Cisco Telepresence EX60

Manufacturer: Cisco

Model: EX60

Software Version: TC 5.0.0

Optional Features and Modifications: Premium Resolution Option

Date of Test: 6th – 20th January 2012

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A: INTRODUCTION

The Cisco TelePresence EX60 is a high definition (HD) self contained desktop videoconferencing system with a maximum picture resolution of 1920 x 1080 pixels (1080p) at 30fps. The desktop unit includes a 21.5” picture monitor, the CODEC, camera, microphone and the loudspeakers. A separate touch screen control panel with an audio handset completes the package. Compatibility with other H.323 and SIP CODECs is achieved across a range of resolutions from SIF (352 x 240 pixels) up to 1920 x 1080 depending on the capability of the remote CODEC and the connection bandwidth.

Available options: Premium Resolution

The systems supplied for evaluation included the Premium Resolution option which supports conference resolutions of 720p at 60 fps and 1080p at 30fps.

EX60 Feature Summary:

- A high definition videoconferencing system which supports variable resolutions up to a maximum of 1920 x 1080 pixels (1080p) at 30fps or 1280 x 720 pixels (720p) at 60fps.

- A single integrated desktop unit comprising: The 21.5” picture monitor, CODEC, camera, microphone and loudspeakers.
- Touch screen control panel with audio handset
- An IP CODEC operating at connection speeds up to 6 Mbit/s over H.323.
- A 1920 x 1080 native resolution HD camera with a manual privacy shutter. The camera may also be tilted forward to view documents on the desk.
- Supports H.261, H.263, H.263+ and H.264.
- Supports G.711, G.722, G.722.1 and MPEG-4 AAC-LD stereo audio coding.
- External hands free headset, microphone and headphone connections.
- DVI-I PC data input.
- Stereo analogue audio input for connection of PC audio.
- H.239 second HD video connection with up to 720p (1280 x 720) resolution at 16 frames per second.
- Far end camera control.
- AES Encryption.

B: SETUP PROCEDURE

Installing the Cisco TelePresence EX60 system was straight forward. The Installation Guide clearly illustrated this simple procedure:

- Secure the audio handset base unit to the touch screen control panel.

- Connect the touch screen control panel to the EX60 System.

- Connect the RJ45-RJ45 cable to establish an Ethernet IP network connection

- Connect the external power supply to the unit.

System set up was also convenient and trouble free. The IP address, IP Gateway, Subnet mask and Gatekeeper address were all configured by the touch screen control panel via the on screen menus.

Approximate set-up time: 15 minutes

Documentation quality: The documentation was concise and easy to follow and included: Installation, Quick Reference, User and Administrator guides.

C: Hardware Description

EX60 System

The EX60 systems supplied for evaluation supported a maximum call bandwidth of 6 Mbit/s and included the Premium Resolution Option which delivered a maximum resolution of 1080p at 30fps.

The system was silent in operation and heat dissipation was minimal, the unit's case being only just warm. This "cool running" was confirmed by the low 55 Watt power consumption detailed in the specifications.

The CODEC offers several video resolutions including:

• CIF 352 x 288 pixels

• 4CIF 704 x 576 pixels

• High definition w720p i.e. 1280 x 720 @ 60 frames per second

• High definition w1080p i.e. 1920 x 1080 @ 30 frames per second

The Maximum resolution and frame rate are determined by camera frame rate selection. With the Premium Resolution Option, setting the camera frame rate to 30 frames per second also selects the maximum picture resolution of 1920 x 1080 pixels. If the camera frame rate is increased to 60 frames per second the maximum resolution then reduces to 1280 x 720. This frame rate/resolution selection can only be set by an SSH connection from a PC to the CODEC; it cannot be set via the touch panel menus or web interface.

The achievable image resolution and frame rate are not only dependent on the call connection bandwidth but also on the source video mode i.e. either "Sharpness" or "Motion". The default setting for the camera is "Motion".

