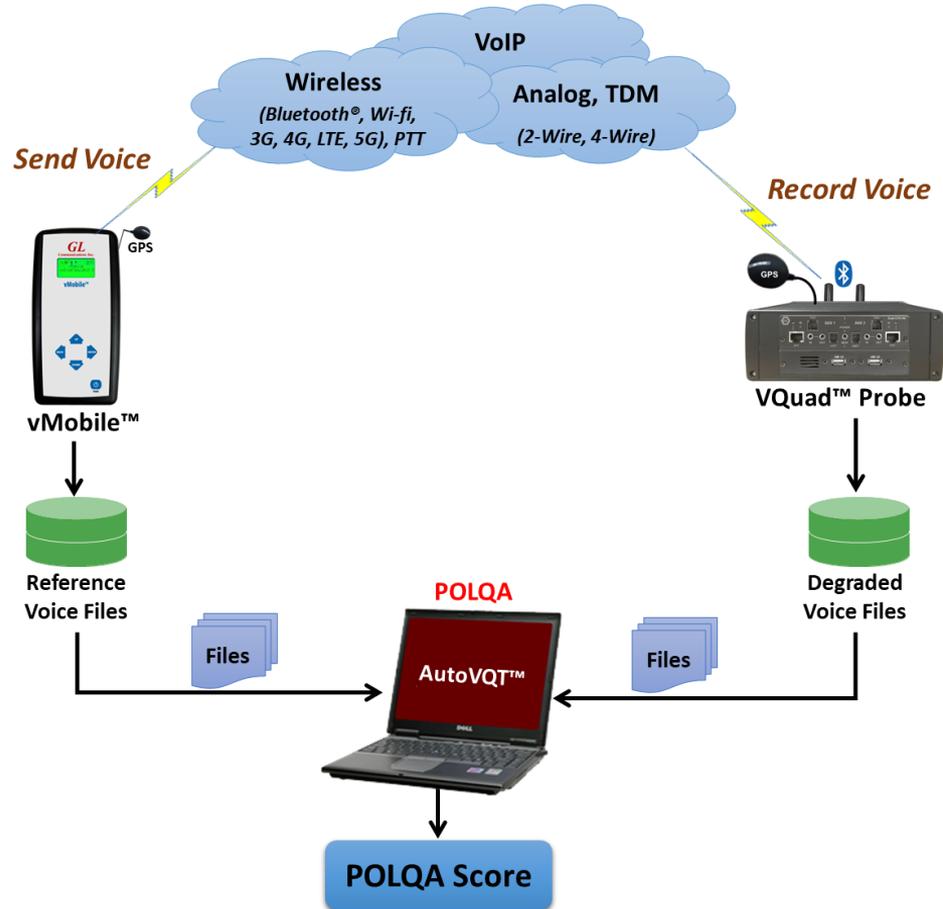

Automated Voice Quality Testing - AutoVQT™

(POLQA v2.4)



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GL Automated VQT POLQA Testing Solution



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

POLQA - Perceptual Objective Listening Quality Assessment

(POLQA v2.4)

