Voice Quality Testing

(POLQA v3, POLQA v2.4, PESQ)

GL Communications Inc.
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

Fundamentals of Perceptual Modeling

Opinion Scale for Speech Quality Tests

Grade	Impairment	Quality of Speech
5	Excellent	Imperceptible
4	Good	Perceptible but not annoying
3	Fair	Slightly annoying
2	Poor	Annoying
1	Bad	Very annoying

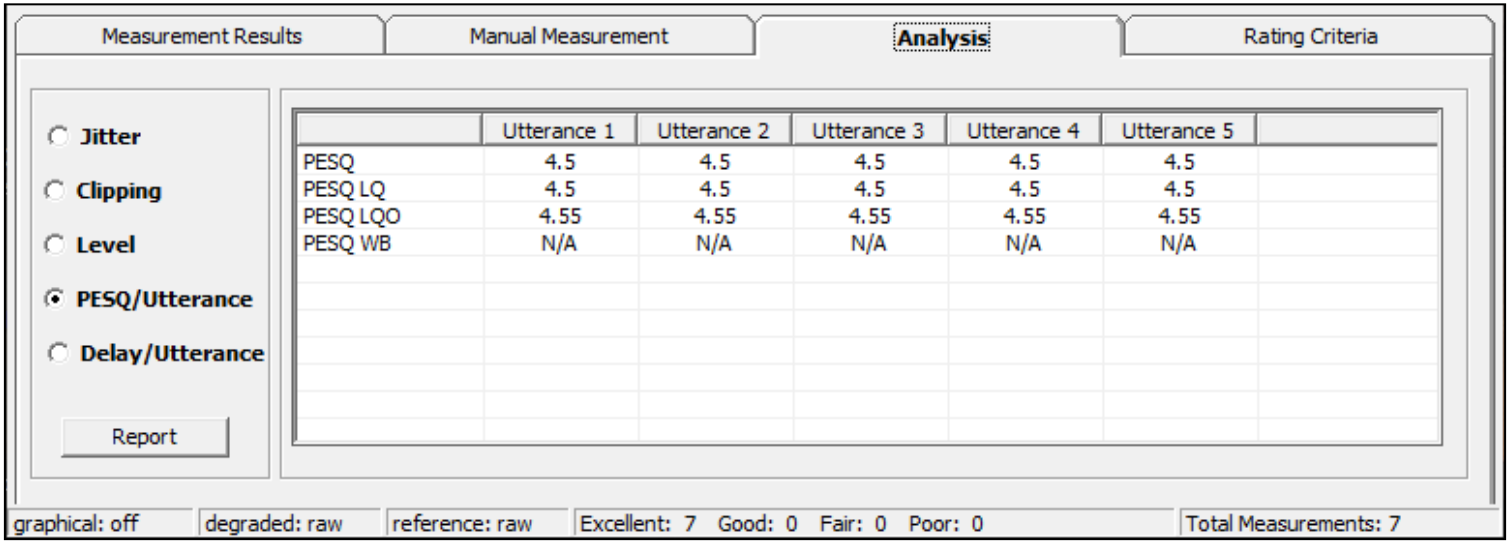
- The common idea behind perceptual quality measures is to mimic the situation of a subjective test, where human beings would have to score the quality of sound samples in a listening laboratory environment
- Requires large number of subjects, very costly and time consuming; analysis based on human perception not accurate or repeatable

PESQ - Perceptual Evaluation of Speech Quality

Voice Quality Algorithm based on ITU-P.862

- PESQ (introduced in 2001) incorporates many new developments that distinguish this algorithm
- Level alignment
  - Input filtering
  - Auditory transform
  - Time alignment
  - PESQ LQ –closer to the Listening Quality subjective opinion scale – customer's perception of quality
  - PESQ LQO (P.862.1) – Listening Quality Objective, correlating better to subjective test results
- PESQ WB (P.862.2) – support for WB codecs. However, PESQ had limitations with WB VoIP codecs where it was scoring too low

GL's PESQ Analysis



POLQA
Perceptual Objective Listening Quality Assessment

(POLQA v3, POLQA v2.4)

Voice Quality Algorithm based on ITU-P.863

POLQA (introduced in 2011) produces very similar scores as PESQ for NB codecs (uses similar mathematical techniques). However, POLQA was mainly introduced for SWB (and WB) support.

Operations Performed by POLQA

- Temporal alignment
- Sample rate estimation
- Resample
- Level alignment
- Frequency response and time alignment

Results Provided by POLQA

- MOS-LQO
- G.107 R-Factor / E-Model
- Attenuation
- Level and Background Noise Measurements
- Signal to Noise Ratio (SNR)
- Active Speech Ratio (ASR)

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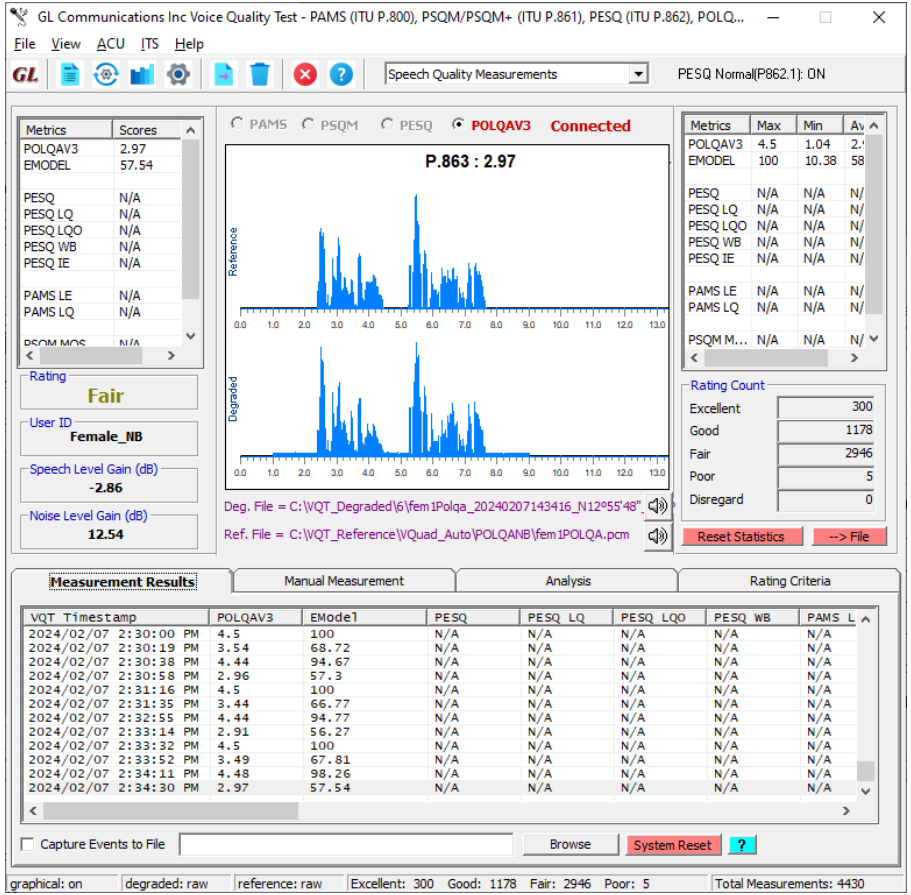
POLQA Algorithm

