Voice, Video, and Data Quality Testing Solutions
GL Communications Inc. - Overview

- Located in the United States – Gaithersburg, Maryland
- Founded in 1986
- Telecommunications Consulting Services
- Test & Measurement Equipment
  - All telecom networks (PSTN, Ethernet/IP, Wireless, SONET/SDH, …)
  - Analysis, Monitoring, Visualization, Capture, Storage
Topics

- Voice Quality Testing (VQT)
- Hardware Platforms
- Testing Environments
- Available Metrics
- WebViewer™ - Web Based Client for Voice and Data Quality Testing
- Data Testing
- Video Testing
Voice Quality Testing (VQT)
Centralized Analog Voice Quality Testing

- POLQA, PESQ, LQ/LQO/WB
- MOS, Jitter, Clipping, Speech and Noise Levels
- Data Testing - Wired and Wireless Networks
- Call Events - Progress & Failures
- Fax Events - Encoding, Resolution, ECM
- Delay Measurements – RTD, OWD
- E-Model, SNR, Signal Level
- Echo Measurements - ERL, Delay
- QoS, Timeouts, Retransmissions
- Google Mapping
Voice Quality Test Software
Voice Quality for NB, WB, and SWB

Dual UTA HD configured as Wired Headset (connected using Smartphone ACC cable)

Voice Quality Testing (NB, WB, SWB) VoLTE Supported

Dual UTA HD configured as Wired Headset (connected using Smartphone ACC cable)

Voice Quality Testing (NB, WB, SWB) VoLTE Supported
VQT Highlights

• Supports ITU Standards (POLQA, PESQ LQ/ LQO / WB)
• Auto-Measurement Capabilities
• Detailed Results / Statistics
• Criteria Rating System
• Remote Access Capabilities
• Delay Measurement
• Jitter (Min, Max, Average per Utterance)
• Clipping (front, back, all)
• Noise/Signal Levels (Activity, Peak, etc.)
Manual Measurement

For manually specified reference and degraded files measures POLQA/PESQ

Tabular view of the results and configured current measurement parameters display

View / analyze the reference and degraded files with the waveform viewer application
• Automatically analyze the degraded files using GL VQT Software
• Detailed results including Jitter (min / max / avg), Clipping (front/back/all), Latency, and Noise / Signal Measurements (activity / peak)
• VQT uses the File Monitor to perform automated measurements on remote locations VQT Solutions
Analysis

- Organizes the results into different categories – Jitter, Clipping, Level, and Delay/Utterance
- Jitter is the variation in time offset between reference and degraded utterances
- Calculates levels for the reference and degraded files
- PESQ score is available on a per utterance basis
Complete VQT Test Solution

-w/o Dual UTA Interfaces

- Video Conference Testing on Android, Windows, or Linux Devices
- Data Testing on Smartphone, Tablet, or PC (TCP, UDP, HTTP, VoIP, FTP, DNS, SMS, Email)
- VoIP SIP

-w/ Dual UTA Interfaces

- GPS
- 4-Wire WiFi / 3G / 4G / VolTE
- 2-Wire FXO PSTN / TDM
- Analog ATA
- Military Radio Radio w/PTT

- WebViewer™
- Control, Analysis, Data Retrieval
- GL Central QoS System

VQuad™ Probe HD (VQuad™, Dual UTA HD, PC)
Hardware Platforms
Dual UTA HD Hardware Unit

Back Panel

Front Panel
VQuad™ Probe HD

Back Panel

Front Panel
VQuad™ mTOP™ Specifications

Front and Back Panel of VQuad™ mTOP™ 1

Front and Back Panel of VQuad™ mTOP™ 2

GPS connection on mTOP™ 1 daisy chains the GPS to multiple mTOP™ systems
Testing Environments
Single-box Portable QoS Testing Solution