Voice Quality Algorithm based on ITU-P.863

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

Operations Performed by POLQA

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

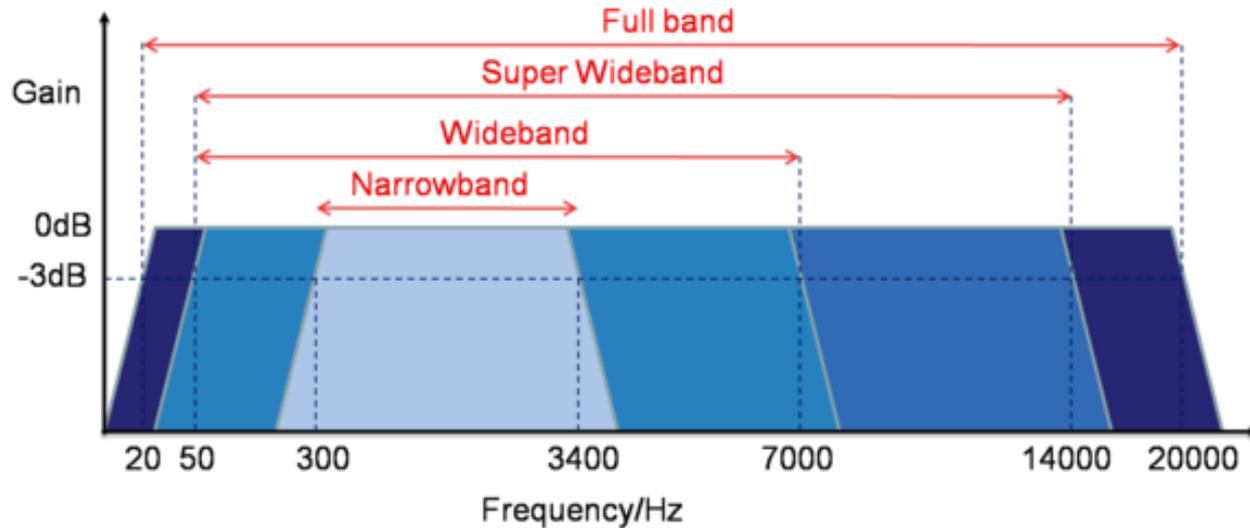
Results Provided by POLQA

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

POLQA Algorithm

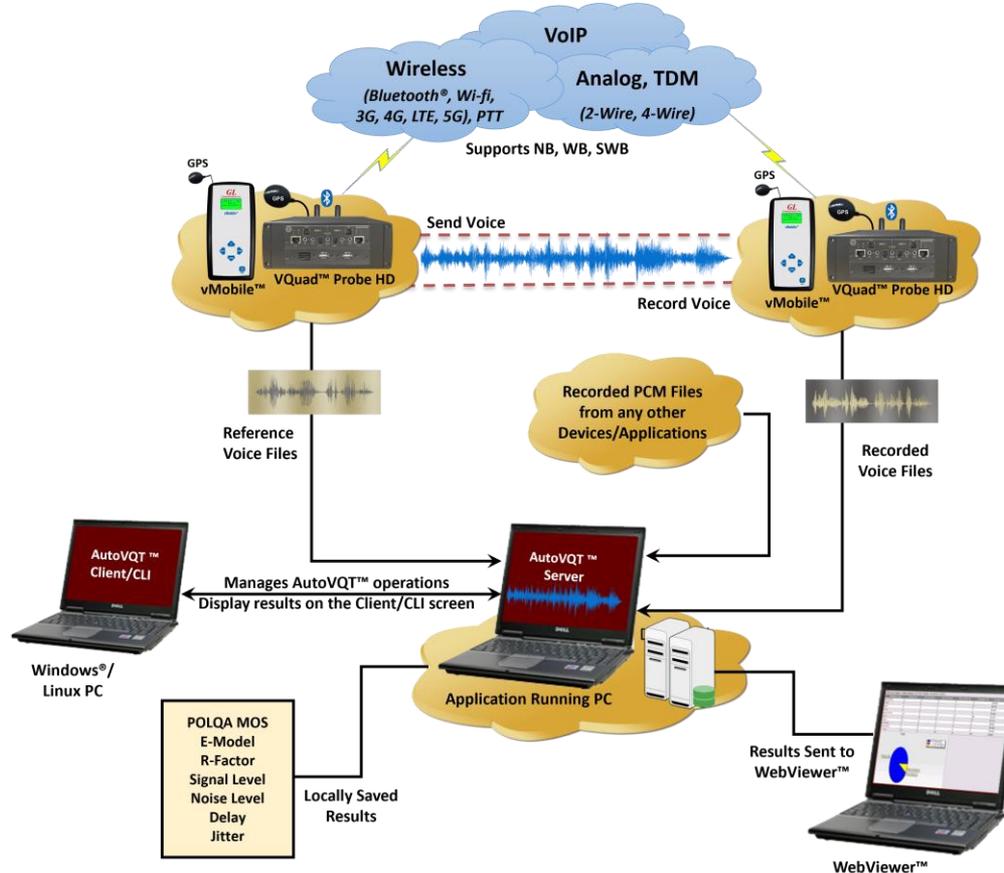
- POLQA is an objective model of subjective Listening Only Tests
- VQT POLQA supports analysis of 16-bit uncompressed PCM and WAV files, including NB (8000 sampling), WB (16000 sampling), SWB (48000 sampling)
- Revised Psycho-Acoustic and Cognitive Model
- Supports:
 - EVRC type codecs
 - Noise Reduction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

