Cisco WebEx Network Bandwidth

White Paper

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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, where as 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) functions. This paper does not contain information about Cisco WebEx Connect and Cisco Jabber™ client.

Optimized Bandwidth Usage

Cisco WebEx services optimize bandwidth usage to minimize the amount of data transmitted over the network, helping reduce network congestion, increase performance, and improve your experience. The most significant optimizations follow:

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, not only reducing network traffic, but also adding a level of encryption to the data stream. For more information about Cisco WebEx security, please refer to our security white paper at: http://www.webex.com/pdf/Security.pdf.

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 Secure HTTP (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 Transport Layer Security (TLS) 1.0 (Secure Sockets Layer [SSL] 3.0) standard protocol.

WebEx Data Share

Cisco WebEx services create 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 the PowerPoint slide generates intermittent spikes in the 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 presenters to use the Streaming Video Share feature for sharing the video from their computers (refer to the 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 your desktop.

Figure 1.   How to Share Your Desktop
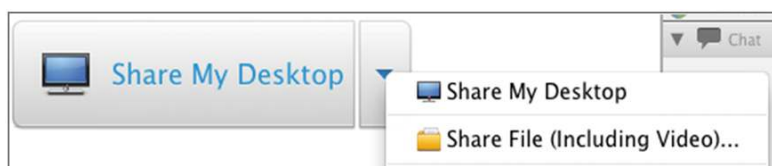
WebEx Video

Cisco WebEx Video allows you to share the video by using the web cam attached to your PC, Mac machines, or share and receive it on some mobile devices. High definition (HD) with resolution up to 720p is now available in Cisco WebEx Meeting Center, and high-quality (HQ) 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. Table 1 lists our video products and their features, and Table 2 lists the video resolutions that WebEx Video supports.

Table 1.   High-Quality and High-Definition Cisco WebEx Video At-a-Glance

	High-Definition Video	High-Quality Video	Standard WebEx Video
Products	• Cisco WebEx MeetingCenter (WebEx Meeting Center Release WBS27.29 or later)	• Cisco WebEx MeetingCenter (Release WBS27.17 or later) • Cisco WebEx SupportCenter (Release WBS27.26 or later) • Cisco WebEx Training Center (Release WBS27.26 or later)	• Cisco WebEx Event Center
Resolutions Maximum resolution (pixels)	• 720p (1280x720)	• 360p (640x360)	• CIF (352x288)
Maximum frame rates (per second)	• 30fps	• 30fps	• 30fps
Transport protocol	• TCP port 80 • SSL 443, or • UDP port 9000	• TCP port 80 • SSL 443, or • UDP port 9000	• TCP port 80, or • SSL 443
Maximum number of participants	• 500 (HQ/HD)	• 500 (HQ; WebEx Training Center only)	• 1000 single-point video(SPV)
Video codec	• H.264	• H.264	• H.264

Table 2.   High-Quality and High-Definition Video Resolutions

	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

The following platforms support Cisco WebEx Video.

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

Video Features for iPad and iPad 2

WebEx multipoint 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
- Ability to receive up to 360p video
- Ability to send up to 180p video (iPad 2 only)

System Requirements

Table 3 lists the system requirements for Cisco WebEx Video.

Table 3.   CPU and Memory for Cisco WebEx Video

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.

Supported Cameras

Cisco WebEx Video supports HD for the cameras listed in Table 4 and HQ for the cameras listed in Table 5.
(Please refer to the latest WebEx release notes for the updated list.)

Table 4.　Cameras Supported by HD Cisco WebEx Video

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	Cisco Unified Video Advantage and Cisco VT Camera III (CUVA-V3)
14	Cisco	Cisco TelePresence® 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 720p HD resolution from the WebEx client.

Table 5.　Cameras Supported by HQ Cisco WebEx Video

| HQ Video Tested (Recommended)		
Number	**Manufacturer**	**Camera Model**
1	Cisco	VT Camera I
2	Cisco	VT Camera III
3	Cisco	Cisco TelePresence PrecisionHD
4	Logitech	QuickCam 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 cameras were not tested.

WebEx Video Modes

WebEx Video provides two types of operation modes: single-point video and multipoint 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.