For Wireless Network:
- Connectivity - Bluetooth® (NB & WB), PTT, GPS, 4-wire Balanced I/O Interfaces
- Devices – Military/Mobile Radios, 5G/4G(legacy)/Wifi Smartphones on any mobile device, Bluetooth® Headsets/Car Kits, Wired Headset with Smartphone Automated Call Control (ACC)

For PSTN Network:
- Connectivity – FXO Interface on Dual UTA HD
- Devices – Analog Phones, Media Gateway, PBX, ATAs over PSTN network

For VoIP Network:
- Connectivity – SIP UA devices on VQuad™ (SIP Signaling - Does not require Dual UTA HD), 4-wire Balanced I/O, HSET Interfaces
- Devices – VoIP Phones, HATS

For TDM Network:
- Connectivity – T1/E1 Interface facilitated through GL’s T1/E1 Analyzer Hardware (ISDN and CAS Signaling - Does not require Dual UTA HD)
- Devices – Digital Phones, PBX, Media Gateways over TDM network

• GPS and ITS location tracking with results overlay
Automated QoS Testing of Wireless Network

- **Connectivity** - Bluetooth® NB & WB, PTT, GPS, Wired Headset Smartphone ACC, 4-wire Balanced I/O Interfaces on Dual UTA HD
- **Devices** – Military/Mobile Radios, 5G/4G/3G/Wifi Smartphones (all Mobile phones), Bluetooth® Headsets/Car Kits, Mobile devices with Smartphone ACC
Automated QoS Testing of Analog Network

- **Connectivity** – 2-Wire FXO, 4-Wire Balanced I/O, HSET Interfaces on Dual UTA HD
- **Devices** – Analog Phones, Next Generation Gateways, PBX, ATAs over PSTN network
Automated Testing of Mobile Radios (PTT)

- The Dual UTA HD provides a contact-closure control to support the push-to-talk (PTT) function of a mobile radio
- Software (VQuad™) Script:
  - Enable PTT
  - Pause for User-Defined Period
  - Send Audio (VQT Reference) File
  - Pause for User-Defined Period
  - Disable PTT
Automated Testing of VoIP (SIP) Interface, Digital VoIP Phones, VoIP Softphones

- **Connectivity** – Internal SIP cores within VQuad™ (SIP Signaling - Does not require Dual UTA HD), 4-wire Balanced I/O, HSET Interfaces on Dual UTA HD
- **Devices** – VoIP Phones, Soft Phone, HATS
Interactive Voice Response (IVR) Systems

Interfaces
- Smart Phones
- WiFi / 3G / 4G / LTE
- 2-wire FXO
- Over IP
- Handset
- IP Phone

IVR USERS
- Supports NB, WB

VQuad™
- Dual UTA HD

IVR SYSTEM
- Menu (DTMF digits)
- Announcements (Voice Prompts)

Services
- Bank
- Voice Mail

Technology
- T1 E1, Analog, Digital, IP, Wireless
Available Metrics
Single-box Portable- QoS Testing Solution

• VQuad™ provides a single-box solution with the following interfaces:
  ➢ Any Communication Device (Smartphones via Wired or Bluetooth® supporting 5G/4G/3G/WiFi/WiMax, Military/Mobile radio
  ➢ 2-Wire POTS (connect to PSTN, ATA, Media Gateway) using GL's Dual UTA HD
  ➢ SIP Call Agent (act as a SoftPhone while configuring Proxy and Registrar)
  ➢ VoIP Ethernet (connect directly to any SoftPhone or any digital/VoIP hardware phone)
  ➢ T1/E1 (CAS and PRI ISDN protocols supported) using GL's USB T1 / E1 Analyzer
• VQuad™ analysis functions include:
  ➢ Send/Record voice for Voice Quality Testing (VQT) using POLQA or PESQ (ITU-P.863/P.862.2)
  ➢ One Way Delay (OWD) and Round-Trip Delay (RTD) measurements
  ➢ Echo Measurements and Analysis using EMU
  ➢ Automated Data Testing via VQuad™ scripting
  ➢ Fax Emulation supporting up to 4 simultaneous sessions with speeds up to 33600 baud
• VQuad™ supports drive testing with GPS Mapping and Indoor Tracking System (ITS) to provide tracking information during Voice Quality Testing at remote locations
**One Way Delay (OWD)**

