

APPENDIX 10/05

TEST RESULTS FOR RADVISION SCOPIA® XT 1000

Manufacturer: Radvision
Model: SCOPIA® XT1000
Software Version: 2.00.0018
Optional Features and Modifications: 9 Site Multisite

Date of Test: 24th – 28th January 2011



High definition Camera

C O N T E N T S

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A: INTRODUCTION

The SCOPIA XT1000 is a High Definition (HD) videoconferencing system with a maximum picture resolution of 1080p i.e.1920 x 1080 pixels at 30 fps (frames per second). The optional Sony 60 fps camera extends the frame rate to 60 fps but with a consequent reduction in resolution to 720p or 1280 x 720 pixels. Compatibility with other H.323 CODECS is achieved across a range of resolutions from CIF (352 x 288) up to 1920x1080 pixels depending on the capability of the remote CODEC and the connection bandwidth.

The SCOPIA XT1000 offers a number of options including:

Options	Features
Sony 60fps Camera	720p at 60fps
Extended IP Bit Rate	12 Mbit/s connectivity
ISDN	ISDN connectivity via SCOPIA Gateway
MultiSite	Internal 4 or 9 site MCU
SCOPIA Desktop	Support for SCOPIA Desktop Client
Audio	Support for G.728 Audio
Dual LAN	10/100 Base-T full-duplex second LAN connection

The equipment submitted for evaluation had version 2.00.0018 software installed and the standard Radvision camera. One system included the optional 9 Site MCU.

Feature Summary:

- A high definition videoconferencing system which supports several resolutions up to 1080p (1920 x 1080) pixels at 30 fps. With the option of 720p (1280 x 720) pixels at 60 fps.
- A 1U height CODEC, operating at connection speeds up to 4 Mbit/s over H.323 and SIP with optional extension to 12 Mbit/s.
- H.261, H.263, H.263+, H.263++ and H.264 video coding.
- G.711, G.722, G.722.1, G.729, G.719 and MPEG4 AAC-LD audio coding. Optional G.728 support.
- Separate pan and tilt HD camera with 1920 x 1080 native resolution at 30fps.
- No analogue audio input or output connections.
- No separate, composite, S-video or other analogue video inputs or outputs.
- Digital audio input and output (SPDIF).
- DVI auto switching PC input
- Digital audio carried on the HDMI input and output connections.
- Supports AES encryption.
- Far end camera control.
- H.239 second video channel up to 1080p resolution @ 30 frames per second in point to point and MultiSite calls.
- Optional 4 or 9 site MultiSite capability (local + 3 or 8 remote sites)
- A comprehensive range of resolutions supported by the analogue VGA and digital PC inputs (full details are included in the Hardware Description)
- Extended Display Identification Data (EDID) is supported
- LDAP global directory support

B: SETUP PROCEDURE

Setting up the SCOPIA XT1000 system was straightforward. The CODEC unit may be mounted on a shelf in an under-monitor cabinet or positioned vertically adjacent to the monitor using the stand supplied. A rack mounting kit is not available. The HD camera may be positioned either on top or below a picture monitor. A microphone pod and infrared remote control complete the basic package.

The connections for basic operation were clearly illustrated on the installation reference card and in the documentation available on the web and involved:

- mounting the camera adjacent to the monitor
- connecting the combined HDMI-DVI video, DIN-DIN control and DC power cable between the camera and the CODEC
- connecting the CODEC to the monitor/s with the supplied HDMI-HDMI cables
- cabling the microphone to the CODEC
- establishing an Ethernet IP network connection through the single RJ45-RJ45 cable
- connecting external power supply to the unit.

System set up was conveniently configured through the on-screen menus via the hand-held remote control. IP address, IP Gateway, Subnet mask and Gatekeeper address were all entered through these menus.

Approximate set-up time: 20 minutes

Documentation quality: The supplied installation card and web sourced Administrators guide were both concise and easy to follow.

C: HARDWARE DESCRIPTION

General

This IP-only CODEC with one 10/100/1000Mbps and additional optional 10/100Mbps auto switching Ethernet ports delivered an image resolution up to 1080p at the maximum connection bandwidth of 4Mbit/s. A 12Mbit/s option is also available. The equipment submitted for evaluation had version 2.00.0018 software installed with the 9-site MCU available on one system. When initially switched on the variable speed fan was noisy for the first few minutes of operation but then settled down and was virtually silent. Adequate air flow around the unit would be necessary as the case becomes quite hot and appears to be acting as a heat sink.

The CODEC supports single and dual monitors via two high definition (w1080p) outputs. The main HDMI output connection carries audio signals but a separate SPDIF digital audio output is also available. Analogue audio input or output connections are not provided on the CODEC.

