Test Solutions for Air Traffic Management

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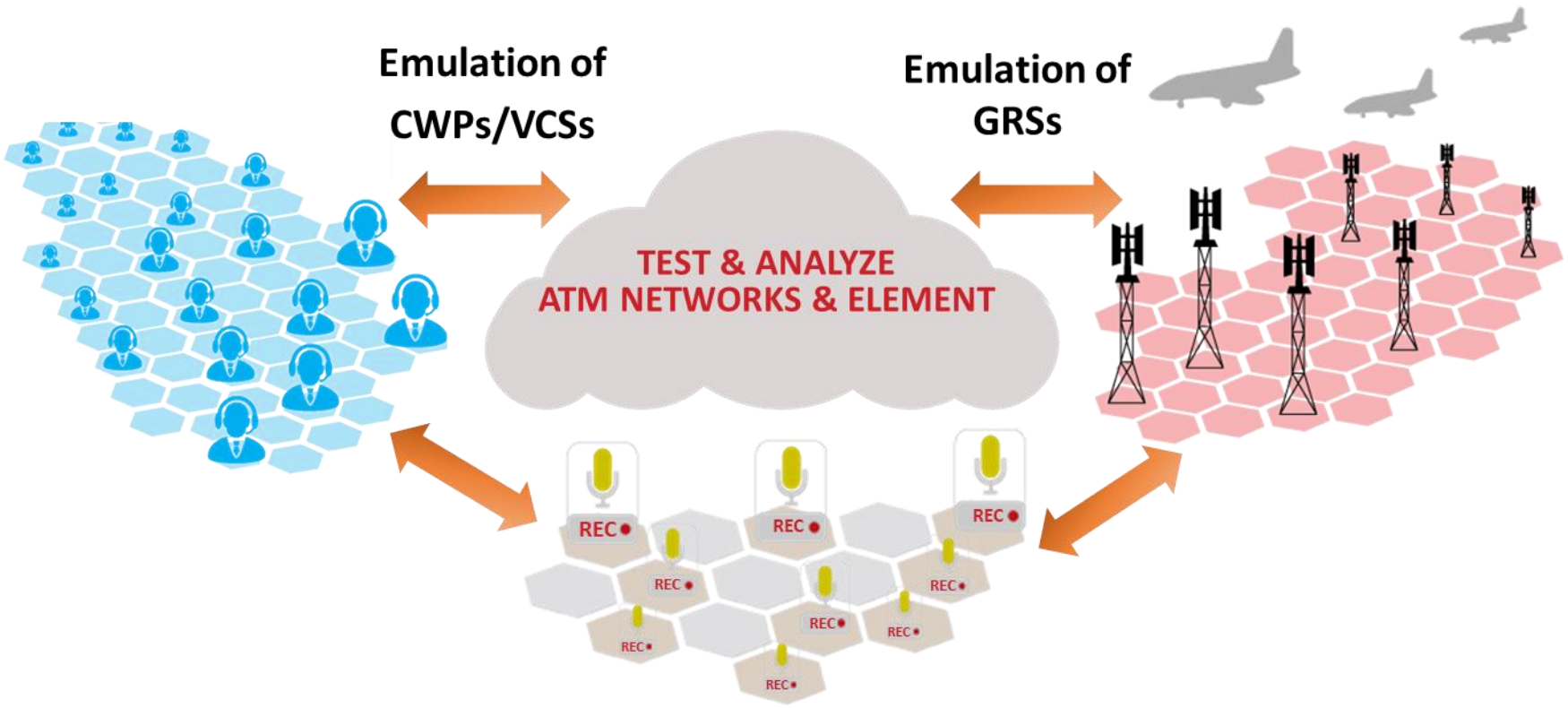
Overview



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

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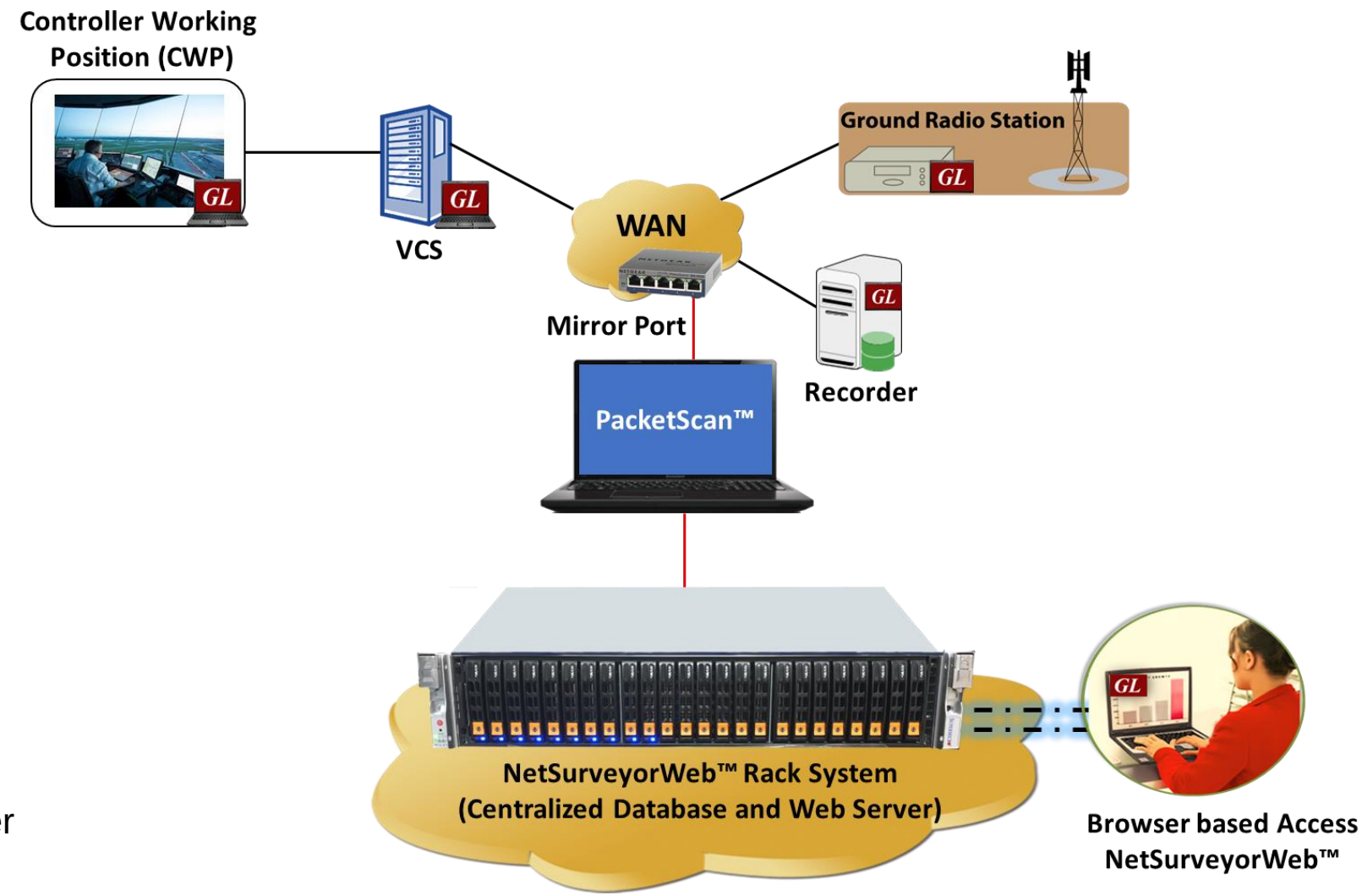
GL's ATM Test Solutions Overview

- **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



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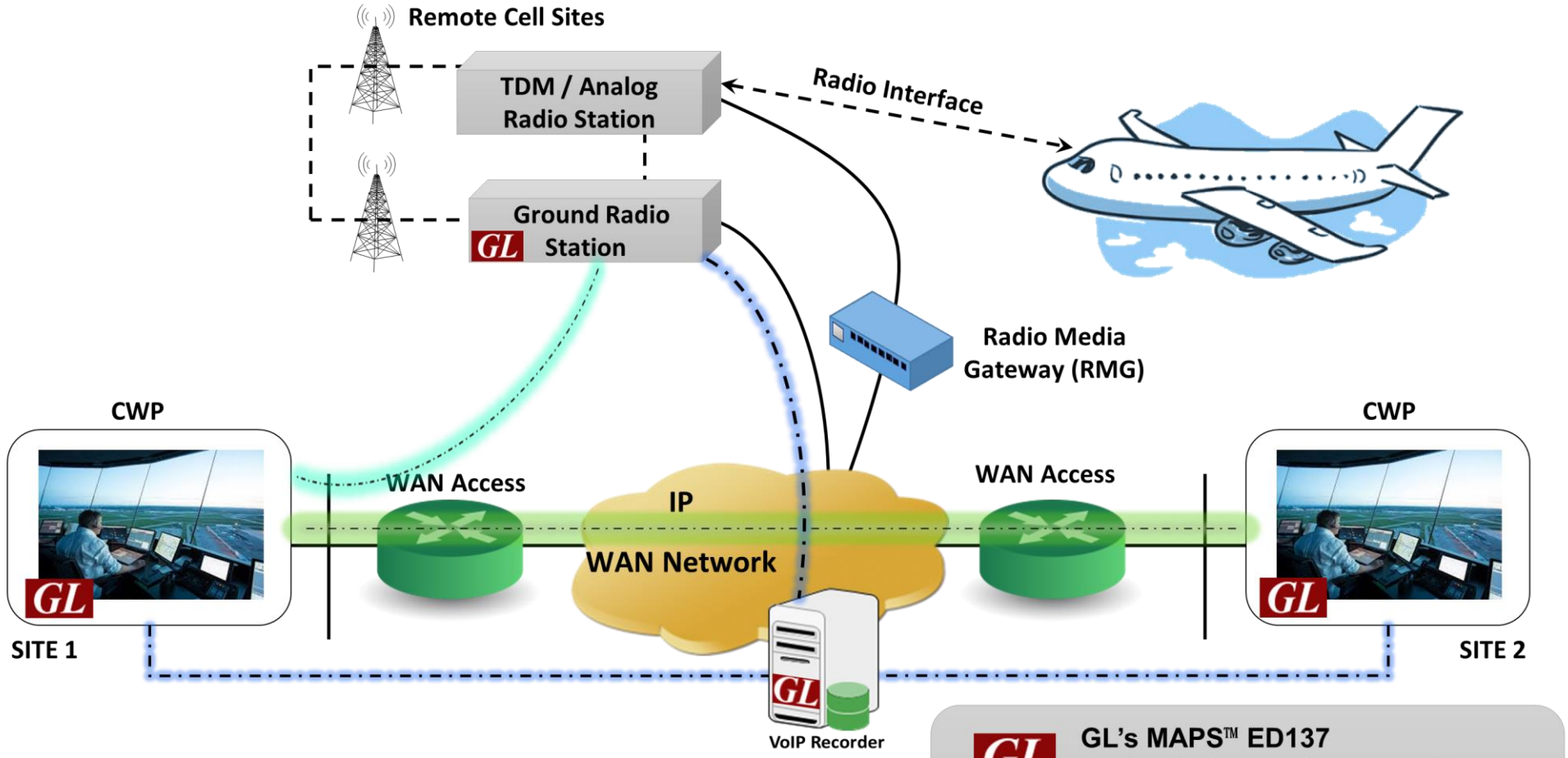
MAPS™ ED-137 Radio, Telephone, and Recorder



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

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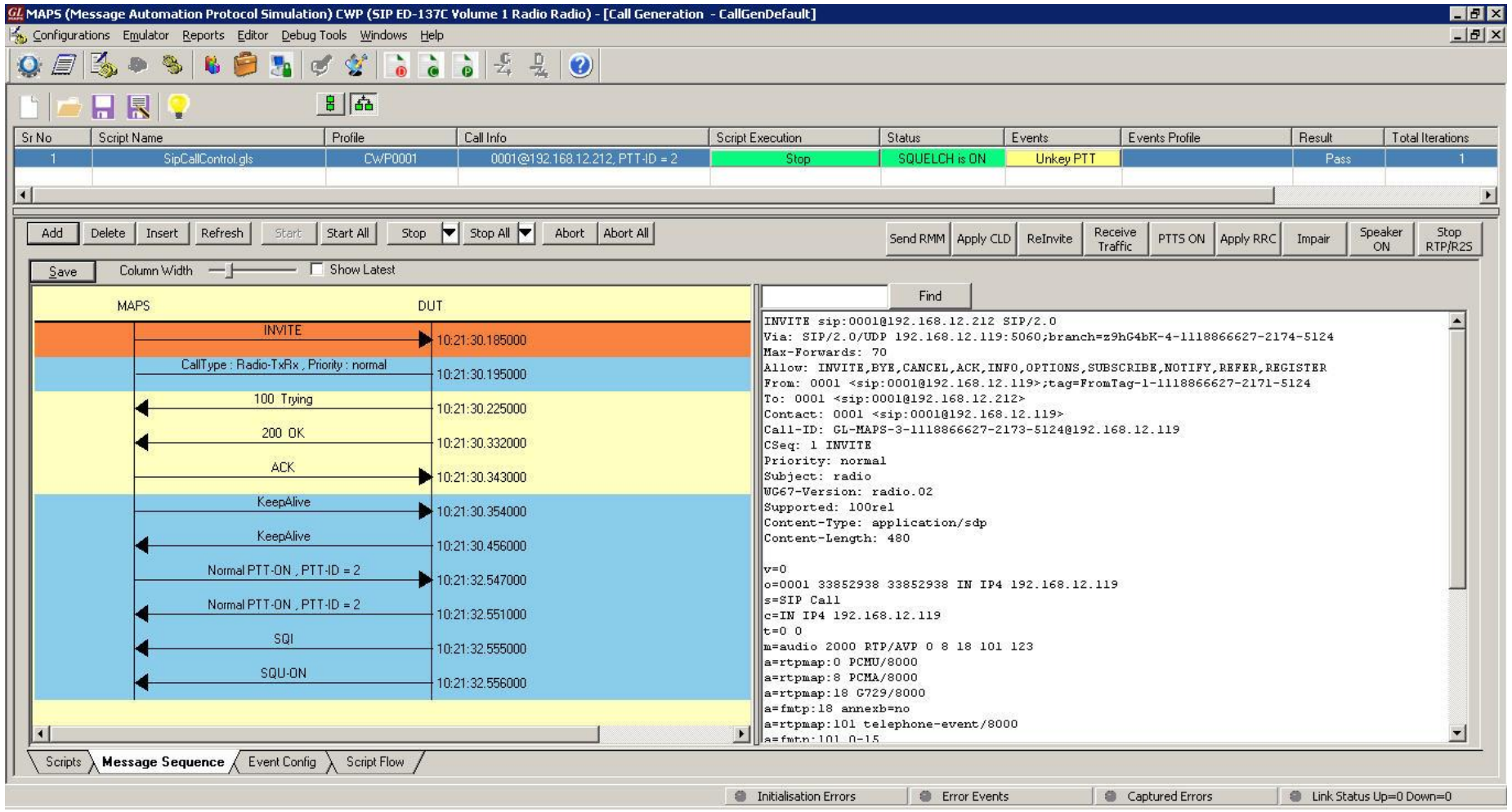
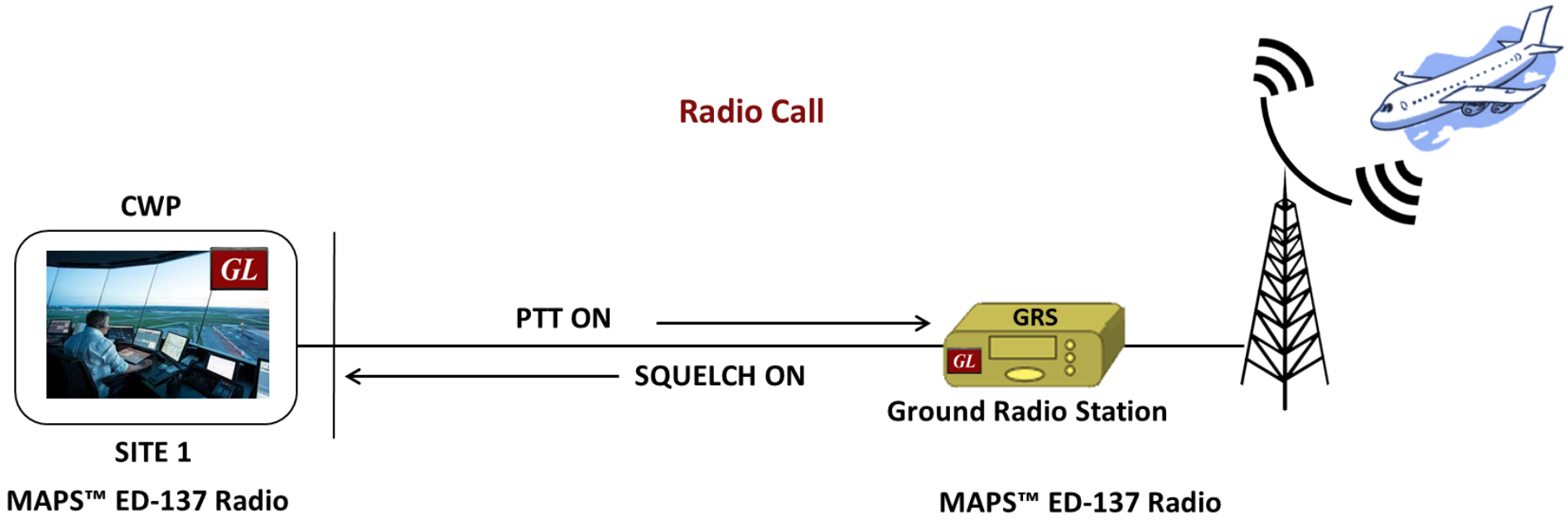
MAPS™ ED-137 Radio Emulator