To optimise picture quality to the available lighting conditions three, Optimal

Definition Profiles may be selected, these permit the frame rate and resolution to be increased for low bandwidth connections when the room lighting is good enough.

• Normal - Standard meeting room. Default setting (Recommended)

• Medium - Good, stable light conditions

• High - Optimal light conditions for video conferencing

During the evaluation the default Normal setting was used throughout.

Premium Resolution Option, Camera Frame Rate 60fps, Optimal Definition Normal

Camera Video Mode	Motion		Sharpness	
Connection Bandwidth	Resolution	Frame rate	Resolution	Frame rate

128 Kbit/s	512 x 288	19	1280 x 720	3
384 Kbit/s	640 x 360	30	1920 x 1080	4
768 Kbit/s	1024 x 576	30	1920 x 1080	9
1 Mbit/s	1280x720	30	1920 x 1080	15
2 Mbit/s	1280x720	30	1920 x 1080	25
3 Mbit/s	1280x720	60	1920 x 1080	30
4 Mbit/s	1280x720	60	1920 x 1080	30
6 Mbit/s	1280x720	60	1920 x 1080	30

Premium Resolution Option, Camera Frame Rate 30fps, Optimal Definition Normal

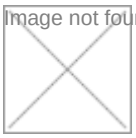
Camera Video Mode	Motion		Sharpness	
Connection Bandwidth	Resolution	Frame rate	Resolution	Frame rate
128 Kbit/s	512 x 288	19	1280 x 720	3
384 Kbit/s	640 x 360	30	1920 x 1080	4
768 Kbit/s	1024 x 576	30	1920 x 1080	9
1 Mbit/s	1280x720	30	1920 x 1080	15

2 Mbit/s	1280x720	30	1920 x 1080	25
3 Mbit/s	1920 x 1080	30	1920 x 1080	30
4 Mbit/s	1920 x 1080	30	1920 x 1080	30
6 Mbit/s	1920 x 1080	30	1920 x 1080	30

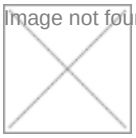
With “Sharpness” selected, at lower bandwidths, the frame rate reduces significantly to preserve the higher definition. If movement is important then this could be a consideration.

Both Picture in Picture (PIP) and Picture outside Picture (POP) display formats are supported. This allows both near and far end images together with presentation material to be displayed simultaneously on a single system monitor.

During a call with no presentation material transmitted or received, the “Selfview” button on the touch screen toggles the near end Selfview PIP image on/off.

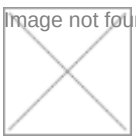


When the “Presentation” button on the touch screen is selected the EX60 picture monitor previews the PC input full screen with a PIP Far end image superimposed, the Selfview button on the touch screen toggles the near end Selfview PIP image on/off.



When widescreen H.329 dual images are transmitted the touch screen layout button selects various combinations of screen layout:

- Full screen presentation image with/without near image PIP
- Large presentation image, small near image POP with/without near image PIP
- Medium presentation and far images side by side, with/without near image POP



The touch screen image replicates the screen image layout including a description of the content displayed in each window on the main screen. For example the touch screen image below relates to the third example above Widescreen Presentation Side by Side, Medium.

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When 4x3 H.239 images are transmitted along with the main video the system concentrates on these two more important images, and excludes the incidence of PIP superimposed images. The touch screen layout button selects various combinations of screen layout:

- Full screen presentation image, far image POP, with/without near image POP
- Large presentation image, small far image POP, with/without near image POP
- Medium presentation and far images side by side, with/without near image POP

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When H.329 dual images are received, in addition to the layouts described above it is also possible to minimise the remote presentation and maximise the far end image size.

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The Precision HD camera has a native resolution of 1920 x 1080 (1080p) with an auto focus lens and tilt adjustment. A manual privacy shutter is provided by rotating the front element of the camera lens. The camera may be manually tilted forward to view documents or objects on the desk surface. When the camera tilts to its forward position, documents on the desk readable by the conference participants would appear upside down to the camera. The camera automatically reverses its vertical orientation to produce a true image for both local and remote viewing.

