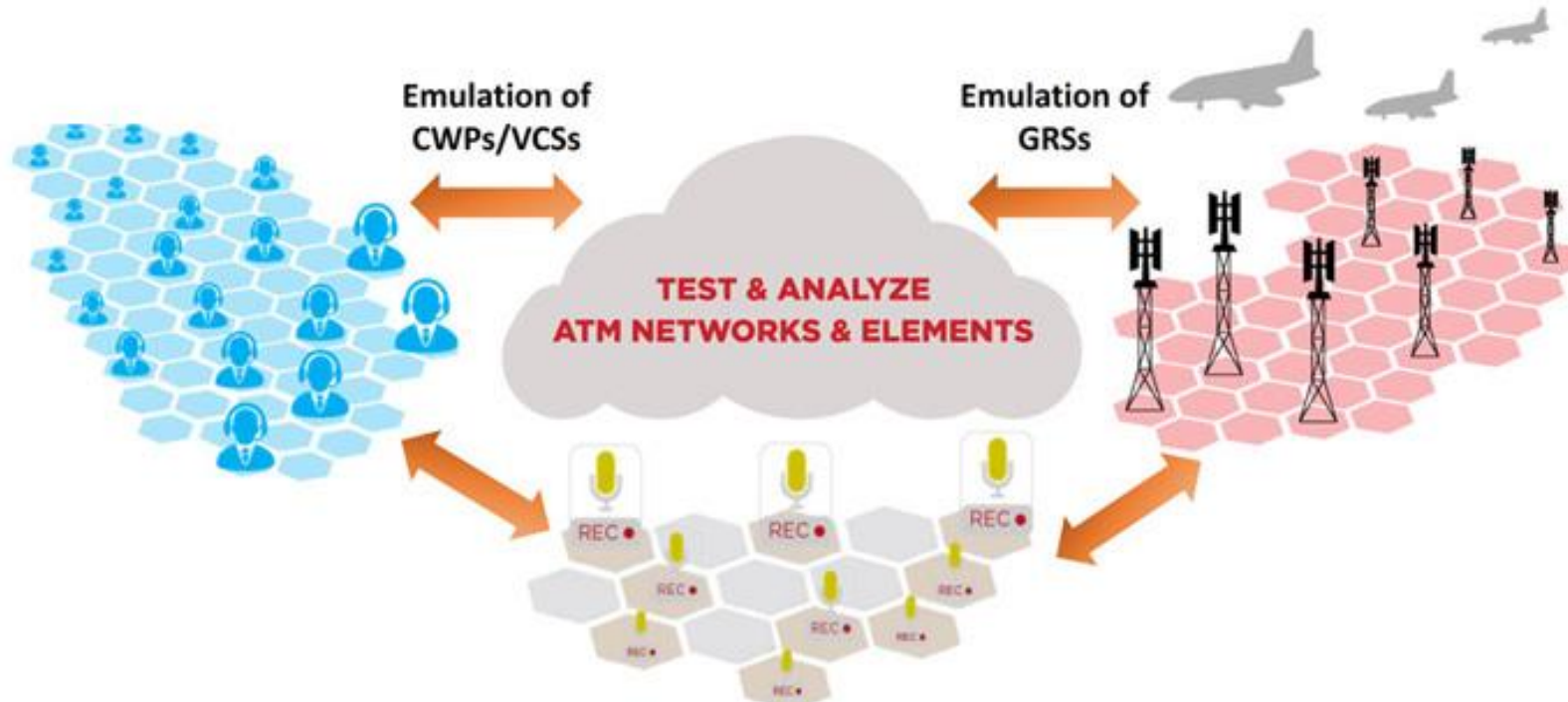

Test Solutions for Air Traffic Management



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Website: <https://www.gl.com>

Overview



ED137 B & C Compliant

VOTER Validated

ED138 Monitoring System

Critical Delay Measurement

Voice Quality Testing

GL's ATM Test Solutions Overview

- **ED-137 Emulators**

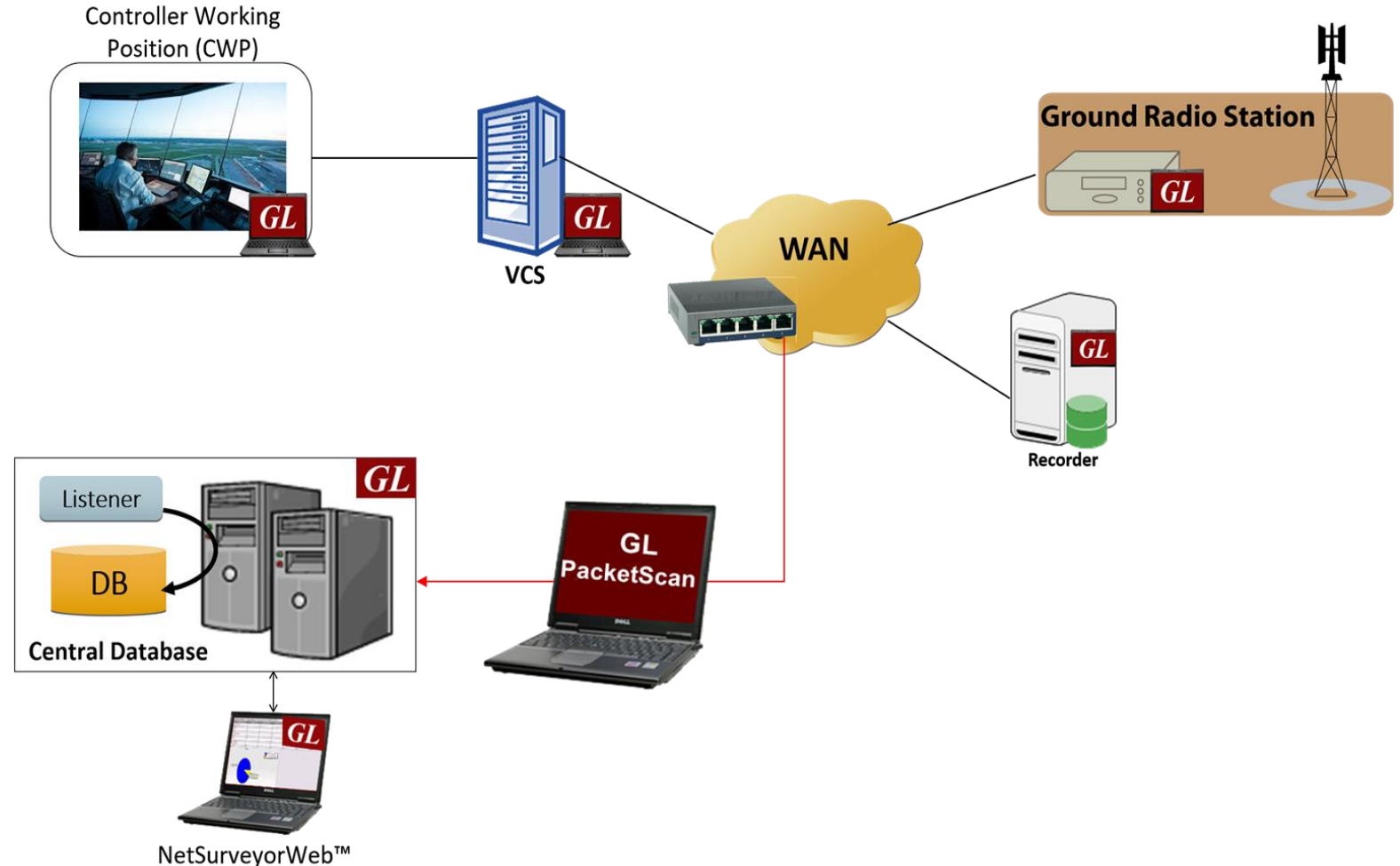
- MAPS™ ED-137 Radio
- MAPS™ ED-137 Telephone
- MAPS™ ED-137 Recorder

- **ED-138 Monitoring Solutions**

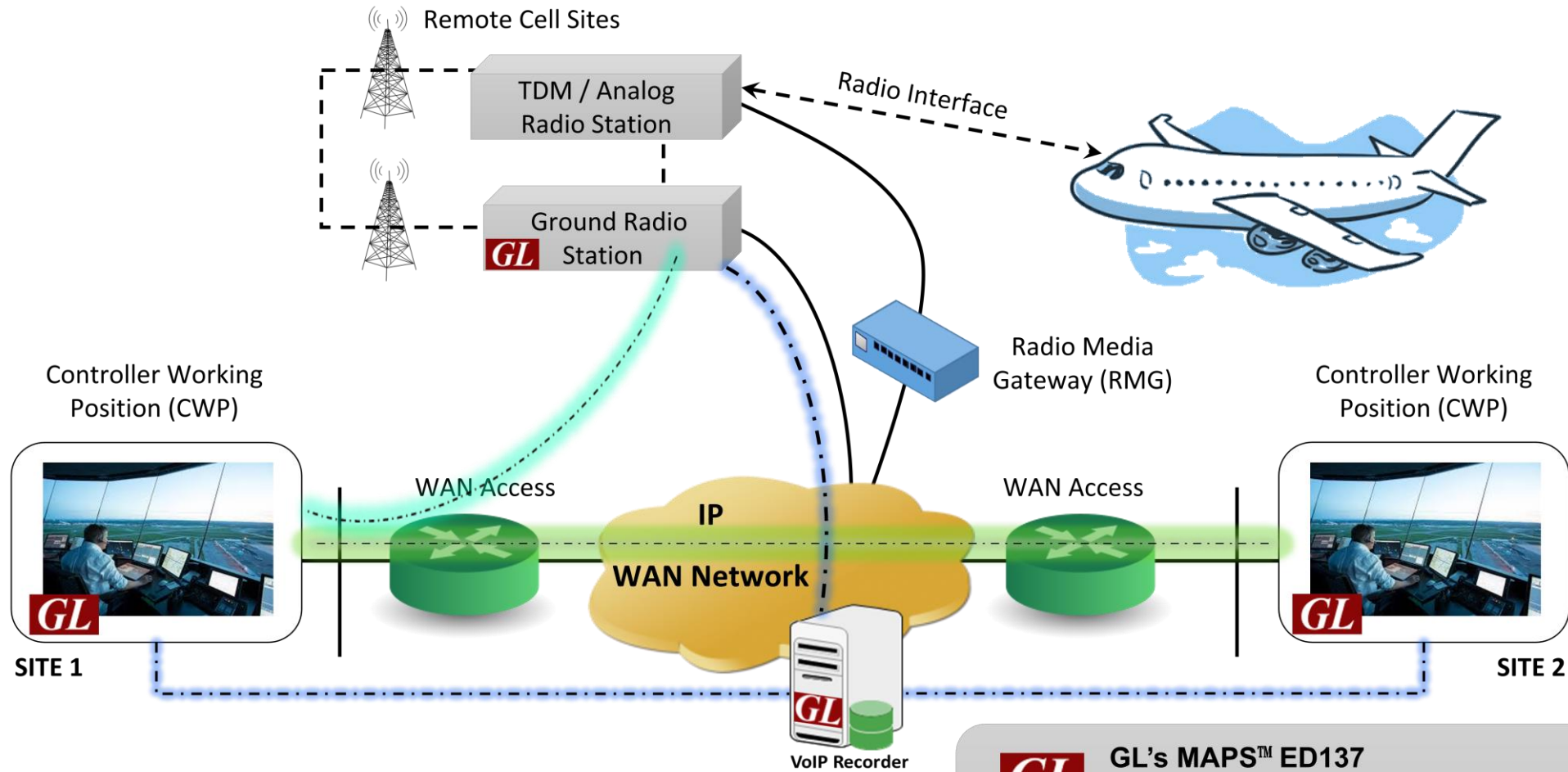
- PacketScan™
- NetSurveyorWeb™

- **Critical Delay and Voice Quality Measurements**

- Traffic Generation (Background, Test, Stress)
- Audio Analyzer
- Packet Analyzer
- Discrete Signal Logger, Packetizer
- IP WAN Simulation



MAPS™ ED-137 Radio, Telephone, and Recorder



- ED-137 Radio, Telephone, Recorder are based on **MAPS™** (Message Automation and Protocol Simulation) architecture

GL GL's MAPS™ ED137 Radio/Telephone/Recorder Emulator

- MAPS™ ED137 Radio
- MAPS™ ED137 Telephone
- MAPS™ ED137 Recorder

MAPS™ 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

The screenshot displays the MAPS software interface. At the top, the title bar reads "GL MAPS (Message Automation Protocol Simulation) CWP (SIP ED-137C Volume 1 Radio Radio) - [Call Generation - CallGenDefault]". Below the title bar is a menu bar with options: Configurations, Emulator, Reports, Editor, Debug Tools, Windows, Help. A toolbar contains various icons for file operations and execution. Below the toolbar is a table showing call execution results:

Sr No	Script Name	Profile	Call Info	Script Execution	Status	Events	Events Profile	Result	Total Iterations
1	SipCallControl.gls	CwP0001	0001@192.168.12.212, PTT-ID = 2	Stop	SQUELCH is ON	Unkey PTT		Pass	1

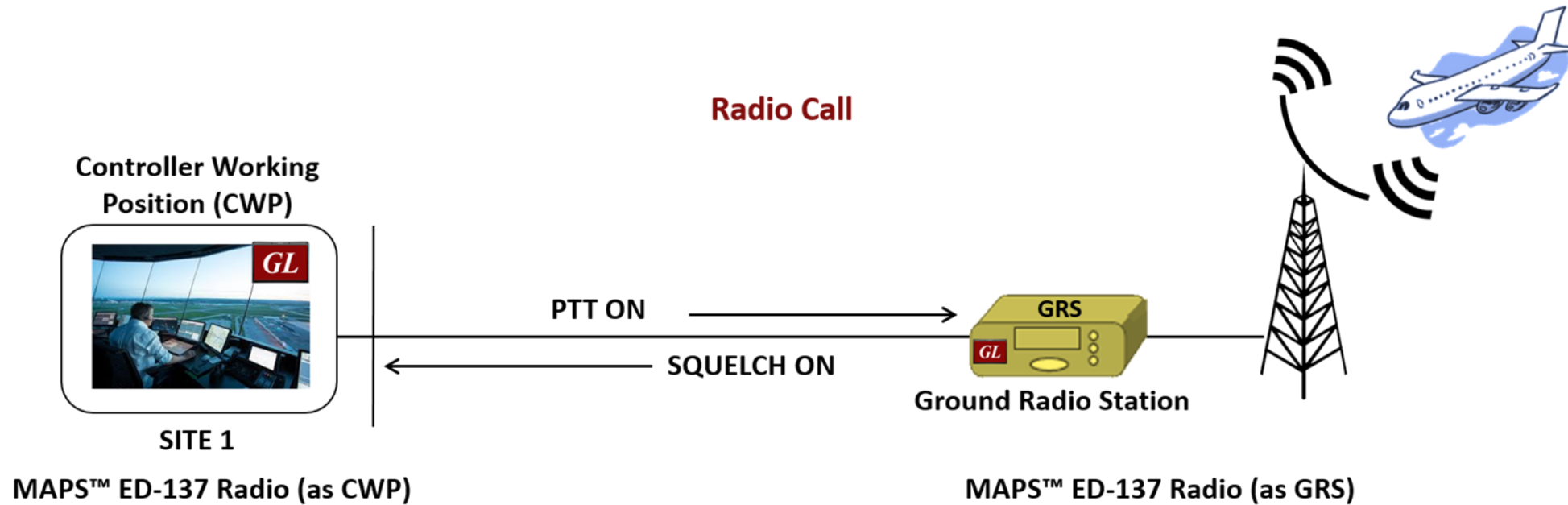
Below the table is a toolbar with buttons: Add, Delete, Insert, Refresh, Start, Start All, Stop, Stop All, Abort, Abort All. To the right are buttons: Send RMM, Apply CLD, ReInvite, Receive Traffic, PTTs ON, Apply RRC, Impair, Speaker ON, Stop RTP/R25. Below the toolbar is a section for "Save" and "Column Width" settings. The main area is divided into two panes: "MAPS" and "DUT". The "MAPS" pane shows a message sequence diagram with arrows indicating the flow of messages between the two entities. The "DUT" pane shows a log of SIP messages:

```
INVITE sip:0001@192.168.12.212 SIP/2.0
Via: SIP/2.0/UDP 192.168.12.119:5060;branch=z9hG4bK-4-1118866627-2174-5124
Max-Forwards: 70
Allow: INVITE, BYE, CANCEL, ACK, INFO, OPTIONS, SUBSCRIBE, NOTIFY, REFER, REGISTER
From: 0001 <sip:0001@192.168.12.119>;tag=FromTag-1-1118866627-2171-5124
To: 0001 <sip:0001@192.168.12.212>
Contact: 0001 <sip:0001@192.168.12.119>
Call-ID: GL-MAPS-3-1118866627-2173-5124@192.168.12.119
CSeq: 1 INVITE
Priority: normal
Subject: radio
WG67-Version: radio.02
Supported: 100rel
Content-Type: application/sdp
Content-Length: 480

v=0
o=0001 33852938 33852938 IN IP4 192.168.12.119
s=SIP Call
c=IN IP4 192.168.12.119
t=0 0
m=audio 2000 RTP/AVP 0 8 18 101 123
a=rtpmap:0 PCMU/8000
a=rtpmap:8 PCMA/8000
a=rtpmap:18 G729/8000
a=fmtp:18 annex=no
a=rtpmap:101 telephone-event/8000
a=fmtp:101 0-15
```

At the bottom of the interface, there are tabs for "Scripts", "Message Sequence", "Event Config", and "Script Flow". Below the tabs are status indicators: "Initialisation Errors", "Error Events", "Captured Errors", and "Link Status Up=0 Down=0".

MAPS™ 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™ 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 & IPv6. Validated against VOTER versions 4.1.33.1 and 4.1.33.2

MAPS™ 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 CWP (SIP ED-137C Volume 1 Radio Radio) - [Profile Editor -ED137_Radio_CWP_Profiles]

Config

Config	Value
IP Address Type	IPv4
Apply DiffServ Code Point	
Call Parameters	
Transport	UDP
Contact Address	0001@192.168.12.73
Address Of Record	0001@192.168.12.73
To Address	0001@192.168.12.74
Outbound Proxy or Registrar Address	
Subnet Mask	255.255.255.0
SDP Parameters	
RTP IP Address	192.168.12.73
RTP Port	2000
Packetization time in msec	20
ED137 Options	
PTT Type	Normal PTT
PTT Mute	OFF
SIP Headers	
WG67 Version	radio.02
Priority	normal
Max Forwards	70
Expires in sec	0
Mandatory SDP attributes	
R2S Keep Alive Period in msec	200
R2S Keep Alive Multiplier	10
Call Type	Radio-TxRx
Optional SDP attributes	
txrxmode	Connection Type TxRx
bss	BSS quality index method RSSI
sigtime	Signalling Info Time Period 1
ptt rep	PTT OFF Repetition 0
Fid	Frequency ID 126.000
Linked Session Parameters	
Receiver Multicast Operation	Disconnection Mode Disable
RTP Header Extension Types	
CLIMAX Time Delay	
Radio Remote Control	

RadioCallType

Select Option

Radio-TxRx
Radio-Idle
RxOnly
Radio-TxRx
Coupling

Add Insert Delete

Properties

Insert Delete Clear

Initialisation Errors Error Events Captured Errors

MAPS™ 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)

MAPS GRS (SIP ED-137C Volume 1 Radio Radio) - [Call Reception]

Sr No	Script Name	Profile	Call Info	Script Execution	Status	Events	Events Profile	Results
1	SipCallControl.gls	GRS0001	CWP03@192.168.12.208	Stop	Sending R25 KeepAlive	None		Pass
2	SipCallControl.gls	GRS0001	CWP04@192.168.12.208, PTT-ID = 8	Stop	Sending R25 KeepAlive	Start Squelch		Pass
3	SipCallControl.gls	GRS0001	CWP02@192.168.12.208, PTT-ID = 9	Stop	Sending R25 KeepAlive	Start Squelch		Pass
4	SipCallControl.gls	GRS0002	CWP06@192.168.12.208, PTT-ID = 5	Stop	Sending R25 KeepAlive	Start Squelch		Pass
5	SipCallControl.gls	GRS0002	CWP07@192.168.12.208	Stop	Sending R25 KeepAlive	None		Pass
6	SipCallControl.gls	GRS0003	CWP13@192.168.12.208, PTT-ID = 5	Stop	Sending R25 KeepAlive	Start Squelch		Pass
7	SipCallControl.gls	GRS0003	CWP14@192.168.12.208, PTT-ID = 6	Stop	Sending R25 KeepAlive	Start Squelch		Pass

Control Bar: ApplyMAM Values, Receive Traffic, Apply SQU, SCT ON, PTTs ON, Impair, Speaker ON, Stop RTP/R25

Message Sequence:

Direction	Message	Time
DUT → MAPS	INVITE	10:50:22.318000
MAPS → DUT	CallType: Radio-TxRx, Priority: normal	10:50:22.319000
DUT → MAPS	100 Trying	10:50:22.320000
MAPS → DUT	200 OK	10:50:22.428000
DUT → MAPS	ACK	10:50:22.443000
MAPS → DUT	KeepAlive	10:50:22.444000
DUT → MAPS	KeepAlive	10:50:22.464000
MAPS → DUT	Emergency PTT-ON, PTT-ID = 9	10:50:36.107000
DUT → MAPS	Emergency PTT-ON, PTT-ID = 9	10:50:36.108000
MAPS → DUT	PTT-OFF, PTT-ID = 9	10:50:38.918000
DUT → MAPS	PTT-OFF, PTT-ID = 9	10:50:38.919000
MAPS → DUT	PTT-OFF, PTT-ID = 9	10:50:39.115000

Message Decode:

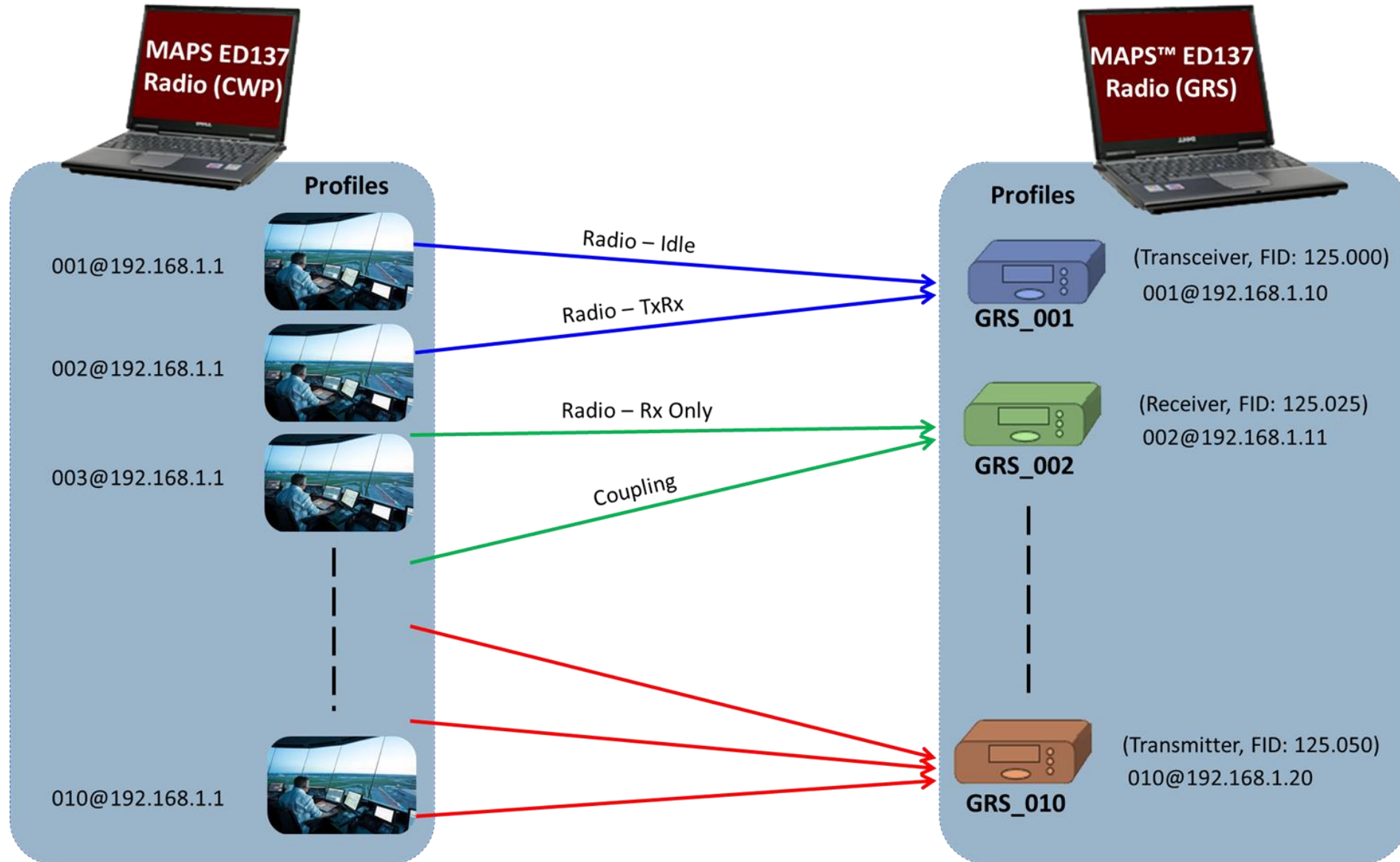
```

INVITE sip:GRS1@192.168.12.218 SIP/2.0
Via: SIP/2.0/UDP 192.168.12.208:5060;branch=z9hG4bK-49-27326481-9696-3520
Max-Forwards: 70
Allow: INVITE,BYE,CANCEL,ACK,INFO,OPTIONS,SUBSCRIBE,NOTIFY,REFER,REGISTER
From: CWP02 <sip:CWP02@192.168.12.208>;tag=FromTag-46-27326481-9693-3520
To: GRS1 <sip:GRS1@192.168.12.218>
Contact: CWP02 <sip:CWP02@192.168.12.208>
Call-ID: GL-MAPS-48-27326481-9695-3520@192.168.12.208
CSeq: 1 INVITE
Recv-Info:
WG67-Version: radio.02
Priority: normal
Subject: radio
Supported: 100rel
Content-Type: application/sdp
Content-Length: 411

v=0
o=CWP02 33852938 33852938 IN IP4 192.168.12.208
s=SIP Call
c=IN IP4 192.168.12.208
t=0 0
m=audio 29202 RTP/AVP 8 101 123
a=rtpmap:8 PCMA/8000
a=rtpmap:101 telephone-event/8000
a=fmtp:101 0-15
a=rtpmap:123 R2S/8000
a=rtphe:1
a=ptime:20
o=D2S-KeepAlivePeriod:200
    
```