- POLQA is an objective model of subjective Listening Only Tests
- VQT POLQA supports analysis of 16-bit uncompressed PCM and WAV files, including NB (8000 sampling), WB (16000 sampling), SWB (48000 sampling)
- Revised Psycho-Acoustic and Cognitive Model
- Supports:
  - EVRC type codecs
  - Noise Reduction
  - Time-warping
  - VoIP
  - Non-optimal presentation levels
  - Filtering and spectral shaping
  - Recordings made at an ear simulator

POLQA v3 Algorithm

- POLQA v3 Upgrade Enhancements
- POLQA v3 Super Wideband (SWB) supports 14kHz to full audio bandwidth up to 24kHz.
- Full band analysis improves accuracy in assessment of codecs such as EVS, OPUS, AAC and LC3, as these codecs are used in many OTT applications
- With Full band support the discriminative power of POLQA at the upper high-quality range of the MOS scale is increased
- Current OTT voice services using VoLTE/5G include highly dynamic delay jitter which leads to variations of the duration of very short pauses during speech. POLQA v3 handles these variations with increased precision
- POLQA v3 reacts with less sensitivity to linear frequency distortions than POLQA v2.4. This makes measurements less dependent on the frequency characteristics of headsets
- Perceptual model of POLQA v3 is significantly improved and streamlined

GL's POLQA Analysis



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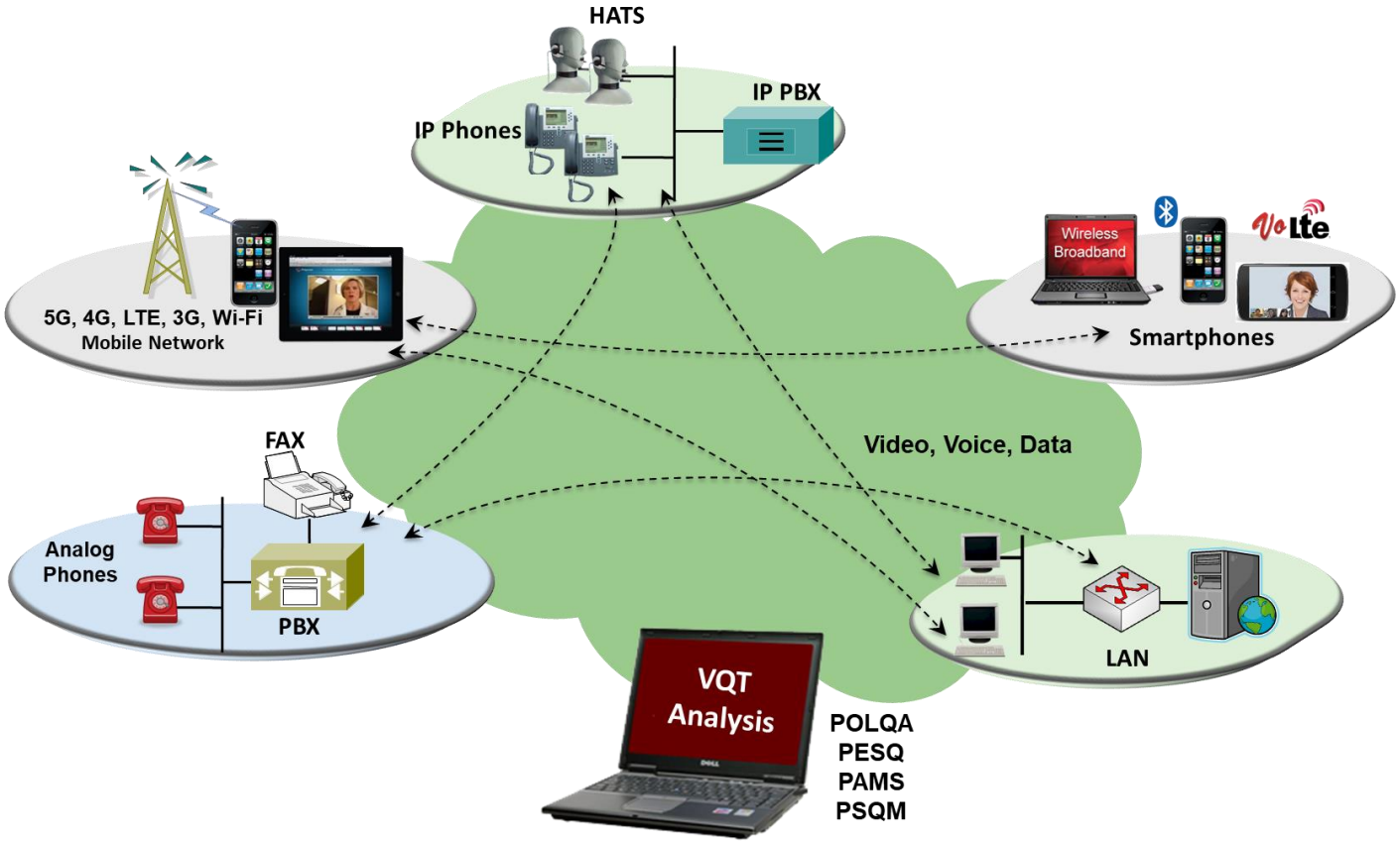
POLQA Testing