POLQA WB and SWB



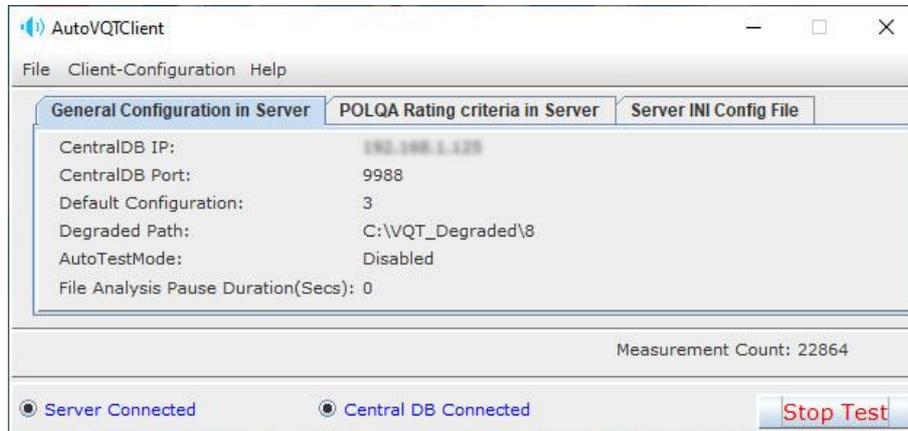
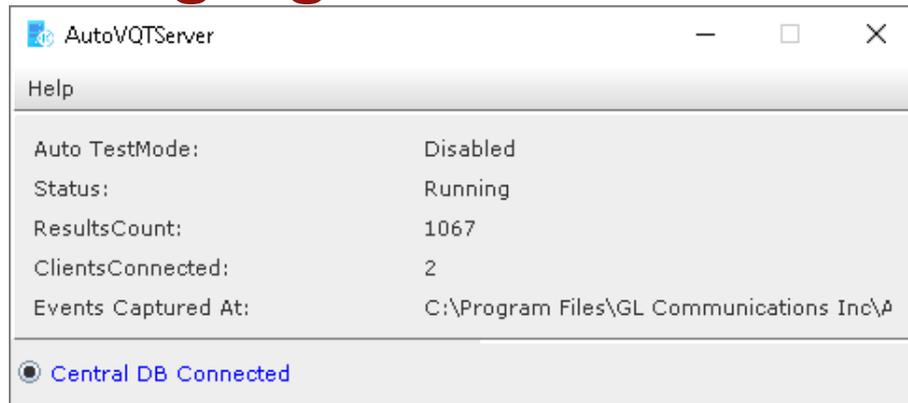
- Support for WB (7kHz) and SWB (14kHz) codecs/networks
- Support for networks delivering HD-quality voice services including VoIP and Mobile
- Supports networks with variable delay and time scaling

Working Principle



GL AutoVQT™ Highlights

- 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



Application Analysis Time

- The following table summarizes the average time taken to analyze PCM files when they are provided at the same time using Windows® 11 Pro 64-bit operating system, equipped with a 12th generation Intel® Core™ i9-12900K processor at 3.20 GHz and on 32 GB of RAM

PCM Type	Approximate Time Required to Process 1000 PCM Files Simultaneously (Min : Sec)	Approximate Time Required to Process 1 PCM File (Sec)
Narrowband (NB)	02:01	0.12
Wideband (WB)	02:13	0.13
Super wideband (SWB)	02:26	0.14

