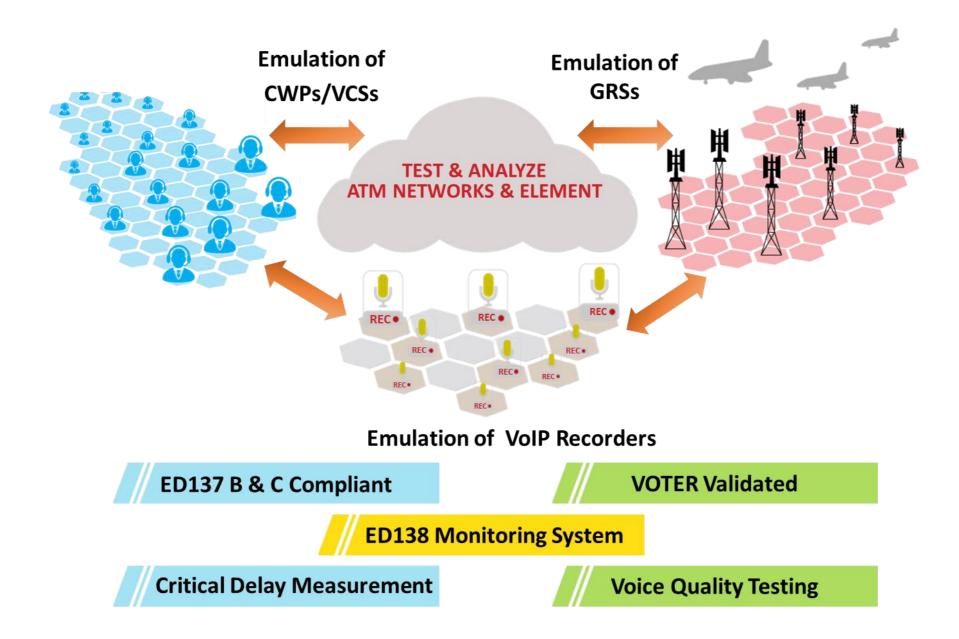
## **Test Solutions for Air Traffic Management**

**GL** Communications Inc.

818 West Diamond Avenue - Third Floor, Gaithersburg, MD 20878 Phone: (301) 670-4784 Fax: (301) 670-9187 Email: <u>info@gl.com</u> Website: <u>https://www.gl.com</u>

#### Overview





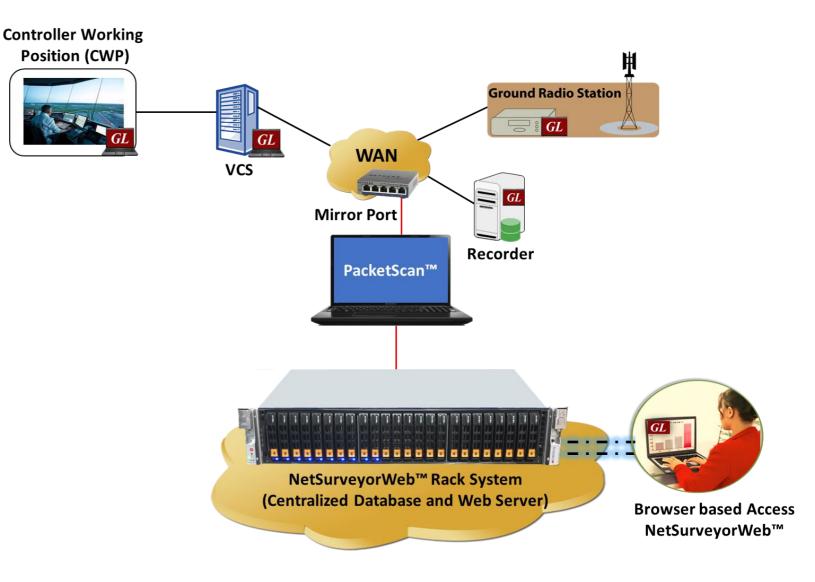
### **GL's ATM Test Solutions Overview**

#### ED-137 Emulators

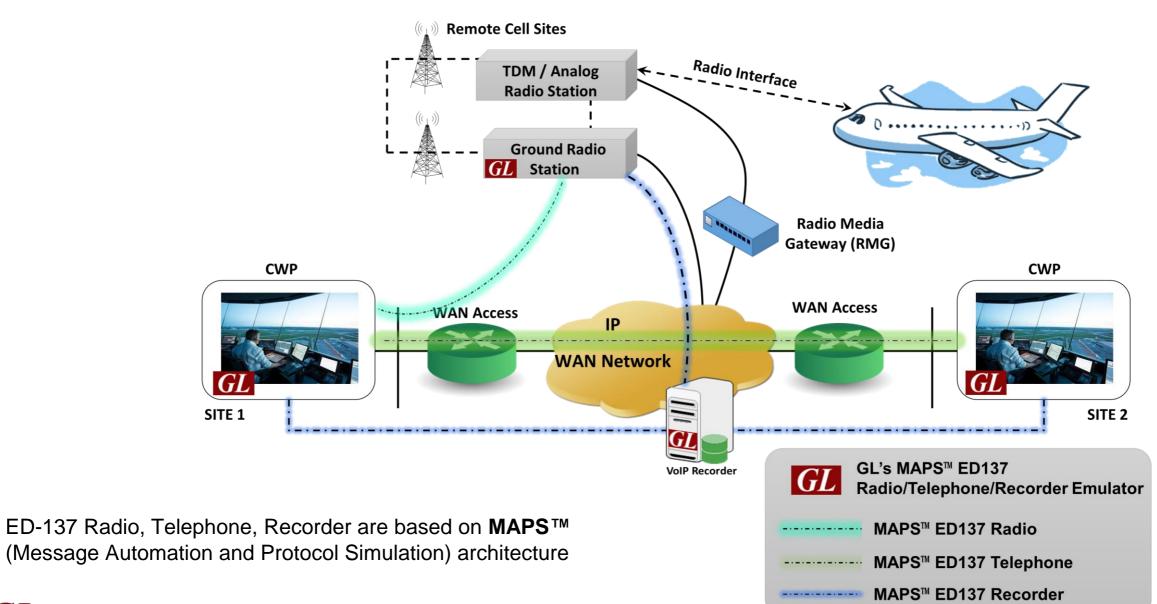
- ➤ MAPS<sup>™</sup> ED-137 Radio
- ➤ MAPS<sup>™</sup> ED-137 Telephone
- MAPS<sup>™</sup> ED-137 Recorder
- ED-138 Monitoring Solutions
  - ➢ PacketScan™
  - ➢ NetSurveyorWeb™
- Critical Delay and Voice Quality Measurements
  - Traffic Generation (Background, Test, Stress)
  - Audio Analyzer
  - Packet Analyzer

Communications

- > Discrete Signal Logger, Packetizer
- IP WAN Simulation



#### MAPS<sup>™</sup> ED-137 Radio, Telephone, and Recorder





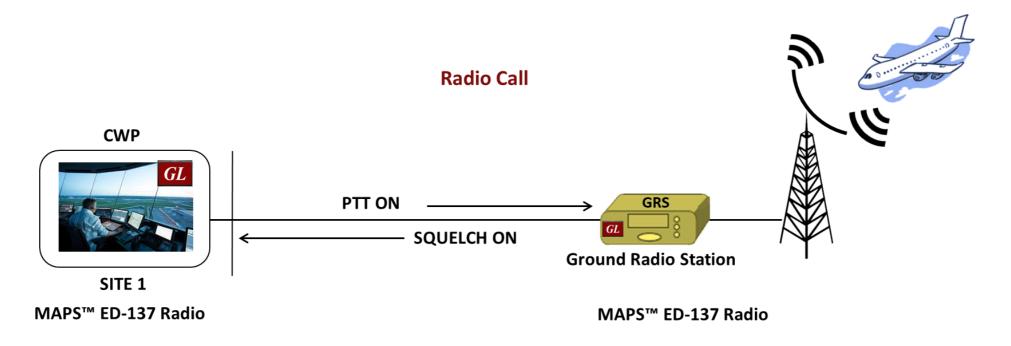
#### MAPS<sup>™</sup> ED-137 Radio Emulator

- Emulates Air-to-Ground Calls as per EUROCAE ED-137 Volume 1 Radio Interface
- Flexible Architecture for custom testing scenarios
- Software based solution
- Easy-to-Use Graphical User
  Interface
- Scripting and Automation capability for regression testing. Support for Python APIs

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### MAPS<sup>™</sup> ED-137 Radio Emulator Highlights



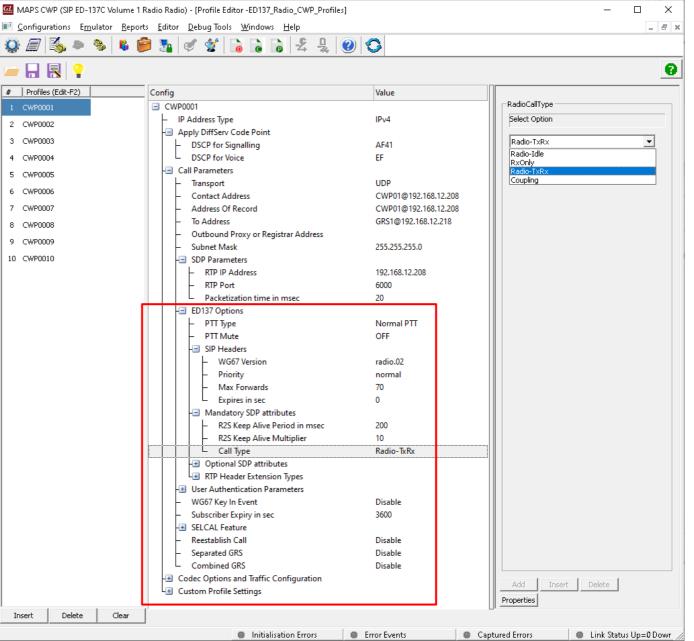
- Emulates CWP or GRS as per ED-137/1B and ED-137/1C Radio interface
- Simulates multiple CWPs or Radios in single instance of MAPS<sup>™</sup> using unique IP addresses
- Portable, easy to configure and use during the field installation, testing and commissioning

