Cisco WebEx Network Bandwidth

White Paper

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Contents

Introduction

The performance of a Cisco WebEx® session depends on many factors. Some of these factors can be administratively controlled within the WebEx admin user interface, and the Cisco® Collaboration Cloud, while others can be managed within the customer's corporate network or home computing infrastructure. In this paper, we provide measurements for the network bandwidth generated during a WebEx session. This document also describes the new Cisco WebEx high-quality/high-definition (HQ/HD) video technology and provides details on how it works in the context of your meetings. Finally, this paper also offers information about storage capacity required for the Network-Based Recording (NBR) functionality. This paper does not contain information about Cisco WebEx Connect® and the Cisco Jabber™ client.

Optimized Bandwidth Usage

Cisco WebEx services optimize bandwidth usage to minimize the amount of data transmitted over the network. This helps reduce network congestion, increase performance, and improve user experience. The most significant optimizations are listed below.

Optimized Desktop and Application sharing

The client software monitors text and graphics, and shared document views are transmitted. Incremental changes are detected and only these changes are transmitted again, therefore fully optimizing the bandwidth use and preserving the user experience.

Compression and Encryption

All large data transfers and file uploads are compressed. This not only reduces network traffic, but also adds a level of encryption to the data stream. For more information about Cisco WebEx security, please refer to the WebEx security [white paper](#).

Incremental Update

During application sharing, the contents of the window are dynamically updated. WebEx services incrementally update only those portions of the screen that have changed. The updates are transmitted as vector graphics commands and not as bitmaps.

Video Compression

Several video compressions and optimizations have been incorporated into WebEx HQ and HD video. The amount of bandwidth produced by video transmission is directly related to the rate of change of captured video images.

Optimal Protocol

WebEx services can work through all firewalls using the HTTPS protocol. However, WebEx will first check if communication can be established using the User Datagram Protocol (UDP). This approach is more efficient and reduces network traffic by approximately 10 percent when compared to HTTPS. Security is achieved with use of the TLS 1.0 (SSL 3.0) standard protocol.

WebEx Data Share

Cisco WebEx services creates data streams that vary depending on the type of application being shared, complexity of the graphics, use of voice over IP (VoIP), use of video, and other factors. WebEx services typically create network traffic when users actively share slides, desktop, and video, or use VoIP. Simply viewing a slide presentation does not generate any activity in the meeting and transmits very little network traffic. Intense activity such as changing a PowerPoint slide generates intermittent spikes in network traffic, with a return to low bandwidth use while there is no activity or no changes on the shared screen. WebEx data sharing provides up to five frames per second (fps) refresh rate, requiring the presenter to use the "Streaming Video Share" feature for sharing the video from his or her computer (see next section for details). The "Data Share" or "Presentation Share" features should not be used for streaming a video file during a meeting. Figure 1 illustrates how to share a desktop.

Figure 1.   How to Share Your Desktop
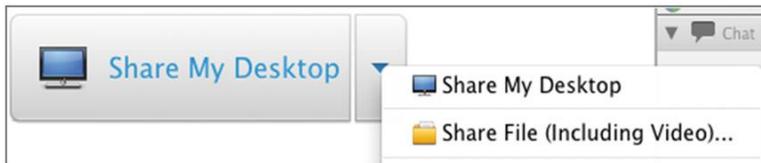
WebEx Video

Cisco WebEx video allows users to share the video by using the web cam attached to their PC, Mac machines, or share and receive it on some mobile devices. High definition with resolution up to 720p is now available in Meeting Center, and high quality with up to 360p resolution is available in other centers. Please review the details about the WebEx web cam video usage options and supported hardware in this section.

High-Quality and High-Definition Video At a Glance

Table 1 provides an overview of HD and HQ.

Table 1.   HQ and HD Video

	High-Definition Video	High-Quality Video	Standard WebEx Video
Products	Cisco WebEx Meeting Center (WBS27.29 or later)	Cisco WebEx Meeting Center (WBS27.17 or later) Cisco WebEx Support Center (WBS27.26 or later) Cisco WebEx Training Center (WBS27.26 or later)	Cisco WebEx Event Center
Resolutions • Maximum Resolution (pixels) • Maximum Frame Rates (per second)	720p (1280x720) 30 fps	360p (640x360) 30 fps	CIF (352x288) 30 fps
Transport Protocol	TCP Port 80, SSL 443, UDP Port 9000	TCP Port 80, SSL 443, UDP Port 9000	TCP Port 80, SSL 443
Maximum Participants	500 (HQ/HD)	500 (HQ/WebEx Training Center Only)	1000 SPV
Video Codec	H.264	H.264	H.264

High-Quality and High-Definition Video Resolutions

Table 2 identifies the resolutions supported in WebEx Meeting Center.

Table 2.   Resolutions Supported in WebEx Meeting Center

	Format	Display Size	
		Width	**Height**
Full Screen	720p	1280	720
Large View	360p	640	360
Medium View	180p	320	180
Thumb View	90p	160	90

Supported Platforms

Supported platforms include:

- Windows
- Linux (view only)
- Mac
- iOS on iPad

Video Features for iPad and iPad 2

WebEx multi-point video is supported on iPad and iPad 2. Send and receive video is currently supported only on iPad 2 and "receive only" video is supported on the original iPad release. The following features are available on iPad and iPad 2:

- Video wall of 90p thumbnail videos
- Full-screen video mode
- Receive up to 360p video
- Send up to 180p video (iPad 2 only)

System Requirements

Table 3 lists the CPU and memory features in WebEx video.

