Test Solutions for Air Traffic Management

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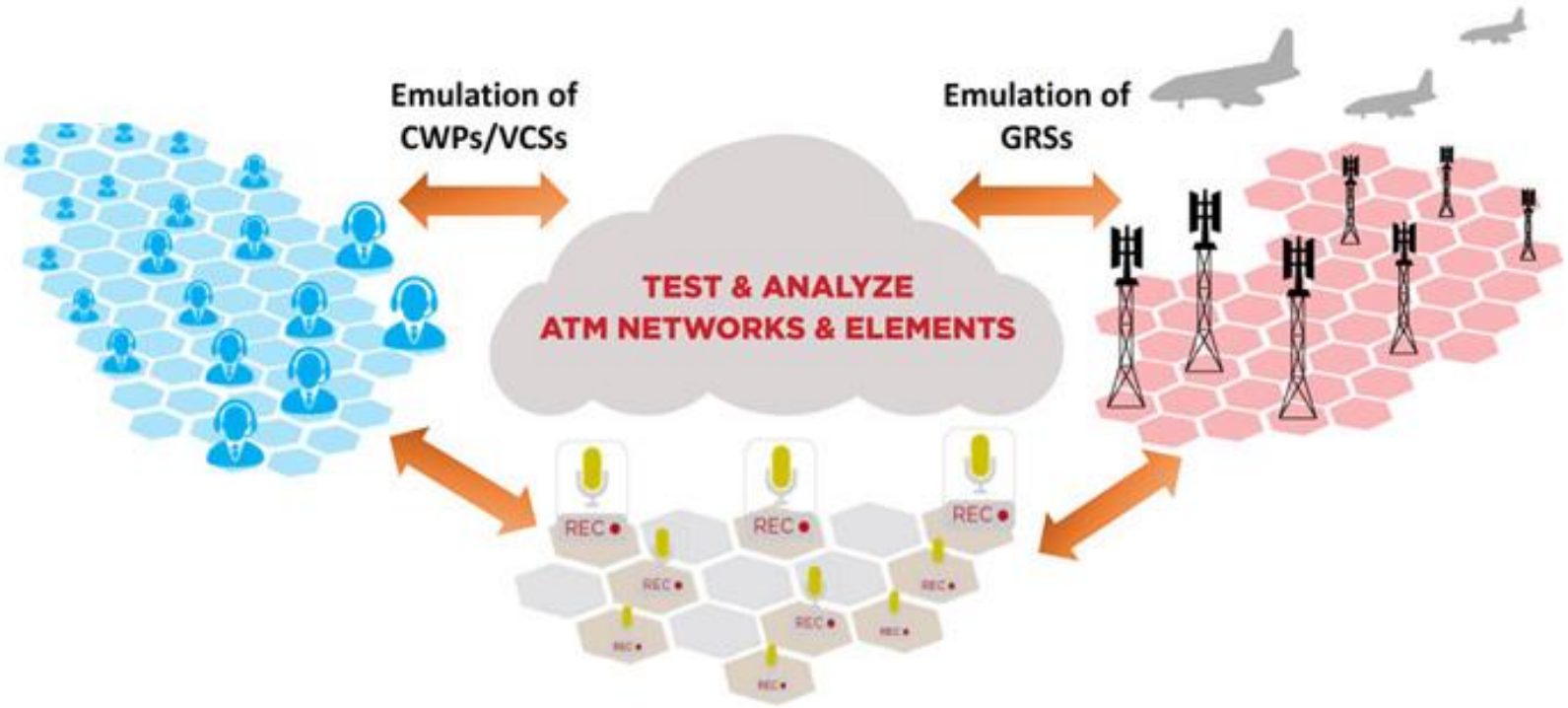
Overview



- ED137 B & C Compliant
- VOTER Validated
- ED138 Monitoring System
- Critical Delay Measurement
- Voice Quality Testing

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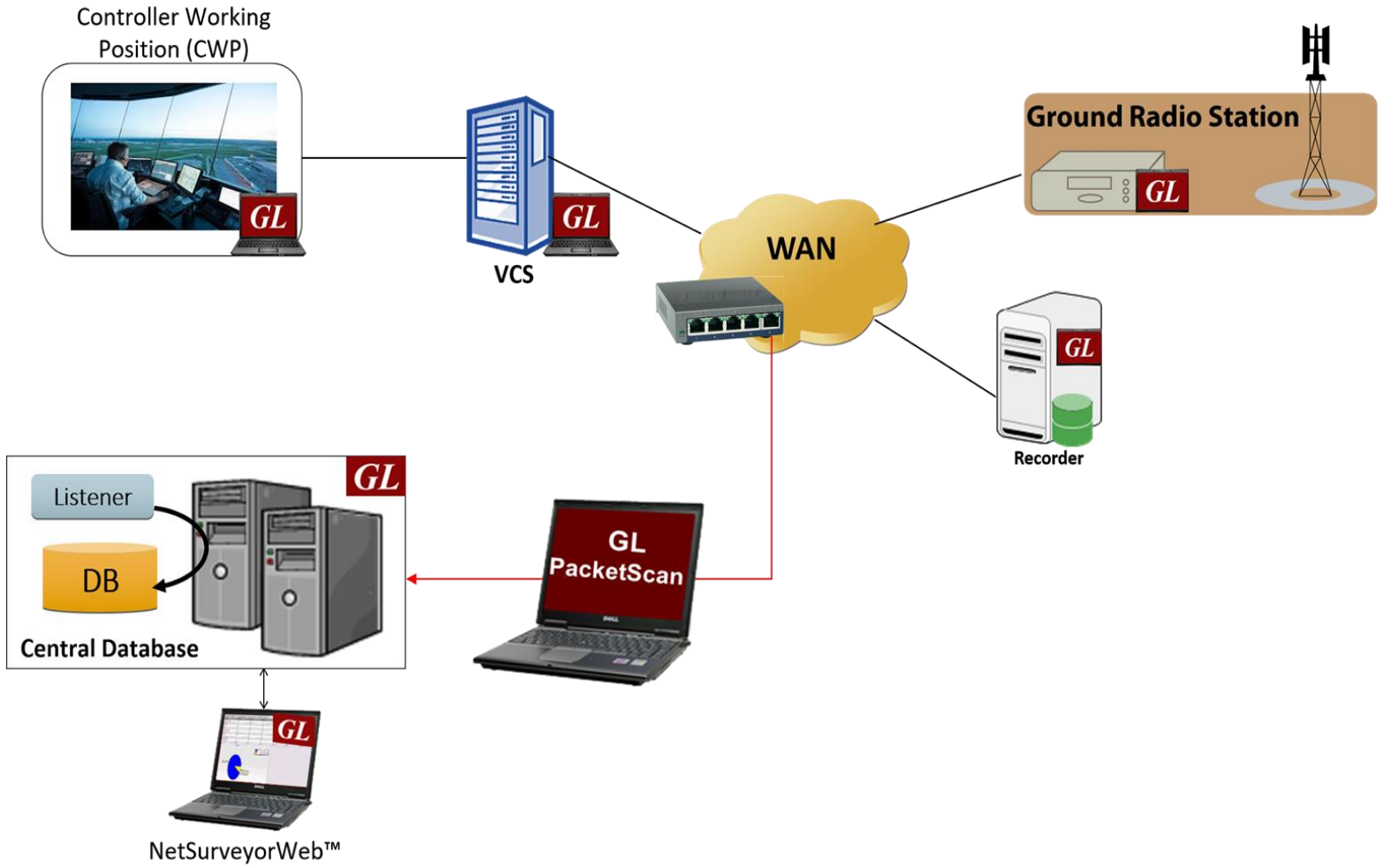
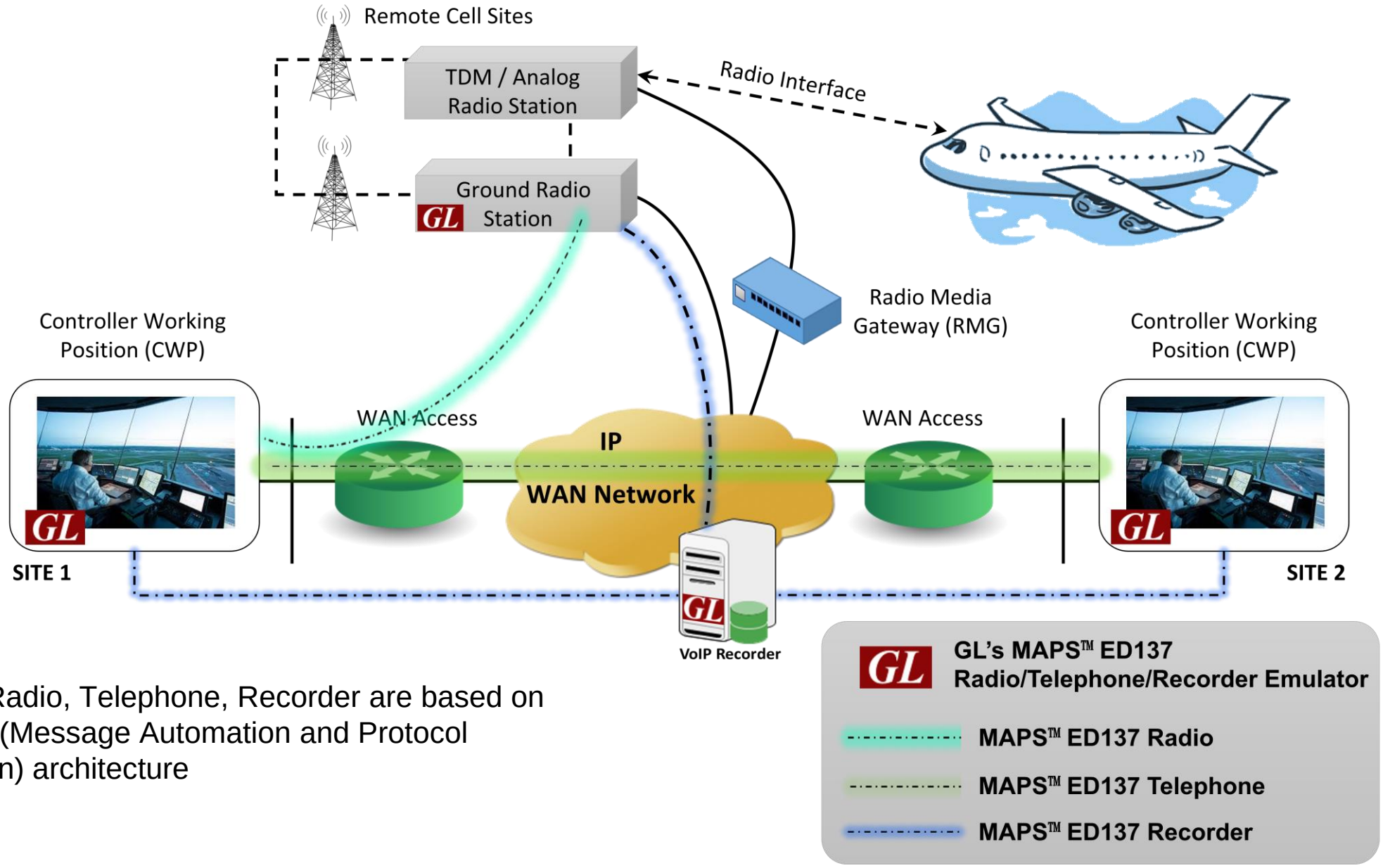
GL's ATM Test Solutions Overview

- **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

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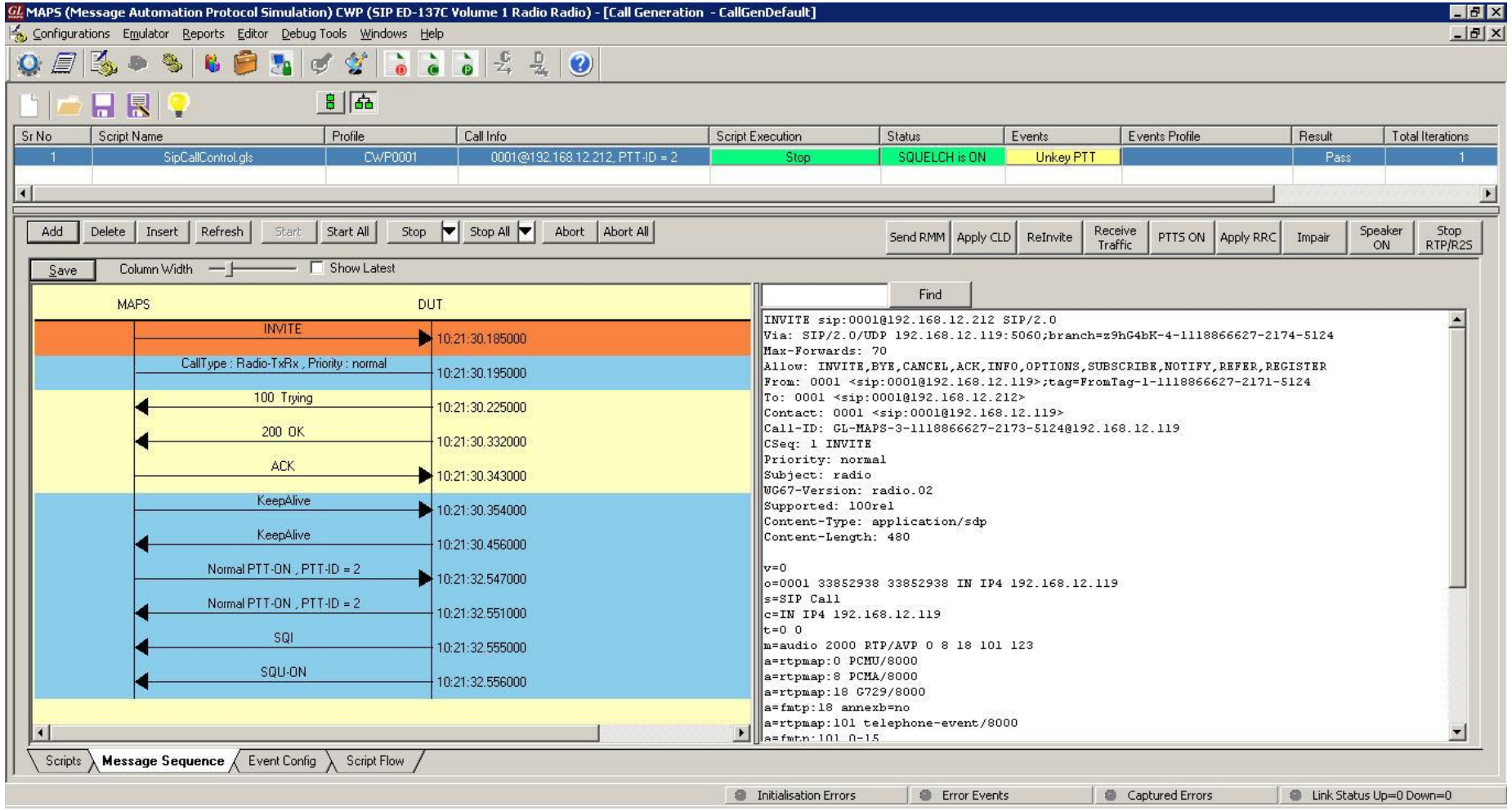
MAPS™ ED-137 Radio Emulator