- Supports all Radio Call Types, PTT Types, SIP Headers and all mandatory/optional SDP attributes
- Supports Linked Session Management, WG67 Key-In Event, Multicast Routing and SELCAL tone
- Supports both IPv4 and IPv6. Validated against VOTER versions 4.1.33.1 and 4.1.33.2



### MAPS<sup>™</sup> ED-137 Radio Emulator – Profiles

- Each profile represents a CWP/ Radio with customizable parameters such as Radio type (Tx, Rx and TxRx), PTT type, Priority, Frequency-Id etc.
- Simulates feature specific RTP header extensions - Climax Time Delay, Signal Quality Index, Radio Remote Control and Dynamic Delay Compensation
- Traffic actions send and record to file, send and detect digits/tones, Talk using microphone and play to speaker
- Impairments (Packet Loss, Duplicate, Out of sequence and Latency) can be applied to RTP traffic
- Codecs G711A, G711U and G729





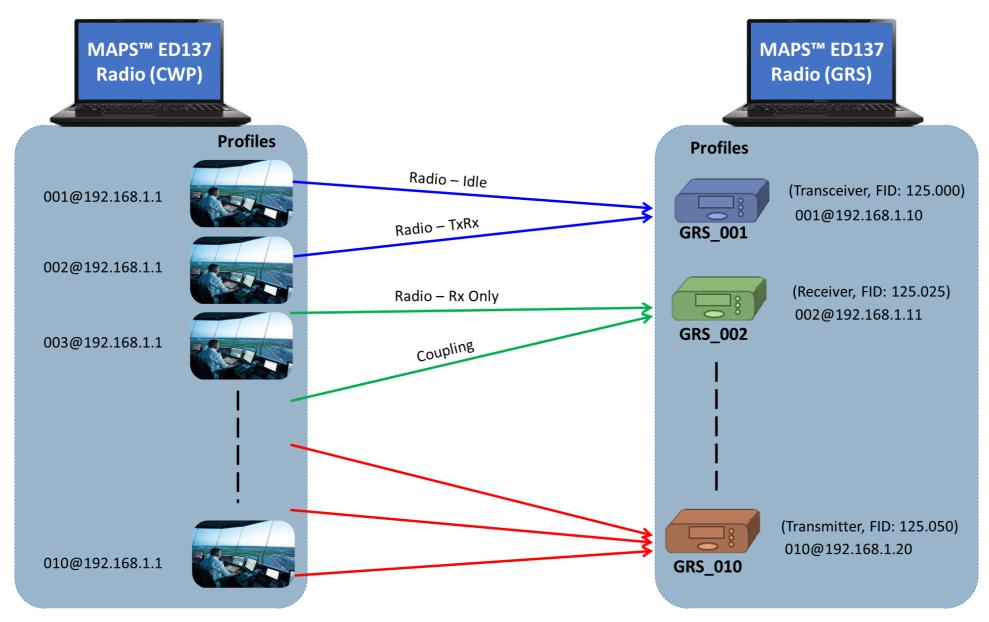
### MAPS<sup>™</sup> ED-137 Radio Emulator – Call Reception

- Supports Call pre-emption, PTT priority handling, permitted users list
- Supports simulation of Combined and Separated Radios
- Displays Call graph and message decodes for each call
- Load generation or background traffic generation can be done using Bulk Call generation feature
- Supports automation of Call and Traffic generation (auto PTT/SQU)

ir No	Script Name	Profile	🔮 🚡 🚡	£ 🖳 🕐 🤇	Script Execution		Status		Events	Events Profile	Results	
1	SipCallControl.gls	GRS0001	CWP03@192	168 12 208	_ Scipt Execution	Stop	Sending R2S	Keenálive	None	Lvens rone	Tresuits	Pass
2	SipCallControl.gls	GRS0001	CWP04@192.168.1			Stop	Sending R2S		Start Squelch			Pass
3	SipCallControl.gls	GRS0001	CWP02@192.168.1			Stop	Sending R2S		Start Squelch			Pass
4	SipCallControl.gls	GRS0002	CWP06@192.168.1	2.208, PTT-ID = 5		Stop	Sending R2S	KeepAlive	Start Squelch			Pass
5	SipCallControl.gls	GRS0002	CWP07@192			Stop	Sending R2S		None			Pass
6	SipCallControl.gls	GRS0003	CWP13@192.168.1			Stop	Sending R2S		Start Squelch			Pass
7	SipCallControl.gls	GRS0003	CWP14@192.168.1	2.208, PTT-ID = 6		Stop	Sending R2S	KeepAlive	Start Squelch			Pass
							_					
Stop	Stop All Abort 4	bort All 🔽 Show F	Records 🔲 Select Active C	all 🗌 Auto Trash 🔤 Tra	ash		ApplyMAM Values	Receive Traffic	Apply SQI SCT ON	PTTS ON Impa	ir Speaker ON	Stop RTP/R2S
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		CallType : Radio-TxF	Bx . Priority : normal			Max-Forwards: 70 Allow: INVITE,BYE,C.	MCRL ACK THE	O ODTTON	C CIRCOLDE NOTIE	Z DEFED DECTOR	<b>P</b> D	
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		200	or	10.00.22.0200		Contact: CWPO2 <sip Call-ID: GL-MAPS-48</sip 						
		200	UK	10:50:22.4280	100	CSeq: 1 INVITE	27020401 000	0 002081				
		ACI	к	•		Recv-Info:						
				10:50:22.4430	100	WG67-Version: radio Priority: normal	. 02					
	4	Кеер4	Alive	10:50:22.4440	100	Subject: radio						
		Кеер4	Alioa			Supported: 100rel						
		Keep4	All YC	10:50:22.4640	000	Content-Type: appli Content-Length: 411	cation/sdp					
		Emergency PTT-0	ON , PTT-ID = 9	10.50.00 1070	00							
				10:50:36.1070	100	v=0 o=CWP02 33852938 33	0E2020 TN TN/	192 160	12 200			
		Emergency PTT-0	DN , PTT-ID = 9	10:50:36.1080	00	s=SIP Call	052530 IN IP4	: 192.100	.12.200			
		PTT-OFF, F	PTT-ID = 9			c=IN IP4 192.168.12	. 208					
			1110-0		000	t=0 0 m=audio 29202 RTP/A	70 0 101 122					
		PTT-OFF, F	PTT-ID = 9	10:50:38.9190	100	a=rtpmap:8 PCMA/800						
		DTT OFF		10.00.00.0100	.00	a=rtpmap:101 teleph	one-event/800	0				
		PTT-OFF , F	1140 = 9	10:50:39.1150	000	a=fmtp:101 0-15 a=rtpmap:123 R2S/80	00					
						a=rtphe:123 k25/80						
						a=ptime:20						



#### **Multiple Controller and Radio Simulation**





#### ED-137/1C Features in MAPS<sup>™</sup> ED-137 Radio Emulator

- Radio Receiver Multicast Operation
- SELCAL (Selective Calling) Tone Transmission
- Simulation of Non-VoIP source PTT keying
- WG67 KEY-IN event package now includes frequency id (fid) of Radio
- Option to retain active sessions at GRS when frequency (fid) changes
- Added Test PTT
- PTT-id 63 is reserved for SELCAL tone transmission and PTT-ids 60, 61 and 62 are reserved for PTT keying from non-VoIP source
- Radio version updated to "radio.02" in WG67-Version SIP header



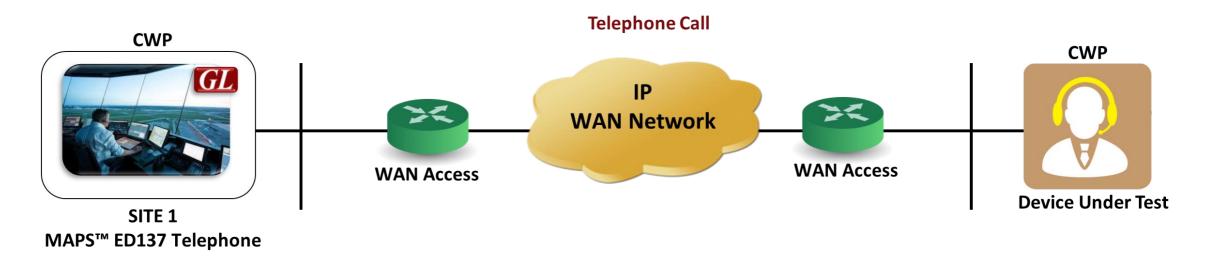
### **MAPS<sup>™</sup> ED-137 Telephone Emulator**

- Emulates Ground-to-Ground Calls as per EUROCAE ED-137 Volume 2 Telephone Interface
- Flexible Architecture for custom testing scenarios
- Software based solution
- Easy-to-Use Graphical
   User Interface
- Scripting and Automation capability for regression testing. Support for Python APIs