**ONE-WAY DELAY (OWD)**
- End points at same location

**AUDIO NETWORK UNDER TEST**

**SIDE 1 PROCEDURE:**
1. **Tx AUDIO**
   - Send pulse through network

**SIDE 2 PROCEDURE:**
1. **START TIMER**
   - At exact time of SIDE 1 Tx’s Audio
2. **Rx(detect) PULSE and STOP TIMER**
   - Report delay
One Way Delay (OWD)

End points at separate locations

**ONE-WAY DELAY (OWD)**
- End Points at two separate location

1. **Tx AUDIO**
   - At pre-determined time (12:00:00.000)
   - Send pulse through network

1. **Start Timer**
   - At pre-determined time (12:00:00.000)
2. **Rx (detect) pulse and Stop Timer**
   - Report delay (12:00:00.000 delay)
Round Trip Delay Functionality

RTD on two systems (geographically separated)

Dual UTA HD

AUDIO NETWORK UNDER TEST

Audio

Round Trip Delay (RTD)

Dual UTA HD
Echo Measurements

Echo Identification

Echo Identification

Acoustic Echo Canceller Testing

Device Under Test

Measure / ID Echo's (Levels, Delays, etc.)

Measure / ID Echo's (Levels, Delays, etc.)
Voice Band Analysis

- Monitor voice band traffic
- Measure Active Speech Level, Activity Factor, RMS Factor, DC Level, Noise Level, Echo Return Loss, Echo Delay, and Echo Dispersion statistics

WebViewer™ Control, Analysis, Data Retrieval

GL Central QoS System

- Speech Level Analysis
- Line Echo Analysis
- Traffic Classification
- FaxScan™ Analysis
- Tone Decoder

Voice Call

Dual UTA HD

Recorded Voice Files

Tx/Rx

GL Communications

30
Automated Voice Quality Testing

Send Voice

Record Voice

VQuad Scripting

Place Call: TEL=5551212;
Do: Iterations=1;
Tx/Rx File Sync:
TxFile1=C:\temp1POLQAa.pcm;
Tx/Rx File Sync:
RxFile1=C:\testPolqa.pcm;

VQuad Scripting

If Incoming Phone Call:
Pause Timer: Interval=4;
Answer Call
Pause Timer: Interval=360;
Disconnect Call
Device ID=7;
Disconnect Call

Interfaces:
(Bluetooth®, WiFi, 3G, 4G, LTE), PSTN/TDM
VoIP
SIP/RTP
Balanced I/O
PTT
Military Radios
HATS (Head and Torso)
2-Wire FXO/FXS
Analog & Digital Phones

GL Communications
Automated FAX Testing

- Sending and receiving 4 independent and simultaneous T.30 faxes (selectable up to V.34)
- Configurable Tx Rx fax rate from 2400 bps up to 33600 bps (V.34 fully supported)
- Fax Testing using the Dual UTA HD 2-wire FXO or 4-wire analog interfaces
- VQuad™ Fax events includes messages, summary, and errors log
- Ability to auto save fax (both East and West directions) to PCM file for enhanced analysis using GL Insight™ and GL Fax Demodulator/Decoder

![Diagram showing fax testing connections and components](image)
End-to-End SMS Testing

VQuad™ Probe HD

GSM Call

Wireless & Wired

GSM Call

NetTest Script based control

IP Network

HTTP, FTP, DNS Email, TCP, UDP

Target Server

Smartphone (GL’s NetTestApp)

PC based NetTest (wired Ethernet, WiFi, or even Broadband card)