- 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



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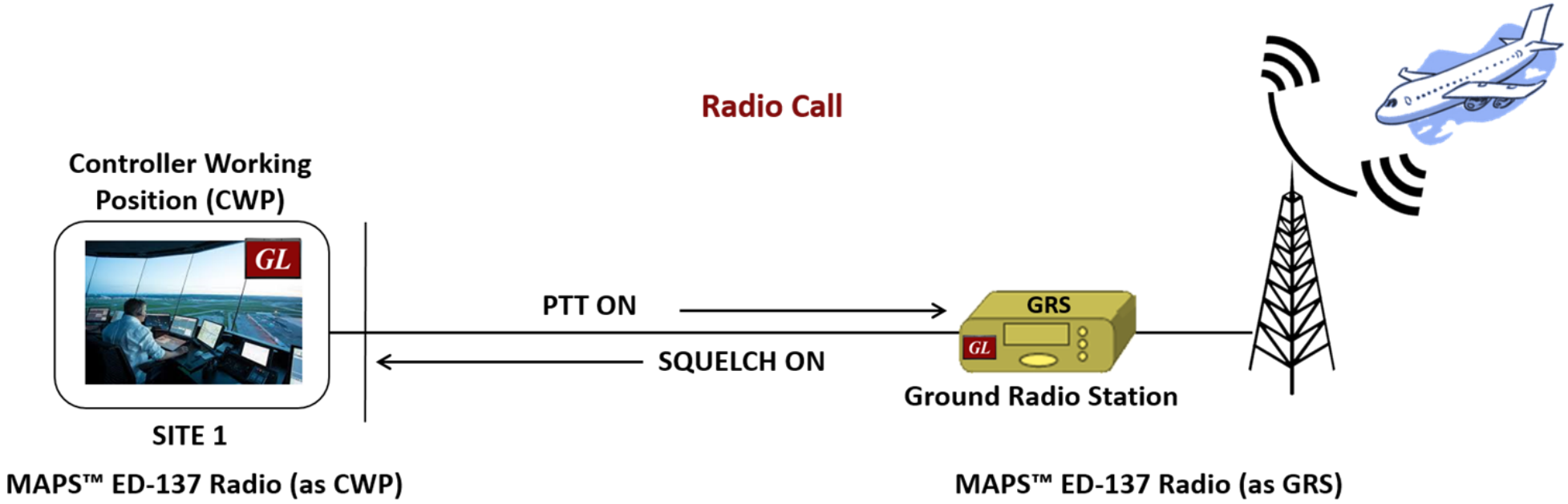
MAPS™ ED-137 Radio Emulator Highlights



- 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

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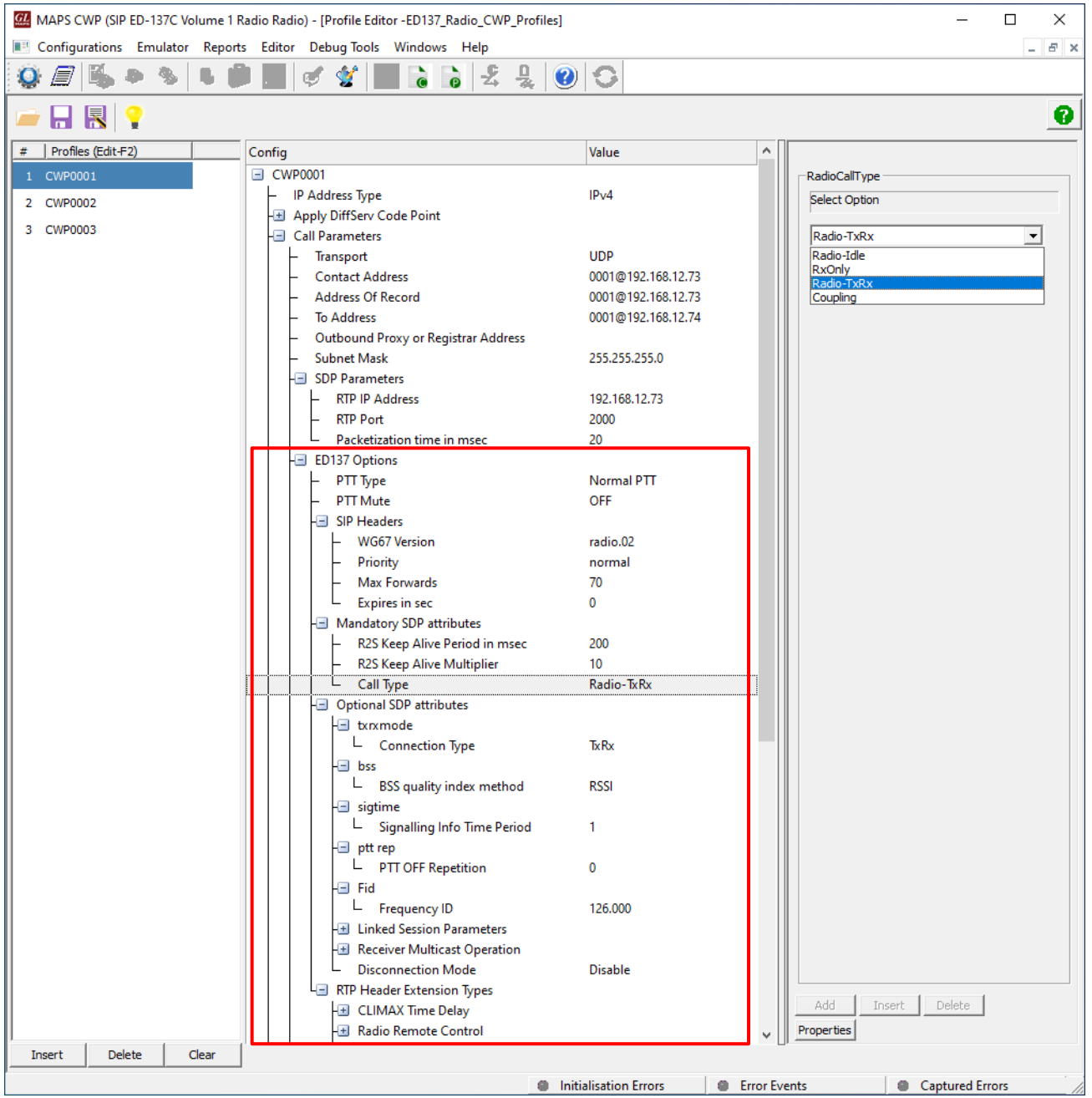
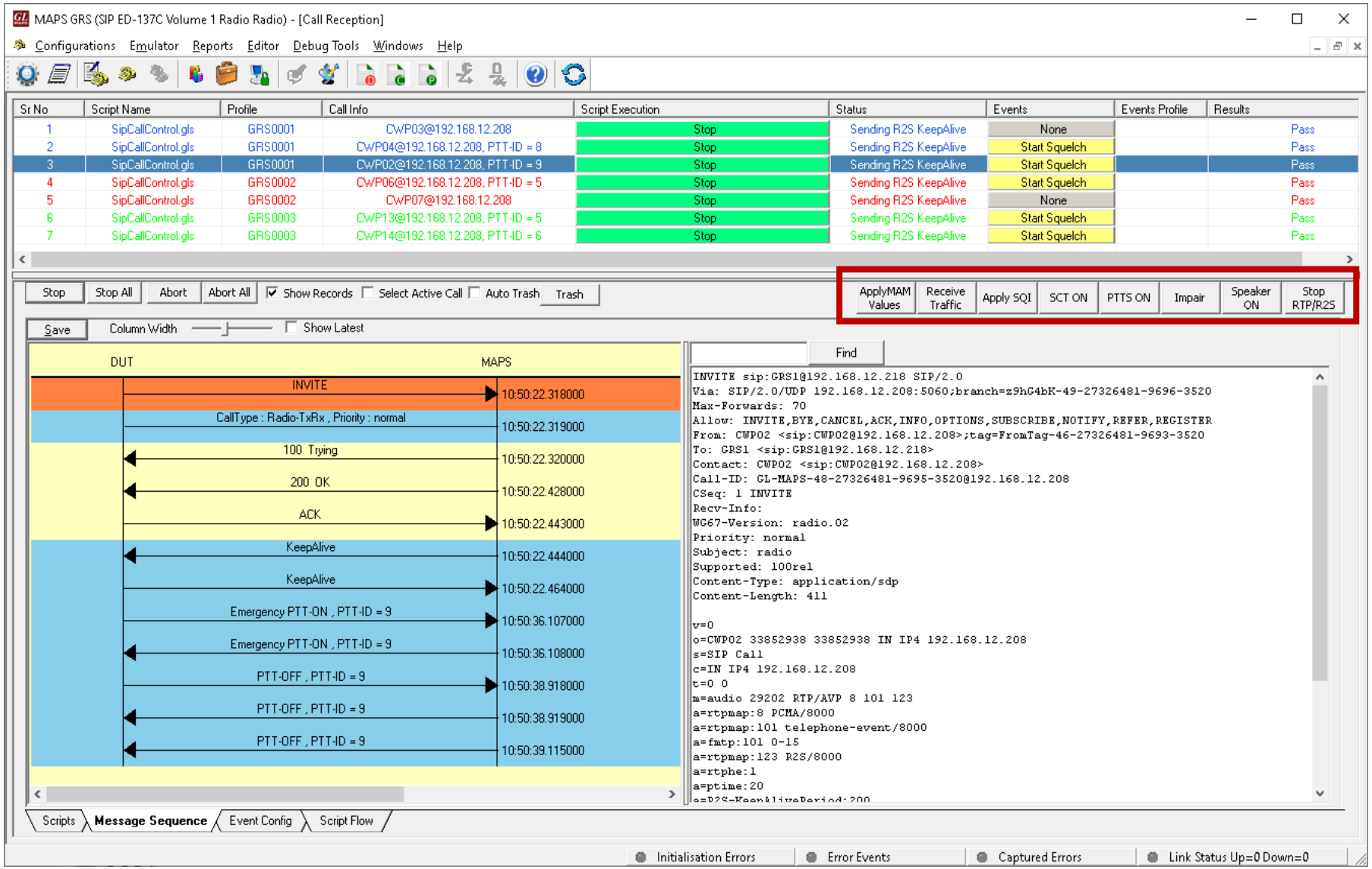
MAPS™ ED-137 Radio Emulator – Profiles

- 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

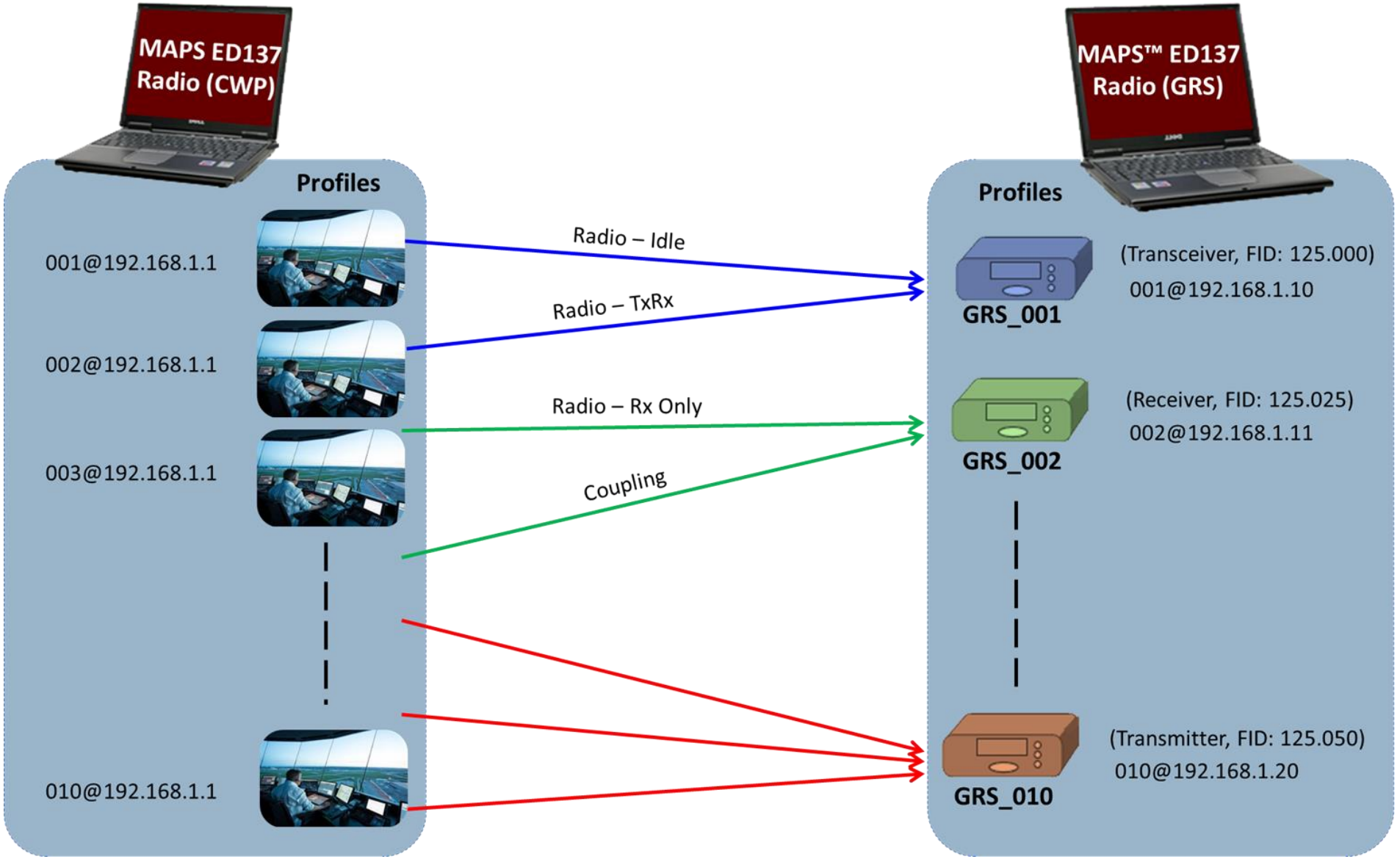


MAPS™ ED-137 Radio Emulator – Call Reception

- 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)



