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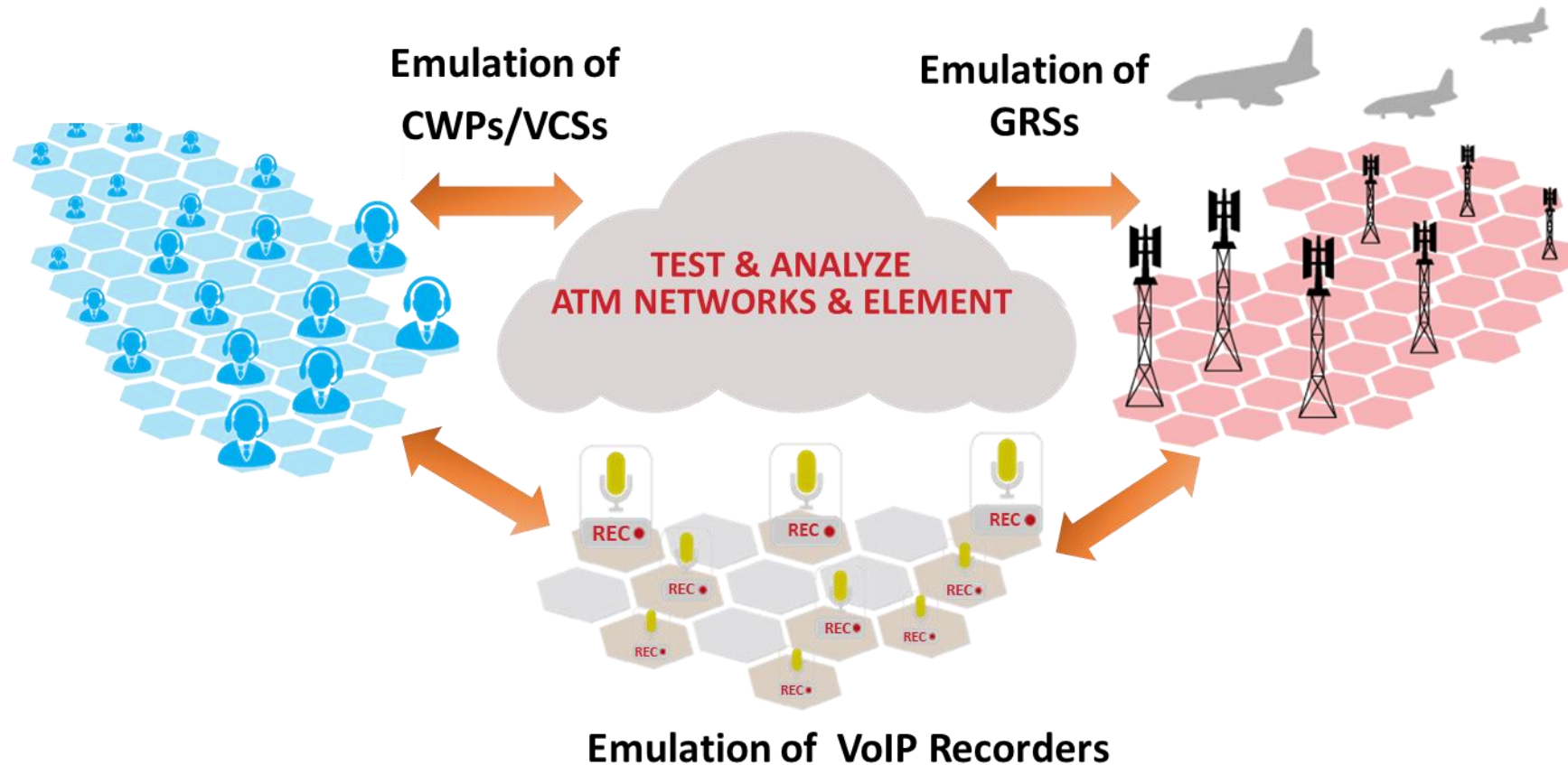
# Test Solutions for Air Traffic Management

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818 West Diamond Avenue - Third Floor, Gaithersburg, MD 20878  
Phone: (301) 670-4784 Fax: (301) 670-9187 Email: [info@gl.com](mailto:info@gl.com)  
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**

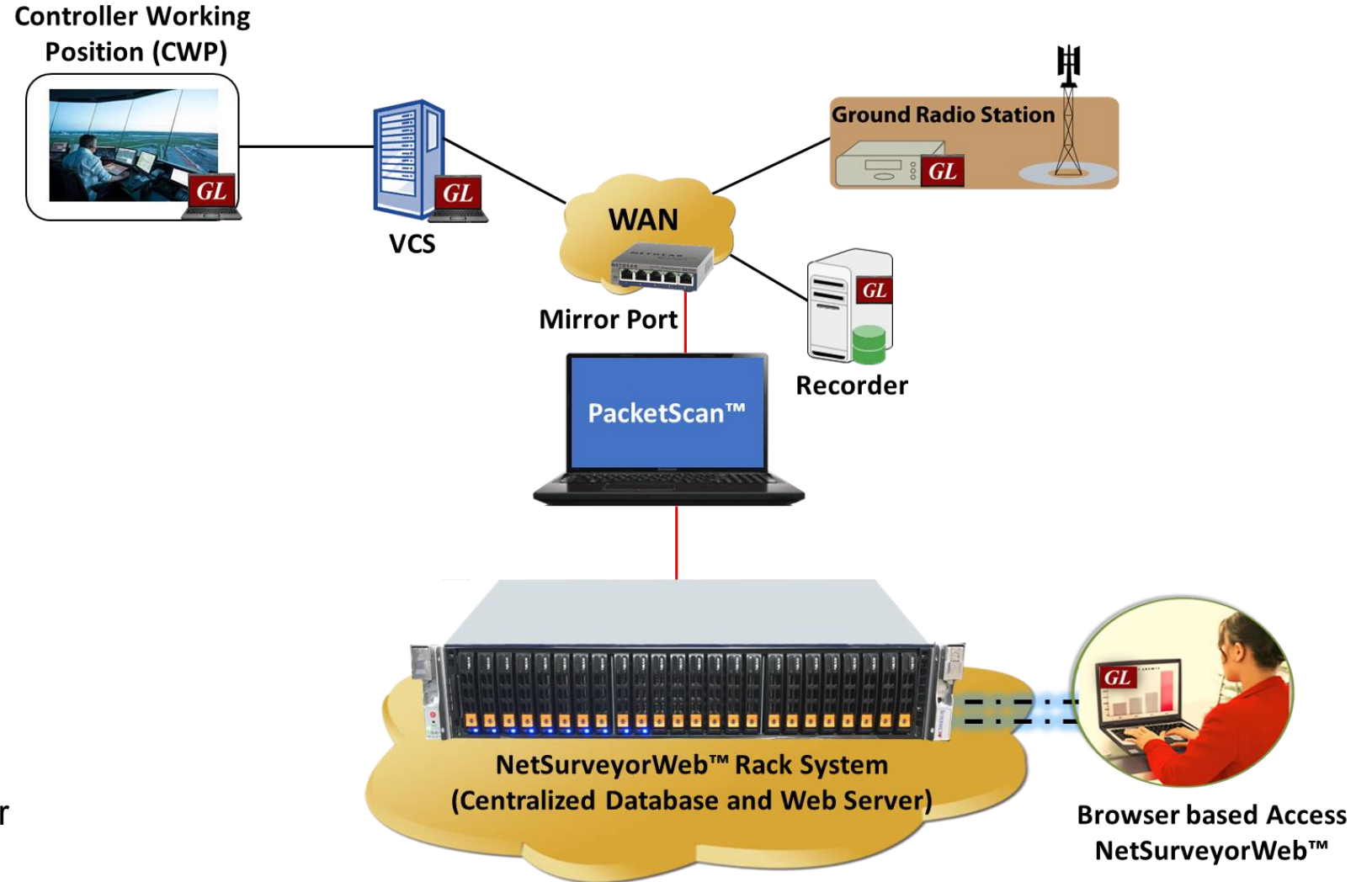
- MAPS™ ED-137 Radio
- MAPS™ ED-137 Telephone
- MAPS™ ED-137 Recorder

- **ED-138 Monitoring Solutions**

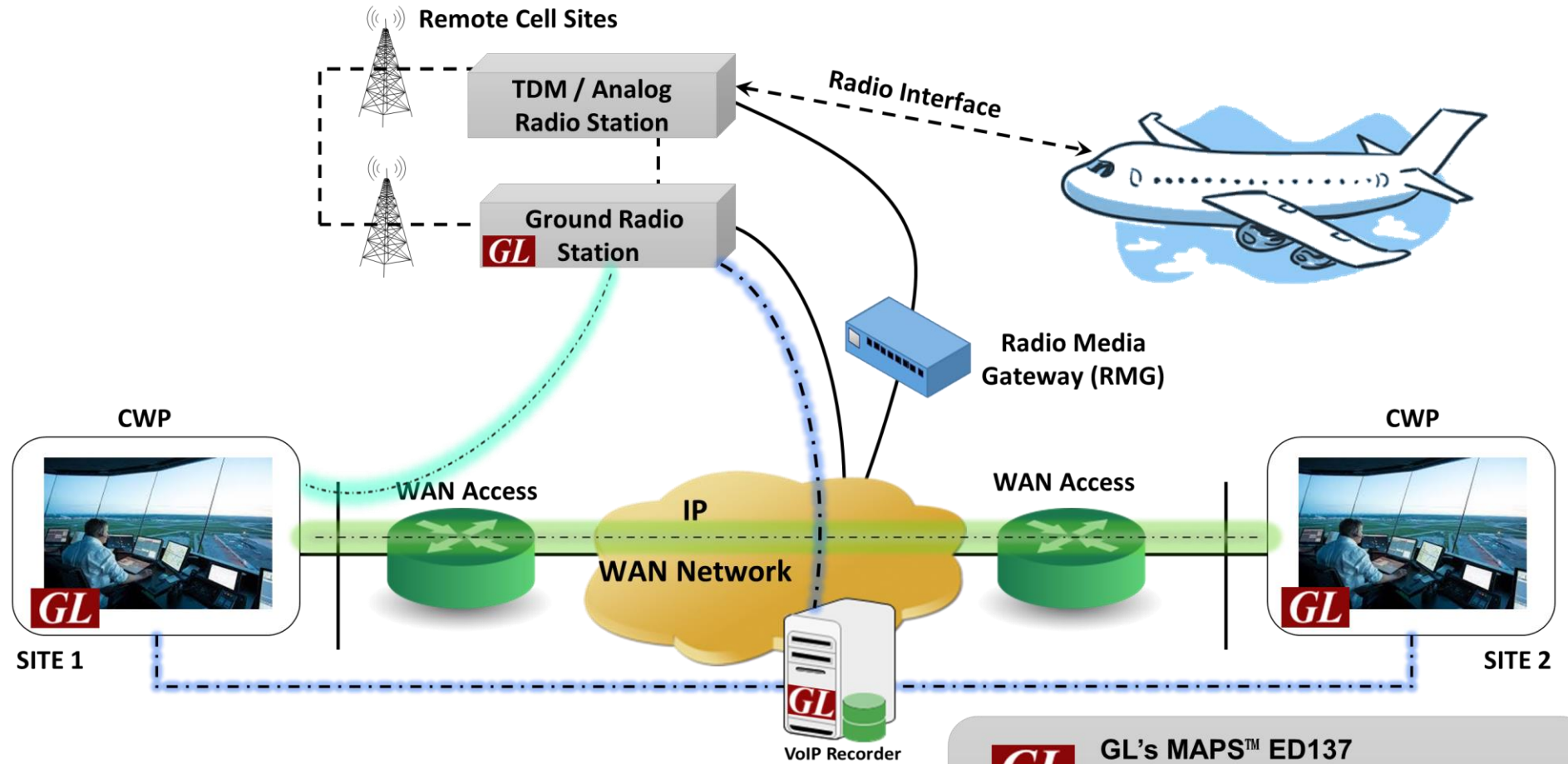
- PacketScan™
- NetSurveyorWeb™

- **Critical Delay and Voice Quality Measurements**

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



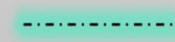
# MAPS™ ED-137 Radio, Telephone, and Recorder



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



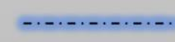
GL's MAPS™ ED137  
Radio/Telephone/Recorder Emulator



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 (Message Automation Protocol Simulation) CWP (SIP ED-137C Volume 1 Radio Radio) - [Call Generation - CallGenDefault] interface. The window includes a menu bar (Configurations, Emulator, Reports, Editor, Debug Tools, Windows, Help) and a toolbar with various icons. 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, Send RMM, Apply CLD, ReInvite, Receive Traffic, PTTs ON, Apply RRC, Impair, Speaker ON, Stop RTP/R25. The main area is divided into two panes. The left pane shows a message sequence diagram with messages between MAPS and DUT. The right pane shows the details of the selected message (INVITE).