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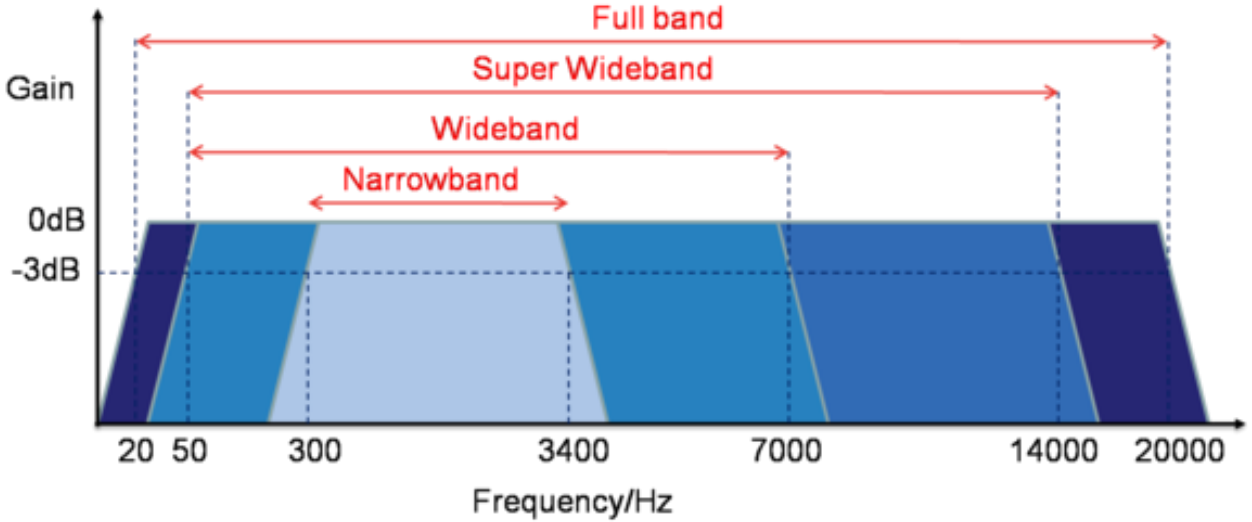
POLQA WB and SWB



- Support for WB (7kHz) and SWB (14kHz) codecs/networks
- Support for networks delivering HD-quality voice services including VoIP and Mobile
- Supports networks with variable delay and time scaling

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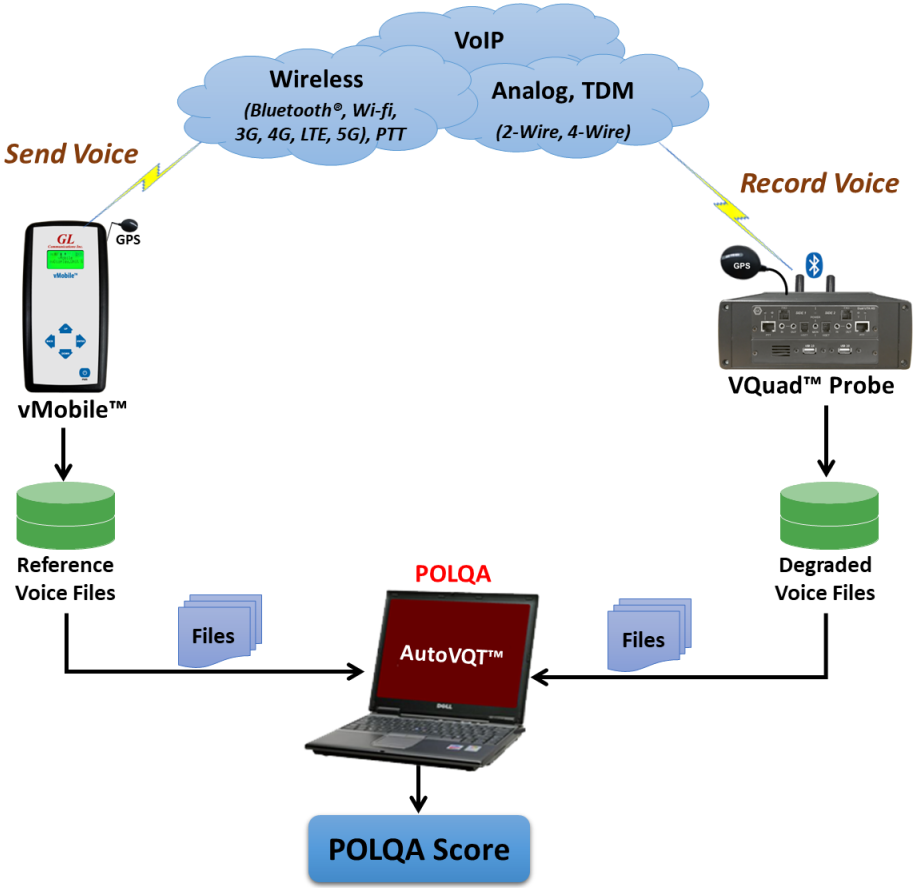
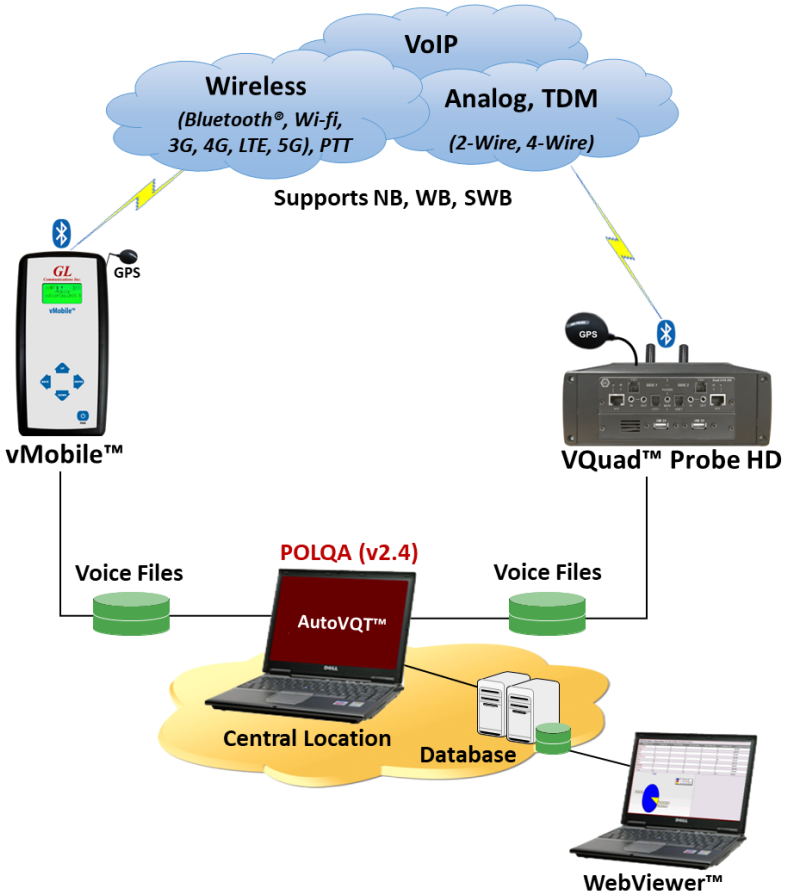
Generate POLQA Score

