Quality of Service (QoS) and H.323 Gatekeepers for IP Video Conferencing

Presented by:

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About the Speaker

- **Dr. Pete Welcher**
  - Cisco CCIE #1773, CCSI #94014, CCIP
  - Network design & management consulting
    - Stock quotation firm, 3000 routers, TCP/IP
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    - Hotel chain, 1000 routers, SNA
    - Government agency, 1500 routers
  - Teach many of the Cisco courses
- **Enterprise Networking Magazine articles**
  - http://www.netcraftsmen.net/welcher/papers

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Objectives

Upon completion of this seminar, you will be able to:

- Describe terminology and basics of H.323
- Explain H.323 video and audio traffic behavior
- Explain recommended QoS practices for IP video-conferencing traffic

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Topics

- **H.323 Background**
- **QoS for H.323**

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H.323 Components

- **H.323 Terminal**
- **H.323 MCU (Multipoint Control Unit)**
- **H.323 Gateway**
- **H.323 Gatekeeper**
- **H.323 Proxies**

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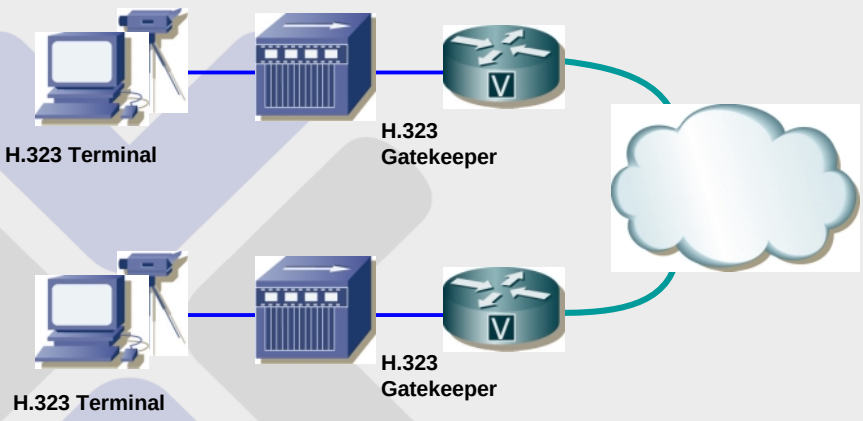
H.323 Networks



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H.323 Signaling Protocols

- **RAS (H.225) signaling**
- **Call Control/Call Setup(H.225)**
- **Media Control and Transport (H.245) signaling**

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What is a Gatekeeper?

- **A gatekeeper provides services such as address translation and network access control for H.323 terminals, gateways, and MCUs.**
- **A gatekeeper can provide other services such as bandwidth management, and accounting. With a gatekeeper, dial plans can be centralized to provide scalability.**
- **Gatekeepers are optional in a H.323 network, but if a gatekeeper is present endpoints must use the services provided by it.**

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What is a Gatekeeper Zone?

- **A zone is the collection of H.323 nodes such as gateways, terminals, and MCUs registered with the gatekeeper.**
- **There can only be one active gatekeeper per zone.**
- **Zones can overlay subnets and one gatekeeper can manage gateways in one or more subnets.**

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Mandatory Gatekeeper Functions

- **Address Translation - translate H.323 IDs (such as gwy1@domain.com) and E.164 numbers (standard telephone numbers) to endpoint IP addresses.**
- **Admission Control - control endpoint admission into the H.323 network via H.225 Registration, Admission, and Status (RAS) messages**
- **Bandwidth Control - manage endpoint bandwidth requirements via H.225 RAS messages.**
- **Zone Management - provide zone management for all registered endpoints in the zone, e.g. control endpoint registration**

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Optional Gatekeeper Functions

- **Call Authorization - Restrict access to certain terminals or gateways, possibly based on time of day**
- **Call Management - Maintain active call information and use it to indicate busy endpoints or redirect calls**
- **Bandwidth Management - Reject admission when the required bandwidth is not available**
- **Call Control Signaling - Route call-signaling messages between H.323 endpoints using the Gatekeeper-Routed Call Signaling (GKRCS) model. Or allow endpoints to send H.225 call-signaling messages directly to each other.**
- **Note: Cisco IOS gatekeepers are Direct Endpoint Signaling based.**

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RAS Gatekeeper Discovery

- **Unicast Discovery (manual method) - Uses UDP port 1718.**
  - Endpoints are configured with the gatekeeper IP address and can attempt registration immediately.
  - The gatekeeper will reply with a gatekeeper confirm (GCF) or gatekeeper rejection (GRJ) message.
- **Multicast Discovery (auto-discovery) - Uses UDP multicast address 224.0.1.41.**
  - Auto discovery enables an endpoint to discover its gatekeeper through a multicast message.
  - Less administrative overhead.
  - A gatekeeper will reply with a GCF message or remain silent.
  - A gatekeeper can be configured to respond only to certain subnets.