Multiple Controller and Radio Simulation



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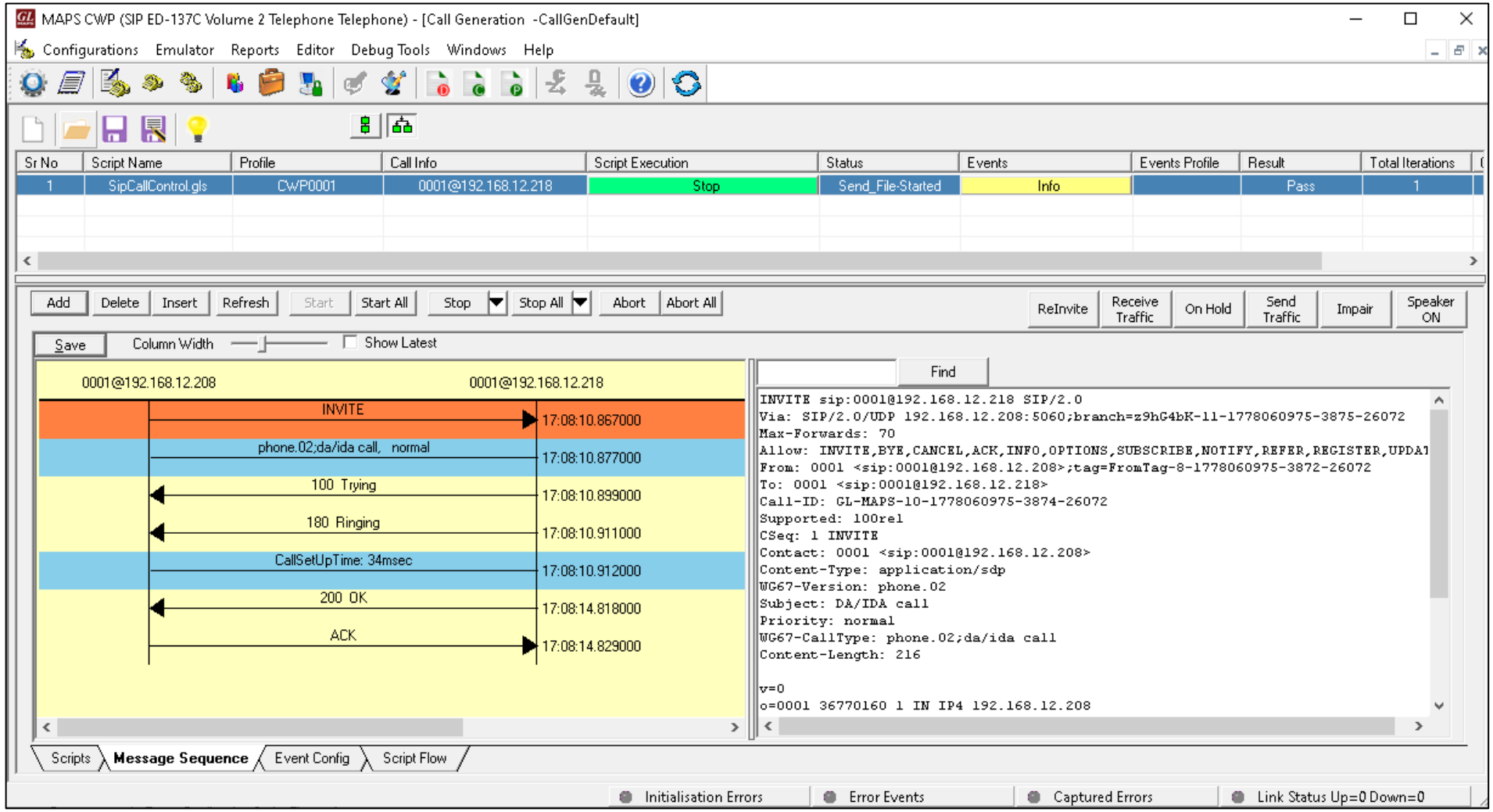
ED-137/1C Features in MAPS™ ED-137 Radio Emulator

- 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



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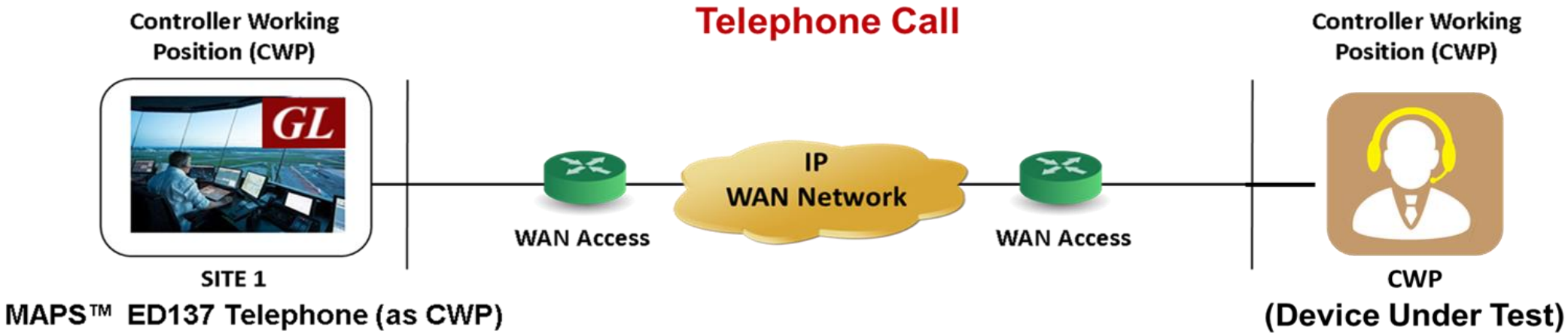
MAPS™ ED-137 Telephone Emulator Highlights



- 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

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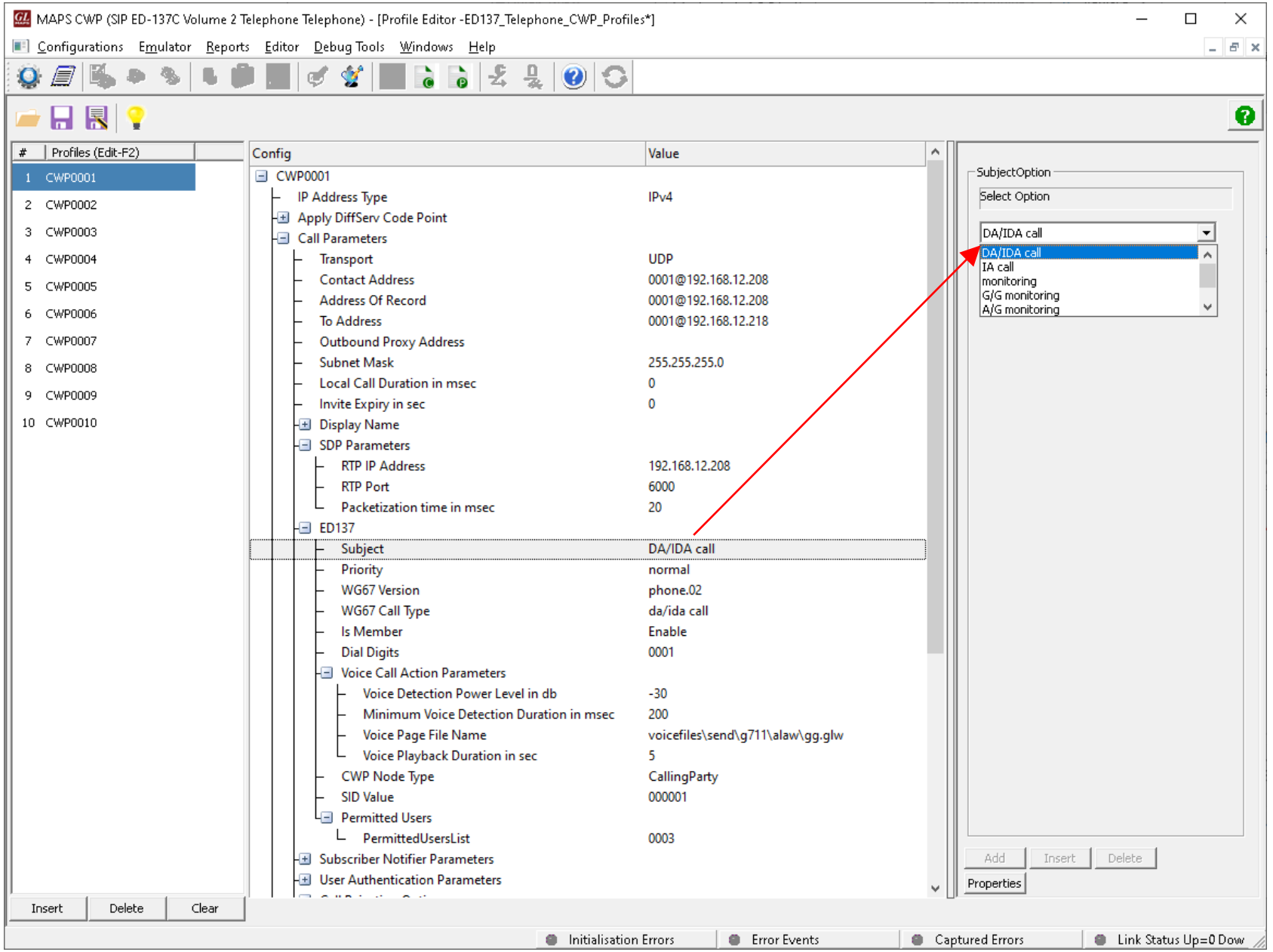
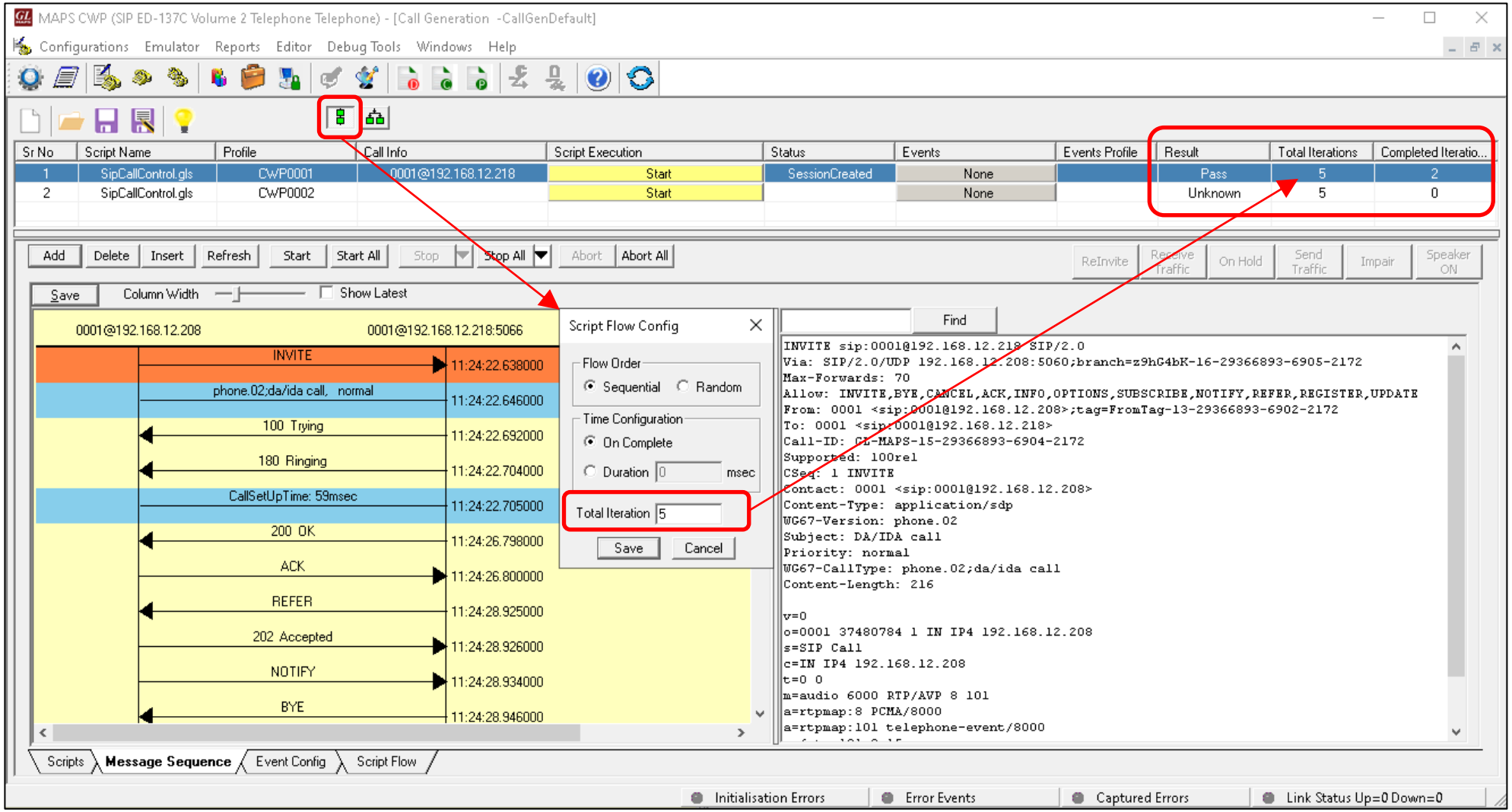
MAPS™ ED-137 Telephone Emulator – CWP Profiles