The SCOPIA XT1000 system supports multiple video resolutions including:

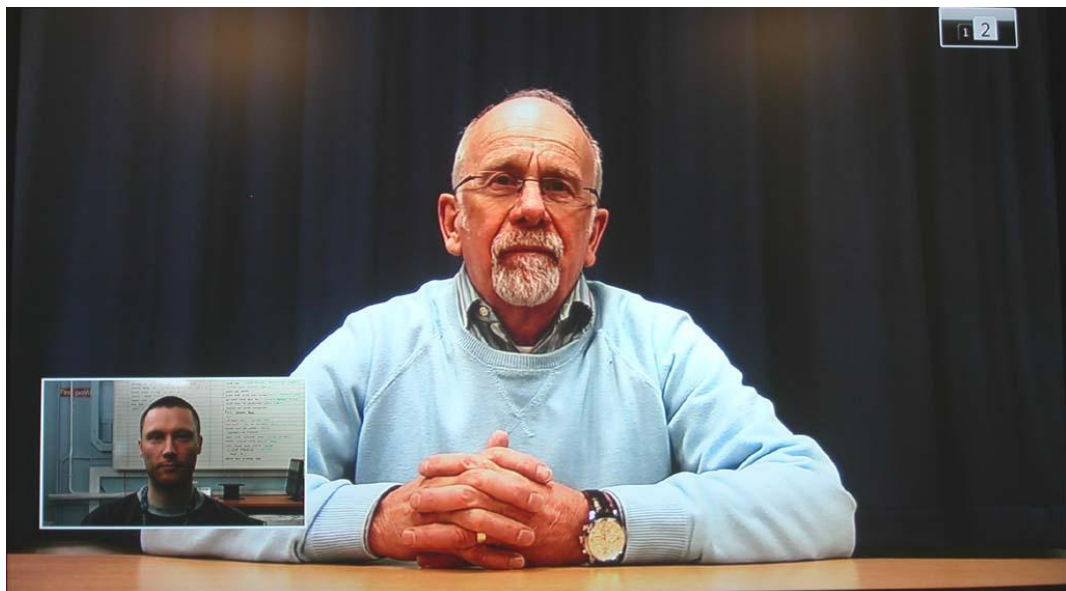
- the basic CIF format resolution of 352 x 288 pixels
- w288p at 512 x 288
- w448p at 768 x 448
- High Definition (HD) w720p 1280 x 720 30 fps
- High Definition (HD) w720p 1280 x 720 60 fps*
- High Definition (HD) w1080p 1920 x 1080 30 fps

* Requires optional Sony 60 fps camera

The image resolution is dependent on the call connection bandwidth:

Connection Bandwidth	Resolution
128 Kbit/s	w224p 400 x 224
384 Kbit/s	w448p 768 x 448
768 Kbit/s	720p
1 Mbit/s	720p
2 Mbit/s	1080p
4 Mbit/s	1080p

In addition to the traditional Picture in Picture (PIP) display format, the CODEC also supports Picture outside Picture (POP). This allows both near and far end images to be displayed simultaneously on a single picture monitor.



Full screen of the far end image with near image Picture in Picture (PIP)



Far and near image, Picture outside Picture (POP)

POP is particularly useful when a single large screen display device such as a plasma/LCD panel or video/data protector is used.

In single monitor mode the Layout and PIP buttons on the remote control can select multiple display options.

The PIP button cycles between

- near end full screen
- near end full screen and far end PIP
- near end and far end side by side POP.

The Layout button modifies the selection to

- far end full screen
- far end full screen and near end PIP
- near and far end side by side POP.

During H.239 conferences in single display mode the PIP button selects various combinations of screen layout:

- far end full screen with Presentation image PIP
- far end and Presentation image side by side POP
- far end full screen.

The Layout button modifies the selection to

- presentation image full screen with far end PIP
- far end full screen and near end PIP
- near end full screen and far end PIP
- far end full screen and Presentation image PIP.



Large presentation image, far image PIP

This two button (PIP and Layout) selection could be confusing for a new user especially, when Presentation material was being used, due to the large number of possible combinations. There was no option to display all three images – near, far and presentation – on a single screen simultaneously.

In dual monitor mode without presentation material the two monitors display the near and far images. The menu may be selected to overlay on either monitor display.

When H.239 presentation material is either transmitted or received, the Layout and PIP buttons determine how the images are displayed.

Several main monitor screen layouts are possible:

Monitor 1

- Full screen of the far image

Monitor 2 (PIP button options)

1. Full screen presentation image
2. Full screen presentation image and near end PIP
3. Near end and presentation image side by side POP

In order to see all three images simultaneously on dual monitors a full screen far image is seen on monitor 1. With option (2) above, a near end PIP is superimposed over the presentation material on monitor 2. A much clearer and preferred arrangement is to have near and far images on one monitor with the other devoted to a full screen of the presentation material.

The Radvision 1080p High Definition (HD) camera has a native resolution of 1920x1080 pixels and features pan, tilt and zoom functions. Its lens offers a wide horizontal viewing angle of 74 degrees. Remote camera control is supported with ten preset positions being able to be saved and recalled. A five metre long combined HDMI-DVI video, control and power cable is supplied. When multiple cameras are

in use the control/signal cables may be daisy-chained between cameras, but as the CODEC is only capable of powering one camera the second camera will require an external power supply. If the higher frame rate of 60fps is required for fast action display then the optional 60fps Sony camera is available but with a reduced resolution of 720p.

The SCOPIA XT1000 has three digital vision inputs: 2xHDMI and 1xDVI. There are no separate analogue composite, S-Video or component video input or output connections.

The DVI auto selects between the following signal formats:

- analogue RGB
- digital.

High Definition Content Protection (HDCP) is not supported on either the HDMI or DVI inputs.