Status Bar: Initialisation Errors, Error Events, Captured Errors, Link Status Up=0 Down=0

Multiple Controller and Radio Simulation



ED-137/1C Features in MAPS™ 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
- Provides an option to send packets with RRC responses from GRS at defined intervals
- Supports enable/disable active voice call preemption at GRS node

MAPS™ 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

MAPS CWP (SIP ED-137C Volume 2 Telephone Telephone) - [Call Generation - CallGenDefault]

Configurations Emulator Reports Editor Debug Tools Windows Help

Sr No	Script Name	Profile	Call Info	Script Execution	Status	Events	Events Profile	Result	Total Iterations
1	SipCallControl.gls	CWP0001	0001@192.168.12.218	Stop	Send_File-Started	Info		Pass	1

Add Delete Insert Refresh Start Start All Stop Stop All Abort Abort All ReInvite Receive Traffic On Hold Send Traffic Impair Speaker ON

Save Column Width Show Latest

0001@192.168.12.208 0001@192.168.12.218

INVITE 17:08:10.867000

phone.02;da/ida call, normal 17:08:10.877000

100 Trying 17:08:10.899000

180 Ringing 17:08:10.911000

CallSetUpTime: 34msec 17:08:10.912000

200 OK 17:08:14.818000

ACK 17:08:14.829000

Find

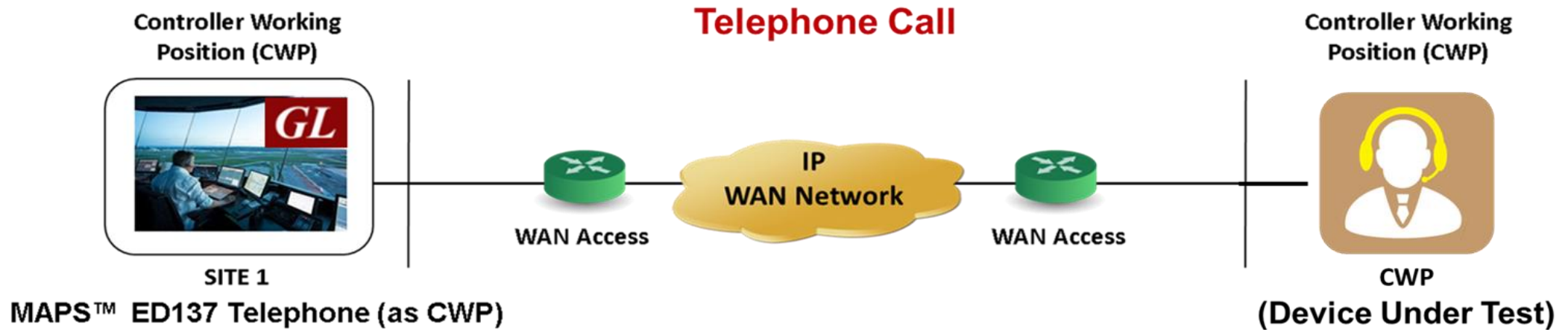
```
INVITE sip:0001@192.168.12.218 SIP/2.0
Via: SIP/2.0/UDP 192.168.12.208:5060;branch=z9hG4bK-11-1778060975-3875-26072
Max-Forwards: 70
Allow: INVITE,BYE,CANCEL,ACK,INFO,OPTIONS,SUBSCRIBE,NOTIFY,REFER,REGISTER,UPDA1
From: 0001 <sip:0001@192.168.12.208>;tag=FromTag-8-1778060975-3872-26072
To: 0001 <sip:0001@192.168.12.218>
Call-ID: GL-MAPS-10-1778060975-3874-26072
Supported: 100rel
CSeq: 1 INVITE
Contact: 0001 <sip:0001@192.168.12.208>
Content-Type: application/sdp
WG67-Version: phone.02
Subject: DA/IDA call
Priority: normal
WG67-CallType: phone.02;da/ida call
Content-Length: 216

v=0
o=0001 36770160 1 IN IP4 192.168.12.208
```

Scripts Message Sequence Event Config Script Flow

Initialisation Errors Error Events Captured Errors Link Status Up=0 Down=0

MAPS™ 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™. 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™ 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

The screenshot displays the MAPS CWP (SIP ED-137C Volume 2 Telephone Telephone) - [Profile Editor - ED137_Telephone_CWP_Profiles*] application. The interface includes a menu bar (Configurations, Emulator, Reports, Editor, Debug Tools, Windows, Help), a toolbar, and a main workspace. On the left, a 'Profiles (Edit-F2)' list shows profiles CWP0001 through CWP0010. The central 'Config' pane shows a tree view for profile CWP0001, with 'ED137' expanded to show 'Subject' set to 'DA/IDA call'. The right pane shows the 'SubjectOption' dropdown menu with 'DA/IDA call' selected. A red arrow points from the 'Subject' field in the configuration tree to the 'DA/IDA call' option in the dropdown menu. The bottom status bar shows 'Initialisation Errors', 'Error Events', 'Captured Errors', and 'Link Status Up=0 Dow'.

MAPS™ ED-137 Telephone Emulator – Call Generation

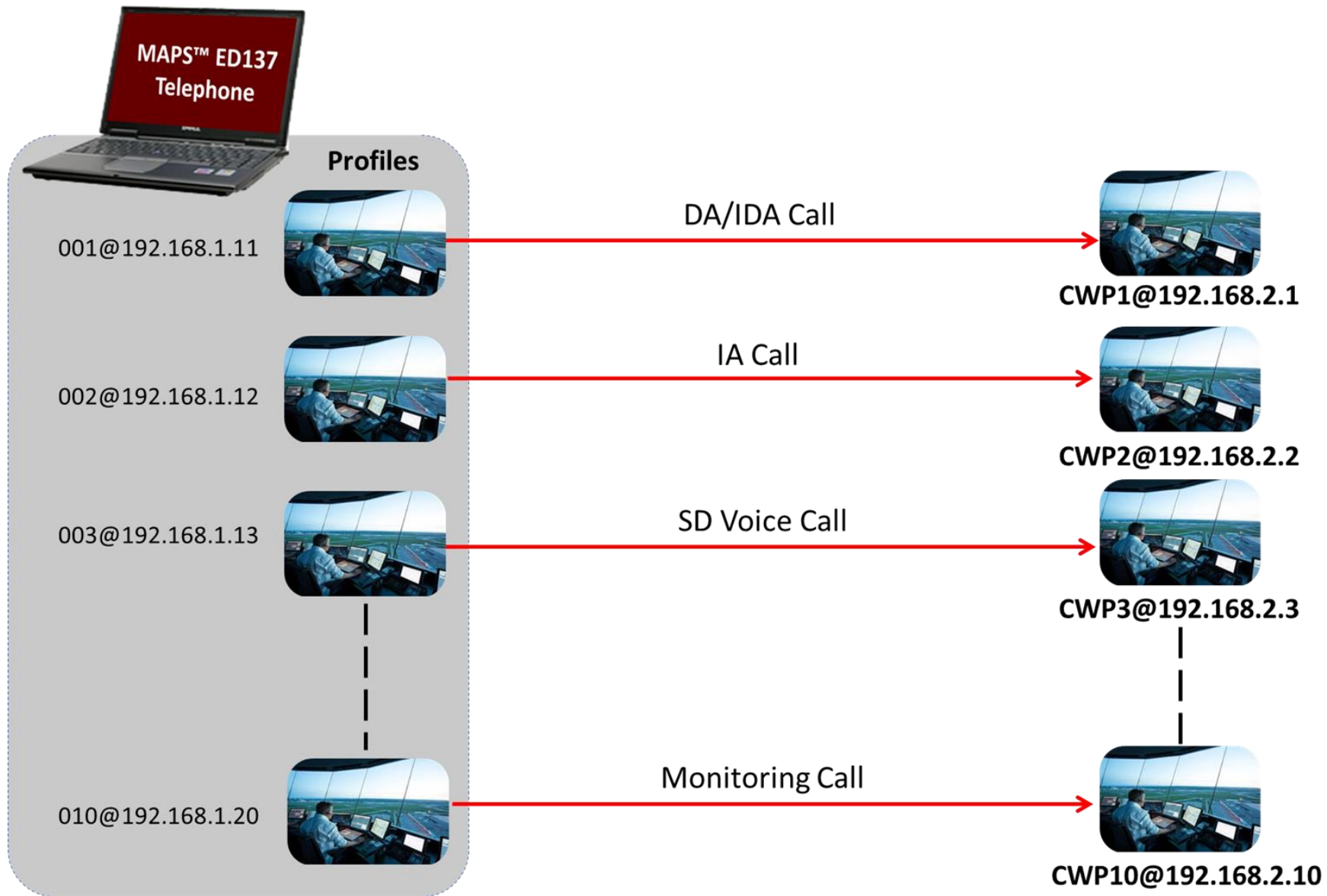
- Displays Call graph and message decodes for each call
- Load generation or background traffic generation using Bulk Call Generation
- Scripts/sessions can be run repeatedly for defined number of iterations with results of each iteration
- Multiple scripts can be run simultaneously or sequentially or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

The screenshot displays the MAPS CWP (SIP ED-137C Volume 2 Telephone Telephone) - [Call Generation - CallGenDefault] interface. The interface is divided into several sections:

- Table:** A table showing call generation results. The columns are Sr No, Script Name, Profile, Call Info, Script Execution, Status, Events, Events Profile, Result, Total Iterations, and Completed Iteration. The data is as follows:

Sr No	Script Name	Profile	Call Info	Script Execution	Status	Events	Events Profile	Result	Total Iterations	Completed Iteration...
1	SipCallControl.gls	CWP0001	0001@192.168.12.218	Start	SessionCreated	None		Pass	5	2
2	SipCallControl.gls	CWP0002		Start		None		Unknown	5	0
- Call Flow Diagram:** A diagram showing the call flow between 0001@192.168.12.208 and 0001@192.168.12.218:5066. The flow includes: INVITE (11:24:22.638000), phone.02:da/ida call, normal (11:24:22.646000), 100 Trying (11:24:22.692000), 180 Ringing (11:24:22.704000), CallSetUpTime: 59msec (11:24:22.705000), 200 OK (11:24:26.798000), ACK (11:24:26.800000), REFER (11:24:28.925000), 202 Accepted (11:24:28.926000), NOTIFY (11:24:28.934000), and BYE (11:24:28.946000).
- Script Flow Config Dialog:** A dialog box for configuring the script flow. It includes options for Flow Order (Sequential, Random), Time Configuration (On Complete, Duration), and a Total Iteration field set to 5.
- Message Sequence:** A section showing the message sequence for the call, including INVITE, 100 Trying, 180 Ringing, 200 OK, ACK, REFER, 202 Accepted, NOTIFY, and BYE.
- Script Flow:** A section showing the script flow configuration, including the script name, profile, and call info.