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Far End camera control is supported. This allows remote control of a distant camera if the remote CODEC is equipped with an appropriate pan and tilt camera.

During an H.323 call a second unidirectional video channel (dual stream) is provided through the H.239 protocol. Thus video from the camera and a PC or laptop image could be transmitted simultaneously. The bandwidth may be dynamically allocated between each video channel or defined by the user.

During H.239 dual channel conferences the maximum available resolution reduces to 720p for both channels. The H.239 or presentation channel also has its frame rate limited to around 16fps. This degradation also applied to the received signals, so an EX60 system transmitting H.239 would only receive signals at a maximum of 720p resolution incoming. This means that even for a 6 Mbit/s connection both the transmitted and received main camera images would have their resolution reduced from 1080p to 720p.

To transmit PC presentation material at a high frame rate it must be sent on the main video channel, this selection may only be made via the web interface. Video images only may be transmitted this way however as the sound is muted.

The system's microphone is within the main cabinet. Alternatively, when audio privacy is required, the audio handset attached to the control panel or a hands free headset may be used.

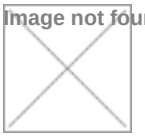
Several audio formats are supported by the CODEC. Cisco has implemented the MPEG-4 AAC-LD audio coding with 20 KHz analogue audio bandwidth. A separate stereo audio input using a 3.5mm mini jack connector allows for straightforward interfacing to a PC or laptop.

> The system specification sheet indicates that the EX60 system supports AAC-LD stereo audio. During the evaluation only AAC-LD mono could be negotiated in calls between EX60 systems and other CODECS which also support AAC-LD stereo.

When PC presentation material is being previewed (not in a call), its associated audio is heard at the local site. During an H.239 conference a useful feature mutes this presentation audio on the local and remote loudspeakers until dual stream is selected for transmission. Echo cancellation is appropriately disabled on this input.

Normal system control is through the wired touch screen control unit. Remote configuration is another option via a web browser from a network connected PC. This comprehensive web interface provides control and configuration of the CODEC and displays diagnostic information if required, together with web snapshots of the EX60 camera and presentation input. For added security this remote management system may be password protected.

D: SYSTEM OPERATION

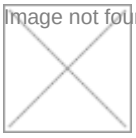


The touch screen control panel includes dedicated controls for “Volume, Microphone mute, Selfview, Do not disturb and Audio output select”, the latter selecting: audio handset, personal headset or the main system loudspeaker.

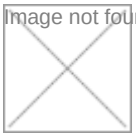
Additional controls are displayed depending on the system status e.g. if the audio handset is picked up the audio selection automatically switches to the handset.

The handset was found to be very sensitive to mechanical vibrations. If the handset is replaced on the cradle during a normal conference, the call is automatically ended. During testing when the handset was not being used and was on its cradle a slight movement could disconnect the call. This required participants to be particularly careful not to move the handset.

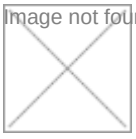
When not in a call two buttons are displayed at the bottom of the touch screen: “Call” and “More”. Selecting these buttons provides access to further menu selections that appear as a pop up or keyboard entry screens. “More” provides access to manual focus and to the system settings page. These pop ups can be hidden by re-pressing the “More” button.



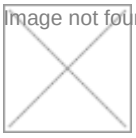
The “Call” button provides access to the call options including Dial Pad, Favourites, Directory, and recent call history, the call rate may also be set from this interface.



When Presentation is selected, the PC input is previewed on screen and the Present button must be pressed to transmit the presentation to the other sites.



When the presentation is complete it is a simple matter of pressing the Stop Presenting button, seen on the screen below, to end the sequence.



Successful H.239 conferences were established in both directions between EX60 systems and with other manufacturers’ CODECs for both high and standard definition conferences. The EX60 CODEC supports far end camera control.

