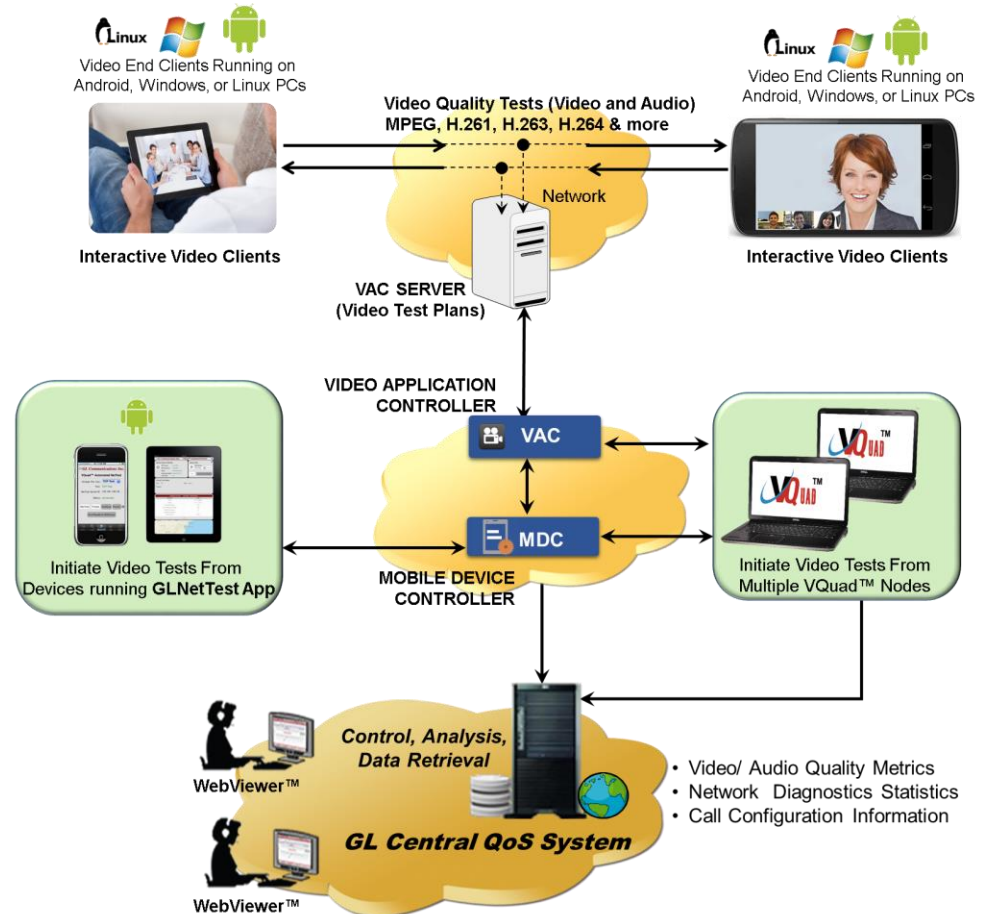

Video Conference Quality Testing



818 West Diamond Avenue - Third Floor, Gaithersburg, MD 20878
Phone: (301) 670-4784 Fax: (301) 670-9187 Email: info@gl.com
Website: <https://www.gl.com>

Video Conference Network

- Supports Android, Windows, and Linux video end client devices
- Supports both manual and automated (scripted) video testing within VQuad™
- Monitor Audio/Video Quality in Real-time
- Monitor service level compliance with SLAs
- Perform pre-deployment service testing
- Unlimited test plans configurations with Codec, Frame Rate, Bandwidth, Latency, GoP (Group of Pictures) Structure and Video Resolution
- Test results include Video Quality (Relative MOS-V), Audio Quality (Relative MOS-A), Audio Video Quality (Relative MOS-AV), IP Network condition parameters, Signaling Performance, and Call Config Info
- Initiate multiple (consecutive and/or concurrent) IP video calls between licensed agents
- Customized, consolidated, and interactive charts showing quality and diagnostic metrics
- Supported on Linux/CentOS, Windows operating systems