Table 3.   CPU and Memory

Best Encoded (Sending) Resolution	Best Decoded (Receiving) Resolution	Minimum CPU Requirement	Memory Requirement
720p	720p	Quad core (sending only in meeting with three or more participants) Dual core 2.8 GHz or Dual core 2.4 GHz with Intel HT (send with maximum of two participants; receive with three or more participants)	2 GB
360p	720p	Dual core	2 GB
360p	360p	Dual core	1 GB
180p	360p	Single core 2.4 GHz	1 GB
180p	180p	Single core with less than 2.4 GHz or Intel Celeron	None

[*] System requirements are the same for Mac and PC models.

Supported Cameras

Table 4 outlines supported cameras.

(Please refer to the latest WebEx release notes for the updated list.)

Table 4.   Supported Cameras

HD Video Supported		
Number	**Manufacturer**	**Camera Model**
1	Logitech	C310
2	Logitech	C500
3	Logitech	C510
4	Logitech	C905, B905
5	Logitech	C910, B910
8	Microsoft	LifeCam Cinema
9	Microsoft	LifeCam Studio
10	Microsoft	LifeCam HD-5000
11	Microsoft	LifeCam HD-5001
12	Microsoft	LifeCam HD-6000
13	Cisco Systems	V3 CUVA
14	TANDBERG	PrecisionHD
15	Apple Inc.	iSight (some models)

Note: In the initial release (WBS27.29) only these tested HD cameras are supported. Other camera models will not be enabled to send the 720 p HD resolution from the WebEx client.

Table 5 lists recommendations of cameras to use to stream the video.

Table 5.   Recommended Camera Models

HQ Video Tested (Recommended)		
Number	**Manufacturer**	**Camera Model**
1	Cisco	VT Camera I
2	Cisco	VT Camera III
3	TANDBERG	PrecisionHD
4	Logitech	Quick Cam Pro 9000
5	Logitech	QuickCam Orbit AF
6	Logitech	QuickCam C905
7	Logitech	QuickCam S7500
8	Microsoft	LifeCam HD
9	Microsoft	LifeCam VX-1000
10	Microsoft	LifeCam Cinema
11	Microsoft	LifeCam VX-6000
12	Microsoft	LifeCam NX-6000
13	Microsoft	LifeCam VX-3000

Note: FireWire-type cameras connected to a PC may work but these were not tested.

WebEx Video Modes

WebEx video provides two types of operation modes: single-point video and multi-point video. Please note that WebEx Support Center includes only point-to-point video to support the most common type of interaction between a support representative and the customer.

Multi-point video (MPV) in WebEx Meeting Center and Training Center provides main active speaker window and thumbnail windows where up to six participants can be viewed simultaneously in the participant list view; or up to five in the full screen view. Each user has the flexibility to scroll through the alphabetical list of participants. It is preferred for highly collaborative group meetings where multiple people are actively participating. Figure 2 demonstrates what a multi-point video looks like. Multi-point video is preferred for collaborative meetings or training sessions where multiple attendees are actively participating.
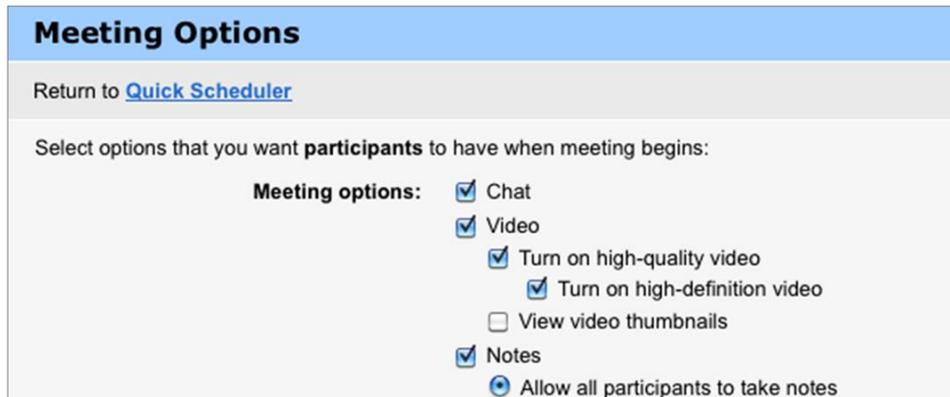
Figure 2.   User Interface of Multi-Point Video (MPV) Meeting

Single point video (SPV) provides one window where a single meeting participant can be viewed. The presenter determines which participant is viewed in the meeting. It is ideal for one-to-one or one-to-many meetings, where a single person is the primary focus. The SPV feature is available only in the WebEx Event Center release and it was removed from the other centers with introduction of the HQ video in WBS27.17. Please refer to customer communication notices, release notes, and kb.webex.com for more information about how the new HQ/HD video operates and how this functionality has changed.

Due to the number of video streams and the flexibility available to the attendees, MPV requires more bandwidth than SPV. Meeting participants can customize their own view between the active speaker only or thumbnail view. This can be done either through the Meeting Options menu or by right-clicking the Video Panel title and selecting the video mode. The person scheduling the meeting also has the option to disable the thumbnails feature during the scheduling process using the WebEx Advanced scheduler UI. Figure 3 displays the options a user has when setting up a meeting.