The system takes two minutes and twenty seconds to boot up from cold. When not in a call the system automatically reverts to sleep mode after a user definable period. An incoming call or pressing the touch screen will return the system to active mode.

In addition to the menus available from the touch screen a web interface is available to both configure and monitor the EX system, several menu selections e.g. camera frame rate are only available via the web interface. For security this connection may be password protected

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Screen shots of the CODEC input sources are also available from the web interface which provides snapshots of the camera and presentation images. Source selection and Presentation Start/Stop is also possible.

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Screenshots reproduced by permission of Cisco

E: VIDEO TESTS SUMMARY

The video quality experienced between EX60 systems at 1080p 30fps and 720p 60fps was exceptional; The high resolution images at 1080p 30fps and the superb motion rendition at 720p 60fps were both most impressive. The Precision camera performed very well. Video noise was low even in poorly lit scenes and the auto-focus, exposure and white balance were highly responsive and accurate in operation. Picture monitor performance was also excellent for 1080p camera images and transcoded 720p PC content, the non reflective screen ensuring clean images without objectionable on screen reflections. For connections exceeding 2Mbit/s the video quality was first class, even fast moving movie trailer material that challenge conference links to the limit was almost artefact free.

At lower connection speeds on standard VC material the video quality was also excellent. The detailed video test scores below confirm the products exceptional performance across the board.

F: AUDIO TESTS SUMMARY

Setup The echo canceller is fully automatic in operation. The quality of echo cancellation and doubletalk from the system was excellent.

Audio levels adequate? (Yes/No)	Yes
Audio quality acceptable? (Yes/No)	Yes
Echo cancellation acceptable? (Yes/No)	Yes
Quality of double talk	Excellent

G: DATA TESTS

A PC may be directly connected to the CODEC via the DVI interface and may be transmitted on either the main channel or the H.239 channel. Audio from a PC can only be transmitted when the PC is selected on the H.239 channel.

H: CONNECTIVITY

Connectivity between Like Machines

H.323

There were no problems in establishing connections between the HDX units over IP.

During an H.323 call the network connection was removed and reconnected after a specific time:

5 Seconds	Picture froze – successful reconnection call does not terminate
15 Seconds	Picture froze – successful reconnection call does not terminate
30 Seconds	Picture froze – call intermittently terminated on reconnection

Time to Connect

H.323

All speeds Approx. 3 seconds

Connectivity with Other Machines (models listed with comments)

H.323

Successful connections were made in each direction with the following CODECs, where the systems supported H.239 presentation material was also shared.

CODEC **Model and Software Version**	**Call Bandwidth**	**Resolution Transmitted by the EX60**	**Resolution Received by** **the EX 60**
Polycom PVX Software (SW) 8.0	1.5 Mbit/s	512 x 288	320 x 240
Polycom Telepresence M100 SW 1.0.0	2 Mbit/s	720p	640 x 480
Polycom® VSX7000 SW 9.0.5.1	2 Mbit/s	352 x 288	352 x 288
Tandberg Edge 95 SW F9.0 PAL	2 Mbit/s	512 x 288	512 x 288
Tandberg 6000 MXP SW F9.0 PAL	2 Mbit/s	720p	720p
Tandberg C40 SW TC4.2.1	6 Mbit/s	720p	720p

ConnectC Tandberg C60* L SW TC4.2.1 Po	6 Mbit/s	1080p	1080p
H Tandberg C90* R SW TC4.2.1	6 Mbit/s	1080p	1080p
Polycom HDX 9002 SW 2.6.0	2 Mbit/s	720p	720p
Lifesize Team SW 4.7.10	4 Mbit/s	720p	720p
Lifesize Room 200 SW 4.7.0	6 Mbit/s	720p	720p

* Tandberg C60 and C90 Systems included the Premium Resolution Option and 1080p support.

