
语音质量测试

(POLQA v3, POLQA v2.4, PESQ)

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感知建模的基本原理

语音质量测试等级

分数	等级	语音
5	极好	无法察觉任何干扰因素
4	好	察觉到干扰因素但不影响通话
3	一般	轻微的影响通话
2	差	影响通话
1	极差	严重影响通话



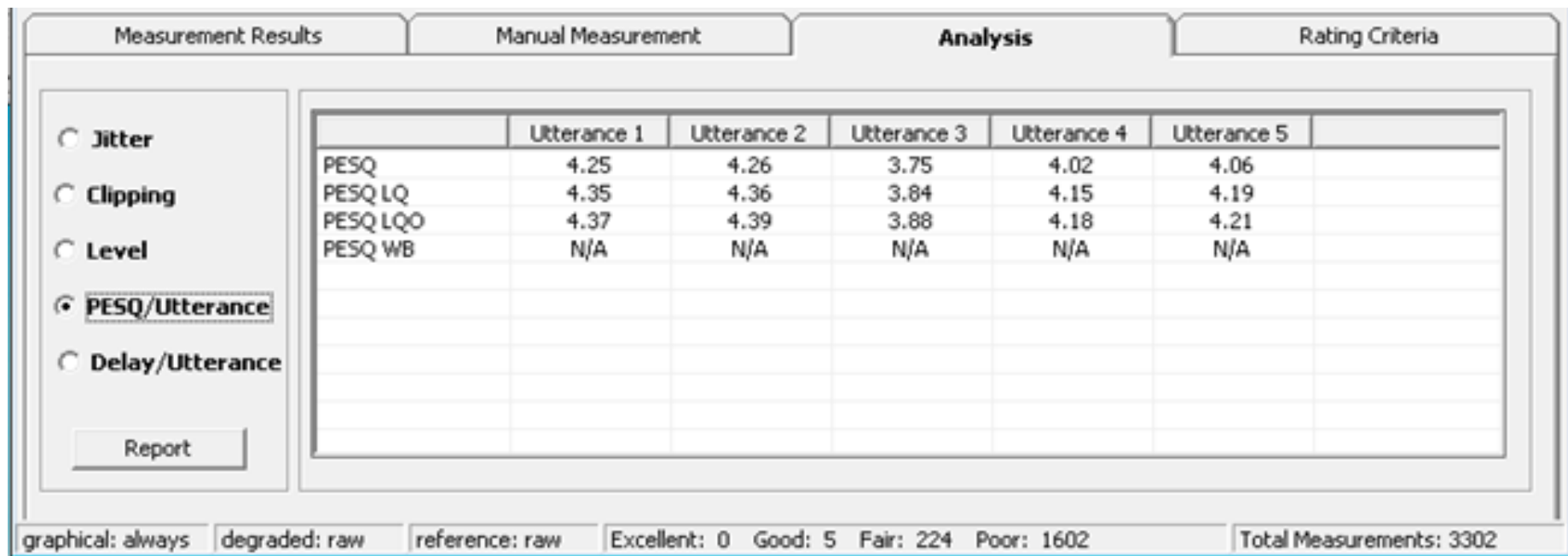
- 普遍观点 —— 模拟主观测试的情况，人们必须在听力实验室环境中对声音样本的质量进行评分
- 基于人类感知的分析的缺点 —— 不准确/不可重复，需要大量的主题，非常昂贵和耗时

PESQ – 语音质量感知评价

基于ITU-P.862的语音质量算法

- **PESQ** (始于2001年) 融合了许多新的发展
 - 信号水平对齐
 - 输入信号的过滤
 - 时间对齐 (从PAMS采用)
 - PESQ LQ – 更接近听力质量的主观评价等级 – 顾客对质量的感知
 - PESQ LQO (P.862.1) – 听力质量客观, 与主观测试结果相关性较好
- **PESQ WB** (P.862.2) – 支持WB编解码。然而, PESQ 在 WB VoIP 解码器上有局限性, 因为得分太低

GL PESQ分析



POLQA — 客观知觉听觉质量评价

(POLQA v3, POLQA v2.4)

基于ITU-P.863的语音质量算法

POLQA (始于2011) 为 NB 编解码语音文件计算出的分数，与 PESQ 算法类似（使用相似的计算机制）。POLQA主要针对 SWB 和 WB 编解码。

POLQA执行的操作

- 时间序列
- 采样率估计
- 水平对齐
- 频率响应和时间对齐

POLQA提供的结果

- MOS-LQO
- G.107 R-Factor / E-Model
- 衰减
- 电平及背景噪音测量
- 信噪比(SNR)
- 活跃语音率 (ASR)

POLQA 算法

- POLQA主观听力测试的客观模型
- VQT POLQA 支持分析16-bit 未压缩 PCM 和 WAV 文件, 包括 NB (8000采样率)、WB (16000 采样率)、SWB (48000采样率)
- 修正的心理声学 and 认知模型
- 支持:
 - EVRC类型编解码
 - 非最佳呈现水平
 - 降噪
 - 滤波和光谱整形
 - 时间扭曲
 - 在耳朵模拟器上录制的声音
 - VoIP

POLQA v3 算法

- POLQA v3升级增强
- POLQA v3 超宽带 (SWB) 支持14kHz到全音频带宽24kHz
- 全带分析提高了编解码器评估的准确性，如EVS、OPUS、AAC and LC3，这些编解码器用于很多OTT 应用程序
- 在全带支持下，提高了POLQA在MOS尺度高质量范围内的鉴别能力
- 当前 OTT语音服务使用 VoLTE/5G包括高动态延迟抖动，这导致了在讲话期间非常短暂停的持续时间的变化，POLQA v3以更高的精度处理这些变化
- POLQA v3对线性频率失真的敏感度低于POLQA v2.4，这使得测量更少依赖于耳机的频率特性
- POLQA v3感知模型显著改进和简化

GL POLQA 分析

GL Communications Voice Quality Test - PAMS (ITU P.800), PSQM/PSQM+ (ITU P.861), PESQ (ITU ... - □ ×

File View Help

GL Speech Quality Measurements PESQ Normal(P862.1): ON

Metrics	Scores
POLQA	2.27
EMODEL	44.09
PESQ	N/A
PESQ LQ	N/A
PESQ LQO	N/A
PESQ WB	N/A
PESQ Ie	N/A
PAMS LE	N/A
PAMS LQ	N/A
PSQM MOS	N/A
PSQM+ MOS	N/A

Rating: **Fair**

User ID: _____

Speech Level Gain (dB): **-9.82**

Noise Level Gain (dB): **-9.72**

PAMS **PSQM** **PESQ** **POLQA** **Disconnected**

P.863 : 2.27

Deg. File = C:\VQT_Degraded\7\test2.pcm

Ref. File = C:\VQT_Reference\Quad_Auto\POLQANB\fm1POLQA.pcm

Metrics	Max	Min	Avg.
POLQA	4.5	2.21	3.94
EMODEL	100	42.86	82.56
PESQ	0	0	0
PESQ LQ	0	0	0
PESQ LQO	0	0	0
PESQ WB	0	N/A	N/A
PESQ Ie	0	0	0
PAMS LE	N/A	N/A	N/A
PAMS LQ	N/A	N/A	N/A
PSQM M...	N/A	N/A	N/A
PSQM+ ...	N/A	N/A	N/A