Figure 3. GUI of Meeting Options

Meeting Options

Return to **Quick Scheduler**

Select options that you want **participants** to have when meeting begins:

Meeting options:
- ☑ Chat
- ☑ Video
  - ☑ Turn on high-quality video
    - ☑ Turn on high-definition video
  - ☐ View video thumbnails
- ☑ Notes
 - ◉ Allow all participants to take notes

Streaming a Video File into a WebEx Meeting

Streaming a video file into a WebEx meeting allows users to share the video file during the meeting. This is a different video sharing method from the desktop-sharing feature and from the website-sharing feature. Similar to webcam video, streaming utilizes scalable video coding to encode or decode multiple layers of video bit streams. In Cisco WebEx Meeting Center and Cisco WebEx Training Center, users should distinguish between the webcam video usage for video presence of the participants in the meeting and the shared video file feature, which is used to play the video file to the audience from the presenter's computer.

The webcam video refers to video conferencing in real time, encoded and sent to the receiving clients using the Cisco WebEx Cloud. Webcam video is used primarily for video conferencing. The Streaming Video File feature is a video that is encoded and streamed to other meeting participants as shared content during a meeting. This streaming video feature contains the video and audio (if it is included in the file) and does not appear in a multipoint video conferencing pod as an active speaker. It can be played, paused, or stopped from the file-sharing tab. It is similar to a previously uploaded presentation or whiteboard (see Figure 4).

From Presentation Desktop, click on the arrow next to "Share My Desktop," then select "Share file," and select your video file. The following media file formats are currently supported: WMV, WMA, WAV, MP3, ASF, AVI, MPG, MPEG, MOV, FLV, F4V, QT, and MP4 (note: user's computer from where the file is shared from must be capable of playing the file locally at the user's computer).

Figure 4.   Streaming Video Feature
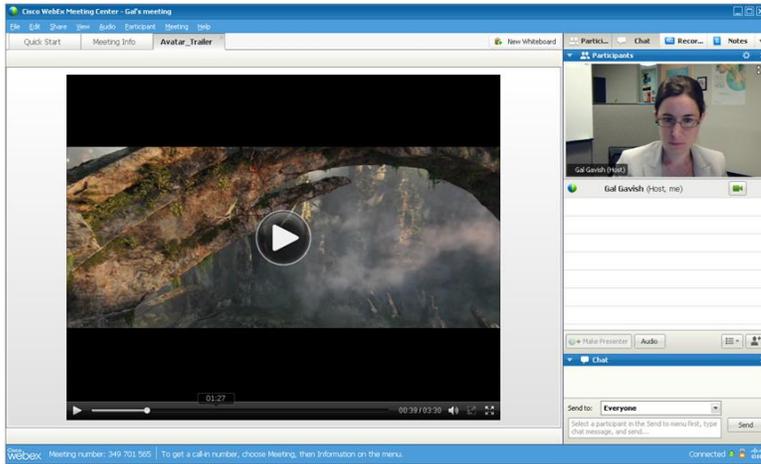
About the WebEx Video Codec

The Cisco WebEx Meeting Center (WBS27.17 or later) has adopted the H.264 standards-based Scalable Video Coding (SVC) for video compression to deliver adaptive standard-quality (SQ), high-quality (HQ) and high-definition (HD) video. High-definition (720p) video was introduced in the WBS27.29 and is currently available in Meeting Center only.

The video engine consists of all the fundamental video processing modules, including capture, encoding, transmission, receiving, decoding, and rendering. It also includes supporting modules for error control, congestion control, bit rate adaptation, and encryption.

Use of the SVC encoding protocol is allowing the captured video to be separated into multiple layers of resolutions, frame rates, and quality. In the WebEx video encoder implementation, raw video sequences are compressed into a single "base layer" and several "enhancement layers" before they are transmitted to the receiving clients. The base layer in the compressed video bit streams provides a relatively low video quality and can be independently decoded. Enhancement layers serve as add-ons for the base layer to improve the video experience. If more bandwidth is available, then more enhancement layers will be sending, resulting in better video quality. Similarly, when network congestion occurs for any participants, the clients could save bandwidth by receiving fewer enhancement layers, gradually degrading the video quality, while maintaining the best video experience and dynamically adjusting the quality to changing conditions of the network or the participant's computer.

Depending on various conditions such as user eligibility, subscription modes of the receivers, capability of camera and PC, network conditions, etc., one or more of the available resolutions can be encoded at the same time when the video is sent. On the receiving side, the client will automatically select and decode one specific resolution. This encoding and decoding capability is resulting in a higher bandwidth requirement for transmitting video compared to receiving video.

Frame Rate Range

WebEx supports various frame rate ranges. On the sender side, it depends on the camera capture capability and available computing and bandwidth resources. On the receiver side, it further depends on the bandwidth and computing resources.

- Up to 30 fps HQ/HD video is supported in a one-on-one meeting (only two participants - P2P)
- Up to 24 fps HQ/HD video is supported in a multipoint meeting (three and more participants)
- Up to 18 fps 180p video is supported in a one-on-one meeting (only two participants - P2P)
- Up to 12 fps 180p video is supported in a multipoint meeting (three and more participants)
- WebEx client may stop sending and receiving the video if the network or hardware environment conditions deteriorate drastically

Site-Level Control

An administrator cannot control the default and the maximum bandwidth levels for multipoint HQ/HD video. The levels and frame rates are controlled automatically by software - the administrator cannot override the software control. An administrator can choose to disable the HQ/HD mode and limit the video to 180p resolution. See Figure 5 for the checkmark to "enable HQ/HD video." This is a site-wide setting that affects all users. Please refer to site admin guide for more details.