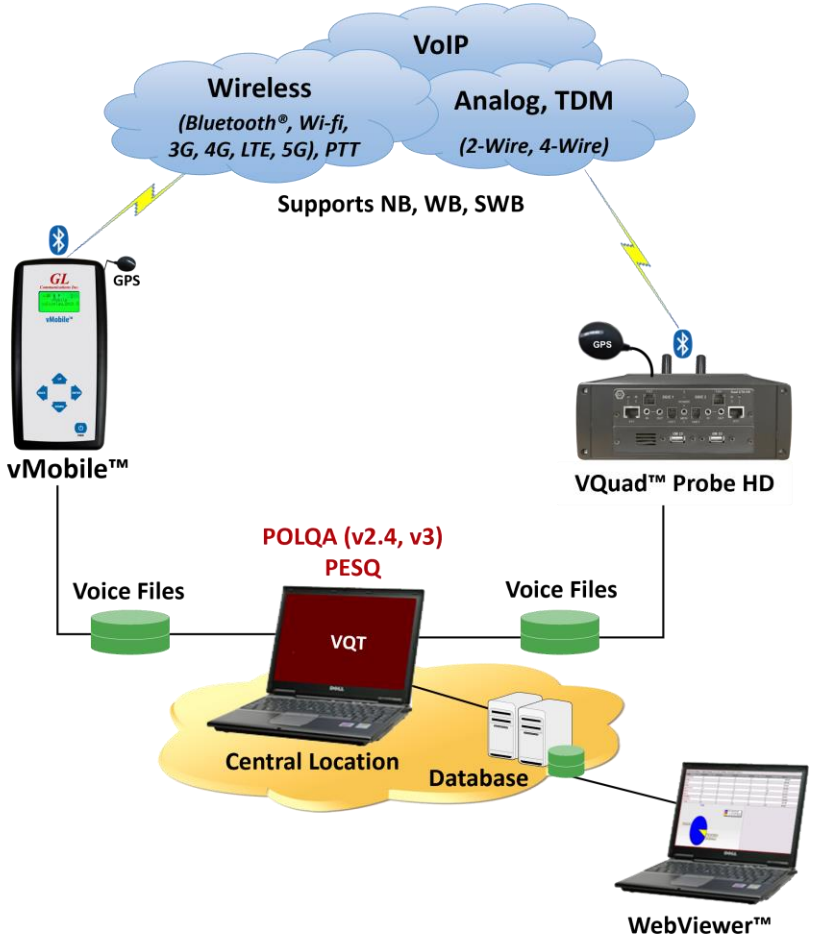


AutoVQT™

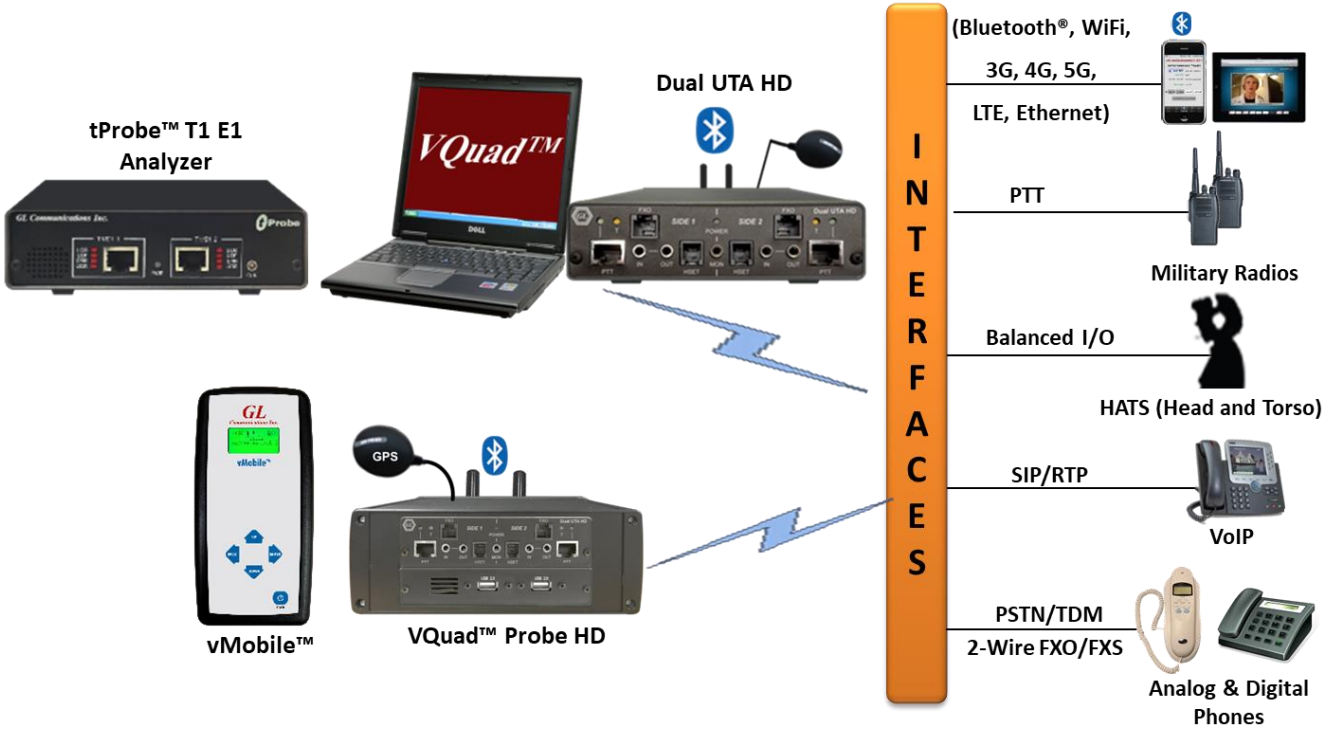
- Thousands of voice files analyzed in mere minutes
- Supports Command Line Interface (CLI) for Windows® and Linux
- Any application that can send POLQA Reference audio and record it to PCM or WAV is acceptable
- Supports ITU Standards (POLQA v2.4)
- Detailed Results / Statistics
  - POLQA MOS
  - E-Model R-Factor
  - Signal Level
  - Noise Level
  - Delay
  - Jitter
  - Clipping
  - Criteria Rating System



Centralized Voice Quality Testing



GL Supported Connections



POLQA Test Results

VoIP Network (NB and WB)

Polycom VoIP through G.722 Network

Polycom Tx/Rx WB Files	
Fem Outbound	4.59
Fem Inbound	4.51
Male Outbound	4.15
Male Inbound	4.07