Configurations Emulator Report Editor Debug Tools Windows Help	🔐 MAPS	S CWP (SIP ED-137C Vol	ume 2 Telephone Teleph	none) - [Call Generation -C	[allGenDefault]							_	
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Save         Column Width         Traffic         Inhall         ON           Save         Column Width         Show Latest         Find         Inhall         ON           0001@192.168.12.208         0001@192.168.12.218         Find         INVITE         INVITE         IP/0.011892.168.12.218         INVITE         IP/0.011892.168.12.218         IP/0.011892.168.12.208.506.0branch=39hG4bK-11=1778060975-3875-26072         IP/0.011892.168.12.208.506.0branch=39hG4bK-11=1778060975-3875-26072         IP/0.011892.168.12.208.506.0branch=39hG4bK-11=1778060975-3875-26072         IP/0.011892.168.12.208.506.0branch=39hG4bK-11=1778060975-3875-26072         IP/0.0118122.168.12.208.506.0branch=39hG4bK-11=1778060975-3875-26072         IP/0.0118122.168.12.208.5001840.5001840.5001840.5001840.5001840.5001840.5001840.5001840.5001840.5001840.5001840.5001840.5000186.500186.500186.5001840.5000186.500186.5001840.5001840.5000186	<												>
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phone.02/da/da call. normal         17:08:10.877000           100 Trying         17:08:10.893000           180 Ringing         17:08:10.911000           CallSetUpTime: 34msec         17:08:10.912000           200 0K         17:08:10.912000           ACK         17:08:14.818000           W67-CallType: phone.02;da/ida call           V=0           0=0001 36770160 1 IN IP4 192.168.12.208           ×			INVITE	t	7:08:10.867000			168.12.20	)8:5060;branch	=z9hG4bK-11	1778060975-	3875-260	)72
1/.08.10.899000     1/.08.10.899000       180 Ringing     17.08.10.911000       CallSetUpTime: 34msec     17.08.10.912000       200 OK     17.08.10.912000       ACK     17.08.14.818000       ACK     17.08.14.829000       Content-Type: application/sdp       Woofenet-Length: 216       v=0       o=0001 36770160 1 IN IP4 192.168.12.208       V       Kessage Sequence			phone.02;da/ida call	, normal 1	17:08:10.877000	Allow:	INVITE, BYE, CAN						UPDA1
180 Ringing     17.08:10.911000     Supported: 100rel       CallSetUpTime: 34msec     17.08:10.912000     Content-Type: application/sdp       200 OK     17.08:14.818000     WG67-Version: phone.02       ACK     17.08:14.829000     Subject: DA/IDA call       Priority: normal     WG67-CallType: phone.02;da/ida call       Content-Length: 216     v=0       0=0001 36770160 1 IN IP4 192.168.12.208     >			100 Trying		17:08:10.899000	1.0	-						
CallSetOprime: 34msec         17:08:10.912000           200 OK         17:08:14.818000           ACK         17:08:14.829000           Content-Type: application/sdp           WG67-Version: phone.02           Scripts         Message Sequence           Event Config         Script Flow		▲	180 Ringing	• • • • • • • • • • • • • • • • • • •	17:08:10.911000	Suppor CSeq:	ted: 100rel 1 INVITE						
200 OK     17:08:14.818000       ACK     17:08:14.829000       V=0       0:0001 36770160 1 IN IP4 192.168.12.208       Scripts     Message Sequence       Event Config     Script Flow			CallSetUpTime: 34	4msec .	17:08:10.912000				58.12.208>				
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Content-Length:         216           v=0         o=0001 36770160 1 IN IP4 192.168.12.208           <			ACK			WG67-C	allType: phone.(	)2;da/ida	a call				
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	,	- T \-			Initialization 5	rrors	Error Events		Cantured Ex	rors	Link Statu	e llo=0 De	-0



### MAPS<sup>™</sup> ED-137 Telephone Emulator Highlights



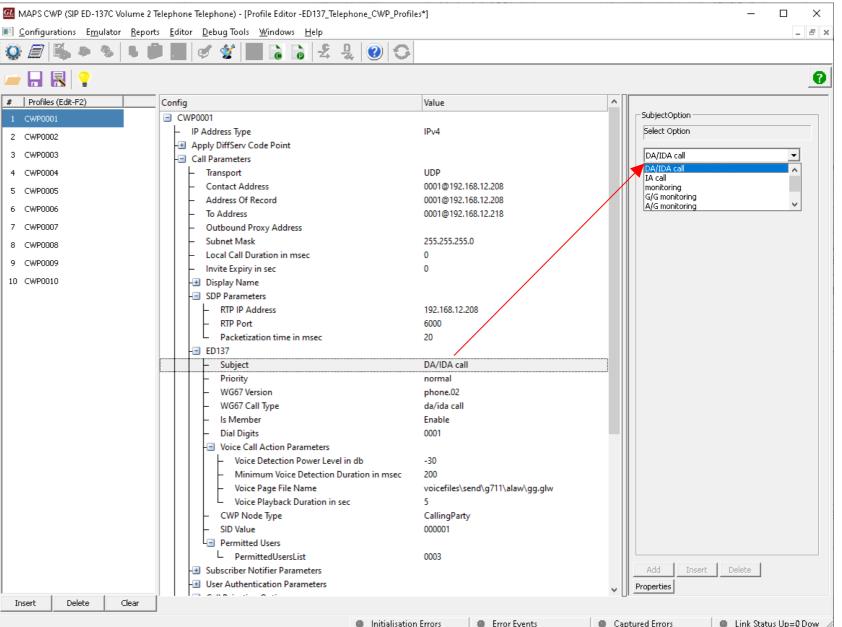
- Emulates CWP endpoints as per ED-137/2B and ED-137/2C versions
- Simulates multiple CWPs from single instance of MAPS<sup>™</sup>. Each simulated CWP can have unique IP address
- Supported Codecs G711 A-law, U-Law and G729

- Supports Addendum 2: FAA Legacy Telephone Networking, Addendum 4: Override Call and Addendum 5: Voice Call optionally
- Portable, easy to configure and use during in-the-field installation, testing and commissioning
- Supports both IPv4 and IPv6. Validated against VOTER
   version 4.1.33.3



### MAPS<sup>™</sup> ED-137 Telephone Emulator – CWP Profiles

- Each profile represents a CWP with customizable parameters
- Supports all call types (IA, DA/IDA, Monitor etc.) and call scenarios such as Call Hold, Call Transfer (Attended and Unattended), Call Pickup, Call Intrusion etc.
- Supports simulating invalid test cases by malforming SIP and SDP messages
- Allows simulating all SIP error responses such as 3xx, 4xx, 5xx and 6xx
- Traffic Actions send and record to file, send and detect digits/tones, Talk using microphone and play to speaker
- Impairments (Packet Loss, Packet Effects and Latency) can be applied to RTP traffic





### MAPS<sup>™</sup> ED-137 Telephone Emulator – Call Generation

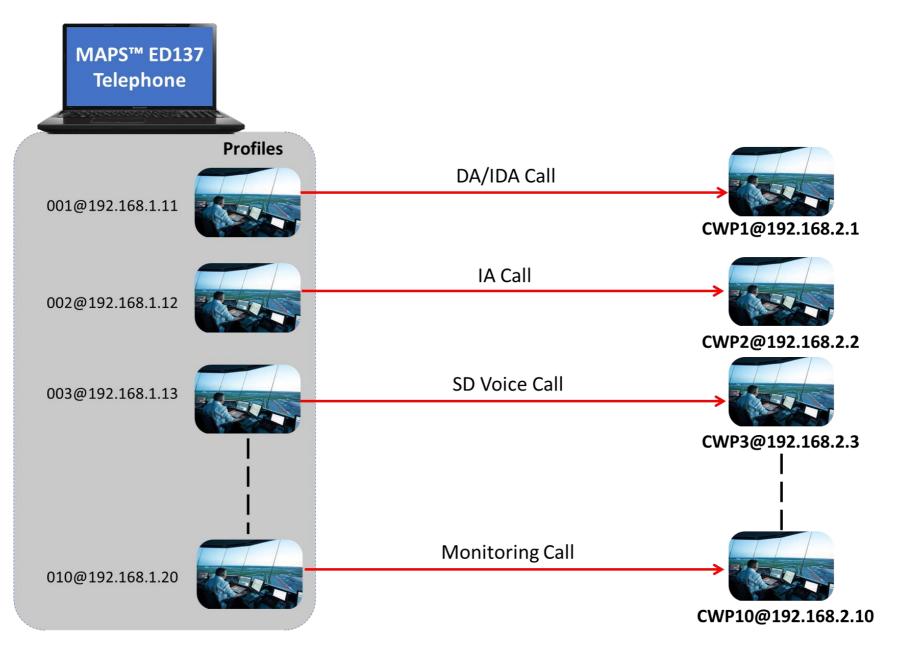
- Displays Call graph and message decodes for each call
- Load generation or background traffic generation using Bulk Call Generation
  - Scripts/sessions can be run repeatedly for defined number of iterations with results of each iteration
- Multiple scripts can be run simultaneously or sequentially or randomly
- Scheduler helps to run a set of scripts (test cases) at different intervals as defined by user

MAPS CWP (SIP ED-137C V	olume 2 Telephone Tele	phone) - [Call Generation -CallGer	Default]						– 🗆 ×
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🕒 🗀 🔚 🔣 💡									
Sr No Script Name	Profile	Call Info	Script Execution	Status	Events	Events Profile	Result	Total Iterations	Completed Iteratio
1 SipCallControl.gls	CWP0001	0001@192.168.12.218	Start	SessionCreated	None		Pass	5	2
2 SipCallControl.gls	CWP0002		Start	1	None		Unknown	5	0
Add Delete Insert	Refresh Start S	Start All Stop 🔽 Stop All 🔻	Abort Abort All			ReInvite	Receive On Ho	ld Send Ir Traffic Ir	npair Speaker ON
Save Column Width	_j □	Show Latest							
0001@192.168.12.208		0001@192.168.12.218:5066	Script Flow Config 🛛 🗙	2	Find				
	INVITE	11:24:22.638000	Flow Order	Via: SIP/2.0/	010192.168.12.218 SI WDP 192.168.12.208:5	P/2.0 060;branch=z9	hG4bK-16-2936	6893-6905-2172	^
	phone.02;da/ida.call,	normal 11:24:22.646000		Max-Forwards: Allow: INVITE From: 0001 <s< td=""><td>70 BYE,CANCEL,ACK,INFO ip:00010192.168.12.2</td><td>,OPTIONS,SUBS</td><td>CRIBE,NOTIFY,1</td><td>REFER, REGISTER, 3-6902-2172</td><td>UPDATE</td></s<>	70 BYE,CANCEL,ACK,INFO ip:00010192.168.12.2	,OPTIONS,SUBS	CRIBE,NOTIFY,1	REFER, REGISTER, 3-6902-2172	UPDATE
	100 Trying	11:24:22.692000	Time Configuration	To: 0001 ≺sir	0001@192.168.12.218	>	ag 15 2556665.	5 0502 2172	
	180 Ringing	11.24.22.632000	On Complete	Call-ID: CL-M Supported: 10	APS-15-29366893-6904 Orel	-2172			
	rou hinging	11:24:22.704000	O Duration 0 msec	CSeq: 1 INVII	E				
	CallSetUpTime: 59m	sec 11:24:22.705000	Total Iteration 5		<pre><sip:0001@192.168.1 <="" application="" pre="" sdp=""></sip:0001@192.168.1></pre>	2.208>			
<b>↓</b>	200 OK	11:24:26.798000		Subject: DA/I	DA call				
· ·	ACK	11:24:26.800000	Save Lancel	Priority: nor WG67-CallType Content-Lengt	: phone.02;da/ida ca	11			
┃	REFER	11:24:28.925000		v=0					
	202 Accepted	11:24:28.926000		s=SIP Call	84 1 IN IP4 192.168.	12.208			
	NOTIFY	11:24:28.934000		c=IN IP4 192. t=0 0 m=audio 6000					
▲	BYE	11:24:28.946000		a=rtpmap:8 PC	MA/8000				
<		,	>	a=rtpmap:101	telephone-event/8000				~
Scripts Message Seque	ence Event Config	Script Flow							
			Initialis	ation Errors	Error Events	Captured	d Errors	Link Status Up	=0 Down=0