Figure 5. How to Enable HQ/HD Video

Figure 6 shows the HQ/HD settings available for a user profile.
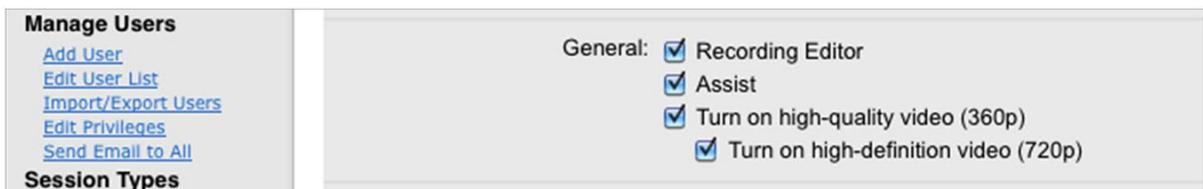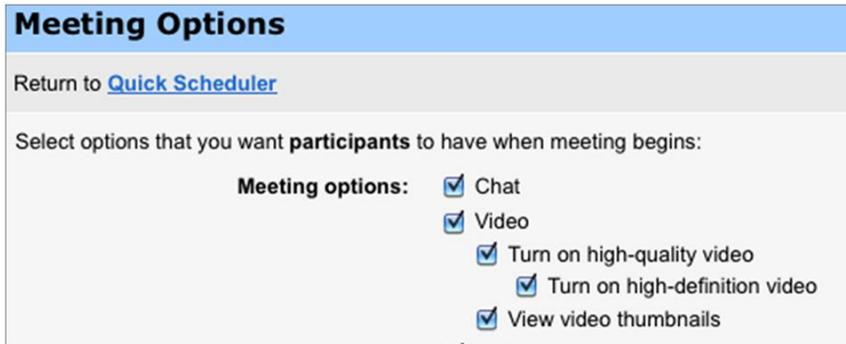
Figure 6. HQ/HD Settings

Figure 7 illustrates the settings available for meeting scheduling.

Figure 7. HQ/HD Meeting Scheduling Settings

User Interface

User-Level Controls

Most of the time, the bandwidth that the video streams consume on users' networks depends on the type of video view modes. Table 6 provides an example of the different modes with video, and average bandwidth usage. You can use information from table 6 to calculate the approximate bandwidth consumption per client.

Table 6. Example of Different Modes

UI Mode	Definition	Default Video Resolution	Default Frame Rate (fps)	Default Receiving Bandwidth per Video Channel	Screenshots
Thumbnail View	One active speaker plus up to six thumbnail videos	90p (up to six thumbnails) 180p (active)	Six (multi-point[*]) Six (P2P[*]) 12 (multi-point) 12 (P2P)	64 Kbps (multi-point) 64 Kbps (P2P) 180 Kbps (multi-point) 180 Kbps (P2P)	
List View	Only one active speaker on the panel	180p (active)	12 (multi-point) 12 (P2P)	180 Kbps (multi-point) 180 Kbps (P2P)	

UI Mode	Definition	Default Video Resolution	Default Frame Rate (fps)	Default Receiving Bandwidth per Video Channel	Screenshots
Application Sharing	Only one active speaker video	180p	12 (multi-point) 12 (P2P)	180 Kbps (multi-point) 180 Kbps (P2P)	
Full-Screen Video Mode with Thumbnails	One large video of the active speaker plus up to five thumbnail videos	360p (active)	24 (multi-point) 24 - 30 (P2P)	520 Kbps (multi-point) 520- 640 Kbps (P2P)	
HD Expanded Full-Screen Video Mode	One video of the active speaker, increased up to the display monitor size	720p	24 (multi-point) 15 - 30 (P2P)	1490 Kbps (multi-point) 1260 - 1820 Kbps (P2P)	

[*]**Note:**

P2P refers to meetings with a maximum of two participants. "Multi-point" are meetings with three or more participants.

- Both multi-point and P2P video sessions go through the WebEx cloud
- The active, or main, speaker video window can be enlarged to up to 360p resolution by dragging the sides of the main video panel

Network Adaptation

All video resolutions listed in the above table are the default target resolutions. They are based on the assumption of a perfect network environment. In the video engine design, Cisco has implemented network adaptation to help enable smooth transition from lower-quality video to higher-quality, and vice versa. Between the default target resolutions, FPS, and bandwidth (90p, 180p, 360p, 720p), users may send and receive other temporary resolutions to allow graceful adaptation of the video quality to current conditions.

Bandwidth Bottleneck Detection

One of the most common network problems is insufficient or unreliable bandwidth. Bandwidth limitation can cause packet loss, delays, and jitters. In addition, if the required sending and receiving bit rates exceed the network's bandwidth limitations, network congestion will occur and eventually lead to a poor video experience. During the video session, the client software closely monitors the transmission and packet loss rates through the RTCP feedback protocol. When changes in network conditions are detected, the quality of service (QoS) module will allocate bandwidths for VoIP, data, and video session. The video session will then adjust the outgoing bit streams through encoder control.

After the network condition becomes stable, the QoS module, together with the encoder control module, will upgrade the video experience if the bandwidth allows it. This QoS prioritization is for the WebEx client software operation. Cisco WebEx client currently does not take an advantage of the settings within the Cisco IOS® router QoS marking configuration.

Dynamic Parameters

Bandwidth bottleneck detection is part of the design improvement in WBS27.29. Its function is to probe the current bandwidth capability by sending and receiving network test packets. The probing results are used to guide the network adaptation process as described in the section above. In general, bandwidth bottleneck detection will be triggered:

1. When starting the Meeting

2. When pressing the video start or stop button

3. Before upgrading video resolution to the next level that involves a significant bandwidth gap

Cisco WebEx OneTouch

Cisco TelePresence® integration with the Cisco WebEx Meeting Center web conferencing service helps enable transparent voice and data share between Cisco TelePresence environments and remote Cisco WebEx users. This integration extends the reach of a Cisco TelePresence meeting to remote participants.