**Message Sequence Diagram:**

```

sequenceDiagram
    participant MAPS
    participant DUT
    MAPS->>DUT: INVITE
    Note over DUT: 10:21:30.185000
    Note over DUT: CallType: Radio-TxRx, Priority: normal
    DUT->>MAPS: 100 Trying
    Note over MAPS: 10:21:30.225000
    DUT->>MAPS: 200 OK
    Note over MAPS: 10:21:30.332000
    MAPS->>DUT: ACK
    Note over DUT: 10:21:30.343000
    MAPS->>DUT: KeepAlive
    Note over DUT: 10:21:30.354000
    DUT->>MAPS: KeepAlive
    Note over MAPS: 10:21:30.456000
    MAPS->>DUT: Normal PTT-ON, PTT-ID = 2
    Note over DUT: 10:21:32.547000
    DUT->>MAPS: Normal PTT-ON, PTT-ID = 2
    Note over MAPS: 10:21:32.551000
    MAPS->>DUT: SQU
    Note over DUT: 10:21:32.555000
    DUT->>MAPS: SQU-ON
    Note over MAPS: 10:21:32.556000
    
```

**SIP Message Details (INVITE):**

```

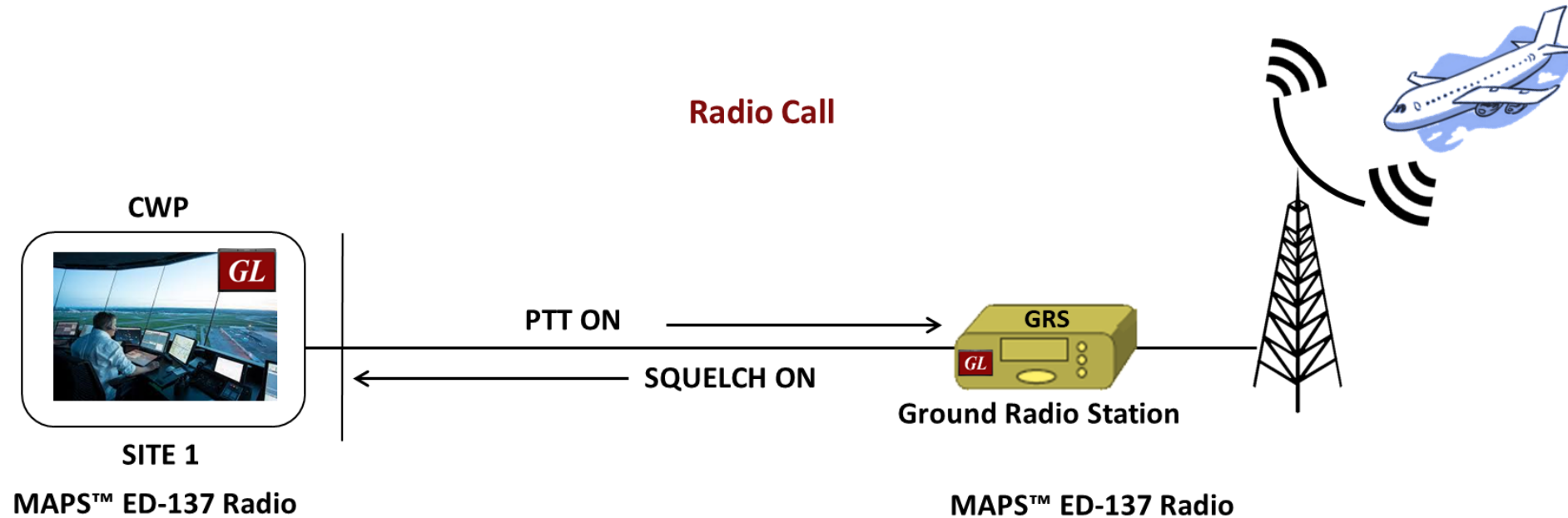
INVITE sip:0001@192.168.12.212 SIP/2.0
Via: SIP/2.0/UDP 192.168.12.119:5060;branch=z9hG4bK-4-1118866627-2174-5124
Max-Forwards: 70
Allow: INVITE,BYE,CANCEL,ACK,INFO,OPTIONS,SUBSCRIBE,NOTIFY,REFER,REGISTER
From: 0001 <sip:0001@192.168.12.119>;tag=FromTag-1-1118866627-2171-5124
To: 0001 <sip:0001@192.168.12.212>
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 annexb=no
a=rtpmap:101 telephone-event/8000
a=fmtn:101 0-15
    
```

The bottom of the window shows tabs for Scripts, Message Sequence, Event Config, and Script Flow. The status bar at the bottom indicates: Initialisation Errors, Error Events, Captured Errors, and Link Status Up=0 Down=0.



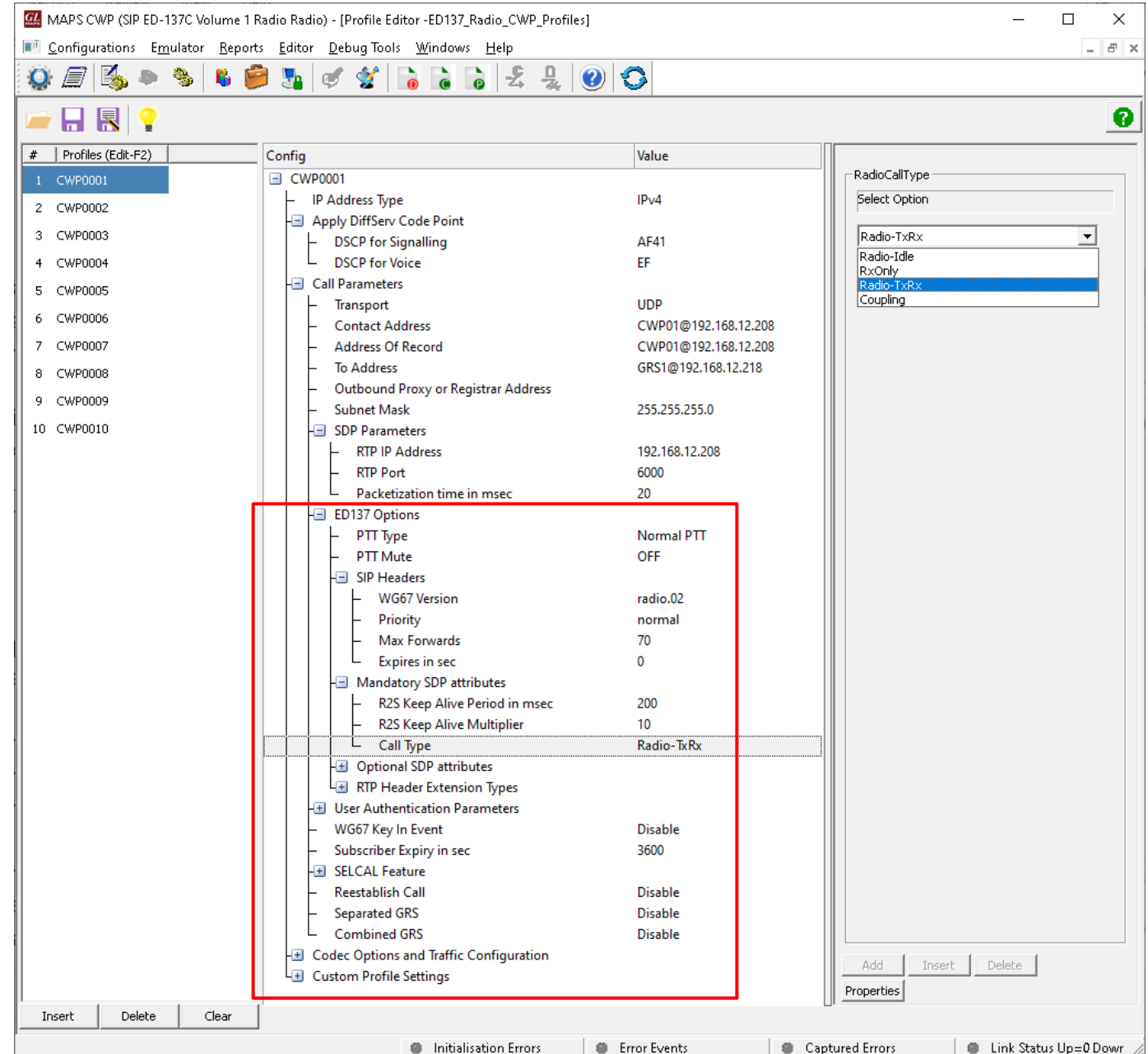
# MAPS™ ED-137 Radio Emulator Highlights



- 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 and 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™ 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)

The screenshot displays the MAPS GRS (SIP ED-137C Volume 1 Radio Radio) - [Call Reception] interface. The window includes a menu bar (Configurations, Emulator, Reports, Editor, Debug Tools, Windows, Help) and a toolbar. The main area is divided into three sections:

**Call Reception Table:**

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 R2S KeepAlive	None		Pass
2	SipCallControl.gls	GRS0001	CWP04@192.168.12.208, PTT-ID = 8	Stop	Sending R2S KeepAlive	Start Squelch		Pass
3	SipCallControl.gls	GRS0001	CWP02@192.168.12.208, PTT-ID = 9	Stop	Sending R2S KeepAlive	Start Squelch		Pass
4	SipCallControl.gls	GRS0002	CWP06@192.168.12.208, PTT-ID = 5	Stop	Sending R2S KeepAlive	Start Squelch		Pass
5	SipCallControl.gls	GRS0002	CWP07@192.168.12.208	Stop	Sending R2S KeepAlive	None		Pass
6	SipCallControl.gls	GRS0003	CWP13@192.168.12.208, PTT-ID = 5	Stop	Sending R2S KeepAlive	Start Squelch		Pass
7	SipCallControl.gls	GRS0003	CWP14@192.168.12.208, PTT-ID = 6	Stop	Sending R2S KeepAlive	Start Squelch		Pass

**Message Sequence Diagram:**

The diagram shows a sequence of messages between DUT (Device Under Test) and MAPS. The messages are:

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

**SIP Message Decode:**

```

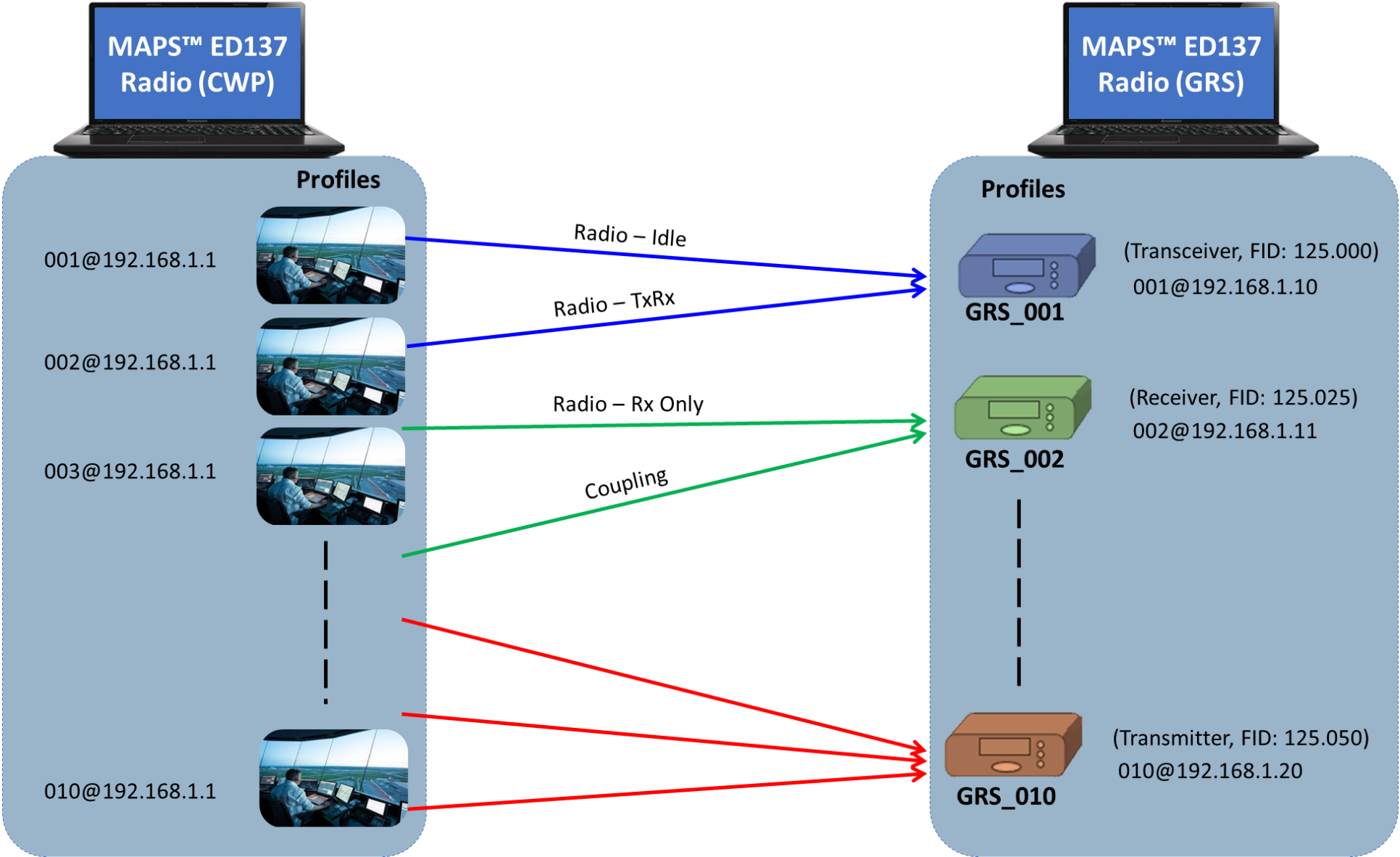
INVITE sip:GRS1@192.168.12.218 SIP/2.0
Via: SIP/2.0/UDP 192.168.12.208:5060;branch=z9hG4bK-49-27326481-9696-3520
Max-Forwards: 70
Allow: INVITE,BYE,CANCEL,ACK,INFO,OPTIONS,SUBSCRIBE,NOTIFY,REFER,REGISTER
From: CWP02 <sip:CWP02@192.168.12.208>;tag=FromTag-46-27326481-9693-3520
To: GRS1 <sip:GRS1@192.168.12.218>
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
a=0?S=KeepAlivePeriod:200
    
```

The interface also includes a toolbar with buttons for Stop, Stop All, Abort, Abort All, Show Records, Select Active Call, Auto Trash, and Trash. A red box highlights a set of buttons: ApplyMAM Values, Receive Traffic, Apply SQI, SCT ON, PTTs ON, Impair, Speaker ON, and Stop RTP/R2S.