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#### **Multiple Controllers Simulation**





15

### MAPS<sup>™</sup> ED-137 Recorder Emulator

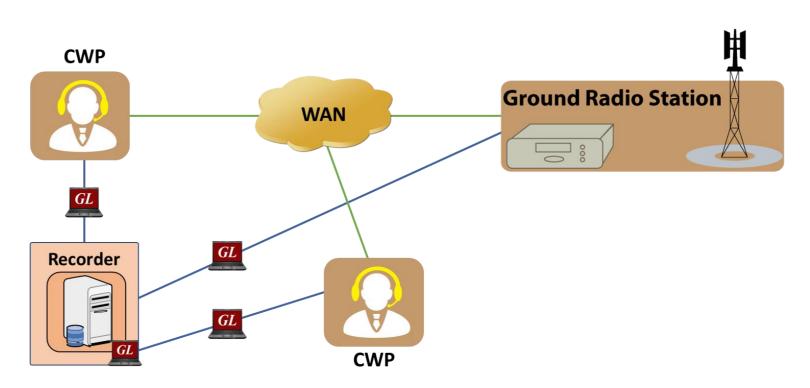
- Emulates Recording sessions as per EUROCAE ED-137 Volume 4 Recorder Interface
- Flexible Architecture for custom testing scenarios
- Software based solution
- Easy-to-Use Graphical
   User Interface
- Scripting and Automation capability for regression testing

MAPS (Message Automation Protocol Simu	lation) CWP (SIP ED-13	7C Volume 4 Recorde	er ) - [Call Generation - (	CallGenDefault]						—	$\Box \times$
🐇 Configurations Emulator Reports Edit	or <u>D</u> ebug Tools <u>W</u> ir	ndows <u>H</u> elp									_ 8 ×
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Sr No Script Name	Profile	Call Info		Script Execution	9	Status		Events	Events Profile	Result	Total Iteratic
1 RTSPCallControl.gls	CWP0001	192.	168.12.77:554	Stop		Send_File-9	itarted	UnKey PTT		Pass	
<											>
Add Delete Insert Refresh Sta	art Start All Stop	Stop All	Abort Abort All			Voting	Simultaneous	Start Squelch Call Int	trusion Unattende Transfer		Attended Transfer
Save Column Width —	- 🗌 Show Latest						-				
MAPS	C	DUT	<u>^</u>	Find							
ANNOU	INCE	15:34:21.331.9855	RECORD rt CSeq: 4	sp://192.168.12.77:	54/iprecorder	RTSP/1.0					
200 0	-			ion: recorder.02 GL-MAPS 3 1651593803	-125202-12522	0					
•		15:34:21.74.3021	Content-T	ype: application/x-		-					
SETU		15:34:21.75.5161		ength: 967							
200 0	ЭК	15:34:22.247.9033		ord-data connref="G roperties>	-MAPS_3_16516	04883-125411-99	932@192.168	.1.101">			
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200 0	•				"CalledNr">sip	p:0002@192.168.3					
RECO	IPD .	15:34:22.413.8148		properties>	5110001011 - 5	, property.					
		15:34:32.35.3916	~					2.880+0000">156.			
₹ 200 0		15:34:32.96.2766		<operation name<="" td=""><td>="PTT" time="2</td><td>2024-04-02_10:04</td><td>1:32.880+000</td><td>04:32.880+0000"&gt; 00"&gt;3<td>&gt;</td><td></td><td></td></td></operation>	="PTT" time="2	2024-04-02_10:04	1:32.880+000	04:32.880+0000"> 00">3 <td>&gt;</td> <td></td> <td></td>	>		
GET_PARA	AMETER	15:35:26.110.9878						0">Tx=13344 <td></td> <td></td> <td></td>			
200 0	-	15:35:27.154.9487						)+0000">Tx=1.1.1 )+0000">Rx=2.1.0			
GET PARA	AMETER			operations> cord-data>							
200 (		15:36:21.171.2779	, call-fe	cold daba-							
•		15:36:21.220.6510									
GET_PARA	AMETER	15:37:15.232.2084									
200 0	эк	15:37:15.279.3181									
GET_PARA	AMETER	15:38:09.290.4625									
200 0	אכ										
•		15:38:09.333.9365	<b>~</b>								
		,	>								
Scripts Message Sequence Event C	onfig <u>Script</u> Flow /										
				Initialisa	ion Errors	Error Events		Captured Errors	Link	Status Up=0 Do	own=0 //.



#### MAPS<sup>™</sup> ED-137 Recorder Emulator Highlights

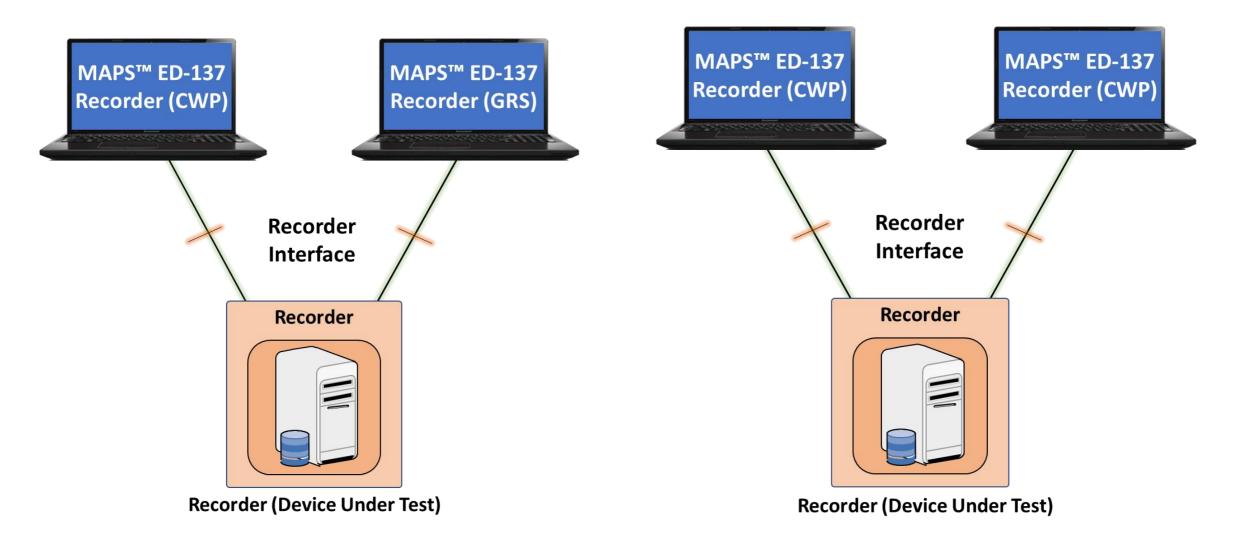
- Emulates ED-137/4B and ED-137/4C Recorder interface at CWP, GRS and Recorder endpoints
- Simulates Recorder interface on multiple CWPs, Radios and Recorders from single instance of MAPS<sup>™</sup>
- Supports all three transport types embedded binary data, independent TCP and independent UDP
- Audio codecs G711 A-law, G711 U-law and G729
- Supports both IPv4 and IPv6
- Validated against VOTER 4.1.33.4





#### MAPS<sup>™</sup> ED-137 Recorder Use Cases

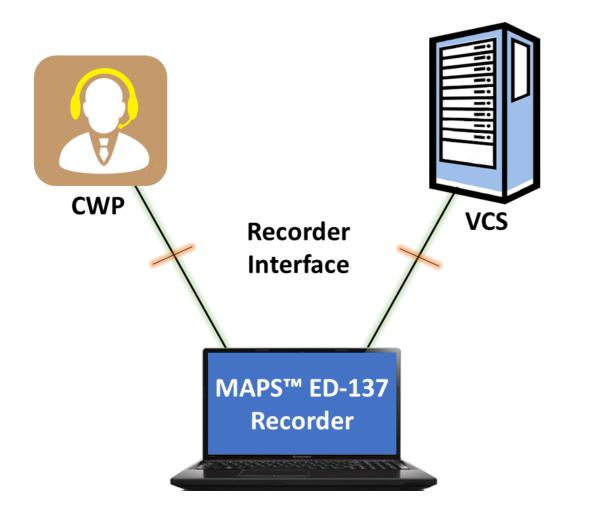
CASE 1: Simulate AG call recording towards Recorder CASE 2: Simulate GG call recording towards Recorder



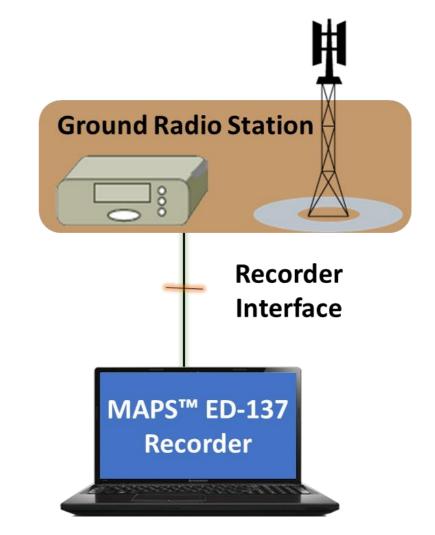


#### MAPS<sup>™</sup> ED-137 Recorder Use Cases (Contd.)

CASE 3: Testing Recorder interface of CWP/VCS



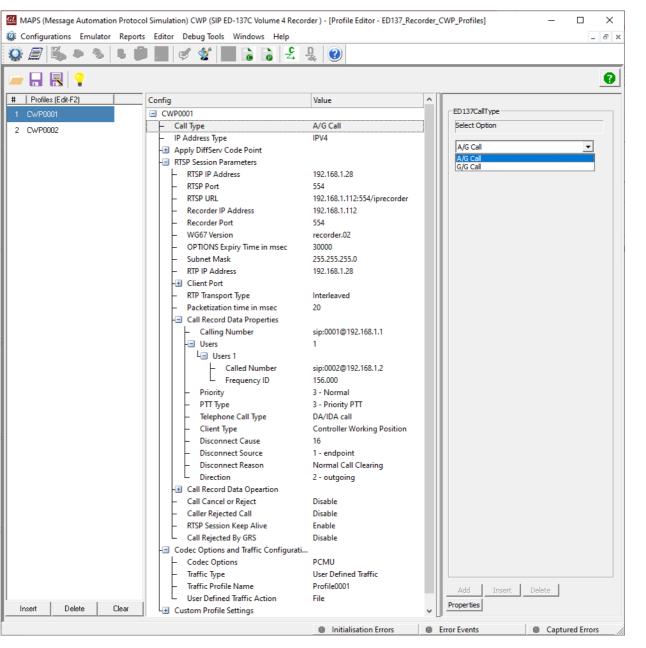
**CASE 4: Testing Recorder interface of GRS** 