Multipoint 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 multipoint video looks like. Multipoint video is preferred for collaborative meetings or training sessions where multiple attendees are actively participating.

Figure 2.   User Interface of Multipoint Video Meeting
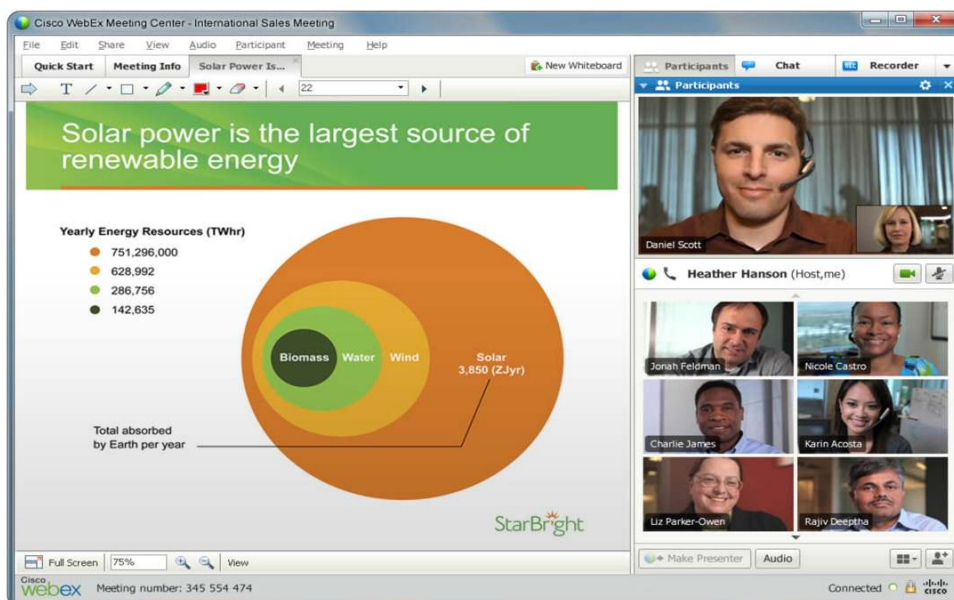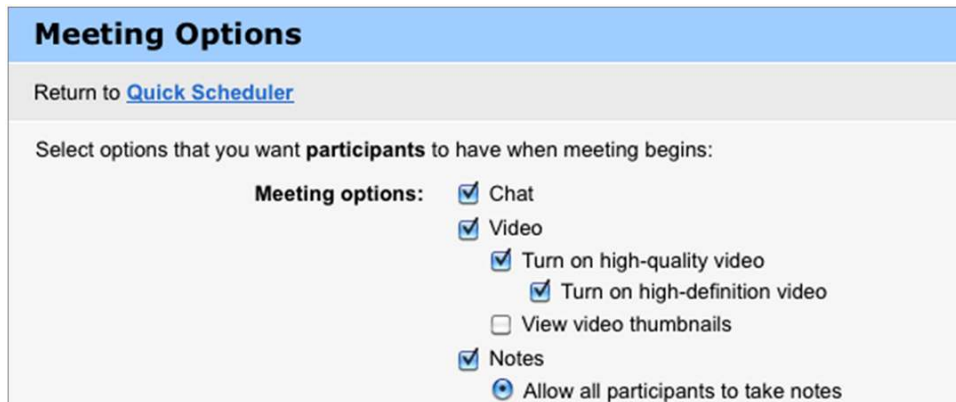
Single-point video (SPV) provides one window where a single meeting participant can be viewed. The presenter determines which participant is viewed in the meeting. It is ideal for one-to-one or one-to-many meetings, where a single person is the primary focus. The SPV feature is available only in the WebEx Event Center release; it was removed from the other centers with introduction of the HQ video in Release WBS27.17. Please refer to customer communication notices, release notes, and kb.webex.com for more information about how the new HQ and HD video operates and how this function has changed.

Because of the number of video streams and the flexibility available to the attendees, MPV requires more bandwidth than SPV. Meeting participants can customize their own views between the active speaker only and thumbnail view. Participants can customize 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 user interface (UI).

Figure 3 displays the options you have when setting up a meeting.

