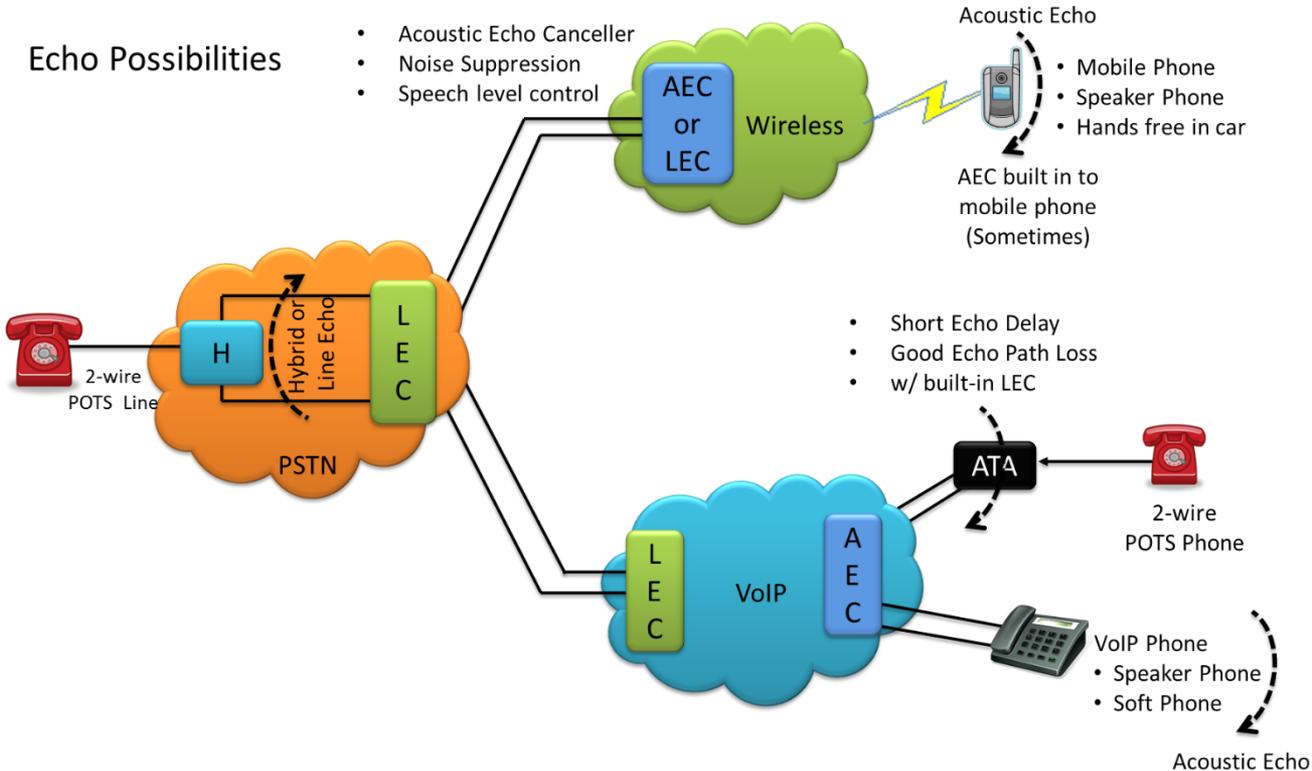

Echo Canceller Testing Solutions

(VoIP, TDM, & Wireless Networks)



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>

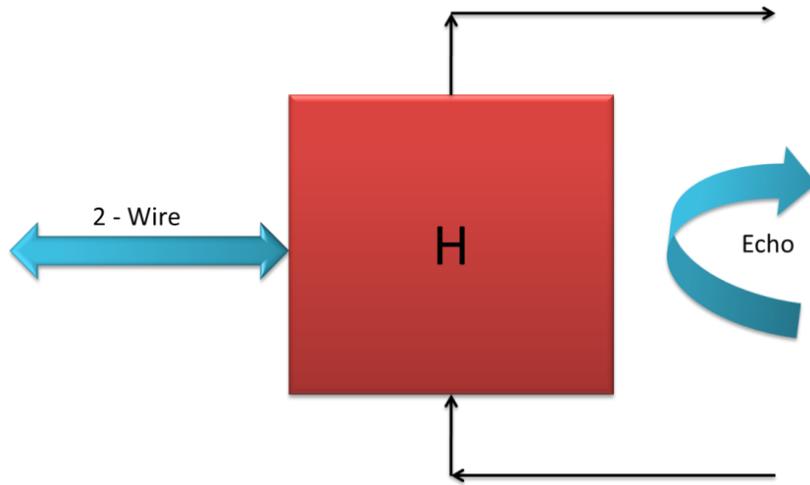
Where are the echoes in your network - TDM, VoIP, Wireless ?



Echo - Overview

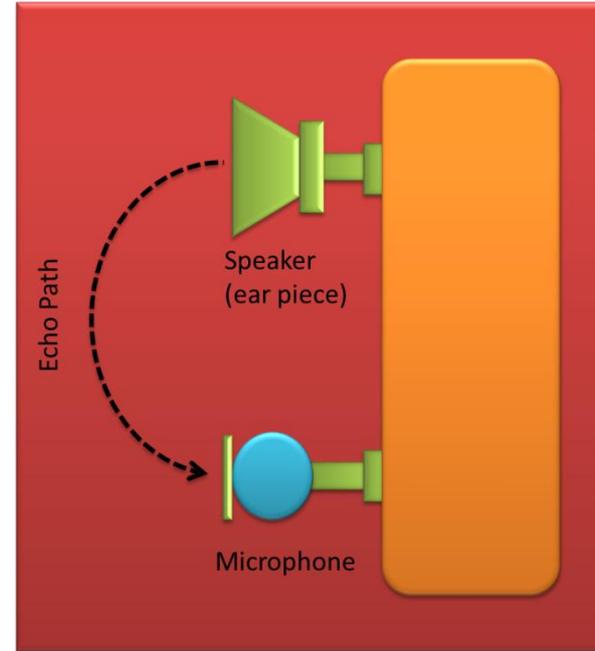
- In today's digital networks, almost all calls except local wire-line calls require an echo canceller
- Talker echo is disturbing if :
 - echo delay > 25 ms and / or
 - echo loss < 46 dB
- Terrestrial voice networks have two echo cancellers, one at each tail
- Cellular networks may have a line echo canceller to cancel terrestrial tail echo and an acoustic echo canceller to cancel mobile acoustic echo
- VoIP networks may have a line echo canceller to cancel terrestrial tail echo and an acoustic echo canceller to cancel speaker acoustic echo

Line Echo and Acoustic Echo Cancellers



Hybrid Echo (Line or electric echo):

Imperfect signal separation in the hybrid creates the echo.



Acoustic Echo:

Poor voice coupling between the earpiece and microphone in handsets and hands-free devices creates Acoustic Echo

GL's EC Testing Solutions

TDM Solutions

Wireless Solutions

VoIP Solutions

EC Testing in TDM, Analog, Wireless Networks

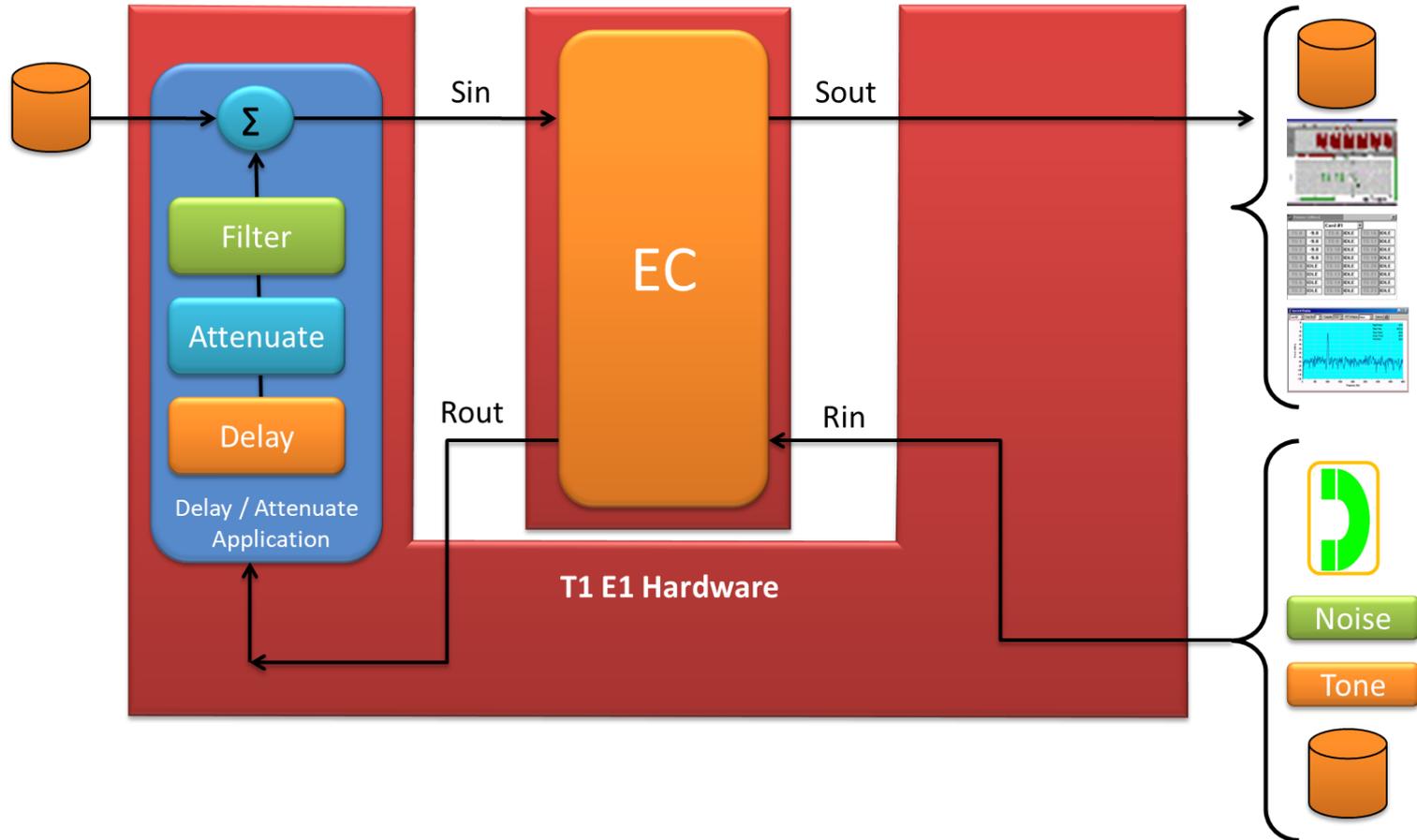
Solutions and Techniques

- Quick Testing and Verification of EC Performance
- Field Characterization of Echo Paths, Impulse Responses, Delay, & Loss Statistics
- Field Measurement of Echo Return Loss and Echo Loop Delay
- Live Monitoring of EC Operation
- EC Compliance Testing per G.168 Using Manual Methods
- Automated EC Compliance Testing per G.168 Standard

Solutions and Techniques (Contd.)

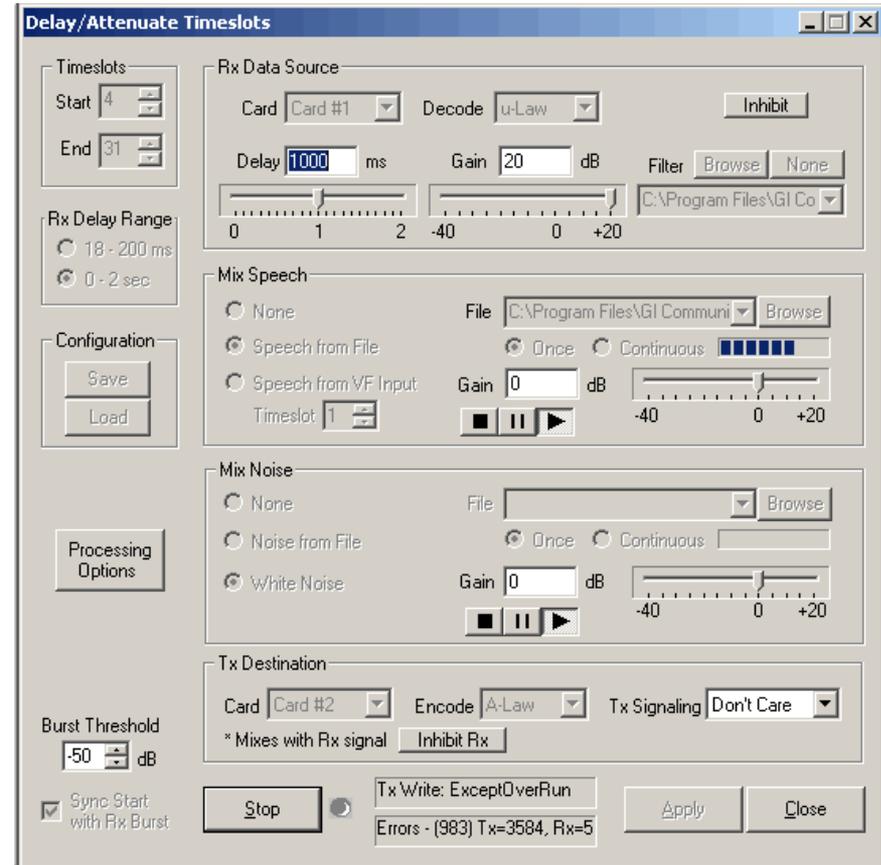
- Semi-Automated and Scripted EC Testing
- Testing Developmental EC Software (w/o EC Hardware)
- End-to-End Subjective Testing
- Automated Acoustic EC Testing (Digital, Analog)
- Network Wide Monitoring of Echo and Voice Quality

Quick Testing and Verification of EC Performance

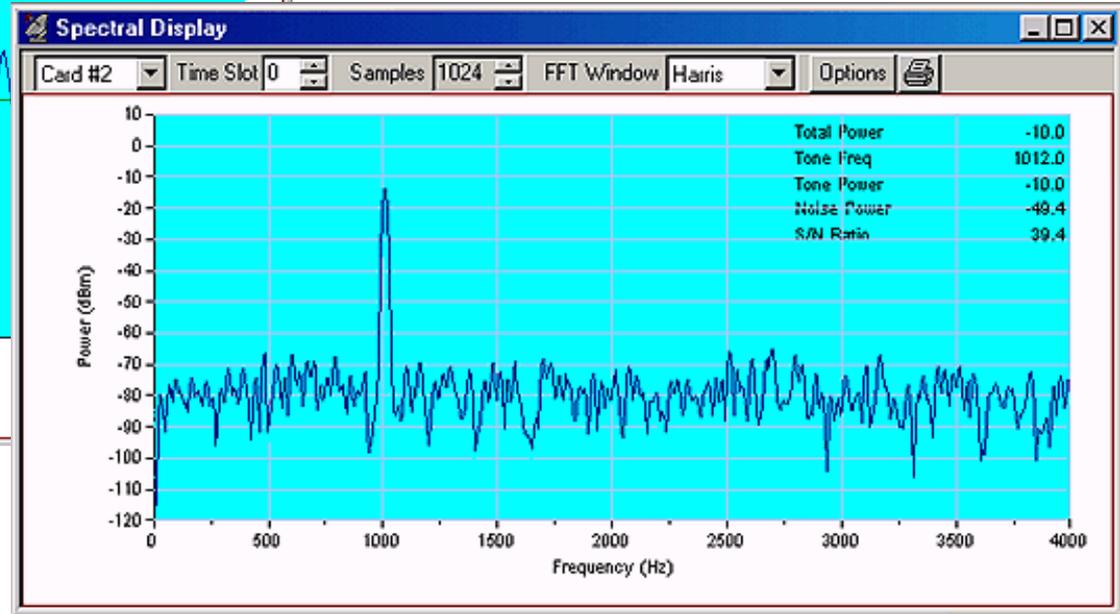
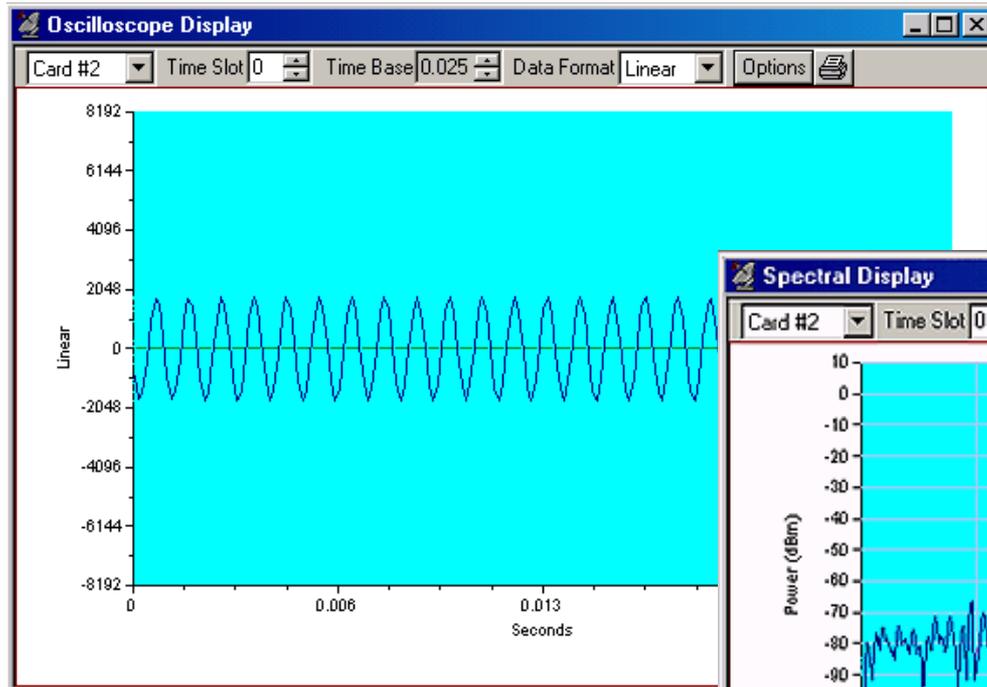