Resolution in pixels and their common designation:

- 1920 x 1080 1080p
- 1280 x 720 720p
- 1024 x 576 W4CIF
- 704 x 576 4CIF
- 576 x 448 448p
- 512 x 288 WCIF
- 352 x 288 CIF
- 352 x 240 SIF
- 320 x 240 QVGA

Connectivity with JANET Videoconferencing Switching Service (JVCSS)

The EX60 connected to the Codian MCU using H.264 Video and G.722.1 audio in both directions. It interoperated successfully also negotiating 720p resolution on the H.239 channel.

Received audio level was measured as peaking to -4dBm.

Procedure for making a call

1. Press the Call button on the touch panel
2. Select dial pad
3. Input IP address or E.164 number
4. Press the Call button.

Local Contacts Directory, Favourites and Recent Call lists are also available from the touch panel interface.

Appendix 1 Detailed Physical Information

Dimensions: (w x h x d) 52 x 50.8 x 13.8 cm

Video Inputs	Format	Connector

Main camera	Internal connection	
PC input	VGA, DVI, Component	DVI-I

Video Outputs	Format	Connector
Main monitor	Internal connection	

Audio Inputs	Level	Connector
EX60 microphones	**Internal connection**	
PC audio input	**Line**	3.5mm mini jack
Headset Microphone	**Microphone**	3.5mm mini jack

Audio Outputs	Level	Connector
Monitor Loudspeakers	**Internal connection**	
Headset Output	**Line**	3.5mm mini jack

Data

1. 1 off LAN 10/100/1000 Mbits/s Ethernet connection (RJ45)
2. 1 off PC loop through 10/100/1000 Mbits/s Ethernet connection (RJ45)
3. 1 off USB connector (future Use)

Cables Supplied

1. 1 off 1.5 metre, VGA-DVI cable
2. 1 off 1.5 metre, DVI-DVI cable
3. 1 off 1.5 metre mini jack – mini jack
4. 1 off 3.6 metre RJ45-RJ45 network cable

5. 1 off IEC power cord

Mobility

The Cisco TelePresence EX60 slim, lightweight system can be moved easily. To establish a connection, each new location will need the local area network information re-entered into the configuration menu.

Appendix 2 Detailed Video Tests

It was not possible to force either the video or audio protocols in the EX60 CODECs, hence we were only able to carry out detailed tests on H.264 video coding. At all speeds the audio protocol AAC-LD 64K was negotiated.

For the following tests using the DVI input and with the PC input set to Motion and the PC selected to the main channel the following video resolutions were negotiated:

Connection Bandwidth	Resolution and Frame Rate
384 kbit/s	640 x 480 30fps
768 kbit/s	1024 x 576 30fps
2 Mbit/s	1280 x 720 30fps
4 Mbit/s	1280 x 720 60fps
6 Mbit/s	1280 x 720 60fps

Objective Video Tests: Signal measurements

1. 75% EBU bars
2. Grey scale

Subjective Video Impairments Tested:

Lip synchronisation **LS**

Block distortion (tiling)	**BLK**
Blurring (reduced edge sharpness and spatial detail)	**BLR**
Colour errors	**CLR**
Jerkiness (distortion of smooth motion)	**JRK**
Object persistence (lagging images from previous frames as faded or outline images)	**OP**
Scene cut response (i.e. time to build up the new image)	**SCR**

Scale of impairments:	
Imperceptible	**1**
Perceptible	**2**
Slightly annoying	**3**
Annoying	**4**
Very annoying	**5**

MII Test Tape:

Signals recorded	Time on tape
1. EBU colour bars	1min 30secs
2. Grey scale	1.40 - 2.40
3. Blue field	2.50 - 3.50
4. Medium close up female face, still	4.00 - 5.00
5. Medium close up female face, talking	5.10 - 6.10
6. Close up face, nodding	6.20 - 7.20
7. Close up face, shaking head side to side	7.30 - 8.30
8. Zoom out slowly to wide angle three people	8.40 - 9.40
9. Zoom in quickly to close up of centre person	9.50 - 10.50
10. Turntable speeds: 1,2,3 and 4	11.00 - 15.30
11. Football sequence	15.40 - 16.40
12. Zoom in and out of "A to Z" map	16.50 - 17.50
13. Text legibility, font sizes 20 to 12 pt	20.30 - 20.50
14. Cut tests, scenes various with camera movements	21.00 - 22.00