Rating Count

Excellent	11
Good	0
Fair	3
Poor	0
Disregard	0

Reset Statistics --> File

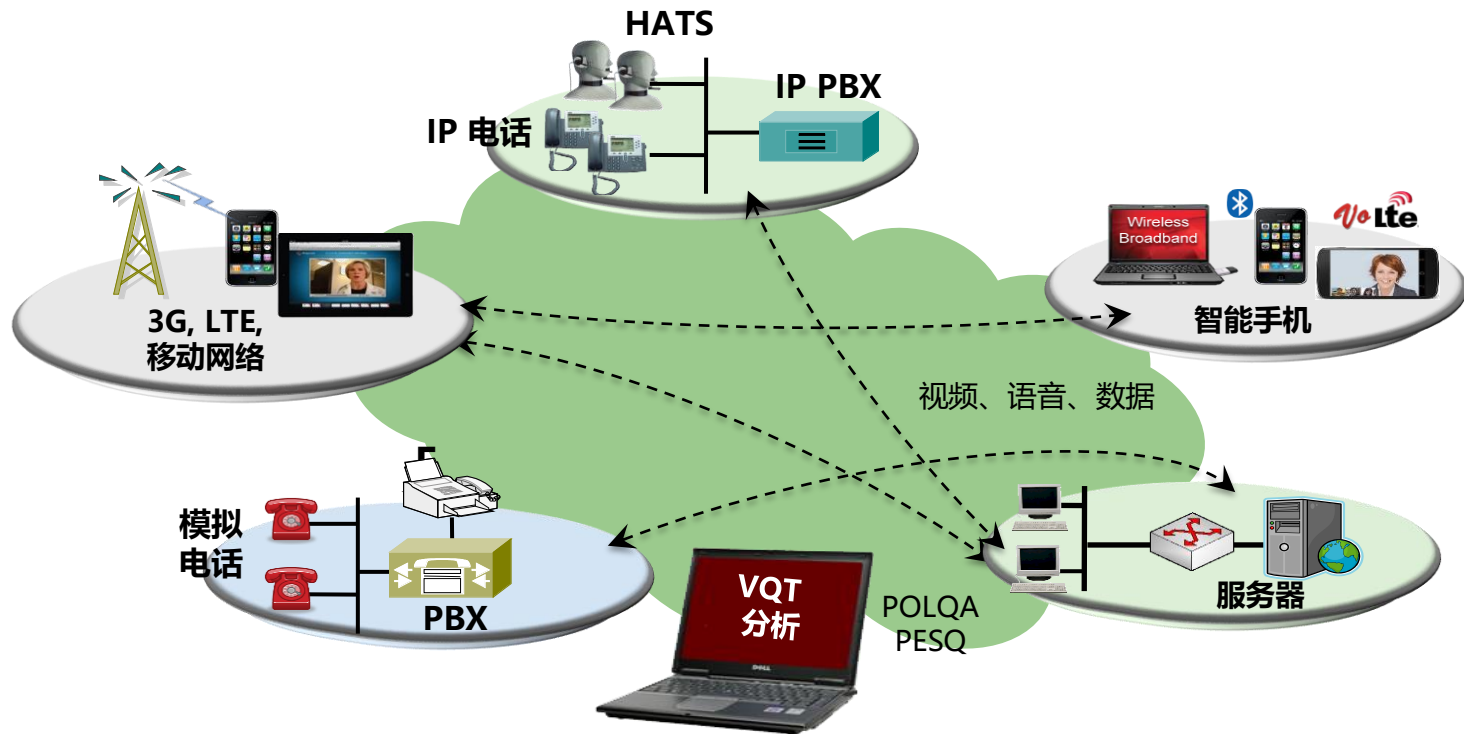
Measurement Results Manual Measurement Analysis Rating Criteria

VQT Timestamp	POLQA	EMode1	PESQ	PESQ LQ	PESQ LQO	PESQ WB
2015/08/17 11:52:36 AM	2.51	48.71	N/A	N/A	N/A	N/A
2015/08/17 11:52:55 AM	4.26	87.21	N/A	N/A	N/A	N/A
2015/08/17 11:54:33 AM	4.5	100	N/A	N/A	N/A	N/A
2015/08/17 11:54:51 AM	4.5	100	N/A	N/A	N/A	N/A
2015/08/17 11:55:09 AM	4.29	88.22	N/A	N/A	N/A	N/A
2015/08/17 11:55:28 AM	4.16	83.78	N/A	N/A	N/A	N/A
2015/08/17 11:57:18 AM	4.42	93.62	N/A	N/A	N/A	N/A
2015/08/17 11:57:39 AM	4.26	87.14	N/A	N/A	N/A	N/A
2015/08/17 11:57:55 AM	2.21	42.86	N/A	N/A	N/A	N/A
2015/08/17 11:58:11 AM	4.41	93.2	N/A	N/A	N/A	N/A
2015/08/17 11:58:26 AM	4.36	90.8	N/A	N/A	N/A	N/A
2015/08/17 11:58:37 AM	2.27	44.09	N/A	N/A	N/A	N/A

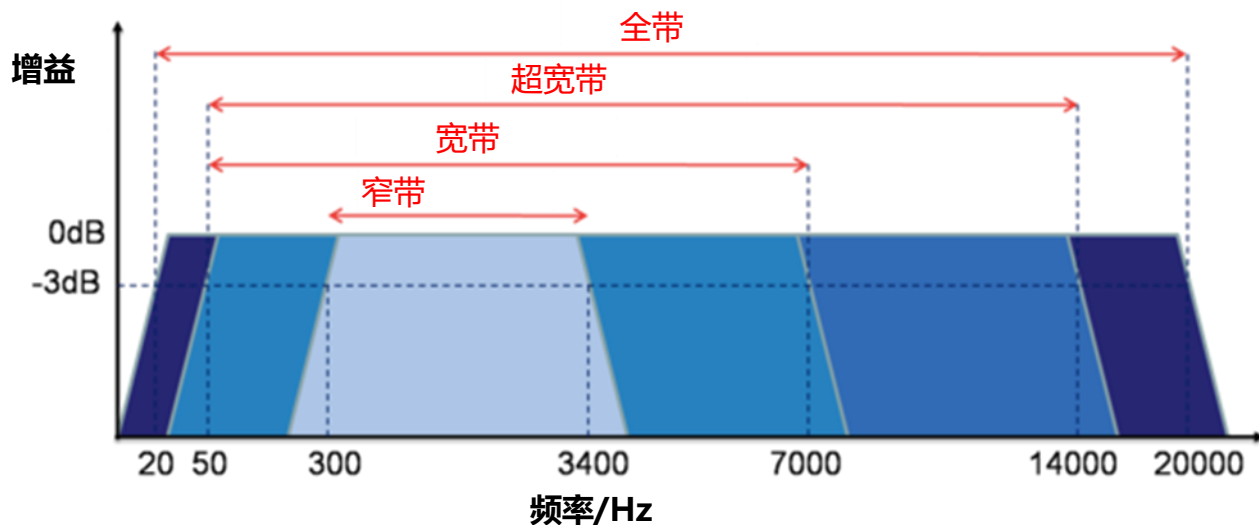
Capture Events to File Browse System Reset

graphical: always degraded: u-Law reference: u-Law Excellent: 11 Good: 0 Fair: 3 Poor: 0 Total Measurements: 14