Delay/Attenuate Timeslot

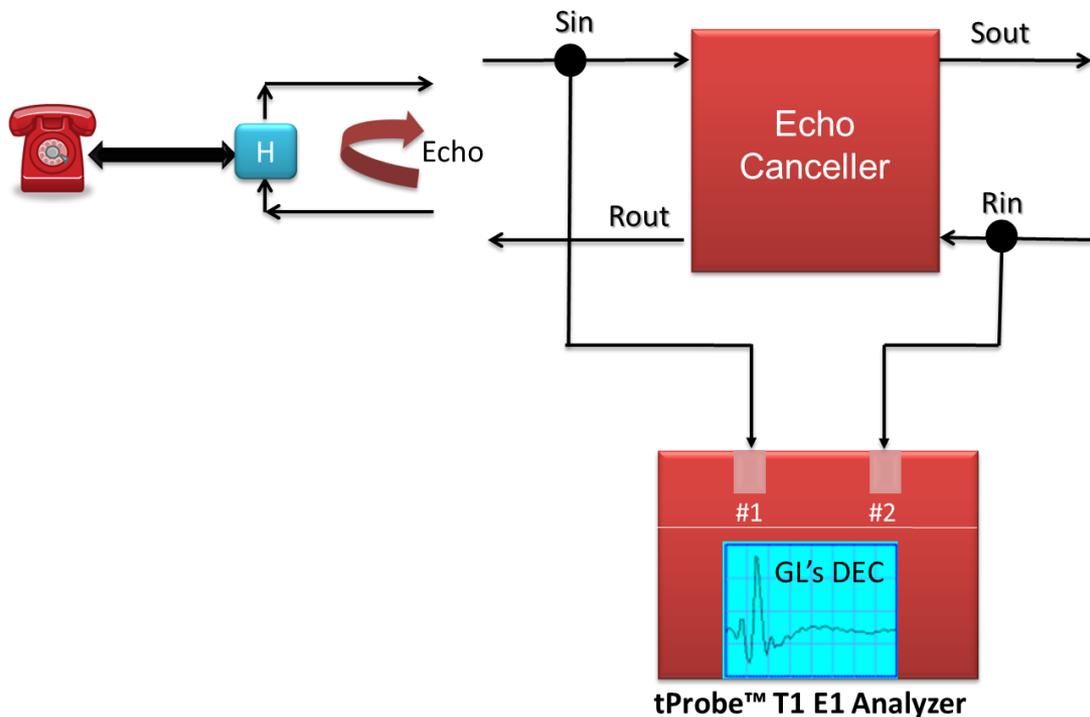
- Allows to apply delay, attenuation, and/or filtering to a received signal on any number of timeslots
- Mix in additional signals from a number of sources, including
 - Speech and/or Noise signals from files
 - Speech signals inserted via VF input
 - Gaussian noise signals generated internally



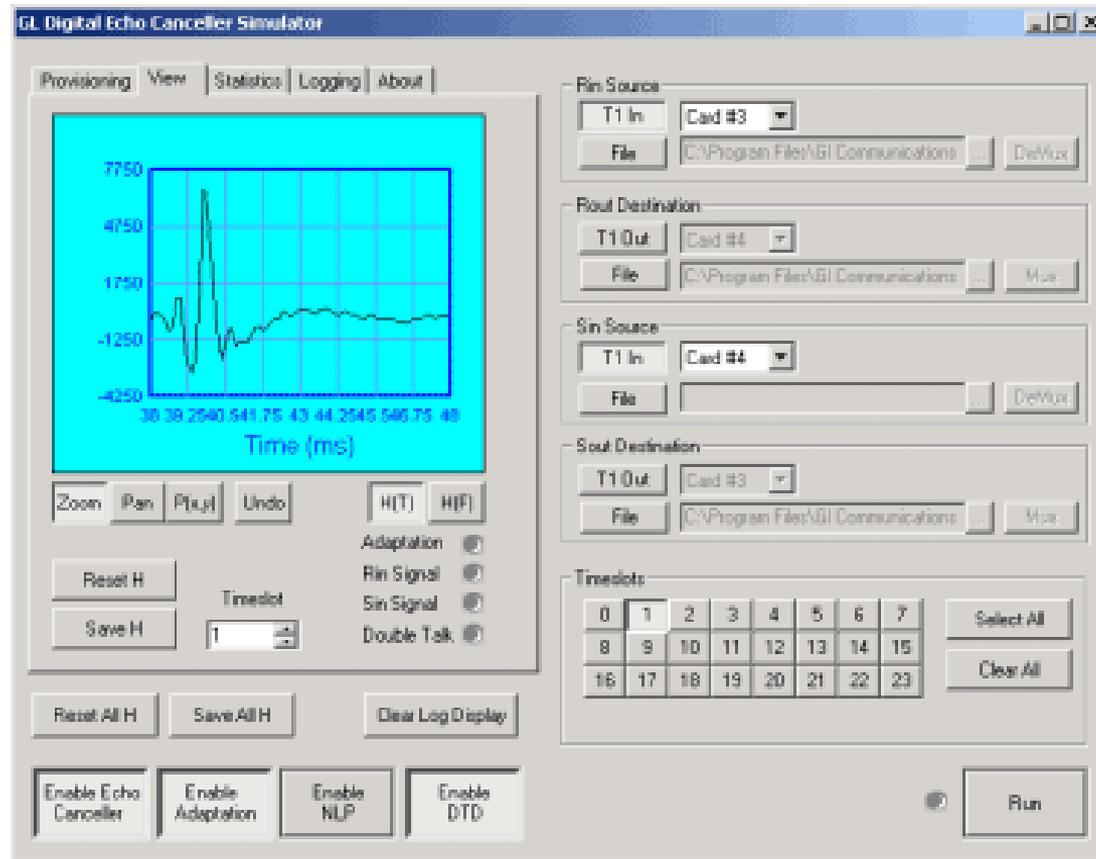
Oscilloscope and Power Spectral Display



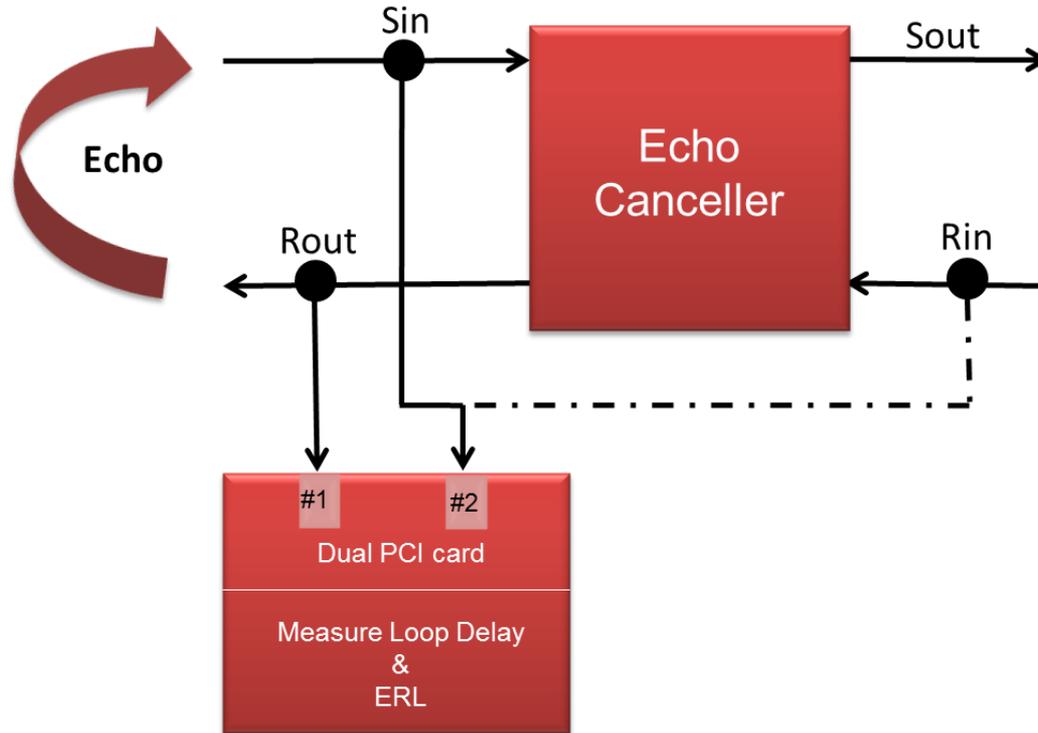
Accurate Field Characterization of Echo Path, Impulse Response, Delay, Loss



Impulse Response Characteristics



Field Measurement of Echo Return Loss and Echo Loop Delay



Measure Loop Delay and Echo Return Loss

Delay/ERL

Original data Card #1 Returned data Card #2

Delay ERL		Delay ERL		Delay ERL		Delay ERL	
0	...	8	...	16	...	24	...
1	...	9	...	17	876 -44.8	25	876 -44.8
2	...	10	876 -44.8	18	876 -44.8	26	876 -44.8
3	...	11	876 -44.8	19	876 -44.8	27	876 -44.8
4	876 -44.8	12	876 -44.8	20	876 -44.8	28	876 -44.8
5	876 -44.8	13	...	21	876 -44.8	29	...
6	876 -44.8	14	...	22	...	30	...
7	876 -44.8	15	...	23	...	31	...

Select All Timeslots Deselect All Timeslots

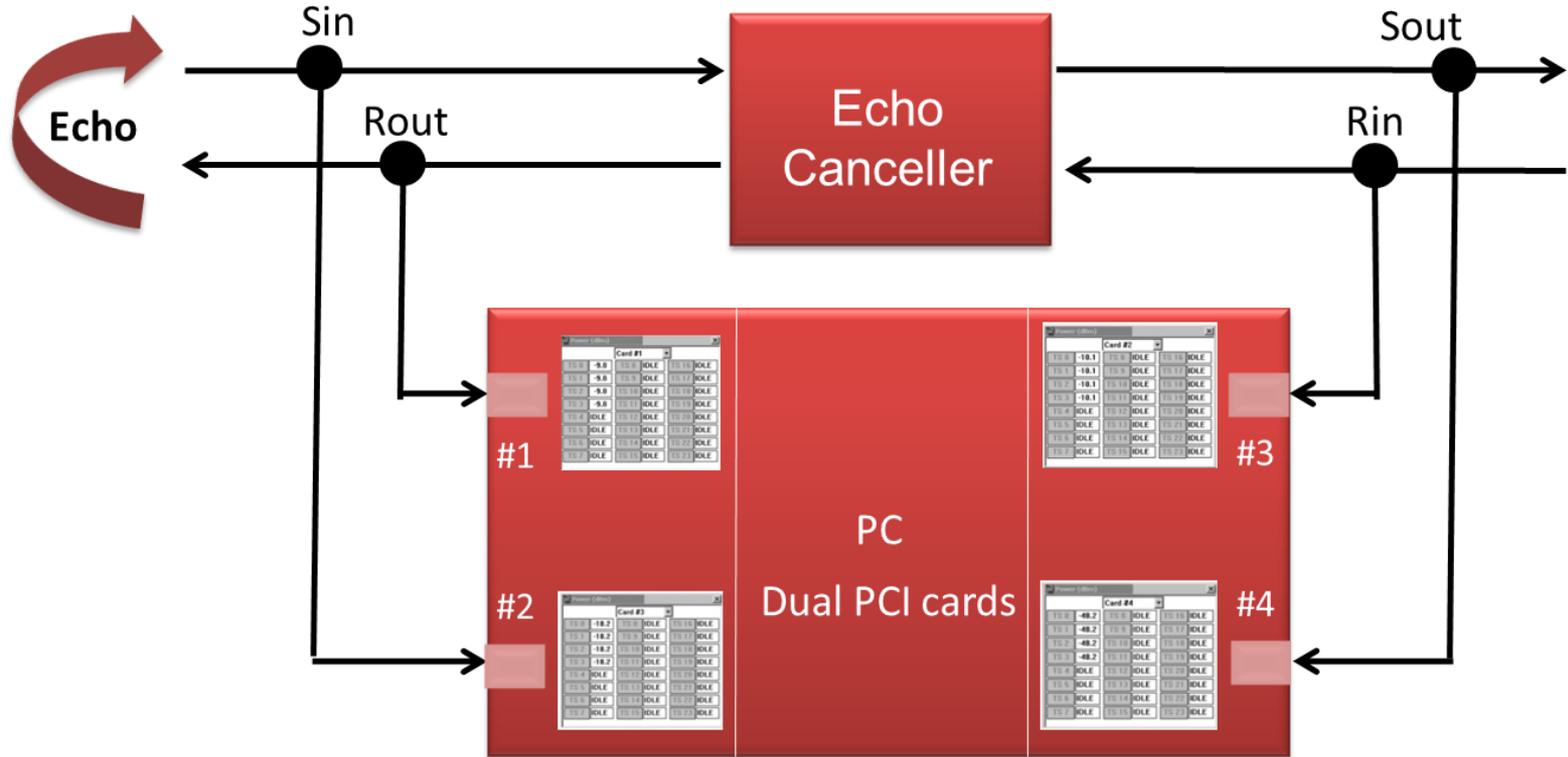
Delay (ms): Minimum 0 Maximum 1000
ERL (dB): Minimum 6 Maximum 60

Original Data Source

E1 Input Only when Off Hook
 Gaussian Noise 0 dBm Signaling Don't Care
 File A-Law Samples\2x2lcq1 a.pcm

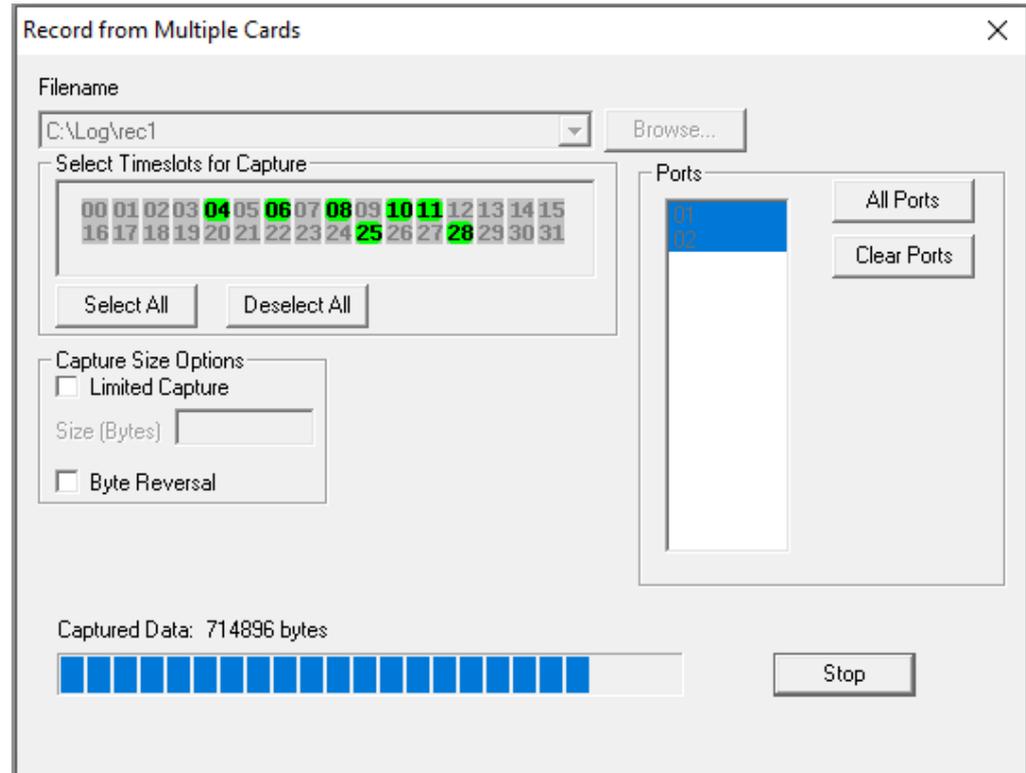
Stop

Live Monitoring of EC Operation



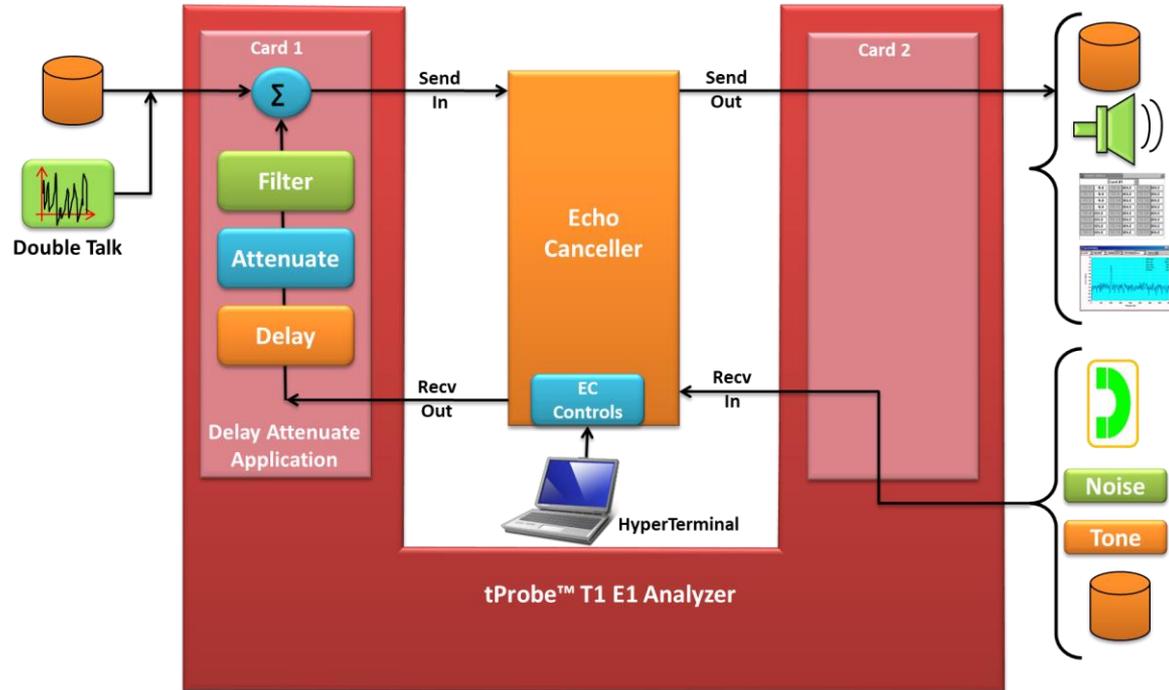
Record From Multiple Cards

- Capture of data from non-contiguous timeslots
- Capture of bytes in reverse or normal order
- Limited capture (specific number of bytes) to files from all or selected timeslots