15. Man teaching at whiteboard 22.10 - 23.23

(Insert 75% EBU bars at local site, measure at remote site)

Test 1 (H264): Colour bar test

(Insert 75% EBU bars at local site, measure at remote site)

Subjective Impairments H.323	384 kbit/s	768 kbit/s	2 Mbit/s	4 Mbit/s	6 Mbit/s
BLK	1	1	1	1	1
BLR	1	1	1	1	1
CLR	1	1	1	1	1

Test 2 (H.264): Grey scale

(Insert grey scale at local site, measure at remote site)

Subjective Impairments H.323	384 kbit/s	768 kbit/s	2 Mbit/s	4 Mbit/s	6 Mbit/s
BLK	1	1	1	1	1
BLR	1	1	1	1	1
CLR	1	1	1	1	1

Test 3 (H.264): Blue screen

(Insert blue screen at local site, measure at remote site)

Subjective Impairments H.323	384 kbit/s	768 kbit/s	2 Mbit/s	4 Mbit/s	6 Mbit/s

BLK	1	1	1	1	1
CLR	1	1	1	1	1

Test 4 (H.264): Medium close up female (still)

Subjective Impairments H.323	384 kbit/s	768 kbit/s	2 Mbit/s	4 Mbit/s	6 Mbit/s
BLK	1	1	1	1	1
BLR	2	2	1	1	1
CLR	1	1	1	1	1

Test 5 (H.264): Medium close up female (talking)

Subjective Impairments H.323	384 kbit/s	768 kbit/s	2 Mbit/s	4 Mbit/s	6 Mbit/s
LS	1	1	1	1	1
BLK	2	1	1	1	1
BLR	3	2	1	1	1
CLR	1	1	1	1	1
JRK	2	1	1	1	1

Test 6 (H.264): Close up head (nodding)

Subjective Impairments H.323	384 kbit/s	768 kbit/s	2 Mbit/s	4 Mbit/s	6 Mbit/s
BLK	2	1	1	1	1
BLR	2	2	1	1	1
CLR	1	1	1	1	1
JRK	1	1	1	1	1

Test 7 (H.264): Close up head (shaking side to side)

Subjective Impairments H.323	384 kbit/s	768 kbit/s	2 Mbit/s	4 Mbit/s	6 Mbit/s
BLK	3	2	1	1	1
BLR	3	3	2	1	1
CLR	1	1	1	1	1
JRK	1	1	1	1	1

Test 8 (H.264): Medium close up, slow zoom out to three shot

Subjective Impairments H.323	384 kbit/s	768 kbit/s	2 Mbit/s	4 Mbit/s	6 Mbit/s

BLK	2	1	1	1	1
BLR	2	1	1	1	1
CLR	1	1	1	1	1
JRK	1	1	1	1	1

Test 9 (H.264): Three shot, quick zoom in to medium close up centre person

Subjective Impairments H.323	384 kbit/s	768 kbit/s	2 Mbit/s	4 Mbit/s	6 Mbit/s
BLK	2	1	1	1	1
BLR	2	1	1	1	1
CLR	1	1	1	1	1
JRK	1	1	1	1	1

Test 10a (H.264): Turntable speed 1

Subjective Impairments H.323	384 kbit/s	768 kbit/s	2 Mbit/s	4 Mbit/s	6 Mbit/s
BLK	2	1	1	1	1
BLR	1	1	1	1	1

CLR	1	1	1	1	1
JRK	1	1	1	1	1

Test 10b (H.264): Turntable speed 2

Subjective Impairments H.323	384 kbit/s	768 kbit/s	2 Mbit/s	4 Mbit/s	6 Mbit/s
BLK	2	1	1	1	1
BLR	2	1	1	1	1
CLR	1	1	1	1	1
JRK	1	1	1	1	1