Figure 3.   GUI of Meeting Options

Streaming a Video File in to a WebEx Meeting

Streaming a video file in to a WebEx meeting allows you to share a video file during a meeting. This method of video sharing is different from the desktop sharing and the website sharing features. Similar to webcam video, streaming uses scalable video coding to encode and decode multiple layers of video bit streams. In Cisco WebEx Meeting Center and Cisco WebEx Training Center, you should distinguish between the webcam video usage for video presence of the participants in the meeting and the shared video file feature, which the presenter uses to play the video file to the audience from the presenter's computer. The webcam video refers to videoconferencing in real time, encoded and sent to the receiving clients using the Cisco® Collaboration Cloud. Webcam video is used primarily for videoconferencing. 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 videoconferencing pod as an active speaker. You can play, pause, or stop it from the file-sharing tab; it is similar to a previously uploaded presentation or whiteboard (refer to Figure 4).

From the Presentation Desktop, click the arrow next to Share My Desktop, 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:** The computer of the person sharing the file must be capable of playing the file).

Figure 4.
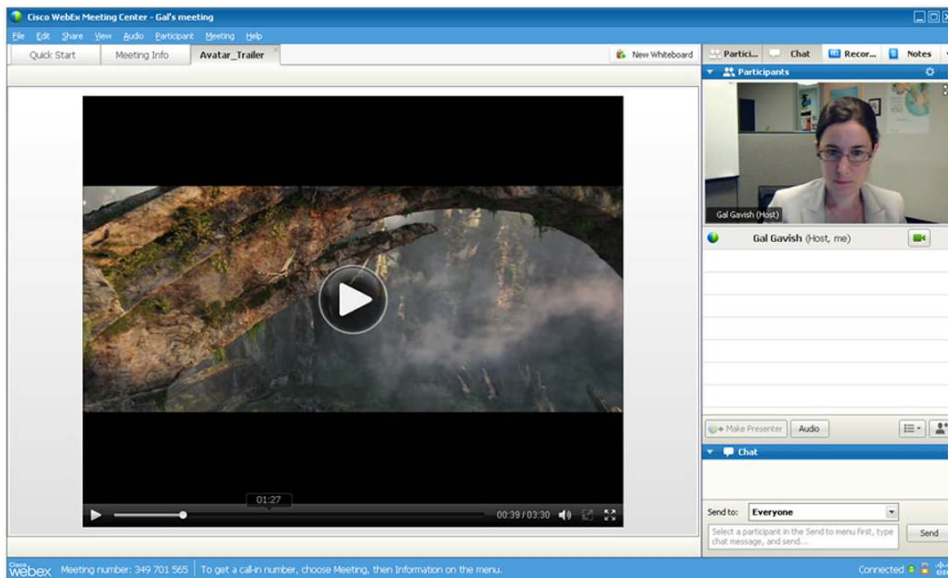
About the WebEx Video Codec

The Cisco WebEx Meeting Center (Release 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. HD (720p) video was introduced in ReleaseWBS27.29 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.

The SVC encoding protocol allows 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 send, 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 that the video is sent. On the receiving side, the client automatically selects and decodes one specific resolution. This encoding and decoding capability results 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 and HD video is supported in a one-on-one meeting (only two participants-point-to-point [P2P]).
- Up to 24-fps HQ and HD video is supported in a multipoint meeting (three or 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

Administrators cannot control the default and the maximum bandwidth levels for multipoint HQ and HD video. The levels and frame rates are controlled automatically by software - administrators cannot override the software control. Administrators can choose to disable the HQ/HD mode and limit the video to 180p resolution. Refer to Figure 5 for the "Turn on high-quality video" or "Turn on high-definition video" checkboxes. This setting is a site wide setting that affects all users. Please refer to the site administrator's guide for more details.