- On average, when the application is required to analyze multiple PCM files with different sampling rates (300 NB, 300 WB, and 400 SWB files), the total time taken to analyze all the 1000 PCM files at the same time is approximately **02 minutes and 31 seconds**

General Configuration

General Configuration

File Information

Folder Path:

Test Mode

Enable AutoTest

Default Auto Configuration for Analysis

Configuration Number:

Server Configurations

DataImport (Central Database)		AutoVQT Server IP/Port	
IP:	<input type="text" value="127.0.0.1"/>	IP:	<input type="text" value="127.0.0.1"/>
PORT:	<input type="text" value="9988"/>	PORT:	<input type="text" value="3333"/>

POLQA Rating Criteria

Algorithm	Excellent	Good	Fair	Poor
POLQA	4.0-5.0	3.0-4.0	2.0-3.0	0.0-2.0

Excellent Good Fair Poor

Note: Rating Criteria should be between 0 and 5

View Auto Measurement Profile

The image shows two overlapping windows from the AutoVQTClient application. The background window is the main client interface, and the foreground window is a settings dialog.

AutoVQTClient Main Window:

- Menu: File, Client-Configuration, Help
- Sub-menu: General Config, Client-Configuration in Server, Server INI Config File
- Selected menu item: View Auto Measurement Profile(INI Config File)
- Other menu items: Reload Auto Measurement Profile(INI Config File), Synchronize Test Configurations with Server
- Default Configuration: 1
- Degraded Path: C:\VQT
- AutoTestMode: Disable
- Server Connected (checked), Client Connected (unchecked)

AutoVQTClient Measurement Profile Settings Dialog:

- Title: AutoVQTClient Measurement Profile Settings
- Section: Auto Measurement Profile(INI Config File)
- INI Config File Path: as\GL Communications Inc\AutoVQTClient\AutoVQTCProfile.ini
- Content: VQT Auto Measurement Profile
- INI File Content:

```
[VQTAutoMeasurement]
1=C:\VQT_Reference\VQuad_Auto\POLQANB\fem1POLQA.pcm|Raw PCM,16,8000,LSMS(Intel)
2=C:\VQT_Reference\VQuad_Auto\POLQANB\male1POLQA.pcm|Raw PCM,16,8000,LSMS(Intel)
3=C:\VQT_Reference\VQuad_Auto\POLQASWB\fem1POLQASWB.pcm|Raw PCM,16,16000,LSMS(Intel)
4=C:\VQT_Reference\VQuad_Auto\POLQASWB\male1POLQASWB.pcm|Raw PCM,16,16000,LSMS(Intel)
5=C:\VQT_Reference\VQuad_Auto\POLQASWB\fem1POLQASWB.pcm|Raw PCM,16,48000,LSMS(Intel)
```
- Note: Any modifications made to the INI file will take effect only after reload the Auto Client-Configuration -> Reload Auto Measurement Profile(INI Config File).