# 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

# 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

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

```

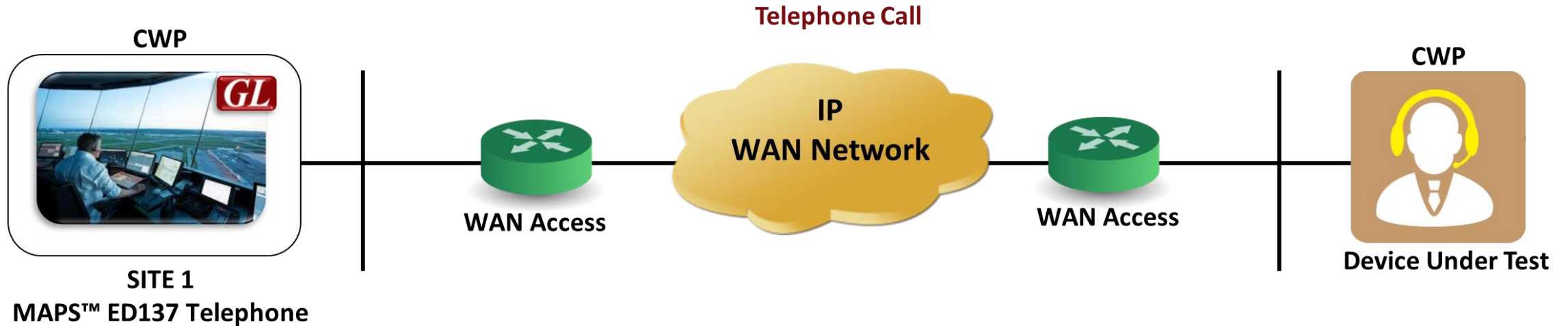
INVITE sip:0001@192.168.12.218 SIP/2.0
Via: SIP/2.0/UDP 192.168.12.208:5060;branch=z9hG4bK-11-1778060975-3875-26072
Max-Forwards: 70
Allow: INVITE,BYE,CANCEL,ACK,INFO,OPTIONS,SUBSCRIBE,NOTIFY,REFER,REGISTER,UPDA1
From: 0001 <sip:0001@192.168.12.208>;tag=FromTag-8-1778060975-3872-26072
To: 0001 <sip:0001@192.168.12.218>
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

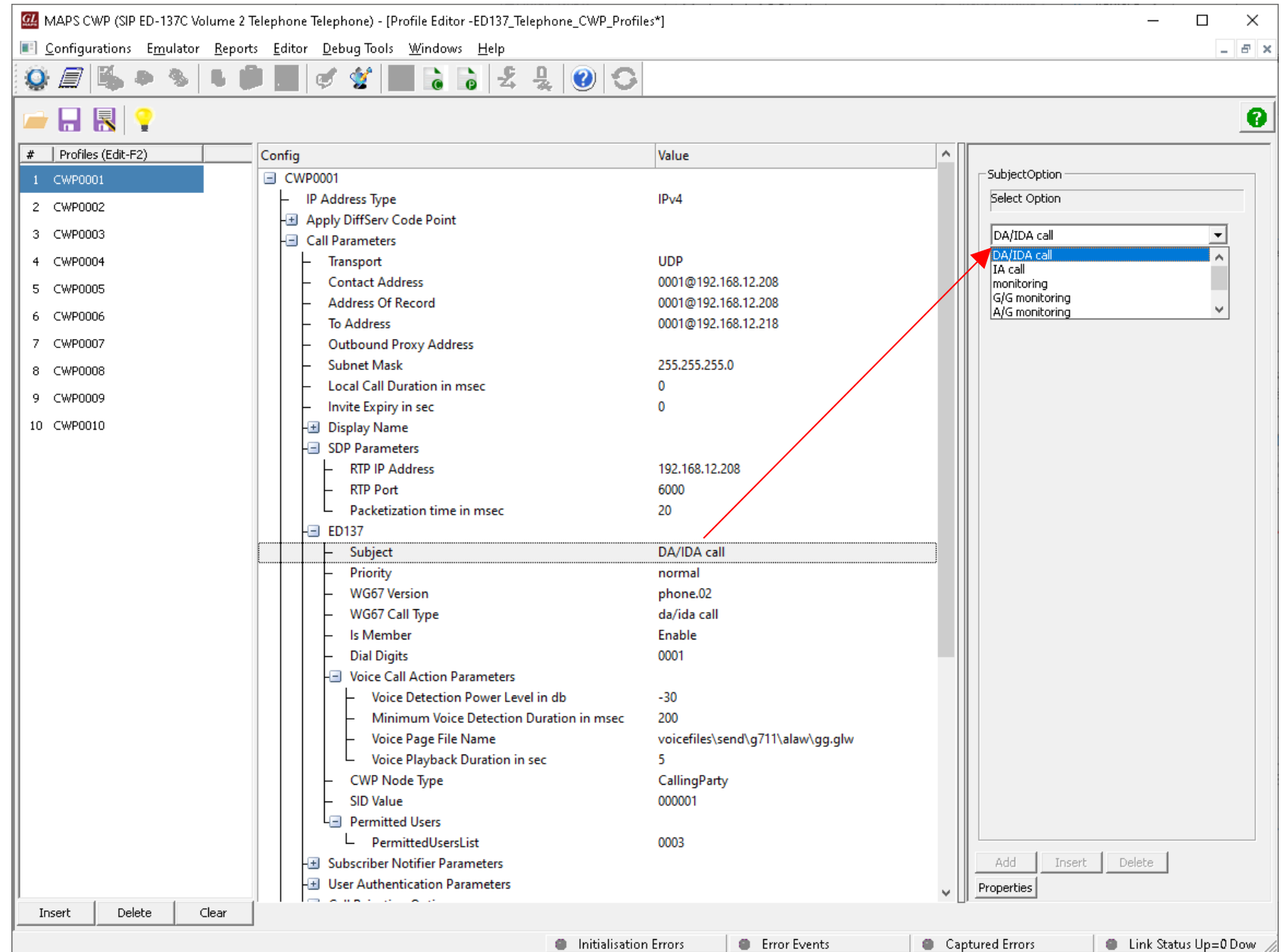
# MAPS™ ED-137 Telephone Emulator Highlights



- 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





# MAPS™ ED-137 Telephone Emulator – Call Generation

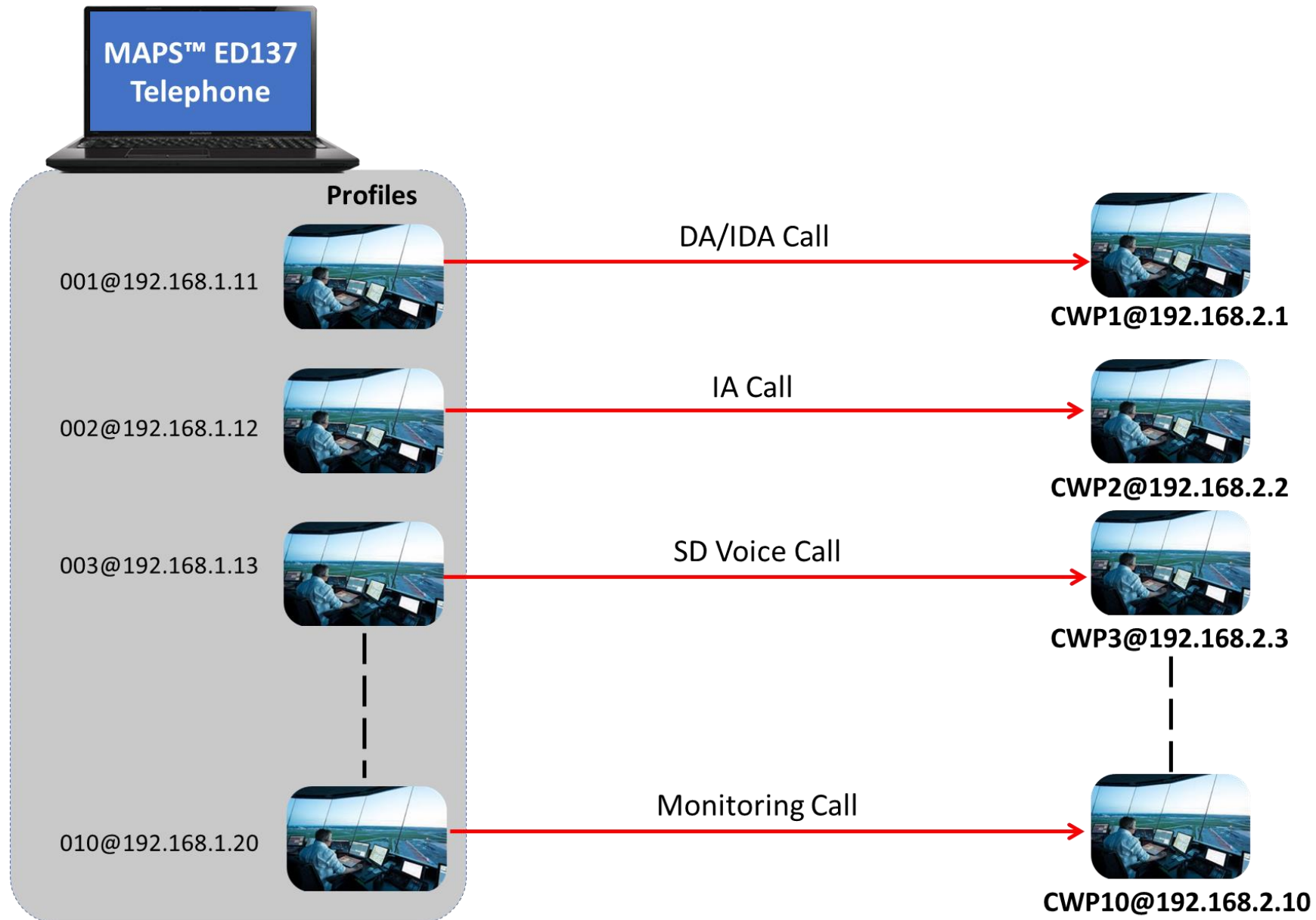
- Displays Call graph and message decodes for each call
- Load generation or background traffic generation using Bulk Call Generation
- Scripts/sessions can be run repeatedly for defined number of iterations with results of each iteration
- Multiple scripts can be run simultaneously or sequentially or 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 includes a menu bar (Configurations, Emulator, Reports, Editor, Debug Tools, Windows, Help) and a toolbar with various icons. A table at the top shows the results of call generation:

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

Below the table, there are buttons for 'Add', 'Delete', 'Insert', 'Refresh', 'Start', 'Start All', 'Stop', 'Stop All', 'Abort', and 'Abort All'. A 'Script Flow Config' dialog box is open, showing the 'Flow Order' (Sequential) and 'Time Configuration' (On Complete). The 'Total Iteration' is set to 5. The 'Script Flow' tab is selected, showing a sequence of events for a call from 0001@192.168.12.208 to 0001@192.168.12.218:5066. The events include INVITE, 100 Trying, 180 Ringing, CallSetUpTime: 59msec, 200 OK, ACK, REFER, 202 Accepted, NOTIFY, and BYE. The 'Message Sequence' tab is also visible, showing the SIP message details for the INVITE request.

# 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]

Configurations Emulator Reports Editor Debug Tools Windows Help

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	

Add Delete Insert Refresh Start Start All Stop Stop All Abort Abort All