Figure 5. Enabling HQ and HD Video
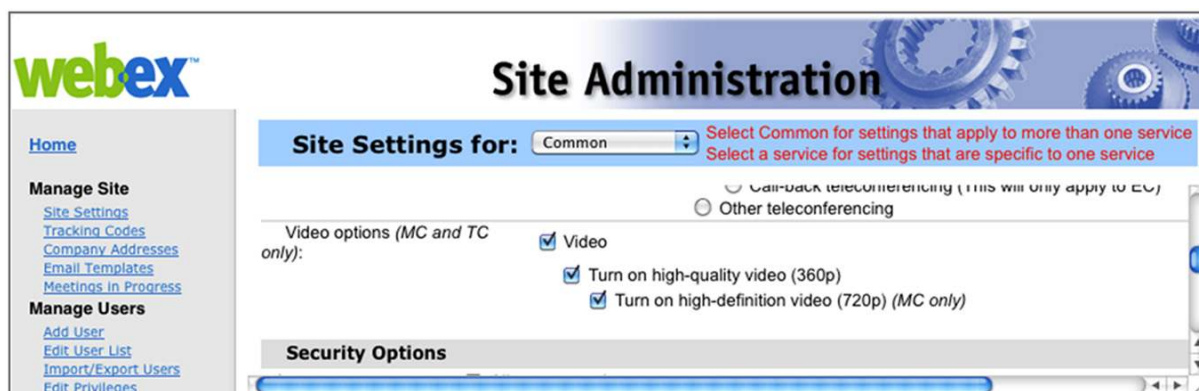
Figure 6 shows the HQ and HD settings available for a user profile.

Figure 6. HQ and HD Settings
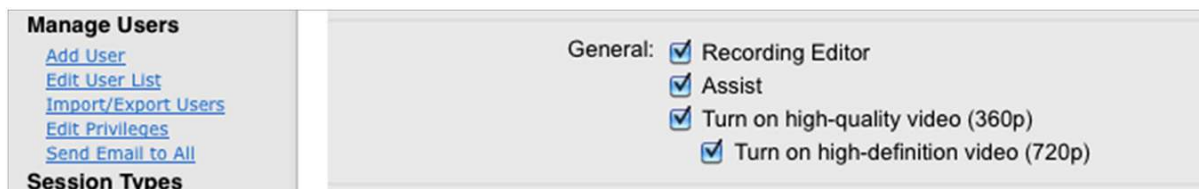
Figure 7 illustrates the settings available for meeting scheduling.

Figure 7. HQ/HD Meeting Scheduling Settings

User Interface

User-Level Controls

Most of the time, the bandwidth that the video streams consume on your network 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 this table to calculate the approximate bandwidth consumption per client.

Table 6. Modes with Video and Average Bandwidth Usage

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 thumbnail)	Six (multi-point[*]) Six (P2P[*])	64 kbps (multipoint) 64 kbps (P2P)	
		180p (active)	12 (multipoint) 12 (P2P)	180 kbps (multi-point) 180 kbps (P2P)	
List view	Only one active speaker on the panel	180p (active)	12 (multipoint) 12 (P2P)	180 kbps (multipoint) 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 (multipoint) 12 (P2P)	180 kbps (multipoint) 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 (multipoint) 24-30 (P2P)	520 kbps (multipoint) 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 (multipoint) 15-30 (P2P)	1490 kbps (multipoint) 1260-1820 kbps (P2P)	

- * Note: P2P refers to meetings with a maximum of two participants. Multipoint refers to meetings with three or more participants.
- Both multipoint 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 Table 6 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 enable smooth transition from lower-quality to higher-quality video, and conversely. Between the default target resolutions, fps, and bandwidth (90p, 180p, 360p, and 720p), you can 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 bandwidth limitations of the network, network congestion will occur and eventually results in a poor video experience. During the video session, the client software closely monitors the transmission and packet-loss rates through the Real-Time Transport Control (RTCP) feedback protocol. When changes in network conditions are detected, the quality-of-service (QoS) module allocates bandwidths for a voice over IP (VoIP), data, and video session. The video session then adjusts the outgoing bit streams through encoder control. After the network condition becomes stable, the QoS module together with the encoder control module upgrades 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® Software router QoS marking configuration.

Dynamic Parameters

The bandwidth bottleneck detection is part of the design improvement in Release 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 previous section. In general, bandwidth bottleneck detection is at:

- Meeting start
- When the Video start/stop button is pressed
- Before upgrading video resolution to the next level that involves a significant bandwidth gap

Cisco WebEx Enabled TelePresence, or Cisco TelePresence WebEx OneTouch

Cisco TelePresence integration with the Cisco WebEx Meeting Center web conferencing service enables transparent voice, video, and data sharing 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 a Cisco WebEx Enabled TelePresence meeting as viewed by the WebEx participant and meeting information screenshot.