A PC may be directly connected to the CODEC via the DVI interface, with the following resolutions and frame rates supported:

Using the RGB VGA PC signals

1280 x 1024 @ 60, 75fps: SXGA
1024 x 768 @ 60, 70, 75fps: XGA
800 x 600 @ 56, 60, 72, 75fps: SVGA

Using the Digital PC signals

1920 x 1200 @ 60fps: WUXGA
1920 x 1080 @ 25, 30, 50, 60fps
1600 x 1200 @ 60fps: UXGA
1440 x 900 @ 60fps: WSXGA
1280 x 1024 @ 60, 75fps: SXGA
1280 x 720 @ 25, 30, 50, 60fps
1280 x 768 @ 60fps: WXGA
1024 x 768 @ 60, 70, 75fps: XGA
800 x 600 @ 56, 60, 72, 75fps: SVGA
640 x 480 @ 60, 67, 72, 75fps: VGA

Although signals above 30 frames per second are supported on the Digital PC input only 30 frames per second are actually transmitted.

The DVI CODEC input supports Extended Display Identification Data (EDID).

H.239 dual video coding provides a second unidirectional video channel during H.323 calls, but without a dedicated second audio channel, the bandwidth is shared between the presentation channel and the main video. The bandwidth allocation between channels is user configurable. Thus the main video from a camera and presentation material from a PC could be transmitted simultaneously and displayed on two monitors at the remote site. In calls between SCOPIA XT1000 systems it was possible to transmit two simultaneous high resolution full frame rate images at

1080p 30fps.

The main video channel allows selection of either HDMI input or the single DVI signal but only the DVI input may be selected on the H.239 second video channel; thus if two camera images are to be transmitted simultaneously the second camera must be connected to the DVI input.

When presentation material is transmitted the resolution and frame rate of the main and second video channels depends on the connection bandwidth and the nature of the material. The system protects the resolution of the presentation channel at 1080p but reduces the resolution of the main video channel and the frame rate of both channels as connection bandwidth is reduced. The following table illustrates this:

Connection Bandwidth	Without Presentation	With Presentation	
	Main Channel	Main Channel	Presentation
4M bit/s	1080p	1080p	1080p
2M bit/s	1080p	720p	1080p
1M bit/s	720p	w576p	1080p
768 kbit/s	720p	w448p	1080p
384 kbit/s	w448p	w228p	1080p
128 kbit/s	w224p	w224p	1080p

Several audio formats are supported by the SCOPIA XT1000. Radvision has implemented the ITU standard G.719, giving 20Hz-20KHz analogue audio with low latency/delay. The 3-way microphone pod uses beam forming technology to improve pickup from the presenters while minimising background noise. In larger installations an additional microphone pod may be daisychain cabled to the main microphone. A microphone mute button with LED mute indication mutes not only the microphone but all other audio transmitted from the CODEC including the SPDIF audio input.

Digital stereo connectivity is provided via SPDIF input and output connectors.

If analogue DVD, PC audio or public address systems are being used then suitable Analogue to Digital (A-D) converters will be required. Radvision specifies that the SPDIF input can accept stereo signals at 32, 44.1 and 48KHz bit rates, and recommends the Cypress conversion device; however Lindy A-D converters were supplied with the CODECs for evaluation and although rated at 48KHz they produced a choppy rather distorted audio signal. A Marantz recorder equipped with a digital SPDIF output at 44.1 KHz operated effectively. Care is therefore required in the selection of A-D convertors.

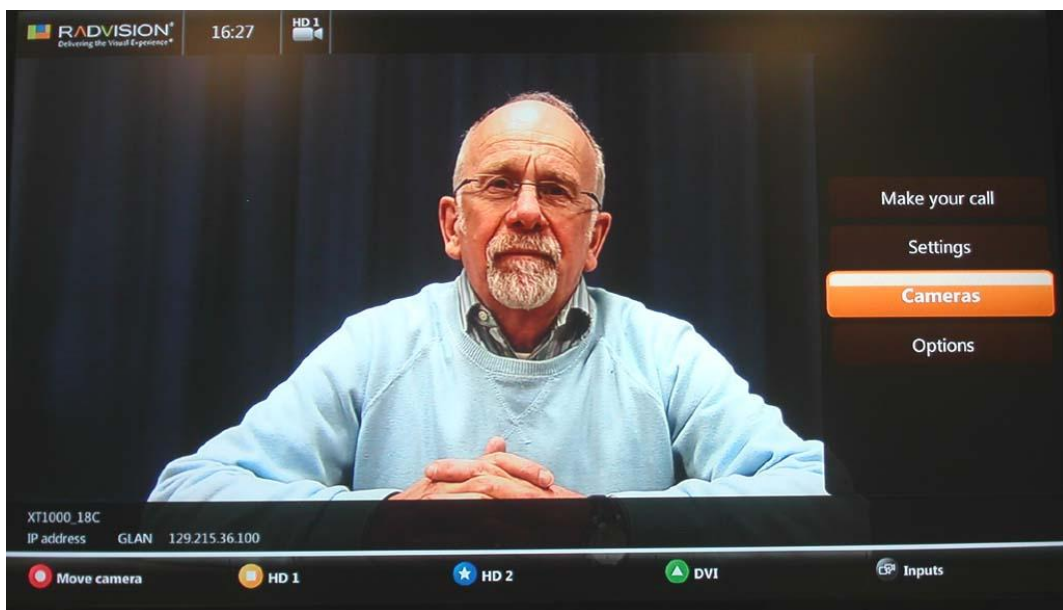
The CODEC's main audio output is also delivered on the main HDMI output.

Encryption is available at all connection speeds through Advanced Encryption Standard (AES).