POLQA 测试

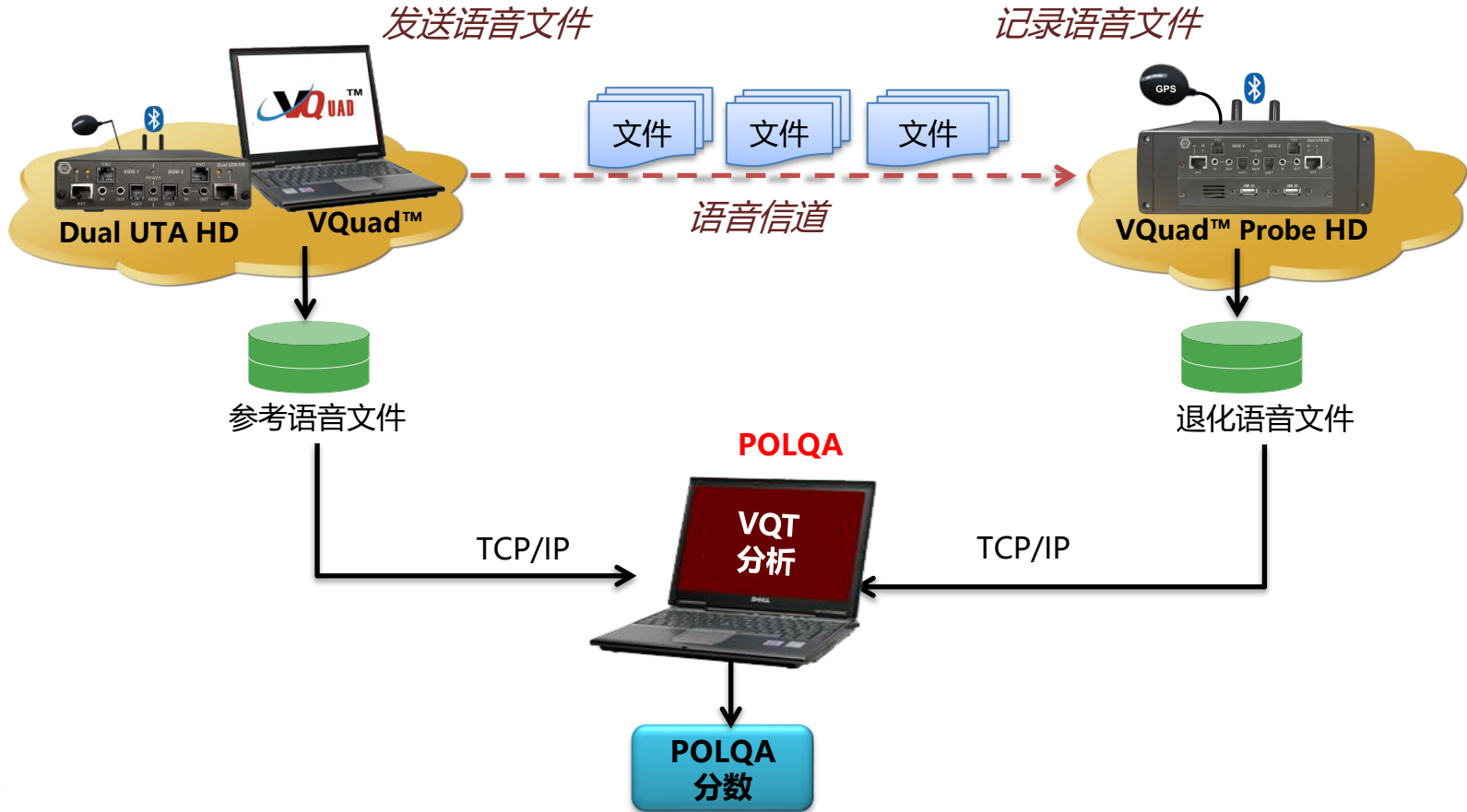


POLQA 宽带和超宽带

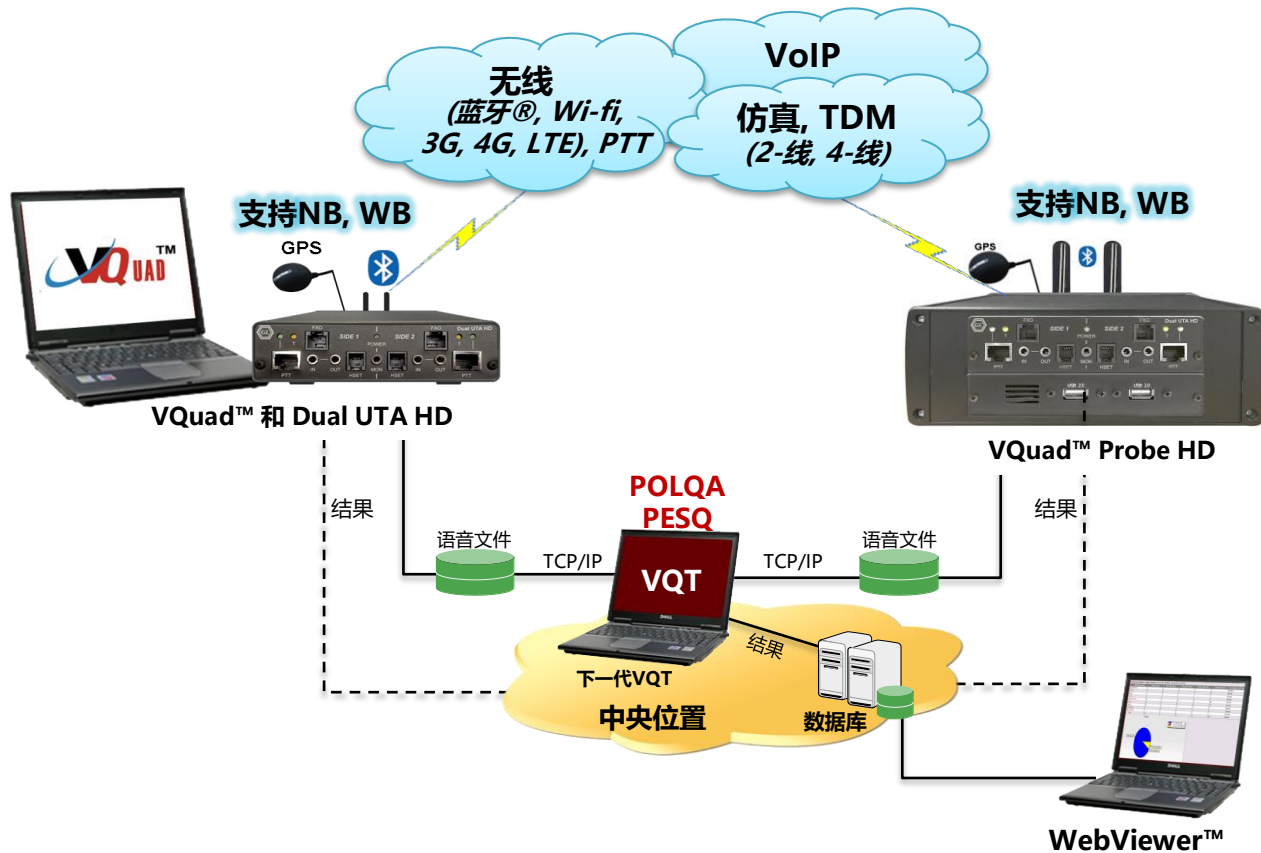


- 支持宽带(7kHz) 和 超宽带(14kHz) 编解码/网络
- 支持网络提供高清质量语音服务的网络, 包括 VoIP 和 无线网络
- 支持具有可变延迟和时间缩放的网络