- 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



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**

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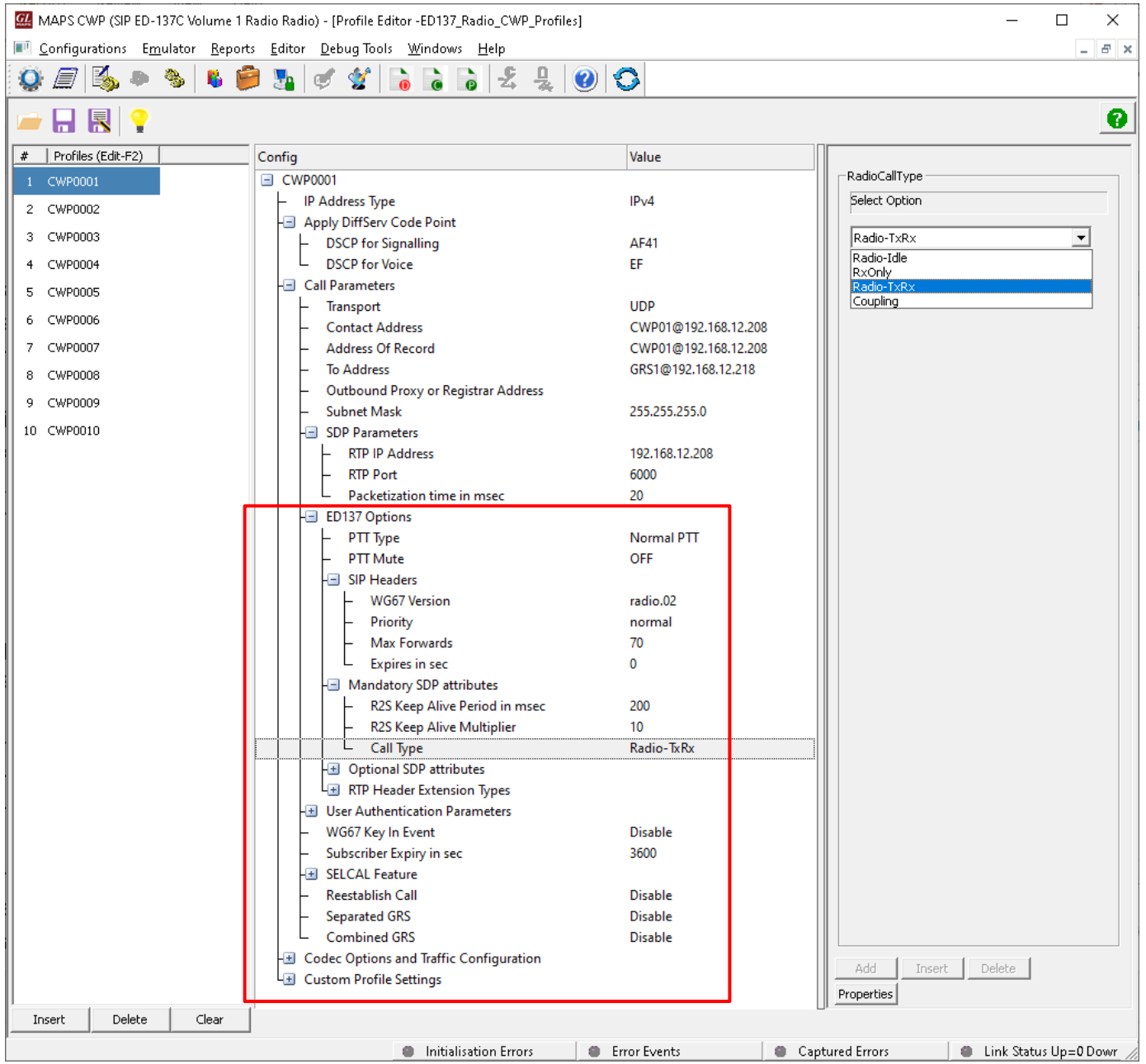
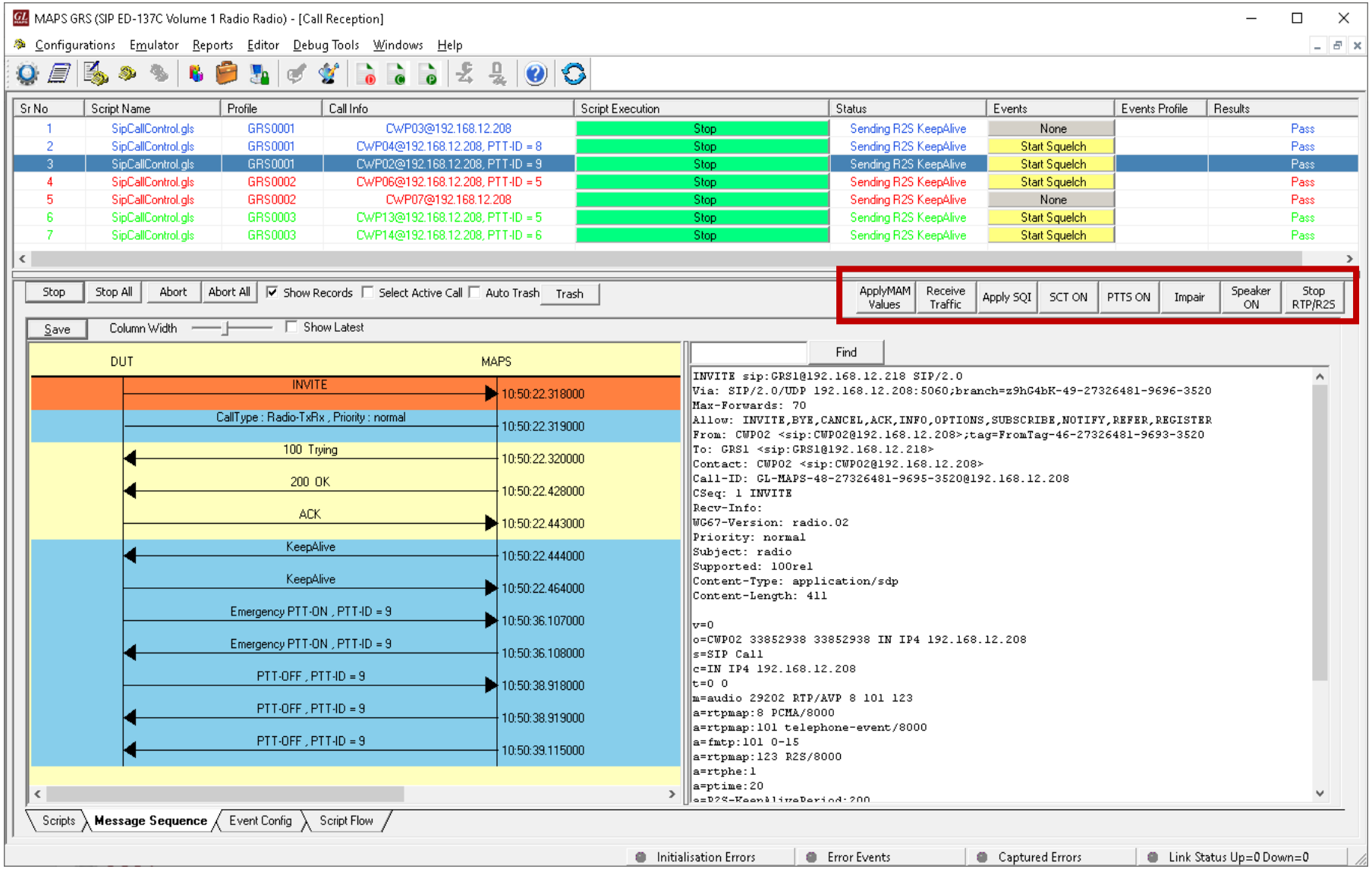
MAPS™ ED-137 Radio Emulator – Profiles