Results

WebViewer™

Central Database System

GL Communications
WebViewer™
(Web Based Client for Voice and Data Quality Testing)
Captured files analyzed at central system for Voice, Video, and Data Quality

Send the Events/Results to Central System and receive remote commands from Central System

GL WebViewer™

Data Testing
- VQuad running NetTest
- Email Testing
- DNS Testing
- Route Testing
- HTTP Website

Video Testing
- Smart Phones/Tablets/PCs w/ VAC Agent
- Network Diagnostics
- MOS-AV
- MOS-V

Voice Testing
- Bluetooth®, WiFi, 3G, 4G, LTE, 5G, PTT
- VoIP, SIP
- PSTN
- Mobile Hotspot
- 3G, 4G, LTE Router

Target Servers
- TCP, UDP, VoIP
- FTP Testing
- SMS Testing

Central System
- Analysis (VQT, MDC, VAC, EMU, VBA & Fax)
- VQuad™ Probe HD
- Custom Report Generator
- GL’s WebViewer

VAC (Video Application Controller with Analysis)
MDC (Mobile Device Controller)
VQT (PESQ and POLQA)
EMU (Echo Measurement Utility)
GL WebViewer™ Records

- Accessible remotely via browser-based clients
- Database stores the real-time and historic data collected
Network Status

- Displays status of all the VQuad™ probes (along with script running status), Mobile Devices, VQT, and File Monitor application status
Remote Access

- The VQuad™ systems connected to the WebViewer™ can be accessed or controlled remotely through the web interface.
- Various options are available to operate and control the systems remotely such as Load desired scripts along with script parameters, Start/Stop the scripts, and make configuration changes to the VQuad systems.
Search Filter Criteria

Main Filters

Select Configuration: ManualNetTest
Configuration Name: ManualNetTest

GPS Location
- Type location here

Start Date: 2014/07/17 15:29:00
End Date: 2014/07/18 15:29:00

VQMap Location: Manual
VQMap PhoneID: Probe
VQMap CallID: Yes
Called Number: 1000 2000

PESQ LQ Rating: Not Use
MOS-CQ (E-Model) Rating: Not Use
Search by Timezone: Yes
Omit User-Filtered Calls: Yes

Parameter Criteria: (Low) to (High)

Use semicolon (;) to delimit multiple entries. Example: order '1000:2000' in Call Number in order to search database for both 1000 and 2000.

Note: wildcards will be added automatically while searching for partial entry search.

Exact matching values can be searched by placing the INPUT between two asterisk symbols (*...*)
Ex.: *3.65, *Connected*, *VQPhoneID=1*, etc.
• Call Process, Analysis, and NetTest graphic display options.
• Calls in Process - Placing Calls, Incoming Calls, Call Duration, and Error Events
• Analysis results - VQT POLQA, Time/Delay Measurements, & FAX Events
• NetTest graphics for PC based and mobile devices (SMS and Email)
Output Report Generation

- The user can save the search results to a local PC in *.xls / *.csv / *.pdf formats. Custom reports are generated using DataImport for Events and Statistics, which can be saved to text or Excel output files via WebViewer™
- Google Maps plotting of various test results (VQT, VBA, VAC, EMU, NetTest, FAX, Call Control)
- Console View - customizing the threshold values for the test result parameters to populate the consolidated Average, Min, Max results in tabular format and plot corresponding graphics statistics
Output Results

Console View
Call Events and Customized Reports

Custom Reports

Filters

- Timestamp Search: VQuad Timestamp
- Event ID / Device ID Filter: GLROBFAXVQTTEST
- Load Filter: Off

Report

<table>
<thead>
<tr>
<th>VQuad Call ID</th>
<th>Call Attempts</th>
<th>Incoming Calls</th>
<th>Call Failed</th>
<th>Call Dropped</th>
<th>Connected Calls</th>
<th>Completed Calls</th>
<th>Fax Done</th>
<th>Fax Success</th>
<th>VQT POLQA</th>
<th>Speech Level Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLROBFAXVQTTEST</td>
<td>1964</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>99.87%</td>
<td>100%</td>
<td>1576</td>
<td>67.49%</td>
<td>4.24</td>
<td>-13.8</td>
</tr>
</tbody>
</table>
Voice and Data Drive Testing

Drive Testing Voice & Data
On the Go...