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Gatekeeper Call Signaling

- **Direct Endpoint Signaling - With this method, call setup messages are directed to the terminating gateway or endpoint.**
- **Gatekeeper-Routed Call Signaling (GKRCS) - With this method, the call setup messages are directed through the gatekeeper.**
  - Note: Cisco IOS gatekeepers are Direct Endpoint signaling based and do not support GKRCS.

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Directory Gatekeeper

- **Gatekeepers keep track of other H.323 zones and forward calls appropriately**
- **When many H.323 zones are present, gatekeeper configuration can become administrative intensive**
- **In large VoIP installations you can use a centralized directory gatekeeper that contains a registry of all the different zones and coordinates LRQ-forwarding processes.**
- **With directory gatekeepers, no full mesh is needed between inter-zone gatekeepers.**
  - Note: A directory gatekeeper is not an industry standard, but is a available in the Cisco implementation.

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Topics

- **H.323 Background**
- **QoS for H.323**

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Video Traffic

- **Video has a very high and very variable bit rate**
- **Video average packet size is high**
- **Video streams consist of reference and difference frames**
  - Large I frames carry a full scene
  - Smaller P and B frames quantize and compress with motion vectors and prediction algorithms
- **Like VoIP, video requires 125-150 msec round trip time for optimal results**
- **Video should not be attempted on a link of less than 768 Kbps bandwidth**

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H.323 Audio Bandwidth Requirements

- **Audio signals contain digitized, compressed sound (usually speech). H.323 supports standard audio codec algorithms, including:**
  - G.711 - 3.1 KHz at 48, 56, and 64 kbps (normal telephony)
  - G.722 - 7 KHz at 48, 56, and 64 kbps
  - G.728 - 3.1 KHz at 16 kbps
  - G.723 - 5.3 and 6.3 kbps modes
- **Selecting a codec involves tradeoffs between speech quality, bit rate, computing power, and signal delay.**

H.323 Video Bandwidth Requirements

- **Video capabilities in H.323 terminals are optional, but if implemented must support the H.261 codec, optionally H.263.**
  - H.261 - Video codec for audiovisual services at multiples of 64 kbps. H.261-compliant devices fully encode initial frames, then code only the differences between the initial and subsequent frames for minimal packet transmissions. Optional motion compensation improves image quality.
  - H.263 - Video codec for video Plain Old Telephone Service (POTS). The H.263 standard is a backward-compatible update to the H.261 standard. It significantly enhances picture quality. The H.263 standard defines five standard picture formats.

H.323 Video Bandwidth

- **Polycom Viewstation compresses traffic to one of the following speeds:**
  - 128, 256, 384, 512, 576, or 768 Kbps
  - This number does not include IP or L2 transport overhead, which should be figured at 20-25%
- **Total VoIP and video conferencing bandwidth including overhead should not exceed 33% of link bandwidth**

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Marking H.323 Traffic

- **Generally, Cisco design guides recommend AF41 (DSCP value 100010) for video. Since there is no advantage to treating the audio portion of the video streams better than the video packets in an IP videoconferencing application, AF41 should be used as the DSCP value for both voice and video media in a videoconference.**
- **At Layer 2, you can use the 3 Class of Service (CoS) bits in the 802.1p field, which is part of the 802.1q tag.**

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Cisco Marking Recommendations

Class of Traffic	IP Precedence or CoS	DSCP Value
Voice RTP	**5**	**EF**
Voice Control	**3**	**AF31**
Video Conferencing	**4**	**AF41**
Streaming Video	**1**	**AF13**
Data	**0-2**	**0-AF23**

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Cisco Marking

- **Streaming video is better at buffering streams and coping with delay and jitter, so it can be marked as DSCP AF13, a lower QoS level.**
- **Control traffic can be marked as AF31, although Cisco proxies use the AF41 marking for both data and control. Control traffic bit rates are negligible, compared to video.**
- **Classify and mark as close to the source as possible.**

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Classifying H.323 Traffic

- **Cisco recommends using an H.323 proxy for queue access, particularly if trust is not configured on every switch port.**
- **At small sites with only a few video terminals, use access control lists (ACLs) based on the video terminal's IP address for queue access. Using ACLs protects against rogue users marking their traffic with IP precedence 4, bypassing the gatekeeper (CAC), and affecting all the video in the PQ.**

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Prioritization of Video

- **Use LLQ with CBWFQ**
  - Add 20% to the video terminal data rate to allow for IP and transport overhead
- **Use the appropriate form of LFI on slower serial links**
- **On FR and ATM, shape all traffic to the guaranteed traffic rate (CIR or EIR)**
- **Streaming video should use the CBWFQ** bandwidth **command, not the LLQ** priority **command**

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Signaling

- **As WAN links become congested, video and other traffic can completely starve the voice control signaling protocols.**
- **If this happens, IP phones cannot complete calls across the IP WAN.**
- **Voice control protocol traffic, such as H.323 and the Skinny Client Control Protocol, requires its own class-based weighted fair queue with a minimum configurable bandwidth, and marking equal to a DSCP value ofAF31. This correlates to an IP precedence value of 3.**

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Serial Links and cRTP

- **On low speed serial links, compressed RTP is often used to reduce the effects of serialization and queuing delay.**
- cRTP is not recommended for use with IP videoconferencing.