- 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



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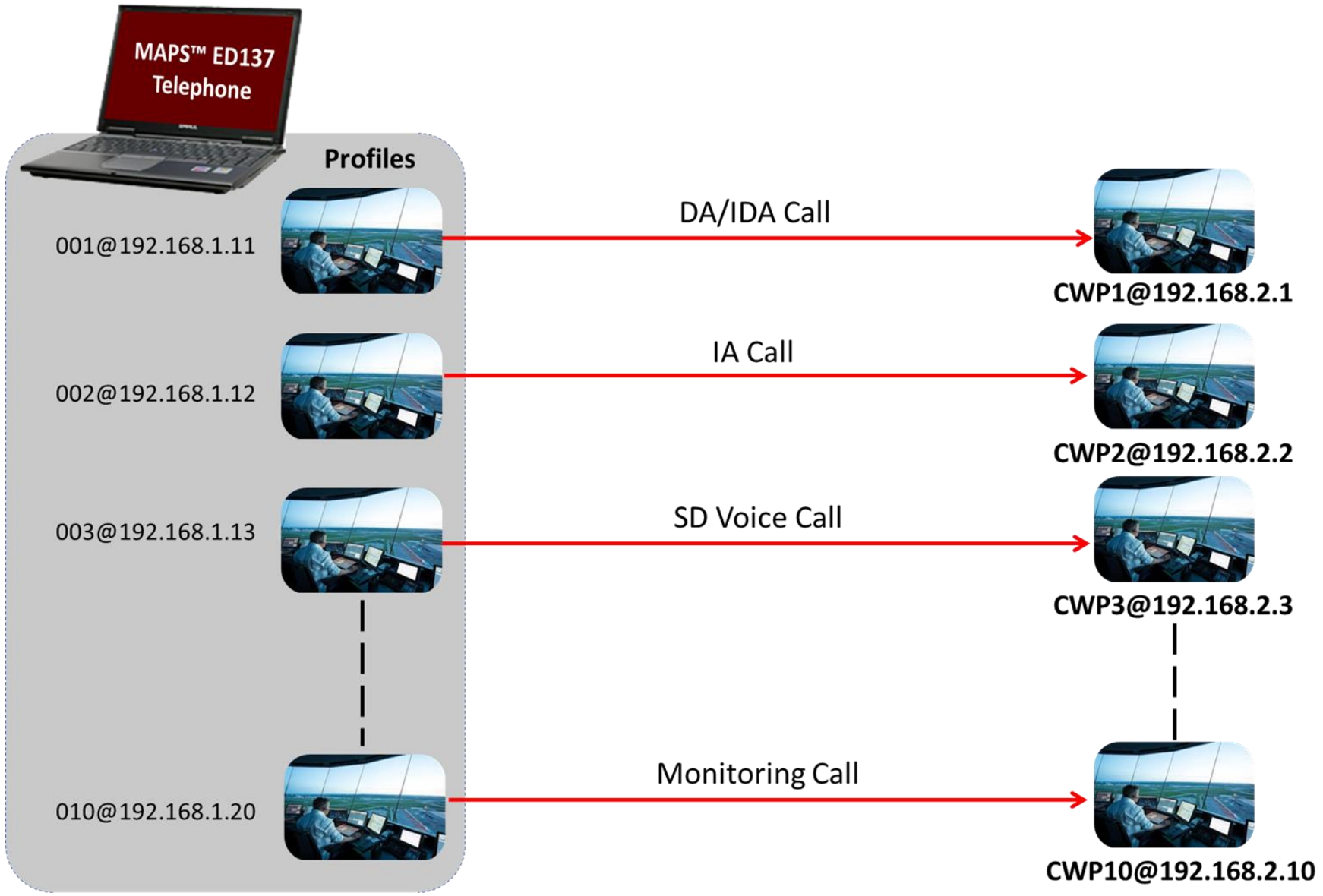
Multiple Controllers Simulation



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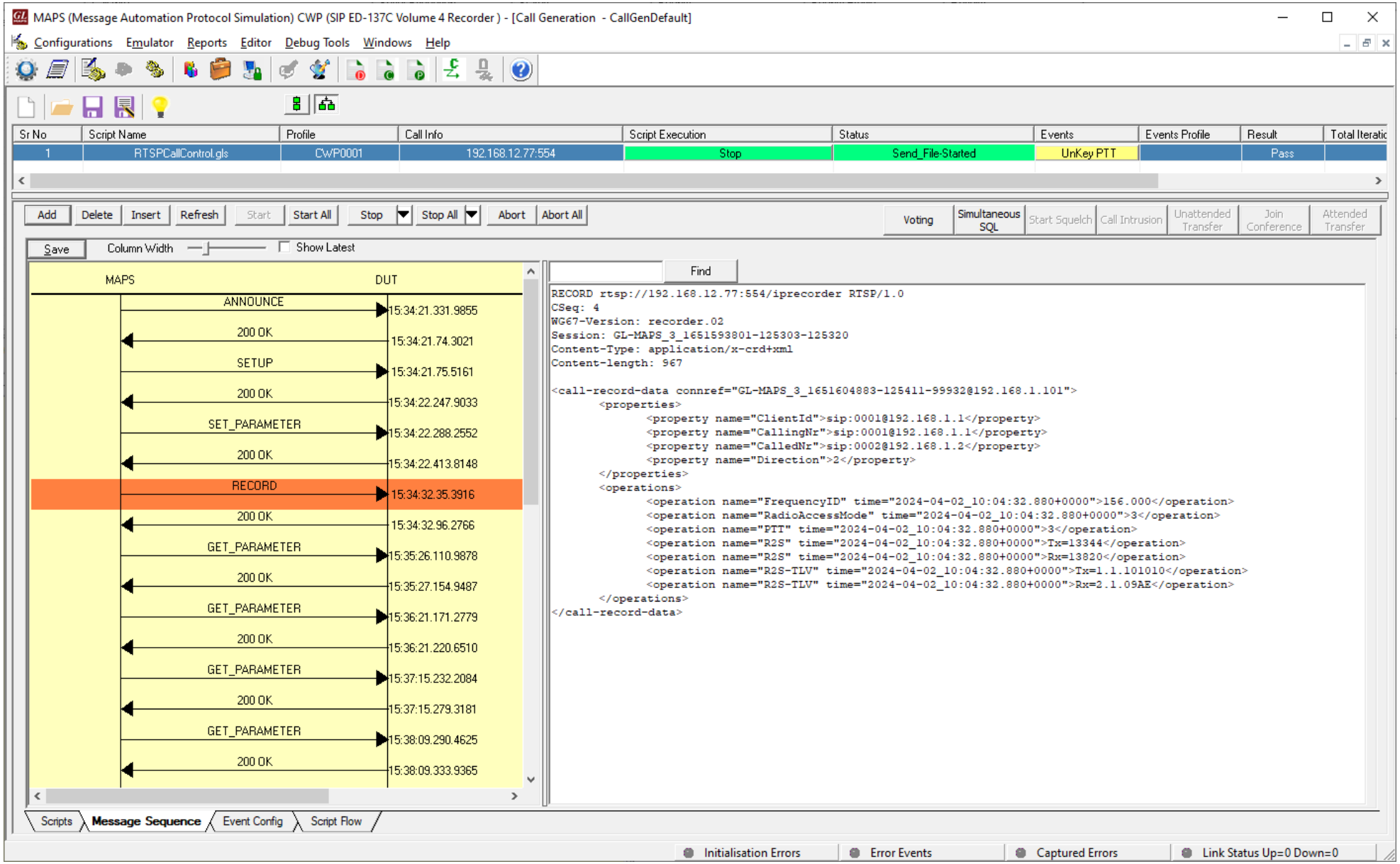
MAPS™ ED-137 Recorder Emulator

- 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.



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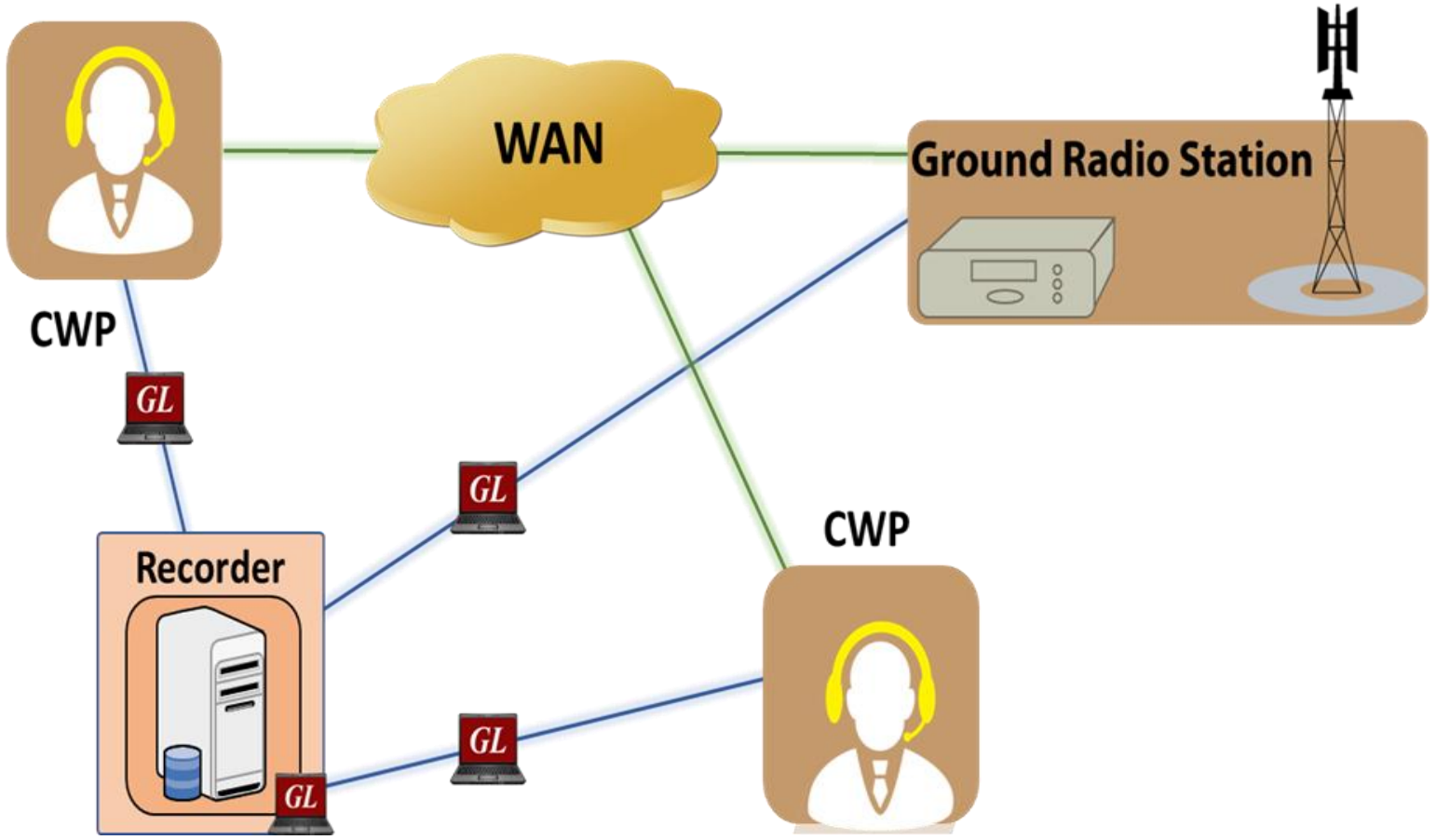
MAPS™ ED-137 Recorder Emulator Highlights

- 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



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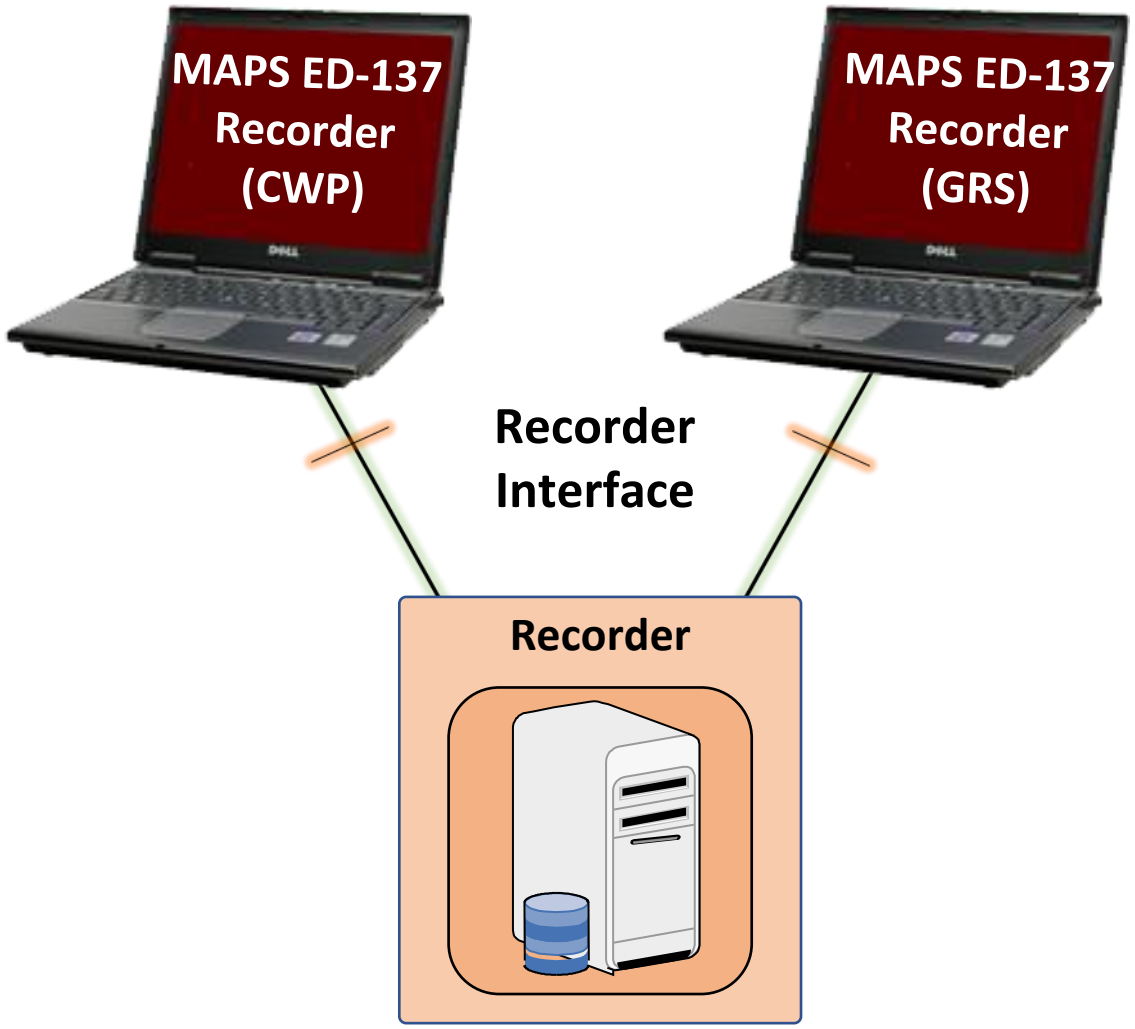
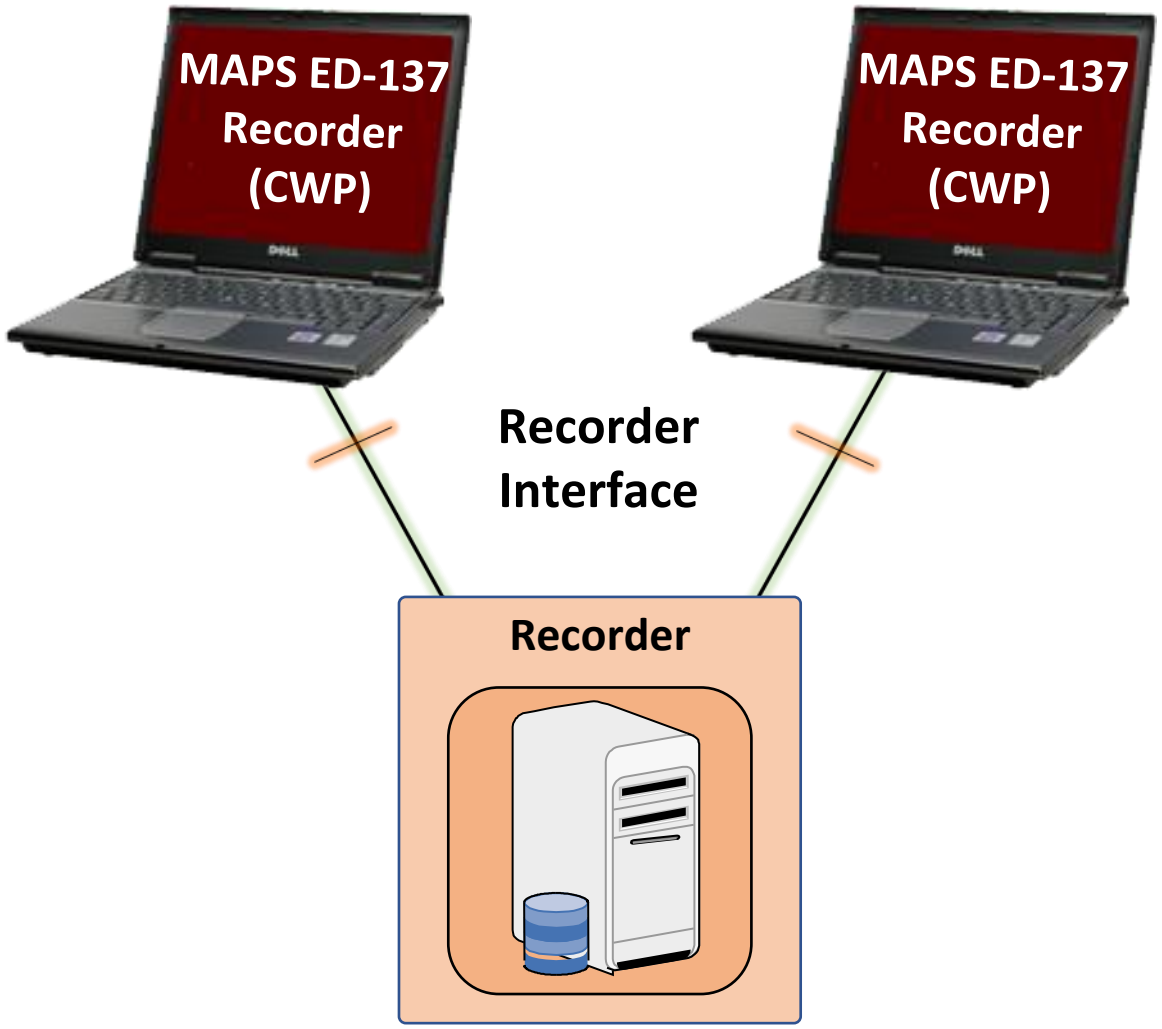
MAPS™ ED-137 Recorder Use Cases