Manual Video Testing using VQuad™

VAC

Show Device: All

Status Results **Manual VAC Test**

VAC Server IP: 192.168.1.80 **Disconnect** Re-connect Send Results To Central DB

Test Agent A

Point A: DSP_LAPTOP

Interface A: Network A

Test Agent B

Point B: GLChinaAgent1

Interface B: Network A

Test Plan: VTP_ST_QCIF_2mins_

Start Test Get Test Param List Get Test Param (ini)

Manual Test Testtitle

VQuad™

VAC Recv: ConnectAccept 000002 UUID: 000002

Automated Video Testing (VQuad™ Scripting)

The screenshot displays the GL VQuad(TM) software interface, which is used for automated video testing. The main window is titled "GL VQuad(TM)" and contains several panes:

- Configure:** A tree view on the left showing a hierarchy of components: motog, 2, Auto Config, Script: Test_VAC, Device Settings, 3, 4, 5, 6, 7, 8.
- GL VQuad(TM) Script View:** A central pane with a "Terminal" window at the top, an "AT command:" input field, and a "Device Name:" dropdown menu set to "2". Below this is a "Scripts" pane showing a script titled "Call Control Scripting" with the following content:

```
18:54:16 / 04-08-2015
start of script
Do: Iterations=9999;
  Create Call IDs: Call IDs=LeePCVACTest;
  Send Call ID: Device ID=7; Direction=Outbound;
  VACTest: ConnectToServer=192.168.1.80;
  VACTest: StartTest=VJAY,local area connection,NEHA,
  Wait Event: Event=VACTest Done,Interval=120;
  If: VACTest Done;
```

Buttons for "Clear Variables" and "Stop" are visible below the script pane. The "Events:" pane on the right shows the execution log, including messages like "Do...loop; iteration=7 of 9999", "Created Call Id -- LeePCVACTest", and "VACTest: Connect to Server:192.168.1.80".
- GL VQuad(TM) Script Editor:** A smaller window in the bottom-left corner, titled "GL VQuad(TM) Script Editor", showing a script file named "Test_VAC_1.scp". It has a menu bar (File, Edit, Help) and a toolbar. The script content is as follows:

```
1 Script Item
2 Do: Iterations=9999;
3 Create Call IDs: Call IDs=LeePCVACTest;
4 Send Call ID: Device ID=7; Direction=Outbound;
5 VACTest: ConnectToServer=192.168.1.80;
6 VACTest: StartTest=SamsungHexus,Network:AGLIN_Agent134,Network:AVTP_ST_0,Interval=30s;
7 Wait Event: Event=VACTest Done,Interval=240;
8 If: VACTest Done;
9 Send Comment: Text=VACTest Done;
10 Pause Timer: Interval=180;
11 Else
12 VACTest: StopTest; Device ID=7;
13 Send Comment: Text=VACTest Error;
14 Pause Timer: Interval=180;
15 End If
16 Loop
```

A red arrow points from the "Script Editor" window to the "Script View" window, indicating the relationship between the two.

Manual Video Testing using Video Application Controller (VAC)

GL Video Application Controller (VAC™)

File Help

Server IP Address: 111.93.251.133

Command: Start Test

Test Parameters: Test Plan : VTP_ST_QCIF_2mins_30fps_VQ50 Source

Server Disconnect

Perform Function

SI N	Test Fron	VQuad II	Test Point A	Test Point B	Progress	Results	Stop Tes	Last Updated
1	VQuad	000002	SamsungNexus	GLIN_Agent134	InProgress	View	Stop	7/23/2015 3:06:36 P
2	VQuad	000002	SamsungNexus	GLIN_Agent134	Completed	View	Stop	7/23/2015 3:05:00 P
3	VQuad	000002	SamsungNexus	GLIN_Agent134	Completed	View	Stop	7/23/2015 2:57:38 P
4	VQuad	000002	SamsungNexus	GLIN_Agent134	Completed	View	Stop	7/23/2015 2:52:07 P
5	VQuad	000002	SamsungNexus	GLIN_Agent134	Completed	View	Stop	7/23/2015 2:46:42 P
6	VQuad	000002	SamsungNexus	GLIN_Agent134	Completed	View	Stop	7/23/2015 2:41:09 P
7	VQuad	000002	SamsungNexus	GLIN_Agent134	Completed	View	Stop	7/23/2015 2:35:32 P
8	VQuad	000002	SamsungNexus	GLIN_Agent134	Completed	View	Stop	7/23/2015 2:30:00 P
9	VQuad	000002	SamsungNexus	GLIN_Agent134	Completed	View	Stop	7/23/2015 2:19:17 P