D: SYSTEM OPERATION

The system may be operated locally either from the remote control or via a room control system. As the system does not support RS.232 control this requires an IP link using the API command protocol. Control is also available via the optional SCOPIA iPad application. The on-screen menus are logical and easy to follow; however the Layout and PIP button for screen layout selection were considered to be overly complex, certainly for a first time or occasional user.

The remote control includes four context sensitive colour coded buttons: green/triangle, yellow/square, red/circle and blue/star. The function of each button is indicated by the on-screen menus. This on-screen indication is vital as the function of each button can change depending on which menu is entered.



Menu with context sensitive colour coded buttons

There are dedicated buttons for Call, Hang Up, Microphone Mute, Video Mute Near/Far Camera Control, Camera Preset, Zoom, Display Layout, PIP, Volume and Input Select. Selecting Microphone Mute cuts sound both from the microphone and the SPDIF audio inputs. The Help button accessed the system information menu that showed call status data including: connection speed, compression protocols and packet loss.

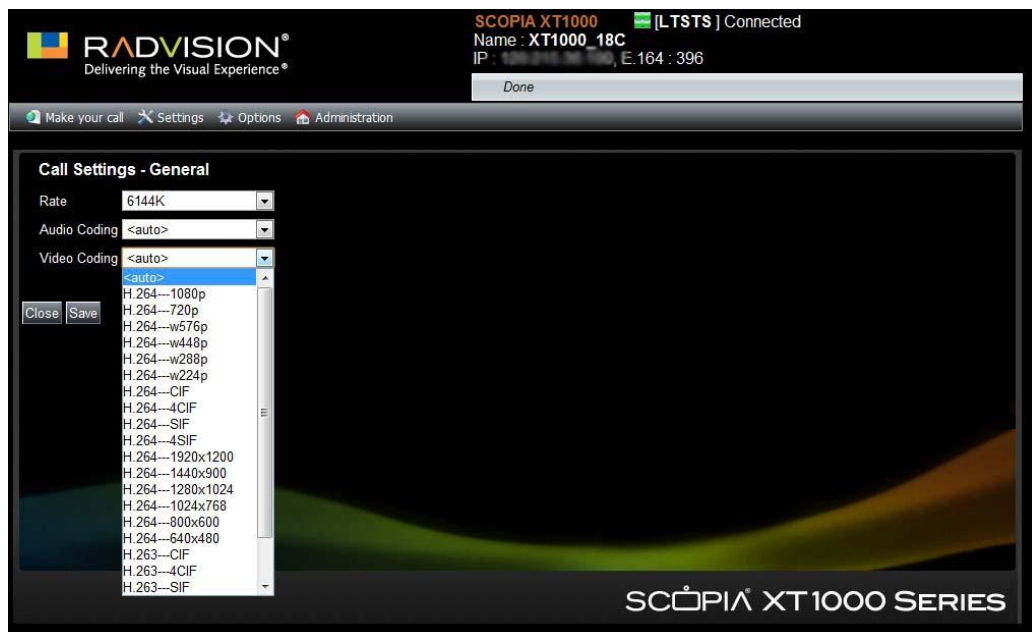
When a signal via the CODEC HDMI output was being displayed, some picture monitors created a cropped image, as if the image was being over-scanned, whereas signals from the DVI output displayed correctly. A similar effect occurs when overlaying the menu structure but this can be corrected by a menu adjustment. Unfortunately this adjustment does not extend to the conferencing images. These cropped images could present a problem if e.g. the task bar was removed while transmitting a PC derived image. Picture monitors will thus need to be carefully selected to work effectively with this CODEC.



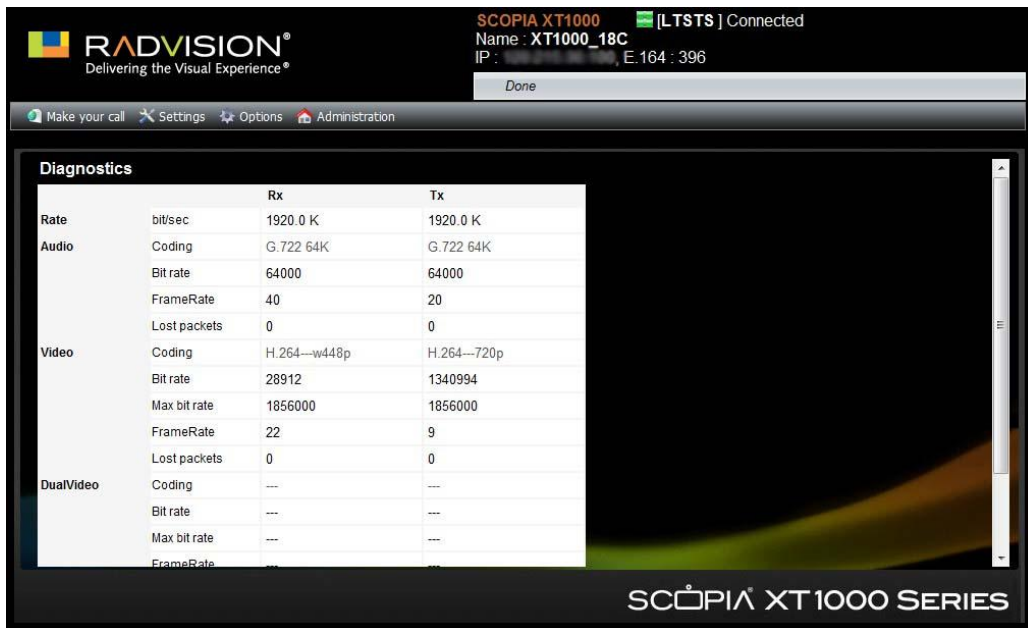
Remote Control

The system may also be remotely configured and controlled via a password protected web browser from a network connected PC. Diagnostic and call statistics are usefully available from this web interface but unfortunately web snapshots of transmitted and received images are not.