#### MAPS<sup>™</sup> ED-137 Recorder Emulator Highlights

- Each CWP/GRS profile allows to define its own set of parameters to emulate an AG/GG call
- Custom Call Record Data properties and operations can be added quickly
- Recorder server can record and playback voice on sessions
- Call Record Data of each session is stored in CSV format
- Scripts to automate PTT and Squelch operations on AG recording sessions





#### MAPS<sup>™</sup> ED-137 Recorder Emulator Highlights

- Provides Call Graph and message decodes
- Scripts/sessions can be run repeatedly for defined number of iterations with results of the test
- Multiple scripts can be run simultaneously or sequentially or randomly
- Scheduler helps to run a set of scripts (test cases) at different intervals as defined by user
- Hundreds of recording sessions can be made to Recorder to verify performance and load testing

Image: Maps (Message Automation Protocol Simulating Configurations Emulator Reports Editor         Image: State			fault]					- D ×
	te la							
Sr No Script Name Profile	Call Info	Script Execution	Status	Events	Events Profile	Result	Total Iterations	Completed Iterations
1 RTSPCallControl.gls CWP0001	192.168.12.218:554	Stop	Call Connected	Key PTT		Pass	3	2
2 RTSPOptionsControl.gls CWP0002		Start		None		Unknown	3	0
Add Delete Insert Refresh Start	Start All Stop Stop All	Abort Abort All		Voting	Simultaneous Stari	t Squeich Buttor	18 Button7	Button6 Button5
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ANNOUNC 200 OK SETUP 200 OK SET_PARAMI 200 OK	E 11:51:25.315.55€ 11:51:25.365.224 11:51:25.366.170 11:51:25.420.152		CSeq: 3 WG67-Version Session: GL-1 Content-Type Content-Lengt <call-record <prope <td><pre>MPS_10_20990173-869, appLication/x-crd4; 776 data connref="GL-MA: rries&gt;</pre></td><td>1-7060 xml PS_5_30990161- cection"&gt;2lingNr"&gt;sip:00 lentType"&gt;CWP4 unectTime"&gt;202 cupTime"&gt;2024- cupTime"&gt;2024-</td><td><pre>%8174-15252@19 operty&gt; perty&gt; 001@192.168.1 01@192.168.1.3 01@192.168.1.3 /property&gt; 4-03-13_06:21:23 me="2024-03-13</pre></td><td>2.168.12.208"&gt; .1 2 1 :25.763+00005.763+0000<td>property&gt; operty&gt; +0000"&gt;156.000</td></td></prope </call-record 	<pre>MPS_10_20990173-869, appLication/x-crd4; 776 data connref="GL-MA: rries&gt;</pre>	1-7060 xml PS_5_30990161- cection">2lingNr">sip:00 lentType">CWP4 unectTime">202 cupTime">2024- cupTime">2024-	<pre>%8174-15252@19 operty&gt; perty&gt; 001@192.168.1 01@192.168.1.3 01@192.168.1.3 /property&gt; 4-03-13_06:21:23 me="2024-03-13</pre>	2.168.12.208"> .1 2 1 :25.763+00005.763+0000 <td>property&gt; operty&gt; +0000"&gt;156.000</td>	property> operty> +0000">156.000
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			utilization Company	Error Events	0.0	ntured Errors	👛 Link St	atus Un=0 Down=0



#### **Key Updates**

- Emulators support both ED-137 B and C versions, including Change 1 and 2 features
- User can choose to simulate ED-137 B or C version when invoking the application. License supports both versions
- Emulators support both IPv4 and IPv6 addressing
- All Emulators (Radio, Telephone and Recorder) are validated against latest VOTER tool
- GL participated in the "FAA VoIP Interoperability Event 2019" in Atlantic City. All GL Air Traffic testing products were extensively used by all other participating Equipment Manufacturers
- GL participated in VoIP in ATM Over IPv6 Plug tests in September 2024 (France)

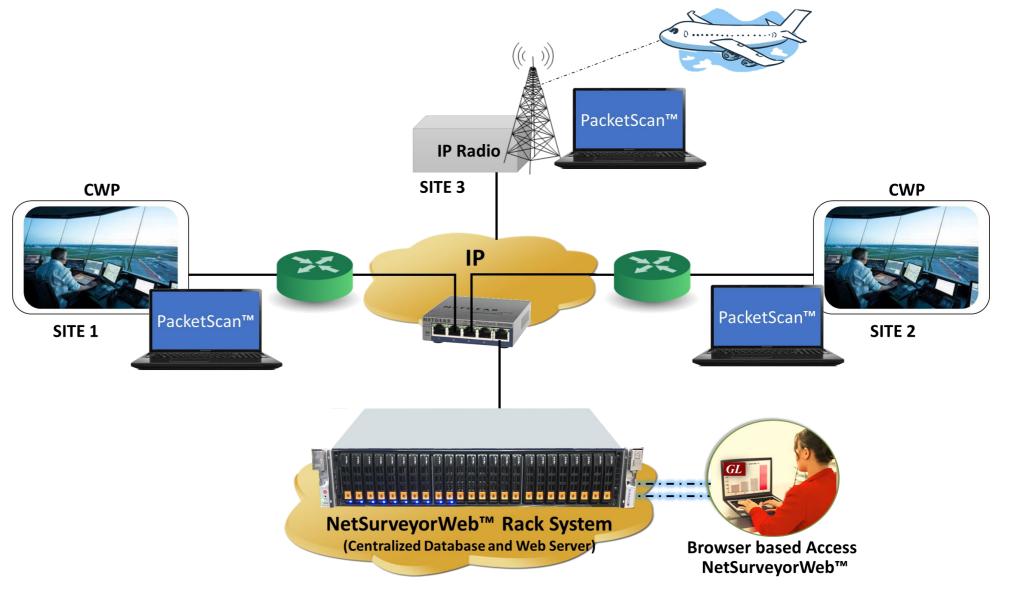


#### Air Traffic Control Monitoring Solutions



#### PacketScan<sup>™</sup> and NetSurveyorWeb<sup>™</sup>

- PacketScan<sup>™</sup> is a capturing probe deployed on the Air Traffic Network
- Results are sent to
   NetSurveyorWeb™
   database for
   centralized analysis
- Scalable to hundreds of probes deployed globally feeding a single database
- Infinite and nonintrusive monitoring of IP traffic



#### PacketScan<sup>™</sup> - Protocol Analysis Software

		etScan 64-bit										_	n x
Monitor up to 2000	Eile Vie	w Capture S	Statistics Database Call Detail		ıre <u>H</u> elp <b>F SI ₩ ₩ </b>		GoTe	- 1					
simultaneous calls with	Device	Frame#	TIME (Relative)	Length (Bytes)		ngth/Protocol Type	Packet Type MAC	Source IP Address	Destination IP Address IPv4	Source Port UDP	Destination Port UDP	SI	P Method
	<b>√</b> 0	0	00:00:00.00000000	1031	Interne	et IP(IPv4)	SIP	192.168.12.208	192.168.12.218	5060	5060	INVITE	
bidirectional RTP traffic	V 0	1	00:00:00.022167000			et IP(IPv4)	SIP	192.168.12.218	192.168.12.208	5060	5060	100 Trying	
Contura and analyza	$\sqrt{0}$	2	00:00:00.132649000			et IP(IPv4) et IP(IPv4)	SIP	192.168.12.218 192.168.12.208	192.168.12.208 192.168.12.218	5060 5060	5060 5060	200 OK ACK	
Capture and analyze	V 0	4	00:00:00.164060000	62	Interne	et IP(IPv4)	RTP	192.168.12.218	192.168.12.208	1028	6000		
packets at wirespeed.	<ul> <li>✓ 0</li> <li></li> </ul>	5	00:00:00.183807000	62	Interne	et IP(IPv4)	RTP	192.168.12.208	192.168.12.218	6000	1028		>
Save the captured trace	000E Ve	ersion	IPv4 Layer ========	= 0	100 (4)								^
to a disk	000E Ir	nternet Hea Ifferentiat	der Length (In 32 bit ed Services Field	words) = . =	0101 (5)								
IU A UISK	000F I	Differentia	ted Services Codepoint ngestion Notification		00000 Default 00 Not-ECT (1	Not FCN_Capab	le Transport)						
Analyze in real-time or	IF	P Hdr No TC Total Lengt	P SegmentationOffload	=	.8 (x0030)	NOT ECH-Capab.	re fransport)						
-	0012 1	Identificat	ion	= 3	9415 (x99F7)								
analyze recorded trace	0014 I	Reserved Bi )on't fragm	ent	= .	0 Not Set								
files off-line		lore fragme Fragment Of		= . = 0	.0 Not Set (00000 000000	100)							
		fime To Liv Protocol	e	= 1	.28 (x80) 0010001 UDP								
Aggregate statistics can	0018 H	Header Chec Source IP A		= 3	:05CB .92.168.12.218 (xC)	(0A80CDA)							
be obtained for any field			IP Address UDP Layer =========	= 1 =	.92.168.12.208 (xC	0A80CD0)							
•		ource Port estination	Port	= 1 = 6	.028 (x0404) .000 (x1770)								
or parameter in the		ength (Head		= 2	8 (x001C) 02EA								
protocol headers to	=== 002A Ve		RTP Layer ========	= 1	.0 (2)								
study the performance of	002A Pa 002A Ex	adding stension he	ader	= . = .	.0 (0) 1 Present								
	002A CS	SRC count arker bit		= . = 0	0000 (0) Not set								
the overall VoIP network	002B Pa	yload type equence Num	bor	= .	1111011 (123) R2S 6218 (x666A)	6 Keep Alive							
	002E Ti	imeStamp		= 3	796309020 (xE2471								
Supports SIP ED-137 for	0036 Ty	SRC identif ype :EUROCA		= 3	193938945 (x472A1) 59 (x0167)	.001)							
Air Traffic Monitoring	0038 Le 003A PI	T-type			. (x0001) 000 PTT OFF								
(Air-to-Ground, and	003A Se 003A PI	T-id		= . = 2	0OFF (0000 10	)							
· ·	003B P1 003B P1	CT Mute CT Summatio	n	= . = .	.0OFF 0OFF								
Ground-to-Ground)	003B S0 003B Re	CT		= . = .	0 No Simulta	aneous Transm:	issions						
	003B X	Padding		-  		led Information	n Present						
	3030	roduring											>
	Stopped. N	Mouse RClick +	CTRL button down for search/filt	er.	C:\Prog	ıram Files∖GL Comm	unications Inc\Packe	tScan-22.12.7. Idle. 102 frames		Missec	l Frames : 0		