Results Summary

```
AutoVQTServerEventLog.txt - Notepad
File Edit Format View Help
VQT Timestamp;DegFile;POLQA Score;EModel;Rating;Speech level gain;Noise level gain;Avg Jitter;Min Jitter;Max Jitter;ActiveSpeechRatioRef;ActiveS
2023/11/03 09:54:34 AM;male1PolqaWB_20230207105229_N12°55'35''_E077°36'04''_000000_I_FXOPOLQATest_FX02_20230207104832_4.pcm;4.22;-1.0;Excellent;
2023/11/03 09:54:35 AM;male1PolqaWB_20230207105655_N12°55'35''_E077°36'05''_000000_O_FXOPOLQATest_FX01_20230207105317_4.pcm;4.2;-1.0;Excellent;-
2023/11/03 09:54:35 AM;male1PolqaWB_20230207105713_N12°55'35''_E077°36'05''_000000_I_FXOPOLQATest_FX02_20230207105317_4.pcm;4.2;-1.0;Excellent;-
2023/11/03 09:54:35 AM;male1PolqaWB_20230207110140_N12°55'35''_E077°36'04''_000000_O_FXOPOLQATest_FX01_20230207105801_4.pcm;4.2;-1.0;Excellent;-
2023/11/03 09:54:35 AM;male1PolqaWB_20230207105211_N12°55'35''_E077°36'04''_000000_O_FXOPOLQATest_FX01_20230207104832_4.pcm;4.22;-1.0;Excellent;
2023/11/03 09:54:39 AM;male1PolqaWB_20230207110158_N12°55'35''_E077°36'04''_000000_I_FXOPOLQATest_FX02_20230207105801_4.pcm;4.21;-1.0;Excellent;
2023/11/03 09:54:39 AM;male1PolqaWB_20230207132313_N12°55'35''_E077°36'04''_000000_O_FXOPOLQATest_FX01_20230207131934_4.pcm;4.23;-1.0;Excellent;
2023/11/03 09:54:39 AM;male1PolqaWB_20230207132331_N12°55'35''_E077°36'04''_000000_I_FXOPOLQATest_FX02_20230207131934_4.pcm;4.24;-1.0;Excellent;
2023/11/03 09:54:39 AM;male1PolqaWB_20230207132757_N12°55'35''_E077°36'04''_000000_O_FXOPOLQATest_FX01_20230207132419_4.pcm;4.11;-1.0;Excellent;
2023/11/03 09:54:41 AM;male1PolqaWB_20230207132816_N12°55'35''_E077°36'04''_000000_I_FXOPOLQATest_FX02_20230207132419_4.pcm;4.24;-1.0;Excellent;
2023/11/03 09:54:42 AM;male1PolqaWB_20230207133243_N12°55'35''_E077°36'04''_000000_O_FXOPOLQATest_FX01_20230207132904_4.pcm;4.21;-1.0;Excellent;
2023/11/03 09:54:43 AM;male1PolqaWB_20230207133301_N12°55'35''_E077°36'04''_000000_I_FXOPOLQATest_FX02_20230207132904_4.pcm;4.23;-1.0;Excellent;
2023/11/03 09:54:43 AM;male1PolqaWB_20230207133729_N12°55'35''_E077°36'04''_000000_O_FXOPOLQATest_FX01_20230207133350_4.pcm;4.22;-1.0;Excellent;
2023/11/03 09:54:43 AM;male1PolqaWB_20230207133747_N12°55'35''_E077°36'04''_000000_I_FXOPOLQATest_FX02_20230207133350_4.pcm;4.2;-1.0;Excellent;-
2023/11/03 09:54:44 AM;male1PolqaWB_20230207134215_N12°55'35''_E077°36'04''_000000_O_FXOPOLQATest_FX01_20230207133836_4.pcm;4.2;-1.0;Excellent;-
2023/11/03 09:54:45 AM;male1PolqaWB_20230207134233_N12°55'35''_E077°36'04''_000000_I_FXOPOLQATest_FX02_20230207133836_4.pcm;4.22;-1.0;Excellent;
2023/11/03 09:54:46 AM;male1PolqaWB_20230207134700_N12°55'35''_E077°36'04''_000000_O_FXOPOLQATest_FX01_20230207134321_4.pcm;4.21;-1.0;Excellent;
2023/11/03 09:54:46 AM;male1PolqaWB_20230207134718_N12°55'35''_E077°36'04''_000000_I_FXOPOLQATest_FX02_20230207134321_4.pcm;4.21;-1.0;Excellent;
2023/11/03 09:54:47 AM;male1PolqaWB_20230207135145_N12°55'34''_E077°36'04''_000000_O_FXOPOLQATest_FX01_20230207134806_4.pcm;4.2;-1.0;Excellent;-
2023/11/03 09:54:47 AM;male1PolqaWB_20230207135203_N12°55'34''_E077°36'04''_000000_I_FXOPOLQATest_FX02_20230207134806_4.pcm;4.23;-1.0;Excellent;
Ln 6, Col 398 100% Unix (LF) UTF-8
```