Figure 8.   Participants List in a Cisco TelePresence Meeting
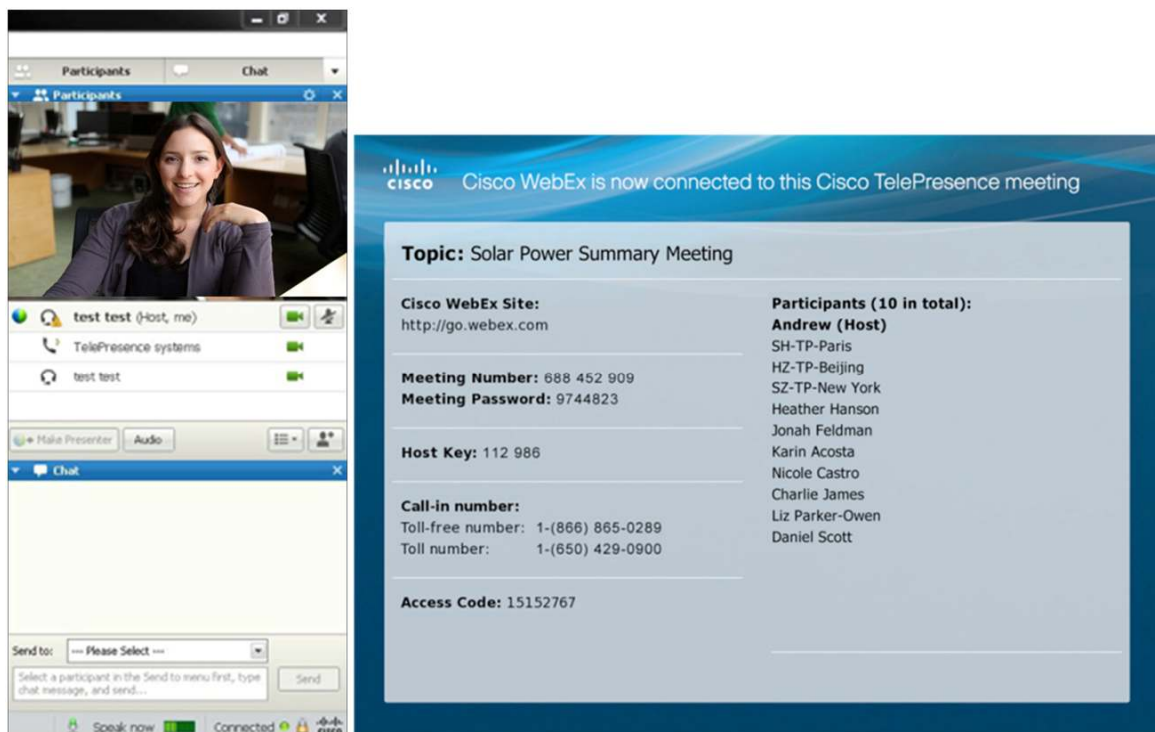
You can limit WebEx participant bandwidth in the Cisco TelePresence Management Suite (TMS) Version 14.2 or later. The recommended bandwidth is 2048 (refer to Figure 9).

Figure 9. Limiting WebEx Participant Bandwidth

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. You can perform this analysis either by using preloaded packet captures in the medianet switch or by uploading customer-generated, WebEx, high-quality video packet captures. When 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: Recorded Video Resolutions and FPS

The Network-Based Recording (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 multipoint video mode with NBR, and Table 8 gives the average storage size when using NBR.

Table 7. Default Maximum Encoding Parameters for P2P and Multipoint Video Mode with NBR

P2P or Multipoint Video Session	Recorded Resolution	Encoding Bit Rate	Frame Rate (fps)
Multipoint (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

Table 8.   Average Storage Size When Using NBR

Meeting Content	Approximate Storage Per 1 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 on 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, and Support Center) and uses 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, and no slide transitions)
- Presentation share (single file uploaded to meeting)
- Desktop and application share
- Integrated WebEx VoIP (public switched telephone network [PSTN] audio was not part of this test)
- Video (various web cams in HQ and HD modes)

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/or received. The actual bandwidth consumption can be affected by admin or user-level settings and/or by network conditions.