#### PacketScan<sup>™</sup> Software – Call Summary

PDA Packet Data Analyzer - Summary View

**ED-138 Statistics** File View Call Summary Protocol Configurations GUI Configurations Help 🎽 🎘 🚮 🎬 📲 SIP Show All Calls Call Count: 5 Ω **\_\_**, (MOS/R-Factor. Call Summary SIP Registration Summary Alert Summary Packet Loss, Delay Call # Packets Missing Packets/(%) Duplicate Out Of Average Cumulativi Max/Min Max/Min Max/Min Max/Min Average It SSRC Payload Packet Conversationa Listening Latest OverAll Average Average Average Received MOS/R-Fac... MOS/R-Factor MOS\_Distribution VoiceQ. Discard. Packets... Sequence Gap(ms) Delay Jitter Inter Packet Gap Delay Jitter and Jitter) Call#000001 Caller:CWP01 Callee:GF Calld GL-MAPS-18-32446300-12/208 Call tartTime:2024-03-13 12:15:41 624 Call Duration: 00:02:00 272 **%**1 11907... PCMA... 3810 2.31 / 47 2.31 / 47 0/0/115 Poor 9/0.16 1960 / 34.02 0/0.00 0/0.00 30.31 0.38 3.20 0 534.67... 474 / -... 30.04 ... 2.969 ... 1.127 1 11937... PCMA... 1976 4.20 / 93 4.20 / 93 31/0/0 Good 070.00 070.00 0/0.00 0/0.00 20.00 0.05 1.04 - 4 1790 40.48 20 / -20 4.06 / ... 0.201 ... 0.184 Provides graphical 🖀 Call#000002 Caller:CWP01 Callee:GRS1 Call/d;GL-MAPS-17-32447696-10380-14584@192.168.12.208 Call StartTime:2024-03-13 12:15:43.024 Call Duration: 00:01:58.885 **%**2 11930... PCMA... 603 4.20 / 93 4.20 / 93 0/0/0 0.00 0.00 0.00 / ... 4.157 ... 1.078 0/0.00 0/0.00 0/0.00 0/0.00 0.00 1 Π 0.00 / ... 0/0 analysis of calls like **2**2 0.05 0.99 0 11902... PCMA... 1977 4.20 / 93 4.20 / 93 31/0/0 0/0.00 0/0.00 20.00 Ω 39.39 .... 197-17 3.94 / ... 0.327 ... 0.234 Good 0/0.00 0/0.00 🖀 Call#000003 Caller:CWP01 Callee:GRS1 Calld:GL-MAPS-17-32448144-10387-10972@192.168.12.208 Call StartTime:2024-03-13 12:15:43.468 Call Duration: 00:01:58.452 Call Ladder **%**a 3 4.20 / 93 11945... PCMA... 601 4.20 / 93 0/0/0 0/0.00 0/0.00 0/0.00 0/0.00 0.00 0.00 0.00 0/0 0.00 / ... 2.319 ... 1 0 0.00 / ... **2**3 PCMA... 1977 4 20 / 93 31/0/0 0/000 0.05 0.99 0 0 3.96 / ... 0.251 ... 0.209 11908.. 4.20 / 93 Good 0/0.00 0/0.00 0/0.00 20.00 39.39 .... 197-17 Diagrams, MOS and Call#000004 Caller:CWP01 Callee:GR Callid:GL-MAP 5 17-32449105-10394-5260@192.168.12.208 Call StartTime:2024-03-13 12:15:44.423 Call Duration: 00:01:57.492 864 11914... PCMA... 2427 2.12 / 43 2.12 / 43 0/0/78 Poor 0 / 0.00 1494 / 38.16 0/0.00 0/0.00 0.46 3.55 5.08 / ... 0.489 . 32.35 0 142.94. 97-10 1 Jitter variation graphs **e** 4 11922... PCMA... 1977 4.20 / 93 4.20 / 93 31/0/0 Good 0/0.00 0/0.00 0/0.00 0/0.00 20.00 0.04 0.99 2 1384 39.39 .... 197-17 3.94 / ... 0.272 ... 0.197 Call#000005 Caller:CWP01 Callee:GF Callid:GL-MA S 17-32449575-10401-1840@192.168.12.208 Call : tartTime:2024-03-13 12:15:44.90 Call Duration: 00:01:57.011 **%**5 PCMA... 2513 1459 / 36.79 31.64 11936... 2.17 / 44 2.17 / 44 0/0/79 Poor 0 / 0.00 0/0.00 0/0.00 0.34 3.41 0 142.55... 127-10 5.21 / ... 5.613 ... 1.470 **2**5 11953... PCMA... 1977 4.20 / 93 4.20 / 93 31/0/0 Good 0/0.00 0/0.00 0/0.00 0/0.00 20.00 0.05 0.99 2 1362 39.39 ... 197-17 3.95 / ... 0.220 ... **Record and Playback** < audio on the call Column Width 🔲 Absolute Timing 🔲 Show Latest Find Complete Stack Detects Frame# 192.168.12.208 192.168.12.218 Time INVITE INVITE sip:GRS10192.168.12.218 SIP/2.0 inband/outband Digits 00.00.000 0 5060 5060 Via: SIP/2.0/UDP 192.168.12.208:5060;branch=z9hG4bK-19-32446300-10374-9692 SIP/2.0 100 Trying Max-Forwards: 70 and Tones 00.00.018 1 5060 5060 Allow: INVITE, BYE, CANCEL, ACK, INFO, OPTIONS, SUBSCRIBE, NOTIFY, REFER, REGISTER SIP/2.0 200 OK From: CWP01 <sip:CWP01@192.168.12.208>;tag=FromTag-16-32446300-10371-9692 2 5060 00.00.140 5060 To: GRS1 <sip:GRS10192.168.12.218> ACK Contact: CWP01 <sip:CWP01@192.168.12.208> **Triggers and Actions** 00.00.151 3 5060 5060 Call-ID: GL-MAPS-18-32446300-10373-9692@192.168.12.208 CSeq: 1 INVITE Normal PTT ON feature can filter on 00.05.185 185 6000 1050 Recv-Info: WG67-Version: radio.02 Normal PTT ON "Calls of Interest" Priority: normal 00.05.185 186 6000 1050 Subject: radio Squelch ON Supported: 100rel 00.09.628 611 6000 1050 Content-Type: application/sdp Logs Call Detailed Squelch OFF Content-Length: 410 6000 00.41.067 10368 1050 Records to CSV files v=0 -- CMD01 00050000 00050000 TW TD4 100 100 10 000 E-Model T.38 Analysis Call Flow Call Summary Calls Rate RTP Packets Graph Average Jitter Distribution



RTDela... RTDela... C

0.841

0.439

0.204

X

#### **Good Call and Bad Call**

ile ⊻iew ⊊all S	and the second se	ocol Configuratio		-												
🕻 🔉 🎦	W 9 Þ	- 10 K	3. 8 3	SIP	• St	ow All Session	s		1							
	Payload	Convers Convers MOS/R	ational	ng Pack R-Factor Disca	Missing Missing Packets[%]	cate Du ets/[%] Pa	e Of Second			Average Inte Anival Jitter (	r Cumulative Packet Lost	Max/Min Gap	Max/Min Delay	Jitter	Max/Min RTDela	RTDela
21 24488 Calm000002 Cal	1 0110 0000	1346 4 207	/93 4.20/	93 070 793 07000 slid GL-MAPS_3 56 070	870.00	0.7.0.00 0 1.52 Call Stud	/0.00 20 /0.00 19			0	991 0 431	24.99 25.16 260.18		0.97/_	1.718 0.164 1.727	0.164
2 25805 Cat#000003 Cat 3 36001	PCMA/8000 er:0001@192.168 PCMA/8000	2401 3411	00 0.617	93 070 site GL-MAPS_3 65 323	0/0.00	1.00 0 1.1.52 Call Sta 0.700 44	rtTime 2018-02-26 15 17 / 16.59 20	2 .05 Ca 0 0.00	ation: 0 34.00	000 52 152 0	285	26.46	6/-6 180/	1.01 /	0.217	0.217
TimeStamp Fra	PCMA/8000	192,168,1			0 / 0.00	0/0.00 0	/ 0.00 0.0	0 0.00 Find	0.00	30	2	0.007	0/0	0.00 /	0.000	0.000
00.00.000 00.00.007 00.00.117 00.00.124 00.00.125 00.00.125 00.00.127 00.09.453 00.41.192 01.22.623 01.42.409	0 1 2 3 4 5 100 1850 2270 3362 4056	5060 5060 5060 6000 6000 6000 6000 6000	SIP/2.0 SIP/2 Kei Kei Norm Kei Squ	WHTE 0 100 Trying 2.0 200 OK ACK ep Alive ep Alive ep Alive ep Alive uelch ON ep Alive BYE	<ul> <li>▶ 5060</li> <li>▶ 5060</li> <li>▶ 5060</li> <li>▶ 5060</li> <li>▶ 5060</li> <li>▶ 1042</li> </ul>		INVITE sip:00 Via: SIP/2.0/ Max-Forwards: Allow: INVITE From: 0001 <sip Call-ID: GL-M CSeq: 1 INVIT Expires: 100 Priority: nor Subject: radi WG67-Version: Contact: 0001 Content-lengt v=0 0=0001 338529 s=SIF Call c=IN IP4 192. t=0 m=audio 6000 a=rtpmap:0 FC</sip 	UDP 192.166 70 ,BYE,CANCHI 19:00018192.1 APS_3_27075 H mal o radio.01 <sip:00016 applicatio h: 464 38 33852936 168.1.52 RTP/AVP 8 (</sip:00016 	0.1.52:5 L,ACK,IN 2.160.1. 160.1.23 59591-13 0192.160 on/sdp 8 IN 1P4	060;branch*: \$0,0FTIONS, \$2>;tag=From 061-8584019: .1.52> 192.168.1.	SUBSCPIBE,NO hTag_1_27075 2.160.1.52	TIFY, DEF	ER, REGIS			
02 52 048		5060			5060		a=rtpmap:0 PC	0008110								