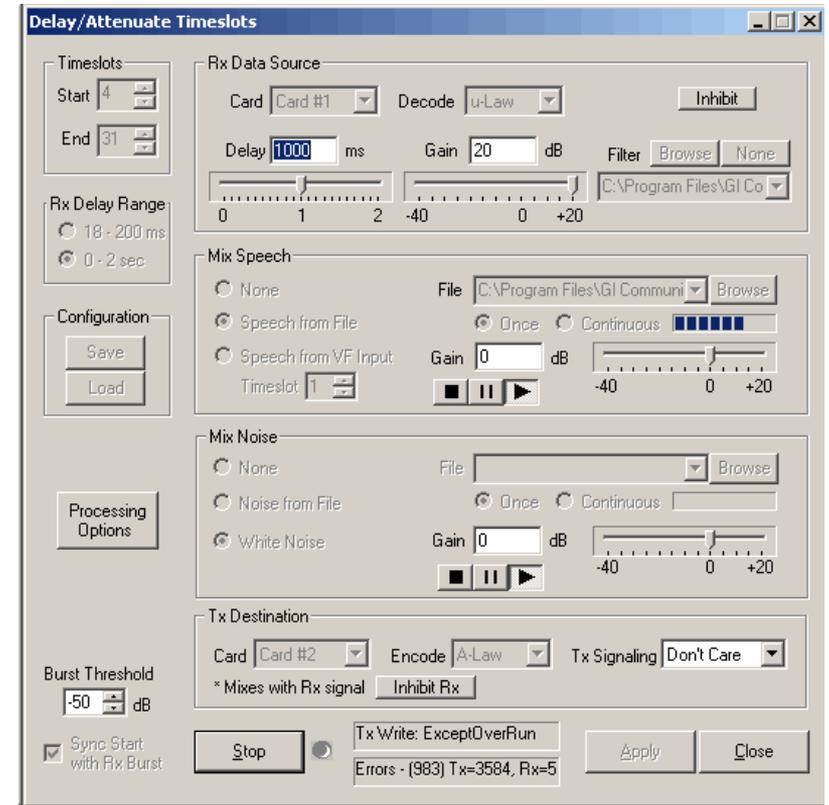
Manual EC G.168 Compliance Testing

- Product used – Playback and Record File (for manual)
- Other Related Products – Delay / Attenuate Timeslot, Transmit Tone, Digits, Noise, and GLC View



Delay/Attenuate Timeslot

- Allows to apply delay, attenuation, and/or filtering to a received signal on any number of timeslots
- Mix in additional signals from a number of sources, including
 - Speech and/or Noise signals from files
 - Speech signals inserted via VF input
 - Gaussian noise signals generated internally



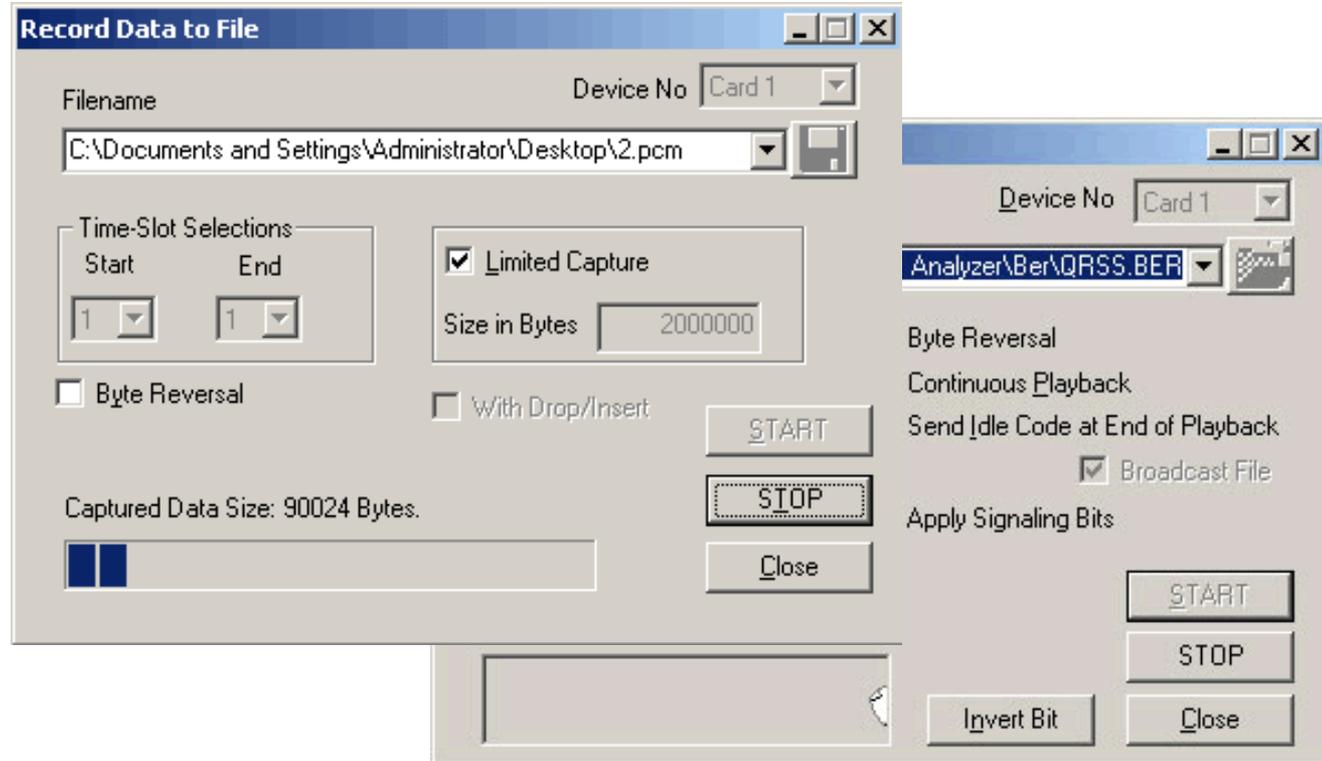
GLC View Analysis

- Displays files captured during G.168 testing
- Linear and Power displays shown



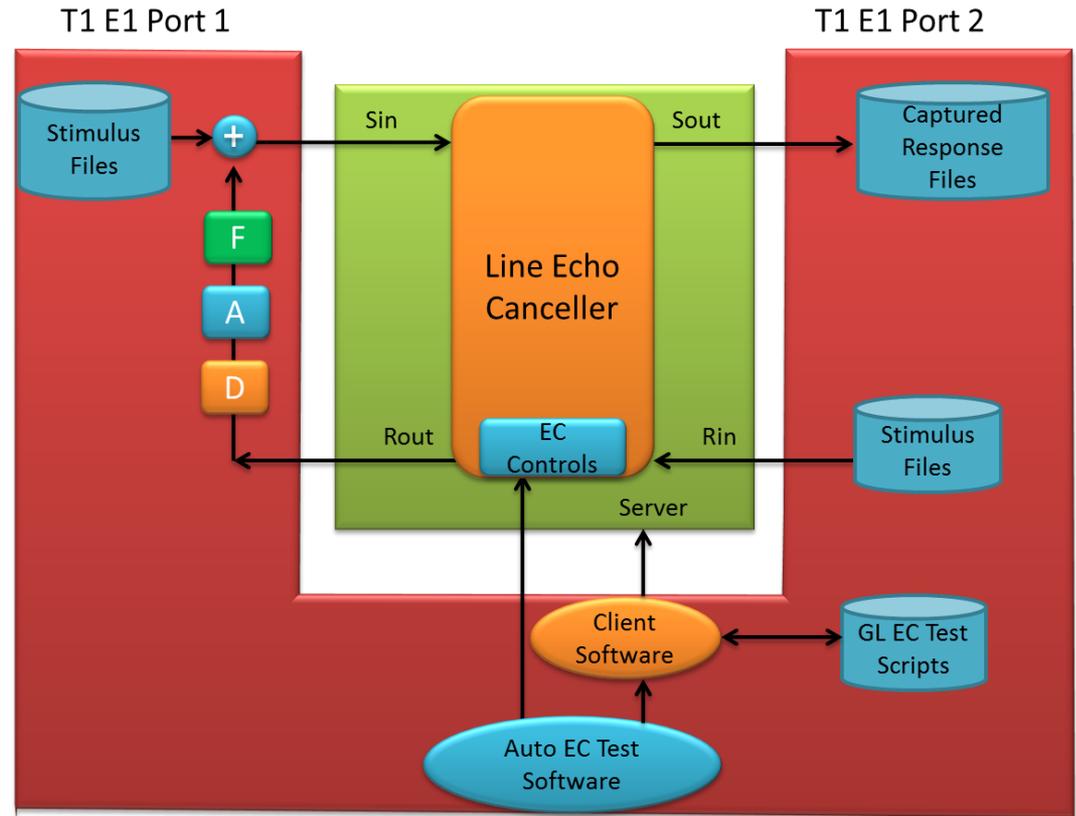
Playback and Record File

- Far End emulation is performed with GUI-based File Playback and Record Software
- Near End emulation of hybrids using GUI based Delay / Attenuate Software
- EC control using standard terminal emulation software, e.g. HyperTerminal



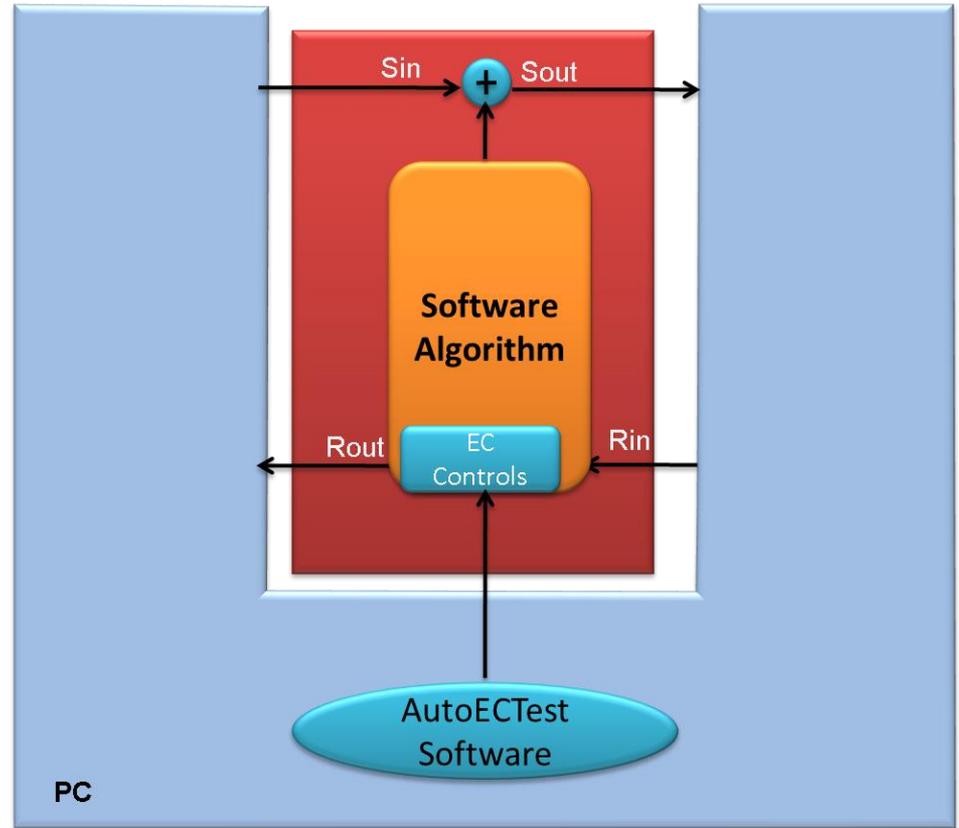
Automated Echo Cancellation Testing - Solution 1

- Uses WCS (Windows Client Server) software to transmit/receive files and to simulate the echoes in real time



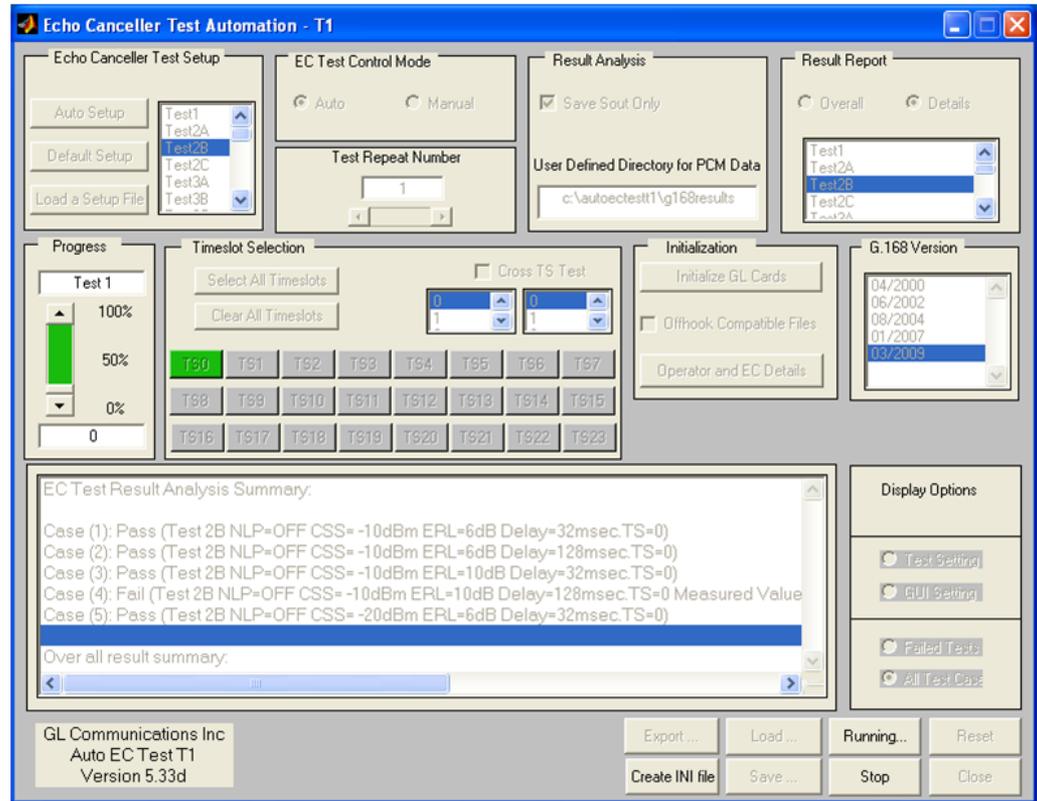
Automatic Echo Canceller Test Software - Solution 2

- This solution is designed for special applications where the LEC is still in development form, i.e. software only. Also, no GL hardware is required, as everything is file based



Automated EC Test Software for T1

- Simulates an actual echo loop with echo path delay, hybrid filter, and attenuation
- Auto analysis of the response according to G.168 (04/2000), G.168 (06/2002), and G.168 (08/2004)
- Auto or Manual control of the EC during testing
- Detailed graphical results for individual overall test



Auto EC Test for E1

Echo Cancellor Test Automation - E1

Echo Cancellor Test Setup

Auto Setup
Default Setup
Load a Setup File

Test1
Test2A
Test2B
Test2C
Test3A
Test3B
Test3C

EC Test Control Mode

Auto Manual

Result Analysis

Save Sout Only

Result Report

Overall Details

Test1
Test2A
Test2B
Test2C
Test3A

Progress

Test 1

100%
50%
0%

0

Timeslot Selection

Enable TS0
Select All Timeslots
Clear All Timeslots

Enable TS16
Cross TS Test

TS0	TS1	TS2	TS3	TS4	TS5	TS6	TS7
TS8	TS9	TS10	TS11	TS12	TS13	TS14	TS15
TS16	TS17	TS18	TS19	TS20	TS21	TS22	TS23
TS24	TS25	TS26	TS27	TS28	TS29	TS30	TS31

Initialization

Initialize GL Cards
Initialize EC Status
Operator and EC Details

G.168 Version

04/2000
06/2002
08/2004
01/2007
03/2009

Display Window

Display Window

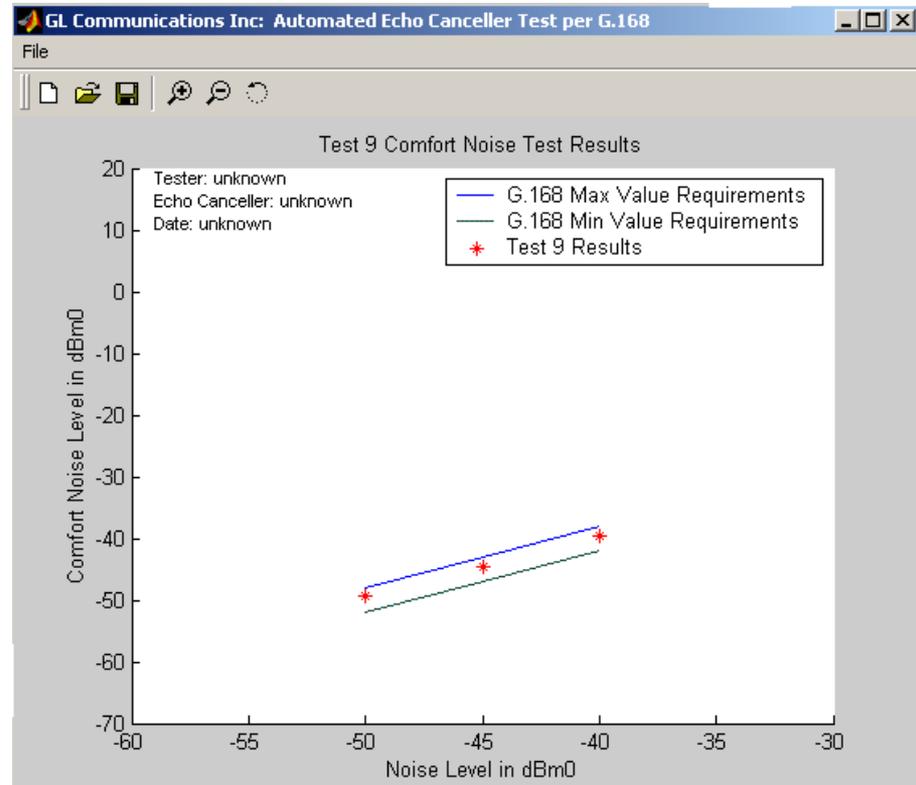
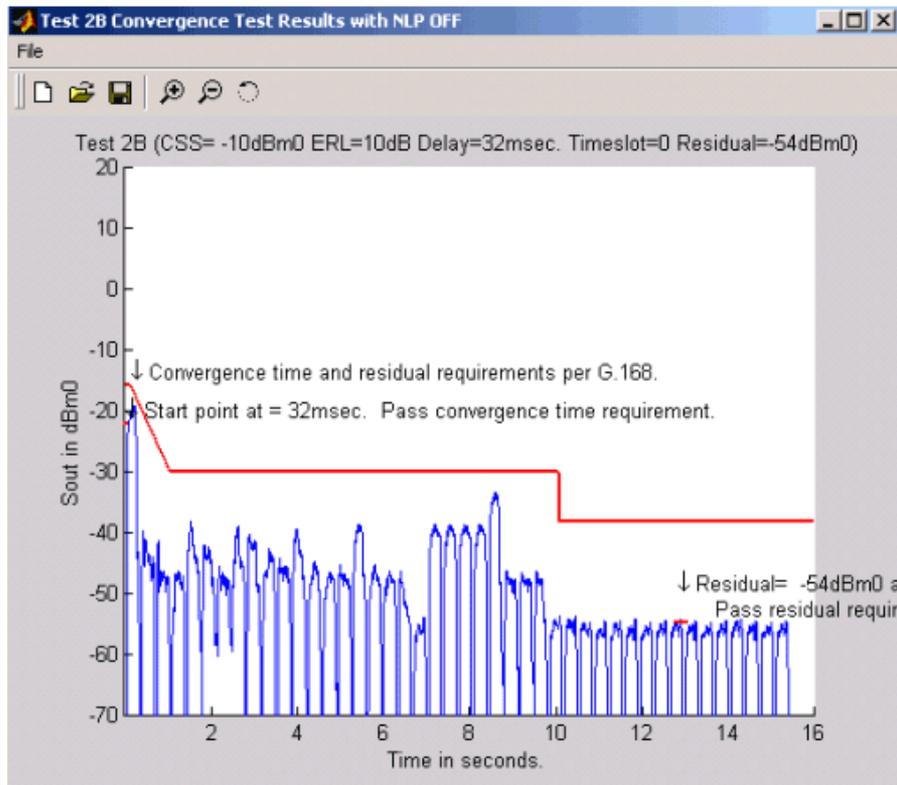
Display Options