Clear Status Capture Status Show Latest

Send Manual Results to Central Database Central Database IP: 192.168.1.91

Central DB Connected

Select Test Parameter

Source

Destination

Test Point: SamsungNexus

Test Point: MALINGA

Interfaces: Network A

Interfaces: Network A

Test Plan: VTP_ST_QCIF_2mins_30fps_VQ50

OK Cancel Refresh

Detailed Results as seen from VAC

The screenshot shows a window titled "Results" with a navigation bar at the top containing "Previous", "1 / 2", and "Next" buttons. The main content is a table with columns for "Caller Info", "CALL ORIGINATOR", and "CALL ANSWERER". The table lists various call parameters and quality metrics.

Caller Info	CALL ORIGINATOR	CALL ANSWERER
Start Time and End Time	16-04-2015 15:55:30	16-04-2015 15:55:49
Service		
Resource Group		
Endpoint Name / URI	VIJAY	NEHA
IP Address (Port)	192.168.1.80	192.168.1.76
VLAN Encap/ID/CoS		
Endpoint/UA Type		
Call ID	1193968886@VIJAY-552f8e17	
Test Plan Name	VideoTP_TwoTests	
+ VIDEO QUALITY (RELATIVE MOS-V)	4.08	3.99
+ AUDIO QUALITY (RELATIVE MOS-A)	4.17	4.17
+ AUDIO-VIDEO QUALITY (RELATIVE MOS-AV)	3.4	3.37
+ IP NETWORK HEALTH		
+ SIGNALING PERFORMANCE		
+ CALL CONFIG INFO		

At the bottom of the window, there is a "Save results to file" button.

Video Quality Metrics

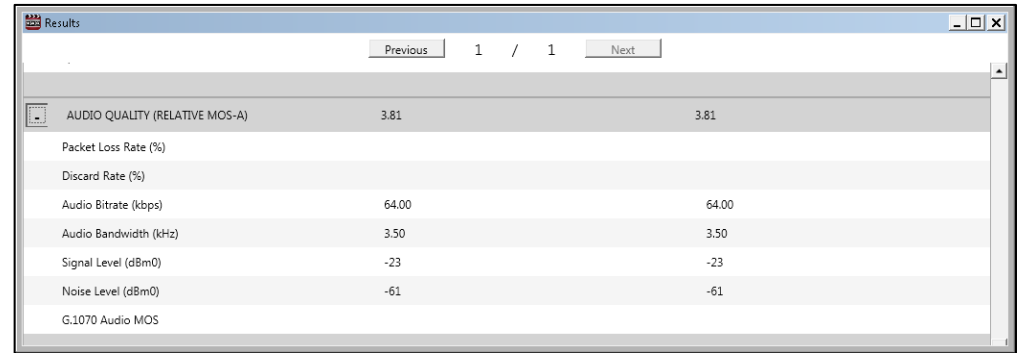
Video Mean Opinion Score (1-5 scale) that measures the impact of the video codec, frame rate, packet loss, GoP structure, content, and frame loss concealment on viewing quality.