Multiple Controllers Simulation



MAPS™ 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 Simulation) CWP (SIP ED-137C Volume 4 Recorder) - [Call Generation - CallGenDefault]

Sr No	Script Name	Profile	Call Info	Script Execution	Status	Events	Events Profile	Result	Total Iteratic
1	RTSPCallControl.gls	CWP0001	192.168.12.77:554	Stop	Send_File-Started	UnKey PTT		Pass	

Message Sequence Diagram:

```
graph TD
    MAPS -- ANNOUNCE --> DUT[15:34:21.331.9855]
    DUT -- 200 OK --> MAPS[15:34:21.74.3021]
    MAPS -- SETUP --> DUT[15:34:21.75.5161]
    DUT -- 200 OK --> MAPS[15:34:22.247.9033]
    MAPS -- SET_PARAMETER --> DUT[15:34:22.288.2552]
    DUT -- 200 OK --> MAPS[15:34:22.413.8148]
    MAPS -- RECORD --> DUT[15:34:32.35.3916]
    DUT -- 200 OK --> MAPS[15:34:32.96.2766]
    MAPS -- GET_PARAMETER --> DUT[15:35:26.110.9878]
    DUT -- 200 OK --> MAPS[15:35:27.154.9487]
    MAPS -- GET_PARAMETER --> DUT[15:36:21.171.2779]
    DUT -- 200 OK --> MAPS[15:36:21.220.6510]
    MAPS -- GET_PARAMETER --> DUT[15:37:15.232.2084]
    DUT -- 200 OK --> MAPS[15:37:15.279.3181]
    MAPS -- GET_PARAMETER --> DUT[15:38:09.290.4625]
    DUT -- 200 OK --> MAPS[15:38:09.333.9365]
```

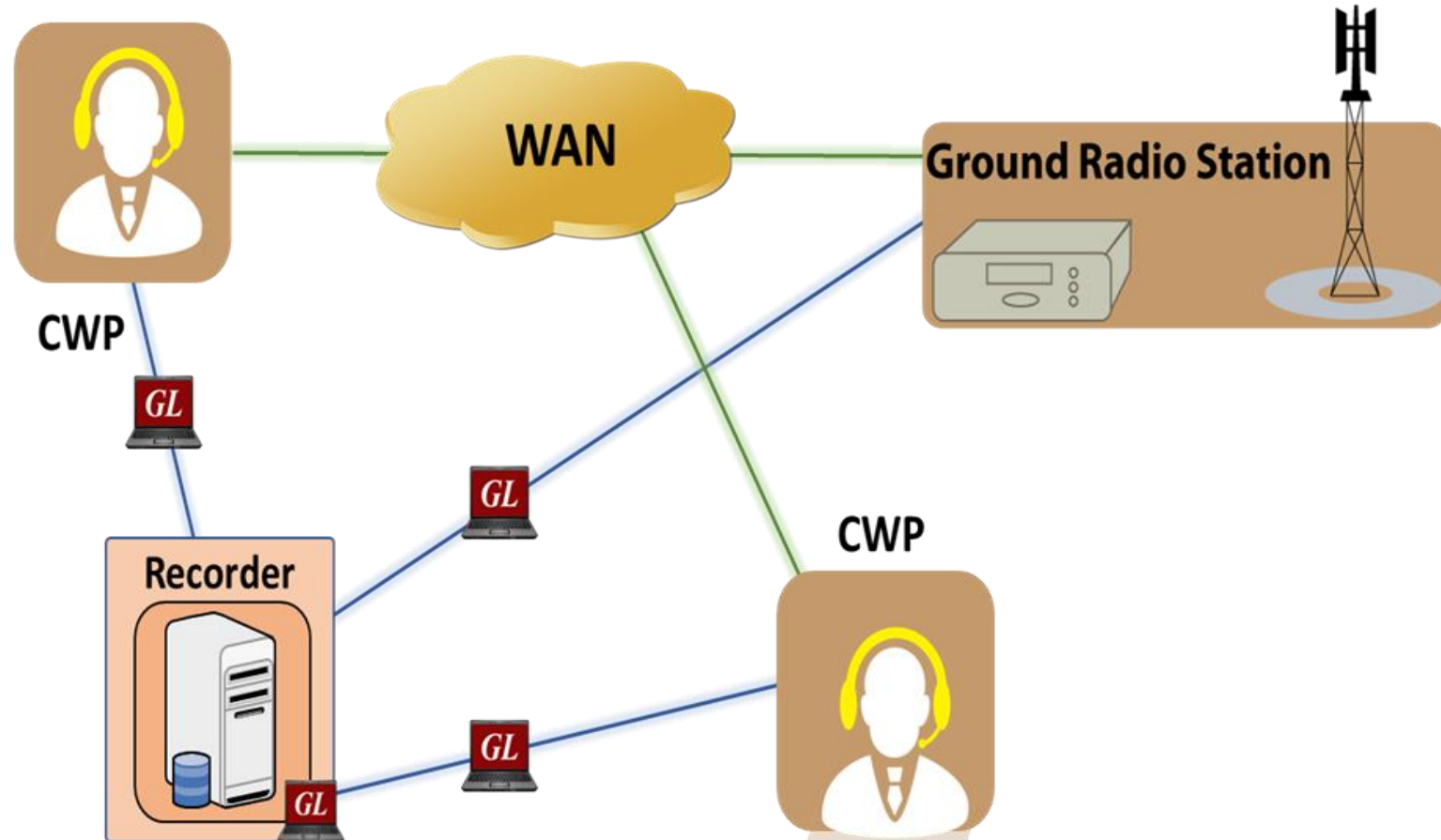
XML Record Data:

```
RECORD rtsp://192.168.12.77:554/iprecorder RTSP/1.0
CSeq: 4
WG67-Version: recorder.02
Session: GL-MAPS_3_1651593801-125303-125320
Content-Type: application/x-crd+xml
Content-length: 967

<call-record-data connref="GL-MAPS_3_1651604883-125411-99932@192.168.1.101">
  <properties>
    <property name="ClientId">sip:0001@192.168.1.1</property>
    <property name="CallingNr">sip:0001@192.168.1.1</property>
    <property name="CalledNr">sip:0002@192.168.1.2</property>
    <property name="Direction">2</property>
  </properties>
  <operations>
    <operation name="FrequencyID" time="2024-04-02_10:04:32.880+0000">156.000</operation>
    <operation name="RadioAccessMode" time="2024-04-02_10:04:32.880+0000">3</operation>
    <operation name="PTT" time="2024-04-02_10:04:32.880+0000">3</operation>
    <operation name="R2S" time="2024-04-02_10:04:32.880+0000">Tx=13344</operation>
    <operation name="R2S" time="2024-04-02_10:04:32.880+0000">Rx=13320</operation>
    <operation name="R2S-TLV" time="2024-04-02_10:04:32.880+0000">Tx=1.1.101010</operation>
    <operation name="R2S-TLV" time="2024-04-02_10:04:32.880+0000">Rx=2.1.09AE</operation>
  </operations>
</call-record-data>
```


MAPS™ ED-137 Recorder Emulator Highlights

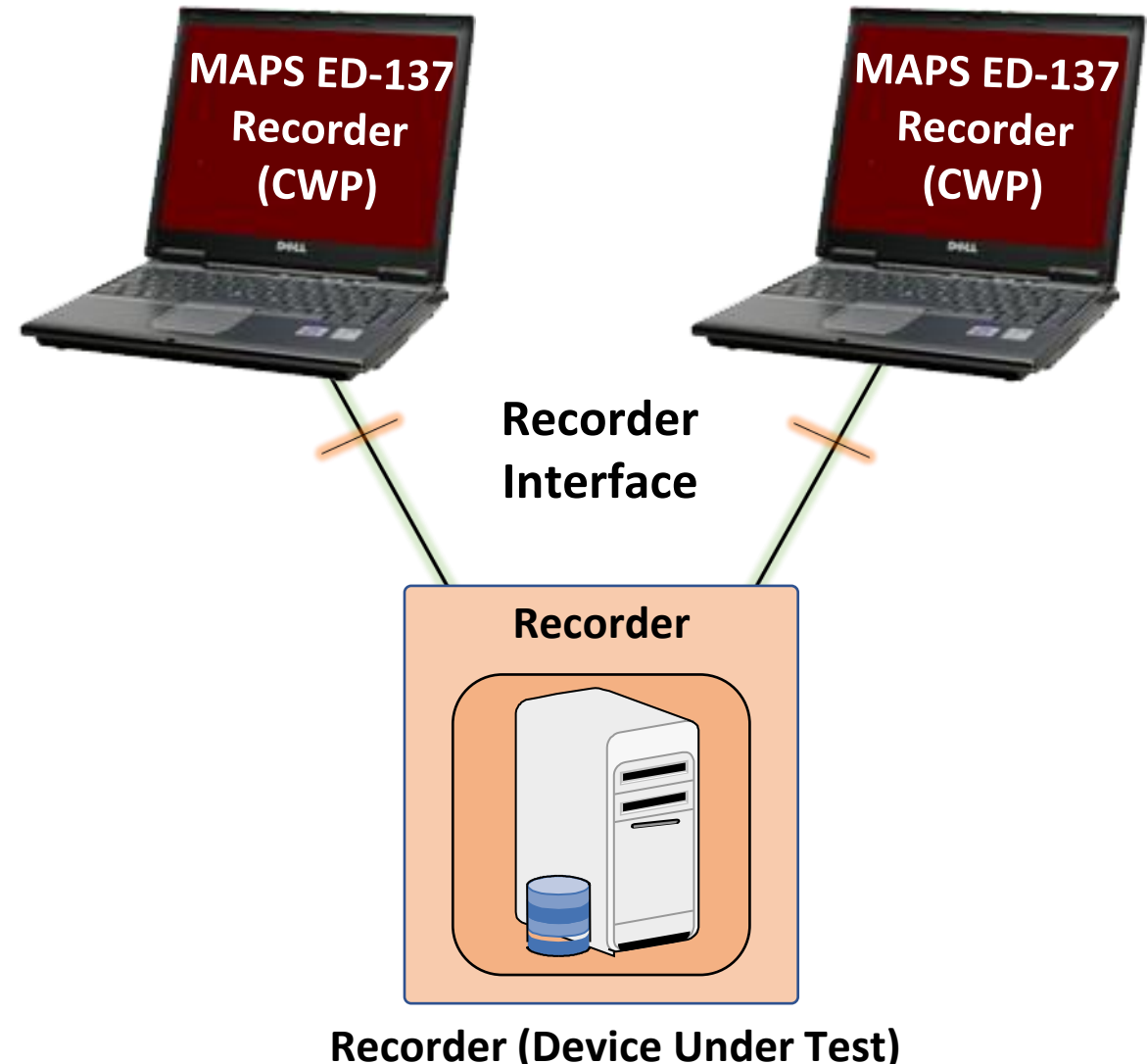
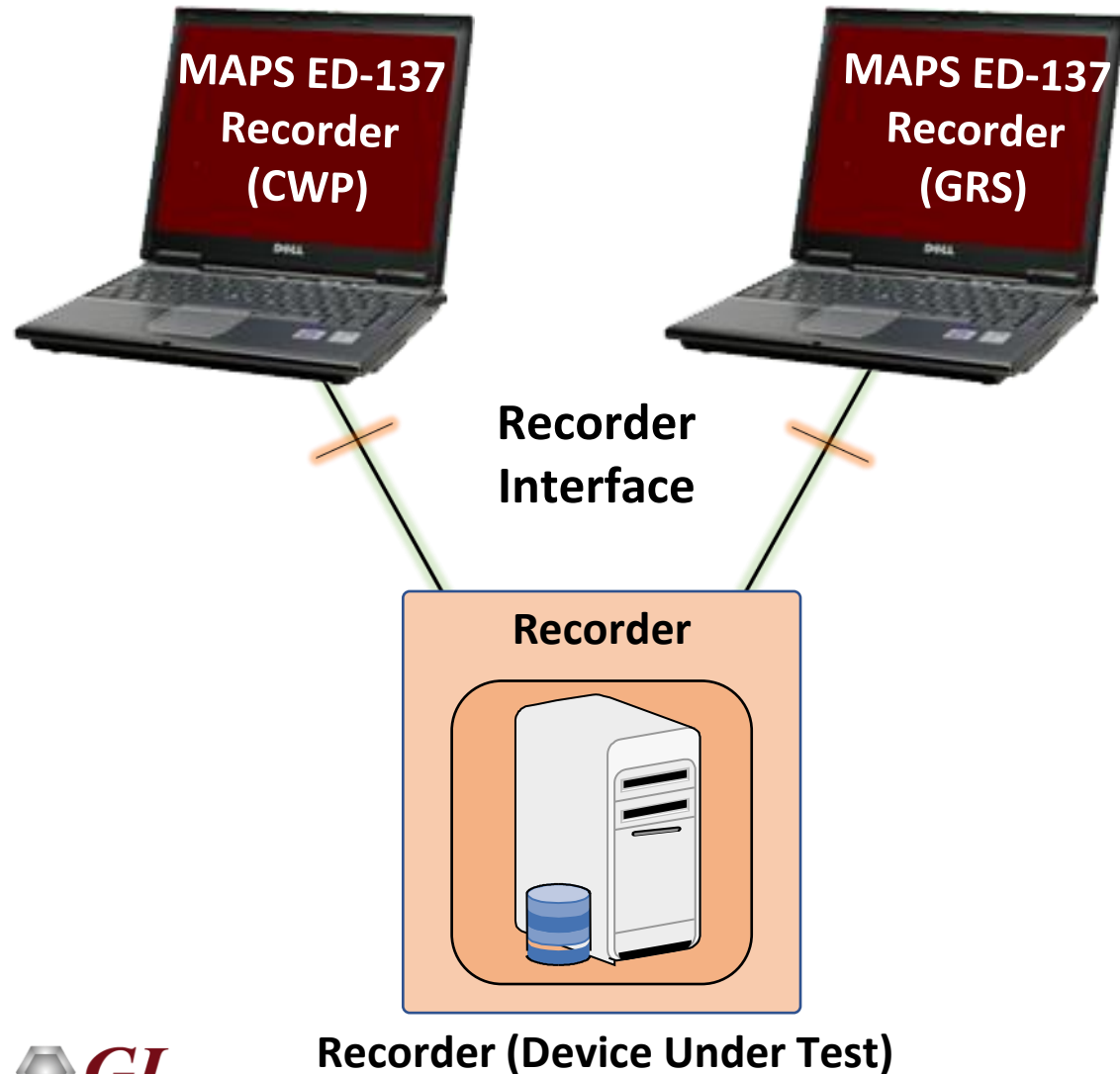
- Emulates ED-137/4B and ED-137/4C Recorder interface at CWP, GRS and Recorder endpoints
- Simulates Recorder interface on multiple CWPs, Radios and Recorders from single instance of MAPS
- Supports all three transport types – embedded binary data, independent TCP and independent UDP
- Audio codecs -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