- 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

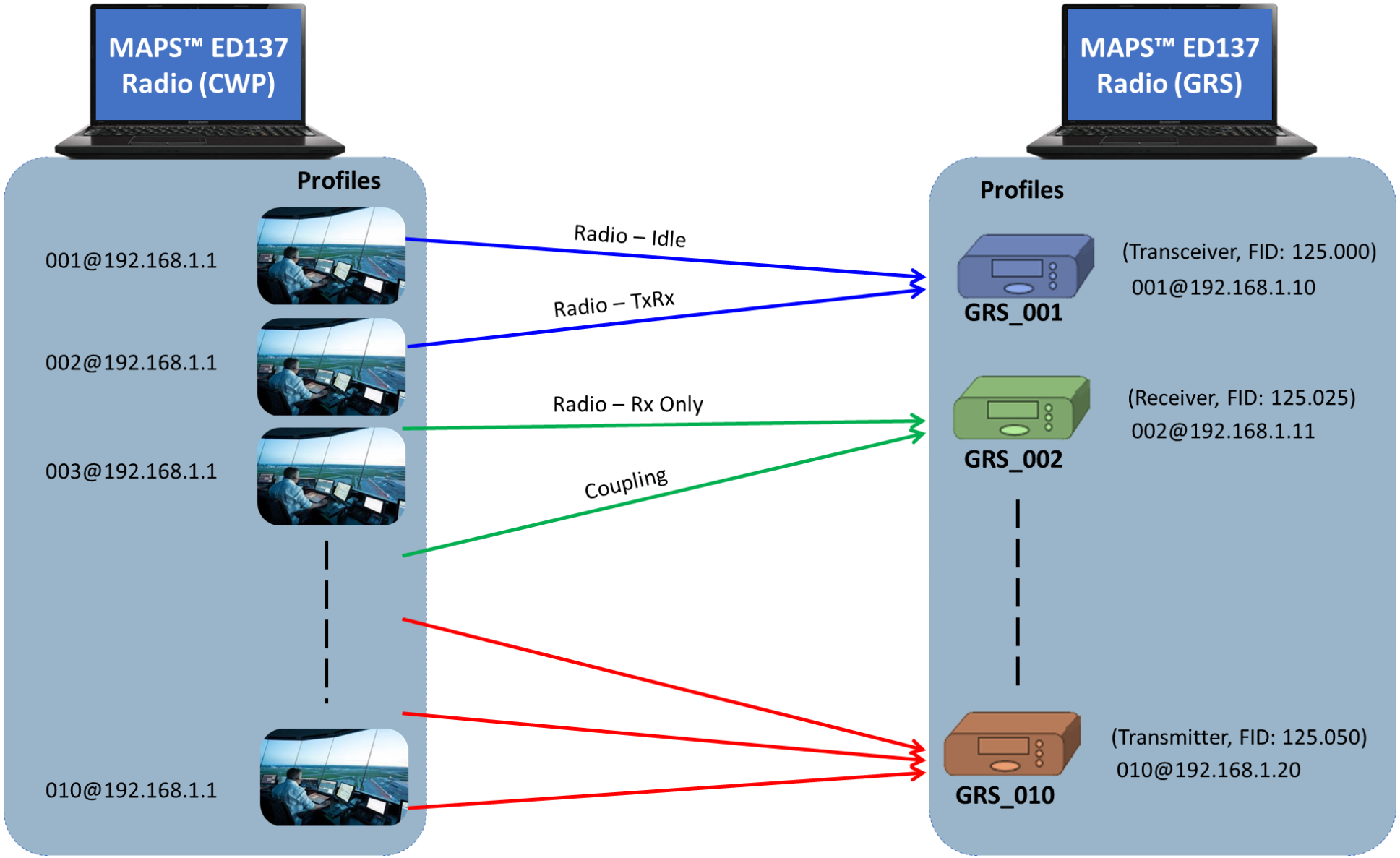


MAPS™ ED-137 Radio Emulator – Call Reception

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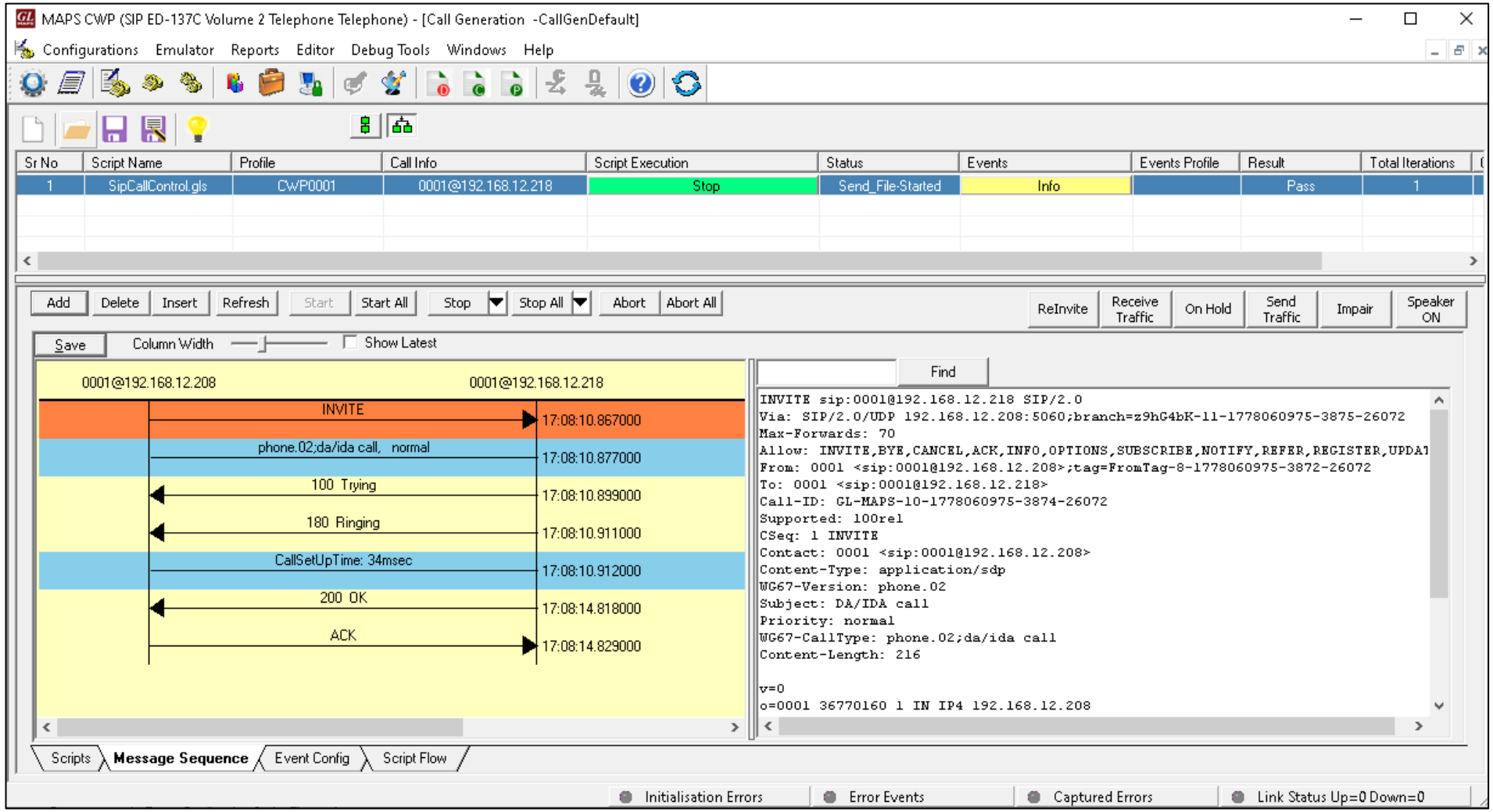
ED-137/1C Features in MAPS™ ED-137 Radio Emulator

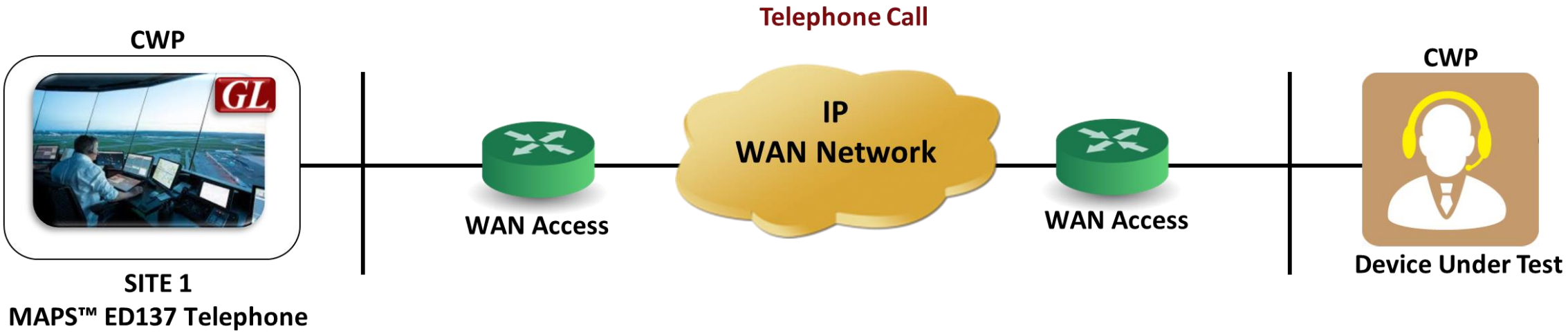
- Radio Receiver Multicast Operation
- SELCAL (Selective Calling) Tone Transmission
- Simulation of Non-VoIP source PTT keying
- WG67 KEY-IN event package now includes frequency id (fid) of Radio
- Option to retain active sessions at GRS when frequency (fid) changes
- Added Test PTT
- PTT-id 63 is reserved 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

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™ 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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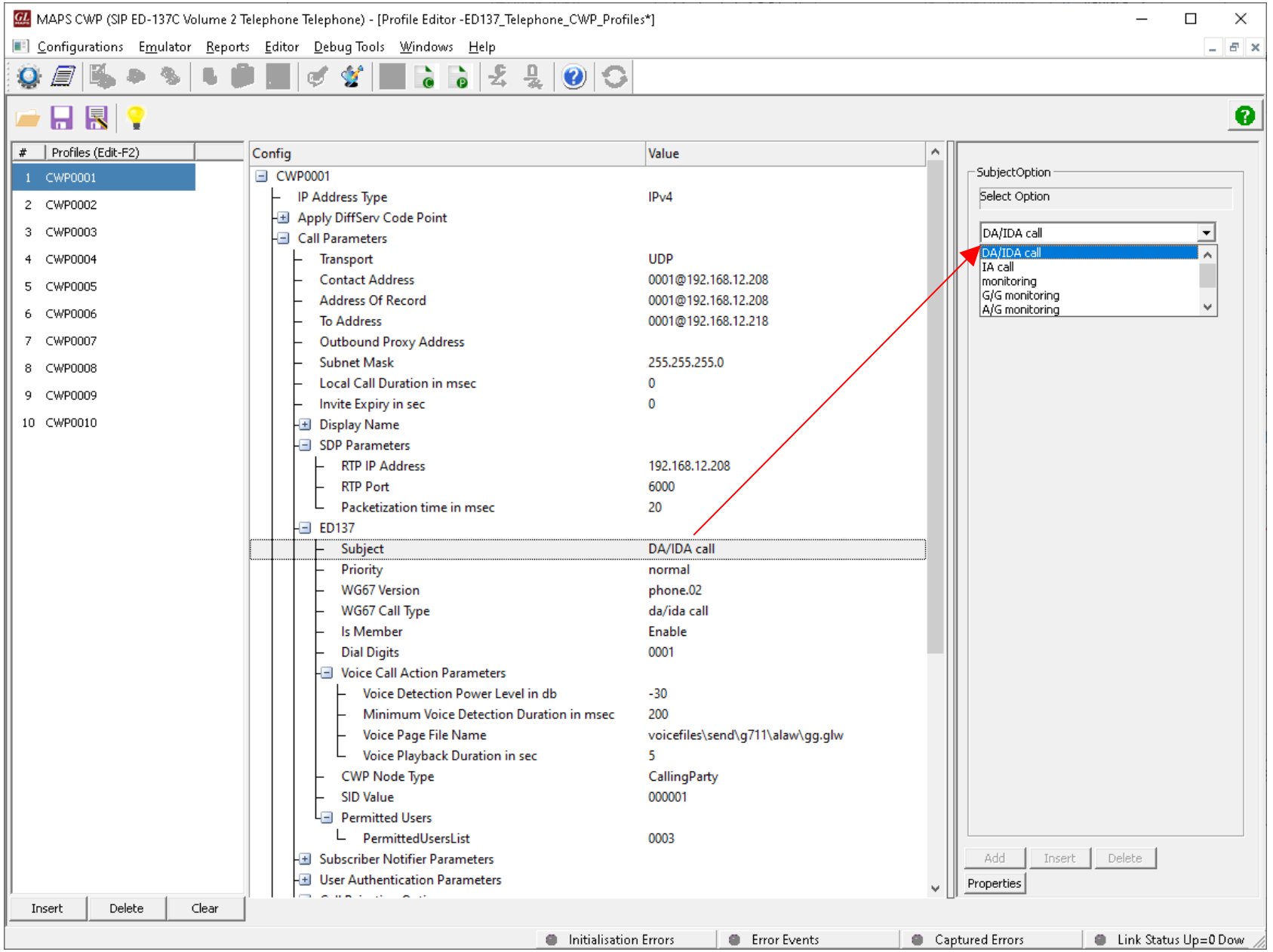
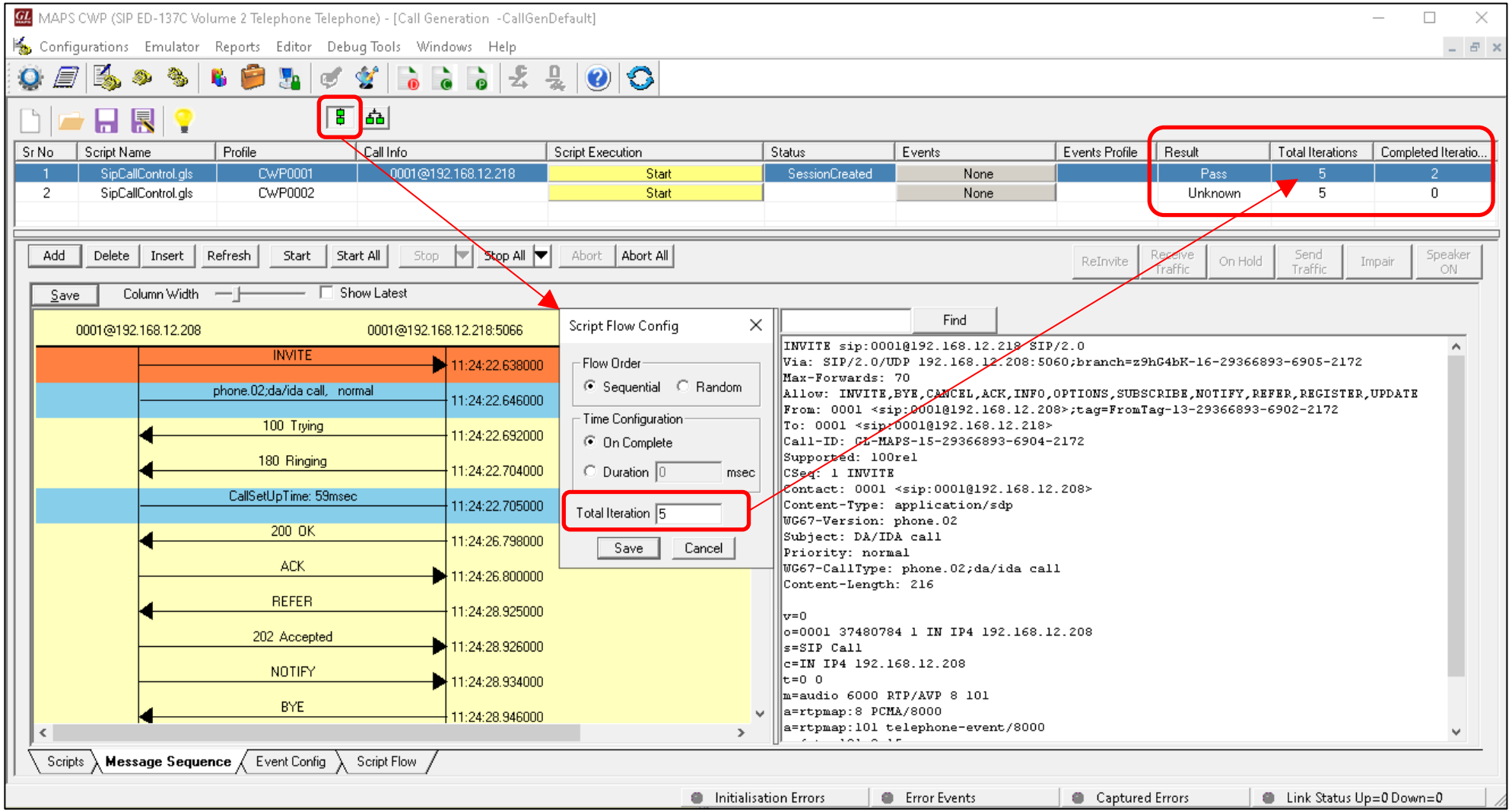
MAPS™ ED-137 Telephone Emulator – CWP Profiles