HQ and HD video was tested on ReleaseT27.29, and mobile client testing on Release T27LSP19.

The test used BlackBerry Bold 9700 (BB). The traffic was monitored with the 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 Collaboration 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 kilobits per second (not kilobytes).

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 gives the average bandwidth consumption for each of the video configurations.

Table 9.   Average Bandwidth Consumption

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

These results are for video traffic only; please add an average of 60 to 80 kbps for VoIP traffic (send and receive).

Table 10 summarizes 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. The audio traffic average should be added to the total average numbers. Data presentation traffic is variable and it is dependent on the shared content and change rate. Following are 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 TCP and User Datagram Protocol (UDP) protocols used; however, note the bandwidth usage difference between the static subject and slow- and faster-moving video subjects.

Table 10 gives test results for HQ-Active Video tests.

Table 10.   Test Results for HQ-Active Video Tests

Session	HQ-Active Video															
Camera	Logitech 9000						Logitech LS 7500						Cisco Camera 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. SVC technology used in the client software uses the multilayer frames to send video and allows the client to automatically select the best possible resolution to receive the video. Table 11 gives results for the tests measuring video bandwidth consumption.

Table 11. Video Bandwidth Consumption

		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	-	0.5 Mbps
One thumbnail	90p	50 kbps	-

The site administrator can set the video quality for the entire site and at the host account level, and the host can set those parameters when scheduling the meeting. Attendees have no control over the video quality; it is controlled automatically during the meeting based on various factors. The host can 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 it cannot be changed.

Each resolution can support variable frame rates: HD (720p) @ 24-30 fps; HQ (360p) @ 24-30 fps; SQ (180p) @ 12 fps; and thumbnail video @ 6-10 fps.

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

Please note that the client can display one main window with an active speaker, meaning that at any time when people are speaking, their videos 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).

Scenario 1: Three participants in the meeting, all capable of sending and receiving video @ 360p:

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

Explanation: Each client will try sending an average of 1 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 1 Mbps of data. The receiving client can also use additional bandwidth for the thumbnail views if enabled (2 x 4 0 kbps average). To use additional bandwidth, the data-sharing portion (kbps hard to predict) and possible WebEx VoIP usage (50-80 kbps if enabled) must be added.

Scenario 2: Eight participants in the meeting with 180p video (non-HQ):

- Multipoint 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) = 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 thumbnail view enabled. For this scenario the data-sharing portion (kbps hard to predict) and possible WebEx VoIP usage (50-80 kbps, if enabled) must be added.

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 is decoded and then rendered by the video engine for display. Average bandwidth usage measurements are listed in Table 12.

Table 12. Average Bandwidth Used

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
mov	Sender traffic (kbps)	980	1273
	Receiver traffic (kbps)	723	964
wav	Sender traffic (kbps)	-	96 (Audio only)
	Receiver traffic (kbps)	-	96 (Audio only)

Cisco TelePresence 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 scenario does not increase the bandwidth usage for that meeting. Multiply the minimum 1 Mbps by the number of expected simultaneous meetings.

Presentation video (desktop sharing) uses approximately 400 kbps with 500 kbps maximum.

The maximum download needed for CIF video is variable, with the encoder rate limited to a maximum of 500 kbps between the Cisco TMS and Cisco TelePresence Gateway and the receiving WebEx client.

Table 13 gives the WebEx client average bandwidth used with Cisco WebEx and Cisco TelePresence integration.

Table 13.   WebEx Client Average Bandwidth Used with Cisco WebEx and Cisco TelePresence Integration

Bandwidth and CPU power: Recommendation for good video quality and 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 2G.
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: 450,000 up and down (depending on whether the client is performing or receiving a presentation) • Cisco WebEx video: 400,000 up; 400,000 x N down, where N is the number of streams the user chooses to view • Cisco WebEx VoIP: Up and down (20,000~70,000) bps • Signaling: 100,000

Network Traffic Summary for Data Presentation on Mobile Devices

Table 14 gives test results for the iPhone 4 (16G) and BlackBerry Bold 9700 over a third-generation (3G) network.