MAPS™ ED-137 Recorder Use Cases

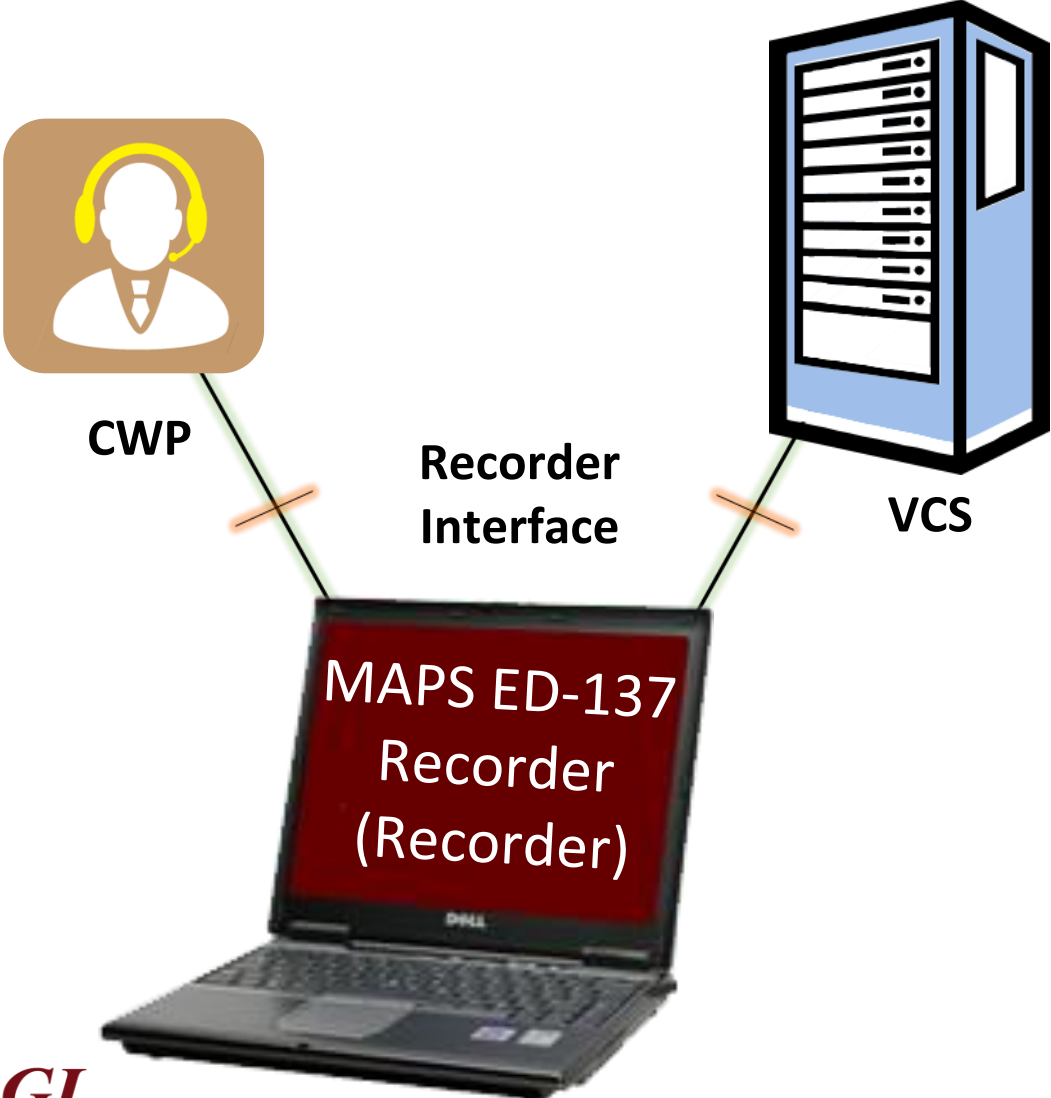
CASE 1: Simulate AG call recording towards Recorder

CASE 2: Simulate GG call recording towards Recorder

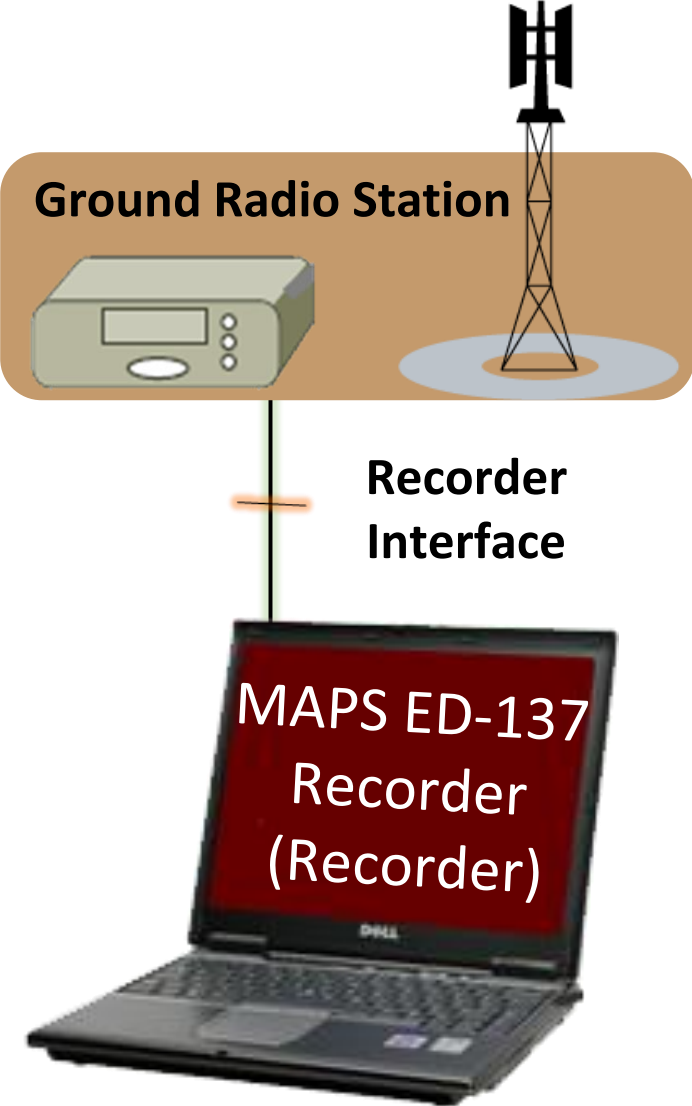


MAPS™ ED-137 Recorder Use Cases

CASE 3: Testing Recorder interface of CWP/VCS



CASE 4: Testing Recorder interface of GRS



MAPS™ 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

The screenshot displays the MAPS software interface for editing a CWP profile. The main window is titled "MAPS (Message Automation Protocol Simulation) CWP (SIP ED-137C Volume 4 Recorder) - [Profile Editor - ED137_Recorder_CWP_Profiles]". The interface includes a menu bar (Configurations, Emulator, Reports, Editor, Debug Tools, Windows, Help) and a toolbar. The central area is divided into three panes:

- Profiles (Edit-F2):** A list of profiles with columns for ID and Name. Profile 1 (CWP0001) is selected.
- Config:** A tree view showing the configuration structure for CWP0001. The right pane displays the values for the selected configuration item.
- ED137CallType:** A dropdown menu for selecting the call type. The options are A/G Call, A/G Call (selected), and G/G Call.

Config	Value
Call Type	A/G Call
IP Address Type	IPv4
Apply DiffServ Code Point	
RTSP Session Parameters	
RTSP IP Address	192.168.1.28
RTSP Port	554
RTSP URL	192.168.1.112:554/iprecorder
Recorder IP Address	192.168.1.112
Recorder Port	554
WG67 Version	recorder.02
OPTIONS Expiry Time in msec	30000
Subnet Mask	255.255.255.0
RTP IP Address	192.168.1.28
Client Port	
RTP Transport Type	Interleaved
Packetization time in msec	20
Call Record Data Properties	
Calling Number	sip:0001@192.168.1.1
Users	1
Users 1	
Called Number	sip:0002@192.168.1.2
Frequency ID	156.000
Priority	3 - Normal
PTT Type	3 - Priority PTT
Telephone Call Type	DA/IDA call
Client Type	Controller Working Position
Disconnect Cause	16
Disconnect Source	1 - endpoint
Disconnect Reason	Normal Call Clearing
Direction	2 - outgoing
Call Record Data Operation	
Call Cancel or Reject	Disable
Caller Rejected Call	Disable
RTSP Session Keep Alive	Enable
Codec Options and Traffic Configuration	
Codec Options	PCMU
Traffic Type	User Defined Traffic
Traffic Profile Name	Profile0001
User Defined Traffic Action	File
Custom Profile Settings	

MAPS™ 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

MAPS (Message Automation Protocol Simulation) CWP (SIP ED-137C Volume 4 Recorder) - [Call Generation - CallGenDefault]

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

Script Flow Config

Flow Order: Sequential Random

Time Configuration: On Complete Duration 0 msec

Total Iteration: 3

Message Sequence:

MAPS	DUT
ANNOUNCE	11:51:25.315.5589
200 OK	11:51:25.365.2241
SETUP	11:51:25.366.1700
200 OK	11:51:25.420.1520
SET_PARAMETER	11:51:25.423.5712
200 OK	11:51:25.497.930

```
SET_PARAMETER rtsp://192.168.12.218:554/iprecorder/ RTSP/1.0
CSeq: 3
WC67-Version: recorder_02
Session: GL-MAPS_10_30990173-8691-7060
Content-Type: application/x-crd+xml
Content-Length: 776

<call-record-data connref="GL-MAPS_5_30990161-8174-15252@192.168.12.208">
  <properties>
    <property name="Direction">2</property>
    <property name="Priority">3</property>
    <property name="CallingNr">sip:0001@192.168.1.1</property>
    <property name="CalledNr">sip:0001@192.168.1.2</property>
    <property name="ClientId">sip:0001@192.168.1.1</property>
    <property name="ClientType">CWP</property>
    <property name="ConnectTime">2024-03-13_06:21:25.763+0000</property>
    <property name="SetupTime">2024-03-13_06:21:25.763+0000</property>
  </properties>
  <operations>
    <operation name="FrequencyID" time="2024-03-13_06:21:25.763+0000">156.000</oper
    <operation name="RadioAccessMode" time="2024-03-13_06:21:25.763+0000">3</oper
  </operations>
</call-record-data>
```