Test 10c (H.264): Turntable speed 3

Subjective Impairments H.323	384 kbit/s	768 kbit/s	2 Mbit/s	4 Mbit/s	6 Mbit/s
BLK	2	2	1	1	1
BLR	3	2	2	1	1
CLR	1	1	1	1	1
JRK	1	1	1	1	1

Test 10d (H.264): Turntable speed 4

Subjective Impairments H.323	384 kbit/s	768 kbit/s	2 Mbit/s	4 Mbit/s	6 Mbit/s
BLK	2	2	1	1	1
BLR	3	3	3	2	2
CLR	1	1	1	1	1
JRK	1	1	1	1	1

Test 11 (H.264): Football sequence

Subjective Impairments H.323	384 kbit/s	768 kbit/s	2 Mbit/s	4 Mbit/s	6 Mbit/s
BLK	3	2	1	1	1
BLR	4	3	2	2	1
CLR	2	2	2	2	2
JRK	1	1	1	1	1

Test 12 (H.264): Zoom in and zoom out of ‘A to Z’ map

Subjective Impairments H.323	384 kbit/s	768 kbit/s	2 Mbit/s	4 Mbit/s	6 Mbit/s

BLK	3	2	1	1	1
BLR	4	2	2	1	1
CLR	1	1	1	1	1
JRK	2	1	1	1	1

Test 13 (H.264): Text legibility (% of screen height) at viewing distance approx. 5x screen diagonal

Legibility H.323	384 kbit/s	768 kbit/s	2 Mbit/s	4 Mbit/s	6 Mbit/s
20 pt (3.5%)	Yes	Yes	Yes	Yes	Yes
16 pt (3%)	Yes	Yes	Yes	Yes	Yes
14 pt (2.5%)	Yes	Yes	Yes	Yes	Yes
12 pt (2.3%)	No	Yes	Yes	Yes	Yes

Test 14 (H.264): Video with several vision cuts

Subjective Impairments H.323	384 kbit/s	768 kbit/s	2 Mbit/s	4 Mbit/s	6 Mbit/s
BLK	3	2	1	1	1
BLR	3	2	2	1	1
CLR	1	1	1	1	1

OP	1	1	1	1	1
SCR	3	2	2	2	2
JRK	2	1	1	1	1

Test 15 (H.264): Man teaching with flip chart

Subjective Impairments H.323	384 kbit/s	768 kbit/s	2 Mbit/s	4 Mbit/s	6 Mbit/s
LS	1	1	1	1	1
BLK	2	1	1	1	1
BLR	2	2	1	1	1
CLR	1	1	1	1	1
JRK	1	1	1	1	1

Test 16 Playback from a domestic VHS videotape player

As there is no analogue video input this test could not be carried out.

Appendix 3 Detailed Audio Tests

Note: In tests between EX60 units it was not possible to select audio protocols so only a limited range could be tested.

Test 1: Frequency response (-3 dB)

(Insert -6 dB signal at local site, measure at remote site)

G.722.1	AAC-LD, 64K
7.00 KHz	20.0 KHz

Test 2: Headroom (measured on AAC-LD connection)

(Insert increasing amplitude 1 KHz tone at local site, monitor for overload distortion at the remote site auxiliary output.)

Overload occurs at: +10 dBm

Test 3: Audio level

(Insert 0dBm 1KHz tone at local site, monitor the received level at the remote site)

As the audio output is varied by the volume control this test could not be carried out.

Test 4: Echo Cancellation

Setup The echo canceller is fully automatic in operation. The quality of echo cancellation and doubletalk from the system was excellent.

Audio levels adequate? (Yes/No)	Yes
Audio quality acceptable? (Yes/No)	Yes
Echo cancellation acceptable? (Yes/No)	Yes
Quality of double talk	Excellent