Save Column Width Show Latest

MAPS DUT

ANNOUNCE 15:34:21.331.9855

200 OK 15:34:21.74.3021

SETUP 15:34:21.75.5161

200 OK 15:34:22.247.9033

SET\_PARAMETER 15:34:22.288.2552

200 OK 15:34:22.413.8148

RECORD 15:34:32.35.3916

200 OK 15:34:32.96.2766

GET\_PARAMETER 15:35:26.110.9878

200 OK 15:35:27.154.9487

GET\_PARAMETER 15:36:21.171.2779

200 OK 15:36:21.220.6510

GET\_PARAMETER 15:37:15.232.2084

200 OK 15:37:15.279.3181

GET\_PARAMETER 15:38:09.290.4625

200 OK 15:38:09.333.9365

Find

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

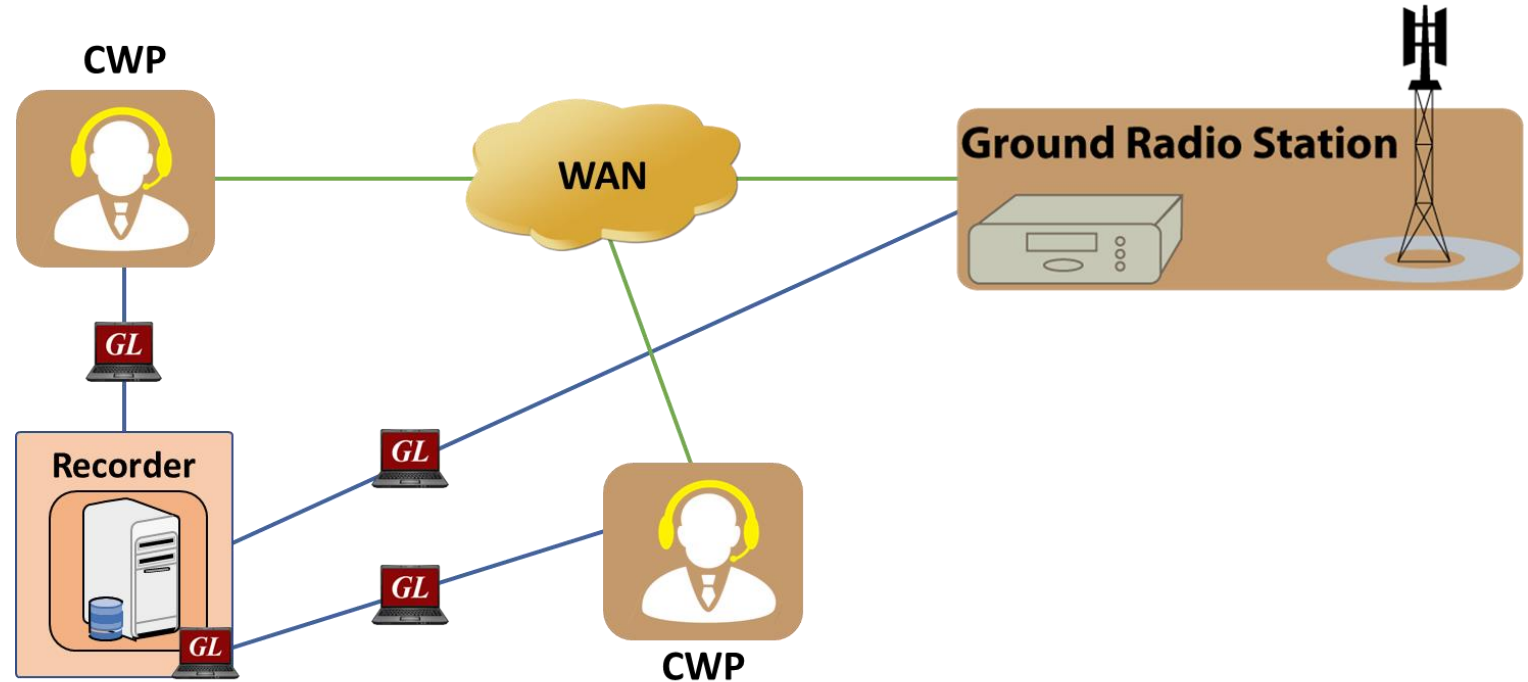
<call-record-data connref="GL-MAPS\_3\_1651604883-125411-99932@192.168.1.101">  
<properties>  
<property name="ClientId">sip:0001@192.168.1.1</property>  
<property name="CallingNr">sip:0001@192.168.1.1</property>  
<property name="CalledNr">sip:0002@192.168.1.2</property>  
<property name="Direction">2</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=13820</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>

Scripts Message Sequence Event Config Script Flow

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

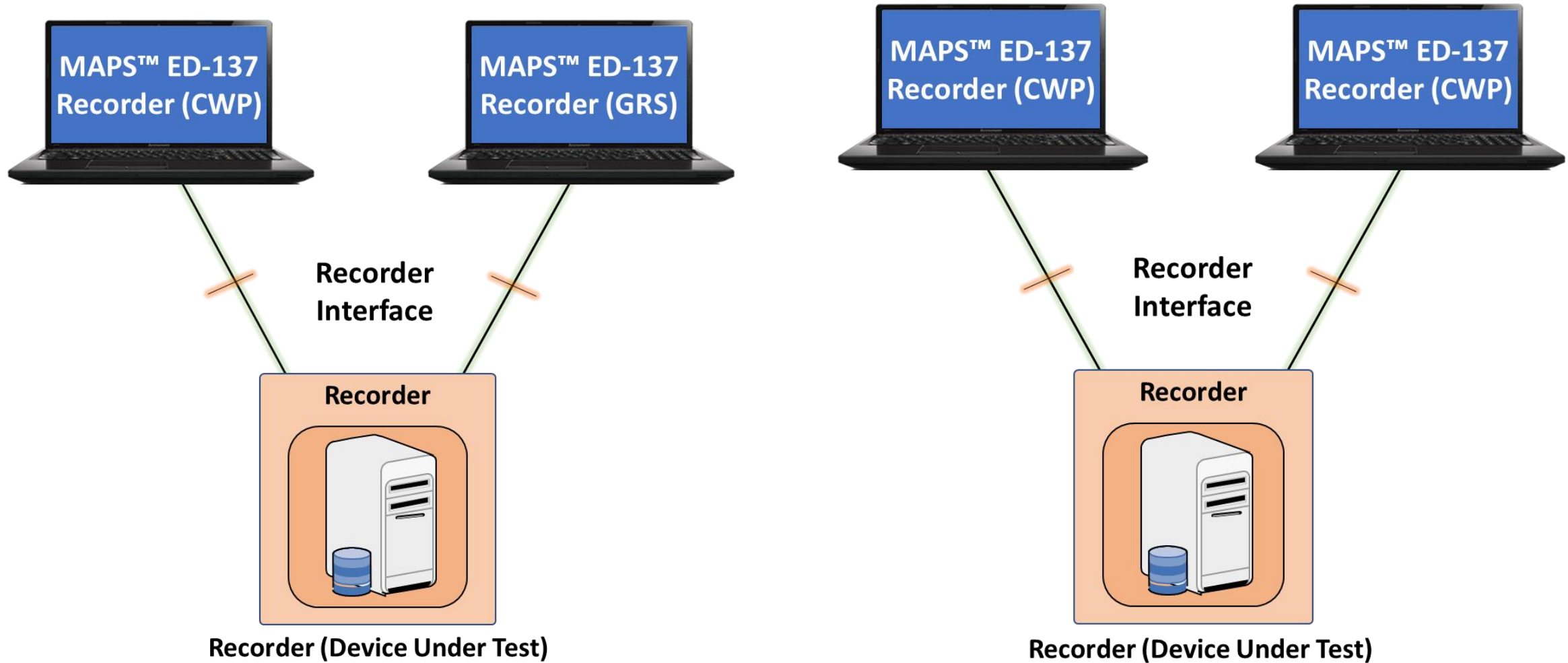
# MAPS™ ED-137 Recorder Emulator Highlights

- 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

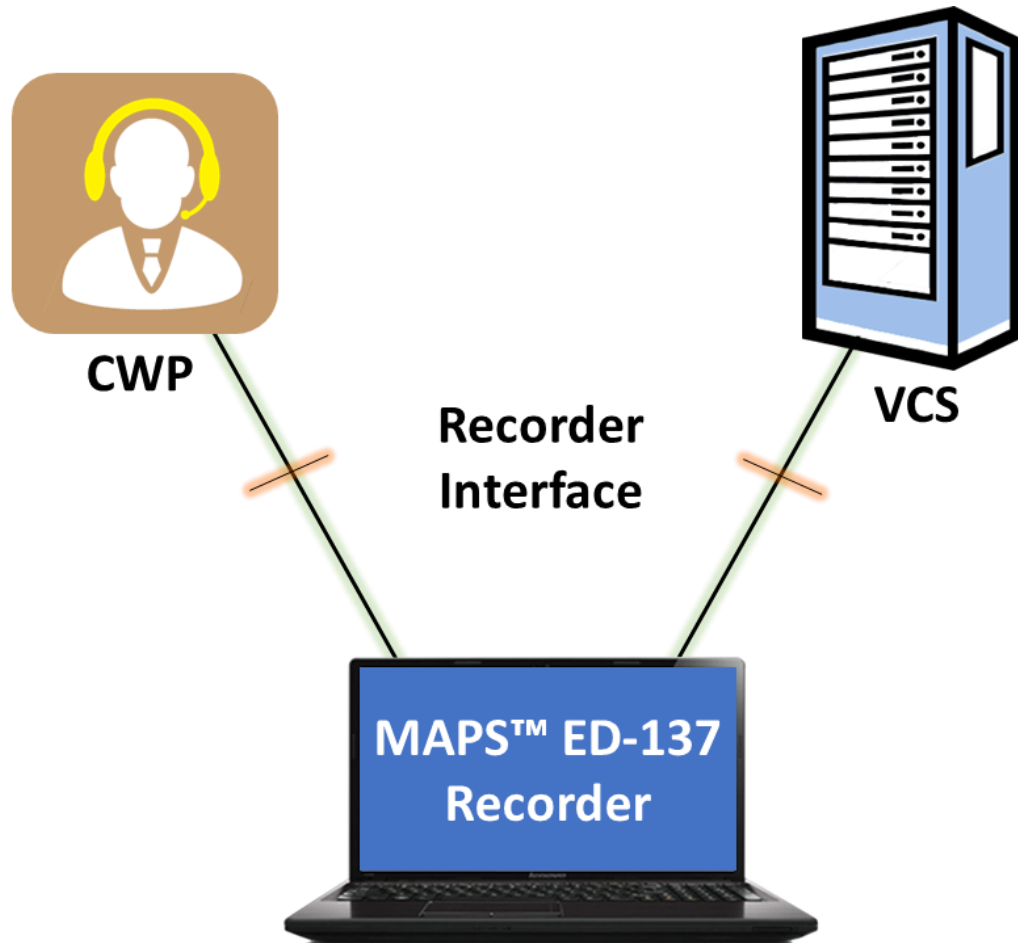
**CASE 1: Simulate AG call recording towards Recorder**   **CASE 2: Simulate GG call recording towards Recorder**



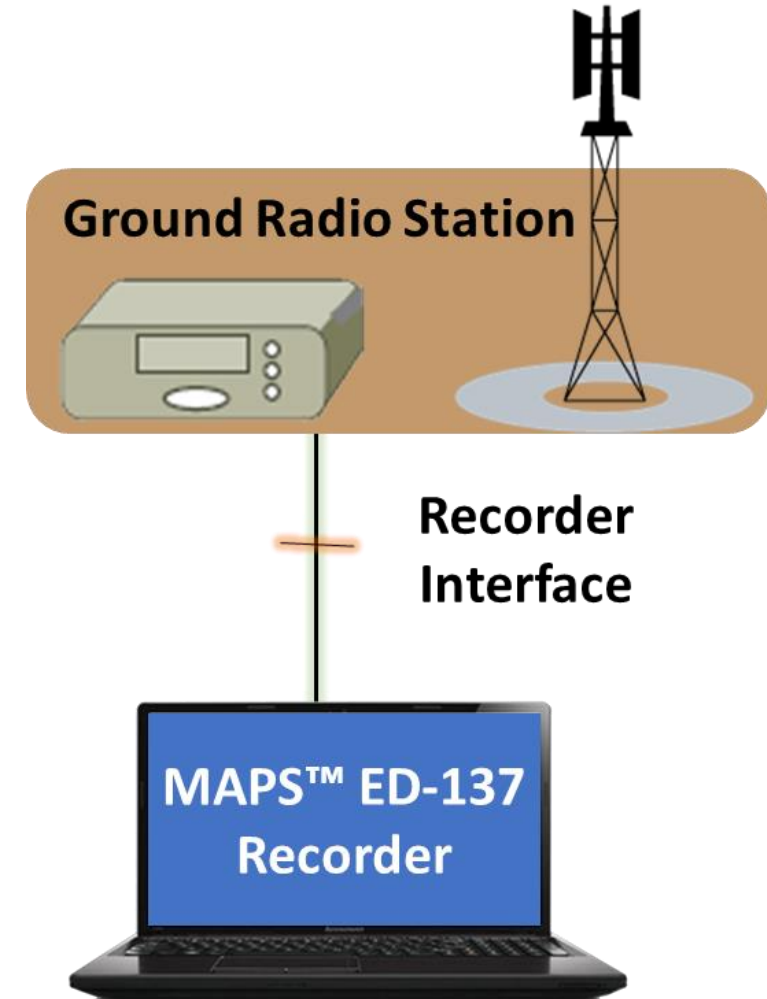


# MAPS™ ED-137 Recorder Use Cases (Contd.)

## CASE 3: Testing Recorder interface of CWP/VCS

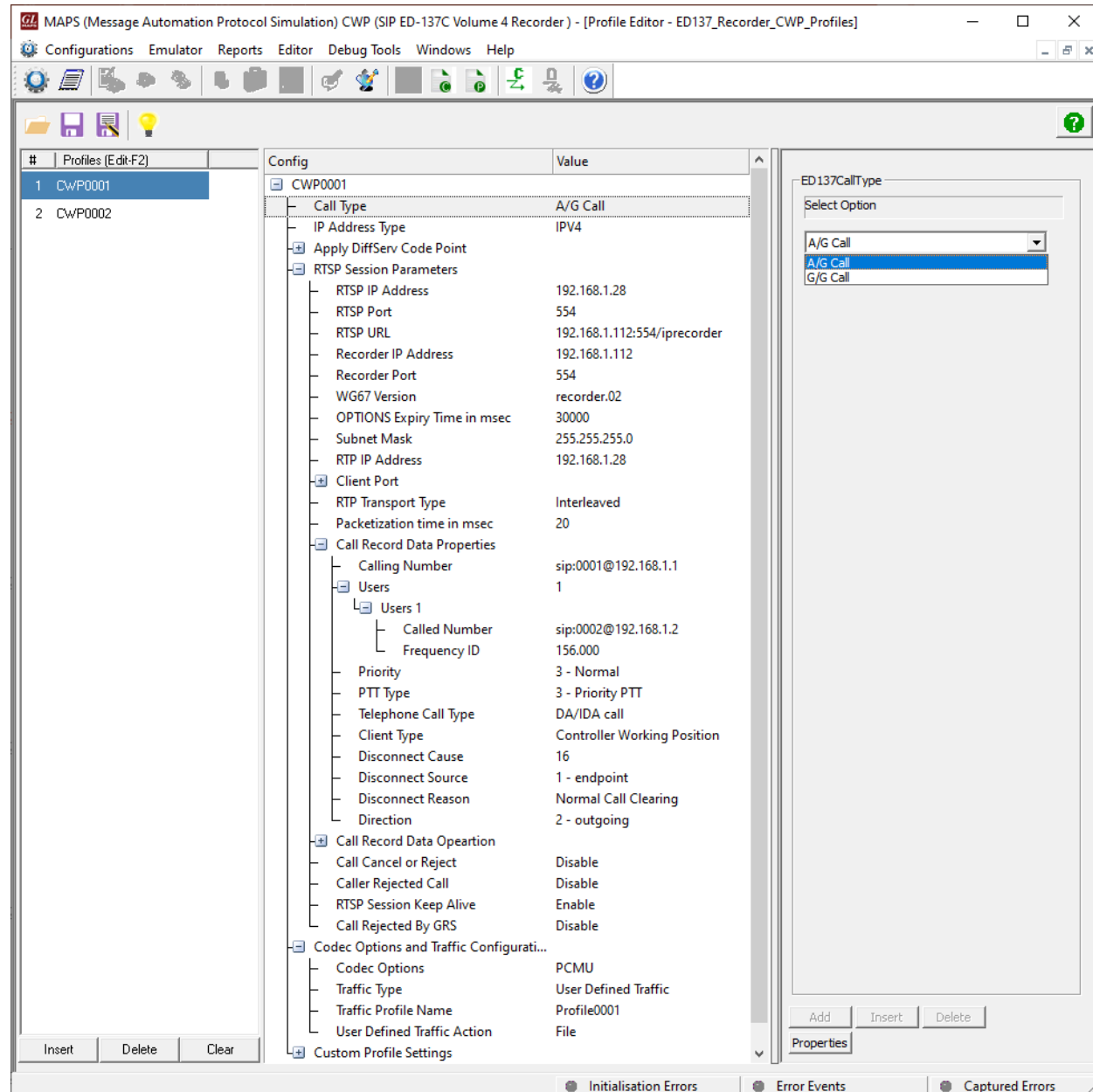


## CASE 4: Testing Recorder interface of GRS



# 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



# 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

The screenshot displays the MAPS (Message Automation Protocol Simulation) CWP (SIP ED-137C Volume 4 Recorder) - [Call Generation - CallGenDefault] interface. The interface includes a menu bar (Configurations, Emulator, Reports, Editor, Debug Tools, Windows, Help), a toolbar, and a main workspace.

**Script Table:**

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 Dialog:**

Flow Order: ☒ Sequential ☐ Random

Time Configuration: ☒ On Complete ☐ Duration [0] msec

Total Iteration:

**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

**Script Flow:**