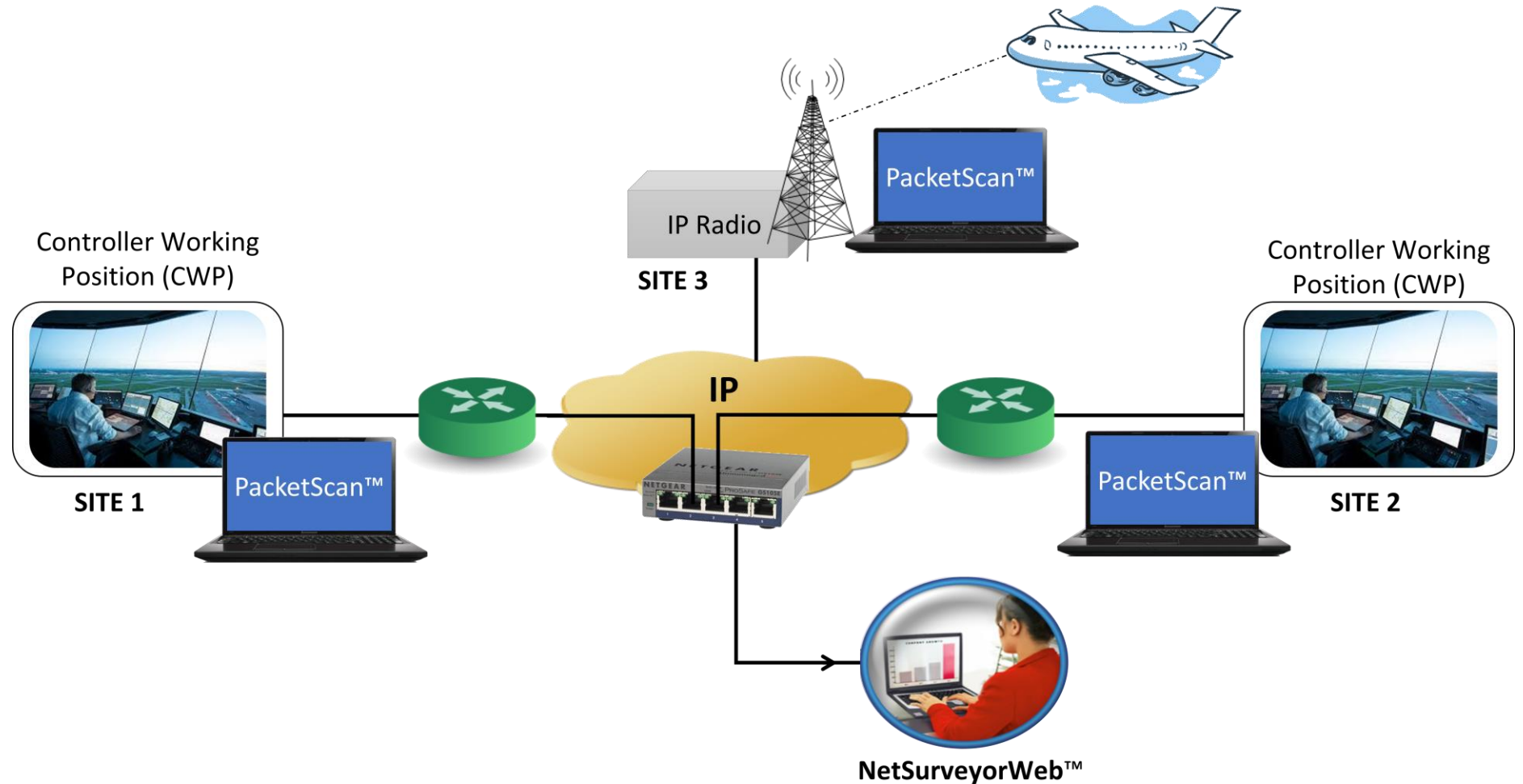
Key Updates

- Emulators support both ED-137 B and C versions, including Change 1 & 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 will participate in VoIP in ATM Over IPv6 Plugtests in September 2024 (France)

Air Traffic Control Monitoring Solutions

PacketScan™ and NetSurveyorWeb™

- PacketScan™ 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 non-intrusive monitoring of IP traffic



PacketScan™: Protocol Analysis Software

- Monitor up to 2000 simultaneous calls with bidirectional RTP traffic
- Capture and analyze packets at wirespeed. Save the captured trace to a disk
- Analyze in real-time or analyze recorded trace files off-line
- Aggregate statistics can be obtained for any field or parameter in the protocol headers to study the performance of the overall VoIP network
- Supports SIP ED-137 for Air Traffic Monitoring (Air-to-Ground, and Ground-to-Ground)

The screenshot displays the PacketScan 64-bit interface. At the top, there is a menu bar (File, View, Capture, Statistics, Database, Call Detail Records, Configure, Help) and a toolbar with various icons. Below the toolbar is a table of captured packets. The table has columns for Device, Frame#, TIME (Relative), Length (Bytes), Error, Length/Protocol Type MAC, Packet Type MAC, Source IP Address IPv4, Destination IP Address IPv4, Source Port UDP, Destination Port UDP, and SIP Method SIP. The fourth packet (Frame# 4) is highlighted in blue, showing a source IP of 192.168.12.218, destination IP of 192.168.12.208, source port of 1028, and destination port of 6000. Below the table, the protocol analysis for this packet is shown. The analysis is divided into layers: IPv4 Layer, UDP Layer, and RTP Layer. The RTP Layer details are highlighted with a red box and include fields such as Version (10), Padding (0), Extension header (Present), CSRC count (0), Marker bit (Not set), Payload type (1111011 (123) R2S Keep Alive), Sequence Number (26218), TimeStamp (3796309020), SSRC identifier (1193938945), Type (EUROCAE ED137 1B), Length (1), PTT-type (PTT OFF), Squelch (OFF), PTT-id (2), PTT Mute (OFF), PTT Summation (OFF), SCT (No Simultaneous Transmissions), Reserved (0), X (No Extended Information Present), and Padding (0).

Device	Frame#	TIME (Relative)	Length (Bytes)	Error	Length/Protocol Type MAC	Packet Type MAC	Source IP Address IPv4	Destination IP Address IPv4	Source Port UDP	Destination Port UDP	SIP Method SIP
✓ 0	0	00:00:00.000000000	1031		Internet IP(IPv4)	SIP	192.168.12.208	192.168.12.218	5060	5060	INVITE
✓ 0	1	00:00:00.022167000	407		Internet IP(IPv4)	SIP	192.168.12.218	192.168.12.208	5060	5060	100 Trying
✓ 0	2	00:00:00.132649000	976		Internet IP(IPv4)	SIP	192.168.12.218	192.168.12.208	5060	5060	200 OK
✓ 0	3	00:00:00.154745000	473		Internet IP(IPv4)	SIP	192.168.12.208	192.168.12.218	5060	5060	ACK
✓ 0	4	00:00:00.164060000	62		Internet IP(IPv4)	RTP	192.168.12.218	192.168.12.208	1028	6000	
✓ 0	5	00:00:00.183807000	62		Internet IP(IPv4)	RTP	192.168.12.208	192.168.12.218	6000	1028	

```

===== IPv4 Layer =====
000E Version = 0100.... (4)
000E Internet Header Length (In 32 bit words) = ....0101 (5)
      Differentiated Services Field =
000F Differentiated Services Codepoint = 000000... Default
000F Explicit Congestion Notification = .....00 Not-ECT (Not ECN-Capable Transport)
      IP Hdr No TCP SegmentationOffload =
0010 Total Length = 48 (x0030)
0012 Identification = 39415 (x99F7)
0014 Reserved Bit = 0..... Not Set
0014 Don't fragment = 0..... Not Set
0014 More fragments = 0..... Not Set
0014 Fragment Offset = 0 (...00000 00000000)
0016 Time To Live = 128 (x80)
0017 Protocol = 00010001 UDP
0018 Header Check Sum = x05CB
001A Source IP Address = 192.168.12.218 (xC0A80CDA)
001E Destination IP Address = 192.168.12.208 (xC0A80CD0)
===== UDP Layer =====
0022 Source Port = 1028 (x0404)
0024 Destination Port = 6000 (x1770)
0026 Length (Header + Data) = 28 (x001C)
0028 Checksum = x02FA
===== RTP Layer =====
002A Version = 10..... (2)
002A Padding = ..0..... (0)
002A Extension header = ...1.... Present
002A CSRC count = ....0000 (0)
002B Marker bit = 0..... Not set
002B Payload type = 1111011 (123) R2S Keep Alive
002C Sequence Number = 26218 (x666A)
002E TimeStamp = 3796309020 (xE247141C)
0032 SSRC identifier = 1193938945 (x472A1001)
0036 Type :EUROCAE ED137 1B = 359 (x0167)
0038 Length = 1 (x0001)
003A PTT-type = 000..... PTT OFF
003A Squelch = ...0.... OFF
003A PTT-id = 2 (...0000 10.....)
003B PTT Mute = 0..... OFF
003B PTT Summation = ...0.... OFF
003B SCT = ...0... No Simultaneous Transmissions
003B Reserved = .....00.. (0)
003B X = .....0 No Extended Information Present
003C Padding = x0000
    
```

PacketScan™ Software – Call Summary

- ED-138 Statistics (MOS/R-Factor, Packet Loss, Delay and Jitter)
- Provides graphical analysis of calls like Call Ladder Diagrams, MOS and Jitter variation graphs
- Record and Playback audio on the call
- Detects inband/outband Digits and Tones
- Triggers and Actions feature can filter on “Calls of Interest”
- Logs Call Detailed Records to CSV files

Packet Data Analyzer - Summary View

File View Call Summary Protocol Configurations GUI Configurations Help

SIP Show All Calls Call Count: 5

Call #	SSRC	Payload	Packet Received	Conversations MOS/R-Fac...	Listening MOS/R-Factor	Latest MOS_Distribution	OverAll VoiceQ...	Packets Discard...	Missing Packets/(%)	Duplicate Packets...	Out Of Sequence	Average Gap(ms)	Average Delay	Average Jitter	Average Inter	Cumulative Packet	Max/Min Gap	Max/Min Delay	Max/Min Jitter	Max/Min RTDela...	Average RTDela...
Call#000001	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	1	0	534.67...	474 / ...	30.04 ...	2.969 ...	1.127 ...
Call#000002	11930...	PCMA...	1976	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	1.04	4	1790	40.48 ...	20 / -20	4.06 / ...	0.201 ...	0.184 ...
Call#000003	11930...	PCMA...	603	4.20 / 93	4.20 / 93	0 / 0 / 0	Good	0 / 0.00	0 / 0.00	0 / 0.00	0 / 0.00	0.00	0.00	0.00	1	0	0.00 / ...	0 / 0	0.00 / ...	4.157 ...	1.078 ...
Call#000004	11908...	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	0	0	39.39 ...	19 / -17	3.94 / ...	0.327 ...	0.234 ...
Call#000005	11945...	PCMA...	601	4.20 / 93	4.20 / 93	0 / 0 / 0	Good	0 / 0.00	0 / 0.00	0 / 0.00	0 / 0.00	0.00	0.00	0.00	1	0	0.00 / ...	0 / 0	0.00 / ...	2.319 ...	0.841 ...
Call#000006	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	32.35	0.46	3.55	1	0	142.94...	9 / -10	5.08 / ...	0.489 ...	0.439 ...
Call#000007	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 ...	19 / -17	3.94 / ...	0.272 ...	0.197 ...
Call#000008	11936...	PCMA...	2513	2.17 / 44	2.17 / 44	0 / 0 / 79	Poor	0 / 0.00	1459 / 36.79	0 / 0.00	0 / 0.00	31.64	0.34	3.41	1	0	142.55...	12 / -10	5.21 / ...	5.613 ...	1.470 ...
Call#000009	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 ...	19 / -17	3.95 / ...	0.220 ...	0.204 ...