Figure 8 shows a picture of the participants list with Cisco TelePresence OneTouch meeting as viewed by the WebEx participant and meeting info screen shot, from the CTS endpoint.

Figure 8. Participants List in a Cisco TelePresence OneTouch Meeting
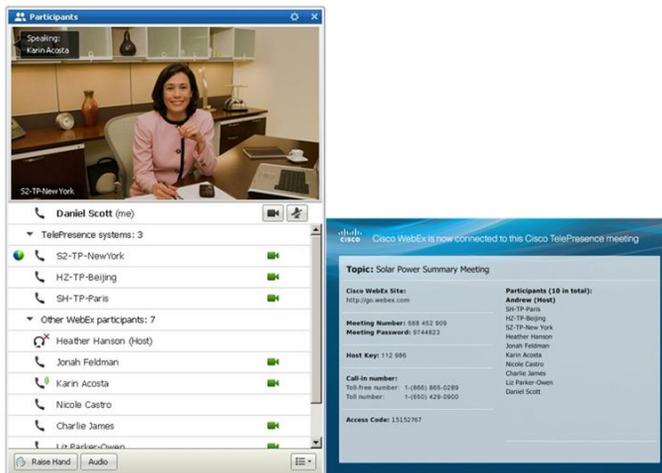
WebEx Video Traffic Simulation Using Cisco Medianet

Customers with Cisco Medianet IP Service Level Agreement Voice Over (IPSLA VO)-enabled Cisco Catalyst® switches or Cisco Integrated Services Routers Generation 2 (ISR G2) can analyze the impact of the WebEx video on their networks prior to deployment by using the Medianet Video Traffic Simulation feature. This can be accomplished either through using pre-loaded packet captures in the Medianet switch, or by uploading customer-generated, WebEx, high-quality video packet captures.

Once uploaded, this traffic stream can be replicated to simulate WebEx high-quality video deployment across multiple sites. Traffic stream statistics are sent to a network management system (NMS) for analysis. Data collected by the switch or router includes end-to-end performance statistics of the traffic on the network, which helps determine whether a particular site can adequately support high-quality video.

To learn more about IPSLA VO and other Cisco Medianet Media Monitoring features, visit: http://www.cisco.com/go/mediamonitoring or http://wwwin.cisco.com/go/medianet

Network-Based Recording (NBR)-Recorded Video Resolutions and FPS

The NBR feature allows the meeting host and participants to record the meeting and play the recording of that meeting at some later time. Please refer to the Cisco WebEx NBR user guide for more information about the NBR feature.

Table 7 provides the default maximum encoding parameters for P2P and multi-point video mode with NBR.

Table 7.   Default Maximum Encoding Paramenter

P2P and Multi-Point Video Session	Recorded Resolution	Encoding Bit Rate	Frame Rate (fps)
Multi-point (three or more participants)	180p	180 Kbps	Up to 12
P2P (two participants only)	180p	180 Kbps	Up to 12
P2P (two participants only)	360p	520 Kbps	Up to 30
P2P (two participants only)	720p	1810 Kbps	Up to 30

Average Storage Size When Using Network Based Recording (NBR)

Table 8 outlines the typical storage size to have when using NBR

Table 8.   Average Storage Size

Meeting Content	Approximate Storage Per One Hour of Recording
Application Sharing	36 MB per hour
Voice	30 MB per hour
180p video	104 MB per hour
360 HQ video	337 MB per hour
720p video	987 MB per hour

Note: Webcam videos are stored as the original resolution during NBR recording. However, during NBR playback, the playing video resolution is restricted to 180p.

Bandwidth Data

Measurements and Methodology

Bandwidth measurements for this paper were taken primarily based upon Cisco WebEx Meeting Center. However, please note that the underlying architecture for WebEx services is common across all Cisco WebEx meeting services (Meeting Center, Training Center, Event Center, Support Center) and utilizes the same network traffic.

For this paper, the bandwidth requirements were measured under the following conditions and scenarios:

- Idle (single static presentation slide, no changes, no slide transitions)
- Presentation share (single file uploaded to meeting)
- Desktop and application share
- Integrated WebEx VoIP (PSTN audio was not part of this test)
- Video (various webcams in HQ and HD mode)

These test scenarios were created to emulate typical usage circumstances and identify how much network traffic resulted from these activities. The test also identified the high and low ranges of expected traffic to help you better understand the potential impact of WebEx on your network.

Measurements were conducted by using various development tools. For the baseline, the test measured idle network traffic to help ensure information packets were not influenced by other network activities. Each test was executed multiple times to get an average result for each scenario.

During a video-enabled WebEx meeting, a portion of the network bandwidth is consumed by the video bit streams that are being transmitted and received. The actual bandwidth consumption can be affected by admin or user-level settings and by network conditions.

HQ and HD video was tested on the T27.29 release while T27LSP19 was used for mobile client testing.

The test used BlackBerry Bold 9700 (BB). The traffic was monitored with Mobile Data Alerter software. For iPhone and iPad, the testing team used the actual devices connected to a Mac and a traffic-monitoring tool to monitor data usage. PC tests were run with Window clients. All measurements were captured locally with the Iris Network analyzer tool. The testing team also monitored the inbound and outbound HTTP traffic from the PCs and other devices to the Cisco WebEx Cloud. Measurements were captured from both the presenter's machine and the attendee's machine. There was no significant difference in the bandwidth for data sharing; therefore tests related to data sharing assume both presenter and attendee traffic to be the same.