```

SET_PARAMETER rtsp://192.168.12.218:554/iprecorder/ RTSP/1.0
CSeq: 3
WC67-Version: recorder.02
Session: GL-MAPS_10_20990173-8691-7060
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</operation>
    <operation name="RadioAccessMode" time="2024-03-13_06:21:25.763+0000">3</operation>
  </operations>
</call-record-data>
    
```

# Key Updates

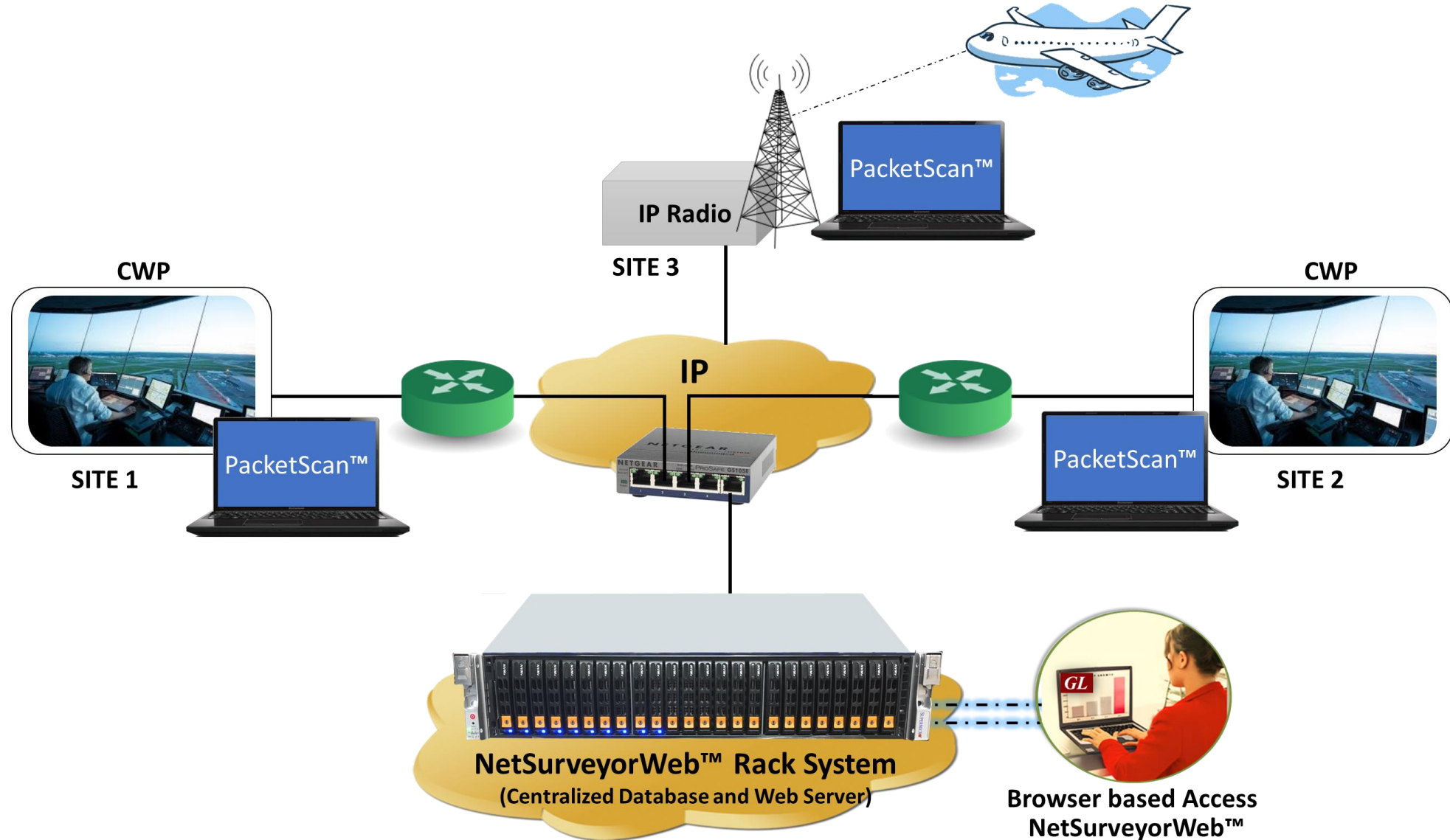
- Emulators support both ED-137 B and C versions, including Change 1 and 2 features
- User can choose to simulate ED-137 B or C version when invoking the application. License supports both versions
- Emulators support both IPv4 and IPv6 addressing
- All Emulators (Radio, Telephone and Recorder) are validated 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™ 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. The top section shows a table of captured packets. The bottom section provides a detailed protocol analysis of the selected packet (Frame 4).

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	00:00:00.000000000	1031		Internet IP(IPv4)	SIP	192.168.12.208	192.168.12.218	5060	5060	INVITE
✓	1	00:00:00.022167000	407		Internet IP(IPv4)	SIP	192.168.12.218	192.168.12.208	5060	5060	100 Trying
✓	2	00:00:00.132649000	976		Internet IP(IPv4)	SIP	192.168.12.218	192.168.12.208	5060	5060	200 OK
✓	3	00:00:00.154745000	473		Internet IP(IPv4)	SIP	192.168.12.208	192.168.12.218	5060	5060	ACK
✓	4	00:00:00.164060000	62		Internet IP(IPv4)	RTP	192.168.12.218	192.168.12.208	1028	6000	
✓	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)
000F Differentiated Services Field = 
000F Differentiated Services Codepoint = 000000... Default
000F Explicit Congestion Notification = .....00 Not-ECT (Not ECN-Capable Transport)
0010 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
    
```

Stopped. Mouse RClick + CTRL button down for search/filter. C:\Program Files\GL Communications Inc\PacketScan-22.12.7.\Idle. 102 frames Missed Frames : 0

# 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

Call Summary SIP Registration Summary Alert Summary

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 Gap	Max/Min Delay	Max/Min Jitter	Max/Min RTDela...	Average RTDela...
Call#000001	Caller:CWP01	Callee:GRS1	CallId:GL-MAPS-18-32446300-10373-9692@192.168.12.208	Call StartTime: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	1	0	534.67...	474 / ...	30.04 ...	2.969 ...
1	11937...	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 ...
Call#000002	Caller:CWP01	Callee:GRS1	CallId: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	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 ...
2	11902...	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 ...
Call#000003	Caller:CWP01	Callee:GRS1	CallId: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															
3	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 ...
3	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	3.96 / ...	0.251 ...
Call#000004	Caller:CWP01	Callee:GRS1	CallId:GL-MAPS-17-32449105-10394-5260@192.168.12.208	Call StartTime:2024-03-13 12:15:44.423	Call Duration: 00:01:57.492															
4	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 ...
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 ...	19 / -17	3.94 / ...	0.272 ...
Call#000005	Caller:CWP01	Callee:GRS1	CallId:GL-MAPS-17-32449575-10401-1840@192.168.12.208	Call StartTime:2024-03-13 12:15:44.908	Call Duration: 00:01:57.011															
5	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 ...
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 ...	19 / -17	3.95 / ...	0.220 ...

Column Width Absolute Timing Show Latest

Time	Frame#	192.168.12.208	192.168.12.218
00.00.000	0	5060	5060
		INVITE	
00.00.018	1	5060	5060
		SIP/2.0 100 Trying	
00.00.140	2	5060	5060
		SIP/2.0 200 OK	
00.00.151	3	5060	5060
		ACK	
00.05.185	185	6000	1050
		Normal PTT ON	
00.05.185	186	6000	1050
		Normal PTT ON	
00.09.628	611	6000	1050
		Squelch ON	
00.41.067	10368	6000	1050
		Squelch OFF	