Web Interface Screen Shots



Configuration Menu



Diagnostics Menu



MCU Conference Control

An H.239 connection is initiated and terminated through the remote control via the on-screen graphical interface. The main or second camera connected to either HDMI input occupies the main video channel while the second (or presentation) channel is restricted to the DVI input source. At the remote site the two images may either be viewed on two separate monitors or using picture outside picture POP displayed on a single large screen.

The SCOPIA XT1000 remote control includes a single Presentation Source button:

- pressing this button for a short period selects the DVI input presentation source and opens the H.239 channel
- pressing the button again for a short period closes the H.239 channel.

The system takes nearly 75 seconds to boot up from cold. When not in a call the

system automatically goes into screensaver mode after a selectable period of time; it can also be put into standby mode via the remote control. An incoming call or button press on the remote control will return the system to active mode.

Optional MCU

An optional nine site MCU supports up to eight remote sites and the host SCOPIA XT1000 MCU CODEC. The maximum combined conference bandwidth with the system supplied was 6 Mbit/s.

Controlling an MCU conference is a simple procedure:

1. Select the “Connect” button during a call.
2. Enter the number of the additional site into the call menu or select the site from the directory or the recent call list.
3. Press the “OK” button.
4. The additional site will then be connected to the conference.

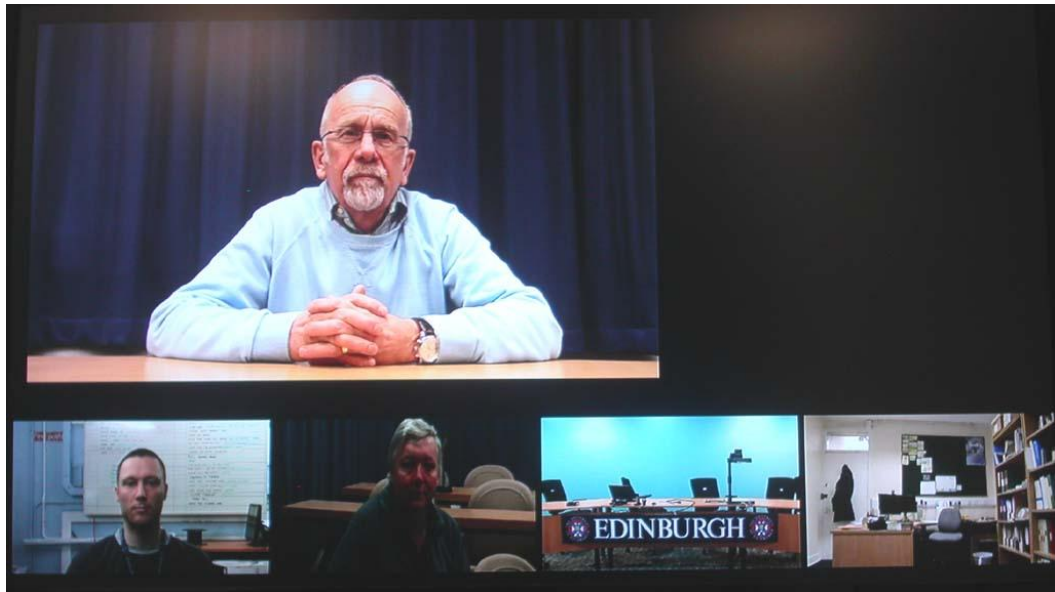
Individual connections or all connections may be disconnected using the graphic interface.

The eight remote sites receive a continuous presence split screen display. The local MCU CODEC offers several layout options. In single display mode with no presentation material transmitted or received, a split screen is displayed including the near end image. With up to four sites a simple fixed split screen is displayed.