Table 14.   Results for iPhone 4 (16G) and BlackBerry Bold 9700 over 3G Network

	Traffic (Test Scenario)	Average (kbps)	Maximum (kbps)
iPhone	Idle meeting	0.17	0.28
BB		0.26	0.33
iPhone	Desktop share (slide presentation with 30-second transitions)	23	41
BB		2.87	3.08
iPhone	Presentation share (slide presentation with 5-second transitions)	14.5	17
BB		5.73	6.4

Note: The iPhone and iPad devices use 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 gives test results for the iPhone 3G, Blackberry Bold 9700, and iPad (16G) with a Wi-Fi network.

Table 15.   Results for iPhone 3G, Blackberry Bold 9700, and iPad (16G) 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
BB		0.42	0.45
PC	Desktop share (slide presentation with 30-second transitions)	43	598
iPhone		67	232
iPad		95	241
BB		24.8	29.92
PC	Presentation share (slide presentation with 5-second transitions)	6.5	7.5
iPhone		23	41
iPad		30	62

	Traffic (Test Scenario)	Average (kbps)	Maximum (kbps)
BB		54.56	55.28

Table 16 gives test results for VoIP using a LAN connection.

Table 16. VoIP (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

Table 17 compares network traffic data from the tests for the iPhone 3G, iPad (16G), and BlackBerry Bold 9700 with a Wi-Fi network.

Table 17. Comparison of Results for iPhone 3G, iPad (16G), and 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
BB	0.42	0.45

Presentation Share (Slide Presentation with 5-Second Transitions)		
	Average (kbps)	Maximum (kbps)
PC	6.5	7.5
iPhone 3G	23	41
iPad 16G	30	62
BB	54.56	55.28

Table 18 gives test results for the iPhone 4 (16G) and BlackBerry Bold 9700 with a 3G Network

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

Idle		
	Average (kbps)	Maximum (kbps)
iPhone	0.17	0.28
BB	0.26	0.33

Common Problems and Location of Log Files

Factors affecting the video quality include:

- WebEx site, host, and meeting settings: For example, a video setting set by the administrator or host for a 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 you will experience lower-quality video (both encode and decode).

- Camera capabilities: For example, certain cameras can compensate 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 automatically reduces the video quality and frame rate from 720p to 360p to 180p resolution or disables the video.

- Video mode and display size: A 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 you 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 "user1"can send is 180p, based on PC hardware and available bandwidth, then 180p is the highest video resolution that a remote site "user2" can receive. This resolution refers to the video resolution after the decoding process for "user2". If the source of the incoming video is 180p, it is impossible for the decoder on the "user2" 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.

A quad-core PC or Mac can send and receive 720p (HD) resolution; a dual-core PC or Mac can receive only720p (HD) in multipoint meetings (three or more participants).

Because of network congestion or client machine use, the video stream may wait to be sent or received. During this time you may have a visible, small-circle icon in the middle of your main video window; it will disappear as soon as the video stream becomes available.

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

Table 19.　Location of Log Files

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

Video Statistics Window

Starting with Release 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 10 provides an example of the statistics window. During a WebEx meeting, you can right click on the main video window and select statistics.

Figure 10.   Statistics Window
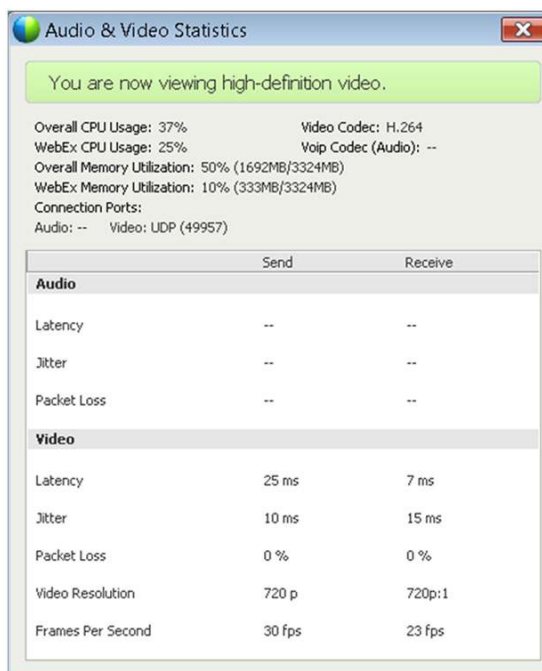
Summary

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 behavior 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 online 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