Test Setting
GUI Setting
Failed Tests
All Test Case

GL Communications Inc
Auto EC Test E1
Version 5.33d

Export ... Load ... Run Reset
Create INI file Save ... Stop Close

Auto EC Test Results



Auto EC Test Results in Text and Excel Form

GL Communications Inc. ITU-T G.168 Test Suites

EC Test Result Summary

Tester: unknown
Echo Canceller: unknown
Date: unknown

Case 1:	Pass	Test 2B	NLP=OFF	Rin= 0dBm0	ERL= 10dB
Case 2:	Pass	Test 2B	NLP=OFF	Rin= 0dBm0	ERL= 10dB
Case 3:	Pass	Test 2B	NLP=OFF	Rin= -10dBm0	ERL= 10dB
Case 4:	Pass	Test 2B	NLP=OFF	Rin= -10dBm0	ERL= 10dB
Case 5:	Pass	Test 2B	NLP=OFF	Rin= -20dBm0	ERL= 10dB
Case 6:	Pass	Test 2B	NLP=OFF	Rin= -20dBm0	ERL= 10dB
Case 7:	Pass	Test 2B	NLP=OFF	Rin= -30dBm0	ERL= 10dB
Case 8:	Pass	Test 2B	NLP=OFF	Rin= -30dBm0	ERL= 10dB

Microsoft Excel - Test1to10Bresult.csv

	A	B	C	D	E	F	G	H	I	J	K
1	Test Case	Pass/Fail	Test No.	NLP	Timeslot	Filter	ERL(dB)	Delay(ms)	Rin(dBm)	Required(dB)	Residual(dB)
2	1	Pass	Test 1	ON	1 m1	6	6	28	0	-55	-66.09
3	2	Pass	Test 1	ON	1 m1	6	6	32	0	-55	-66.09
4	3	Pass	Test 1	ON	1 m1	6	6	64	0	-55	-66.09
5	4	Fail	Test 1	ON	1 m1	6	128	0	-55	-12.3	
6	5	Pass	Test 1	ON	1 m1	10	28	0	-55	-66.09	
7	6	Pass	Test 1	ON	1 m1	10	32	0	-55	-66.09	
8	7	Pass	Test 1	ON	1 m1	10	64	0	-55	-66.09	
9	8	Fail	Test 1	ON	1 m1	10	128	0	-55	-16.6	
10	9	Pass	Test 1	ON	1 m1	12	28	0	-55	-66.09	
11	10	Pass	Test 1	ON	1 m1	12	32	0	-55	-66.09	
12	11	Pass	Test 1	ON	1 m1	12	64	0	-55	-66.09	
13	12	Fail	Test 1	ON	1 m1	12	128	0	-55	-24.95	
14	13	Pass	Test 1	ON	1 m1	14	28	0	-55	-66.09	
15	14	Pass	Test 1	ON	1 m1	14	32	0	-55	-66.09	
16	15	Pass	Test 1	ON	1 m1	14	64	0	-55	-66.09	
17	16	Pass	Test 1	ON	1 m1	14	128	0	-55	0	
18	17	Pass	Test 1	ON	1 m1	6	28	-10	-65	-66.09	
19	18	Pass	Test 1	ON	1 m1	6	32	-10	-65	-66.09	
20	19	Pass	Test 1	ON	1 m1	6	64	-10	-65	-66.09	
21	20	Fail	Test 1	ON	1 m1	6	128	-10	-65	-23.6	

Supported G.165 and G.168 Test Cases

Tests		G.165	G.168
Test 1: Steady state residual and returned echo level test (G.168 version 04/2000 only)	NLP On NLP Off	Yes Yes	Yes Yes
Test 2: Convergence test Test 2A: Test 2A Part b (G.168 version 01/2007): Test 2B: Test 2B Part b (G.168 version 01/2007): Test 2C Convergence test in presence of background noise: Test 2C-c (G.168 version 01/2007) : Convergence test with NLP Off and background noise	NLP On Re-convergence with NLP On NLP Off Re-convergence with NLP Off NLP On NLP OFF For noise level -55 dBmO	No No Yes No No No No	Yes Yes Yes Yes Yes Yes Yes
Test 3: Double talk test Test 3A: low cancelled-end level Test 3B: high cancelled-end level Test 3B Part b (G.168 version 01/2007): stability test with low cancelled-end levels Test 3C: simulated conversation		Yes Yes No No	Yes Yes Yes Yes
Test 4: Leak rate test		Yes	Yes
Test 5: Infinite return loss convergence test		Yes	Yes
Test 6: Non-Divergence on narrow-band signal test		Optional	Yes
Test 7: Stability test		Optional	Yes
Test 8: Overload test		Yes	No

Supported G.165 and G.168 Test Cases (Contd.)

Tests		G.165	G.168
Test 8: Non-convergence of EC on SS5/SS6/SS7 tones in-band signaling and continuity check tones		No	Yes
Test 9: Comfort noise test		Yes	Yes
Test 10: Facsimile test			
Test 10A : Cancellor operation on the calling station side	(with NLP On and NLP Off)	No	Yes
Test 10B : Cancellor operation on the called station side	(with NLP On and NLP Off)	No	Yes
Test 12: Residual acoustic echo test		No	Yes
Test 13: Performance with ITU-T low-bit rate coders in echo path		No	Yes
Test 14: Low speed modem test		No	Yes
Test 15: DC Off sets			
Test 15A:		No	Yes
Test 15B:		No	Yes
Test 16: DTMF tests			
Test 16A:DTMF transparency in the presence of a dial tone		No	Yes
Test 16B:DTMF transparency in the presence of speech		No	Yes

Automated EC G.168 Compliant Test Setup

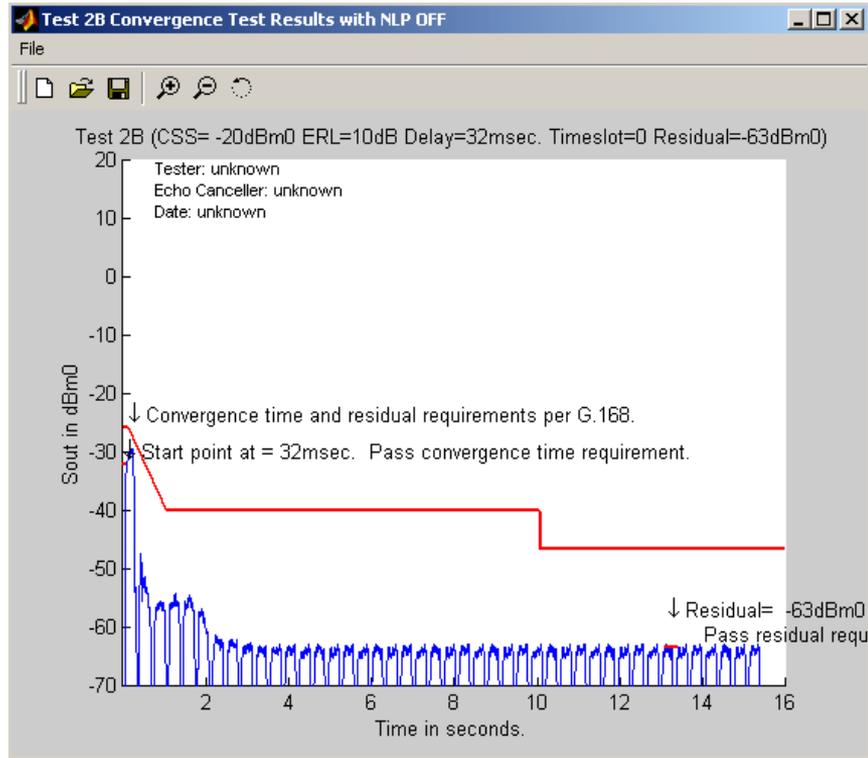
- G.168 (04/2000) - Includes Test 1, Test 2A, Test 2B, Test 2C, Test 3A, Test 3B, Test 3C, Test 4, Test 5, Test 6, Test 7, Test 8, and Test 9
- G.168 (06/2002) – Includes Test 10A and Test 10B
- G.168 (08/2004) - Includes Test 15A and Test 15B
- G.168 (01/2007)- Includes Test 2Ab, Test 2Bb, Test 2Cc, and Test 3Bb
- G.168 (03/2009) - Includes Test 12, Test 13, Test 16A, and Test 16B

The screenshot displays the 'Automated Echo Canceller G.168 Compliant Test Setup' software interface. The window is divided into several sections:

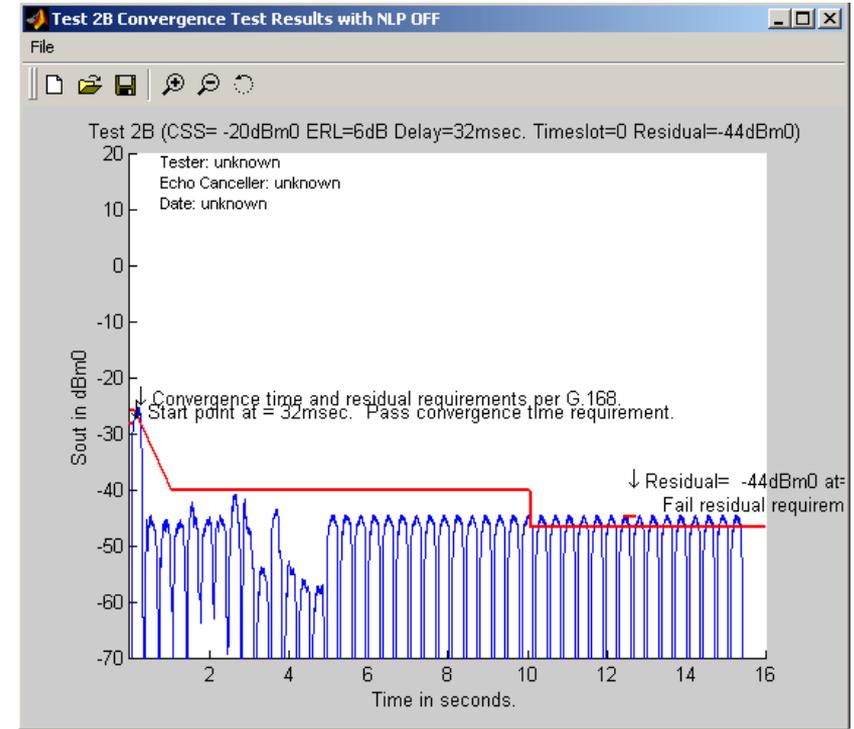
- Echo Path Simulation Settings:** Contains three sub-sections for Echo Path 1, 2, and 3 Hybrid Settings. Each section includes a filter selection (m1, m2, m3, m4), Energy(%), ERL(dB), and Delay(ms) fields.
- Test Signal Settings:** Includes CSS Levels, CSS File, Tone Level for Test 6 & Test 7, Special Inputs for Test 8, Noise Level for Test 9, and Special Inputs for Test 15.
- Test Setting Monitoring:** Divided into 'Overall EC Test Setup' (Summary of Test Setup, Framing format, Total Number of Tests, Estimated time) and 'Parameters for Each Test' (Test 2B-a details like Selected, NLP, HybridType, HybridERL, HybridDelay, Echo Path, and CSSLevel).
- NLP Options:** Includes checkboxes for NLP On/Off and Sgen = -55 dBm0.
- Test Selection Grid:** A grid of buttons for various tests. 'Test 2B-a' is highlighted in yellow.
- Convergence Input for Test 2A/B-b/12:** Includes Time in sec, Delay in ms, ERL in dB, and CSS in dBm0 fields.
- Filter Type:** A dropdown menu with options m1 through m7.
- Version Information:** A red-bordered box in the bottom right corner contains the text 'G.168 Version 03/2009'.
- Buttons:** 'Reset', 'Save', 'Load', and 'Apply' buttons are located at the bottom right.

Detailed Graph of Individual Test Cases

Passed Test 2B

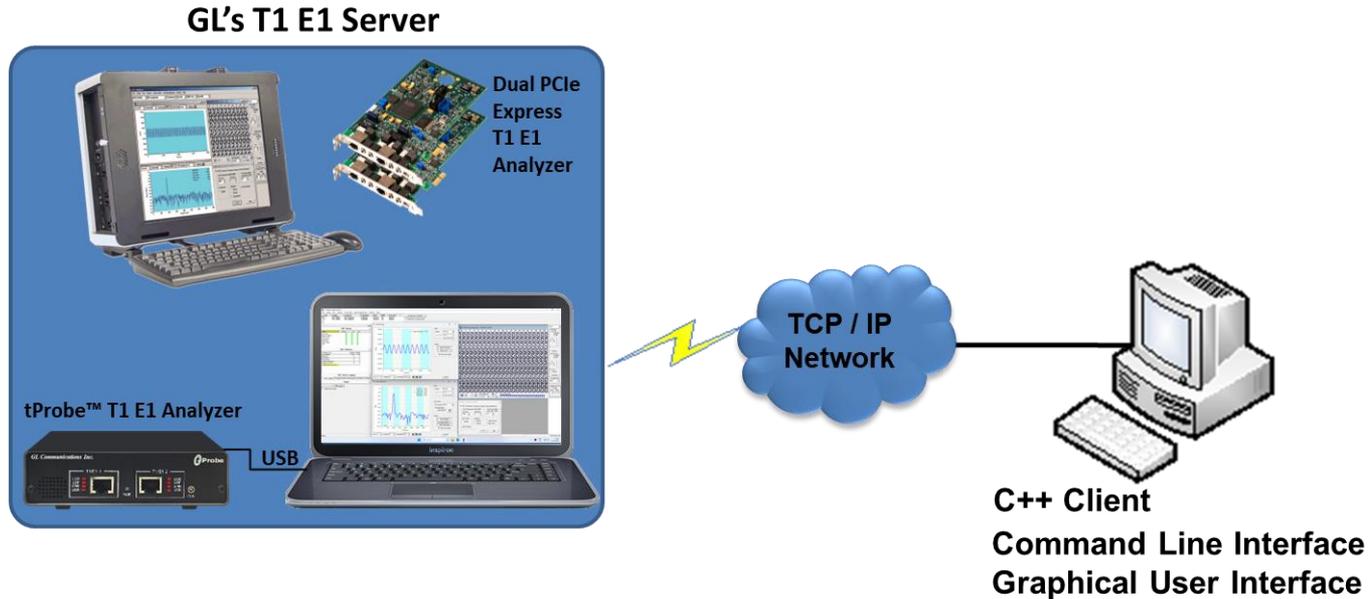


Failed Test 2B

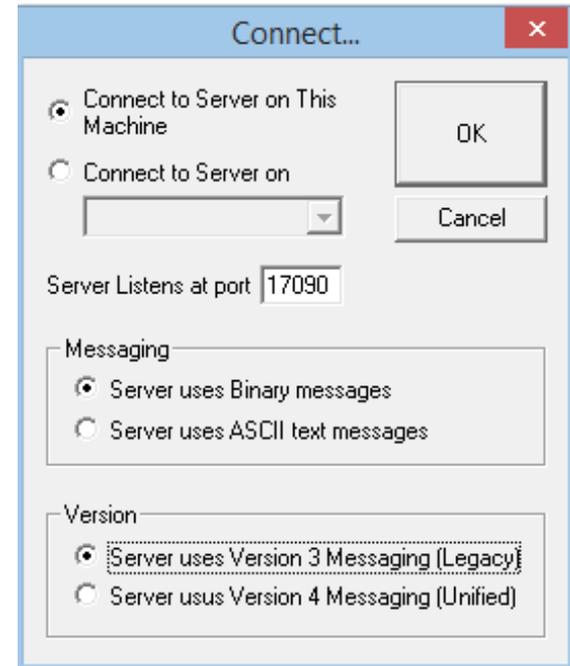
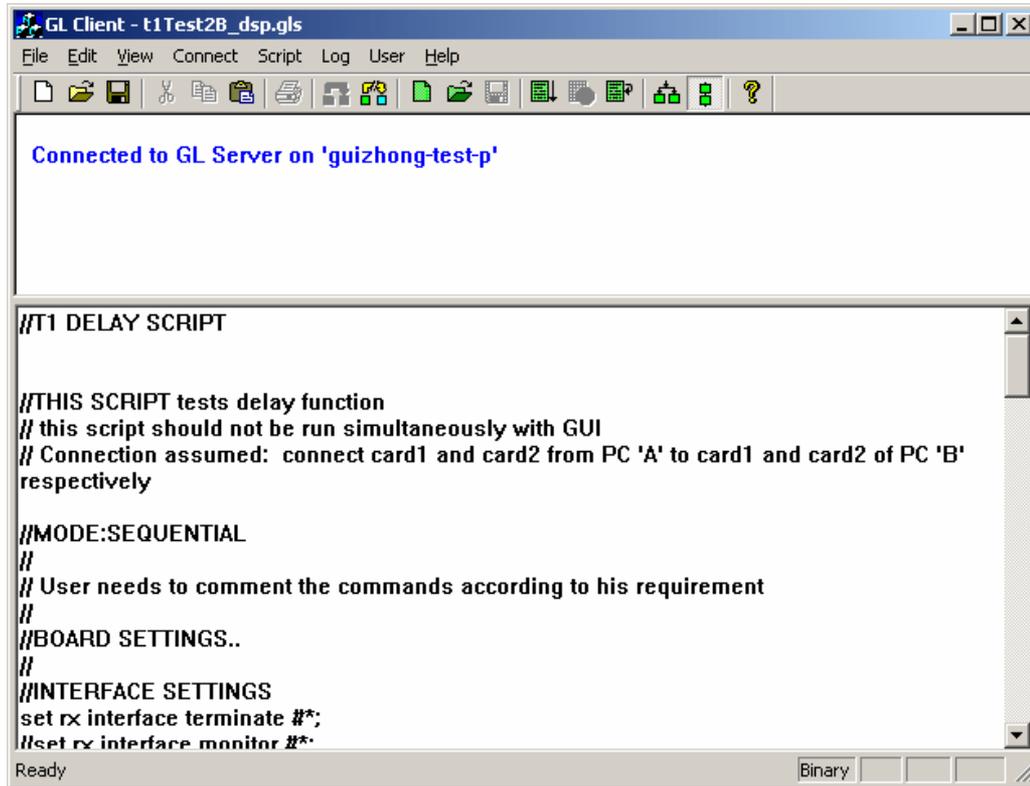