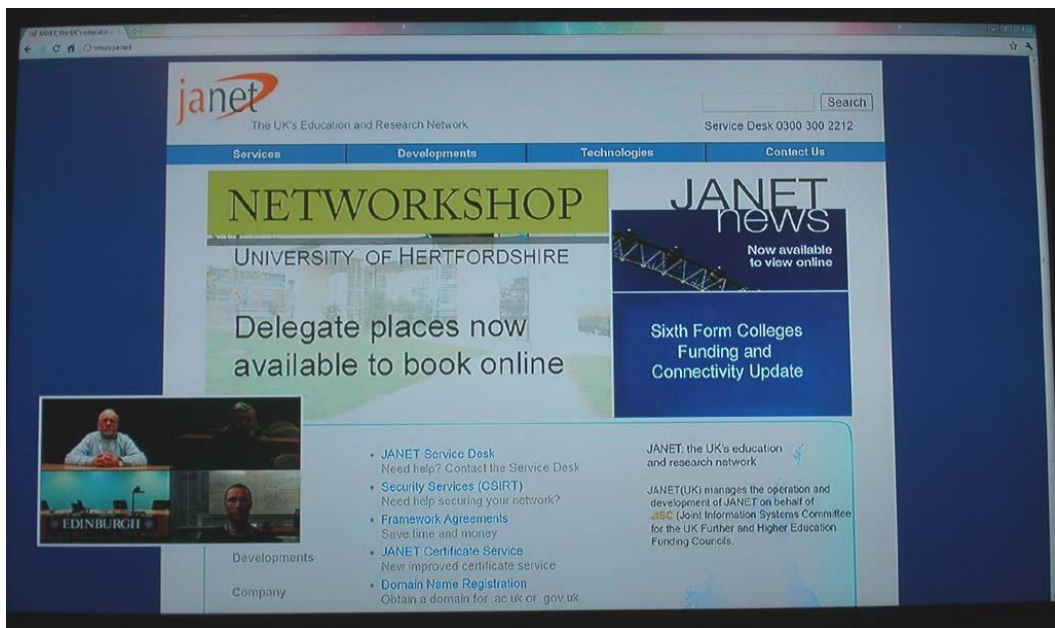
Single Display Mode MCU with four sites

In MCU conferences with more than four sites the active speaker occupies a large image on screen and the other sites are displayed in smaller sections. When any site speaks their image is switched into the larger image: this includes the local MCU host site, which can be distracting for the participant.



Single Display Mode MCU with five sites and voice switching

When presentation material is transmitted or received it is displayed full screen with the continuous presence image PIP. This PIP image may be turned off if required.



Single Display Mode Presentation Material with four site MCU call

In dual monitor mode one monitor displays the near end image and the other the continuous presence image as described above. When presentation material is transmitted or received, one monitor displays the presentation material full screen and the other monitor the continuous presence image as described above.

E: VIDEO TESTS SUMMARY

The SCOPIA XT1000 CODECs were capable of transmitting excellent images. When high resolution full motion video material was played from a PC and transmitted via the main channel at 4Mbit/s bandwidth, received quality was excellent with very few artefacts even on fast moving scenes. The same material

sent as an H.239 channel sharing the bandwidth with the main camera showed some degradation but was still very good. Only when the bandwidth was reduced to 2Mbit/s did the PC image on the H.239 channel become significantly degraded with blocky and blurry artefacts. The ability of the system at 4Mbit/s to transmit two video images simultaneously at both high resolution and frame rates was first class.

The Radvision standard 1080p 30 camera, while executing both pan and tilt functions smoothly, did have a tendency on wide angle shots to hunt for focus. The auto iris also tended to over expose even in a controlled lighting environment.

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.

	Lecture Theatre	Room
Audio levels adequate? (Yes/no)	Not tested	Yes
Audio quality acceptable? (Yes/no)	Not tested	Yes
Echo cancellation acceptable? (Yes/no)	Not tested	Yes
Quality of double talk	Not tested	Excellent

G: DATA TESTS

A PC may be directly connected to the CODEC via the DVI-I interface.

H: CONNECTIVITY

H.323

There were no problems connecting between the SCOPIA XT1000 units over IP.

Time to Connect with encryption On

H.323

All speeds <1 seconds

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 – successful reconnection, call does not terminate
55 Seconds	Picture froze – call terminates after 45 seconds

Connectivity with Other Machines (models listed with comments)

H.323

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

CODEC	Call Bandwidth	Resolution Transmitted by the C40	Resolution Received by the C40
Tandberg 6000* Classic (B version hardware)	2 Mbit/s	CIF	iCIF
Polycom® VSX8000	2 Mbit/s	CIF	CIF
Polycom® PVX	2 Mbit/s	W448p	QVGA
Tandberg Edge 95**	2 Mbit/s	w720p	w720p
Tandberg 6000 MXP**	4 Mbit/s	w720p	w720p
Tandberg C40	4 Mbit/s	w720p	w720p
Lifesize Team	4 Mbit/s	w720p	w720p
Polycom HDX 9002	6 Mbit/s	w720p	w720p
Lifesize Room 200	6 Mbit/s	w720p	w720p

* H.239 was not transmitted from the Tandberg 6000 Classic

** The diagnostics reported 9fps transmitted from XT1000 to the Tandberg Edge 95 and 6000 MXP; however the image quality did not reflect this apparent reduction in frame rate, suggesting a reporting error.

Connectivity with JANET Videoconferencing Switching Service (JVCSS)

H.323

The SCOPIA XT1000 connected successfully to the JVCSS MGC MCU negotiating H.263 Video, CIF resolution and G.722 audio with video and audio in both directions. The received audio level was measured as peaking to -4dBm.

The SCOPIA XT1000 connected successfully to the JVCSS Codian MCU negotiating H.264 Video, 720p resolution and AACLD audio received from the CODIAN MCU with G.722 audio transmitted to the CODIAN MCU. The received audio level was measured as peaking to -4dBm.

H.239 operated successfully to both MCUs.

Procedure for making a call

1. Press Connect button on the remote control.
2. Input IP address.
3. Press the Connect button.

Or, use the local contacts directory available from the user interface Phone Book or the Recent Calls lists.

Appendix 1 Detailed Physical Information

Dimensions: (w x h x d) 38 x 5 x 18 cm

Video Inputs	Signal Type	Connector
Main camera	Digital	HDMI
Second camera	Digital	HDMI
Auxiliary input		
PC	Analogue RGB	DVI
Auxiliary input	Digital	

The DVI input auto switched between the following signal formats:

- analogue RGB
- digital.