Polycom VoIP through NB (Skype) Network

Polycom Tx/Rx WB Files	
Fem Outbound	3.84
Fem Inbound	3.74
Male Outbound	3.58
Male Inbound	3.55

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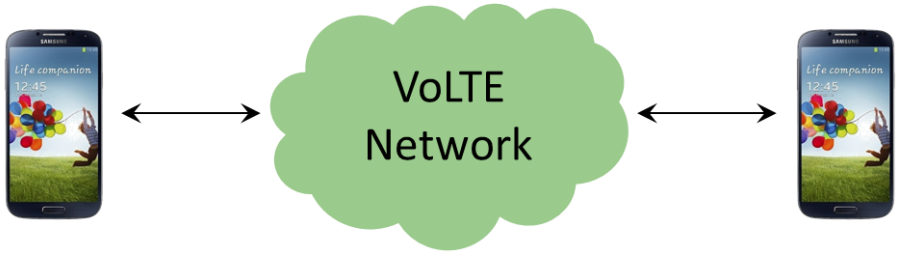
POLQA Test Results (Contd.)

VoLTE (NB and WB)



Samsung4 to Samsung4 through AMR-WB Network

Samsung4 to Samsung4	
Fem Outbound	3.46
Fem Inbound	3.58
Male Outbound	4.2
Male Inbound	4.19

Samsung4 to Samsung4 through AMR Network

Samsung4 to Samsung4	
Fem Outbound	2.27
Fem Inbound	1.96
Male Outbound	3.08
Male Inbound	2.69

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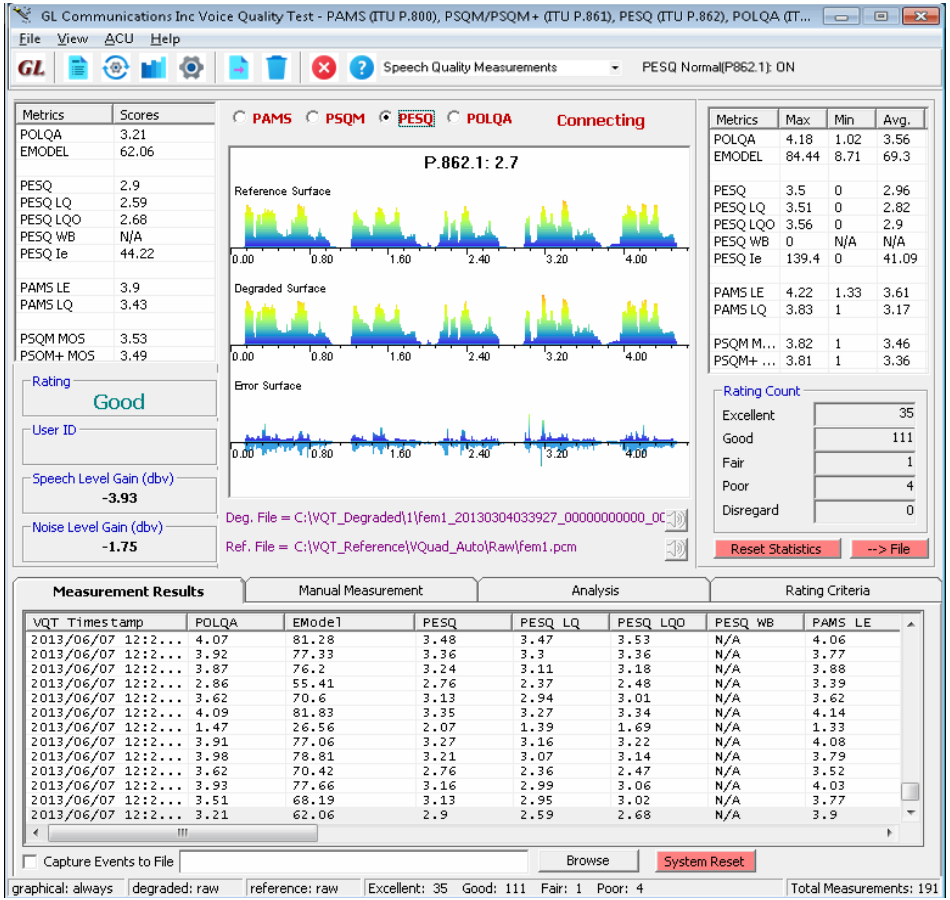
GL VQT Highlights

- Supports ITU Standards (POLQA v2.4 / POLQA v3.0, PESQ LQ/ LQO / WB)
- Auto-Measurement Capabilities
- Detailed Results / Statistics
  - Delay Measurement
  - Noise/Signal Levels (Activity, Peak, etc.)
  - Jitter (Min, Max, Average per Utterance)
  - Clipping (front, back, all) (PESQ Only)
  - PESQ/Delay per utterance
  - Impairment Factor (Ie) measurement (PESQ only)
- Criteria Rating System
- Remote Access Capabilities