AutoVQT™ CLI

CLI for Windows®

```
C:\Users\GLIN68\Desktop>AutoVQTcli.exe 192.168.1.199 1122
AUTOVQTcli Client V1.0.1
Connection has been established with AutoVQTServer IP:192.168.1.199 PORT:1122

Enter the command or (h/Help)
Command:
h
Commands:
StartTest      - To start the AUTO POLQA calculation
StopTest       - To stop the POLQA calculation
EnableAuto     - To enable auto test mode
DisableAuto    - To disable auto test mode
ConnectionStatus - DataImport Server connectivity status
GetEventLog    - To download eventlogs from Server
                Usage: GetEventLog FileName.txt(with full path)
Exit           - Exit from CLI
RunPOLQA       - To start POLQA calculation(analysis)
                Usage: RunPOLQA degradedFileName(with full path) referenceFileName mode(POLQA_SWB(0/1))
                enableToneDetect(0/1) Encoding(Mu-Law(0),A-Law(1),Raw PCM(2)) BitsPerSample(16)
                ByteOrder(LSMS(0)) ChannelNum(1) SampleRate(8000/16000/48000) Version(2)
                EnableLevelAlignment(0/1) Reference16K(0) HAMode(0/1) bEnableWavHdr(0).
RunPOLQAWithINI - To start POLQA calculation(analysis) with INI File
                Usage: RunPOLQAWithINI configurationNumber(0-99) <Command>
                Notes: Ensure that the configuration in the INI file corresponds to the provided
                configuration number before running RunPOLQAWithINI command.

Important Note: ***All commands are case-insensitive***.
```