Voice, Data Quality Testing
• Voice Quality (using POLQA)
• Call failures, call drops,
• Delay and level measurements,
• RSSI (Signal Strength)
• TCP, UDP, VoIP, Route, HTTP, FTP,
  DNS Email, and SMS
• Network and Phone Information

Voice and Data Testing
In the lab...

Results and Call Control Info
Plotted on Google Maps

VQuad™ with Dual UTA HD

Central System w/ Analysis Modules
and Command center

Web Server

Database

Web Viewer™

Interfaces

- PSTN/TDM
- Balanced I/O
- HATS (Head and Torso)
- SIP/RTP
- VoIP
- 2-Wire
- FXO/FXS
- Analog & Digital
  Phones
- PTT
- Military Radios
- (Bluetooth®, WiFi,
  3G, 4G, LTE)
Google Map Plotting (VQT POLQA Results)
• Here is an actual drive test showing the voice quality results along the Beltway around Washington D.C., USA.

• Colors at each dot show the voice quality score for that location
Data Testing
Automated Data Testing over Wired & Wireless (Bluetooth®, WiFi, 3G, LTE, 5G) Networks
Mobile Device Controller (MDC) GUI

- GL's Mobile Device Controller application and the supporting downloadable apps on the Smartphones (iPhone, Android), can remotely perform the data tests when the phone is within a voice call or outside a voice call.
• Mobile Device NetTest and PC based NetTest Statistics and complete results are relayed back to VQuad™, which can be access via WebViewer™

**Note**: NetTest requires a GL Data Server at each target location, and the mobile device requires a GL deployed app (Apple or Android based) for operation
Data Tests running on Android and Apple Devices using GLNetTest App
Video Testing
Automated and Manual Video Quality Testing
(Android, Windows® and Linux Interface)

Interactive Video Clients

Video End Clients Running on Android, Windows, or Linux PCs

Video Quality Tests (Video and Audio)
MPEG, H.261, H.263, H.264 & more

Network

VAC SERVER
(Video Test Plans)

VIDEO APPLICATION CONTROLLER

MOBILE DEVICE CONTROLLER

VAC

MDC

Initiate Video Tests From Devices running GLNetTest App

Initiate Video Tests From Multiple VQuad™ Nodes

Video/ Audio Quality Metrics
Network Diagnostics Statistics
Call Configuration Information