- 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

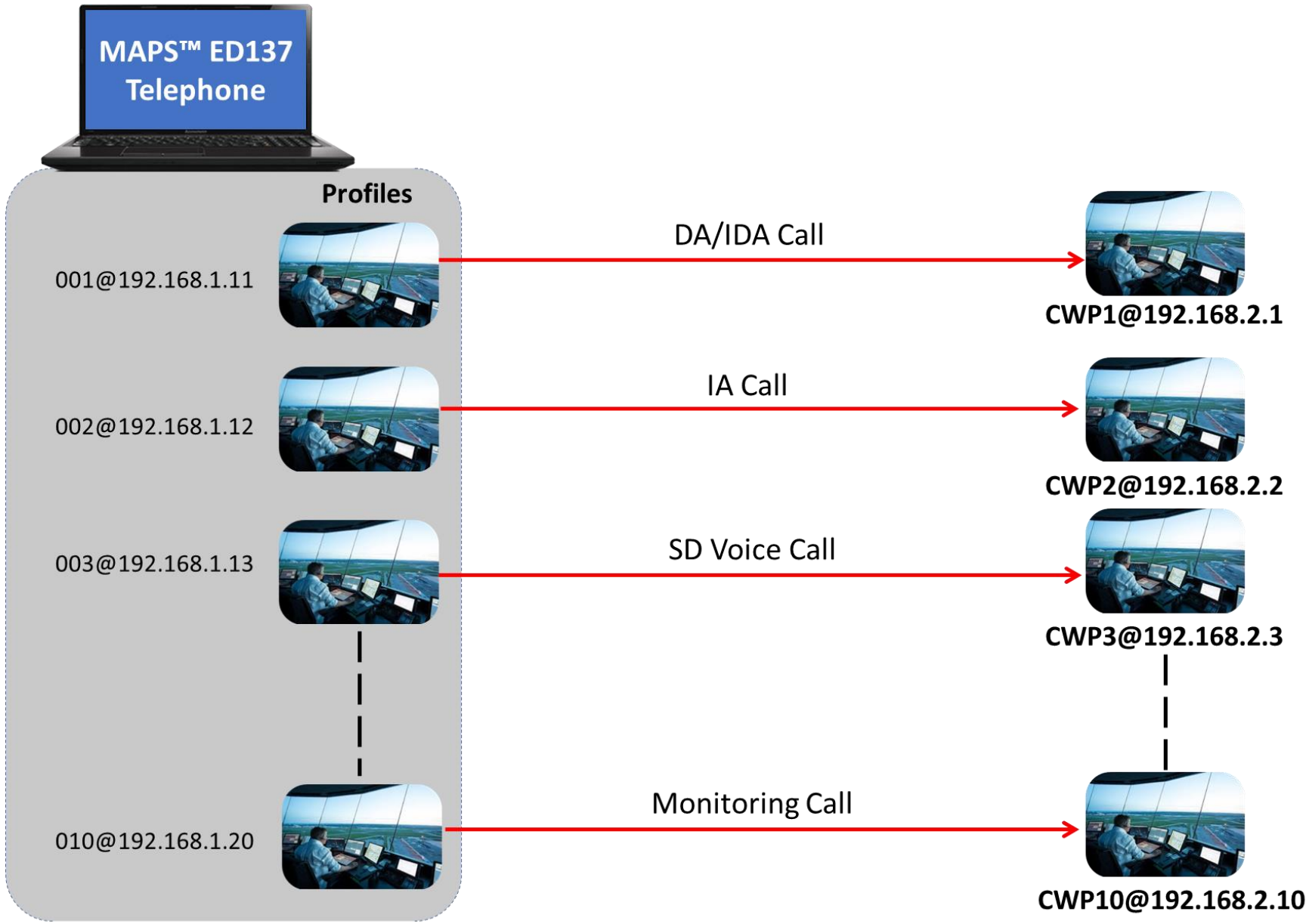


MAPS™ ED-137 Telephone Emulator – Call Generation

- 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



Multiple Controllers Simulation



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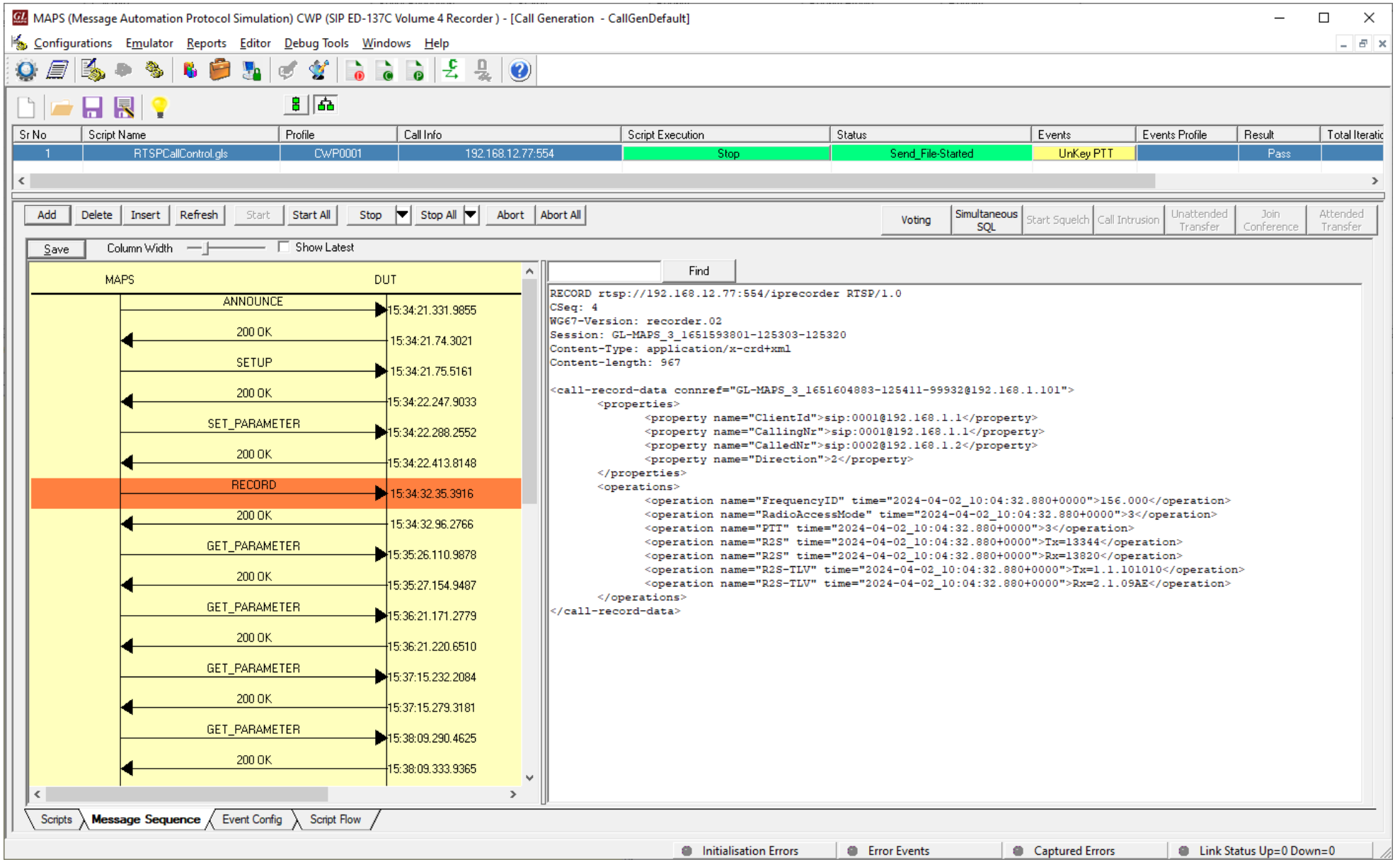
MAPS™ ED-137 Recorder Emulator

- 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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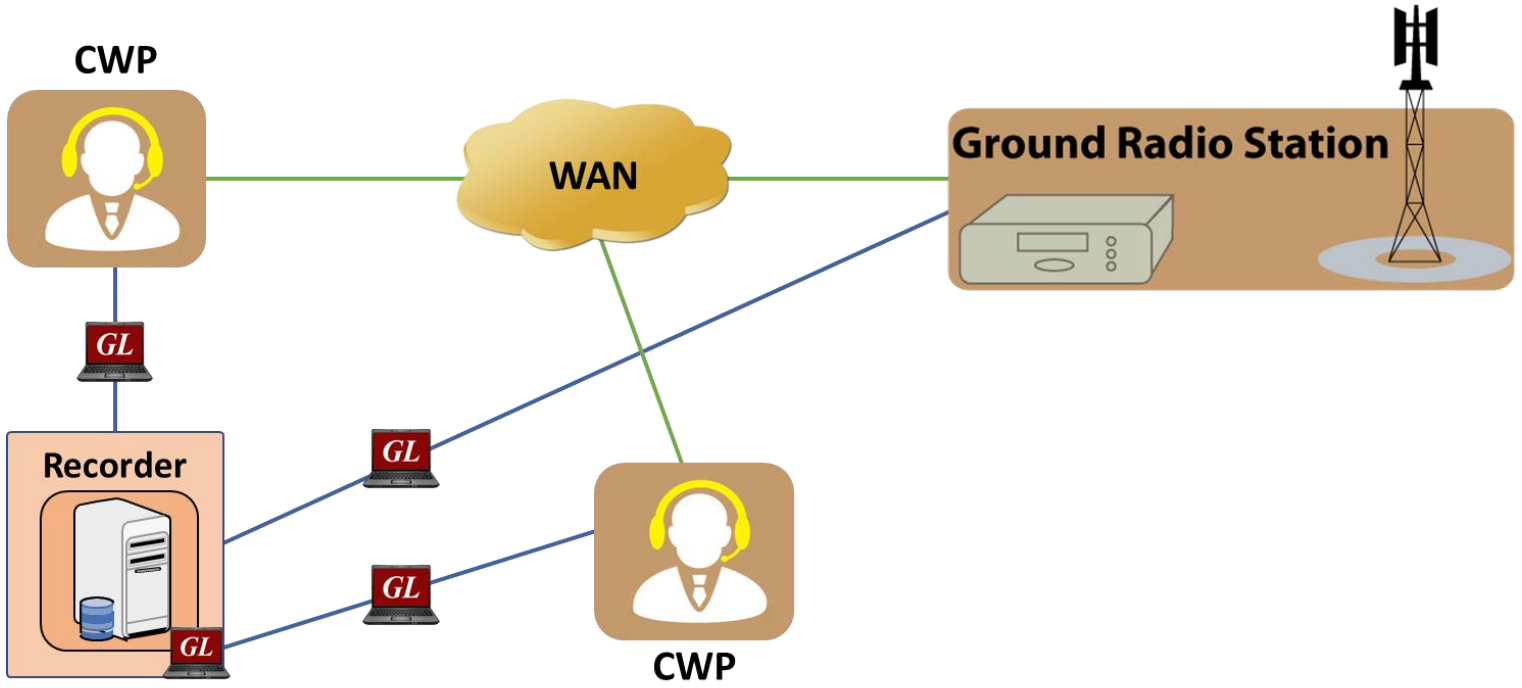
MAPS™ ED-137 Recorder Emulator Highlights

- 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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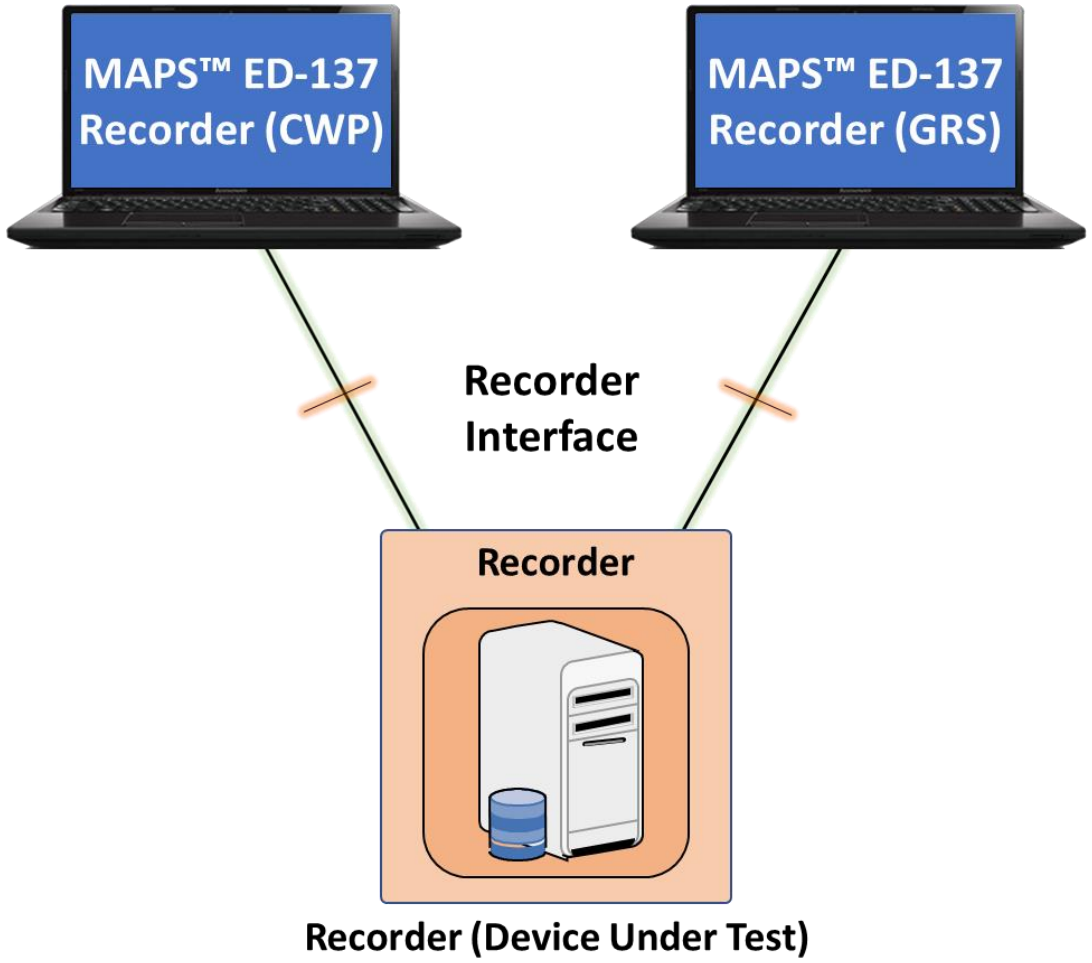
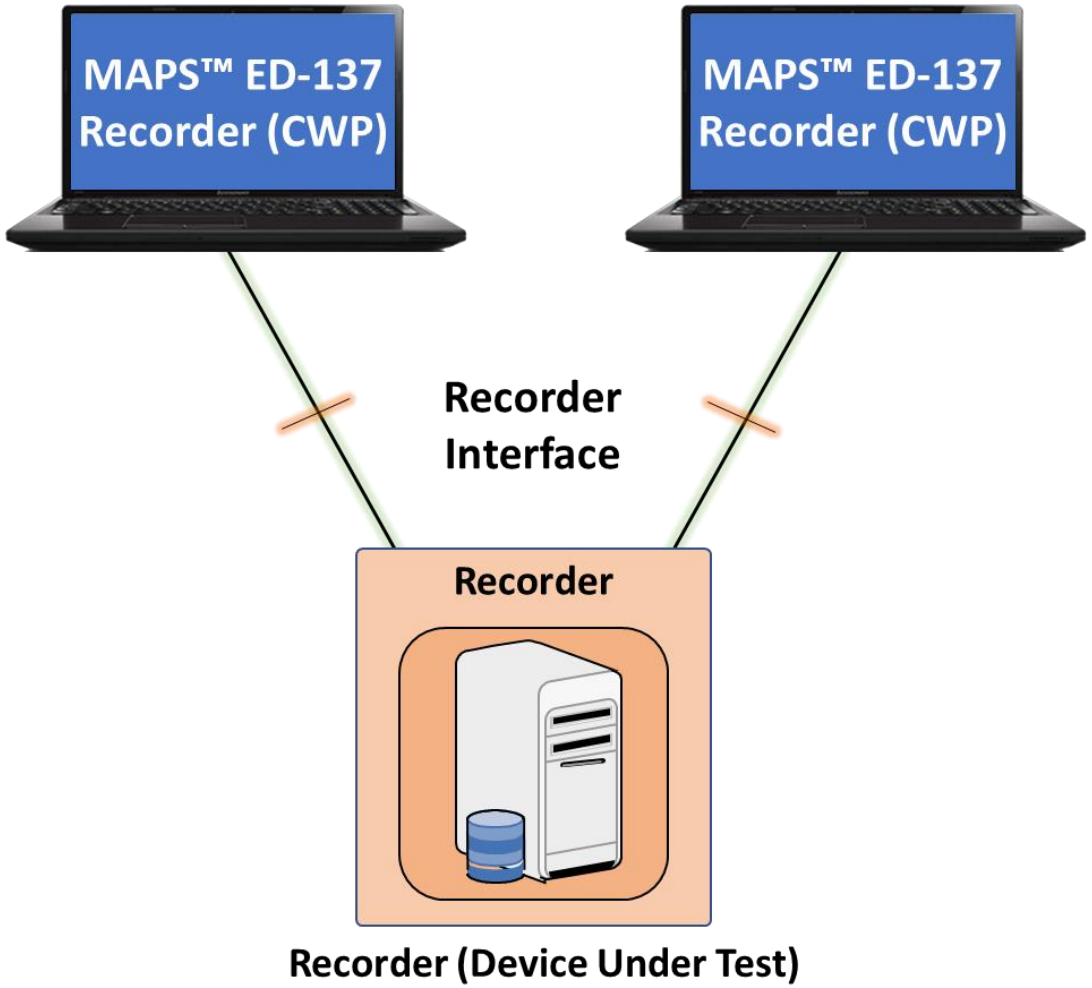
MAPS™ ED-137 Recorder Use Cases