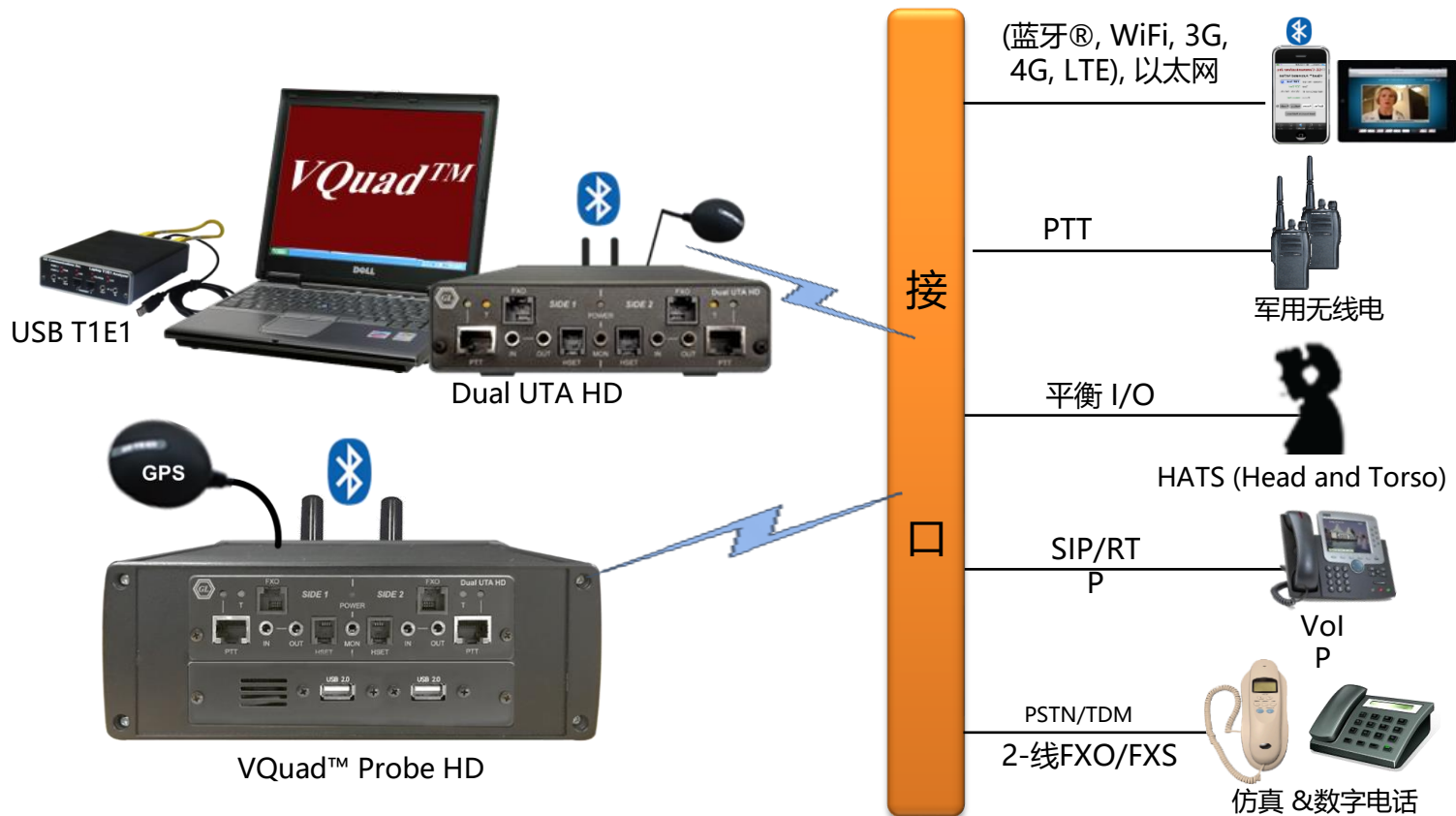
生成POLQA 分数



语音质量集中测试



支持多种设备接入



POLQA测试结果

VoIP 网络 (窄带和宽带)



Polycom VoIP 通过 G.722 网络

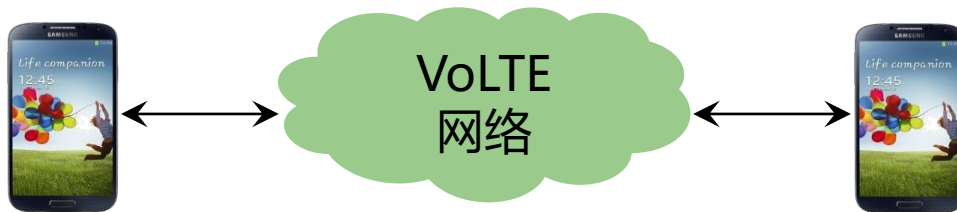
Polycom Tx/Rx WB 文件	
女声输出	4.59
女声输入	4.51
男声输出	4.15
男声输入	4.07

Polycom VoIP 通过窄带(Skype) 网络

Polycom Tx/Rx WB 文件	
女声输出	3.84
女声输入	3.74
男声输出	3.58
男声输入	3.55

POLQA 测试结果...

VoLTE (窄带和宽带)



Samsung4 to Samsung4 通过 AMR-WB 网络

Samsung4 to Samsung4	
女声输出	3.46
女声输入	3.58
男声输出	4.2
男声输入	4.19

Samsung4 to Samsung4 通过 AMR 网络

Samsung4 to Samsung4	
女声输出	2.27
女声输入	1.96
男声输出	3.08
男声输入	2.69

GL VQT 亮点

- 支持ITU标准 (POLQA v3.0 , POLQA v2.4, PESQ LQ/ LQO / WB)
- 自动测量功能
- 详细结果/统计
 - 延时测量
 - 噪声/信号水平 (活动, 峰值等)
 - 抖动 (最小、最大、每段音的平均)
 - 削波 (前、后、所有) (PESQ Only)
 - PESQ/每段语音的延时
 - 损伤因子 (Ie) 测量 (PESQ only)
- 标准评级系统
- 远程访问功能

GL VQT 软件

GL Communications Voice Quality Test - PAMS (ITU P.800), PSQM/PSQM+ (ITU P.861), PESQ (ITU ...