#### **NetSurveyorWeb™**

- Web-based network surveillance system for air traffic monitoring
- Works with multiple PacketScan<sup>™</sup> Probes to non-intrusively monitor remote locations
- Real-time and/or historical analysis
- Multi-user support, and user-friendly interface
- Filter and Search Options. Provides quick database query methods
- Generates Reports, Alarms and E-mail notifications

. NetSurveyorWeb						🍠 🔅 Refrest			Protocol VOIP (SI	P & RTP)	👻 Тура	CDR			gl	
Quick CDR		😐 Data	🚯 Report	s 💽 Ala	rms 🍂 Users :	System Status at 2024-03-13 12:23:5										
	0.	ick CDR \ Air to	Ground C	alls												
Ground to Ground Calls																
Good Quality Calls					ime : 00:00:00 \$ 23	:59:59 🗣										
Poor Quality Calls Fair Quality Calls		oday Yesterday														
Failed Calls	_	🗆 🔄 Refresh	Show L	atest	Actions - Query Exe	cution Time : 0.390	55 Seconds	Sort Order	STARTTIME DESC							
All Calls		Trafficsumid		•	Trafficsumid	pply Clear					Page Size: 20	~				
Custom CDR		Ex:Trafficsumid				ppry clear										
, 			SINo	Trafficsumid	Call Starttime	Calling Number	Called Number	Call Success	Duration PTT C	ount Squelch Cou	nt PTTS Count	PTTM Count Pilot	-Pilot SCT Count Co	ntroller-Pilot SCT Count C	all Endtime Failur	e Cause
CDR		) 🔹 Call Flow	3	223362	2024-03-13 06:47:53.424	0011	0011	1	00:00:11.139 1	3	0	0 1	0		0	
Default KPIs		) = Call Flow	4	223361	2024-03-13 06:47:45.737	0005	0005	1	00:00:18.844 1	2	0	0 0	2		0	
ED137 Reports		SSRC#	Payload	Total Packet	t Count Missing Packet Co	unt/(%) Dupl. Pacl	(et Count/(%)	Re-ordered Pa	icket Count/(%) Packe	ts Discarded/(%)	Conversational	MOS/R Listening M	DS/R Cumulative Pac	ket Loss Gap (Min/Max/Av	) Jitter(Min/Max/A	v) RTD(
Basic KPIs		1263395585					0/0		)/0	0/0	4.2/93	4.2/93		0.00/39.33/20.0		
Config		1264432897	CMU/800	0 190	0/0		0/0	C	0/0	0/0	0/0	0/0	0	0.00/21.69/20.0	0.00/0.71/.47	7 0.000,
Admin		) 🔹 Call Flow	5	223360	2024-03-13 06:47:45.465	0019	0019	0	00:00:00.000 0	0	0	0 0	0		Netwo	ork Failure
		) 🔹 Call Flow	6	223359	2024-03-13 06:47:45.449	0003	0003	1	00:00:19.122 1	2	0	0 0	2		0	
Utilization 2		) 🔹 Call Flow	7	223358	2024-03-13 06:47:44.946	0020	0020	0	00:00:00.000 0	0	0	0 0	0		Netwo	ork Failure
		) 🔹 Call Flow	8	223357	2024-03-13 06:47:42.156	0018	0018	0	00:00:00.000 0	0	0	0 0	0		0	
		) 🔹 Call Flow	9	223356	2024-03-13 06:47:34.458	0012	0012	1	00:00:30.101 2	4	0	0 0	4		0	
		-	10	223355	2024-03-13 06:47:32.044	0020	0020	0	00:00:00.000 0	0	0	0 0	0		0	
		) 🔹 Call Flow	11	223354	2024-03-13 06:47:31.576	0019	0019	0	00:00:00.000 0	0	0	0 0	0		0	
		) 🔹 Call Flow	12	223353	2024-03-13 06:47:31.394	0018	0018	0	00:00:00.000 0	0	0	0 0	0		0	
		) 🔹 Call Flow	13	223352	2024-03-13 06:47:28.096	0004	0004	1	00:00:36.481 2	3	0	0 0	3		0	
		] = Call Flow	14	223351	2024-03-13 06:47:20.312	0014	0014	1	00:00:44.260 0	3	0	0 0	0		0	
		SSRC#														
		1263165441	PCMA/800	0 224	0/0		0/0	C	)/0	0/0	4.2/93	4.2/93	0	0.00/0.00/0.00	0.00/0.00/0	0.802
		1261130753	PCMA/800	0 258	0/0		0/0	C	)/0	0/0	4.2/93	4.2/93	0	0.00/21.39/20.0	0.00/0.66/.42	2 0.000,
		) 🔹 Call Flow	15	223350	2024-03-13 06:47:20.011	0010	0019	0	00:00:00.000 0	0	0	0 0	0		0	

### $NetSurveyorWeb^{TM} - Call Detail View$

GL NetSurveyorWeb		Protocol VOIP (SIP & RTP)	V Type CDR V	او ک	
T Quick CDR	📻 Data 🔥 Reports 🕥 Alarms 🕰 Users	System Status at 0 2024-03-13 12:26:58			
Air to Ground Calls         Ground to Ground Calls         Good Quality Calls         Poor Quality Calls         Fair Quality Calls         Failed Calls         All Calls	Quick CDR \ Air to Ground Calls Constant Constant Consta	📆 Export as PDF 🛛 🔜 Export as HTM	. Response Time : 0.00000 Seconds		
Custom CDR ···································		🔘 💭 💭 🗆 Comple	te Stack Download Decode		
CDR	192.168.15.5	192.168.15.25			
Default KPIs Control C	GIZ	SIP	=====================================	-	
Config >	2024-03-13 06:47:45.737 5060 INVITE	5060	Via: SIP/2.0/UDP 192.168.15.5:5060;branck Max-Forwards: 70 Allow: INVITE,BYE,CANCEL,ACK,INFO,OPTION:		
💽 Admin 🔷	2024-03-13 06:47:45.744 5060	5060	From: 0005 <sip:0005@192.168.15.5>;tag=Fr To: 0005 <sip:0005@192.168.15.25></sip:0005@192.168.15.25></sip:0005@192.168.15.5>		
Utilization >	2024-03-13 06:47:45.858 5060 200 OK	5060	Contact: 0005 <sip:0005@192.168.15.5> Call-ID: GL-MAPS-6589-479926236-162806-8 CSeq: 1 INVITE</sip:0005@192.168.15.5>	1408@192.168.15.5	
	2024-03-13 06:47:45.870 5060 ACK SUBSCRIBE	5060	Recv-Info: WG67-Version: radio.02 Priority: normal		
	Event Summary View	Quick Search: Quick Search Ex.Value1,Value2	•	Apply Clear	
	TimeStamp Packet Type Frame Length S	ource IP Destination IP Event Type	PTT Type PTT Id Conversational Mos Missing Packet	t Count Packet Discarded Reordeed Packet Count Dup	plicate Packet Coun
	2024-03-14 17:14:35.261 SIP 1026 1	92.168.15.14 192.168.15.34 INVITE			
		92.168.15.34 192.168.15.14 100 Trying			
		92.168.15.34 192.168.15.14 200 OK			
		92.168.15.14 192.168.15.34 ACK Squelch ON	0 0	0 0 0	
	2024-03-14 17:14:41.763 2024-03-14 17:14:50.773	Squeich ON Squeich OFF	0 0	0 0 0	
		92.168.15.14 192.168.15.34 BYE	7.6 0	5 5	
		92.168.15.34 192.168.15.14 200 OK			