The HDMI and DVI inputs do not support High Definition Content Protection (HDCP)

Video Outputs	Signal Type	Connector
Main monitor	Digital	HDMI*
Second monitor	Digital	DVI

Note: *The Main Monitor HDMI output includes embedded stereo audio.

Audio Inputs	Level	Connector
Microphone	Microphone	RJ-11
Digital SPDIF input	Digital	RCA Phono
HDMI input	Digital	HDMI

Echo cancellation is available on the SPDIF input.

Audio Outputs	Level	Connector
Main output	Digital	HDMI
Digital SPDIF output	Digital	RCA Phono

Data

1. 1 off GLAN 10/100/1000 Mbits/s Ethernet connection (RJ45).
2. 1 off Optional LAN 10/100 Mbits/s Ethernet connection (RJ45).
3. 1 off RS232 Diagnostic connection (DIN).
4. 2 off USB connector.

Cables Supplied

As the systems supplied for evaluation were demonstration units we are unable to confirm which cables would be supplied with a purchased system.

Mobility

The SCOPIA XT1000 is designed to be installed adjacent to a picture monitor but is also lightweight and portable so can be moved easily. To establish a connection, each new location will need the local IP address to be re-entered into the configuration menu or its DHCP registration amended.

Appendix 2 Detailed Video Tests

During all video tests the audio protocol negotiated was G.719. When the system was forced to H.263 video protocol, image material connected to the DVI input was restricted to 8fps at XGA resolution. This has a serious impact on many of the rating scores as motion and lip synchronisation were significantly affected by this reduction in frame rate.

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

Test DVD:

<u>Signals recorded</u>	<u>Time on tape</u>
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 1a (H261): Colour bar test

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>
BLK	1	1
BLR	2	1
CLR	1	1

Test 1b (H263): Colour bar test

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
BLK	1	1	1
BLR	1	1	1
CLR	1	1	1

Test 1c (H264): Colour bar test

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
BLK	1	1	1
BLR	1	1	1
CLR	1	1	1

Test 2a (H261): Grey scale

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>
BLK	1	1
BLR	2	1
CLR	1	1

Test 2b (H263): Grey scale

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
BLK	1	1	1
BLR	1	1	1
CLR	1	1	1

Test 2c (H.264): Grey scale

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
BLK	1	1	1
BLR	1	1	1
CLR	1	1	1

Test 3a (H261): Blue screen

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>768 kbit/s</u>
BLK	2	2
CLR	1	1

Test 3b (H263): Blue screen

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>768 kbit/s</u>	<u>4 Mbit/s</u>
BLK	1	1	1
CLR	1	1	1

Test 3c (H.264): Blue screen

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>768 kbit/s</u>	<u>4 Mbit/s</u>
BLK	1	1	1
CLR	1	1	1

Test 4a (H261): Medium close up female (still)

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>
BLK	2	2
BLR	2	2
CLR	1	1

Test 4b (H263): Medium close up female (still)

<u>Subjective</u>			
<u>Impairments</u>			
<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
BLK	1	1	1
BLR	2	2	1
CLR	1	1	1

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

<u>Subjective</u>			
<u>Impairments</u>			
<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
BLK	1	1	1
BLR	2	1	1
CLR	1	1	1

Test 5a (H261): Medium close up female (talking)

<u>Subjective</u>		
<u>Impairments</u>		
<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>
LS	1	1
BLK	1	1
BLR	2	2
CLR	1	1
JRK	1	1

Test 5b (H263): Medium close up female (talking)

<u>Subjective</u>			
<u>Impairments</u>			
<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
LS	3	3	3
BLK	1	1	1
BLR	2	2	1
CLR	1	1	1
JRK	2	2	2

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

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
LS	1	1	1
BLK	1	1	1
BLR	2	1	1
CLR	1	1	1
JRK	1	1	1

Test 6a (H261): Close up head (nodding)

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>
BLK	2	1
BLR	2	2
CLR	1	1
JRK	1	1

Test 6b (H263): Close up head (nodding)

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
BLK	2	1	1
BLR	2	2	1
CLR	1	1	1
JRK	2	2	3

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

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
BLK	2	1	1
BLR	2	2	1
CLR	1	1	1
JRK	1	1	1

Test 7a (H261): Close up head (shaking side to side)

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>
BLK	2	1
BLR	3	2
CLR	1	1
JRK	1	1

Test 7b (H263): Close up head (shaking side to side)

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
BLK	3	1	1
BLR	3	2	2
CLR	1	1	1
JRK	2	2	2

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

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
BLK	2	1	1
BLR	3	2	1
CLR	1	1	1
JRK	1	1	1

Test 8a (H261): Medium close up, slow zoom out to three shot

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>
BLK	2	2
BLR	2	2
CLR	1	1
JRK	2	1

Test 8b (H263): Medium close up, slow zoom out to three shot

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
BLK	2	1	1
BLR	2	2	1
CLR	1	1	1
JRK	3	3	3

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

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
BLK	2	1	1
BLR	2	1	1
CLR	1	1	1
JRK	1	1	1

Test 9a (H261): Three shot, quick zoom in to medium close up centre person

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>
BLK	2	2
BLR	2	2
CLR	1	1
JRK	2	2

Test 9b (H263): Three shot, quick zoom in to medium close up centre person

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
BLK	2	1	1
BLR	2	2	1
CLR	1	1	1
JRK	3	3	3