Find Complete Stack

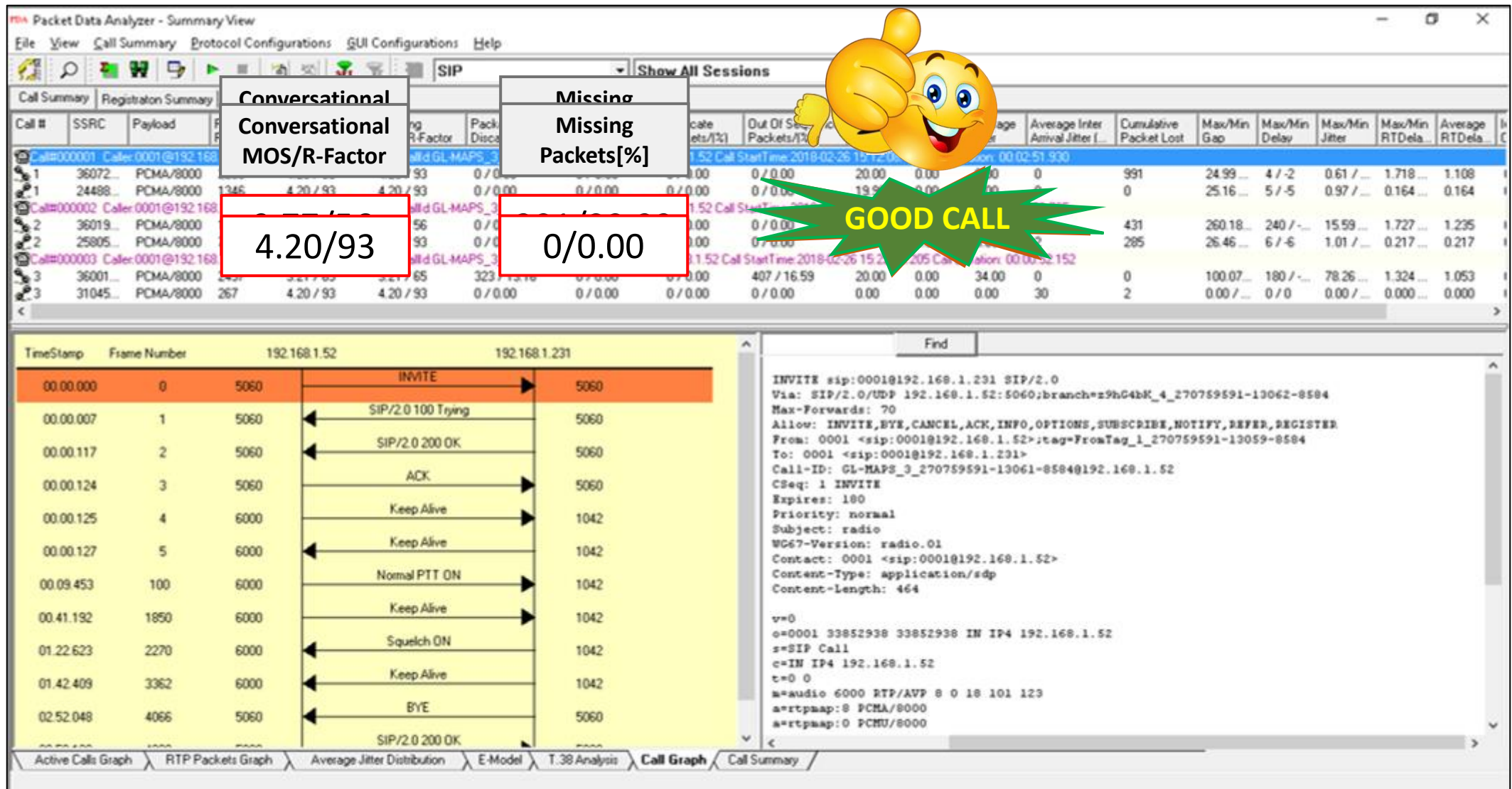
```

===== 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





# 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

GL NetSurveyorWeb

Refresh Protocol: VOIP (SIP & RTP) Type: CDR

System Status at 2024-03-13 12:23:58

Quick CDR

Air to Ground Calls

Ground to Ground Calls

Good Quality Calls

Poor Quality Calls

Fair Quality Calls

Failed Calls

All Calls

Custom CDR

CDR

Default KPIs

ED137 Reports

Basic KPIs

Config

Admin

Utilization

Quick CDR \ Air to Ground Calls

Date: 2024-03-13 Time: 00:00:00 23:59:59

Today Yesterday Last 7 Days Last 30 Days All

Refresh Show Latest

Query Execution Time: 0.39055 Seconds Sort Order: STARTTIME DESC

Trafficsumid Trafficsumid

Page Size: 20

		SI No	Trafficsumid	Call Starttime	Calling Number	Called Number	Call Success	Duration	PTT Count	Squelch Count	PTTS Count	PTTM Count	Pilot-Pilot SCT Count	Controller-Pilot SCT Count	Call Endtime	Failure Cause																																							
<input type="checkbox"/>	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																																							
<input type="checkbox"/>	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																																							
<table border="1"> <thead> <tr> <th>SSRC#</th> <th>Payload</th> <th>Total Packet Count</th> <th>Missing Packet Count/(%)</th> <th>Dupl. Packet Count/(%)</th> <th>Re-ordered Packet Count/(%)</th> <th>Packets Discarded/(%)</th> <th>Conversational MOS/R</th> <th>Listening MOS/R</th> <th>Cumulative Packet Loss</th> <th>Gap (Min/Max/Avg)</th> <th>Jitter(Min/Max/Avg)</th> <th>RTD(M)</th> </tr> </thead> <tbody> <tr> <td>1263395585</td> <td>PCMU/8000</td> <td>321</td> <td>0/0</td> <td>0/0</td> <td>0/0</td> <td>0/0</td> <td>4.2/93</td> <td>4.2/93</td> <td>0</td> <td>0.00/39.33/20.07</td> <td>0.00/1.93/58</td> <td>0.000/</td> </tr> <tr> <td>1264432897</td> <td>PCMU/8000</td> <td>190</td> <td>0/0</td> <td>0/0</td> <td>0/0</td> <td>0/0</td> <td>0/0</td> <td>0/0</td> <td>0</td> <td>0.00/21.69/20.00</td> <td>0.00/0.71/47</td> <td>0.000/</td> </tr> </tbody> </table>																	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/Avg)	Jitter(Min/Max/Avg)	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/
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/Avg)	Jitter(Min/Max/Avg)	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/																																											
<input type="checkbox"/>	Call Flow	5	223360	2024-03-13 06:47:45.465	0019	0019	0	00:00:00.000	0	0	0	0	0	0		Network Failure																																							
<input type="checkbox"/>	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																																							
<input type="checkbox"/>	Call Flow	7	223358	2024-03-13 06:47:44.946	0020	0020	0	00:00:00.000	0	0	0	0	0	0		Network Failure																																							
<input type="checkbox"/>	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																																							
<input type="checkbox"/>	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																																							
<input type="checkbox"/>	Call Flow	10	223355	2024-03-13 06:47:32.044	0020	0020	0	00:00:00.000	0	0	0	0	0	0		0																																							
<input type="checkbox"/>	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																																							
<input type="checkbox"/>	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																																							
<input type="checkbox"/>	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																																							