CASE 1: Simulate AG call recording towards Recorder



Recorder (Device Under Test)

CASE 2: Simulate GG call recording towards Recorder



Recorder (Device Under Test)

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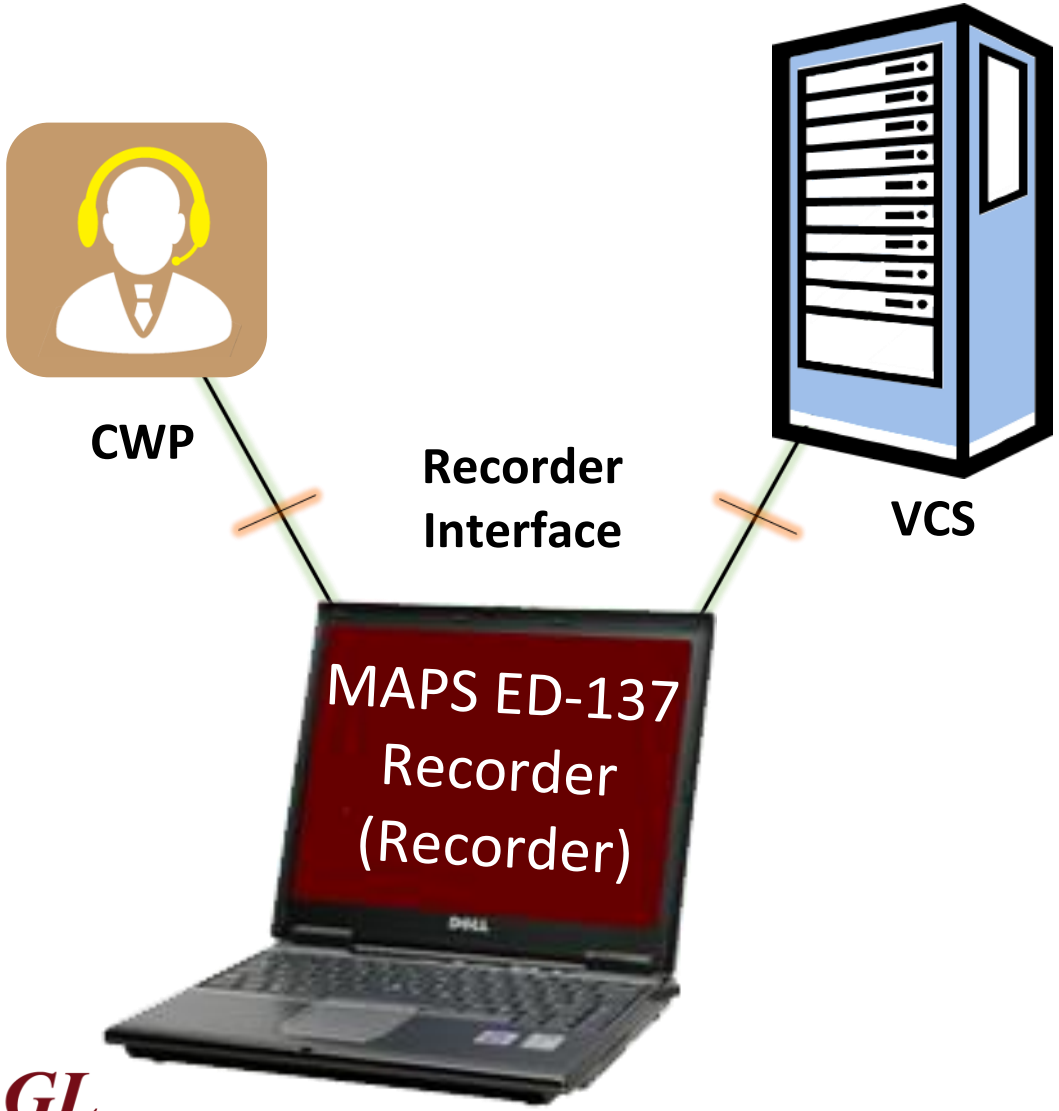
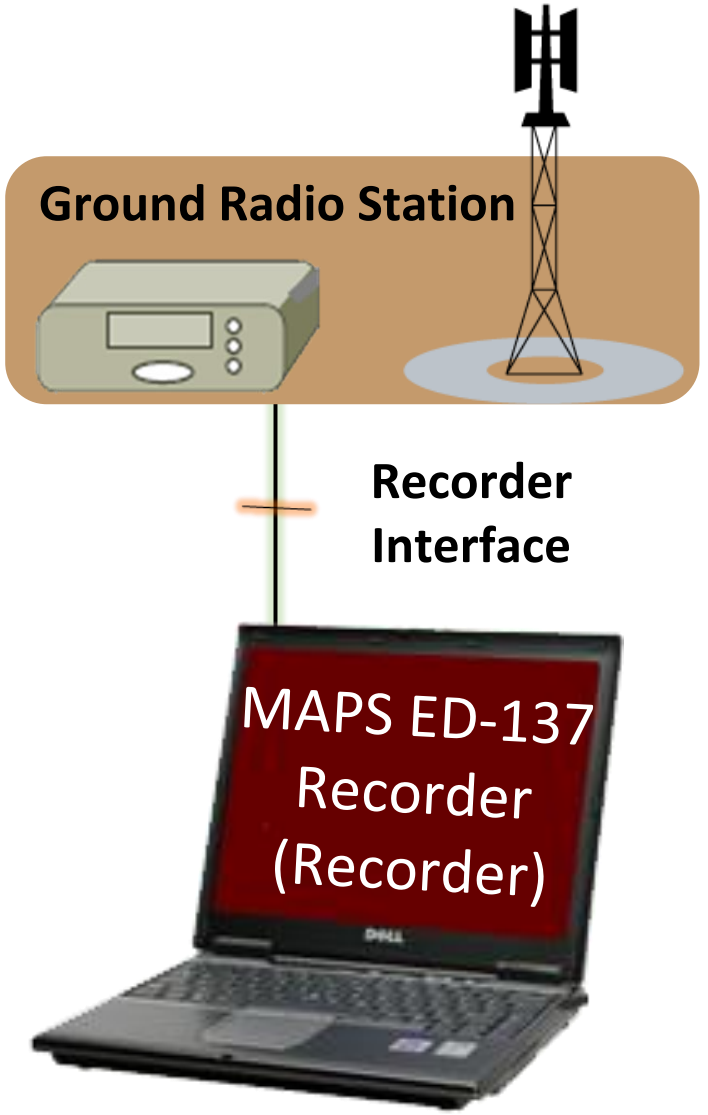
MAPS™ ED-137 Recorder Use Cases

CASE 3: Testing Recorder interface of CWP/VCS



CASE 4: Testing Recorder interface of GRS



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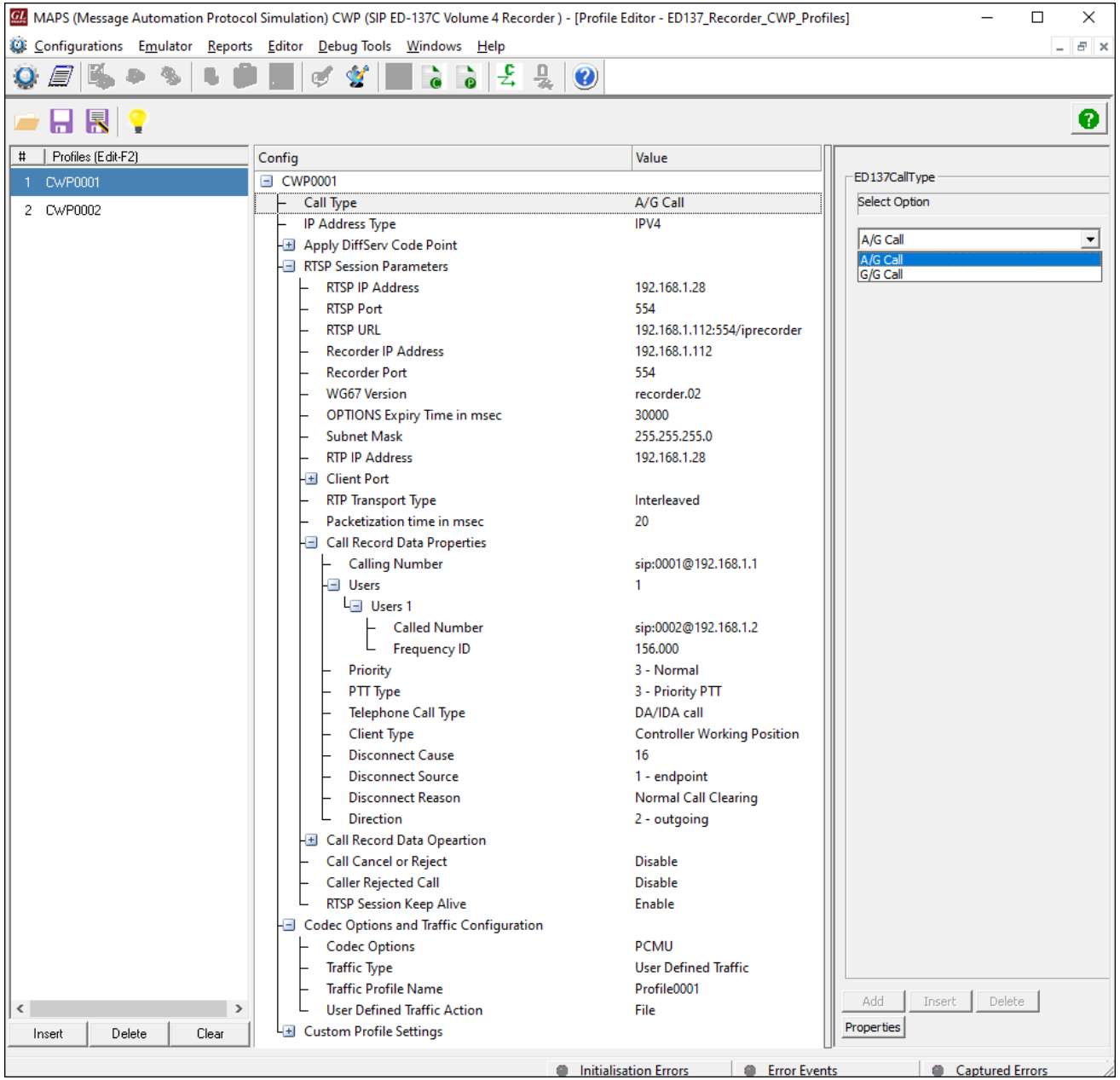
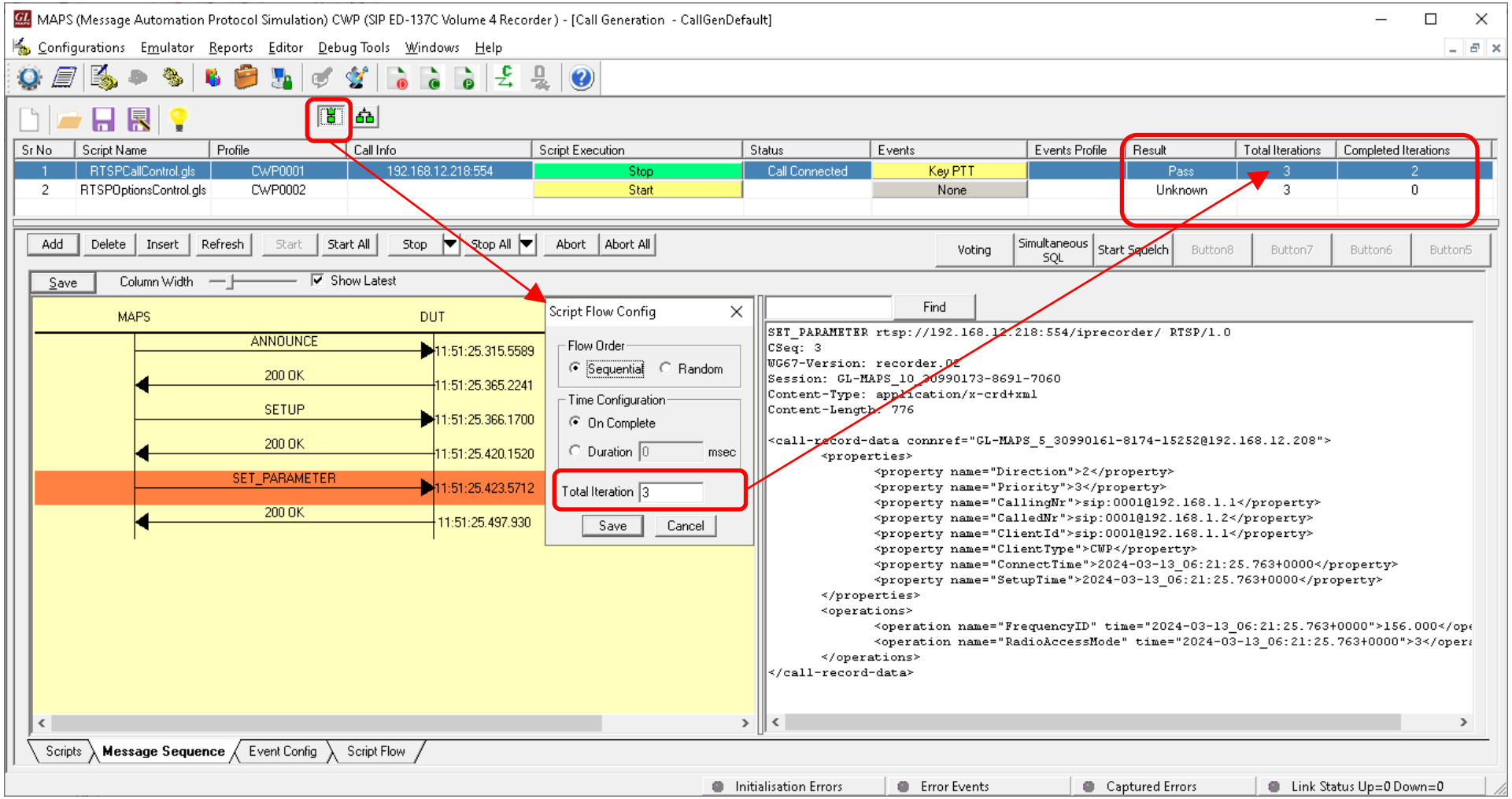
MAPS™ ED-137 Recorder Emulator Highlights