Column Width Absolute Timing Show Latest

Time	Frame#	192.168.12.208	192.168.12.218
00.00.000	0	5060	5060
00.00.018	1	5060	5060
00.00.140	2	5060	5060
00.00.151	3	5060	5060
00.05.185	185	6000	1050
00.05.185	186	6000	1050
00.09.628	611	6000	1050
00.41.067	10368	6000	1050

Find Complete Stack

```

===== SIP Layer =====
INVITE sip:GRS1@192.168.12.218 SIP/2.0
Via: SIP/2.0/UDP 192.168.12.208;branch=z9hG4bK-19-32446300-10374-9692
Max-Forwards: 70
Allow: INVITE, BYE, CANCEL, ACK, INFO, OPTIONS, SUBSCRIBE, NOTIFY, REFER, REGISTER
From: CWP01 <sip:CWP01@192.168.12.208>;tag=FromTag-16-32446300-10371-9692
To: GRS1 <sip:GRS1@192.168.12.218>
Contact: CWP01 <sip:CWP01@192.168.12.208>
Call-ID: GL-MAPS-18-32446300-10373-9692@192.168.12.208
CSeq: 1 INVITE
Recv-Info:
WC67-Version: radio.02
Priority: normal
Subject: radio
Supported: 100rel
Content-Type: application/sdp
Content-Length: 410

v=0
--CWP01-32446300-10373-9692-192.168.12.208
    
```

Calls Rate RTP Packets Graph Average Jitter Distribution E-Model T.38 Analysis Call Flow Call Summary

Good Call and Bad Call

Call Summary

Call #	SSRC	Payload	Rate (packets/s)	Out Of Sequence Packets (%)	Average Inter Arrival Jitter (ms)	Cumulative Packet Lost	Max/Min Gap	Max/Min Delay	Max/Min Jitter	Max/Min RTDela	Average RTDela
1	36072...	PCMA/8000	93	0/0.00	20.00	0	24.99...	4/-2	0.61/...	1.718...	1.108
1	24488...	PCMA/8000	93	0/0.00	19.50	0	25.16...	5/-5	0.97/...	0.164...	0.164
2	36019...	PCMA/8000	93	0/0.00	20.00	0	26.18...	240/-...	15.59...	1.727...	1.235
2	25805...	PCMA/8000	93	0/0.00	20.00	0	26.46...	6/-6	1.01/...	0.217...	0.217
3	36001...	PCMA/8000	323	0/0.00	407/16.59	0	100.07...	180/-...	78.26...	1.324...	1.053
3	31045...	PCMA/8000	267	0/0.00	0/0.00	2	0.00/...	0/0	0.00/...	0.000...	0.000

Call Graph

TimeStamp	Frame Number	192.168.1.52	192.168.1.231
00.00.000	0	5060	5060
00.00.007	1	5060	5060
00.00.117	2	5060	5060
00.00.124	3	5060	5060
00.00.125	4	6000	1042
00.00.127	5	6000	1042
00.09.453	100	6000	1042
00.41.192	1850	6000	1042
01.22.623	2270	6000	1042
01.42.409	3362	6000	1042
02.52.048	4066	5060	5060

Call Details

```

INVITE sip:0001@192.168.1.231 SIP/2.0
Via: SIP/2.0/UDP 192.168.1.52:5060;branch=z9hG4bK_4_270759591-13062-8584
Max-Forwards: 70
Allow: INVITE, BYE, CANCEL, ACK, INFO, OPTIONS, SUBSCRIBE, NOTIFY, REFER, REGISTER
From: 0001 <sip:0001@192.168.1.52>;tag=FronTag_1_270759591-13059-8584
To: 0001 <sip:0001@192.168.1.231>
Call-ID: GL-MAPS_3_270759591-13061-8584@192.168.1.52
CSeq: 1 INVITE
Expires: 100
Priority: normal
Subject: radio
WC67-Version: radio.01
Contact: 0001 <sip:0001@192.168.1.52>
Content-Type: application/sdp
Content-Length: 464

v=0
o=0001 33852938 33852938 IN IP4 192.168.1.52
s=SIP Call
c=IN IP4 192.168.1.52
t=0 0
m=audio 6000 RTP/AVP 8 0 18 101 123
a=rtpmap:8 PCMA/8000
a=rtpmap:0 PCMU/8000
    
```



GOOD CALL

**Conversational
Conversational
MOS/R-Factor**

4.20/93

**Missing
Missing
Packets[%]**

0/0.00

NetSurveyorWeb™

- Web-based network surveillance system for air traffic monitoring
- Works with multiple PacketScan™ 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

The screenshot displays the NetSurveyorWeb interface for monitoring Air to Ground Calls. The top navigation bar includes 'Quick CDR', 'Data', 'Reports', 'Alarms', and 'Users'. The main content area shows a search filter for 'Trafficsumid' and a table of call records.

SSRC#	Payload	Total Packet Count	Missing Packet Count(%)	Dupl. Packet Count(%)	Re-ordered Packet Count(%)	Packets Discarded(%)	Conversational MOS/R	Listening MOS/R	Cumulative Packet Loss	Gap (Min/Max/Av)	Jitter(Min/Max/Av)	RTD(M)
1263395585	PCMU/8000	321	0/0	0/0	0/0	0/0	4.2/93	4.2/93	0	0.00/39.33/20.07	0.00/1.93/58	0.000/
1264432897	PCMU/8000	190	0/0	0/0	0/0	0/0	0/0	0/0	0	0.00/21.69/20.00	0.00/0.71/47	0.000/
1263165441	PCMA/8000	224	0/0	0/0	0/0	0/0	4.2/93	4.2/93	0	0.00/0.00/0.00	0.00/0.00/0	0.802/
1261130753	PCMA/8000	258	0/0	0/0	0/0	0/0	4.2/93	4.2/93	0	0.00/21.39/20.00	0.00/0.66/42	0.000/

NetSurveyorWeb™ – Call Detail View

GL NetSurveyorWeb
Protocol: VOIP (SIP & RTP) | Type: CDR

Quick CDR
System Status at 2024-03-13 12:26:58

Data
Reports
Alarms
Users

Quick CDR \ Air to Ground Calls
TRAFFICSUMID : 223361
Export as PDF
Export as HTML
Response Time : 0.00000 Seconds

Call Graph View

192.168.15.5 SIP
192.168.15.25 SIP

2024-03-13 06:47:45.737 5060
INVITE
5060

2024-03-13 06:47:45.744 5060
100 Trying
5060

2024-03-13 06:47:45.858 5060
200 OK
5060

2024-03-13 06:47:45.870 5060
ACK
5060

SUBSCRIBE

===== SIP Layer =====

```

INVITE sip:0005@192.168.15.25 SIP/2.0
Via: SIP/2.0/UDP 192.168.15.5:5060;branch=z9hG4bK-6590-479926236-162807-81408
Max-Forwards: 70
Allow: INVITE, BYE, CANCEL, ACK, INFO, OPTIONS, SUBSCRIBE, NOTIFY, REFER, REGISTER
From: 0005 <sip:0005@192.168.15.5>;tag=FromTag-6587-479926236-162804-81408
To: 0005 <sip:0005@192.168.15.25>
Contact: 0005 <sip:0005@192.168.15.5>
Call-ID: GL-MAPS-6589-479926236-162806-81408@192.168.15.5
CSeq: 1 INVITE
Recv-Info:
WG67-Version: radio.02
Priority: normal
            
```

Event Summary View
Quick Search:
Apply
Clear

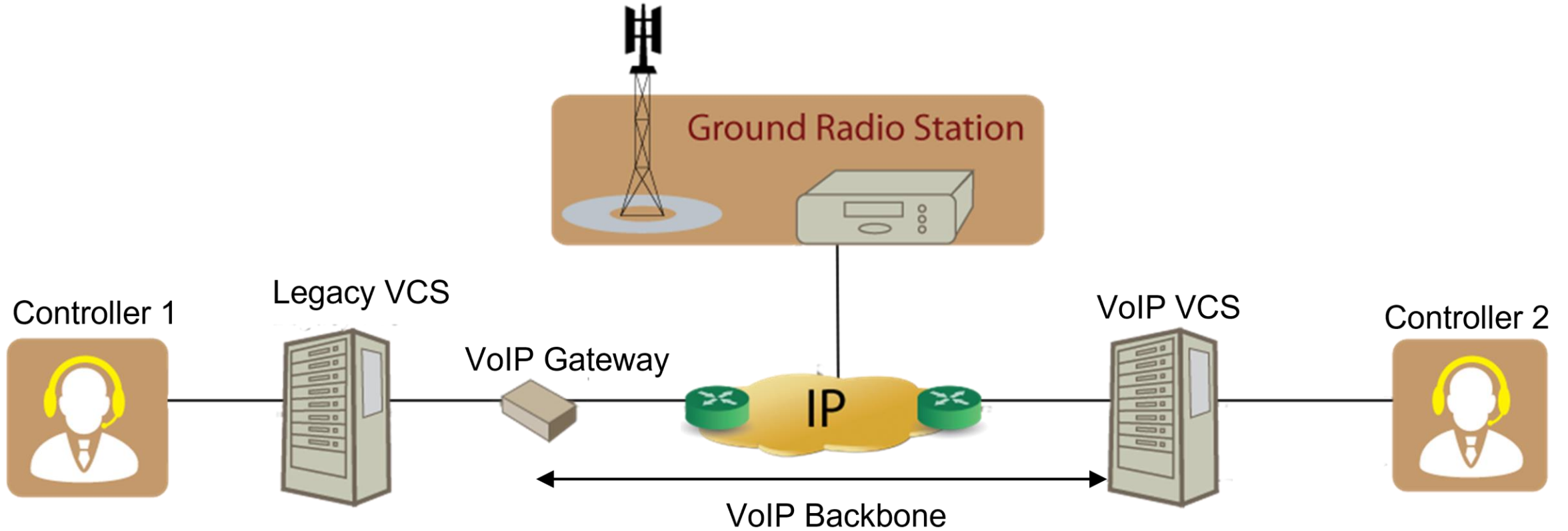
TimeStamp	Packet Type	Frame Length	Source IP	Destination IP	Event Type	PTT Type	PTT Id	Conversational Mos	Missing Packet Count	Packet Discarded	Reordeed Packet Count	Duplicate Packet Count
2024-03-14 17:14:35.261	SIP	1026	192.168.15.14	192.168.15.34	INVITE							
2024-03-14 17:14:35.602	SIP	406	192.168.15.34	192.168.15.14	100 Trying							
2024-03-14 17:14:35.721	SIP	963	192.168.15.34	192.168.15.14	200 OK							
2024-03-14 17:14:35.749	SIP	483	192.168.15.14	192.168.15.34	ACK							
2024-03-14 17:14:41.763					Squelch ON		0	0	0	0	0	0
2024-03-14 17:14:50.773					Squelch OFF		4.2	0	0	0	0	0
2024-03-14 17:14:51.476	SIP	487	192.168.15.14	192.168.15.34	BYE							
2024-03-14 17:14:51.485	SIP	466	192.168.15.34	192.168.15.14	200 OK							

NetSurveyorWeb™ – Reports and Graphs

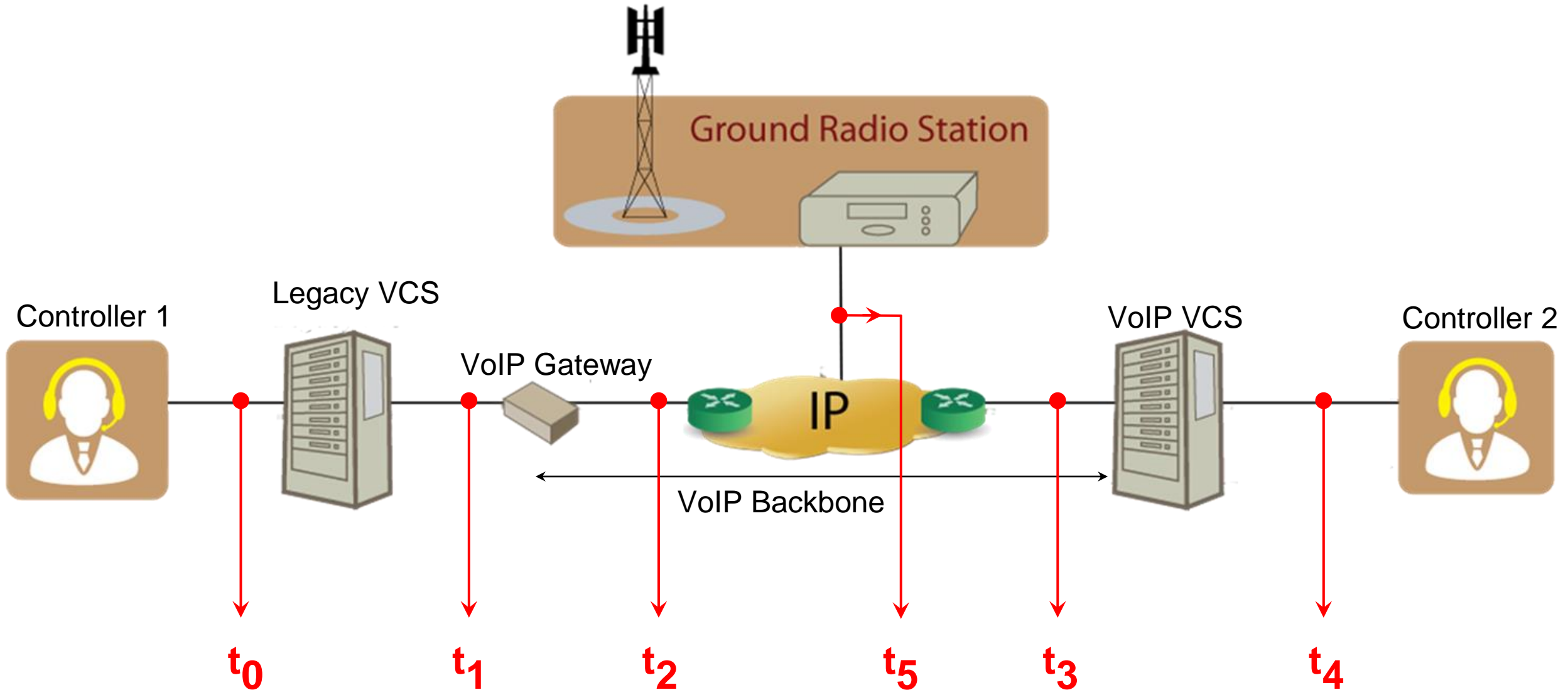


GL's Critical Delay and Voice Quality Measurement in Air Traffic Management (ED-138)