File View Help

GL Speech Quality Measurements PESQ Normal[P862.1]: ON

Metrics	Scores
POLQA	3.97
EMODEL	78.55
PESQ	2.8
PESQ LQ	2.44
PESQ LQO	2.54
PESQ WB	N/A
PESQ Ie	47.82
PAMS LE	N/A
PAMS LQ	N/A
PSQM MOS	N/A
PSQM+ MOS	N/A

Disconnected

P.863 : 3.97

Deg. File = C:\VQT_Degraded\1\test.pcm
Ref. File = C:\VQT_Reference\WQuad_Auto\Raw\fem1.pcm

Metrics	Max	Min	Avg.
POLQA	4.5	1.45	4.12
EMODEL	100	25.81	88.52
PESQ	4.27	1.84	3.86
PESQ LQ	4.36	1.13	3.87
PESQ LQO	4.39	1.52	3.92
PESQ WB	N/A	N/A	N/A
PESQ Ie	84.28	0	11.05
PAMS LE	N/A	N/A	N/A
PAMS LQ	N/A	N/A	N/A
PSQM M...	N/A	N/A	N/A
PSQM+ ...	N/A	N/A	N/A

Rating: **Fair**

User ID: **fem1**

Speech Level Gain (dB): **-10.68**

Noise Level Gain (dB): **-15.42**

Rating Count:

Excellent	17
Good	2
Fair	2
Poor	1
Disregard	0

Reset Statistics --> File

Measurement Results

Manual Measurement

Analysis

Rating Criteria

VQT Timestamp	POLQA	EMode1	PESQ	PESQ LQ	PESQ LQO	PESQ WB
2015/08/17 11:21:32 AM	3.13	60.56	3.54	3.55	3.61	N/A
2015/08/17 11:21:56 AM	1.45	25.81	1.84	1.13	1.52	N/A
2015/08/17 11:22:18 AM	4.5	100	4.19	4.31	4.33	N/A
2015/08/17 11:24:29 AM	4.4	92.7	4.1	4.23	4.25	N/A
2015/08/17 11:24:49 AM	4.41	93.09	4.1	4.23	4.25	N/A
2015/08/17 11:25:07 AM	4.41	93.46	4.09	4.21	4.24	N/A
2015/08/17 11:25:33 AM	4.5	100	4.11	4.23	4.26	N/A
2015/08/17 11:25:51 AM	2.34	45.43	3.04	2.8	2.88	N/A
2015/08/17 11:26:06 AM	4.4	92.59	4.12	4.24	4.26	N/A
2015/08/17 11:29:17 AM	4.5	100	4.22	4.33	4.35	N/A
2015/08/17 11:29:33 AM	4.5	100	4.23	4.34	4.36	N/A
2015/08/17 11:29:42 AM	3.97	78.55	2.8	2.44	2.54	N/A

Capture Events to File Browse System Reset

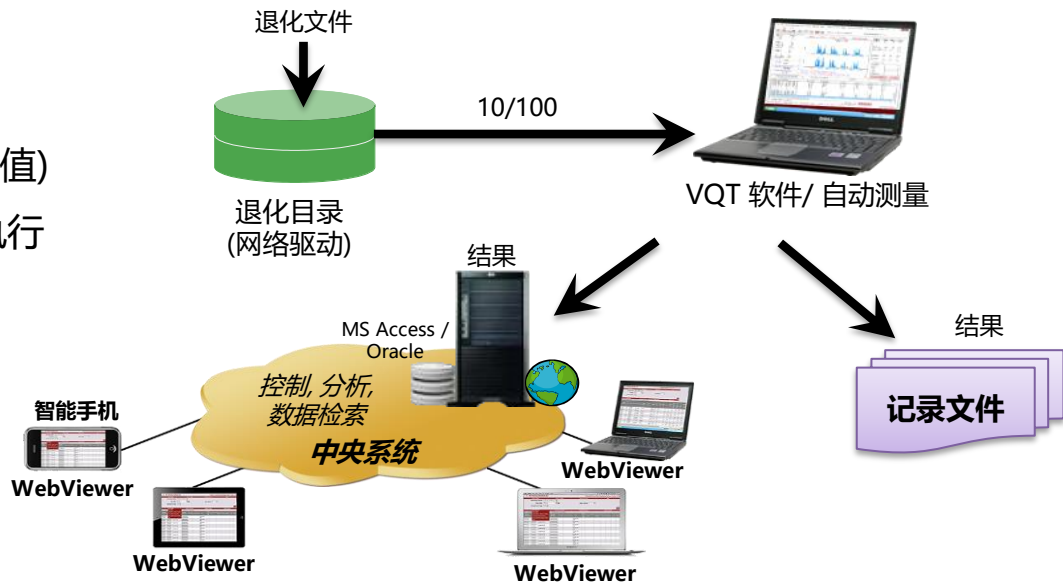
graphical: always degraded: u-Law reference: u-Law Excellent: 17 Good: 2 Fair: 2 Poor: 1 Total Measurements: 22



自动测量

使用GL VQT软件自动分析退化文件

- 详细测量结果包括
 - 抖动(最小 / 最大 / 平均)
 - 削波(前 / 后 / 所有)
 - 延迟
 - 噪声 / 信号测量(活动 / 峰值)
- VQT使用文件监视器对远程位置执行自动测量



自动测量

VQT Auto-Measurement: Full_Test

File Help

Degraded Directory	Reference File	Type	Option	Inventory	User ID	Counts
● C:\WQT_degraded\1	C:\WQT_Reference\WQuad_Auto\Raw\fem1.p...	Raw ...	Auto Del		fem1	
● C:\WQT_degraded\2	C:\WQT_Reference\WQuad_Auto\Raw\fem2.p...	Raw ...	Auto Del		fem2	
● C:\WQT_degraded\3	C:\WQT_Reference\WQuad_Auto\Raw\fem3.p...	Raw ...	Auto Del		fem3	
● C:\WQT_degraded\4	C:\WQT_Reference\WQuad_Auto\Raw\male1....	Raw ...	Auto Del		mal1	
● C:\WQT_degraded\5	C:\WQT_Reference\WQuad_Auto\Raw\male2....	Raw ...	Auto Del		mal2	
● C:\WQT_degraded\6	C:\WQT_Reference\WQuad_Auto\Raw\male3....	Raw ...	Auto Del		mal3	

Options

Degraded Directory * C:\WQT_degraded\1

Reference File * C:\WQT_Reference\WQuad_Auto\Raw\fem1.p...

Auto-delete the degraded file after measurement
 Save degraded files to the inventory directory after measurement

Inventory Directory* []

Saving Criteria (optional)

Excellent Good Fair Poor

User ID fem1 Prohibit Graphics Redraw (save processor power)

PESQ + POLQA PESQ Only POLQA Only

PESQ WB POLQA SWB ?