All measurement results are in kilobits per second (kbps); not kilobytes (KB). File sizes are measured in kilobytes (KB). A byte is eight bits; a kilobyte is 1024 bytes. Eight bits multiplied by 1024 equals 8192 bits. Transmission rates are also measured in kbps (not KBs).

Measurement Scenarios for Mobile Clients

- Idle - baseline network traffic in a meeting
- Presentation share - presenter shares a PowerPoint presentation with graphics and animations
- Desktop share and application share - presenter shares a desktop, running a PowerPoint presentation with 30-second transitions
- Internet phone (VoIP) - presenter and attendees have a conversation using PC microphones

Average Video Bandwidth Consumption

Table 9 outlines average video bandwidth consumption.

Table 9. Bandwidth Consumption

Session	HD	HQ-Active Video			
Source	720p	180p	360p	Six thumbnails at 90p	One 180p plus six thumbnails at 90p
Sender Traffic (kbps)	1750 - 2380	330	911	-	-
Received Traffic (kbps)	1260 - 1820	245	635	313	482

Below is summary of average bandwidth consumption for each of the video configurations.

This is for video traffic only; please add an average of 60-80 kbps for VoIP traffic (send/receive).

Above data is a summary of the average measurements. Each measurement is dependent on what the camera "sees." Video traffic will increase and can be reduced based on the moving subject. Audio traffic averages should be added to the total average numbers. Data presentation traffic is variable and it is dependent on the shared content and change rate. Table 10 includes examples of the video bandwidth measured during the test, with faster moving versus slow moving or static subjects used in the test file. Note the minimal differences between the Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) used; however note the bandwidth usage difference between the static subject versus slow and faster moving video subjects.

Table 10. Examples of Video Bandwidth Measured

Session	HQ-Active video															
Camera	Logitech 9000						Logitech LS 7500						Cisco VT III			
Source	Slow-Moving Subject				No Moving		Slow-Moving Subject				No Moving		Faster Moving Subject			
	180p		360p		180p		180p		360p		180p		180p		360p	
	UDP	TCP	UDP	TCP	UDP	TCP	UDP	TCP	UDP	TCP	UDP	TCP	UDP	TCP	UDP	TCP
Sender Traffic (kbps)	271	264	881	975	72	89	290	308	888	923	59	58	320	330	911	991
Received Traffic (kbps)	220	235	603	631	47	57	228	244	604	628	54	46	261	245	609	635

Maximum Video Bandwidth Consumption

The bandwidth required to send the video is higher than the required bandwidth for receiving the video. Switched virtual channel (SVC) technology used in the client software is using the multilayer frames to send video and allows the client to automatically select the best possible resolution to receive the video. Table 11 details maximum bit rate usage for both sending and receiving video.

Table 11. Maximum Bit Rate Usage for Video Sending and Receiving

		Maximum Bit Rate (Send)	Maximum Bit Rate (Receive)
High-Definition (HD)	720p (1280x720)	3.0 Mbps	2.5 Mbps
High-Quality (HQ)	360p (640x360)	1.5 Mbps	1 Mbps
Standard Quality	180p (320x180)	0.5 Mbps	0.5 Mbps
Six Thumbnails	90p	N/A	0.5 Mbps
One Thumbnail	90p	50 kbps	N/A

The video quality can be set by the site administrator for the entire site and at the host account level and by the host during scheduling of the meeting. Attendees have no control over the video quality; this is done automatically during the meeting based on various factors. The host can choose to schedule the meeting with a maximum video resolution up to 720p (WebEx Meeting Center only), 360p or 180p. Thumbnail video is always set at 90p, and cannot be changed. (See site-level admin control section for more details).

Each resolution can support variable frame rates: HD (720p) @ 24-30 fps, HQ (360p) @ 24-30 fps, SQ (180p) @ 12 fps, thumbnail video @ 6-10 fps (see frame-rate range section for more details).

Examples of the Bandwidth Consumption for Video Use Only (No Data, No WebEx-Integrated VoIP)

Please note that the client is capable of displaying one main window with an active speaker, which means that at any time when the person is speaking, his or her video would appear in the main enlarged window. In addition to the main active speaker window, a client can view up to six additional scrollable thumbnail views in the participant list, and up to five additional scrollable thumbnail windows in the full-screen mode. There are no thumbnail images in the expanded full-screen video in HD mode (Meeting Center only)

a. Scenario: Three participants in the meeting, all capable of sending and receiving video at 360p:

- Multi-point video window (360p) plus two (90p) thumbnails on received view
- Send: 900 from webcam equals 900 (one Mbps) average per participant for video stream
- Receive: 600 plus (2 x 40) equals 680 (0.7 Mbps) average per participant for video stream

Explanation: Each client will try sending an average of one Mbps or up to maximum of the 1.5 Mbps of data. Each client will also receive an average of 600 kbps or up to maximum of the one Mbps of data. The receiving client can also use up additional bandwidth for the thumbnail views if enabled (2 x 4 0 kbps is the average). To do this we have to add the data-sharing portion (kbps are hard to predict) and possible WebEx VoIP usage (50-80 kbps if enabled).

b. Scenario: Eight participants in the meeting with 180p video (non-HQ):

- Multi-point video window (180p) plus six (6 x 90p) thumbnails received view
- Send: 320 from webcam equals 320 kbps (0.3 Mbps) average per participant for video stream
- Receive: 250 plus (6 x 40) equals 490 kbps (0.5 Mbps) average per participant

Explanation: HQ video is disabled. Each client will send 350 kbps on average, or up to 0.5 Mbps maximum. Each client will receive average 250 kbps for the main active speaker window, plus an optional six thumbnails (6 x 40) average equal to 0.5 Mbps average on the receiving side per participant with the thumbnail view enabled. To this we have to add the data-sharing portion (kbps are hard to predict) and possible WebEx VoIP usage (50-80 kbps, if enabled).