CLI for Linux

```
glin33@glin33-desktop:~/Desktop$ ./AutoVQTcli 192.168.1.199 1122
AUTOVQTcli Client V1.0.1
Connection has been established with AutoVQTServer IP:192.168.1.199 PORT:1122

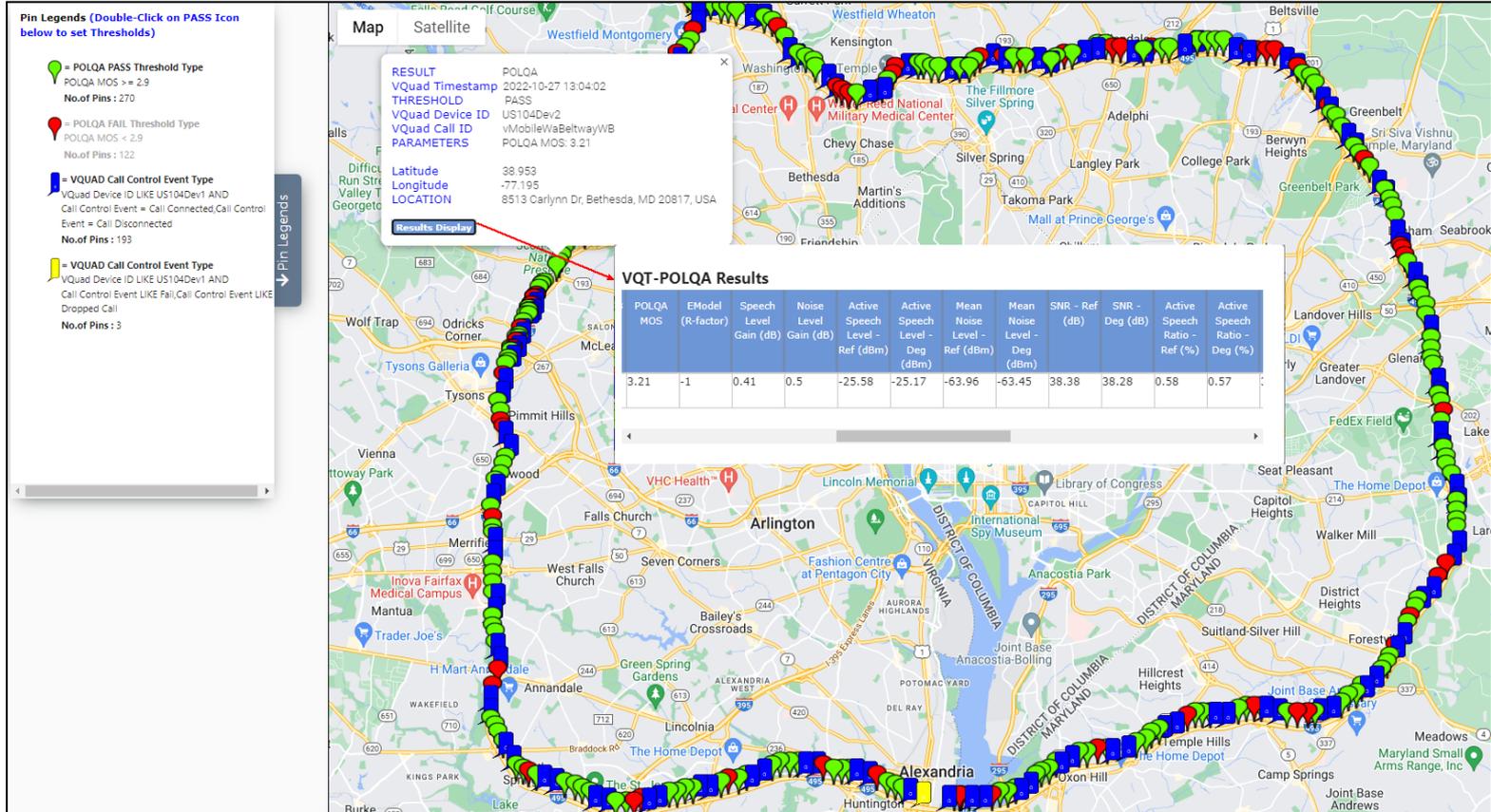
Enter the Command or Help(h)
Command:
h
Commands Sent...
Commands:
StartTest      - To start the AUTO POLQA calculation
StopTest       - To stop the POLQA calculation
EnableAuto     - To enable auto test mode
DisableAuto    - To disable auto test mode
ConnectionStatus - DataImport Server connectivity status
GetEventLog    - To download eventlogs from Server
                Usage: GetEventLog FileName.txt(with full path)
Exit           - Exit from CLI
RunPOLQA       - To start POLQA calculation(analysis)
                Usage: RunPOLQA degradedFileName(with full path) referenceFileName mode(POLQA_SWB(0/1))
                enableToneDetect(0/1) Encoding(Mu-Law(0),A-Law(1),Raw PCM(2)) BitsPerSample(16)
                ByteOrder(LSMS(0)) ChannelNum(1) SampleRate(8000/16000/48000) Version(2)
                EnableLevelAlignment(0/1) Reference16K(0) HAMode(0/1) bEnableWavHdr(0).
RunPOLQAWithINI - To start POLQA calculation(analysis) with INI File
                Usage: RunPOLQAWithINI configurationNumber(0-99) degradedFileName(with fullPath)
                Notes: Ensure that the configuration in the INI file corresponds to the provided
                configuration number before running RunPOLQAWithINI command.

Important Note: ***All commands are case-insensitive***.
```