- Image Size (Width X Height)
- Video Quality (Relative MOS-V)
- Packet Loss Rate (%)
- Discard Rate (%)
- Video Bandwidth (kbps)
- Video Frame Rate (Frames per Second)
- Impaired I Frames %
- Impaired B/P Frames %
- Loss Rate within I Frames (%)
- Loss Rate within B/P Frames (%)
- Error Extension through GoP
- EPSNR in dBm0 (Estimated Peak Signal-to-Noise Ratio)
- G.1070 Video MOS
- I Frames Received
- B/P Frames Received

	Previous	1 / 1	Next
VIDEO QUALITY (ABSOLUTE MOS-V)	1.77		2.55
Image Size (Width X Height)	176 X 144		176 X 144
Video Quality (Relative MOS-V)	2.52		3.31
Packet Loss Rate (%)	0.05		1.51
Discard Rate (%)	3.91		1.15
Video Bandwidth (kbps)			
Video Frame Rate (Frames per Second)	29.97		29.97
Impaired I Frames (%)	0.02286902		0.01687764
Impaired B/P Frames (%)	0.1		0.0
Loss Rate within I Frames (%)			
Loss Rate within B/P Frames (%)	0.02965599		1.42391
Error extension through GoP			
EPSNR	30.69		32.36
G.1070 Video MOS			
I Frames Received			
B/P Frames Received			

Audio Quality Metrics

- **Packet Loss Rate (%)** - Percentage of packets identified as lost
- **Discard Rate (%)** - Percentage of packets identified as discarded by the jitter buffer due to late arrival
- **Audio Bitrate (kbps)** - Audio bitrate in kbps
- **Audio Bandwidth (kHz)** - Audio bandwidth in kHz.
- **Signal Level (dBm0)** - Audio signal level in dBm0
- **Noise Level (dBm0)** - Audio noise level in dBm0
- **G.1070 Audio MOS** - An estimated audio quality score of 1-5 (higher is better) calculated using the ITU-T G.1070 quality assessment model
- **Audio Mean Opinion Score** (1-5 scale) that measures the impact of the audio codec, bit rate, sample rate, and packet loss on audio quality



The screenshot shows a window titled 'Results' with a table of audio quality metrics. The table has two columns for values. The metrics and their values are:

Metric	Value 1	Value 2
AUDIO QUALITY (RELATIVE MOS-A)	3.81	3.81
Packet Loss Rate (%)		
Discard Rate (%)		
Audio Bitrate (kbps)	64.00	64.00
Audio Bandwidth (kHz)	3.50	3.50
Signal Level (dBm0)	-23	-23
Noise Level (dBm0)	-61	-61
G.1070 Audio MOS		

Audio Video Quality Metrics

- Audio-Video Mean Opinion Score (1-5 scale) that measures the impact of picture and audio quality, audio-video synchronization, and the effects of delay on the overall user experience.

Audio Video
Quality (MOS-AV)

Results		
1 / 1		
Test Plan Name	VTP_ST_QCIF_2mins_30fps_VQ50_SM100	
+ VIDEO QUALITY (ABSOLUTE MOS-V)	1.95	1.86
+ AUDIO QUALITY (RELATIVE MOS-A)	3.73	3.48
- AUDIO-VIDEO QUALITY (RELATIVE MOS-AV)	2.6	2.31
Total Round Trip Delay (ms)		
End System Delay (ms)	276	276
Network Round Trip Delay (ms)		
+ IP NETWORK HEALTH		
+ SIGNALING PERFORMANCE		

Save results to file

Video Quality Metrics

GL Webviewer Version 6.1

Results Call Events Status & Statistics Reports Load Filters: --Select Filter--

VAC Results between 05/21/2023 23:04:49 and 11/21/2023 23:04:49 (Last 6 Months)

Date & Time Standard 10 Minutes 1 Hour 12 Hours 24 Hours Today Yesterday 7 Days 1 Month 6 Months

Timestamp Type VQuad Timestamp

Event ID Filter Contains []