GL VQT Software



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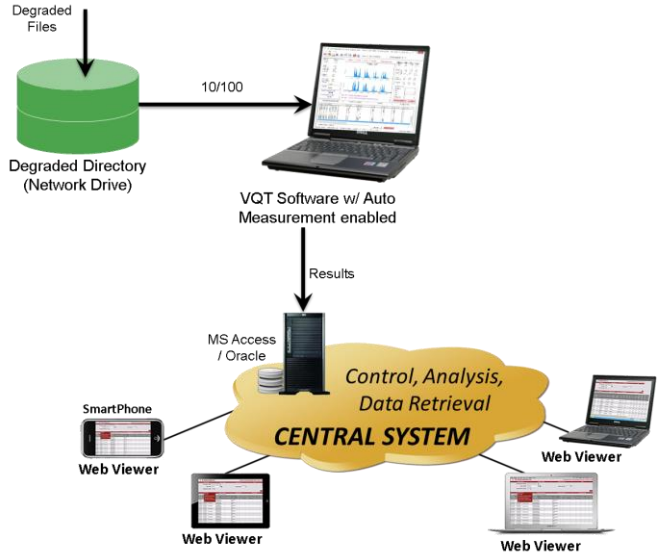
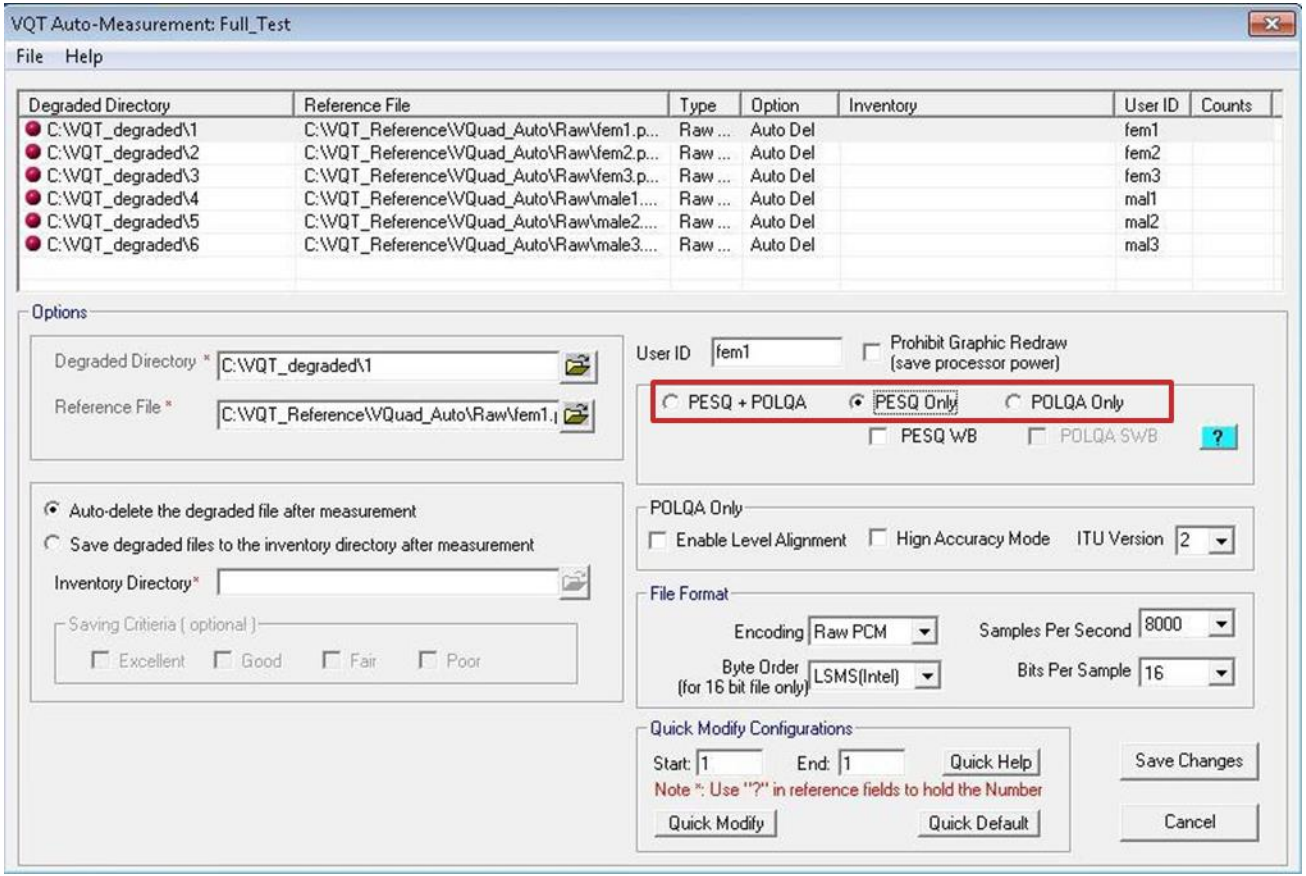
Auto Measurement

Automatically analyze the degraded files using GL VQT Software

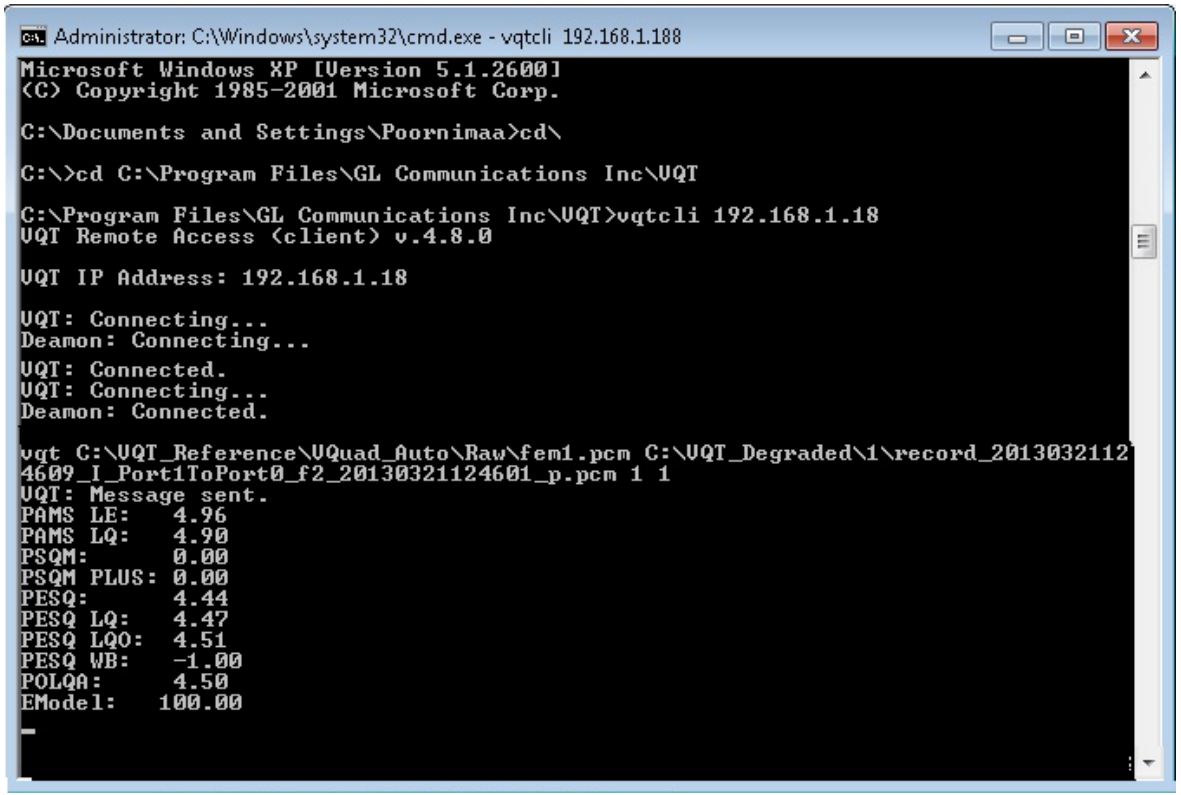


- Detailed results including Jitter (min / max / avg), Clipping (front/back/all), Latency, and Noise / Signal Measurements (activity / peak)
- VQT uses the File Monitor to perform automated measurements on remote locations