POLQA Only

Enable Level Alignment High Accuracy Mode ITU Version 2

File Format

Encoding Raw PCM Samples Per Second 8000

Byte Order (for 16 bit file only) LSMS(Intel) Bits Per Sample 16

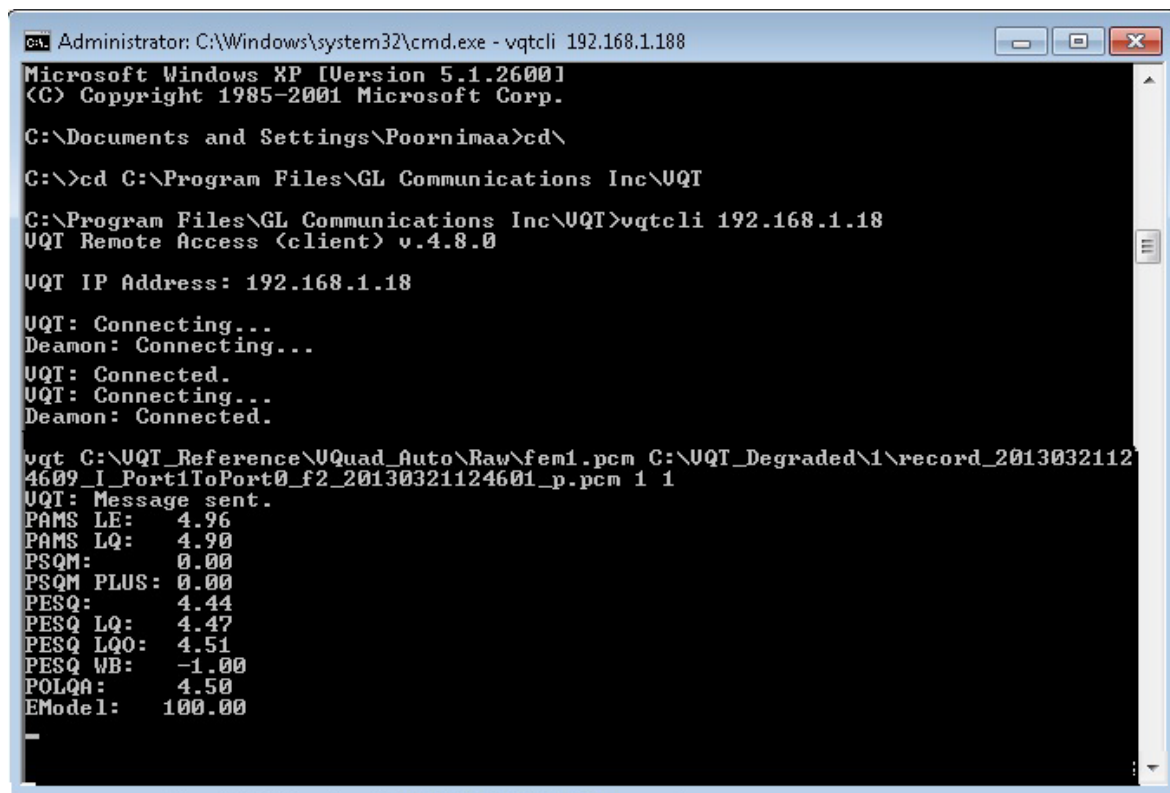
Quick Modify Configurations

Start: 1 End: 1 Quick Help

Note *: Use "?" in reference fields to hold the Number

Quick Modify Quick Default Save Changes Cancel

VQT 命令行接口



```
Administrator: C:\Windows\system32\cmd.exe - vqtccli 192.168.1.188
Microsoft Windows XP [Version 5.1.2600]
(C) Copyright 1985-2001 Microsoft Corp.

C:\Documents and Settings\Poornimaa>cd\

C:\>cd C:\Program Files\GL Communications Inc\VQT

C:\Program Files\GL Communications Inc\VQT>vqtccli 192.168.1.18
UQT Remote Access (client) v.4.8.0

UQT IP Address: 192.168.1.18

UQT: Connecting...
Deamon: Connecting...

UQT: Connected.
UQT: Connecting...
Deamon: Connected.

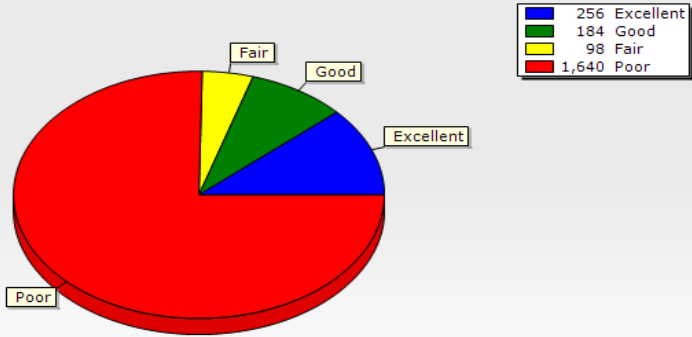
vqt C:\VQT_Reference\UQuad_Auto\Raw\fem1.pcm C:\VQT_Degraded\1\record_2013032112
4609_I_Port1ToPort0_f2_20130321124601_p.pcm 1 1
UQT: Message sent.
PAMS LE: 4.96
PAMS LQ: 4.90
PSQM: 0.00
PSQM PLUS: 0.00
PESQ: 4.44
PESQ LQ: 4.47
PESQ LQ0: 4.51
PESQ WB: -1.00
POLQA: 4.50
EModel: 100.00
```