Semi-Automated EC Testing

- Far End and Near End real-time emulation using GL's WCS (scripted) software / language
- Complete G.168 Test Scripts using a variety of Clients (C++, Lab view, Matlab)

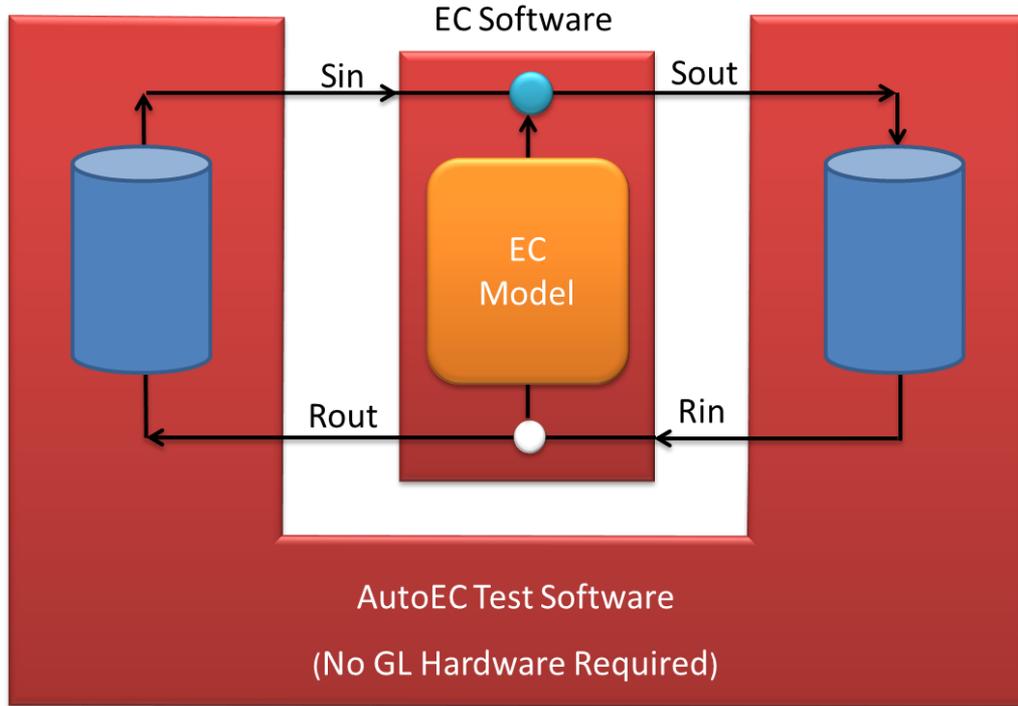


Windows Client / Server Software



Testing Developmental EC Software

EC Software without EC Hardware



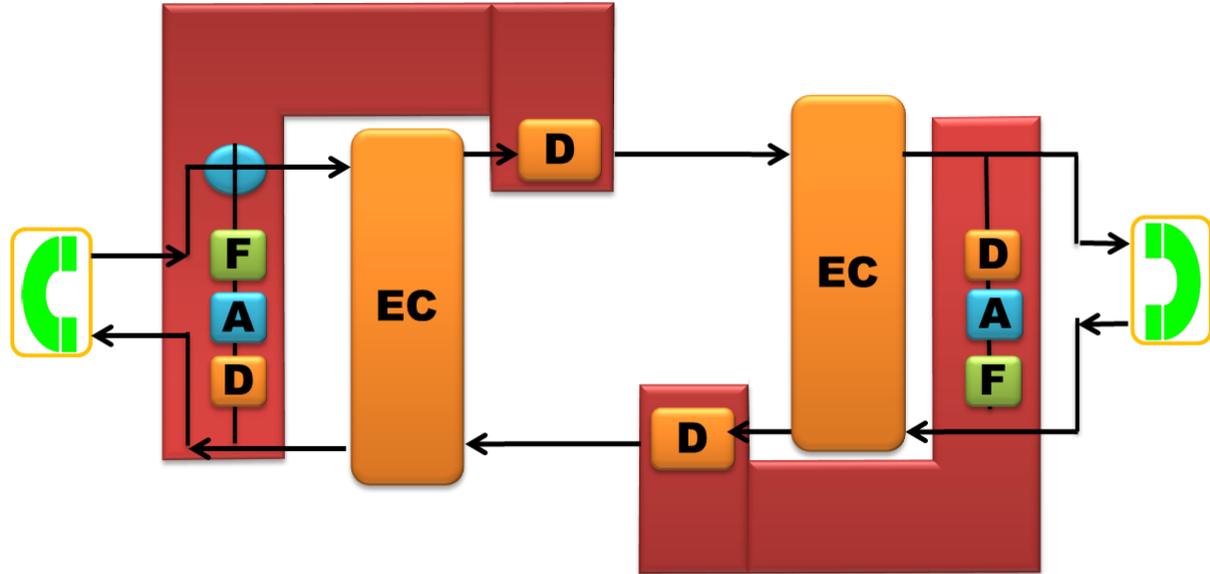
- Product used – Automated EC Testing Software

Testing Developmental EC Software (Contd.)

- AutoECTest Software provides the input files Rin & Sin (with echo) to the EC Software
- EC Software picks up these stimulus files (by frequently polling) and apply them to the EC in synchronous fashion
- EC Software produces the output files Sout and possibly Rout and provides it to the AutoECTest software for analysis
- AutoECTest performs a full analysis (with detailed displays) that results in a "Pass" or "Fail"

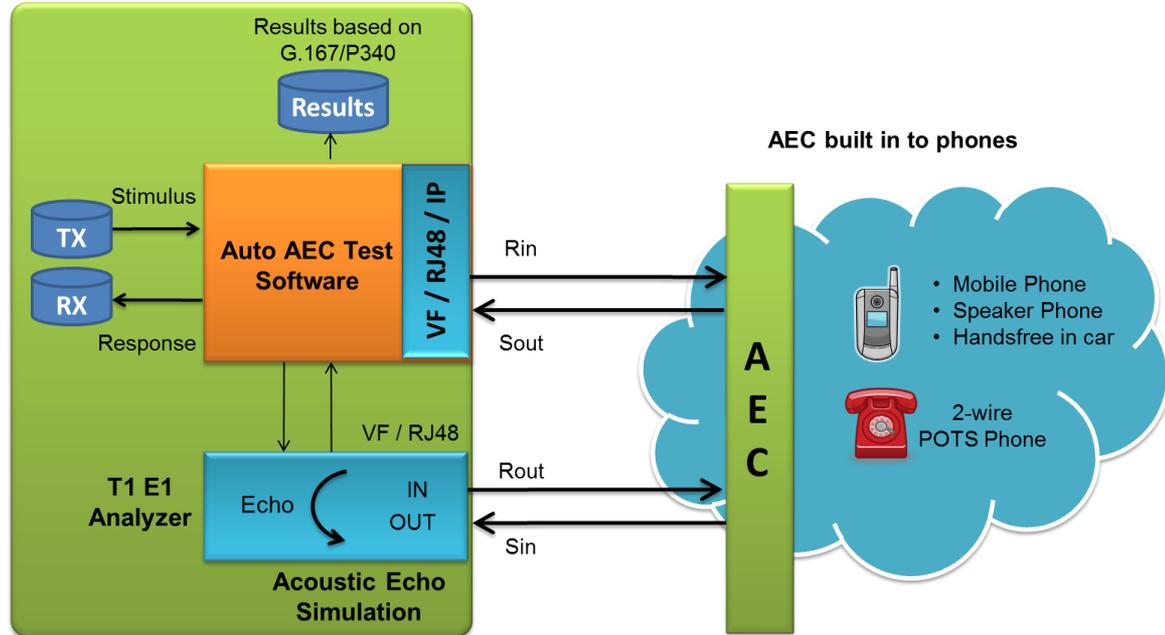
End-to-End Subjective Network EC Testing

- Simulates echo path delay, hybrid filter, attenuation
- Permits addition of noise and other impairments to bi-directional paths independently
- Product used – Delay / Attenuate Timeslot
- Other Related Products – Playback and Record File, Transmit Tone, Digits, Noise, Oscilloscope, and GLC View



Simulating and Testing Acoustic Echo

- GL's Auto AEC Test is used perform acoustic echo cancellation testing in accordance with ITU-T Specifications, G.167 (03/1993) and P.340 (05/2000)
- Rin and Sin files (stimulus and echo) are prepared by Automated AEC Test software in accordance with user inputs. Rout and Sout are captured and processed



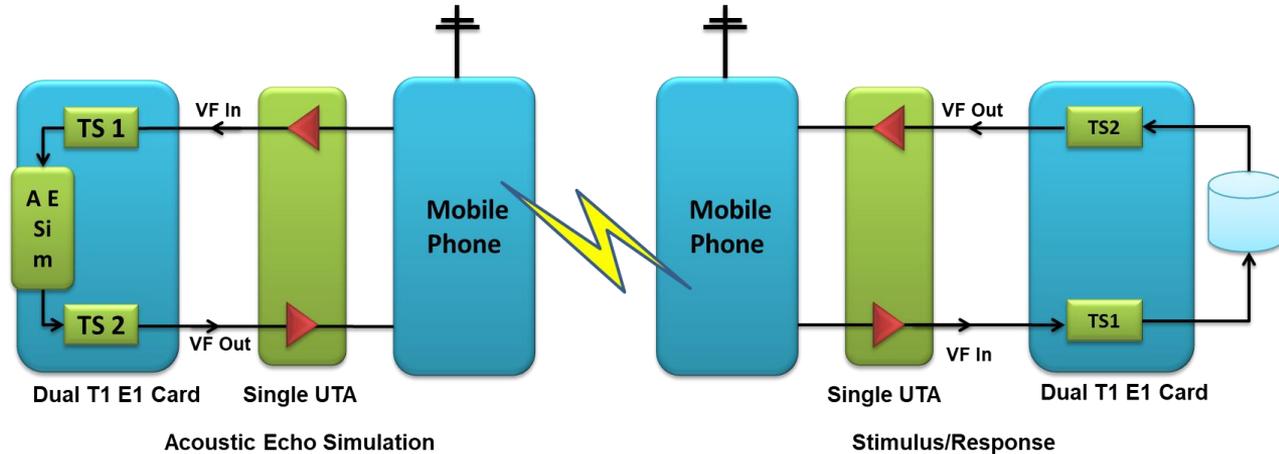
End to End Applications for Mobile, TDM, and VoIP

- **Case 1:** Simulation Digital – Stimulus Digital (TDM to TDM)
- **Case 2:** Simulation Analog – Stimulus Analog (TDM to TDM - Mobile Applications)
- **Case 3:** Simulation Digital – Stimulus RTP (VoIP to TDM with Gateway)
- **Case 4:** Simulation Analog – Stimulus RTP (VoIP to TDM with IP Phone)

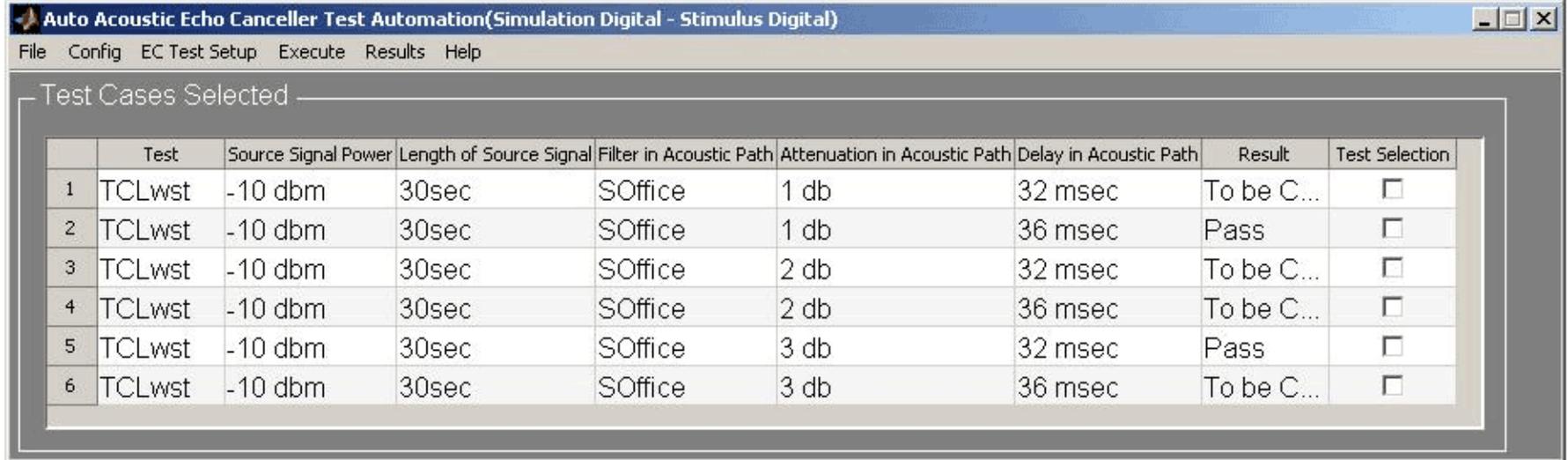
Simulation Analog - Stimulus Analog

(TDM to TDM Mobile Phone Applications)

- In this scenario, the AEC is assumed to be in a mobile phone and accessed through an analog interface
- Again, GL's T1 E1 platforms with analog interfaces are used to convert analog signals to digital and subsequent processing is performed digitally
- Level adjustment accessories are used between mobile phone and the Dual T1 E1 card to accommodate various signal levels and impedances



Configure Test Cases



The screenshot shows a software window titled "Auto Acoustic Echo Celler Test Automation(Simulation Digital - Stimulus Digital)". The menu bar includes "File", "Config", "EC Test Setup", "Execute", "Results", and "Help". The main area is titled "Test Cases Selected" and contains a table with the following data:

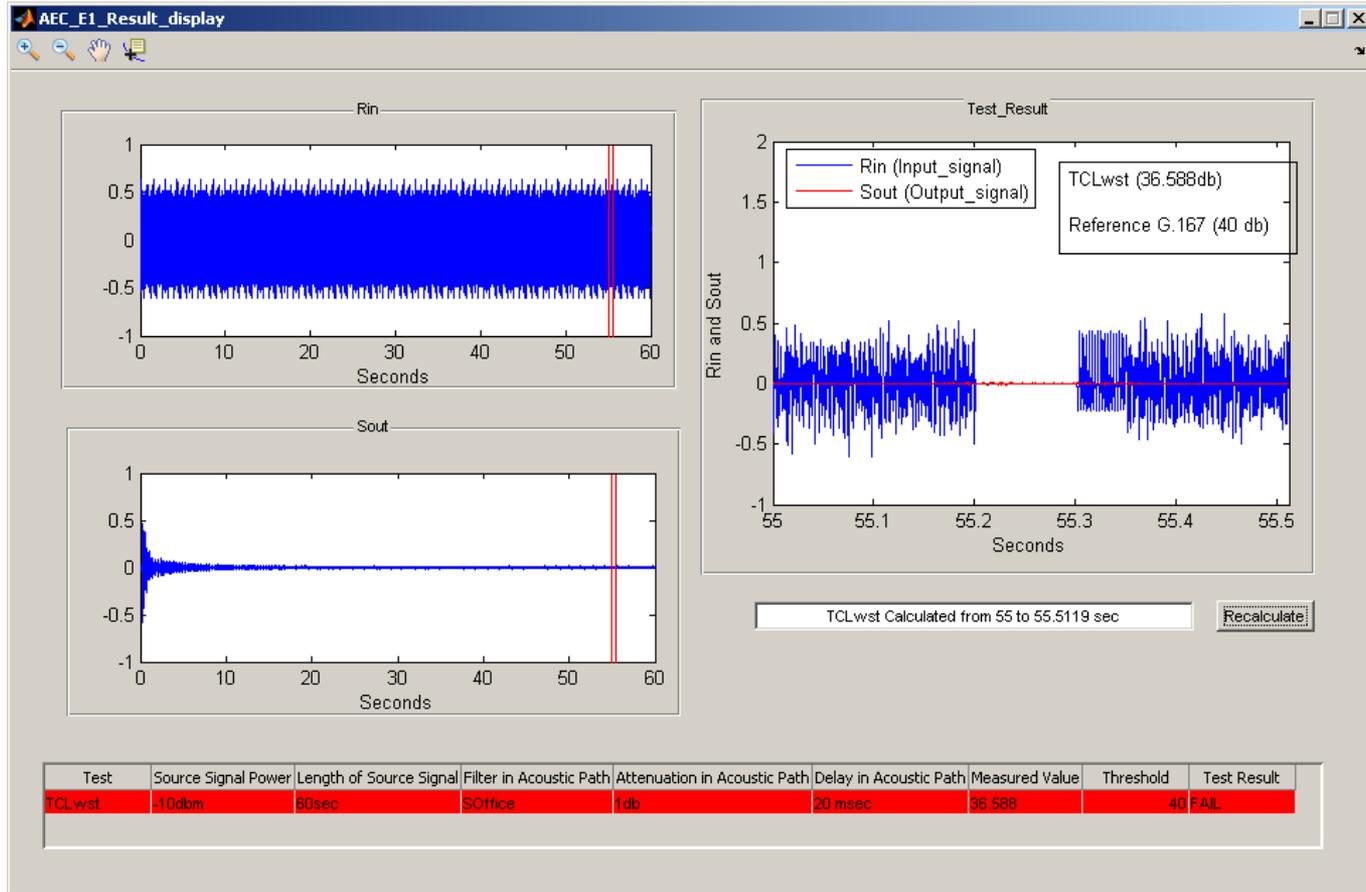
	Test	Source Signal Power	Length of Source Signal	Filter in Acoustic Path	Attenuation in Acoustic Path	Delay in Acoustic Path	Result	Test Selection
1	TCLwst	-10 dbm	30sec	SOffice	1 db	32 msec	To be C...	<input type="checkbox"/>
2	TCLwst	-10 dbm	30sec	SOffice	1 db	36 msec	Pass	<input type="checkbox"/>
3	TCLwst	-10 dbm	30sec	SOffice	2 db	32 msec	To be C...	<input type="checkbox"/>
4	TCLwst	-10 dbm	30sec	SOffice	2 db	36 msec	To be C...	<input type="checkbox"/>
5	TCLwst	-10 dbm	30sec	SOffice	3 db	32 msec	Pass	<input type="checkbox"/>
6	TCLwst	-10 dbm	30sec	SOffice	3 db	36 msec	To be C...	<input type="checkbox"/>