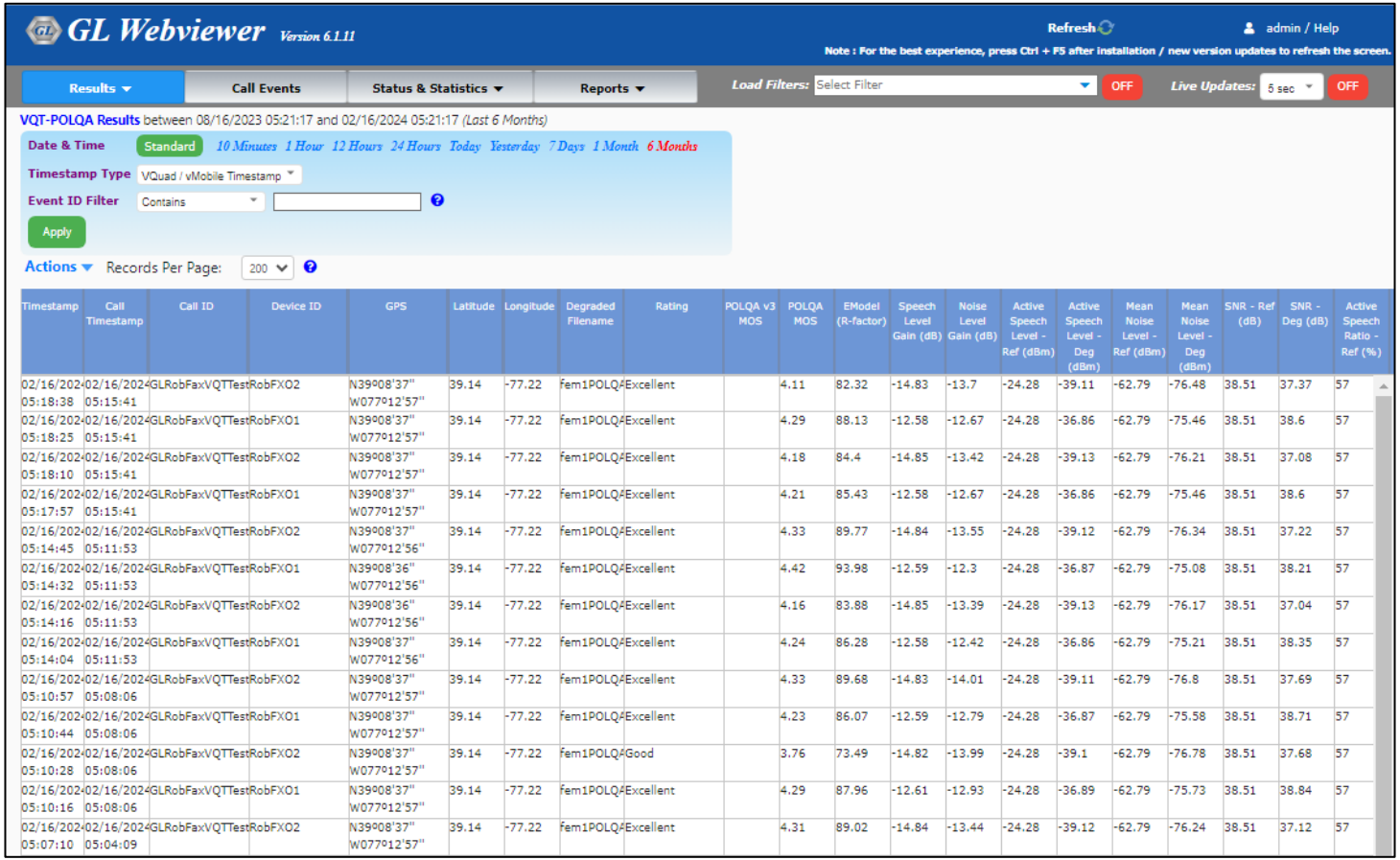
Auto Measurement



VQT Command Line Interface



POLQA Test Results in WebViewer™



GL Webviewer Version 6.1.11

Refresh | admin / Help

Note : For the best experience, press Ctrl + F5 after installation / new version updates to refresh the screen.

Results | Call Events | Status & Statistics | Reports | Load Filters: Select Filter OFF | Live Updates: 5 sec OFF

VQT-POLQA Results between 08/16/2023 05:21:17 and 02/16/2024 05:21:17 (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 / vMobile Timestamp