- 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



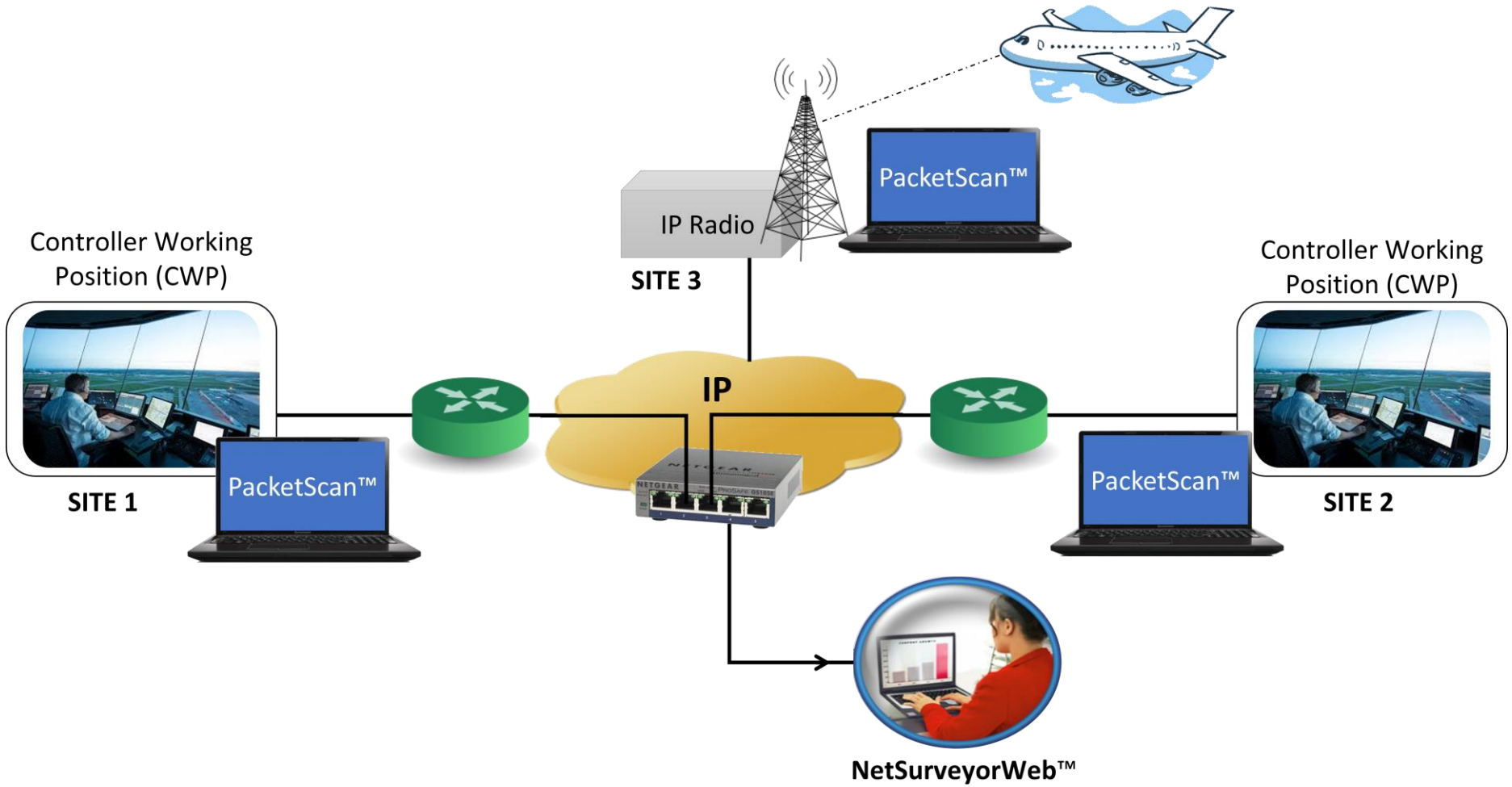
Key Updates

- 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



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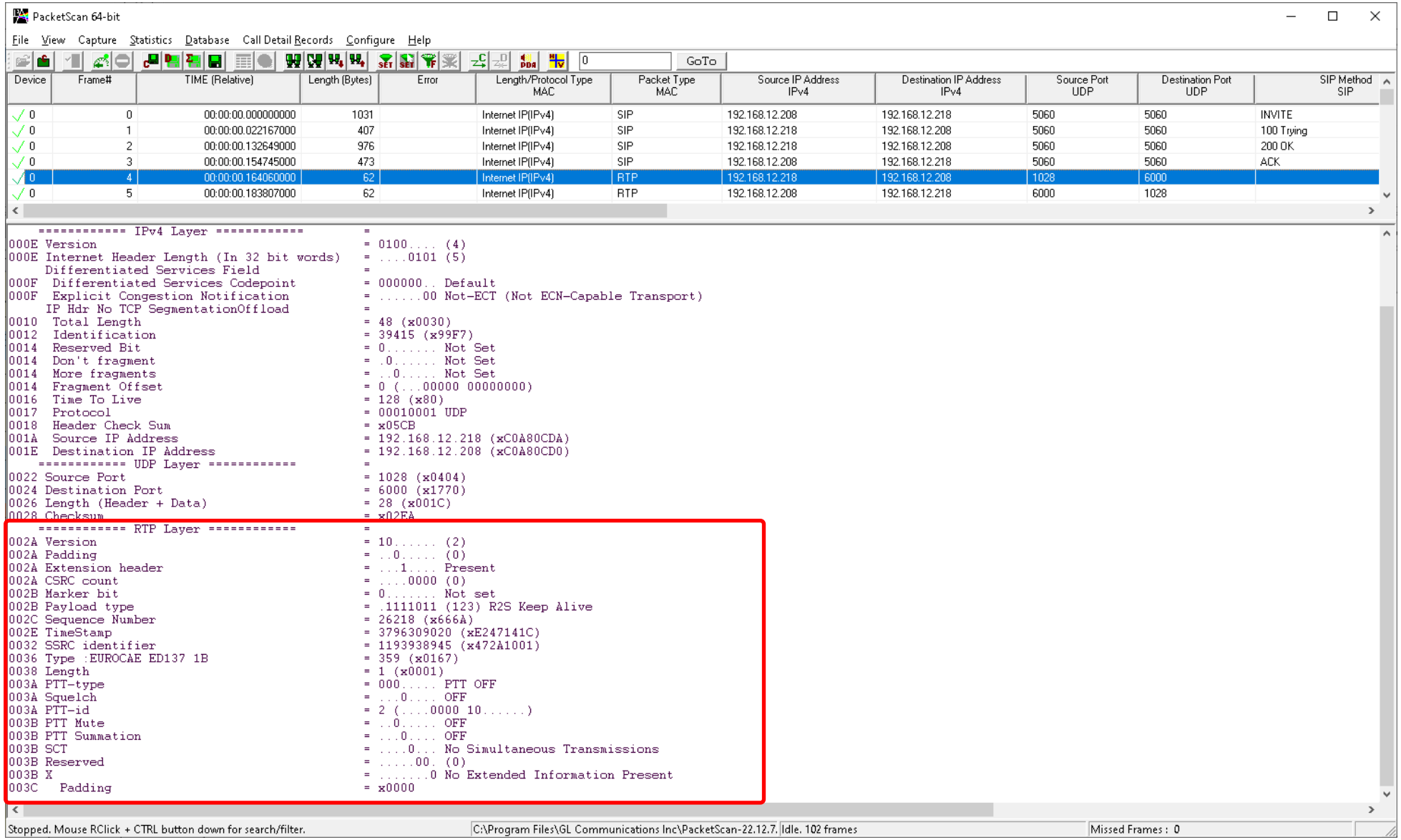
PacketScan™: Protocol Analysis Software

- 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)