Apply

Actions Records Per Page: 200

Test Failed	Direction	Endpoint Name	IP Address (Port)	Test Plan Name	VIDEO QUALITY						EPSNR	AUDIO QUALITY				
					Absolute MOS-V	Relative MOS-V	Video Frame Rate (Frames per Second)	Impaired I Frames (%)	Impaired B/P Frames (%)	Loss Rate within B/P Frames (%)		Relative MOS-A	Audio Bitrate (kbps)	Audio Bandwidth (kHz)	Signal Level (dBm0)	Noise Level (dBm0)
	TERM	LinuxUSAVAC	50.76.16.187	AndroidTest	4.37	4.48	30	0	0	0	36.2	3.84	5	3.5	-23	-61
	ORIG	183SERVER	50.76.16.183	AndroidTest	4.3	4.42	30	0	0	0	36.27	3.84	5	3.5	-23	-61
	TERM	183SERVER	50.76.16.183	VTP_ST_QCIF_2r	3.89	4.65	30	0	0	0	38.94	4.04	7	3.5	-23	-61
	ORIG	LinuxUSAVAC	50.76.16.187	VTP_ST_QCIF_2r	3.9	4.66	30	0	0	0	38.94	4.04	7	3.5	-23	-61
	TERM	LinuxUSAVAC	50.76.16.187	AndroidTest	4.33	4.45	30	0	0	0	36.45	3.84	5	3.5	-23	-61
	ORIG	183SERVER	50.76.16.183	AndroidTest	4.31	4.43	30	0	0	0	36.45	3.84	5	3.5	-23	-61
	TERM	183SERVER	50.76.16.183	VTP_ST_QCIF_2r	3.91	4.66	30	0	0	0	39.06	4.04	7	3.5	-23	-61
	ORIG	LinuxUSAVAC	50.76.16.187	VTP_ST_QCIF_2r	3.88	4.64	30	0	0	0	38.94	4.04	7	3.5	-23	-61
	TERM	LinuxUSAVAC	50.76.16.187	AndroidTest	4.3	4.42	30	0	0	0	36.45	3.84	5	3.5	-23	-61
	ORIG	183SERVER	50.76.16.183	AndroidTest	4.31	4.43	30	0	0	0	36.45	3.84	5	3.5	-23	-61

- MOS-V, Video Frame Rate/sec, Impaired I Frames (%), Impaired B/P Frames (%), Loss Rate within B/P Frames (%), EPSNR (Estimated Peak Signal-to-Noise Ratio in dBm0)

Audio Quality Metrics

- MOS-A, Audio Bit Rate (kbps), Audio Bandwidth (kHz), Signal Level (dBm0), Noise Level (dBm0)

GL Webviewer Version 6.1

Results | Call Events | Status & Statistics | Reports | Load Filters:

VAC Results between 05/21/2023 23:04:49 and 11/21/2023 23:04:49 (Last 6 Months)

Date & Time: Standard | 10 Minutes | 1 Hour | 12 Hours | 24 Hours | Today | Yesterday | 7 Days | 1 Month | 6 Months

Timestamp Type: VQuad Timestamp

Event ID Filter: Contains []

Apply

Actions | Records Per Page: 300

IP Address (Port)	Test Plan Name	VIDEO QUALITY							AUDIO QUALITY					AUDIO-VIDEO QUALITY	
		Absolute MOS-V	Relative MOS-V	Video Frame Rate (Frames per Second)	Impaired I Frames (%)	Impaired B/P Frames (%)	Loss Rate within B/P Frames (%)	EPSNR	Relative MOS-A	Audio Bitrate (kbps)	Audio Bandwidth (kHz)	Signal Level (dBm0)	Noise Level (dBm0)	Relative MOS-AV	End System Delay (ms)
50.76.16.187	AndroidTest	4.37	4.48	30	0	0	0	36.2	3.84	5	3.5	-23	-61	3.66	166
50.76.16.183	AndroidTest	4.3	4.42	30	0	0	0	36.27	3.84	5	3.5	-23	-61	3.64	166
50.76.16.183	VTP_ST_QCIF_2m	3.89	4.65	30	0	0	0	38.94	4.04	7	3.5	-23	-61	3.54	166
50.76.16.187	VTP_ST_QCIF_2m	3.9	4.66	30	0	0	0	38.94	4.04	7	3.5	-23	-61	3.54	166
50.76.16.187	AndroidTest	4.33	4.45	30	0	0	0	36.45	3.84	5	3.5	-23	-61	3.66	166
50.76.16.183	AndroidTest	4.31	4.43	30	0	0	0	36.45	3.84	5	3.5	-23	-61	3.65	166
50.76.16.183	VTP_ST_QCIF_2m	3.91	4.66	30	0	0	0	39.06	4.04	7	3.5	-23	-61	3.55	166
50.76.16.187	VTP_ST_QCIF_2m	3.88	4.64	30	0	0	0	38.94	4.04	7	3.5	-23	-61	3.54	166
50.76.16.187	AndroidTest	4.3	4.42	30	0	0	0	36.45	3.84	5	3.5	-23	-61	3.64	166
50.76.16.183	AndroidTest	4.31	4.43	30	0	0	0	36.45	3.84	5	3.5	-23	-61	3.65	166