CASE 1: Simulate AG call recording towards Recorder



CASE 2: Simulate GG call recording towards Recorder



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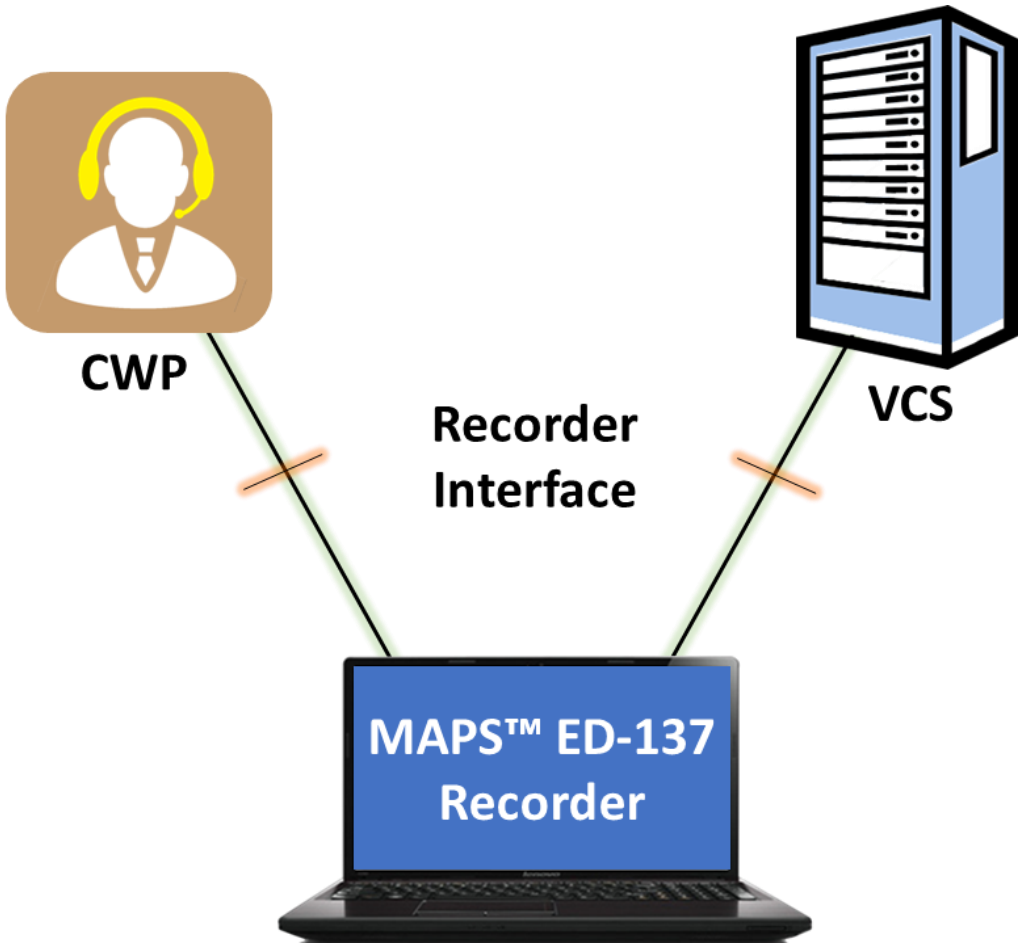
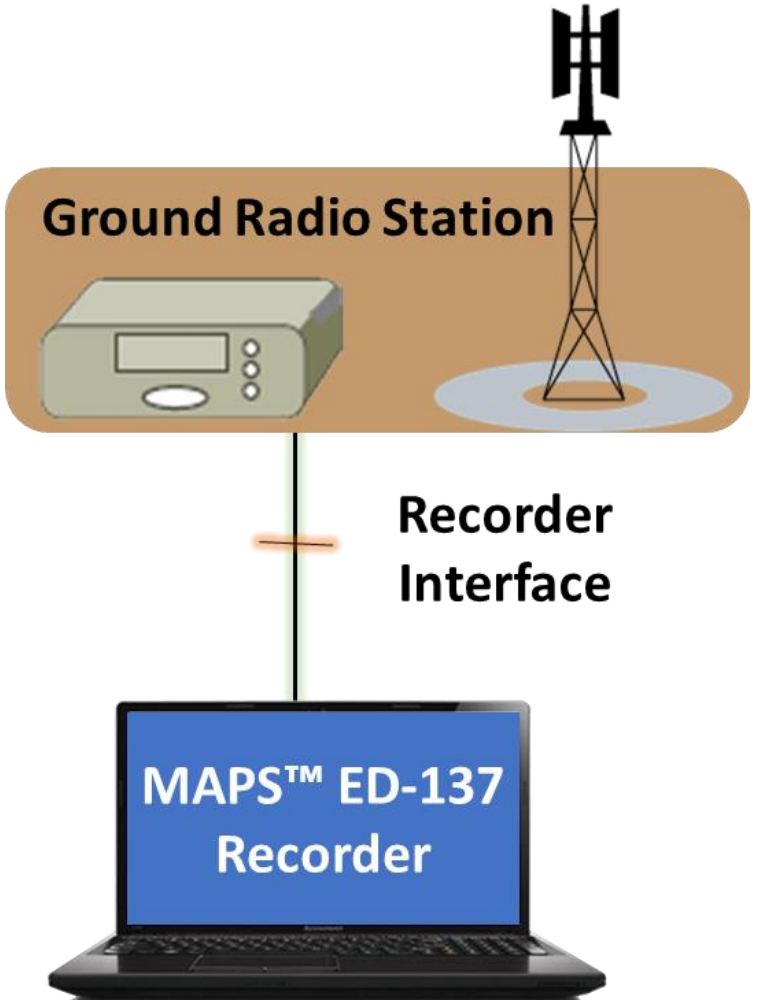
MAPS™ ED-137 Recorder Use Cases (Contd.)

CASE 3: Testing Recorder interface of CWP/VCS



CASE 4: Testing Recorder interface of GRS



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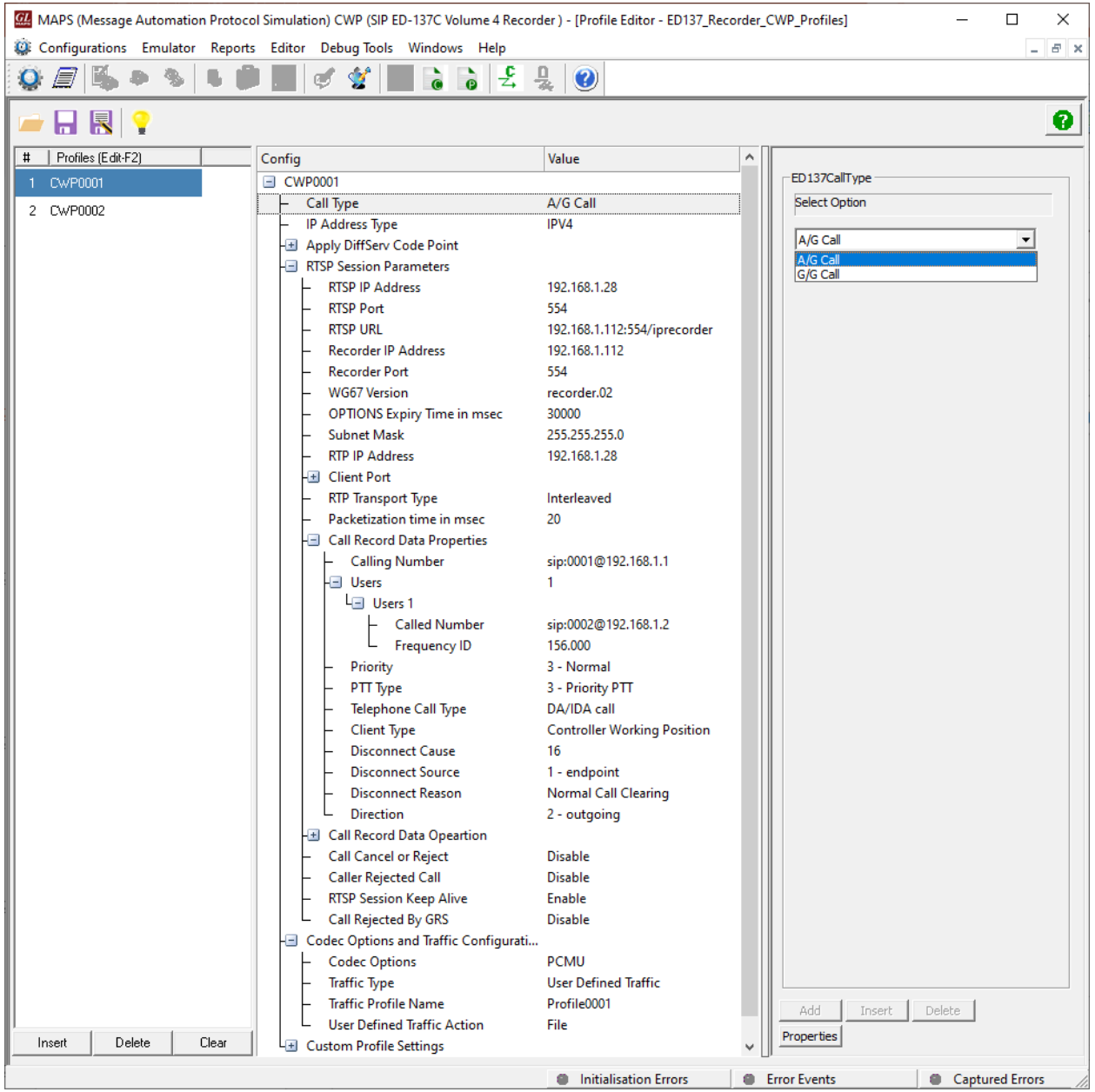
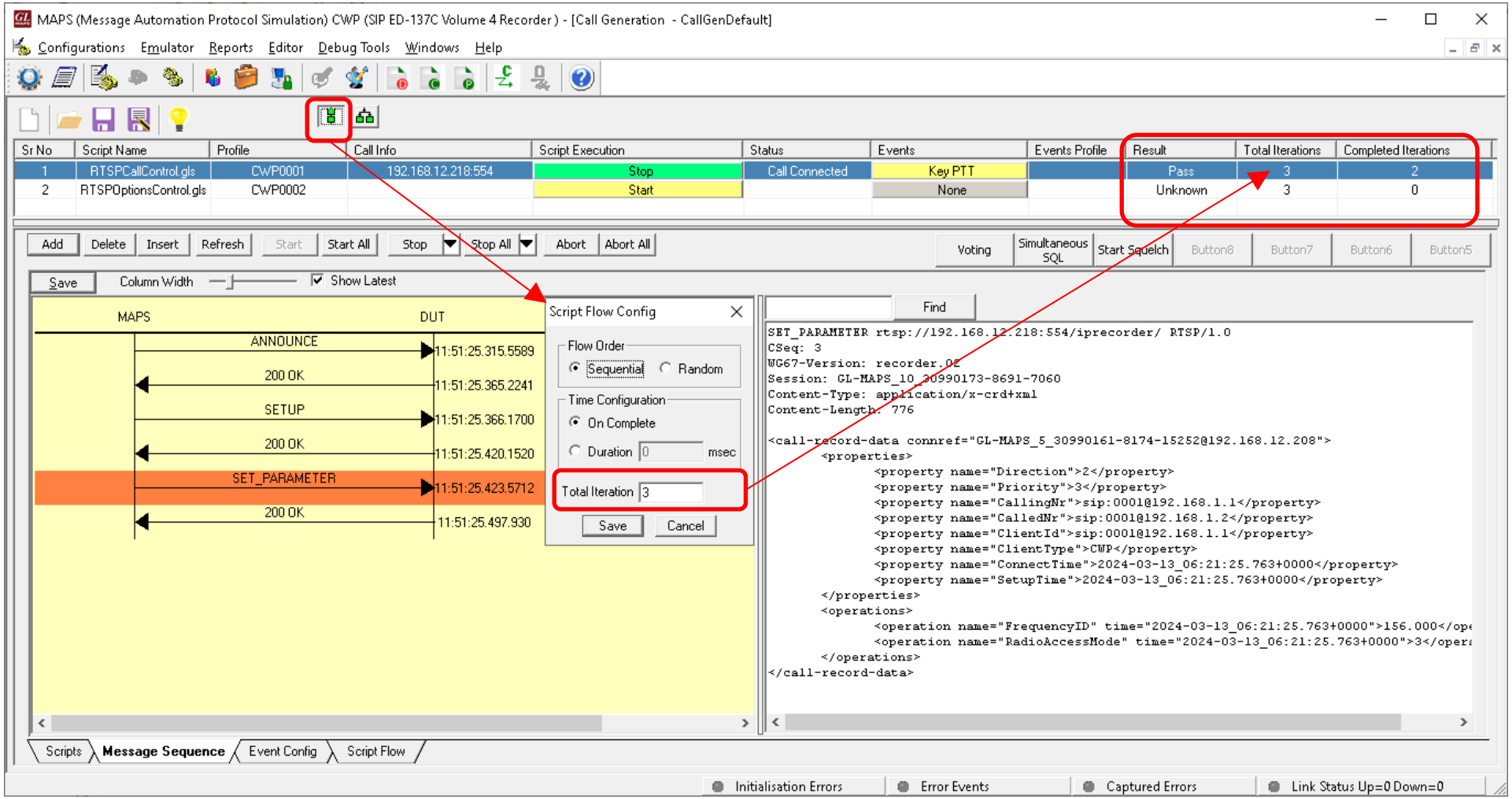
MAPS™ ED-137 Recorder Emulator Highlights

