

A Cisco on Cisco Case Study: Inside Cisco IT
Overview

- Challenge
  New applications require special data handling – especially voice and video

- Solution
  Standards of classification, QoS, and QoS management in both LAN and WAN
  Low Latency Queuing (LLQ) and Class Based Weighted Fair Queuing (CBWFQ)

- Results
  QoS provides better quality, better traffic handling during congestion

- Next Steps
  Expanding QoS use in network – to VPN, labs, MPLS, SAN, and more
Challenge - New Applications Require Special Data Handling

- Previous IP networks sent data that (mostly) tolerated delay
- New applications have new QoS requirements
  - IP voice is sensitive to latency, jitter, packet drops
  - IP video is sensitive to latency, packet drops
- Added bandwidth demands can overrun links

When larger or more input pipes meet smaller or fewer output pipes
Challenge - New Applications Require Special Data Handling (Contd.)

- QoS can be applied incrementally, but is much easier to manage if applied as a standard
Solution - Standards of Classification, QoS, and QoS Management

- Classification of services: Separating voice, video, and special data applications
- Marking services at a trusted edge: Marking traffic as close to the device as possible (IP phone, video camera, application server)
- CBWFQ: Guarantees a minimum amount of bandwidth during congestion based upon the service class marks
- LLQ: Provides a priority queue for voice, which pushes all voice packets to the front of the queue, ensuring that voice packets aren’t stuck behind larger data packets
- NBAR: Recognizes special application traffic and classifies that traffic appropriately
Class-Based WFQ - QoS Guarantees Plus Bandwidth Efficiency

- Buffering (LLQ) controls latency for voice
- Weights (CBWFQ) guarantee minimum bandwidth
- Bandwidth percentage allocation defined according to link size
- Unused capacity is shared among the other three classes
Class-Based WFQ - QoS Guarantees Plus Bandwidth Efficiency (Contd.)

- Each queue is separately configured for QoS
- Benefits
  - Minimum latency for voice traffic
  - Class of service SLAs supported for all data classes
  - No wasted bandwidth
Low Latency Queuing (LLQ) for Voice

- LLQ: Voice, Class 5
- CBWFQ: Video, Class 4
- CBWFQ: Control, Class 3
- CBWFQ: Data, Class 0

Interface Queueing:
- LLQ
- WFQ

Exhaustive Queuing:
- 0
- 4
- 0
- 3
- 4
- 5
- 5

WAN Circuit
### Cisco IT Classes of Service

<table>
<thead>
<tr>
<th>Service Class</th>
<th>Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 6</td>
<td>Network control traffic among switches and routers</td>
</tr>
<tr>
<td>Class 5</td>
<td>IP voice traffic (with LLQ)</td>
</tr>
<tr>
<td>Class 4</td>
<td>IP video traffic</td>
</tr>
<tr>
<td>Class 3</td>
<td>Voice and video signaling traffic</td>
</tr>
<tr>
<td>Class 2</td>
<td>Reserved for future use</td>
</tr>
<tr>
<td>Class 1</td>
<td>Low priority (scavenger class) traffic</td>
</tr>
<tr>
<td>Class 0</td>
<td>Default data traffic</td>
</tr>
</tbody>
</table>
LAN and WAN QoS

Phone marks voice – both data and signaling. Switch trusts:
- Voice CoS = 5
- Voice Signal CoS = 3
Switch marks:
- Video CoS = 4
- Video Signal CoS = 4
- High Priority CoS = 2
- Regular data CoS = unmarked (0)
- Low priority CoS = 1

Router performs congestion management based on per-class behaviors.
- LLQ for:
  - IP Precedence 5 for voice traffic (RTP)
- CBWFQ for:
  - IP Precedence 4 for production video traffic
  - IP Preference 2 for high priority data
- WFQ for:
  - IP Precedence 0 (regular traffic)
- Scavenger for:
  - IP Precedence 1 (low priority traffic)
Results - QoS Provides Better Quality

- Users hear better voice quality
  Voice packets given priority
- The network handles congestion gracefully
  Less important traffic is dropped first
Next Steps - Expanding QoS Use in Network

- Lab traffic with QoS needs: Labs are not trusted traffic sources, but may need QoS
- IP voice over VPN: Home office users starting to need QoS over the Internet
- QoS over MPLS VPN: Service providers handle and bill for varying classes of service differently
- Call admission control: Gatekeeper handling of oversubscription needs to know the network topology
Next Steps - Expanding QoS Use in Network (Contd.)

- Desktop trusted edge: Cisco IT is migrating trusted edge to desktop to support desktop videoconferencing
- Storage networking: Cisco IT is beginning to put very high volume SAN traffic across the LAN, and is studying how best to use QoS to support SAN and other traffic needs during congestion
To read the entire case study, or for additional Cisco IT case studies on a variety of business solutions, visit Cisco on Cisco: Inside Cisco IT www.cisco.com/go/ciscoit

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