<input type="checkbox"/>	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																																							
<table border="1"> <thead> <tr> <th>SSRC#</th> <th>Payload</th> <th>Total Packet Count</th> <th>Missing Packet Count/(%)</th> <th>Dupl. Packet Count/(%)</th> <th>Re-ordered Packet Count/(%)</th> <th>Packets Discarded/(%)</th> <th>Conversational MOS/R</th> <th>Listening MOS/R</th> <th>Cumulative Packet Loss</th> <th>Gap (Min/Max/Avg)</th> <th>Jitter(Min/Max/Avg)</th> <th>RTD(M)</th> </tr> </thead> <tbody> <tr> <td>1263165441</td> <td>PCMA/8000</td> <td>224</td> <td>0/0</td> <td>0/0</td> <td>0/0</td> <td>0/0</td> <td>4.2/93</td> <td>4.2/93</td> <td>0</td> <td>0.00/0.00/0.00</td> <td>0.00/0.00/0</td> <td>0.802/</td> </tr> <tr> <td>1261130753</td> <td>PCMA/8000</td> <td>258</td> <td>0/0</td> <td>0/0</td> <td>0/0</td> <td>0/0</td> <td>4.2/93</td> <td>4.2/93</td> <td>0</td> <td>0.00/21.39/20.00</td> <td>0.00/0.66/42</td> <td>0.000/</td> </tr> </tbody> </table>																	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/Avg)	Jitter(Min/Max/Avg)	RTD(M)	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/
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/Avg)	Jitter(Min/Max/Avg)	RTD(M)																																											
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/																																											
<input type="checkbox"/>	Call Flow	15	223350	2024-03-13 06:47:20.011	0019	0019	0	00:00:00.000	0	0	0	0	0	0		0																																							



# NetSurveyorWeb™ – Call Detail View

GL NetSurveyorWeb

Protocol VOIP (SIP & RTP)Type CDR

gl

Quick CDR

Air to Ground Calls

Ground to Ground Calls

Good Quality Calls

Poor Quality Calls

Fair Quality Calls

Failed Calls

All Calls

Custom CDR

CDR

Default KPIs

ED 137 Reports

Basic KPIs

Config

Admin

Utilization

Data

Reports

Alarms

Users

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

Quick CDR \ Air to Ground Calls

Go Back

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

Complete Stack

Download Decode

===== 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: Quick Search

Ex.Value1,Value2

Apply

Clear

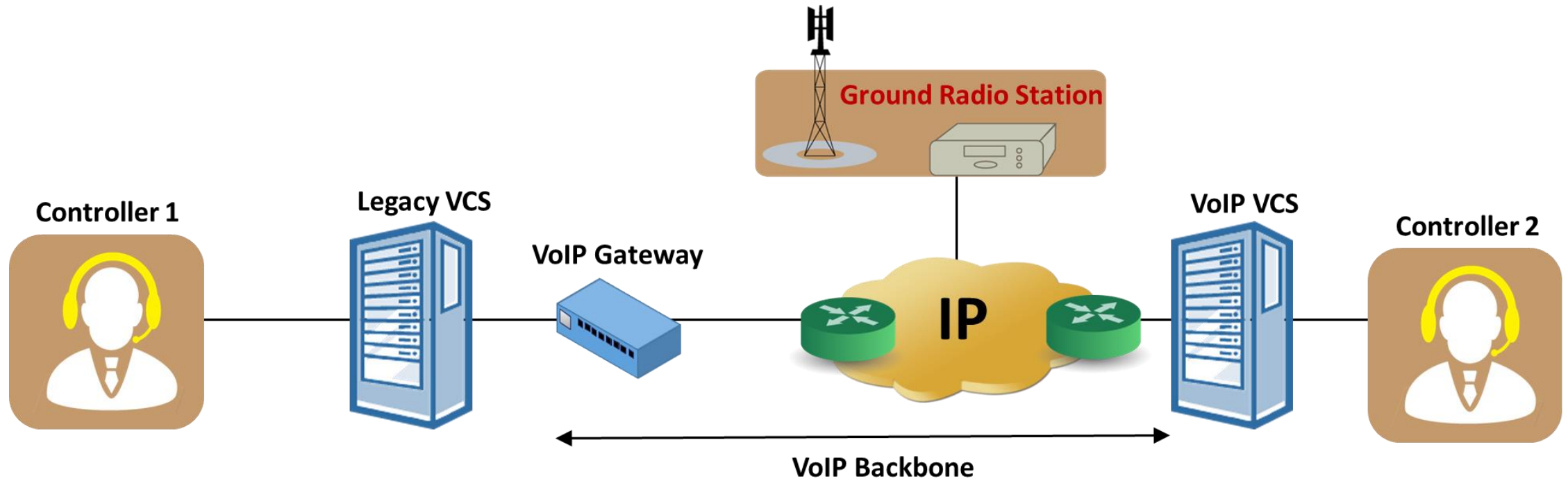
Time Stamp	Packet Type	Frame Length	Source IP	Destination IP	Event Type	PTT Type	PTT Id	Conversational Mos	Missing Packet Count	Packet Discarded	Reordeced Packet Count	Duplicate Packet Count
2024-03-14 17:14:35.261	SIP	1026	192.168.15.14	192.168.15.34	INVITE							
2024-03-14 17:14:35.602	SIP	406	192.168.15.34	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

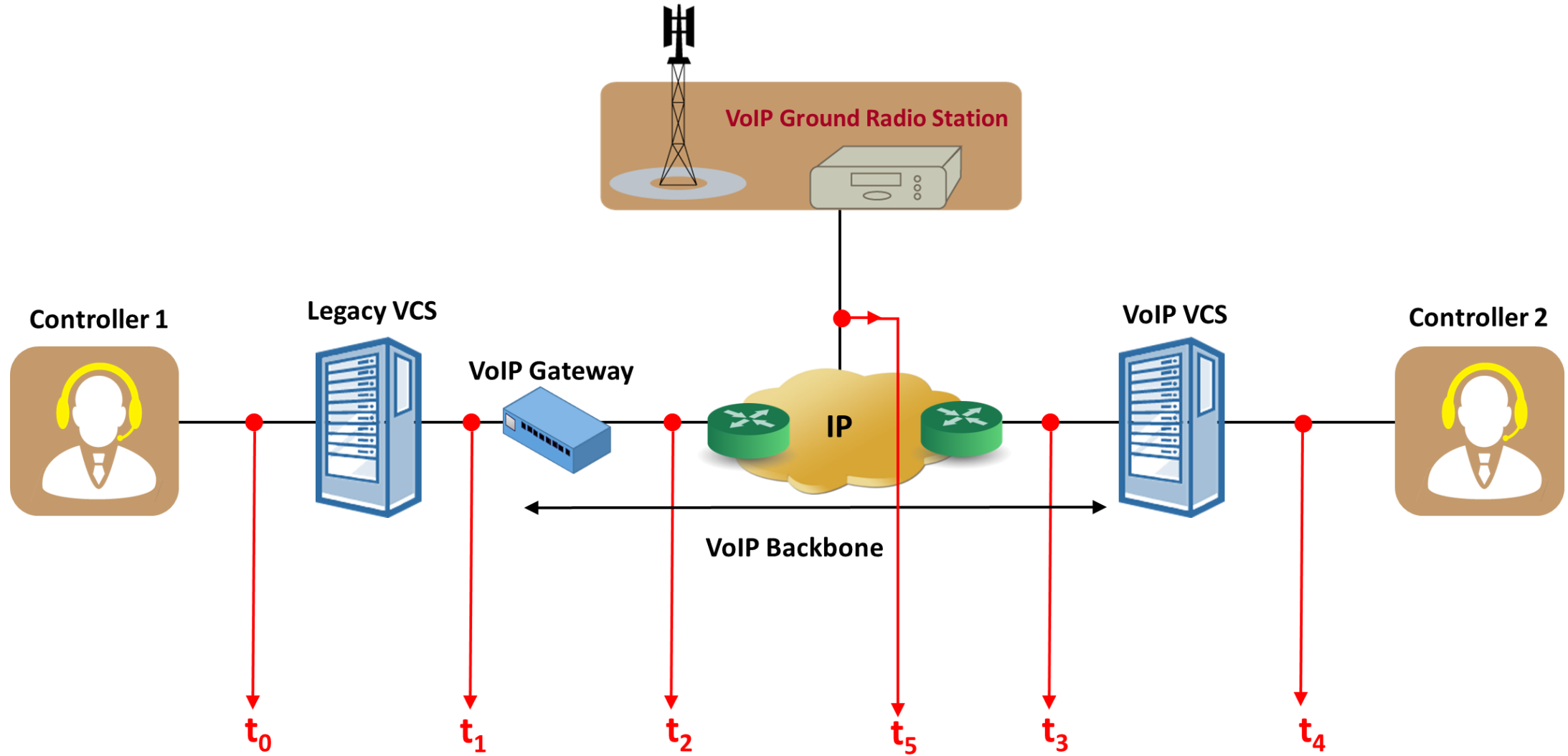


# GL's Critical Delay and Voice Quality Measurement in Air Traffic Management (ED-138)

# Critical Time Delay Measurements



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

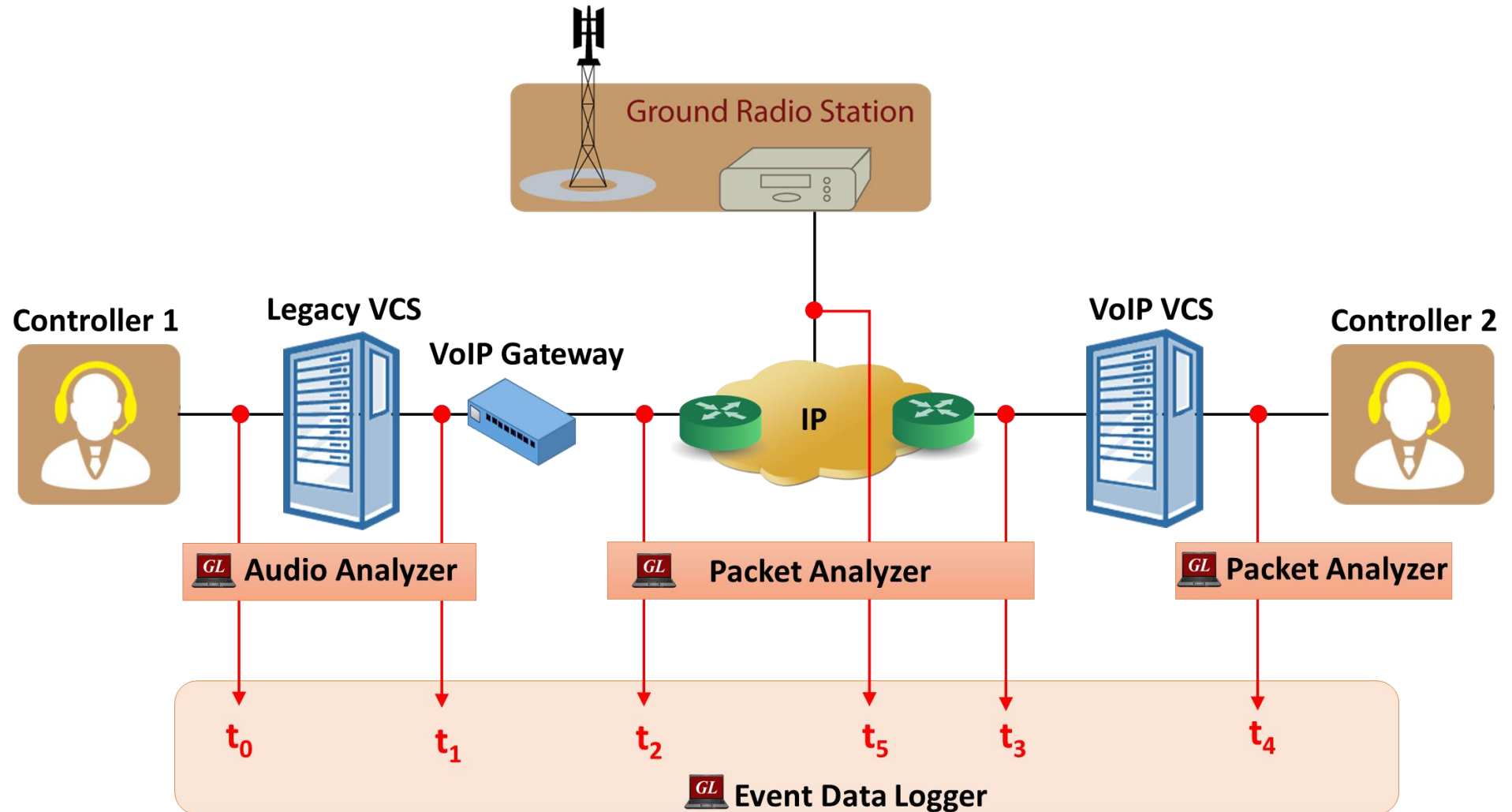


# Important Events to Measure in ATM Network

- 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

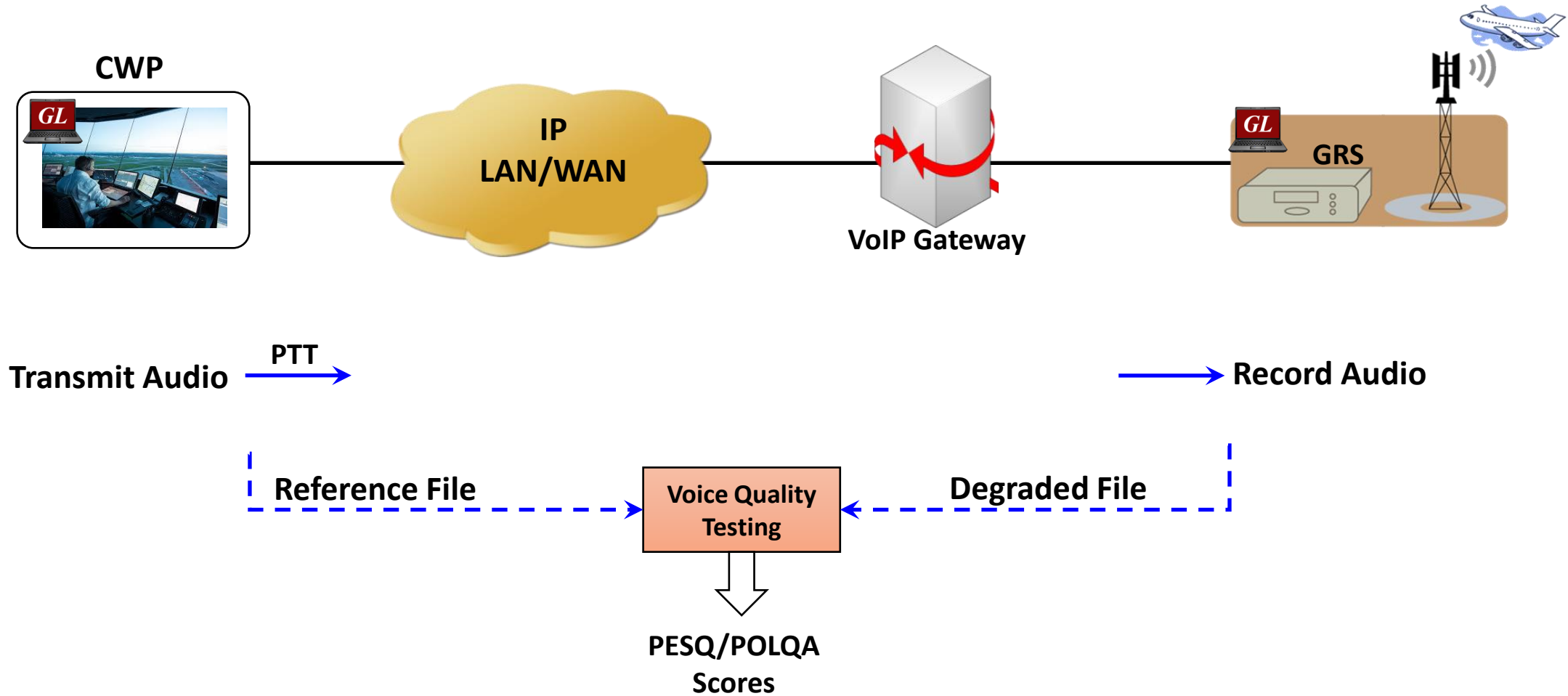
GL meets all critical specifications for ATM Delay and Voice Quality measurements





# 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



**Central System for Delay and Voice Quality Measurements**

## **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 + MAPS™ ED137 Radio**

## **Packet Analyzer**

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



**Audio Analyzer**

## **MAPS™ 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

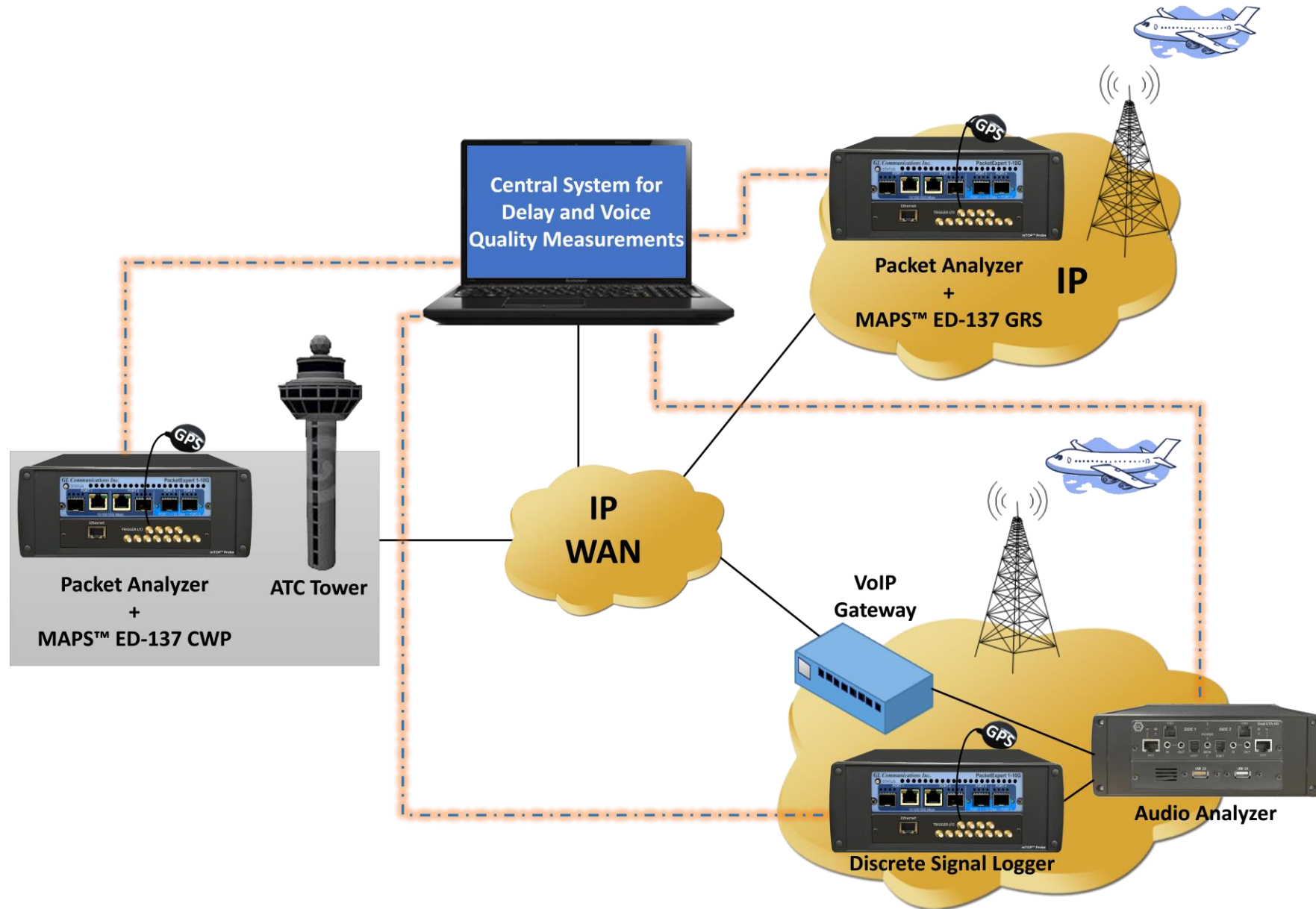


**Discrete Signal Logger**

## **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