Audio and Video Quality Metrics

- MOS-AV, and End System Delay (ms)

GL Webviewer Version 6.1

Results Call Events Status & Statistics Reports Load F

VAC Results between 05/21/2023 23:04:49 and 11/21/2023 23:04:49 (Last 6 Months)

Date & Time **Standard** 10 Minutes 1 Hour 12 Hours 24 Hours Today Yesterday 7 Days 1 Month 6 Months

Timestamp Type VQuad Timestamp

Event ID Filter Contains ?

Apply

Actions Records Per Page: 200

LITY			AUDIO QUALITY					AUDIO-VIDEO QUALITY		IP NETWORK HEALTH						
Impaired B/P Frames (%)	Loss Rate within B/P Frames (%)	EPSNR	Relative MOS-A	Audio Bitrate (kbps)	Audio Bandwidth (kHz)	Signal Level (dBm0)	Noise Level (dBm0)	Relative MOS-AV	End System Delay (ms)	Network Packet Loss Rate (%)	Network Packet Discard Rate (%)	Mean Burst Loss Rate (%)	Mean Burst Length (Packets)	Mean Gap Loss Rate (%)	Mean Gap Length (Packets)	Jitter (PPDV) (ms)
0	0	36.2	3.84	5	3.5	-23	-61	3.66	166	0	0	0	0	0	8840	0.62
0	0	36.27	3.84	5	3.5	-23	-61	3.64	166	0	0	0	0	0	8865	0.56
0	0	38.94	4.04	7	3.5	-23	-61	3.54	166	0	0	0	0	0	5132	2.5
0	0	38.94	4.04	7	3.5	-23	-61	3.54	166	0	0	0	0	0	5136	3.62
0	0	36.45	3.84	5	3.5	-23	-61	3.66	166	0	0	0	0	0	8865	0.56
0	0	36.45	3.84	5	3.5	-23	-61	3.65	166	0	0	0	0	0	8859	0.5
0	0	39.06	4.04	7	3.5	-23	-61	3.55	166	0	0	0	0	0	5124	3.63
0	0	38.94	4.04	7	3.5	-23	-61	3.54	166	0	0	0	0	0	5136	3.62
0	0	36.45	3.84	5	3.5	-23	-61	3.64	166	0	0	0	0	0	8857	0.56
0	0	36.45	3.84	5	3.5	-23	-61	3.65	166	0	0	0	0	0	8973	0.81

Manual Video Testing using VAC Server

Run tests from the VAC Test Manager:

- Test Point-to-Test Point
- Test Point-to-Test Group
- Test Group-to-Test Group
- Test Group-to-Test Point

Run Test

Service: VidConf ▼
Test Plan: VTP_ST_1080p_2mir ▼

Source		Destination	
Type	<input type="radio"/> Test Group <input checked="" type="radio"/> Test Point	Type	<input type="radio"/> Test Group <input checked="" type="radio"/> Test Point
Type	Equipment ▼	Type	Equipment ▼
Group	TestResGrp ▼	Group	TestResGrp ▼
Agent	LAPTOP1 - (License) ▼	Test Point	GLIN_Agent134 - (Lic) ▼
Interface	Bluetooth Network C ▼	Interface	Local Area Connectic ▼
IP	fe80::39d0:4abd:85ea ▼	IP	fe80::30aa:27fa:3010 ▼