POLQA 在WebViewer™内的测试结果

GL Communications Inc.		Hi Administrator															
Telecommunication Products and Consulting		VQuad WebViewer - Real Time Monitoring System, Version 4.3															
Results	Call Events	Statistics/Status	Filters	Graphics	Output Results	Configuration	Logout										
Load Filter AppleTest <input type="radio"/> ON <input checked="" type="radio"/> OFF																	
Time Filter 7 days <input type="button" value="Refresh"/>		Auto refresh 5 sec <input type="checkbox"/>															
Timestamp Search VQuad Timestamp <input type="button" value="Filter"/>		Call ID / Phone ID Search VQuad CallID ; VQuad PhoneID <input type="button" value="Filter"/>															
Records Per Page 20 <input type="button" value="Filter"/>																	
VQT POLQA (Display duration: 08-10-2015 03:22:52 - 08-17-2015 03:25:52)																	
VQuad Timestamp	Call Timestamp	VQuad Location	VQuad PhoneID	VQuad Lat/Long	Degraded Filename	Rating	POLQA Score	EModel (R-factor)	Speech Level Gain (dBv)	Noise Level Gain (dBv)	Jitter Ave (ms)	Jitter Min (ms)	Jitter Max (ms)	Active Speech Ratio - Ref (%)	Active Speech Ratio - Deg (%)	Number of Utterance	VQuad CallID
08/16/2015 08:37:35	08/16/2015 08:33:03	GLRobFaxVQTTTest	VQFXO-2	N39°08'36"W077°12'57"	fem1POLQA.PCM	Good	3.31	64.15	-8.79	5.15	3.81	0	7.62	0.57	0.41	2	I_GLRobFaxVQTTTest_VQFXO-2_20150816083303
08/16/2015 08:37:18	08/16/2015 08:33:03	GLRobFaxVQTTTest	VQFXO-1	N39°08'36"W077°12'57"	fem1POLQA.PCM	Fair	2.99	57.96	-9.80	3.85	2.25	0	4.50	0.57	0.41	2	C_GLRobFaxVQTTTest_VQFXO-1_20150816083303
08/16/2015 08:37:00	08/16/2015 08:33:03	GLRobFaxVQTTTest	VQFXO-2	N39°08'36"W077°12'57"	fem1POLQA.PCM	Good	3.31	64.07	-8.81	5.21	2.50	-5	0	0.57	0.41	2	I_GLRobFaxVQTTTest_VQFXO-2_20150816083303
08/16/2015 08:36:42	08/16/2015 08:33:03	GLRobFaxVQTTTest	VQFXO-1	N39°08'36"W077°12'57"	fem1POLQA.PCM	Good	3.02	58.47	-9.81	3.97	0	0	0	0.57	0.41	2	C_GLRobFaxVQTTTest_VQFXO-1_20150816083303
08/16/2015 08:32:09	08/16/2015 08:28:07	GLRobFaxVQTTTest	VQFXO-2	N39°08'36"W077°12'56"	fem1POLQA.PCM	Good	3.31	64.02	-8.81	5.29	0	0	0	0.57	0.41	2	I_GLRobFaxVQTTTest_VQFXO-2_20150816082807
08/16/2015 08:31:52	08/16/2015 08:28:07	GLRobFaxVQTTTest	VQFXO-1	N39°08'36"W077°12'56"	fem1POLQA.PCM	Good	3.11	60.28	-9.81	3.72	3.94	-7.88	0	0.57	0.40	2	C_GLRobFaxVQTTTest_VQFXO-1_20150816082807
08/16/2015 08:31:33	08/16/2015 08:28:07	GLRobFaxVQTTTest	VQFXO-2	N39°08'36"W077°12'56"	fem1POLQA.PCM	Good	3.17	61.39	-8.82	5.31	1.25	0	2.50	0.57	0.41	2	I_GLRobFaxVQTTTest_VQFXO-2_20150816082807
08/16/2015 08:31:16	08/16/2015 08:28:07	GLRobFaxVQTTTest	VQFXO-1	N39°08'36"W077°12'56"	fem1POLQA.PCM	Good	3.02	58.38	-9.82	3.96	1.94	-3.88	0	0.57	0.41	2	C_GLRobFaxVQTTTest_VQFXO-1_20150816082807
08/16/2015 08:26:20	08/16/2015 08:23:00	GLRobFaxVQTTTest	VQFXO-1	N39°08'36"W077°12'57"	fem1POLQA.PCM	Good	3.05	59.09	-9.82	2.02	4	-8	0	0.57	0.41	2	C_GLRobFaxVQTTTest_VQFXO-1_20150816082300
08/16/2015 08:22:05	08/16/2015 08:17:52	GLRobFaxVQTTTest	VQFXO-2	N39°08'36"W077°12'57"	fem1POLQA.PCM	Good	3.15	60.99	-8.80	5.52	3.88	0	7.75	0.57	0.41	2	I_GLRobFaxVQTTTest_VQFXO-2_20150816081752
08/16/2015 08:21:48	08/16/2015 08:17:52	GLRobFaxVQTTTest	VQFXO-1	N39°08'36"W077°12'57"	fem1POLQA.PCM	Good	3.02	58.48	-9.80	3.87	1.88	-3.75	0	0.57	0.41	2	C_GLRobFaxVQTTTest_VQFXO-1_20150816081752
08/16/2015 08:21:30	08/16/2015 08:17:52	GLRobFaxVQTTTest	VQFXO-2	N39°08'36"W077°12'57"	fem1POLQA.PCM	Good	3.38	65.42	-8.79	5.60	0	0	0	0.57	0.41	2	I_GLRobFaxVQTTTest_VQFXO-2_20150816081752