- 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



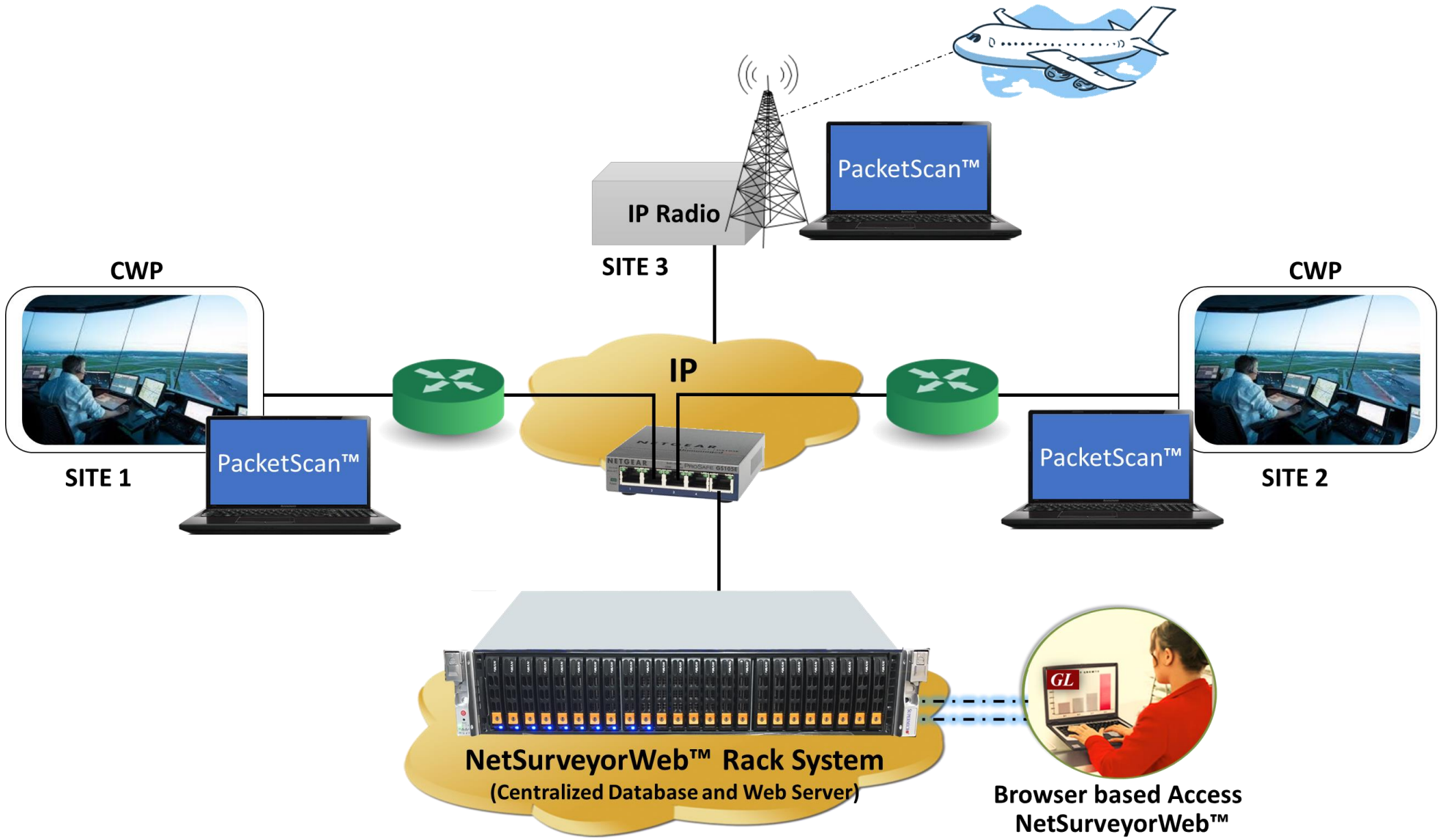
Key Updates

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

Air Traffic Control Monitoring Solutions

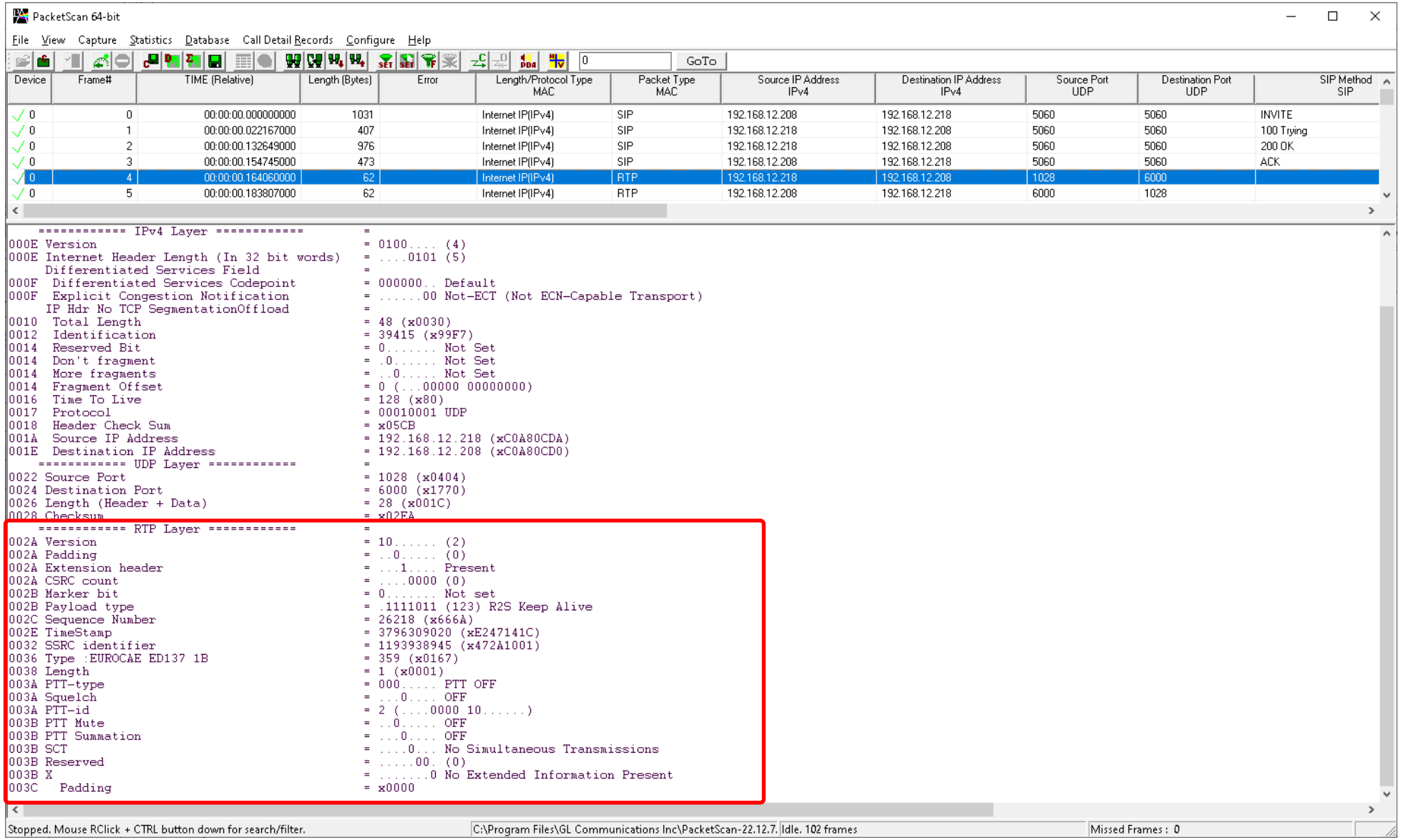
PacketScan™ and NetSurveyorWeb™

- 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)



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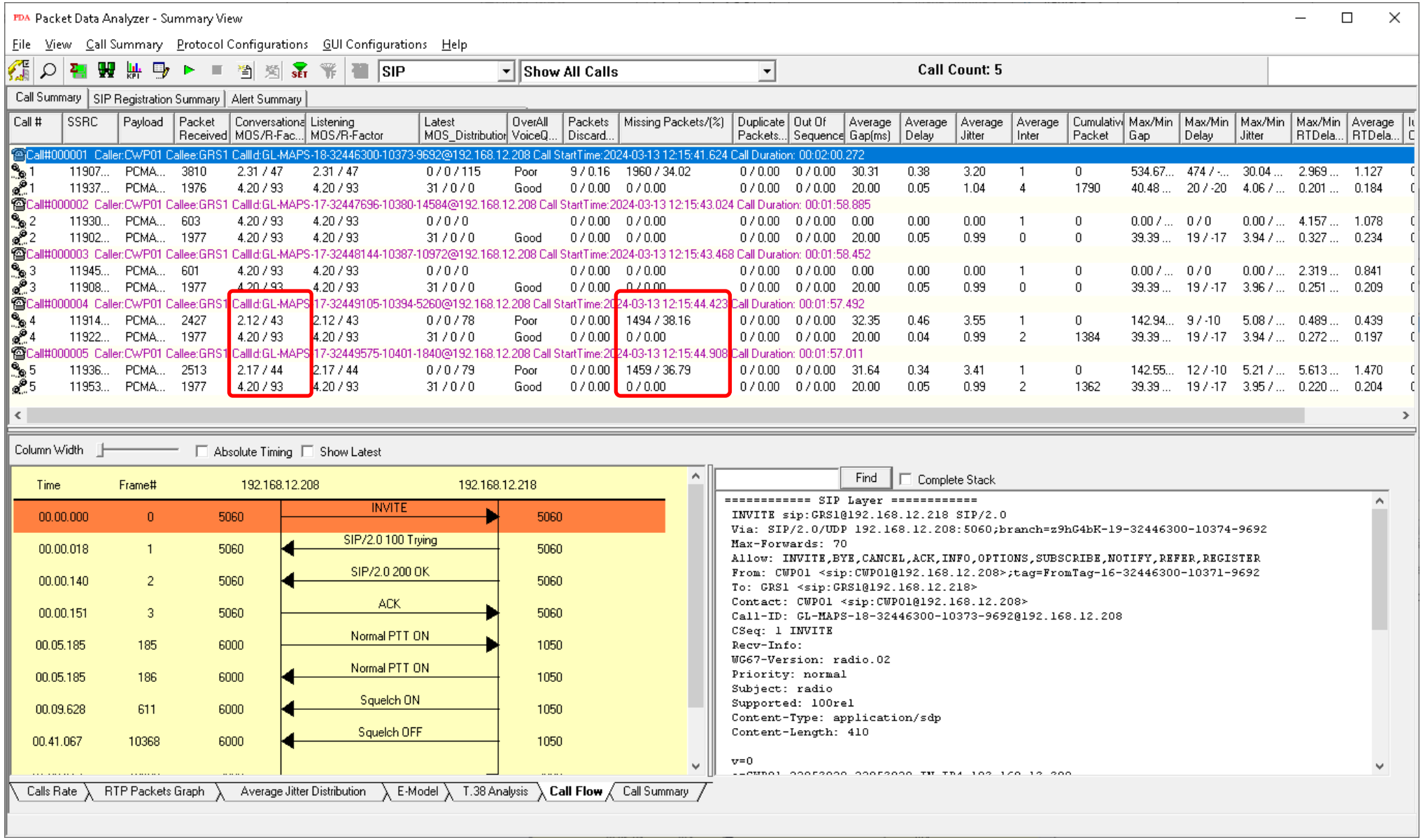
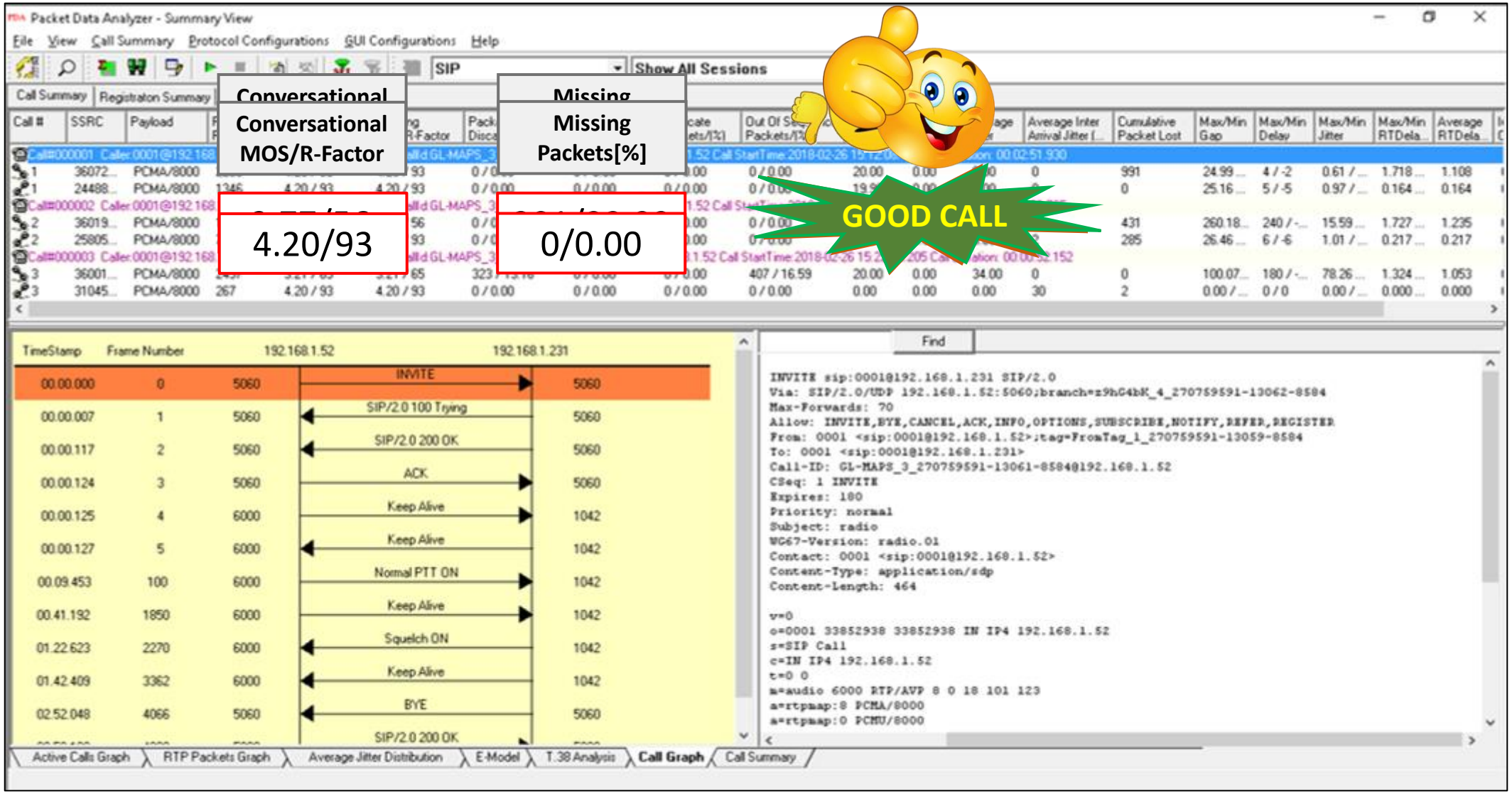
PacketScan™ Software – Call Summary