Streaming Video File-Bandwidth Consumed

Actual sending and receiving bit rates are independent of which multimedia file format is used. Before transmission, shared multimedia content is first extracted and transcoded into an H.264 SVC bit stream. When the participating client receives the bit stream, the stream will be decoded and then rendered by the video engine for display. Average bandwidth utilization measurements are listed in Table 12.

Table 12. Average Bandwidth Utilization Measurements

File Format	Sent/Received	Video Only	Video Plus Audio
flv	Sender traffic (kbps)	932	1282
	Receiver traffic (kbps)	697	989
avi	Sender traffic (kbps)	984	1271
	Receiver traffic (kbps)	730	976
wmv	Sender traffic (kbps)	1225	1261
	Receiver traffic (kbps)	906	968

File Format	Sent/Received	Video Only	Video Plus Audio
mov	Sender traffic (kbps)	980	1273
	Receiver traffic (kbps)	723	964
wav	Sender traffic (kbps)	N/A	96 (Audio only)
	Receiver traffic (kbps)	N/A	96 (Audio only)

Cisco WebEx OneTouch Bandwidth Requirements

The bandwidth requirement for Cisco TelePresence WebEx OneTouch is different from the standalone traditional WebEx video or the new HQ video-featured WebEx site. One Mbps send/receive is a minimum requirement per single meeting. A single meeting may contain more than one Cisco TelePresence system, but this does not increase the bandwidth usage for that meeting. Multiply the minimum one Mbps by the number of expected simultaneous meetings.

Presentation video (desktop sharing) is using approximately 400 Kbps with 500 kbps maximum.

The maximum download needed for Common Intermediate Format (CIF) video is variable, with the encoder rate limited to a maximum of 500 Kbps between the Cisco TelePresence Multipoint Switch, Cisco TelePresence Gateway, and the receiving WebEx client.

The WebEx client average bandwidth used with Cisco WebEx and Cisco TelePresence integration is identified in Table 13.

Table 13.   WebEx Client Average Bandwidth When Integrated with Cisco TelePresence

Bandwidth and CPU Power (Recommendation for good video quality when integrating the Cisco TelePresence network with Cisco WebEx)	Network bandwidth should be at least 1 Mbps upstream between the infrastructure and WebEx TelePresence Gateway per call. For example, if you are anticipating five simultaneous Cisco WebEx calls, you will need to have five 1-Mbps bandwidth instances. Suggested CPU power (depends on running applications) is dual core CPU, 2.5 GHz memory running at least 2 G.
Cisco WebEx Client Resource Requirements (Expected resource allocation per meeting)	Users must have at least 850k of available resources per meeting to uplink to Cisco WebEx: • CIF video - 300k down only • Presentation video - 450k up and down (depending on whether the client is performing or receiving a presentation) • Cisco WebEx video - 400k up; 400k x N down, where N is how many streams the user chooses to view • Cisco WebEx VOIP - Up and down (20 -70k) bps • Signaling - 100k

Network Traffic Summary for Data Presentation on Mobile Devices

Tables 14, 15, and 16 summarize data presentation of average and maximum speeds on common mobile devices, and when using voice over IP.

Table 14.   iPhone 4 (16 G), BlackBerry Bold 9700 over 3G Network

	Traffic (Test Scenario)	Average (kbps)	Maximum (Kbps)
iPhone	Idle meeting	0.17	0.28
BlackBerry		0.26	0.33
iPhone	Desktop share (slide presentation with 30-second transitions)	23	41
BlackBerry		2.87	3.08
iPhone	Presentation share (slide presentation with five-second transitions)	14.5	17
BlackBerry		5.73	6.4

Note: The iPhone and iPad devices are using vector graphic technology, which provides better image quality for viewing the shared content and therefore requires more bandwidth compared to imaging technology used with the other mobile devices.

Table 15. iPhone 3G, Blackberry Bold 9700, iPad (16 G) with Wi-Fi Network

	Traffic (Test Scenario)	Average (kbps)	Maximum (Kbps)
PC	Idle meeting	0.8	3.7
iPhone		0.17	0.4
iPad		8.9	9
BlackBerry		0.42	0.45
PC	Desktop share (slide presentation with 30-second transitions)	43	598
iPhone		67	232
iPad		95	241
BlackBerry		24.8	29.92
PC	Presentation share (slide presentation with five-second transitions)	6.5	7.5
iPhone		23	41
iPad		30	62
BB		54.56	55.28

Table 16. VoIP Using a LAN Connection

	Average (kbps)	Maximum (Kbps)
Upload Direction (Client to Multichassis Multilink PPP [MMP] Server)	26	34
Download Direction (MMP Server to Client)	56	80

Network Traffic Data Comparison Chart

Tables 17 and 18 offer a comparison in data traffic among common mobile devices in a wireless network, and in a 3G network.