POLQA 统计

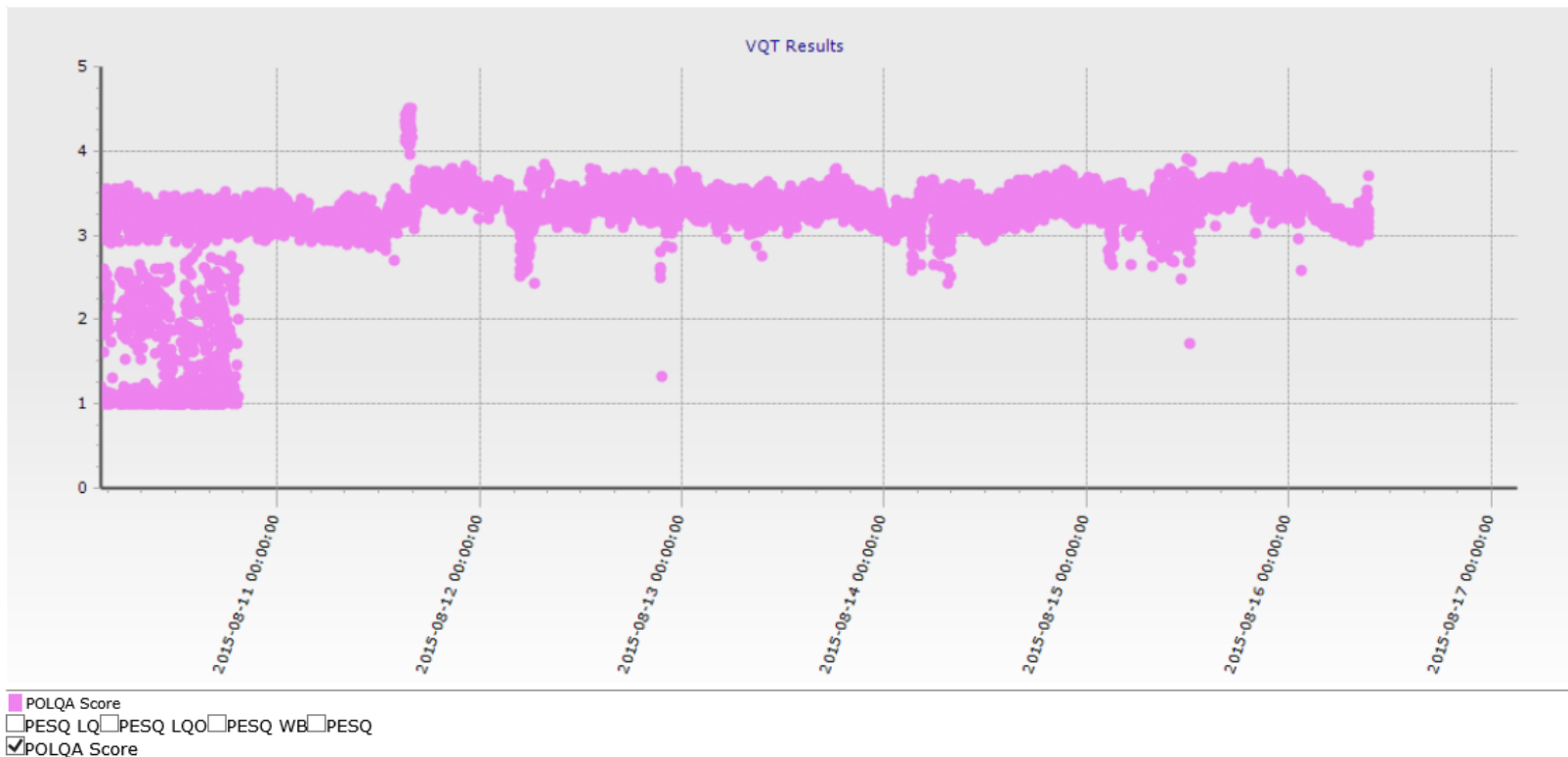
VQT POLQA Measurements																			
VQual Call ID	Average Of POLQA Score	MAX Of POLQA Score	MIN Of POLQA Score	Average Of EModel (S-factor)	MAX Of EModel (S-factor)	MIN Of EModel (S-factor)	Average Of Speech Level Gain (dBz)	MAX Of Speech Level Gain (dBz)	MIN Of Speech Level Gain (dBz)	Average Of Noise Level Gain (dBz)	MAX Of Noise Level Gain (dBz)	MIN Of Noise Level Gain (dBz)	Average Of Jitter Ave (ms)	MAX Of Jitter Max (ms)	MIN Of Jitter Min (ms)	Average Of Active Speech Ratio - Ref (%)	Average Of Active Speech Ratio - Dug (%)	Average Of Number of Interference	Total Record
	1.38	4.73	0	04.51	000	-1	-23.89	17.16	-971.83	-23.21	01.36	-930.44	0.38	414.33	-10	0.61	0.54	0.72	2178
BALANCEDVQIETDTEST	4.49	4.50	1.08	09.21	000	12.87	-2.72	-1.86	-10.62	-4.41	11.60	-14.22	0	0	0	0.96	0.59	1	1154
POORVQIETDTEST	4.43	4.50	0	05.82	000	0	04.43	1.97	-46.58	-6.21	-21.23	0.55	23.88	-15.62	0.92	0.60	1.38	17195	
BLUEFOOTPOLQAQTEST	0.23	4.31	1.02	02.54	08.73	9.08	-3.09	1.37	-11.39	-3.94	-10.52	-18.82	32.85	1.56	-1323.69	0.59	0.37	1.89	44
INTNET	0.50	0.50	0.50	000	000	100	112.23	111.96	-13.13	-17.18	-16.23	0	0	0	0	0.97	0.53	14	14
BLUEFOOTHVQIETDTEST	0.44	4.22	1.17	07.23	05.74	17.08	-3.28	-1.49	-4.98	-5.64	-1.88	-0.50	0	0	0	0.93	0.66	1	11
Dim7inZiaTbvoice	4.35	4.50	1.08	06.08	000	12.79	-5.67	-13.14	-8.40	-4.42	-20.13	0	0	0	0	0.96	0.66	1	45
BluefootPOLQAMer	0.01	0.01	1.02	07.58	01.79	0.75	17.64	19.98	-978.83	-15.48	-1.84	-937.32	17.91	28.88	-824.12	0.54	0.43	2	126
ITTTDTEST	1.09	1.05	1.03	11.39	11.39	11.39	45.90	45.90	45.90	-30.24	-30.24	0	0	0	0	0.97	0.96	1	1
IMVQIET	0.19	0.50	0.08	00.47	000	29.70	27.01	-4.70	-15.97	-15.97	-16.92	0	0	0	0	0.87	0.64	1	14
BALANCEDPOLQAQTEST	0.94	4.50	1.04	04.44	000	10.62	-14.14	2.48	-58.19	-8.59	0.67	-22.42	18.44	382.94	-320.81	0.54	0.46	2	43
BALANCEDVQIETDTEST	4.48	4.44	1.01	00.73	000	11	12.84	0.41	-33.78	-8.86	0.95	-28.03	0.10	198.02	-145.29	0.88	0.63	1.08	4384
BALANCEDVQIETASVNC	0.40	4.50	1.03	02.22	000	11.01	-16.47	-9.25	-31.62	-10.09	0.82	-18.20	0	0	0	0.97	0.48	1	26



POLQA

随时间推移的VQT结果

Analysis Graphics(Display duration: 08-10-2015 03:04:11 - 08-17-2015 03:07:11)



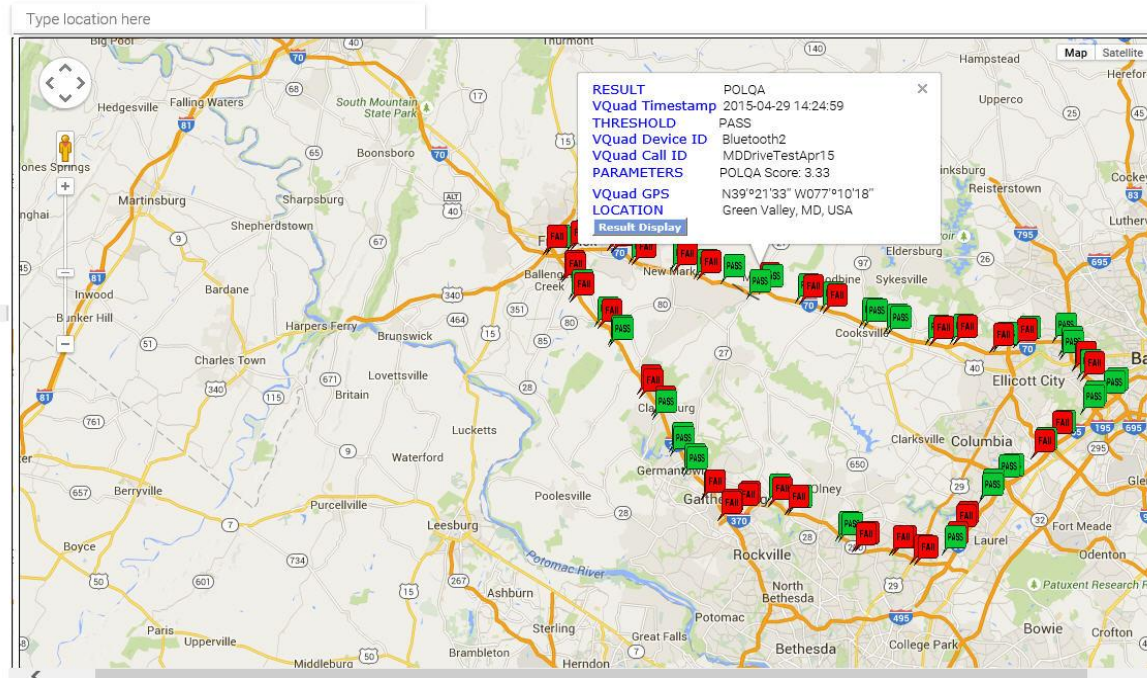
谷歌地图绘制

Google maps plotting

Select Configuration OFF ON Refine search
POLQA Score

Draw route line by Default

Draw lines as



Pin Legends

PASS = POLQA - PASS, Threshold Type (POLQA Score >= 3)

FAIL = POLQA - FAIL, Threshold Type (POLQA Score < 3)

谢谢