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Cisco cRTP Recommendations

- **Use cRTP only with low bit rate voice codecs, such as G.729. If G.711 is used as the audio codec for a voice or videoconference call, the statistical throughput gains achieved with cRTP are not significant enough to merit its use.**
- **Use cRTP only when low bit rate voice is a significant percentage of the offered load. In general, this only helps when low bit rate voice is greater than 30 percent of the offered load to a circuit.**
- **cRTP can affect forwarding performance. Monitor CPU utilization when using cRTP.**

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Share LLQ for Voice & Video?

- **Priority VoIP and video classes put traffic from both classes goes into a single queue. You might choose to not do this because:**
  - Video packets are much larger than voice packets.
  - If a small VoIP packet enters the queue behind one or several large video packets, then VoIP delay increases, possibly substantially.
  - This could adversely affect VoIP performance.
  - Since most EF queues are very small, using them for video traffic might also lead to dropped packets.
- **Testing with links faster than 768 kbps and using CAC (below) showed that putting video in the priority queue does not noticeably delay VoIP**

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Two Approaches to QoS for Video

- **Voice, video, audio in the priority queue, provision bandwidth as needed**
- **Voice in priority queue, video and audio using the CBWFQ** bandwidth **mechanism**
- **You could put video conference audio in the voice priority queue. But video coding takes longer than audio, so the audio will be buffered until the voice arrives anyway**
  - There is no benefit to prioritizing audio

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Call Admission Control (CAC)

- **A complete QoS solution for video conferencing requires CAC**
- **"Protect video from video"**
- **Make sure that too many IPVC calls do not cause quality to deteriorate**
- **The** priority **command does police traffic that exceeds the configured bandwidth**

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Providing CAC for Video Calls

- **Three approaches:**
  - Limit the number of video terminals (especially if a remote site has no H.323 gatekeeper)
  - Use gatekeeper CAC to set bandwidth limits on calls in a hub and spoke environment
    - Inter-zone calls, intra-zone calls
    - Can combine gatekeeper CAC with proxy, so that proxy controls entry to the priority queue
  - Use RSVP
    - Requires RSVP-capable endpoints

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Using RSVP with H.323

- **Appendix II of the H.323 v4 standard outlines how to use RSVP:**
  - When placing a call, an endpoint communicates its ability to use RSVP to the gatekeeper. The gatekeeper then tells the endpoint whether to try to reserve resources.
  - During the H.245 phase, endpoints indicate whether they can signal resource reservations. They then decide whether to proceed with the call.
  - Once the logical channels are opened, but before they are used for data packets, RSVP reservation messages can be sent.

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Working with H.323 Calls

- **Some H.323 terminals offer QoS tools to ensure that the delay and loss parameters of video traffic are met despite unpredictable data flows.**
- **The Polycom Viewstation keeps track of all video packets after a call is established and reports average latency as well as the number of lost video or audio packets.**
- **It also supports debugs with readable output. These can help indicate the source of a problem. For more information, see the document, *How to Configure Video over IP for Polycom Video Units*.**

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Summary

You should now be able to:

- Describe terminology and basics of H.323
- Explain H.323 video and audio traffic behavior
- Explain recommended QoS practices for IP video-conferencing traffic

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Where to Get More Info

- **CCO links:**
  - **Implementing QoS Solutions for H.323 Video Conferencing Over IP**, at http://www.cisco.com/warp/public/105/video-qos.html#9
  - **Understanding H.323 Gatekeepers**, at http://www.cisco.com/en/US/tech/tk652/tk701/technologies_tech_note09186a00800c5e0d.shtml
- **For more info (and links), see my CiscoWorld articles**
  - http://www.netcraftsmen.net/welcher

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Questions

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  - Network management tools & procedures advice: what's right for you
  - Implementation guidance (your staff does the details) or full implementation
- **We do**
  - Small- and Large-Scale Routing and Switching (design, health check, etc.)
  - IPsec VPN and V3PN (design and implementation)
  - QoS (strategy, design and implementation)
  - IP Telephony (preparedness survey, design, and implementation)
  - Call Manager deployment
  - Security
  - Network Management (design, installation, tuning, tech transfer, etc.)

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- **IP Telephony**
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- **Security**
- **(Routing and Switching)**

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