- Test Signal Settings provides options to set dBm level, file and length of the signal in seconds.
- Test cases executed atleast once, displays 'pass' or 'fail' in result column.
- Acoustic filter types (Static and dynamic types - Small Office, Medium Office, Large Office and room impulse response (RIR) generator based on room parameters)

Auto AEC Supported Test Cases (G.167, P.340)

Test Cases	Description	G.167	P.340
TCLwst	Weighted terminal coupling loss – single talk	Yes	Yes
TCLwdt	Weighted terminal coupling loss – double talk	Yes	Yes
Ardt	Received speech attenuation during double talk	No	No
Asdt	Sent speech attenuation during double talk	No	No
Drdt	Received speech distortion during double talk	No	No
Dsdt	Sent speech distortion during double talk	No	No
Pr	Maximum frequency shift (or pitch ratio)	No	No
Tonst	Break-in time – simple talk	Yes	Yes
Tondt	Break-in time – double talk	Yes	Yes
Tic	Initial convergence time	No	No
Trdt	Recovery time after double talk	No	No
TCLwvpv	Terminal coupling loss during echo path variation	No	No
Trpv	Recovery time after echo path variation	No	No

Result Display

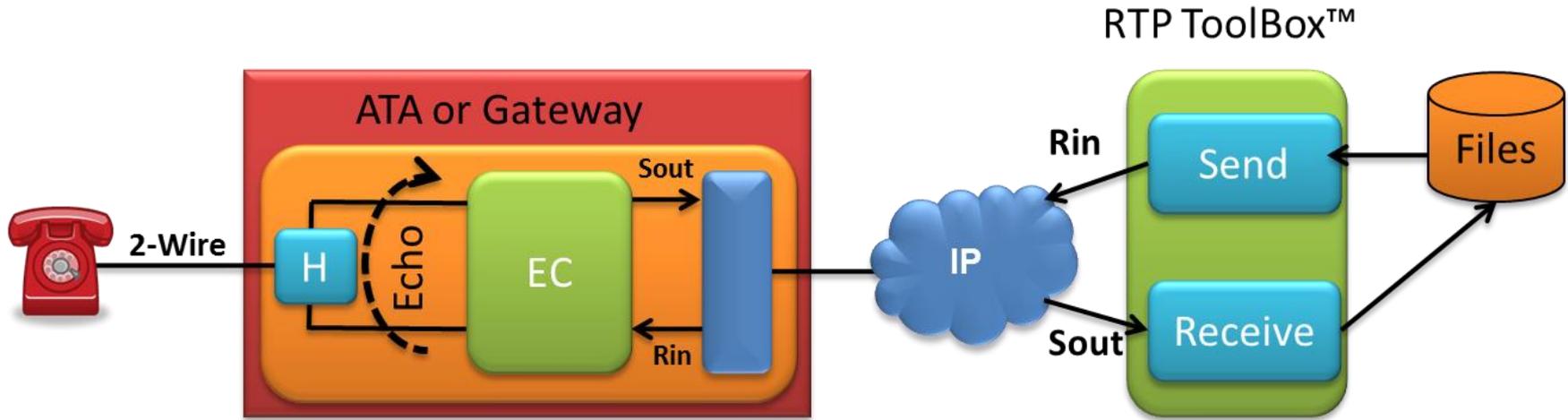


EC Testing in VoIP Networks

Solutions and Techniques

- Manual G.168 EC Compliance Testing of ATAs & Gateways with Two-Wire Interfaces
- Manual G.168 EC Compliance Testing of ATAs & Gateways with T1 E1 Interfaces
- Automated G.168 EC Compliance Testing of ATAs & Gateways - All IP Solutions
- Automated G.168 Compliance Testing of Gateways – Back-to-Back Gateway Solution
- Automated Acoustic G.167 Compliance Testing - Stimulus RTP (Ethernet) / Simulation Analog or Digital (VoIP IP Phone Applications)
- Network Wide Monitoring of Echo and Voice Quality

Manual EC Testing with 2-wire Interfaces



- Far End emulation is performed with GUI-based RTP ToolBox™ Software
- Echo Path Loss (EPL) and Echo Path Delay (EPD) is not fully controllable as it is embedded in gateways
- Manually test most G.168 compliance cases

Manual EC Testing with 2-wire Interfaces (Contd.)

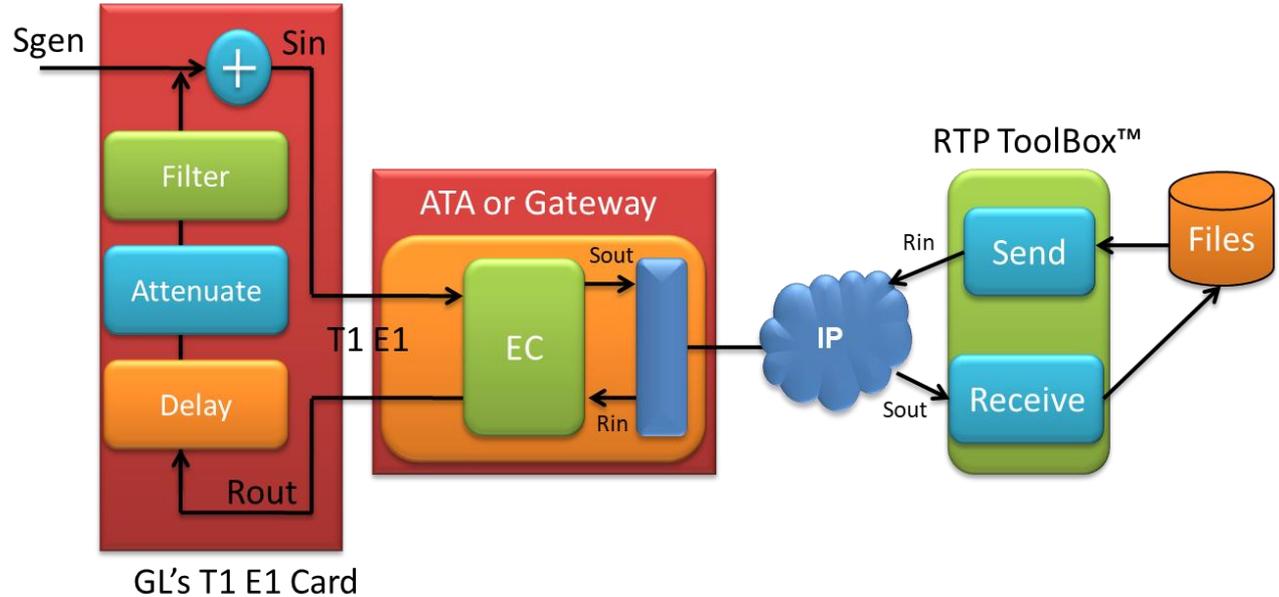
Test 1: Steady state residual and returned echo level test	Yes
Test 2A: Convergence test with NLP enabled	Yes
Test 2B: Convergence test with NLP disabled	Yes
Test 2C: Convergence test in the presence of background noise	
Test 3: Performance under conditions of double talk	
Test 4: Leak rate test	Yes
Test 5: Infinite return loss convergence test	
Test 6: Non-divergence on narrow-band signals	Yes
Test 7: Stability test	Yes
Test 8: Non-convergence of EC on SS5/SS6/SS7 tones	

Manual EC Testing

Test 9: Comfort noise test	
Test 10A: Canceller operation on the calling station side	
Test 10B: Canceller operation on the called station side	Yes
Test 11: Tandem echo canceller test	
Test 12: Residual acoustic echo test	
Test 13: Performance with low bit rate coders	
Test 14: Performance with V-series low-speed modems	Optional
Test 15: PCM offset test	Yes

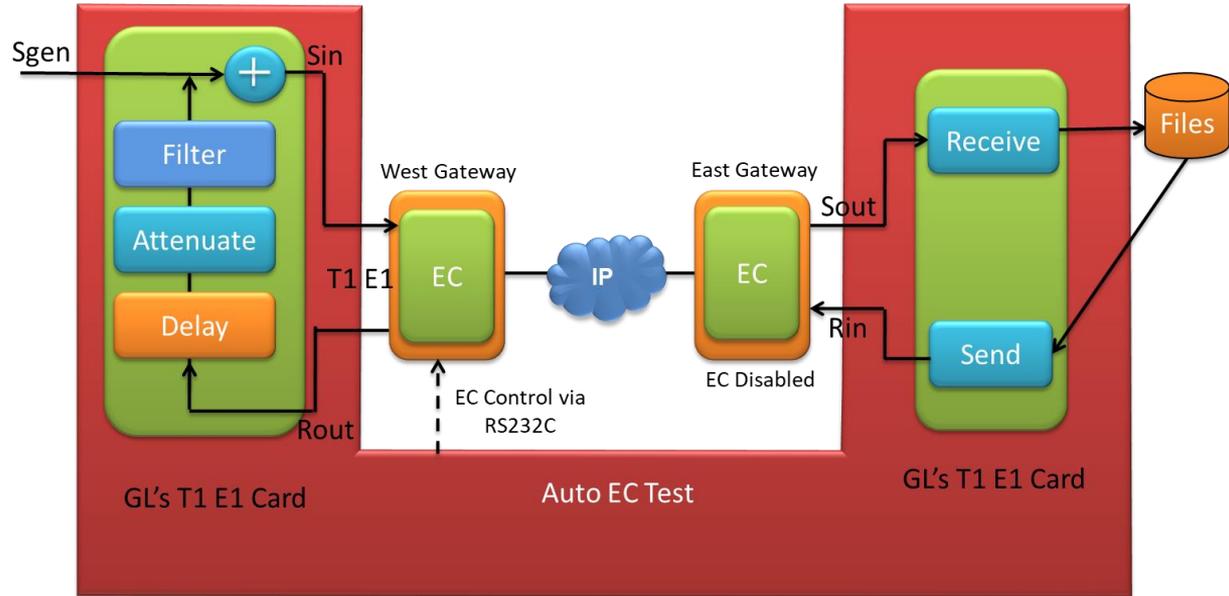
Manual EC Testing With TDM Interface

- Far End emulation is performed with GUI-based RTP ToolBox™ Software
- Echo Path Loss (EPL) & Echo Path Delay (EPD) fully controllable in T1 E1 card
- Complete set of G.168 echo compliance test suite



Automated EC Testing Back-to-Back Gateways

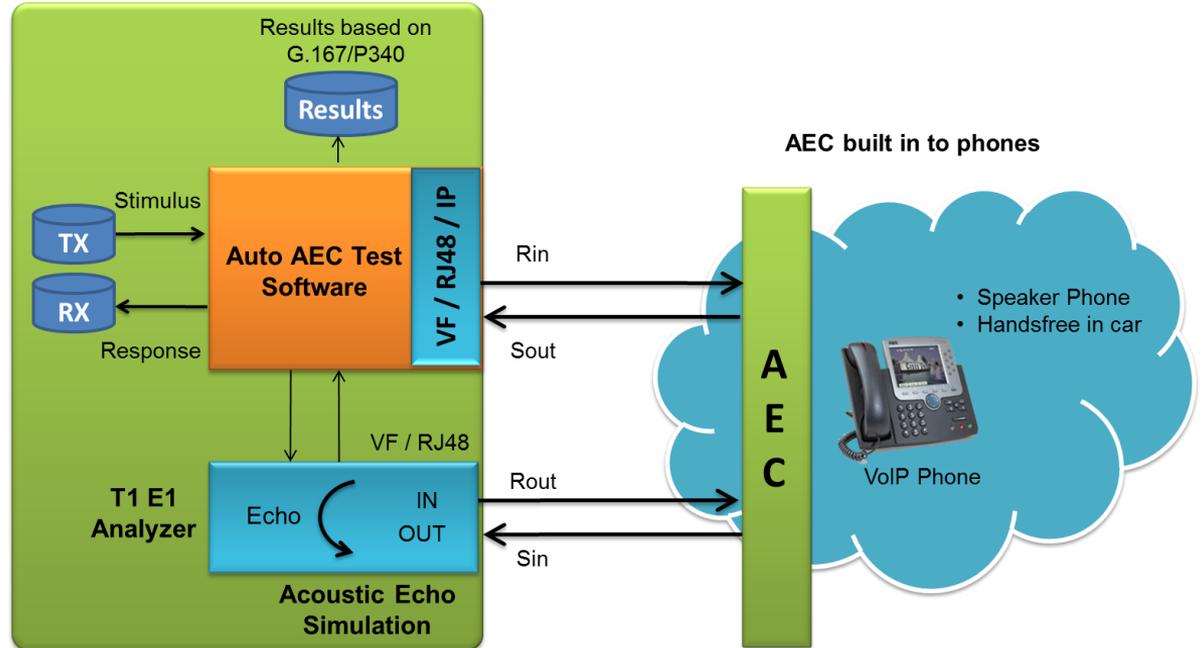
- Full compliance testing of the EC and complete simulation of the EPD and EPL is possible
- Full automation requires availability of Rout, Sin, Rin, and Sout streams through IP interface
- Semi – automated operation is also possible with manual control of the EC



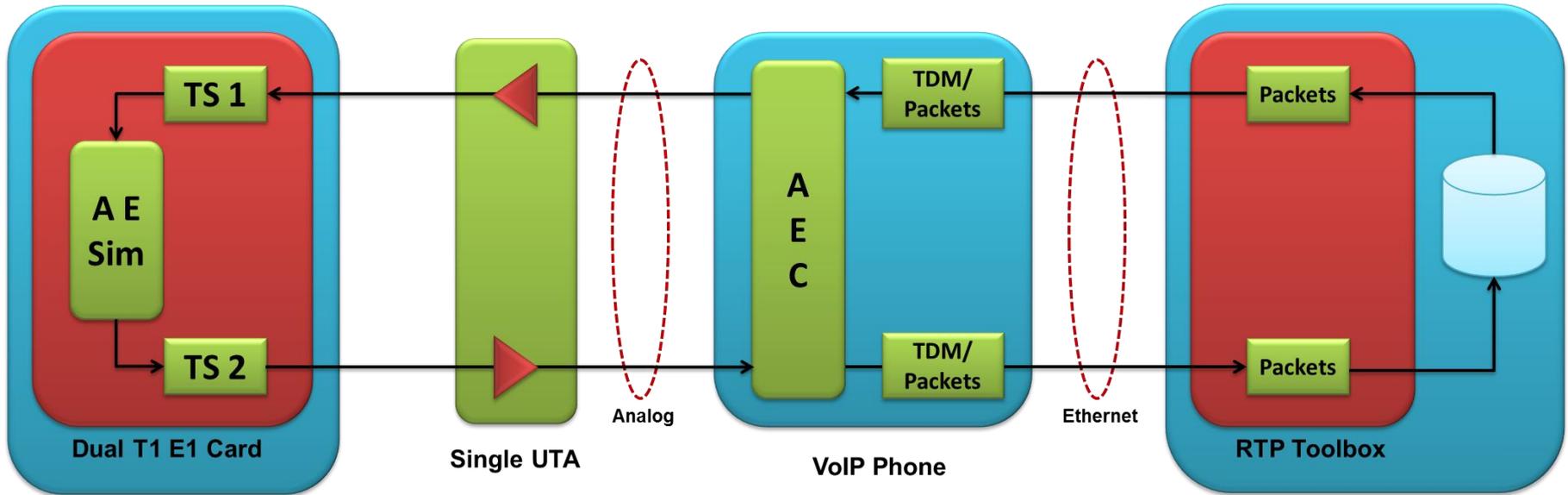
Simulating and Testing Acoustic Echo

- GL's Auto AEC Test is used perform acoustic echo cancellation testing in accordance with ITU-T Specifications, G.167 (03/1993) and P.340 (05/2000)
- Rin and Sin files (stimulus and echo) are prepared by Automated AEC Test software in accordance with user inputs. Rout and Sout are captured and processed