POLQA Test Results in WebViewer™

Results ▾		Call Events		Stats/Status ▾		Reports ▾		Load Filters: --Select Filter-- ▾														
VQT-POLQA Results between 04/11/2023 07:50:59 and 04/11/2023 08:50:59 (Last Hour)																						
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 <input type="text"/>																				
<input type="button" value="Apply"/>																						
Actions ▾		Records Per Page: 200 ▾																				
VQuad Timestamp	Call Timestamp	VQuad Call ID	VQuad Device ID	VQuad 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 (%)	Active Speech Ratio - Deg (%)	POLQA OWD (ms)
04/11/2023 08:50:54	04/11/2023 08:47:46	GLRobFrRobFXO2	N39°08'39.14 W077°91	-77.22	fem1POLQA	Excellent	4.12	82.58	-14.85	-13.57	-24.28	-39.13	-62.79	-76.36	38.51	37.23	57	51	706			
04/11/2023 08:50:40	04/11/2023 08:47:46	GLRobFrRobFXO1	N39°08'39.14 W077°91	-77.22	fem1POLQA	Excellent	4.21	85.49	-12.6	-12.54	-24.28	-36.88	-62.79	-75.33	38.51	38.45	57	50	633.12			
04/11/2023 08:50:23	04/11/2023 08:47:46	GLRobFrRobFXO2	N39°08'39.14 W077°91	-77.22	fem1POLQA	Excellent	4.08	81.52	-14.86	-14.14	-24.28	-39.14	-62.79	-76.94	38.51	37.8	57	51	730.25			
04/11/2023 08:50:10	04/11/2023 08:47:46	GLRobFrRobFXO1	N39°08'39.14 W077°91	-77.22	fem1POLQA	Excellent	4.17	84.26	-12.6	-12.43	-24.28	-36.88	-62.79	-75.22	38.51	38.34	57	50	638.62			
04/11/2023 08:45:14	04/11/2023 08:42:05	GLRobFrRobFXO2	N39°08'39.14 W077°91	-77.22	fem1POLQA	Excellent	4.29	88.04	-14.85	-13.61	-24.28	-39.13	-62.79	-76.41	38.51	37.28	57	50	768.38			
04/11/2023 08:45:01	04/11/2023 08:42:05	GLRobFrRobFXO1	N39°08'39.14 W077°91	-77.22	fem1POLQA	Excellent	4.24	86.4	-12.61	-12.36	-24.28	-36.89	-62.79	-75.15	38.51	38.26	57	50	699.38			
04/11/2023 08:44:44	04/11/2023 08:42:05	GLRobFrRobFXO2	N39°08'39.14 W077°91	-77.22	fem1POLQA	Excellent	4.26	86.99	-14.84	-13.38	-24.28	-39.12	-62.79	-76.17	38.51	37.05	57	50	770.5			
04/11/2023 08:44:31	04/11/2023 08:42:05	GLRobFrRobFXO1	N39°08'39.14 W077°91	-77.22	fem1POLQA	Excellent	4.14	83.23	-12.61	-12.65	-24.28	-36.89	-62.79	-75.44	38.51	38.55	57	50	698.5			
04/11/2023 08:41:03	04/11/2023 08:37:57	GLRobFrRobFXO2	N39°08'39.14 W077°91	-77.22	fem1POLQA	Excellent	4.3	88.66	-14.86	-13.56	-24.28	-39.14	-62.79	-76.35	38.51	37.21	57	50	717.25			
04/11/2023 08:40:50	04/11/2023 08:37:57	GLRobFrRobFXO1	N39°08'39.14 W077°91	-77.22	fem1POLQA	Excellent	4.29	88.18	-12.6	-12.53	-24.28	-36.88	-62.79	-75.32	38.51	38.44	57	50	654			
04/11/2023 08:40:33	04/11/2023 08:37:57	GLRobFrRobFXO2	N39°08'39.14 W077°91	-77.22	fem1POLQA	Excellent	4.11	82.24	-14.84	-13.75	-24.28	-39.12	-62.79	-76.53	38.51	37.41	57	50	708.88			
04/11/2023 08:40:20	04/11/2023 08:37:57	GLRobFrRobFXO1	N39°08'39.14 W077°91	-77.22	fem1POLQA	Excellent	4.23	85.88	-12.6	-12.26	-24.28	-36.88	-62.79	-75.05	38.51	38.17	57	50	642.75			
04/11/2023 08:35:24	04/11/2023 08:32:17	GLRobFrRobFXO2	N39°08'39.14 W077°91	-77.22	fem1POLQA	Excellent	4.27	87.57	-14.85	-13.89	-24.28	-39.13	-62.79	-76.67	38.51	37.54	57	50	688.25			

Google Map Plotting



Thank you