- 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

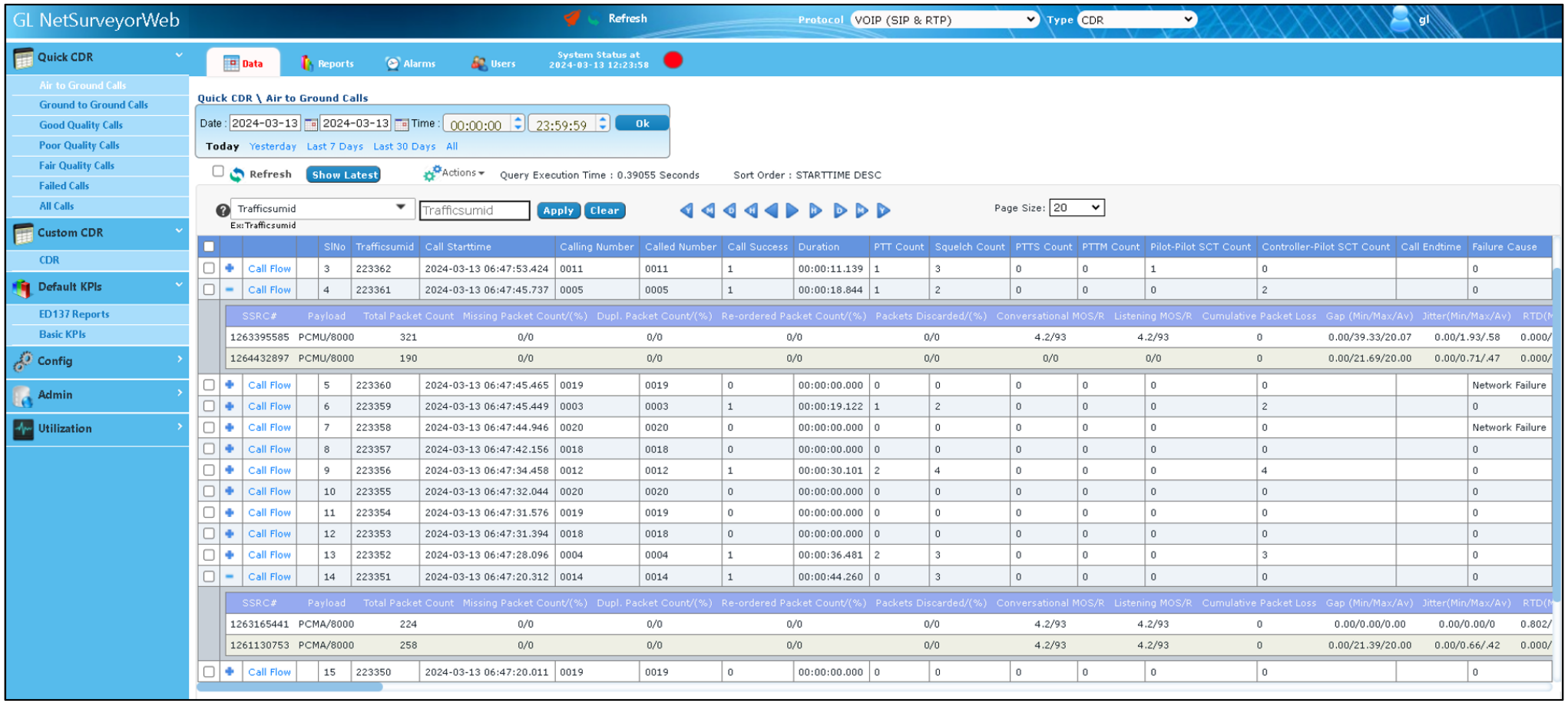


Good Call and Bad Call



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



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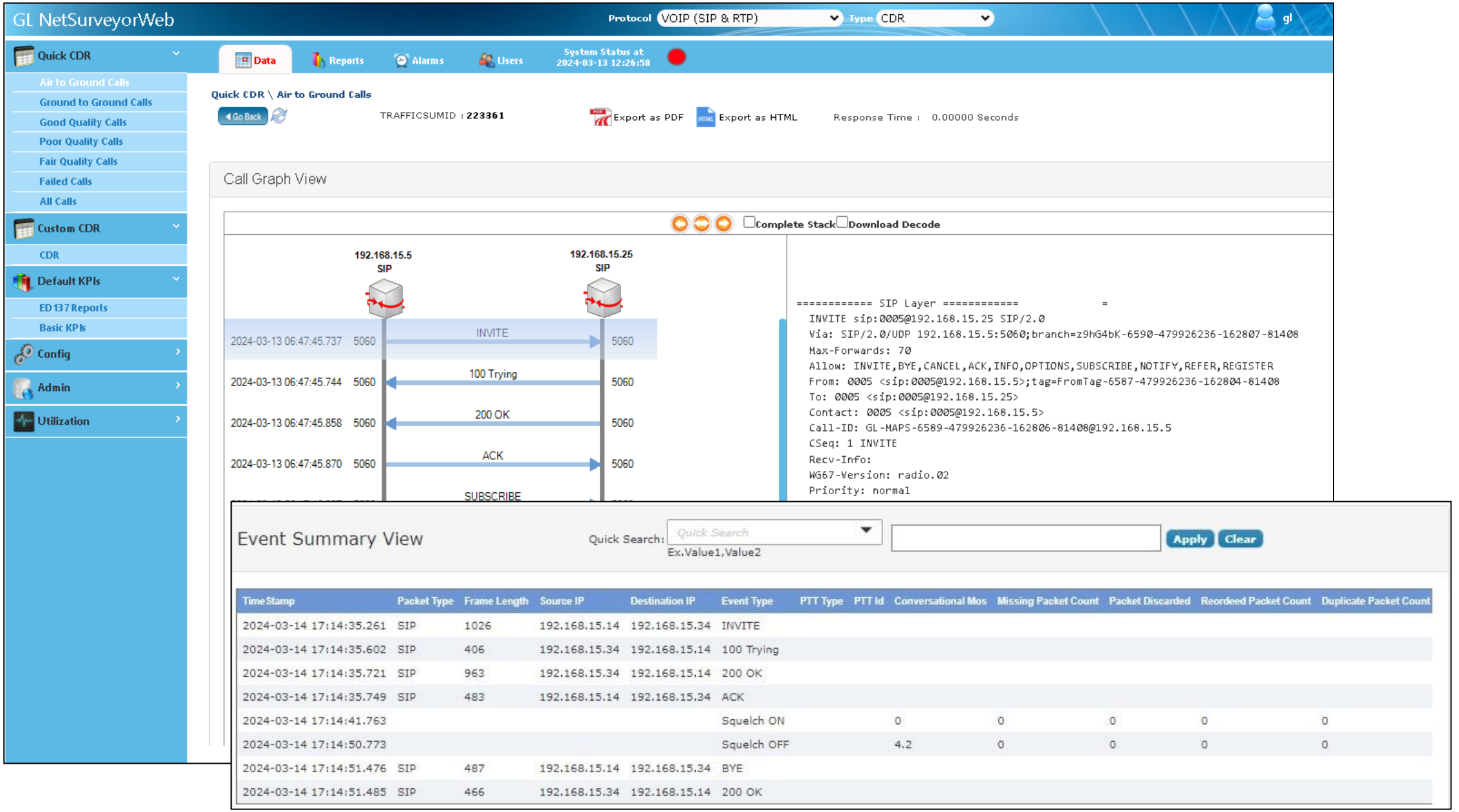
NetSurveyorWeb™ – Call Detail View



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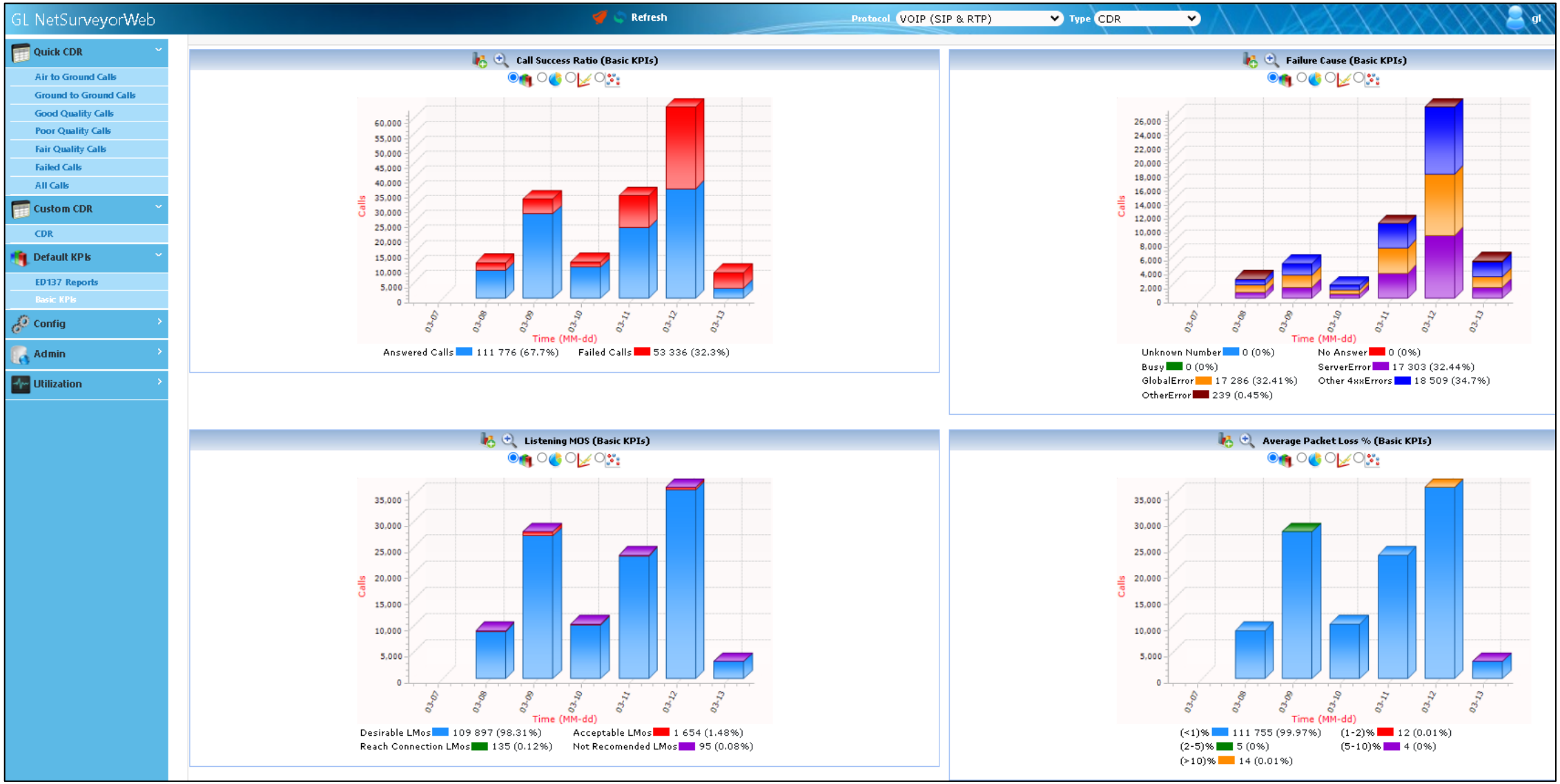
NetSurveyorWeb™ – Reports and Graphs