Auto Acoustic EC Testing in VoIP Phones

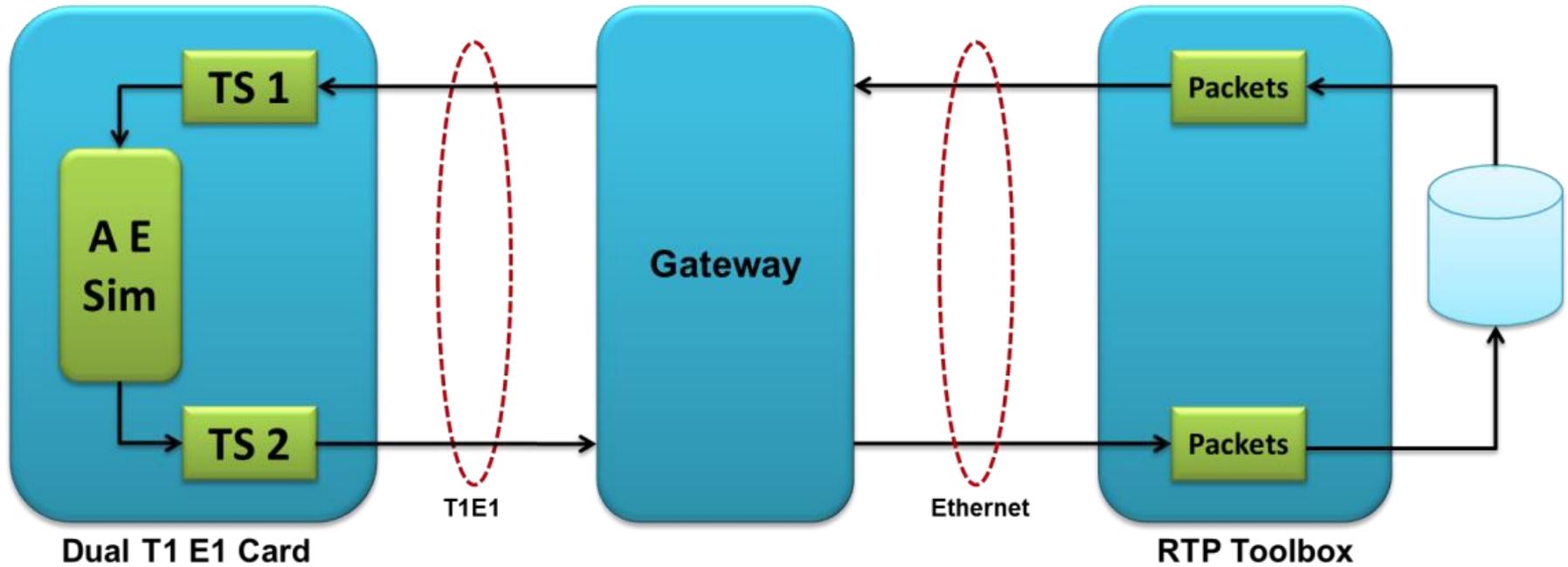


Simulation Analog - Stimulus RTP (VoIP to TDM with IP Phone)



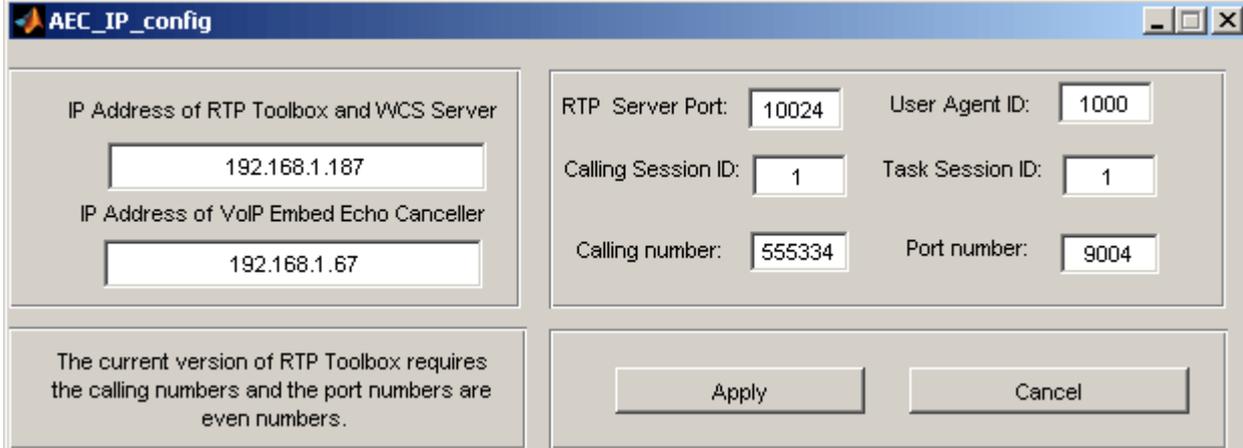
- In this scenario, the stimulus and response signals are generated by GL's RTP Toolbox™ through an Ethernet interface and simulation is performed digitally by GL's T1 E1 platforms, whether accessed through analog or digital interfaces.

Simulation Digital - Stimulus RTP (VoIP to TDM with Gateway)



Auto AEC IP Configuration

- IP Configuration includes -
 - IP Address of RTP Toolbox and WCS Server
 - IP Address of VoIP Embed Echo Cancellor
 - RTP Server Port, User Agent ID, Calling Session ID, Task Session ID, Calling Number, and Port Number



The screenshot shows a window titled "AEC_IP_config" with the following configuration fields:

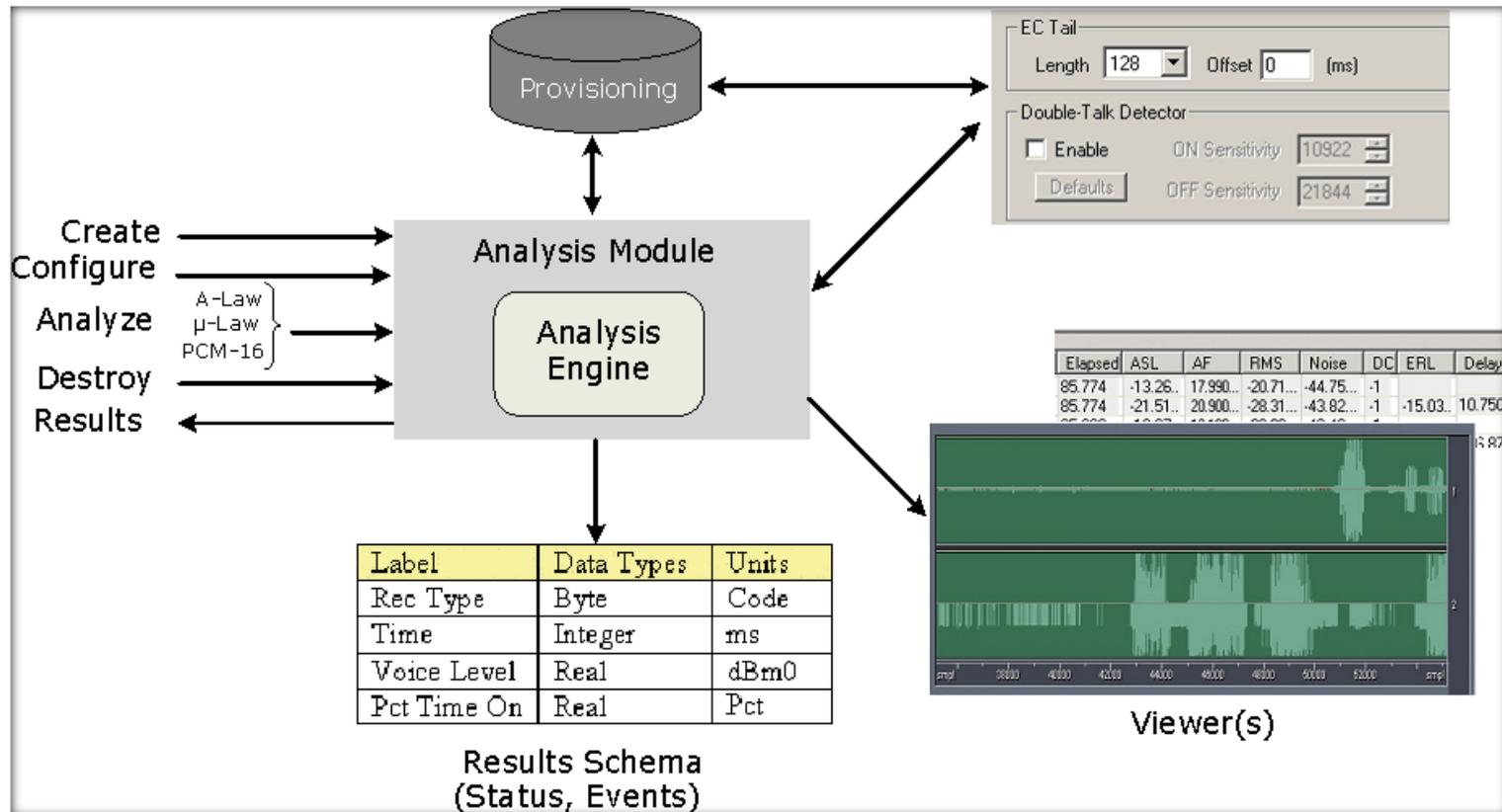
IP Address of RTP Toolbox and WCS Server <input type="text" value="192.168.1.187"/>	RTP Server Port: <input type="text" value="10024"/>	User Agent ID: <input type="text" value="1000"/>
IP Address of VoIP Embed Echo Cancellor <input type="text" value="192.168.1.67"/>	Calling Session ID: <input type="text" value="1"/>	Task Session ID: <input type="text" value="1"/>
	Calling number: <input type="text" value="555334"/>	Port number: <input type="text" value="9004"/>

Below the fields, there is a note: "The current version of RTP Toolbox requires the calling numbers and the port numbers are even numbers."

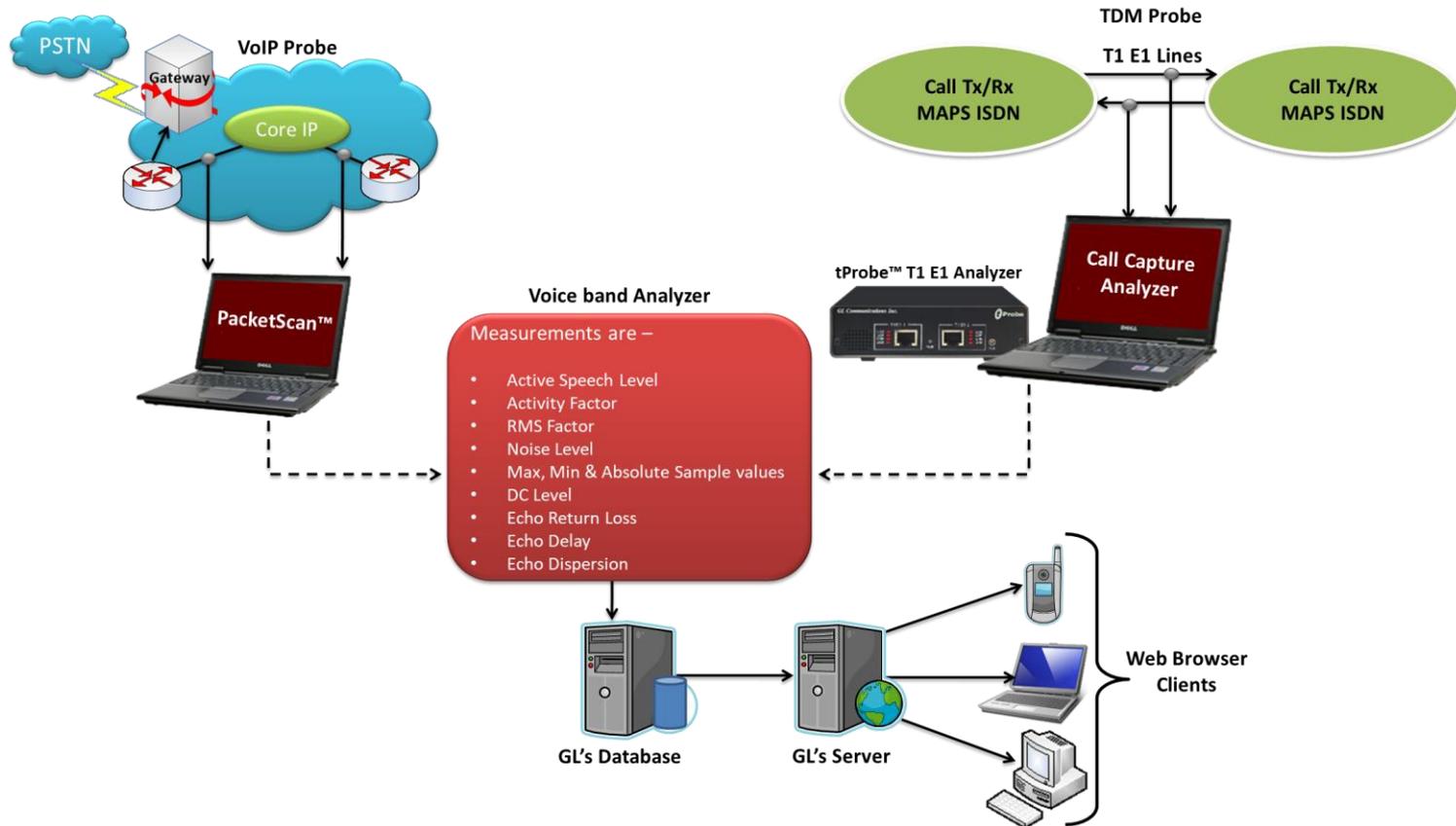
At the bottom right, there are two buttons: "Apply" and "Cancel".

Network Wide Monitoring of Echo and Voice Quality

Integrating Analysis Algorithms (Modules)



TDM and VoIP Monitoring Probes with VBA



Voice Band Analyzer

- VBA is a non-intrusive analysis tool for monitoring voice band network traffic. It can host different analysis modules for monitoring speech and noise levels, line (or hybrid) echo, acoustic echo, and traffic classifier
- The standard modules included in the application are -
 - ITU-T P.56 Active Voice Level analysis
 - Line Echo (Hybrid) analysis
- Other Optional Modules include -
 - 2-Wire Echo analysis
 - Acoustic Echo analysis
 - Traffic Classifier analysis

User Interface

NRT Voiceband Analyzer - VBA Probe 1

Profiles Logging Help

Input	File	Directory	Start	Elapsed	ASL	AF	RMS
E1	S1L.ala	C:\Program Fil...	06/12/2007 15:19:36	200.000	-20.59...	52.897...	-23.36...
W1	S1R.ala	C:\Program Fil...	05/09/2007 12:22:04	200.000	-22.36...	44.043...	-25.92...

Speech Level

Line Echo

Traffic Classifier

FaxScan

Tone Decoder

Right-Click to Configure Each Module

More Modules

RUN

Setup

View Results

Clear Display

Access Point #1: A-Law

Access Point #2: Select Data Format

E1 File: C:\Program Files (x86)\GL Communications Inc\Voiceband Analyzer

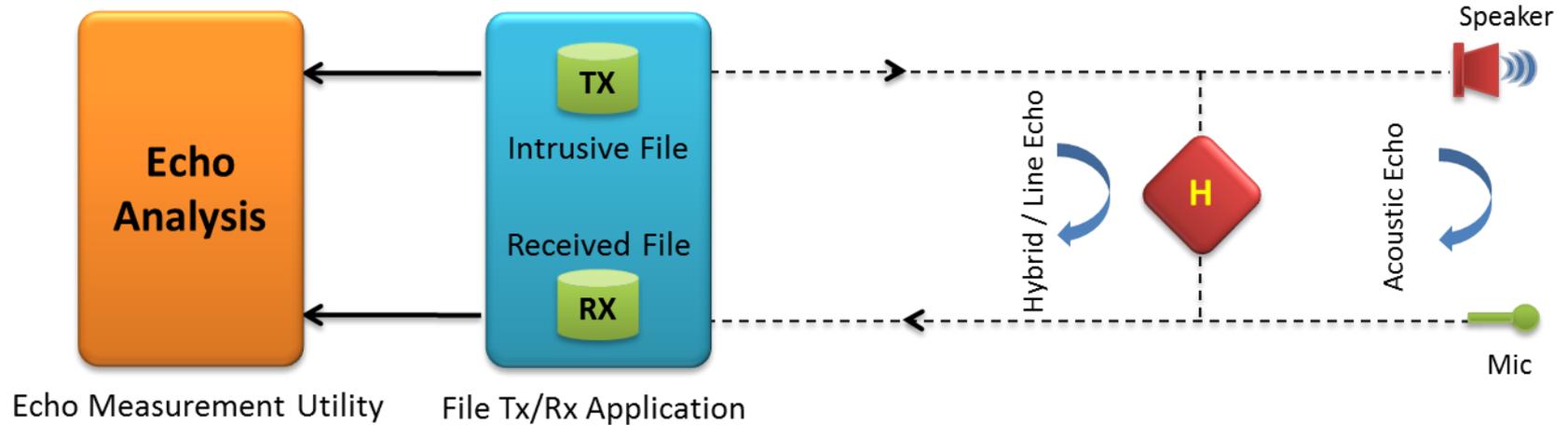
W1 File: C:\Program Files (x86)\GL Communications Inc\Voiceband Analyzer

E2 File:

W2 File:

Ready Manual Log: disabled Results: S1_vbs.csv / S1_vbe.csv 25-02-2015 11:07

Echo Measurement Utility

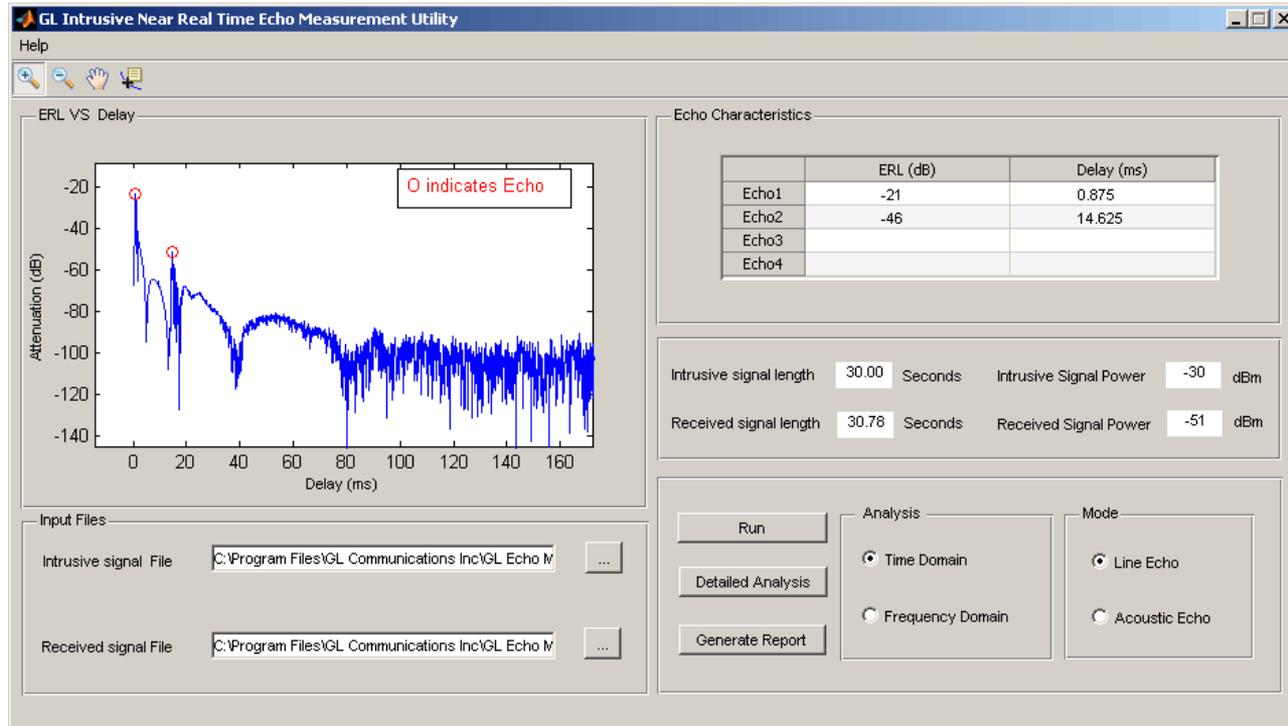


- Echo Measurement Utility Software (EMU) measures Echo Path Delay (EPD) and Echo Return Loss (ERL) of voice calls over TDM, VoIP, and Wireless networks
- EMU software is an offline adjunct analysis application (under control of VQuad™) that compares the source and received files to determine echoes and delay of echoes. EMU software assesses sidetone, line, and acoustic echo and the corresponding delays