Table 17. iPhone 3G, iPad (16G), BlackBerry Bold 9700 with Wi-Fi Network

Idle		
	Average (kbps)	Maximum (Kbps)
PC	0.8	3.7
iPhone 3G	0.17	0.4
iPad 16G	8.9	9
BlackBerry	0.42	0.45
Presentation Share (Slide presentation with five-second transitions)		
PC	6.5	7.5
iPhone 3G	23	41
iPad 16G	30	62
BlackBerry	54.56	55.28

Table 18. iPhone 4 (16G), BlackBerry Bold 9700 with 3G Network

Idle		
	Average (Kbps)	Maximum (Kbps)
iPhone	0.17	0.28
BlackBerry	0.26	0.33

Common Issues and Location of the Log Files

Factors affecting the video quality include:

- WebEx site, host, meeting settings. For example, a video setting set by the administrator or host for the specific meeting may not allow HQ video at the 360p resolution

- PC capabilities. For example, a non-dual core with insufficient memory cannot process the 360p video resolution and the user will experience lower quality video (both encode or decode)

- Camera capabilities. For example, certain cameras are capable of compensating for the low light environment, some have auto focus, and others work in HD and require more CPU power

- In-room lighting or backlight background

- Measured bit rate. Not enough bandwidth available for the client PC will automatically reduce the video quality and frame rate from 720p to 360p to 180p resolution or disable the video

- Video mode and display size. 180p receiving resolution will not achieve the same video quality experience in the full screen (HQ) or expanded full screen (HD) video mode as the 360p or 720p resolution.

The displayed video size is what the user will see in the theater mode. Depending on the resolution of the monitor used, the displayed video can be scaled up and enlarged to fit the monitor screen. This video size is independent of the resolution of the incoming video source.

If the highest quality of video that a "user 1" can send is 180p, based on PC hardware and available bandwidth, then 180p will be the highest video resolution that a remote site "user 2" will be able to receive. This refers to the video resolution after the decoding process for the "user 2." If the source of the incoming video is 180p, it is impossible for the decoder on the "user 2" PC to output any resolutions higher than 180p.

During application sharing, desktop sharing, streaming video sharing, and meeting manager sharing, 720p video (HD) is disabled.

Quad core PC or Mac can send and receive 720p (HD) resolution; dual core PC or Mac can receive only 720p (HD) in multipoint meeting (three or more participants)

Due to network congestion or client machine utilization, the video stream may be waiting to be sent or received. During this time the user may have a visible, small circle icon in the middle of the main video window, which will disappear as soon as the video stream becomes available.

The log files can help the administrators and the support teams to better understand and troubleshoot possible client software issues. Location of the log files is shown in Table 19.

Table 19. Log File Locations

Platform	Location
Windows XP	C:\Documents and Settings\&username&\Local Settings\Temp\Webex\Wbx_AudioVideoStatisticsData.csv
Windows 7	C:\Users\&username&\AppData\Local\Temp\WebEx\Wbx_AudioVideoStatisticsData.csv

Maximum size of the log file is 5 MB. When the size is reached, the oldest data will be overwritten by the new data. Other platforms will be available in future releases.

Video Statistics Window

Starting with WBS27.29, WebEx Meeting Center features a real-time audio and video statistics window. The window includes a summary of the current audio and video usage status such as:

- Audio and video latency in ms
- Audio and video jitter in ms
- Audio and video packet loss percent
- Video resolution
- Video fps
- Number of video streams received
- Video codec type
- Audio codec type
- Overall WebEx CPU usage percent
- Overall memory CPU usage percent
- Connection ports
- Internet Protocol used by audio and video

Figure 9 provides an example of the statistic window. During the WebEx meeting, a user can right-click on the main video window and select statistics.

Figure 9.   Static Window
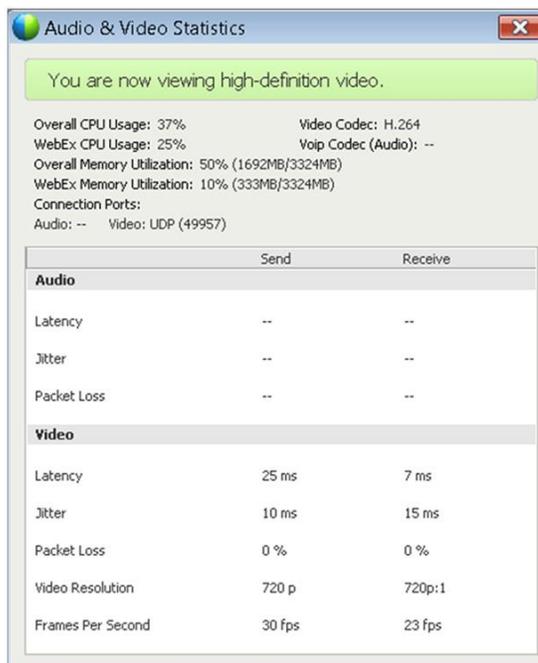
Summary

WebEx services minimize the amount of data transmitted over the network. The WebEx client transmits data only when data is requested. During most of a meeting, the content is static and no data is transmitted, keeping network traffic to a minimum. When there is activity in a meeting, such as loading a presentation, changing a slide or sharing an application, data transfer lasts for only short periods of time, and only parts of the screen change. This includes presentation sharing, desktop sharing, and live video.

This type of behaviour produces inconsistent streams of network traffic, causing the traffic to remain at a below-average point for most of the time, with occasional spikes to a maximum value. In a typical desktop sharing meeting, the bandwidth requirements are usually low and have no major impact on the network.

For More Information

For more information about Cisco WebEx Network Bandwidth and Cisco WebEx products, please visit these additional on-line resources:

http://www.cisco.com/go/webex

http://kb.webex.com

http://support.webex.com

http://www.cisco.com/en/US/solutions/ns669/webex_engage.htm

http://www.cisco.com/en/US/docs/voice_ip_comm/cucm/srnd/8x/collabor.html#wp1113741

http://www.cisco.com/en/US/docs/voice_ip_comm/cucm/srnd/8x/confernc.html#wp1054587

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