#### **NetSurveyorWeb<sup>™</sup> – Reports and Graphs**

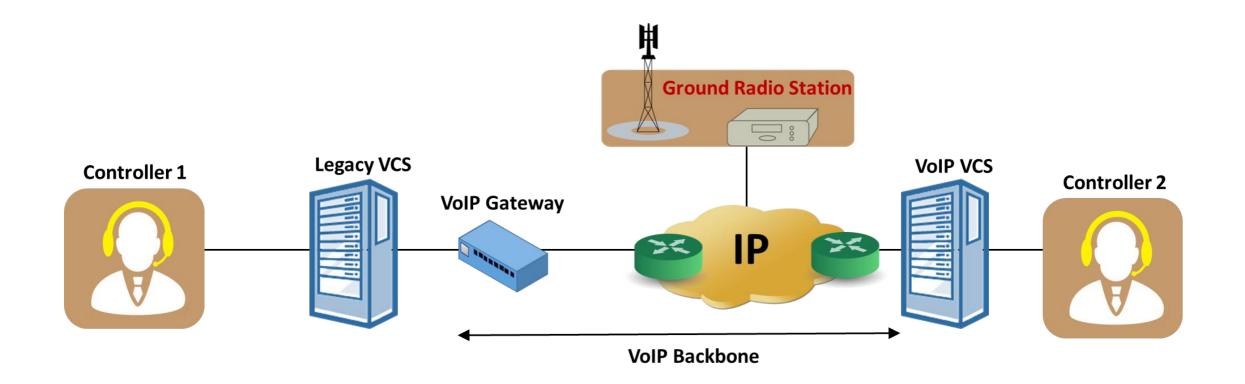




# GL's Critical Delay and Voice Quality Measurement in Air Traffic Management (ED-138)

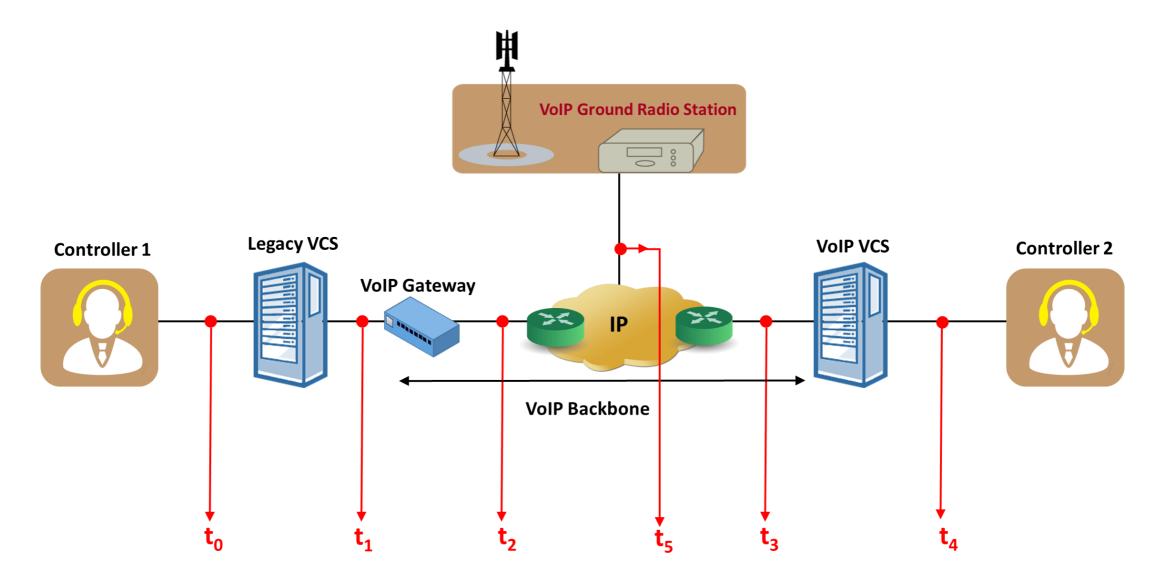


#### **Critical Time Delay Measurements**





#### Critical Time Delay Measurements (ED-138) - Overview





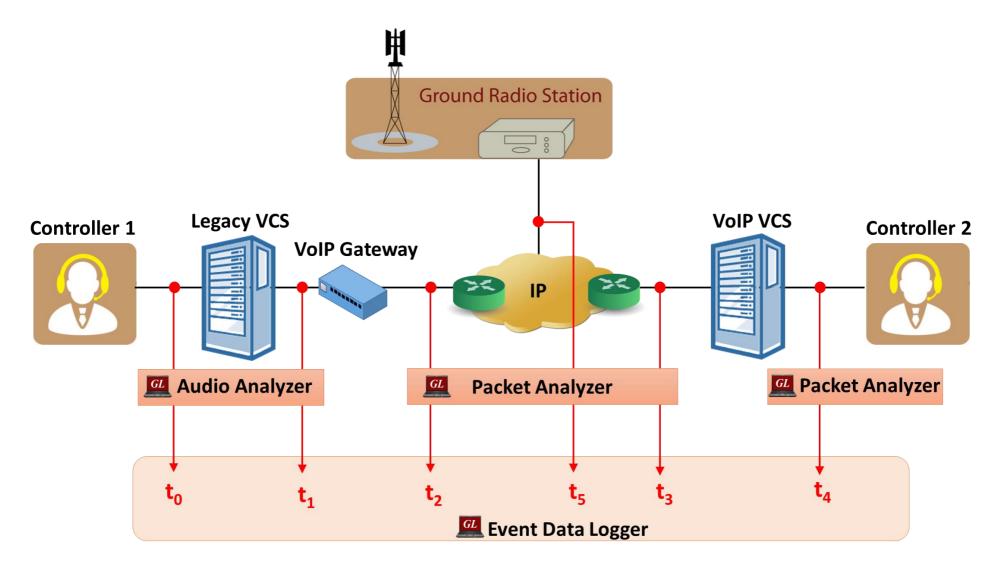
#### Important Events to Measure in ATM Network

- PTT
- PTT confirmation
- PTT release
- PTT release confirmation
- Squelch on
- Squelch off
- End-to-end voice delay for PTT
- End-to-end voice delay for Squelch
- Main/Standby Tx/Rx transfer
- Main/Standby Tx/Rx transfer confirmation
- Remote Receiver Mute
- Remote Receiver Mute Confirmation
- Remote Receiver Unmute
- Remote Receiver Unmute Confirmation



#### **Critical Time Delay Measurements - Overview**

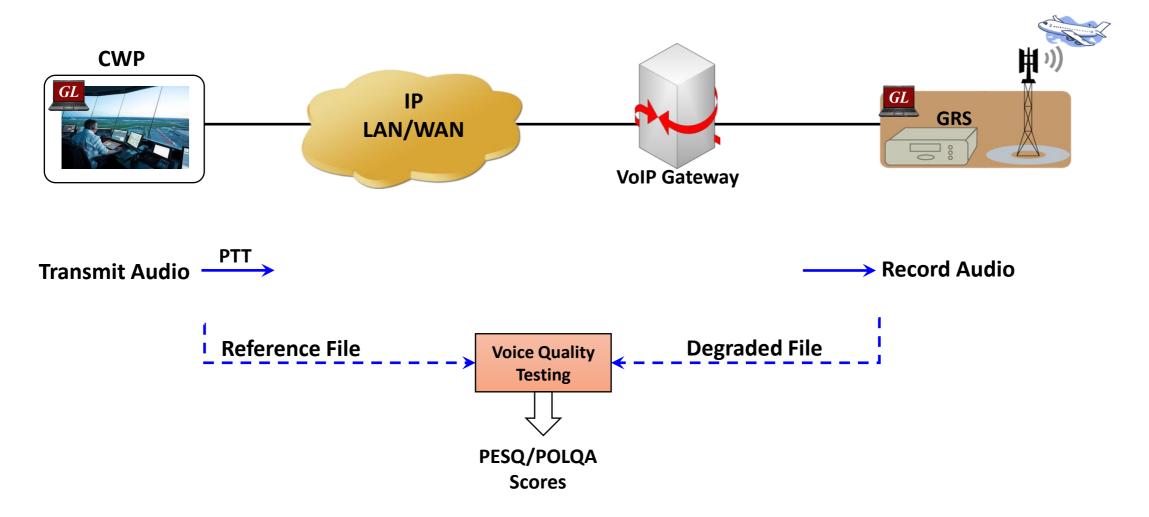
GL meets all critical specifications for ATM Delay and Voice Quality measurements





#### **Voice Quality Measurements in ATM**

Voice Quality measurement can be across IP to IP, IP to Analog and Analog to Analog networks





### **Deployment Architecture Elements**



Central System for Delay and Voice Quality Measurements



Packet Analyzer + MAPS™ ED137 Radio



Audio Analyzer



**Discrete Signal Logger** 

#### Central System for Delay and Voice Quality Measurements (MAPS™ Administrator)

• Controls all other components of the test suite. Executes tests and performs measurements such as call successes/failures, delay and voice quality measurements

#### Packet Analyzer

• Deployed in-line on an Ethernet network. Examines and time stamps packets of interest. Generates TTL pulses with microsecond precision

#### MAPS<sup>™</sup> ED-137 Radio or Telephone

- Simulates CWP and GRS to emulate hundreds of Air-to-Ground or Ground-to-Ground calls
- Key PTT/Squelch, send and record audio

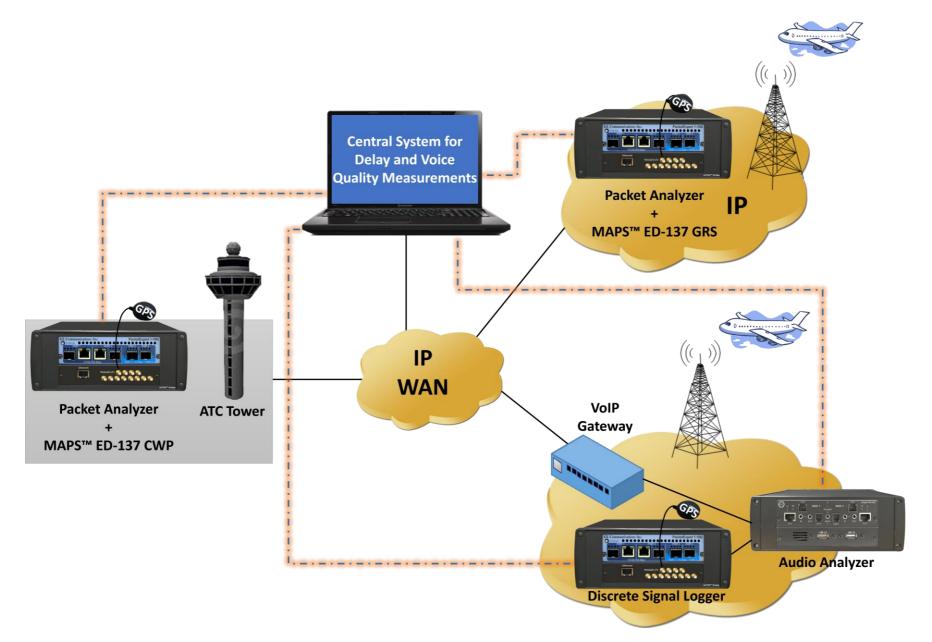
#### Audio Analyzer

- Emulate Controller (PTT and Audio); Generates TTL triggers based on PTT On, PTT Off, Audio Start and Audio Detect (On or Off)
- Inject and record analog signals at the CWP, Radio and VoIP gateway interfaces

#### **Discrete Signal Logger**

Monitors the TTL output from the Audio Analyzer and sends a corresponding IP packet to the central system

#### **ATM Solution for Portable Field Testing**



### Thank you