Features

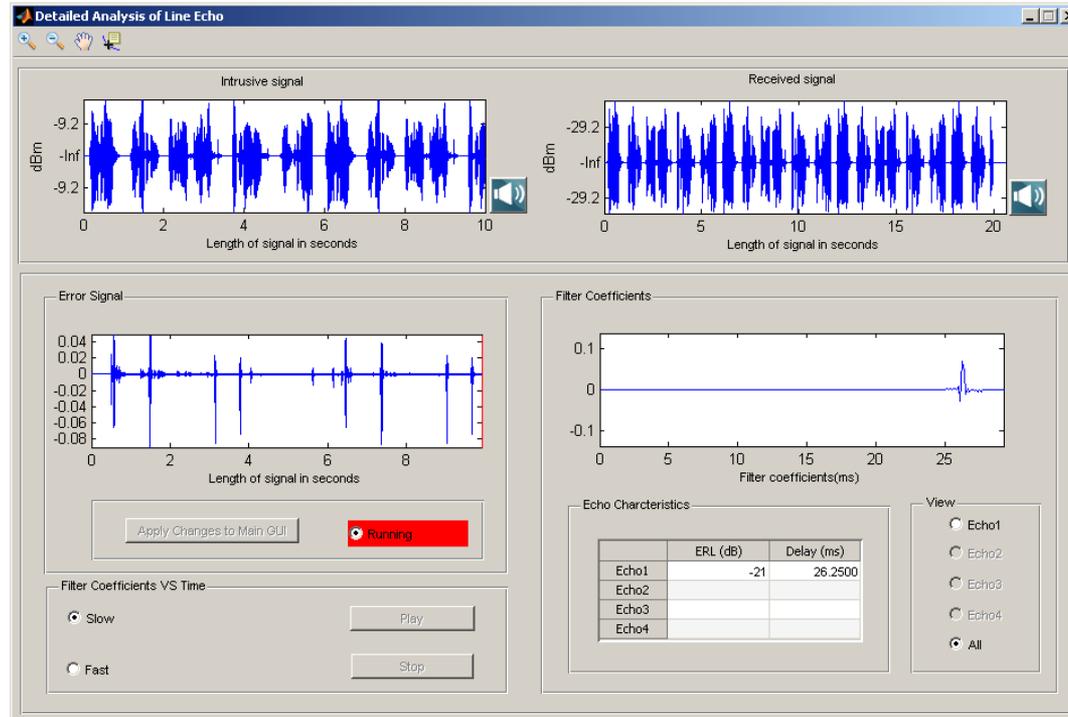
- Echo, Delay, and Voice Quality Analysis of Voice Calls in VoIP, TDM, 2Wire, and Mobile Networks.
- Measures EPD in msec and ERL in dB
- Compares source and received files to detect echo (maximum of four instances)
- Option to zoom-in on any echo to investigate further
- Ability to automate the entire test process using VQuad™ scripting; including sending the results to the central database for access via GL's WebViewer™
- EMU uses EMU Client software to automatically detect the incoming degraded voice files and send the measurements to database after analysis
- Supports Line (Hybrid) and Acoustic Echo Modes
- Graphically displays source signal, received signal, error signal, and adaptive filter coefficients
- Calculates adaptive filter coefficients and echo characteristics for the error signal

User Interface



- Provides Delay and ERL measurements for all detected echoes, along with an 'ERL vs Delay' plot
- Includes signal graphs for source signal, received signal, error signal, and adaptive filter coefficients

Detailed Analysis



- Displays received signal display (in dBm format), error signal display (in seconds), adaptive filter coefficients display and the table of echo characteristics

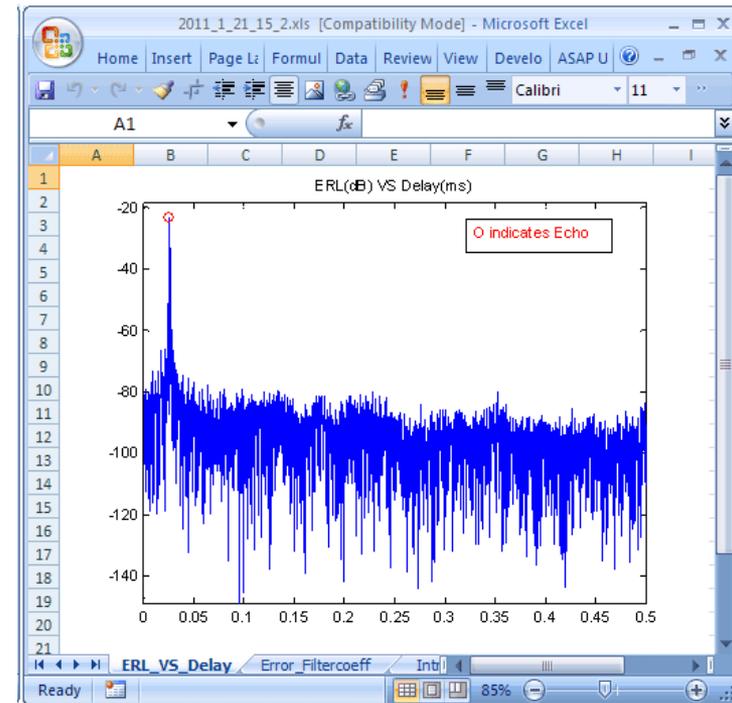
Results

Echo Measurement Results

2011_1_21_15_2.xls [Compatibility Mode] - Microsoft Excel

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	OPERATOR INFORMATION													
2	Name	User's Name												
3	JOB Title	Test Engineer												
4	JOB ID	21-Jan-2011 and Run # Line Echo Mode												
5	User Note	2 wire to mobile measurements												
6														
7														
8	FILE INFORMATION													
9	Intrusive File	E:\Program Files\GL Communications Inc\Echo Measurement Tool\Intrusive_files\Acoustic_fem_10sec.pcm												
10	Received File	E:\Program Files\GL Communications Inc\Echo Measurement Tool\Received_files\Examples\2wire_to_mobile\2w_mob_fem.PCM												
11	Error	Error display												
12	Filtercoef	Filtercoeff display												
13	ERL VS De	ERL VS Delay plot												
14														
15	ECHO CHARACTERISTICS													
16	Total no of Attenuati	Delay(ms)												
17	Echo1	-21	26.25											
18	Echo2													
19	Echo3													
20	Echo4													

Delay vs ERL Results

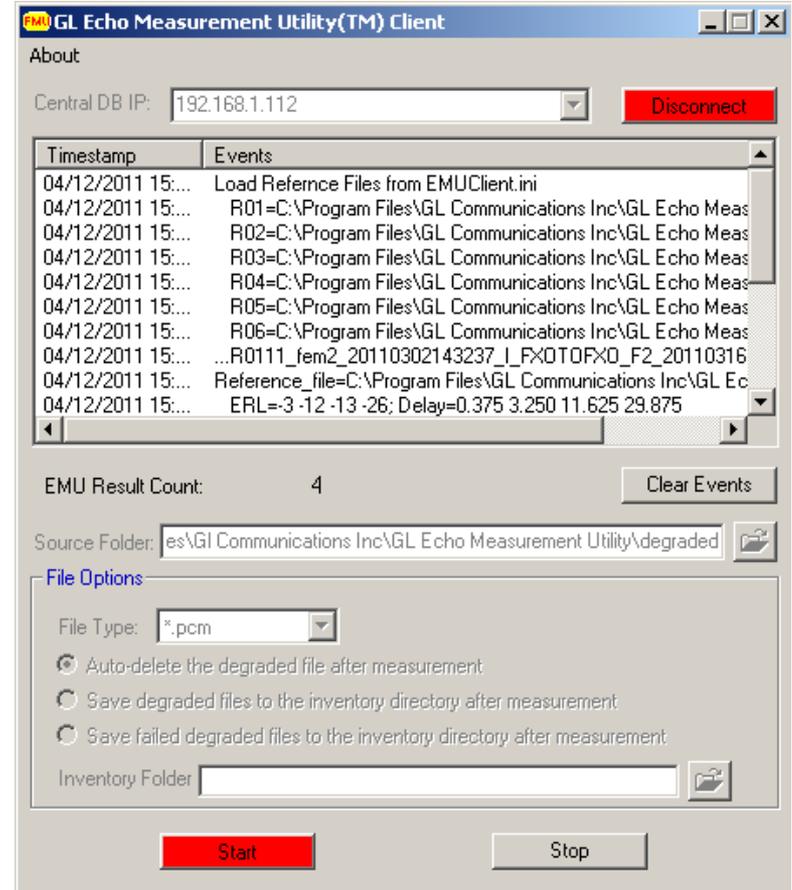


- Generated "Result" spread sheet includes operator information, file information, echo characteristics, and snapshots of all the signal graphs

EMU Client

- EMU Client automatically initiates the Echo measurements on arrival of degraded voice files
- It remotely connects to Central Database and sends the EMU results, which is then observed in VQT

WebView™

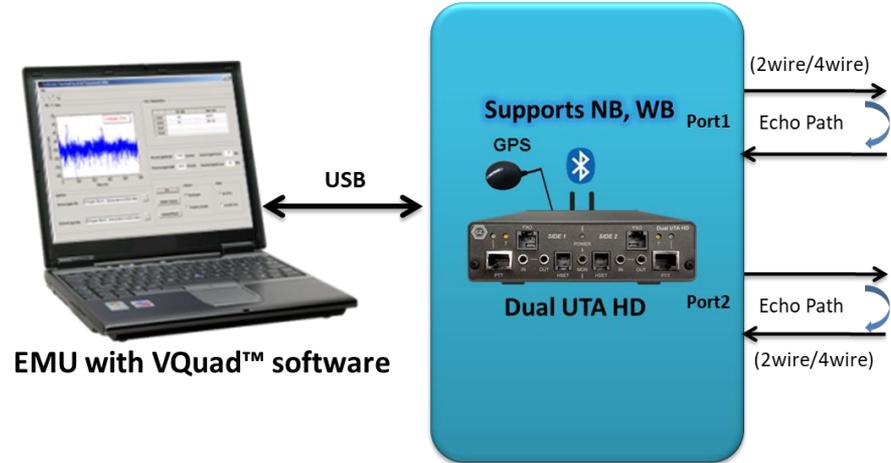


EMU with GL Tools

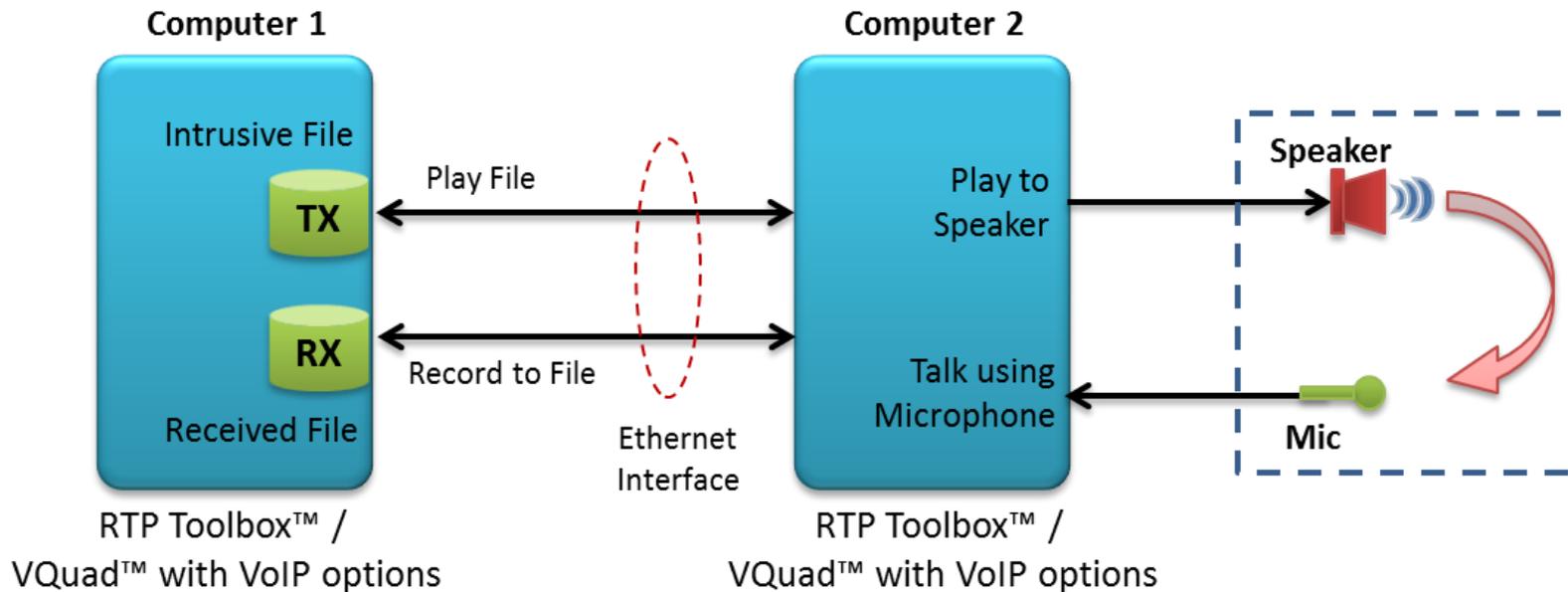
- The EMU requires only two files to function – the 'sent' file and simultaneously recorded 'received' file. Any tool that achieves this can be used with EMU. GL offers various emulation and capture tools that are compatible with the EMU:
 - For **VoIP**: VQuad™ or RTP Toolbox™
 - For **Mobile Phones**: VQuad™ with Dual UTA
 - For **TDM**: VQuad™ with GL's tProbe™ T1 E1 Analyzer
 - For **2-Wire**: VQuad™ with Dual UTA
 - For **4-Wire**: VQuad™ with Dual UTA

EMU with VQuad™ and Dual UTA

- VQuad™ software along with the Dual UTA hardware supports transmitting and receiving files across the following interfaces: RJ11 2-wire analog, 3.5 mm jack for mobile headset connection, Handset phones and balanced I/O for VoIP soft phones



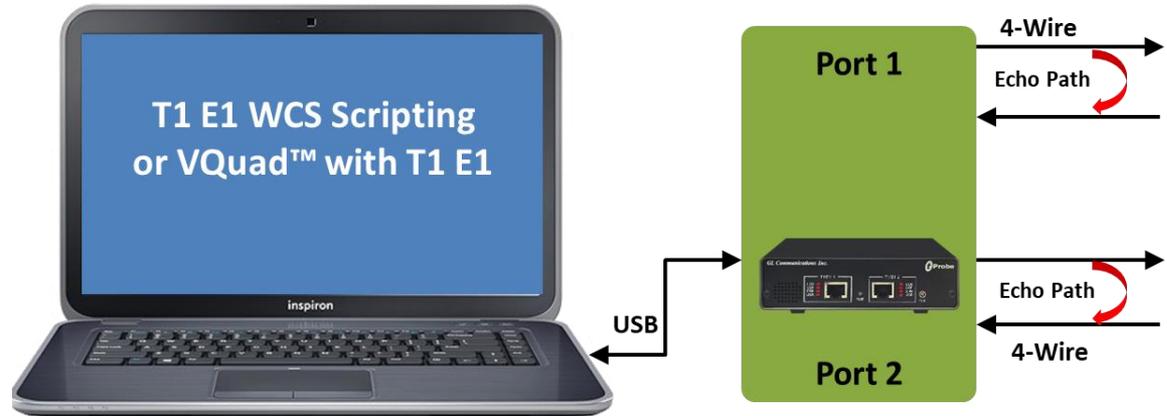
EMU with GL's Intrusive RTPToolbox™ Tool



- GL's RTP Toolbox™ or VQuad™ with VoIP option can be used with EMU to assess line or acoustic echo

EMU with GL's Intrusive T1 E1 Analyzers

- GL's T1 E1 Analysis application (requires hardware) is used with EMU to detect possible echoes through a T1 E1 channel
- Through T1 E1 WCS scripting or VQuad™ with T1 E1 option it is possible to automate the entire testing process including sending and receiving files
- The intrusive files and the received files are fed as input to EMU for further analysis



Testing Scenarios

- Two wire – Two wire Setup
- Two wire – Mobile Setup
- Two wire (direct to gateway) to VoIP Phone Setup
- Two wire (through Class 5 T1 E1 Switch) to VOIP phone setup
- Two wire (through Class 5 T1 E1 Switch) to VQuad™ software (Ethernet Interface) Setup
- Two wire (direct to gateway) to VQuad™ software (Ethernet Interface) Setup
- Mobile phone to Mobile phone Setup
- Mobile phone to VoIP phone Setup
- VQuad™ (Ethernet Interface) to IP PBX to two-wire Setup
- VoIP phone to IP PBX to Two-wire Setup
- Acoustic Echo Mode

Thank you