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

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
BLK	2	1	1
BLR	2	1	1
CLR	1	1	1
JRK	1	1	1

Test 10a (H261): Turntable speed 1

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>
BLK	1	1
BLR	1	1
CLR	1	1
JRK	2	2

Test 10b (H263): Turntable speed 1

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
BLK	1	1	1
BLR	1	1	1
CLR	1	1	1
JRK	3	3	2

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

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
BLK	1	1	1
BLR	1	1	1
CLR	1	1	1
JRK	1	1	1

Test 10d (H261): Turntable speed 2

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>
BLK	2	1
BLR	2	1
CLR	2	1
JRK	2	2

Test 10e (H263): Turntable speed 2

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
BLK	1	1	1
BLR	1	1	1
CLR	1	1	1
JRK	3	3	3

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

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
BLK	1	1	1
BLR	1	1	1
CLR	1	1	1
JRK	2	2	1

Test 10g (H261): Turntable speed 3

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>
BLK	2	2
BLR	2	2
CLR	2	2
JRK	3	2

Test 10h (H263): Turntable speed 3

<u>Subjective</u>			
<u>Impairments</u>			
<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
BLK	1	1	1
BLR	2	2	2
CLR	1	1	1
JRK	4	4	4

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

<u>Subjective</u>			
<u>Impairments</u>			
<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
BLK	1	1	1
BLR	2	2	2
CLR	1	1	1
JRK	2	2	2

Test 10j (H261): Turntable speed 4

<u>Subjective</u>			
<u>Impairments</u>			
<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	
BLK	2	2	
BLR	2	3	
CLR	2	2	
JRK	3	3	

Test 10k (H263): Turntable speed 4

<u>Subjective</u>			
<u>Impairments</u>			
<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
BLK	1	1	1
BLR	2	2	2
CLR	1	1	1
JRK	4	4	4

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

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
BLK	2	1	1
BLR	3	2	2
CLR	1	1	1
JRK	2	2	2

Test 11a (H261): Football sequence

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>
BLK	3	2
BLR	3	3
CLR	2	2
JRK	1	1

Test 11b (H263): Football sequence

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
BLK	4	2	1
BLR	4	2	2
CLR	2	2	2
JRK	3	3	3

Test 11c (H.264): Football sequence

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
BLK	3	2	1
BLR	3	2	2
CLR	2	2	2
JRK	1	1	1

Test 12a (H261): Zoom in and zoom out of ‘A to Z’ map

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>
BLK	4	3
BLR	4	3
CLR	1	1
JRK	3	2

Test 12b (H263): Zoom in and zoom out of ‘A to Z’ map

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
BLK	3	2	2
BLR	4	2	2
CLR	2	1	1
JRK	4	3	3

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

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
BLK	3	2	1
BLR	2	2	2
CLR	1	1	1
JRK	3	2	2

Test 13a (H261): Text legibility (% of screen height) at viewing distance approx.
5x screen diagonal

Legibility

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>
20 pt (3.5%)	Yes	Yes
16 pt (3%)	Yes	Yes
14 pt (2.5%)	No	No
12 pt (2.3%)	No	No

Test 13b (H263): Text legibility (% of screen height) at viewing distance approx.
5x screen diagonal

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

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

<u>Legibility</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
<u>H.323</u>			
20 pt (3.5%)	Yes	Yes	Yes
16 pt (3%)	Yes	Yes	Yes
14 pt (2.5%)	Yes	Yes	Yes
12 pt (2.3%)	Yes	Yes	Yes

Test 14a (H261): Video with several vision cuts

<u>Subjective</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>
<u>Impairments</u>		
<u>H.323</u>		
BLK	3	2
BLR	3	2
CLR	1	1
OP	2	1
SCR	3	2
JRK	3	2

Test 14b (H263): Video with several vision cuts

<u>Subjective</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
<u>Impairments</u>			
<u>H.323</u>			
BLK	3	2	2
BLR	3	2	2
CLR	1	1	1
OP	1	1	1
SCR	3	2	2
JRK	4	3	3

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

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
BLK	2	2	2
BLR	2	2	2
CLR	1	1	1
OP	1	1	1
SCR	2	2	1
JRK	2	2	2

Test 15a (H261): Man teaching with flip chart

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>
LS	1	1
BLK	2	1
BLR	2	2
CLR	2	2
JRK	1	1

Test 15b (H263): Man teaching with flip chart

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
LS	3	3	3
BLK	2	1	1
BLR	2	1	1
CLR	2	1	1
JRK	2	2	2

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

Subjective

Impairments

<u>H.323</u>	<u>768 kbit/s</u>	<u>2 Mbit/s</u>	<u>4 Mbit/s</u>
LS	1	1	1
BLK	1	1	1
BLR	2	2	1
CLR	1	1	1
JRK	1	1	1

Test 16: Playback from a domestic VHS videotape player: is picture stable?

As the SCOPIA XT1000 does not include any analogue video inputs this test was not possible.

Appendix 3 Detailed Audio Tests

As the XT1000 system has no analogue audio input and output connections we were unable to carry out the full set of detailed objective audio tests

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.

	Lecture Theatre	Room
Audio levels adequate? (Yes/no)	Not tested	Yes
Audio quality acceptable? (Yes/no)	Not tested	Yes
Echo cancellation acceptable? (Yes/no)	Not tested	Yes
Quality of double talk	Not tested	Excellent