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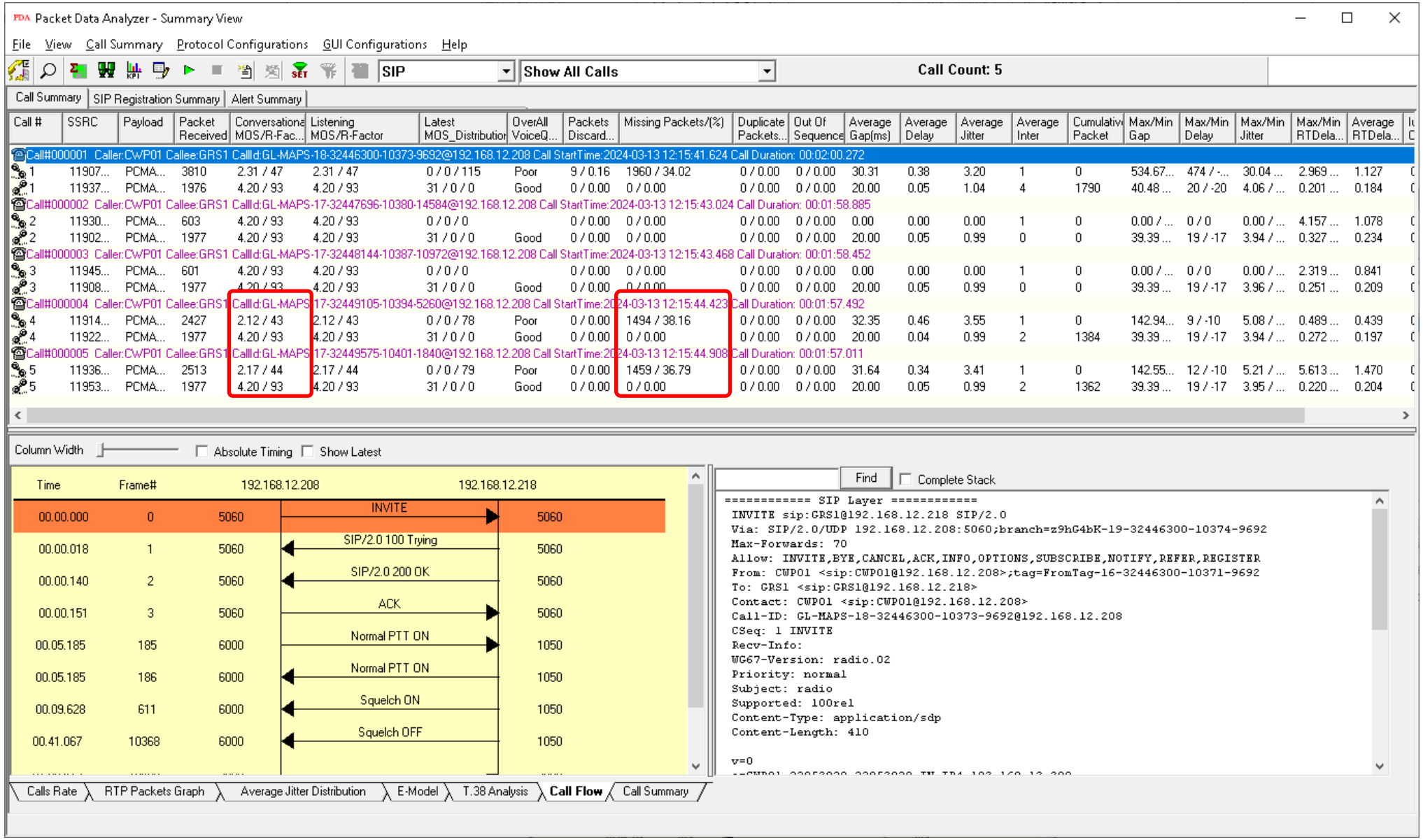
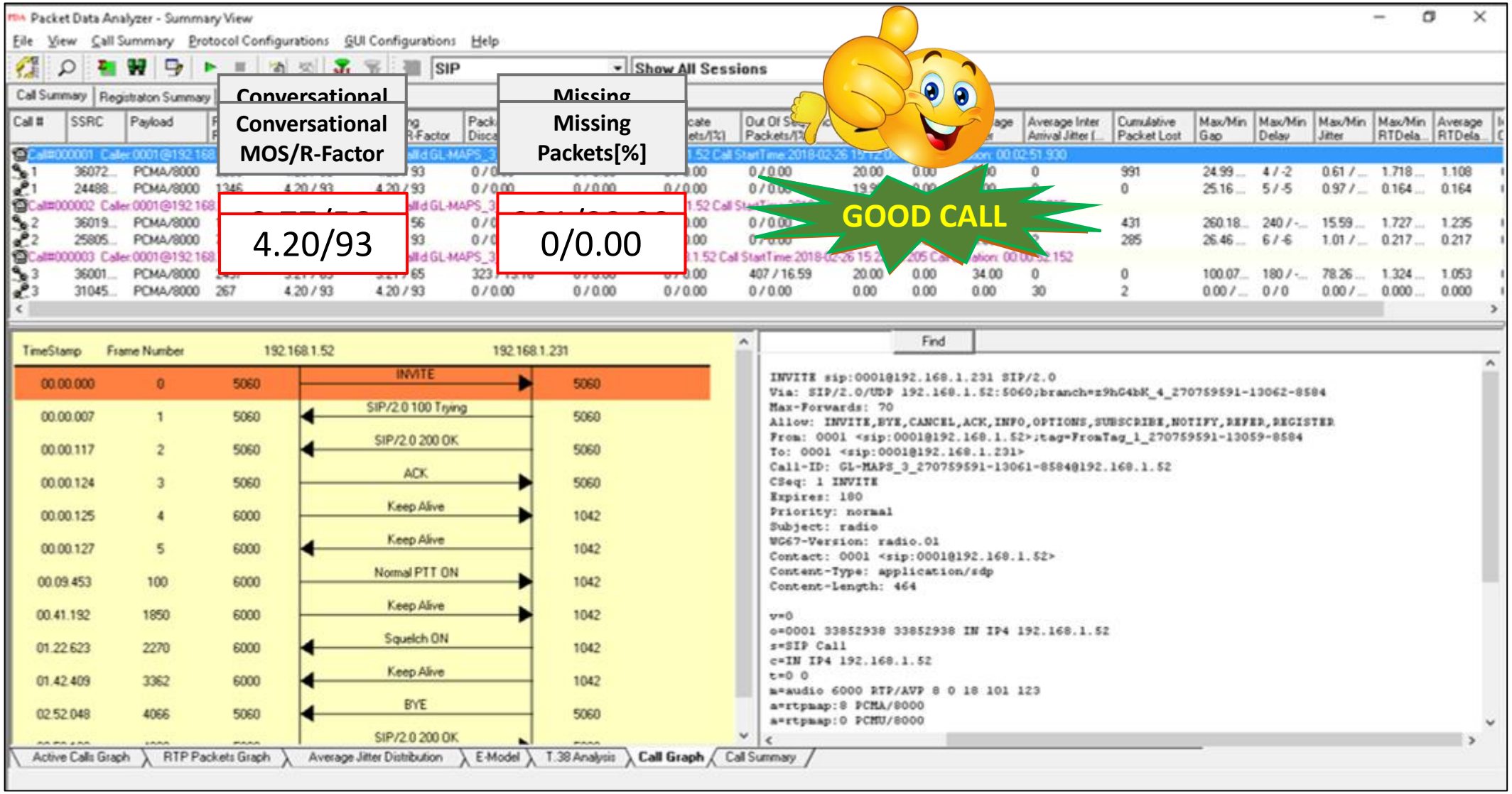
PacketScan™ Software – Call Summary

- 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

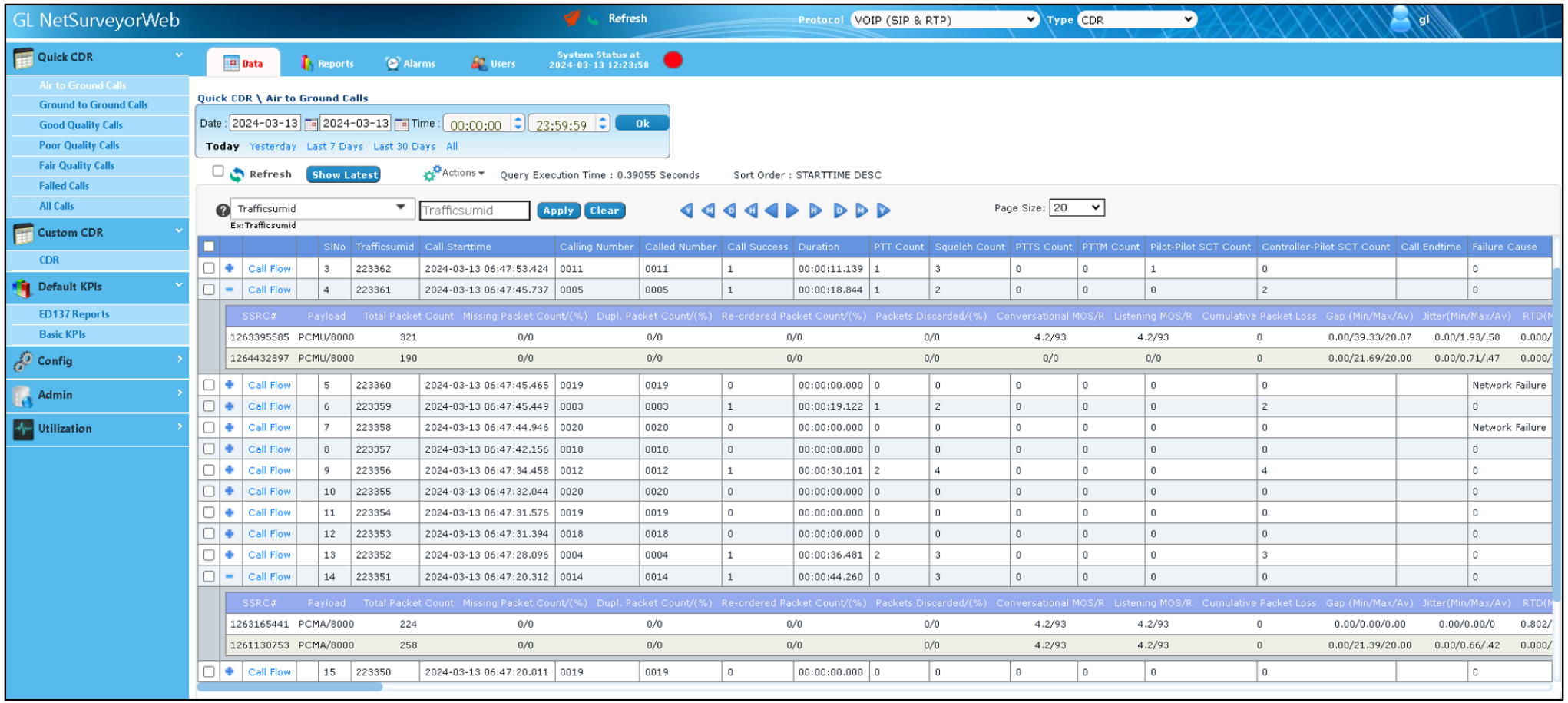


Good Call and Bad Call

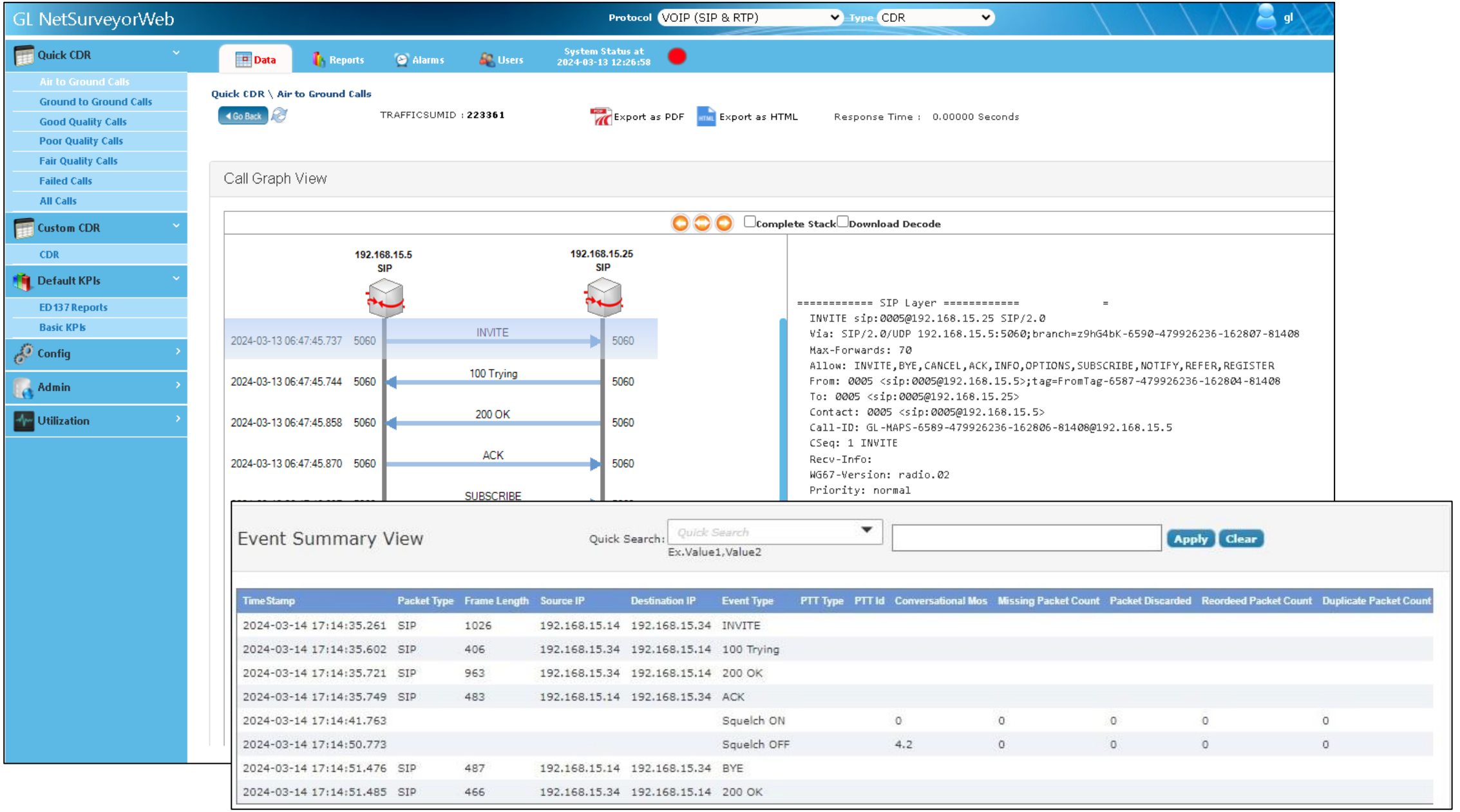


NetSurveyorWeb™

- 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



NetSurveyorWeb™ – Call Detail View



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NetSurveyorWeb™ – Reports and Graphs

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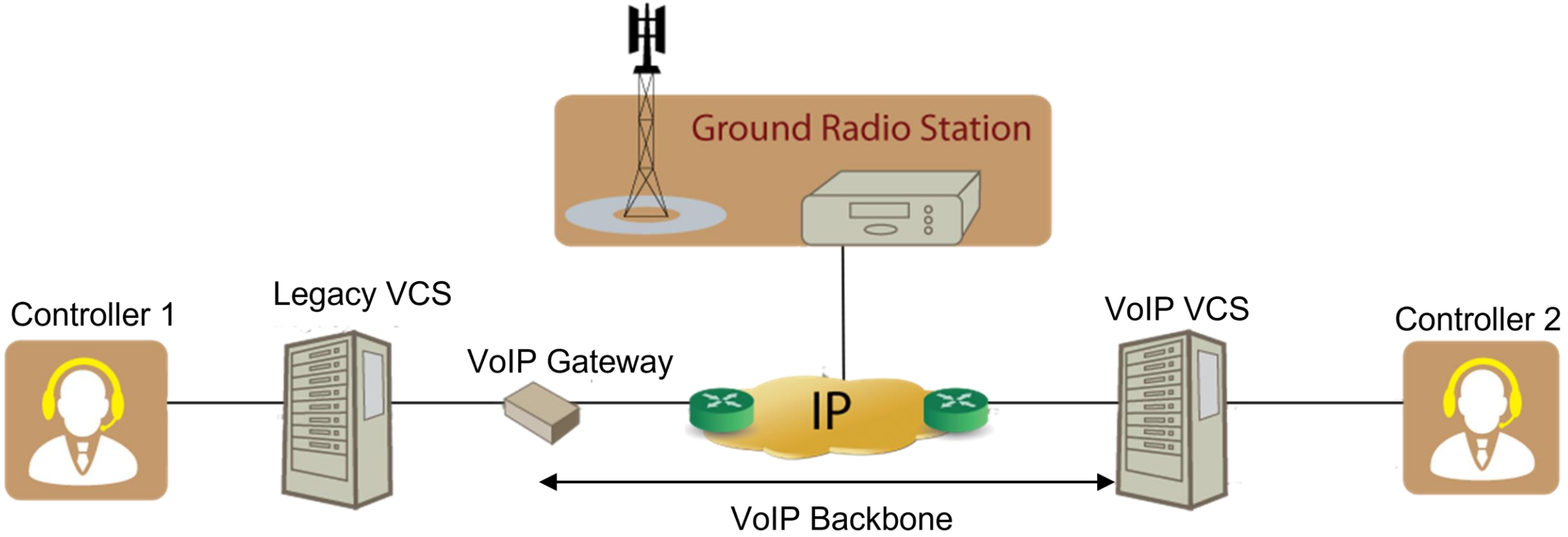
GL's Critical Delay and Voice Quality Measurement in Air Traffic Management (ED-138)