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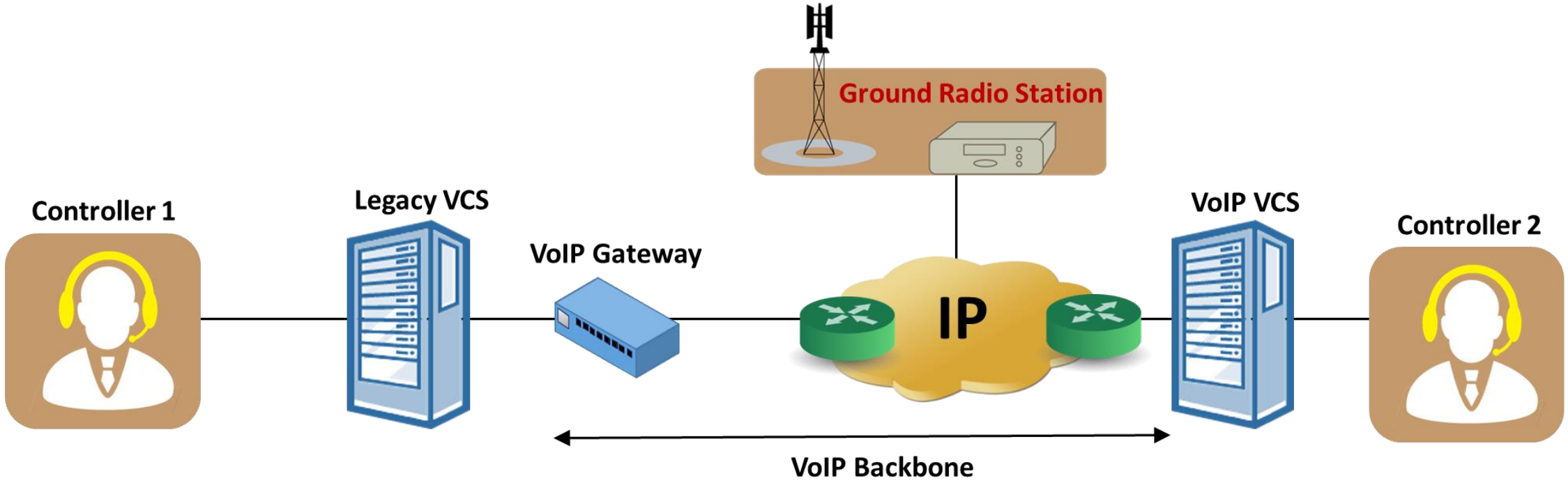
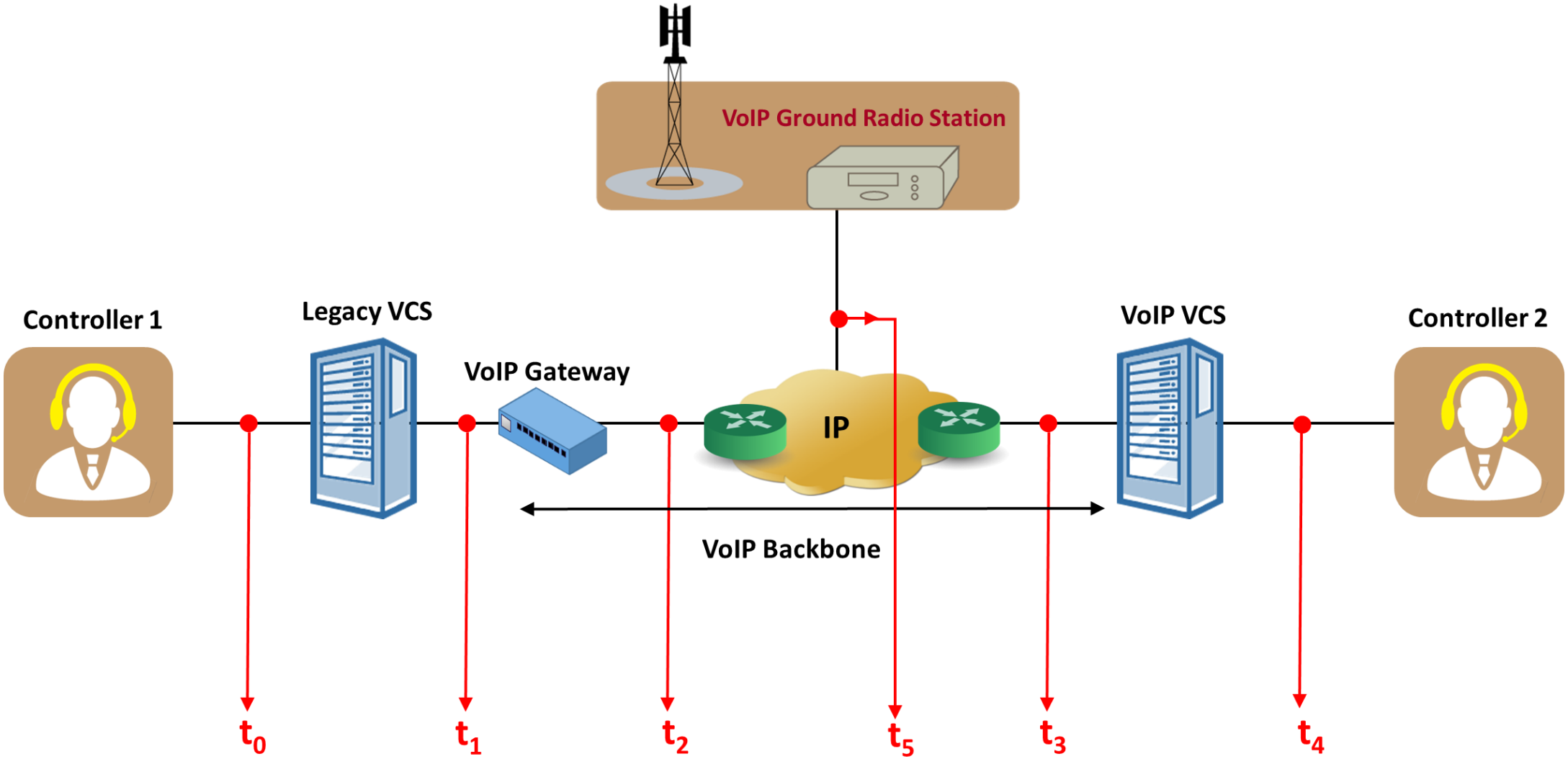
GL's Critical Delay and Voice Quality Measurement in Air Traffic Management (ED-138)

Critical Time Delay Measurements



Critical Time Delay Measurements (ED-138) - Overview

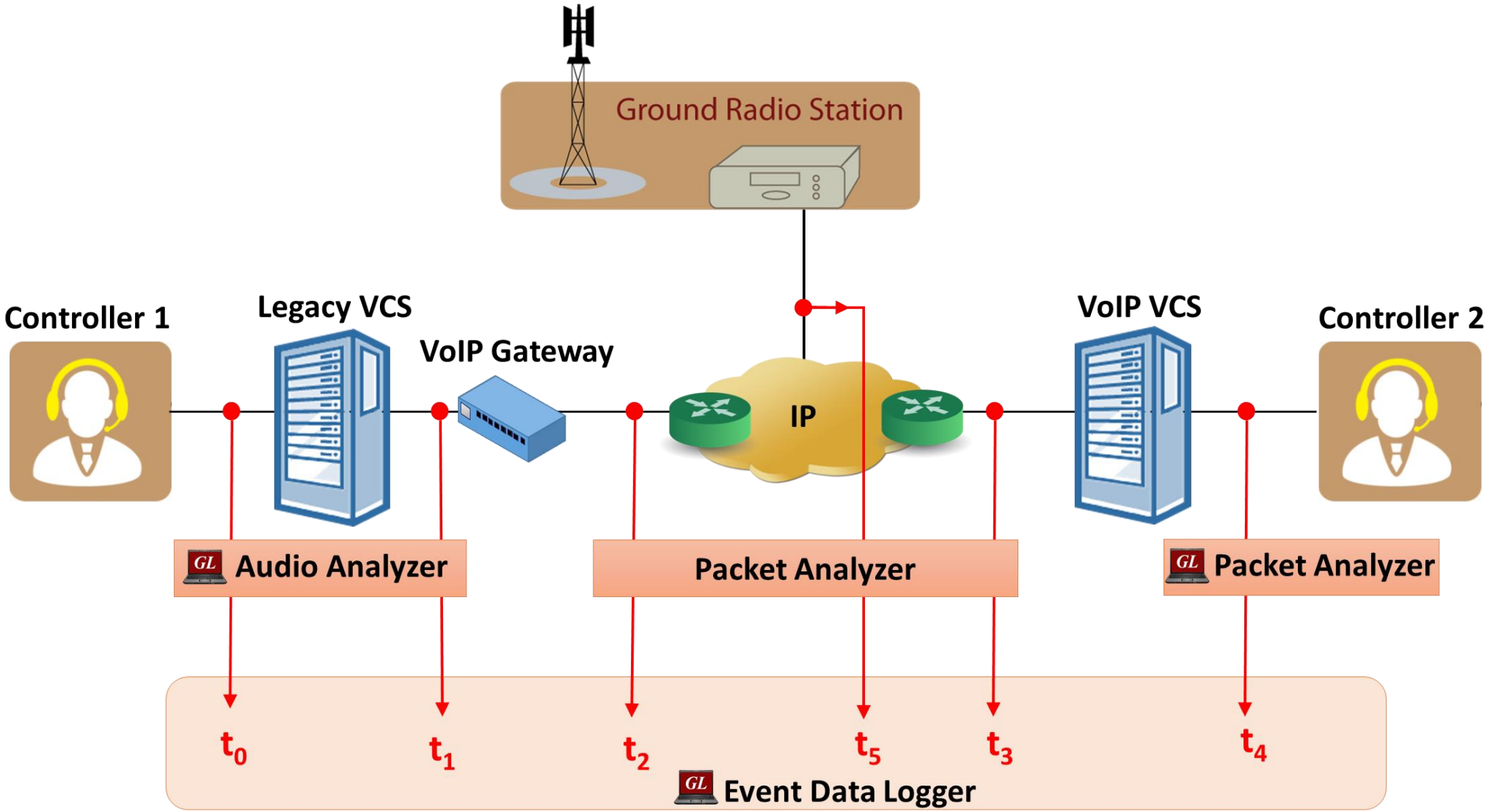


Important Events to Measure in ATM Network

- 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



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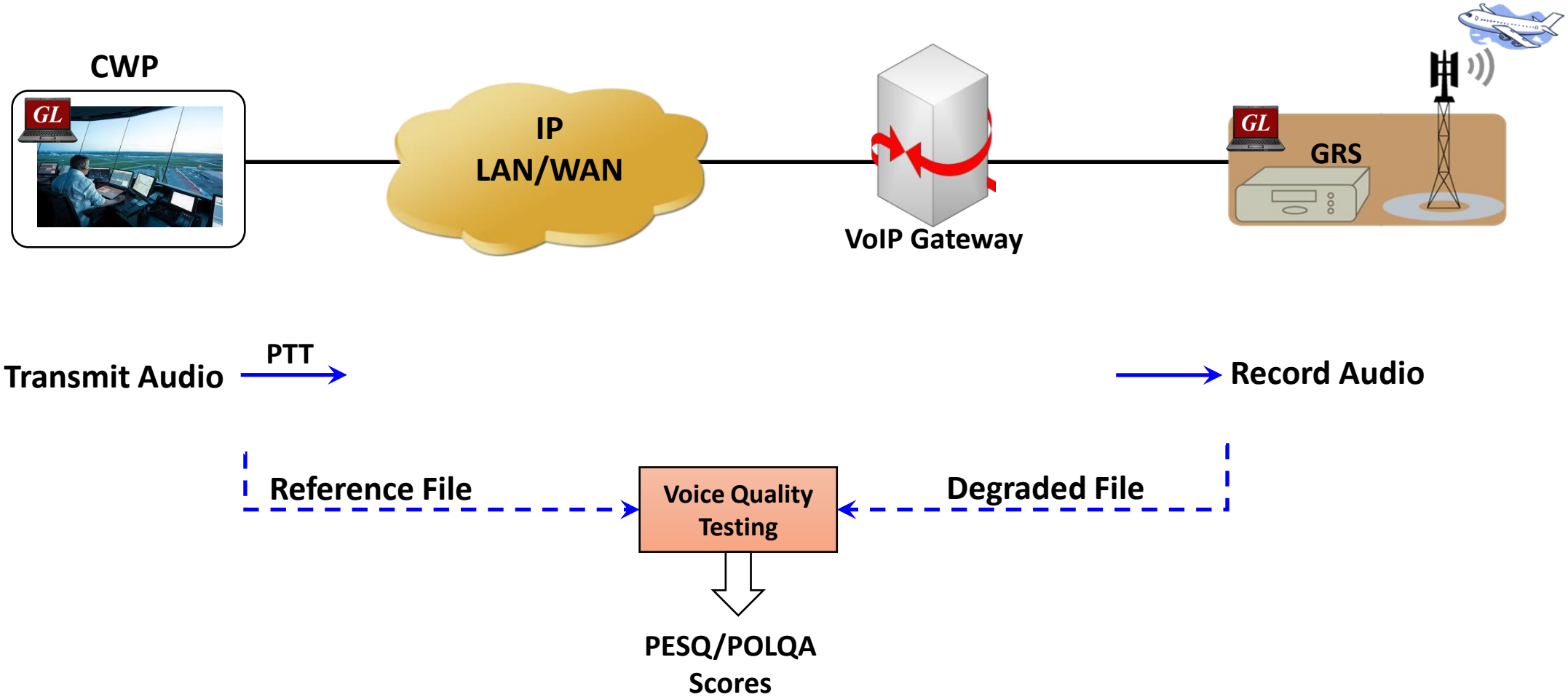
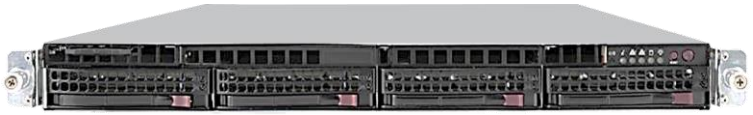
Voice Quality Measurements in ATM

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



Deployment Architecture Elements



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

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

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

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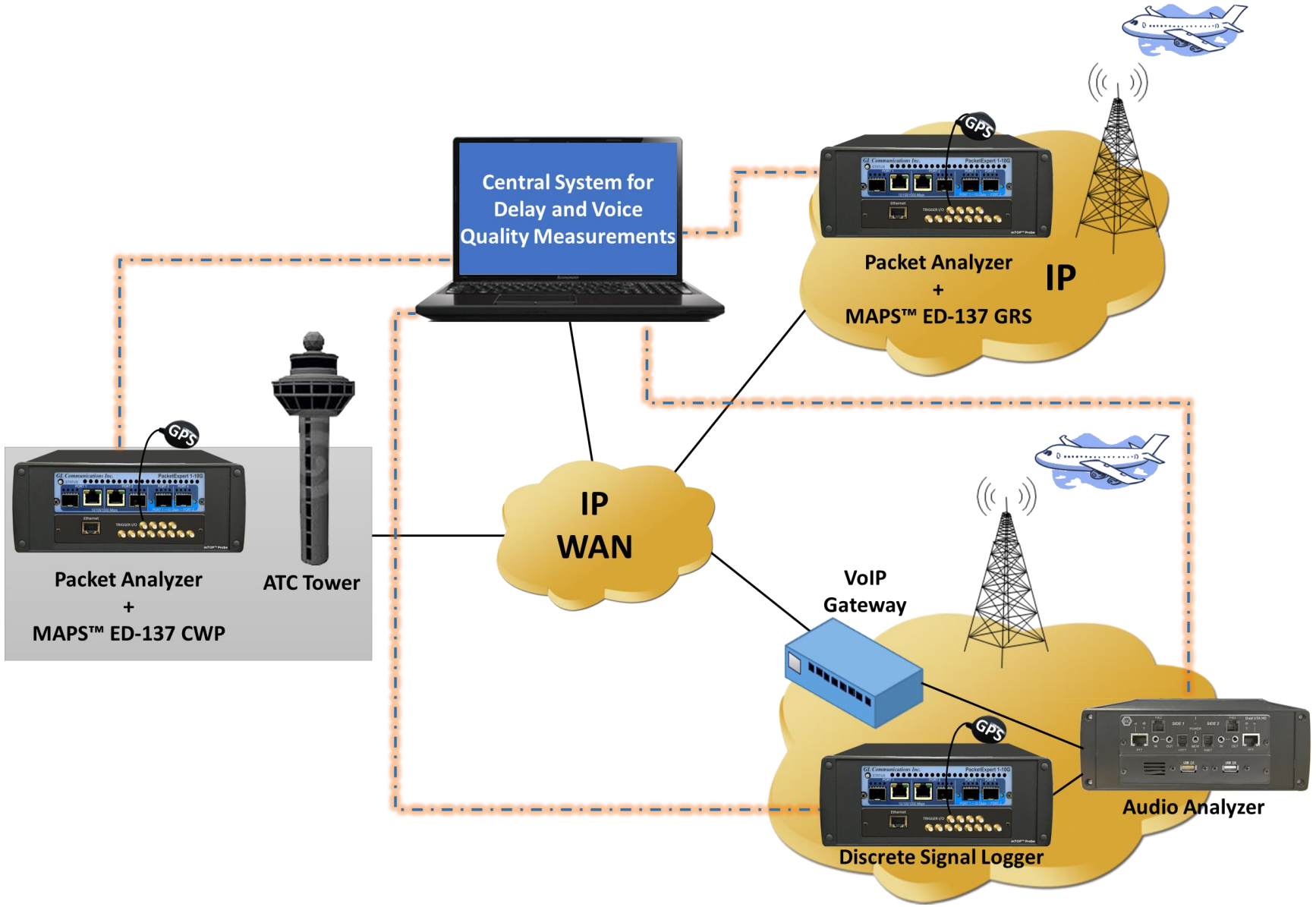
ATM Solution for Portable Field Testing



Thank you