WebViewer™ Control, Analysis, Data Retrieval

GL Central QoS System
## Video Test Results in WebViewer™

<table>
<thead>
<tr>
<th>Endpoint Name</th>
<th>IP Address (Curt)</th>
<th>Video Frame Rate (Frames per Second)</th>
<th>Imbalanced B/P Frames (%)</th>
<th>Loss Rate with B/P Frames (%)</th>
<th>Audio Prate (kbps)</th>
<th>Audio Bandwidth (KHz)</th>
<th>Signal Level (dBm)</th>
<th>Noise Level (dBm)</th>
<th>Network Packet Loss Rate (%)</th>
<th>Mean Burst Loss Rate (%)</th>
<th>Mean Burst Loss Rate (Bursts)</th>
<th>Mean Gap Length (Bursts)</th>
<th>Quad CallID</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPJG NEHA</td>
<td>192.168.1.70</td>
<td>30</td>
<td>0</td>
<td>0</td>
<td>32.55</td>
<td>1.75</td>
<td>-23</td>
<td>-61</td>
<td>0.05</td>
<td>0.00</td>
<td>0.00</td>
<td>4731</td>
<td>120 x 24915</td>
</tr>
<tr>
<td>TERM VIJAY</td>
<td>192.168.1.80</td>
<td>30</td>
<td>0</td>
<td>0</td>
<td>32.54</td>
<td>1.75</td>
<td>-23</td>
<td>-61</td>
<td>0.05</td>
<td>0.00</td>
<td>0.00</td>
<td>4738</td>
<td>120 x 24915</td>
</tr>
<tr>
<td>ORG NEHA</td>
<td>192.168.1.76</td>
<td>30</td>
<td>0</td>
<td>0</td>
<td>32.47</td>
<td>1.75</td>
<td>-23</td>
<td>-61</td>
<td>0.05</td>
<td>0.00</td>
<td>0.00</td>
<td>4738</td>
<td>120 x 24915</td>
</tr>
<tr>
<td>TERM VIJAY</td>
<td>192.168.1.80</td>
<td>30</td>
<td>0</td>
<td>0</td>
<td>32.57</td>
<td>1.75</td>
<td>-23</td>
<td>-61</td>
<td>0.05</td>
<td>0.00</td>
<td>0.00</td>
<td>4738</td>
<td>120 x 24915</td>
</tr>
<tr>
<td>ORG NEHA</td>
<td>192.168.1.76</td>
<td>30</td>
<td>0</td>
<td>0</td>
<td>32.56</td>
<td>1.75</td>
<td>-23</td>
<td>-61</td>
<td>0.05</td>
<td>0.00</td>
<td>0.00</td>
<td>4738</td>
<td>120 x 24915</td>
</tr>
<tr>
<td>TERM VIJAY</td>
<td>192.168.1.80</td>
<td>30</td>
<td>0</td>
<td>0</td>
<td>32.65</td>
<td>1.75</td>
<td>-23</td>
<td>-61</td>
<td>0.05</td>
<td>0.00</td>
<td>0.00</td>
<td>4738</td>
<td>120 x 24915</td>
</tr>
<tr>
<td>ORG NEHA</td>
<td>192.168.1.76</td>
<td>30</td>
<td>0</td>
<td>0</td>
<td>32.58</td>
<td>1.75</td>
<td>-23</td>
<td>-61</td>
<td>0.05</td>
<td>0.00</td>
<td>0.00</td>
<td>4738</td>
<td>120 x 24915</td>
</tr>
<tr>
<td>TERM VIJAY</td>
<td>192.168.1.80</td>
<td>30</td>
<td>0</td>
<td>0</td>
<td>32.58</td>
<td>1.75</td>
<td>-23</td>
<td>-61</td>
<td>0.05</td>
<td>0.00</td>
<td>0.00</td>
<td>4738</td>
<td>120 x 24915</td>
</tr>
<tr>
<td>ORG NEHA</td>
<td>192.168.1.70</td>
<td>30</td>
<td>0</td>
<td>0</td>
<td>32.62</td>
<td>1.75</td>
<td>-23</td>
<td>-61</td>
<td>0.05</td>
<td>0.00</td>
<td>0.00</td>
<td>4738</td>
<td>120 x 24915</td>
</tr>
<tr>
<td>TERM VIJAY</td>
<td>192.168.1.80</td>
<td>30</td>
<td>0</td>
<td>0</td>
<td>32.58</td>
<td>1.75</td>
<td>-23</td>
<td>-61</td>
<td>0.05</td>
<td>0.00</td>
<td>0.00</td>
<td>4738</td>
<td>120 x 24915</td>
</tr>
<tr>
<td>ORG NEHA</td>
<td>192.168.1.70</td>
<td>30</td>
<td>0</td>
<td>0</td>
<td>32.62</td>
<td>1.75</td>
<td>-23</td>
<td>-61</td>
<td>0.05</td>
<td>0.00</td>
<td>0.00</td>
<td>4738</td>
<td>120 x 24915</td>
</tr>
</tbody>
</table>
Thank you!

Questions?

For more information contact us at info@gl.com

(Please subscribe to our newsletter: https://www.gl.com/subscribe.php)