Critical Time Delay Measurements



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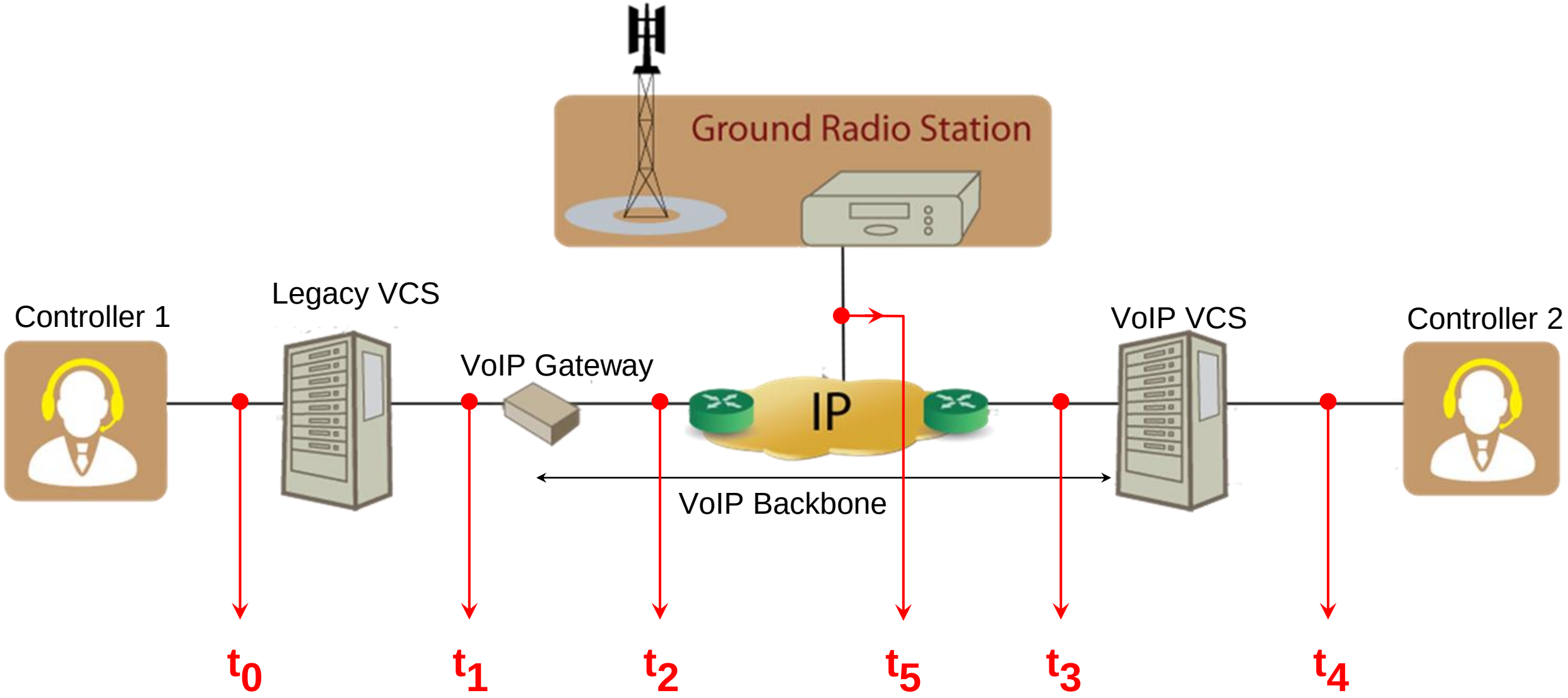
Critical Time Delay Measurements (ED-138) - Overview



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

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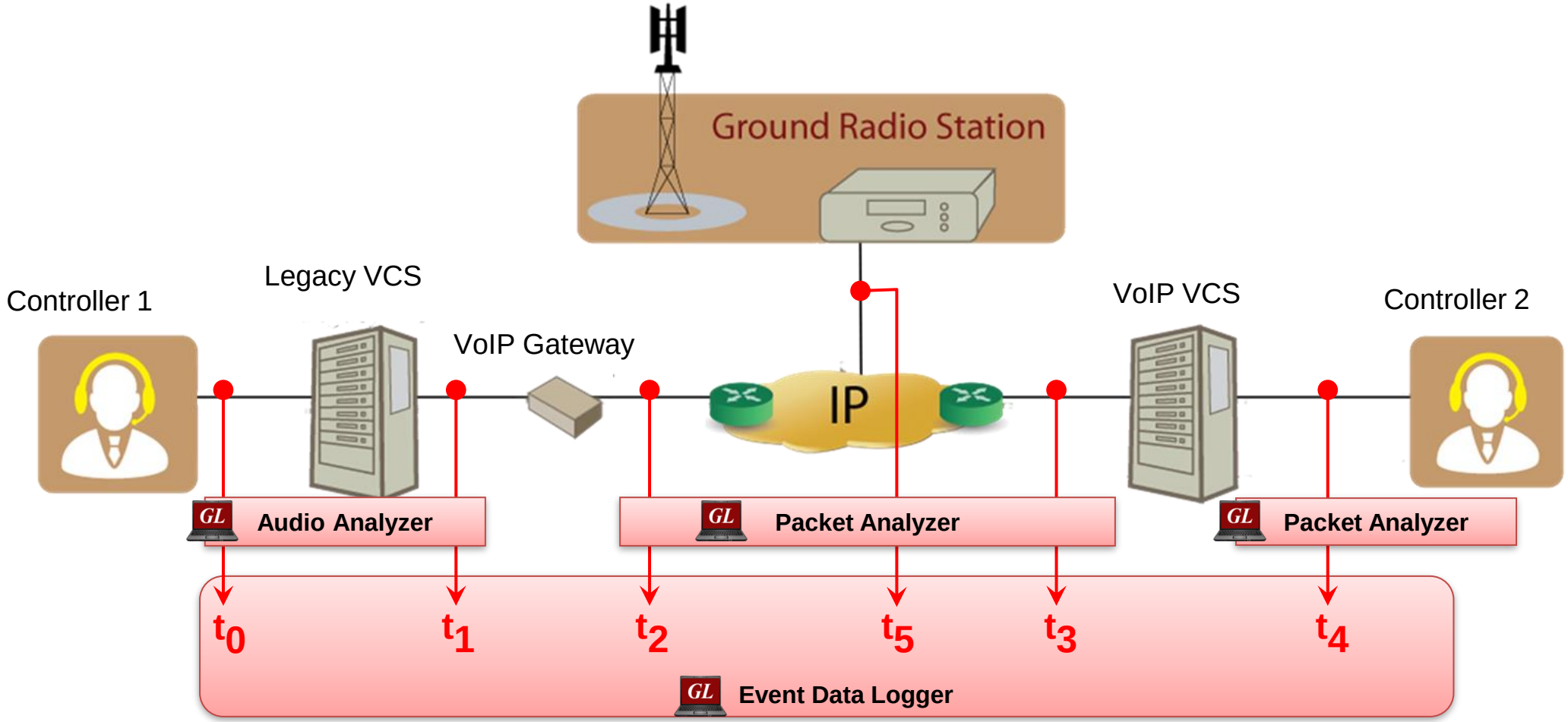
Critical Time Delay Measurements - Overview



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

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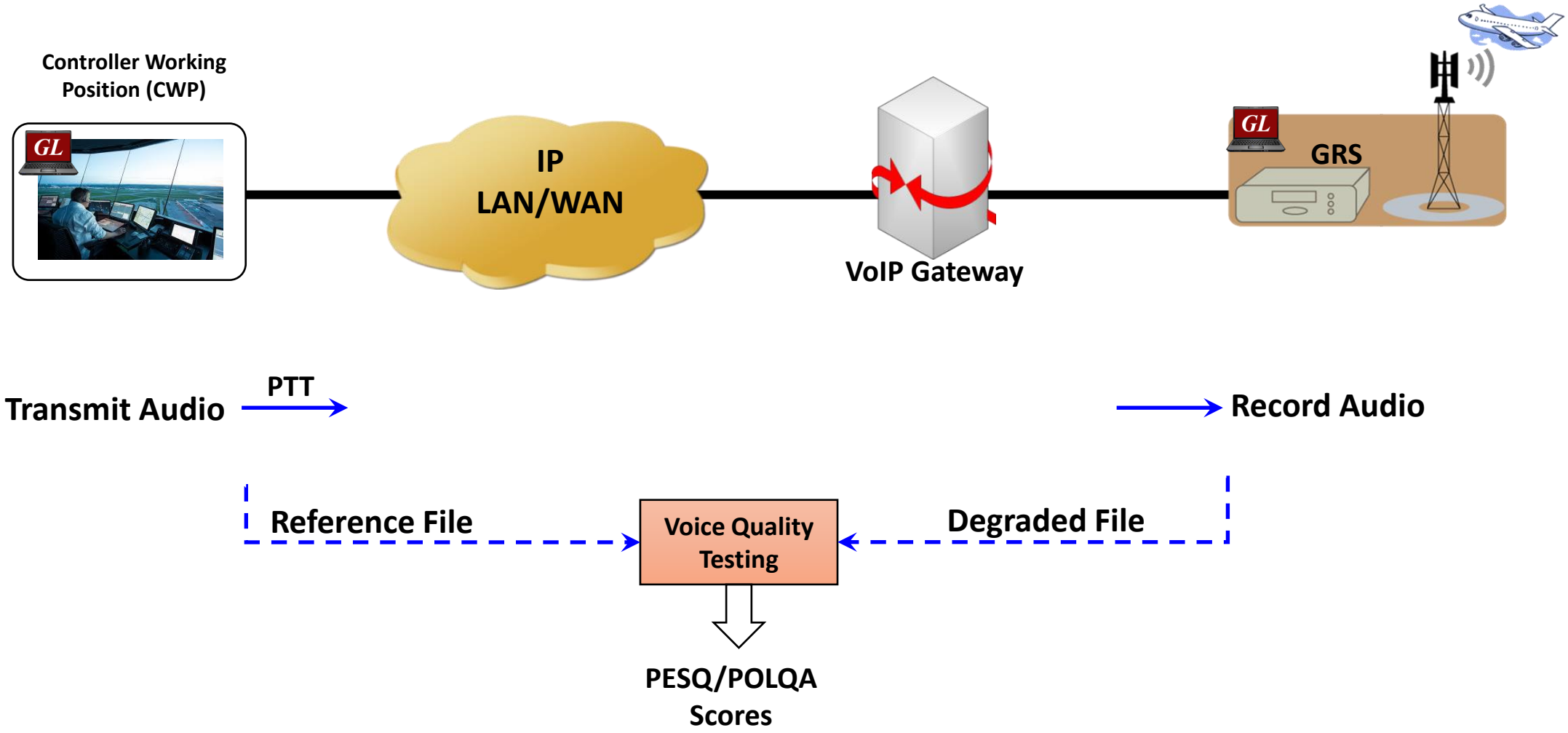
Voice Quality Measurements in ATM



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

Deployment Architecture Elements

Packet Analyzer + MAPS™ ED137 Radio

Audio Analyzer

Discrete Signal Logger

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

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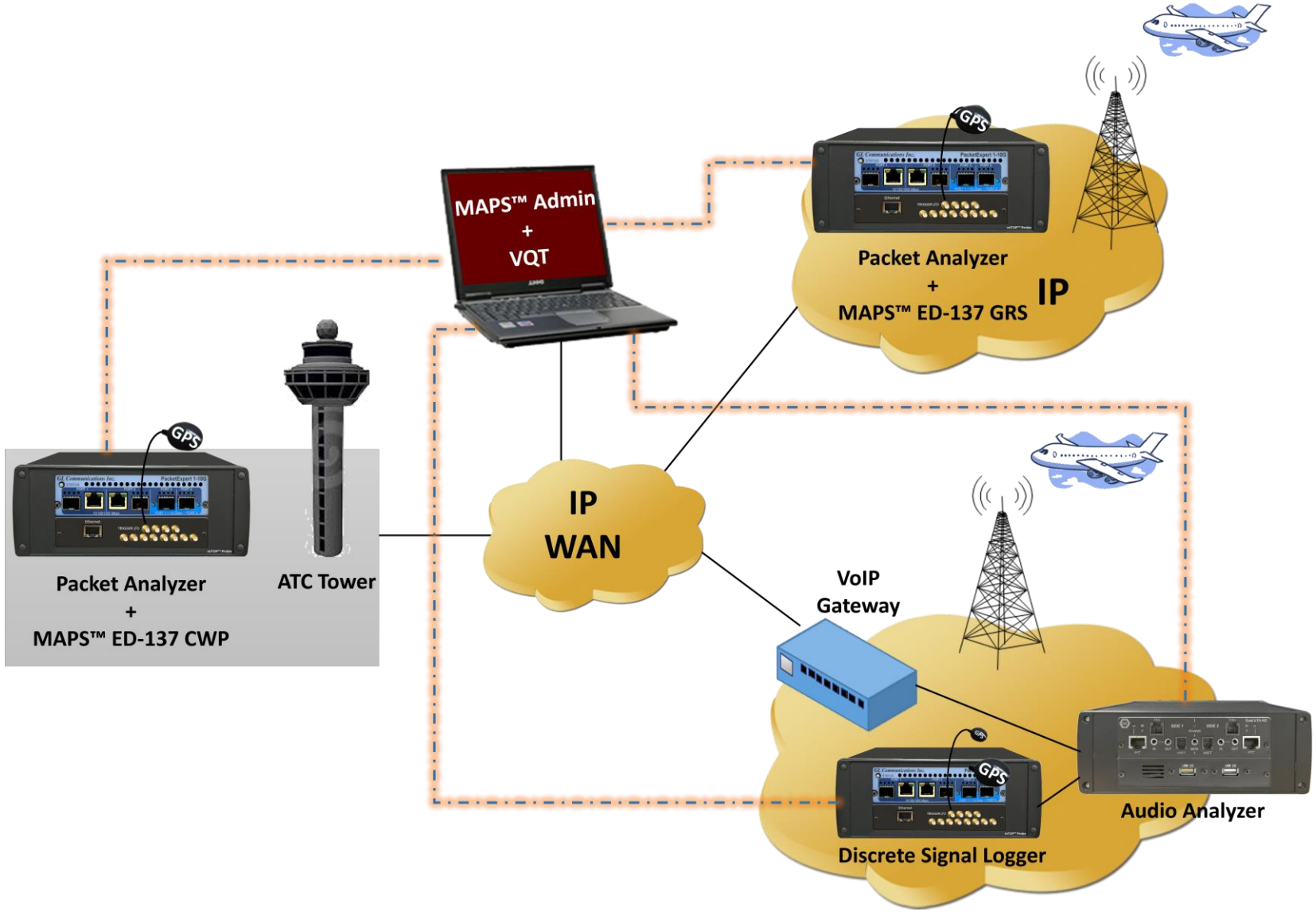
ATM Solution for Portable Field Testing



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Thank you