Critical Time Delay Measurements



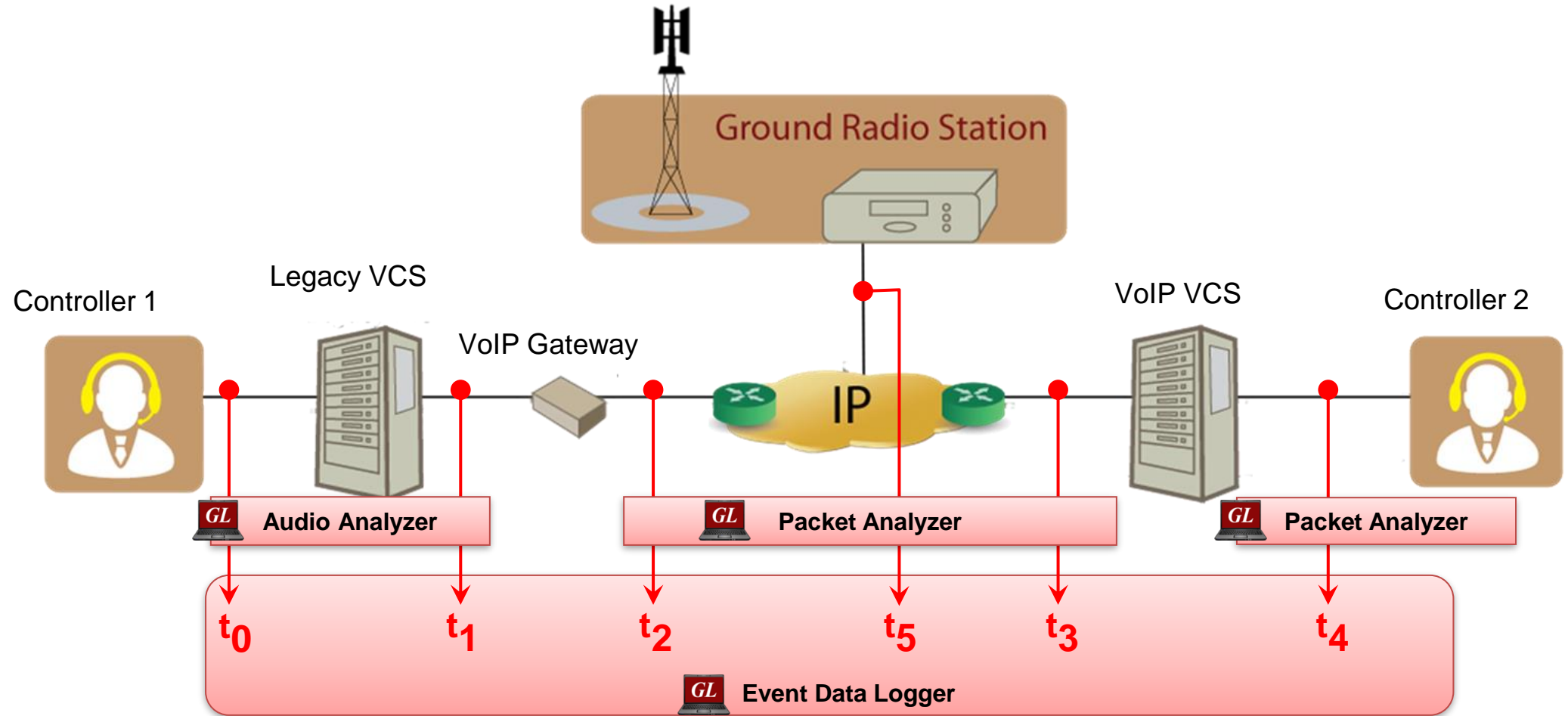
Critical Time Delay Measurements (ED-138) - Overview



Important Events to Measure in ATM Network

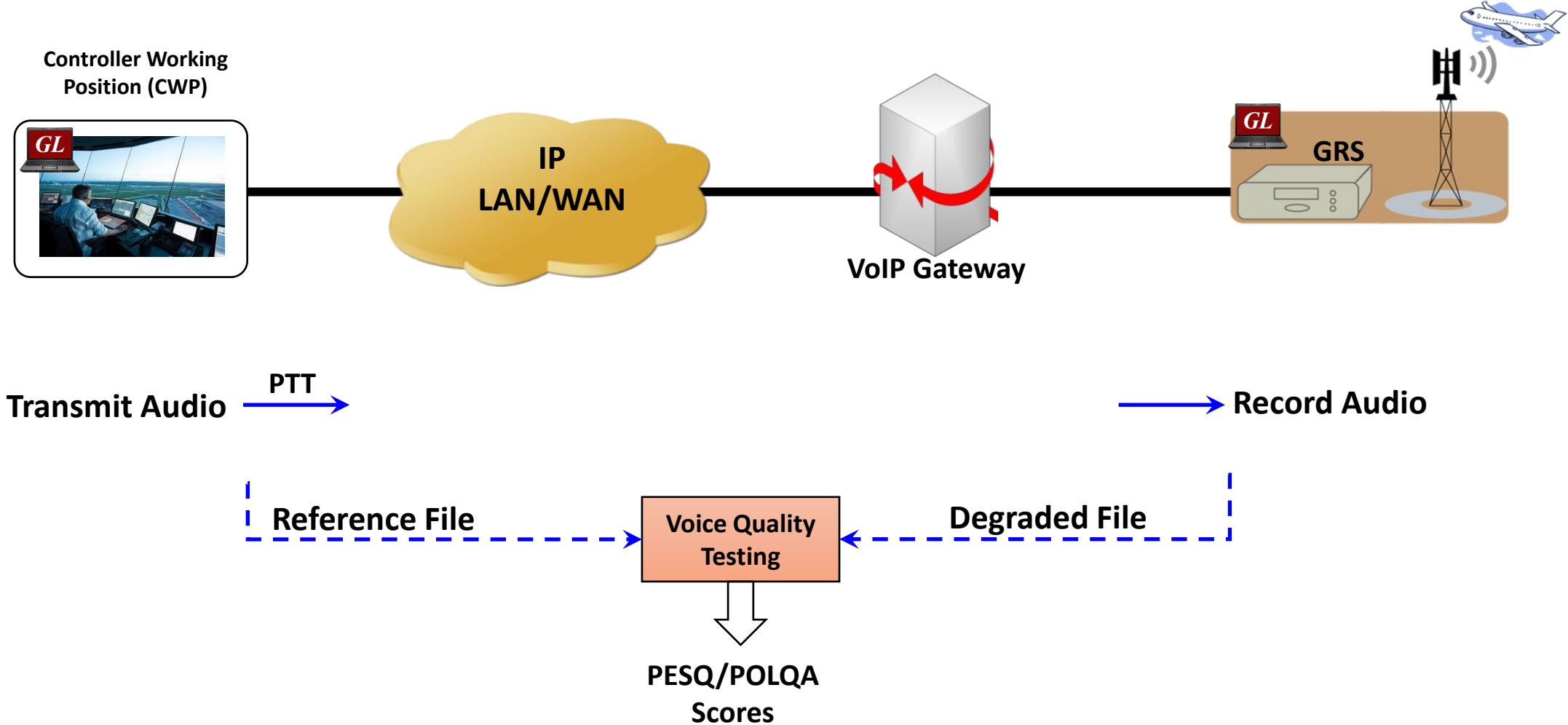
- PTT
- PTT confirmation
- PTT release
- PTT release confirmation
- Squelch on
- Squelch off
- End-to-end voice delay for PTT
- End-to-end voice delay for Squelch
- Main/Standby Tx/Rx transfer
- Main/Standby Tx/Rx transfer confirmation
- Remote Receiver Mute
- Remote Receiver Mute Confirmation
- Remote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



MAPS™ Administrator

- Client application that controls all the components of TM ATM suite and runs the tests to perform measurements
- Calculate the time difference between posted events from the Discrete Signal Logger and Packet Analyzer and reports precise measured delay at different points in the network

Packet Analyzer

- Filter packets of interest on multiple ports with 120 byte depth filters. Define what byte(s) of interest to be filtered at hardware-level
- Capable of routing filtered packet with GPS time stamp or generate TTL triggers (1 Microsecond pulse) for each filter passed

MAPS™ ED-137 Radio

- Simulates CWP and GRS to emulate hundreds of Air-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

- The Discrete Signal Logger monitors the TTL output from the Audio Analyzer and generates a corresponding IP packet indicating a certain event has occurred. The packets generated by the Discrete Signal Logger are named as discrete events and posted to the Event Data Logger



Packet Analyzer + MAPS™
ED137 Radio

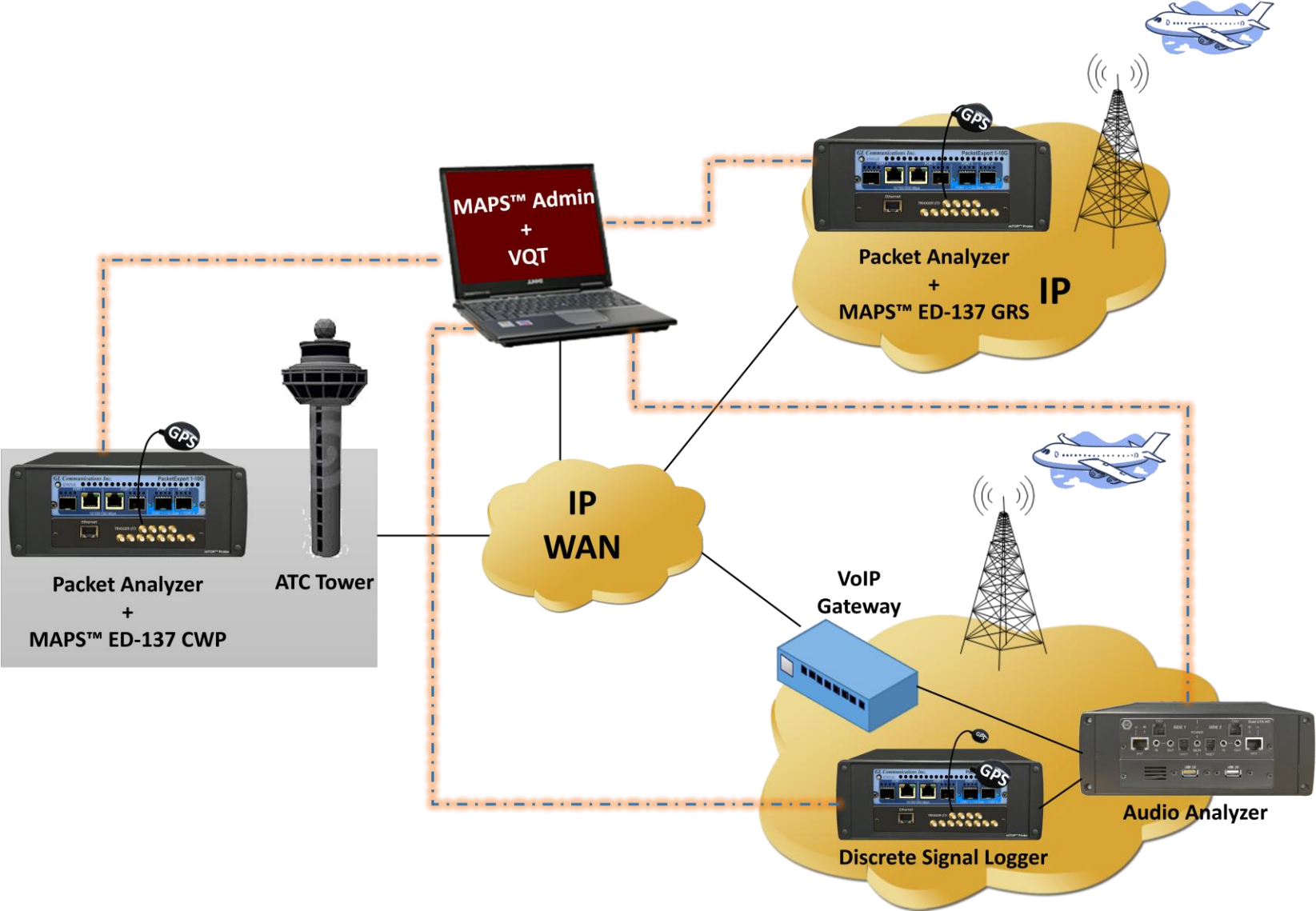


Audio Analyzer



Discrete Signal Logger

ATM Solution for Portable Field Testing



Thank you