Event ID Filter: Contains

Apply

Actions | Records Per Page: 200

Timestamp	Call Timestamp	Call ID	Device ID	GPS	Latitude	Longitude	Degraded Filename	Rating	POLQA v3 MOS	POLQA MOS	EModel (R-factor)	Speech Level Gain (dB)	Noise Level Gain (dB)	Active Speech Level - Ref (dBm)	Active Speech Level - Deg (dBm)	Mean Noise Level - Ref (dBm)	Mean Noise Level - Deg (dBm)	SNR - Ref (dB)	SNR - Deg (dB)	Active Speech Ratio - Ref (%)
02/16/202 05:18:38	02/16/2024 05:15:41	GLRobFaxVQTTest	RobFXO2	N39°08'37" W077°12'57"	39.14	-77.22	fem1POLQA	Excellent		4.11	82.32	-14.83	-13.7	-24.28	-39.11	-62.79	-76.48	38.51	37.37	57
02/16/202 05:18:25	02/16/2024 05:15:41	GLRobFaxVQTTest	RobFXO1	N39°08'37" W077°12'57"	39.14	-77.22	fem1POLQA	Excellent		4.29	88.13	-12.58	-12.67	-24.28	-36.86	-62.79	-75.46	38.51	38.6	57
02/16/202 05:18:10	02/16/2024 05:15:41	GLRobFaxVQTTest	RobFXO2	N39°08'37" W077°12'57"	39.14	-77.22	fem1POLQA	Excellent		4.18	84.4	-14.85	-13.42	-24.28	-39.13	-62.79	-76.21	38.51	37.08	57
02/16/202 05:17:57	02/16/2024 05:15:41	GLRobFaxVQTTest	RobFXO1	N39°08'37" W077°12'57"	39.14	-77.22	fem1POLQA	Excellent		4.21	85.43	-12.58	-12.67	-24.28	-36.86	-62.79	-75.46	38.51	38.6	57
02/16/202 05:14:45	02/16/2024 05:11:53	GLRobFaxVQTTest	RobFXO2	N39°08'37" W077°12'56"	39.14	-77.22	fem1POLQA	Excellent		4.33	89.77	-14.84	-13.55	-24.28	-39.12	-62.79	-76.34	38.51	37.22	57
02/16/202 05:14:32	02/16/2024 05:11:53	GLRobFaxVQTTest	RobFXO1	N39°08'36" W077°12'56"	39.14	-77.22	fem1POLQA	Excellent		4.42	93.98	-12.59	-12.3	-24.28	-36.87	-62.79	-75.08	38.51	38.21	57
02/16/202 05:14:16	02/16/2024 05:11:53	GLRobFaxVQTTest	RobFXO2	N39°08'36" W077°12'56"	39.14	-77.22	fem1POLQA	Excellent		4.16	83.88	-14.85	-13.39	-24.28	-39.13	-62.79	-76.17	38.51	37.04	57
02/16/202 05:14:04	02/16/2024 05:11:53	GLRobFaxVQTTest	RobFXO1	N39°08'37" W077°12'56"	39.14	-77.22	fem1POLQA	Excellent		4.24	86.28	-12.58	-12.42	-24.28	-36.86	-62.79	-75.21	38.51	38.35	57
02/16/202 05:10:57	02/16/2024 05:08:06	GLRobFaxVQTTest	RobFXO2	N39°08'37" W077°12'57"	39.14	-77.22	fem1POLQA	Excellent		4.33	89.68	-14.83	-14.01	-24.28	-39.11	-62.79	-76.8	38.51	37.69	57
02/16/202 05:10:44	02/16/2024 05:08:06	GLRobFaxVQTTest	RobFXO1	N39°08'37" W077°12'57"	39.14	-77.22	fem1POLQA	Excellent		4.23	86.07	-12.59	-12.79	-24.28	-36.87	-62.79	-75.58	38.51	38.71	57
02/16/202 05:10:28	02/16/2024 05:08:06	GLRobFaxVQTTest	RobFXO2	N39°08'37" W077°12'57"	39.14	-77.22	fem1POLQA	Good		3.76	73.49	-14.82	-13.99	-24.28	-39.1	-62.79	-76.78	38.51	37.68	57
02/16/202 05:10:16	02/16/2024 05:08:06	GLRobFaxVQTTest	RobFXO1	N39°08'37" W077°12'57"	39.14	-77.22	fem1POLQA	Excellent		4.29	87.96	-12.61	-12.93	-24.28	-36.89	-62.79	-75.73	38.51	38.84	57
02/16/202 05:07:10	02/16/2024 05:04:09	GLRobFaxVQTTest	RobFXO2	N39°08'37" W077°12'57"	39.14	-77.22	fem1POLQA	Excellent		4.31	89.02	-14.84	-13.44	-24.28	-39.12	-62.79	-76.24	38.51	37.12	57

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VQT Results

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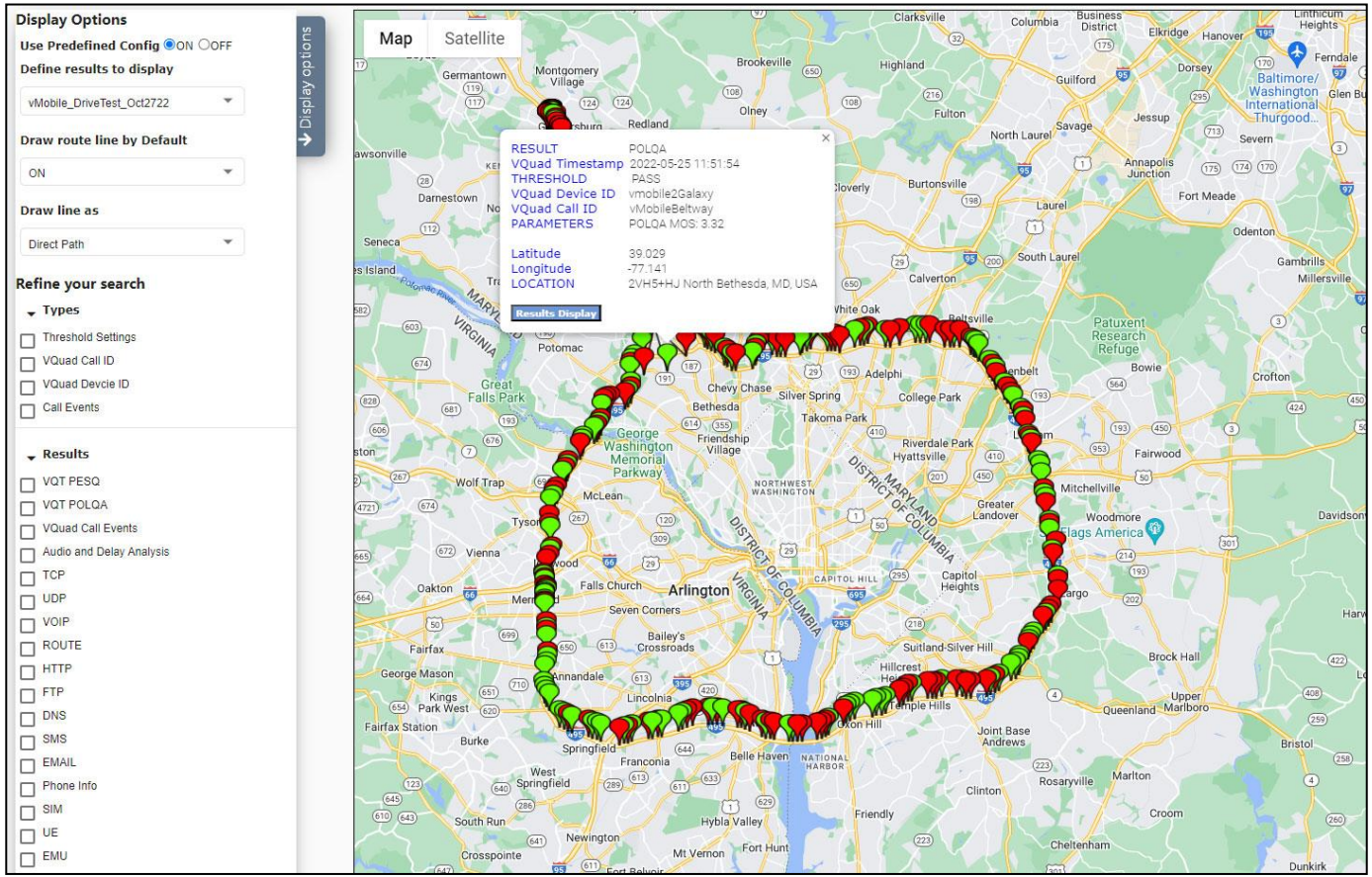
Google Map Plotting



Thank you