*Group tests will not include loopback pairs

Run Cancel

Video Test Characteristics













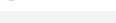
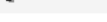


Typical characteristics of a video conferencing system controlled by VAC Server includes:

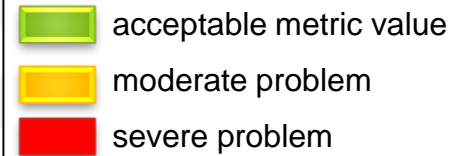
- Video Codecs supported are JPEG, H.261, H.263, H.263+, H.264, MPEG, MPEG-2, MPEG-4, VC1
- Audio Codecs supported are G.711, G.722, G.723, AMR-NB, AMR-WB, and iLBC
- Video Resolutions – HDTV (720p, 1080p, or 1080i), SDTV (480i), CIF, VGA
- Video Frame rate used for the test can range from 5 fps up to 60 fps
- Group of Pictures (GOP) structure

Video Options	
Video Preset	Custom
Codec	H264
Video Image Size	HDTV 720p
Frame Rate	29.97 fps
GoP Structure	IBBPB..
GoP Length	15
Playout Buffer Delay	80
Video Stream Smoothing(%)	0
Video Quality (0-100)	50
Estimated Peak Video Bandwidth	70.33 Mbps
Estimated Avg Video Bandwidth	3.18 Mbps

Audio Options	
Audio Codec	G.711 μ -law PLC 64k
Audio Packet Length (ms)	20
Audio Payload	1kHz Sine Wave

Video Quality Result View

VIDEO QUALITY (ABSOLUTE MOS-V)	2.55	1		5	2.5	1		5
Image Size (Width X Height)	176 X 144		176 X 144		176 X 144		176 X 144	
Video Quality (Relative MOS-V)	3.31	1		5	3.26	1		5
Packet Loss Rate (%)	0.1	0		4	0.08	0		4
Corrected Packet Loss Rate (%)	NR	0		4	NR	0		4
Discard Rate (%)	0.1	0		4	0.54	0		4
Video Bandwidth (kbps)	93.1	0		1000	93	0		1000
Video Frame Rate (Frames per Second)	29.97	0		30	29.97	0		30
Impaired I Frames (%)	0.415	0		5	0.415	0		5
Impaired B/P Frames (%)	0.178	0		5	0.594	0		5
Loss Rate within I Frames (%)	0	0		5	0.414	0		5
Loss Rate within B/P Frames (%)	0.119	0		5	0.03	0		5
Error extension through GoP	0	1		100	0	1		100
EPSNR	32.36	0		50	32.04	0		50
G.1070 Video MOS	1.404	1		5	1.405	1		5
I Frames Received	241				241			
B/P Frames Received	3362				3366			



Audio Quality Result View

 AUDIO QUALITY (RELATIVE MOS-A)	4.17	1  5	4.17	1  5
Packet Loss Rate (%)	0	0  8	0	0  8
Corrected Packet Loss Rate (%)	NR	0  4	NR	0  4
Discard Rate (%)	0	0  8	0	0  8
Audio Bitrate (kbps)	64	0  32	64	0  32
Audio Bandwidth (kHz)	3.5	0  7	3.5	0  7
Signal Level (dBm0)	-23	< -32  > -12	-23	< -32  > -12
Noise Level (dBm0)	-61	< -65  > -40	-61	< -65  > -40
G.1070 Audio MOS	4.21	1  5	4.21	1  5

Audio Video Quality Result View

 AUDIO-VIDEO QUALITY (RELATIVE MOS-AV)	3.37	1  5	3.37	1  5
Total Round Trip Delay (ms)	207 *	20  600	207 *	20  600
End System Delay (ms)	146	20  200	146	20  200
Network Round Trip Delay (ms)	1	20  200	1	20  200
* Asterisk indicates that value is estimated				

Thank you