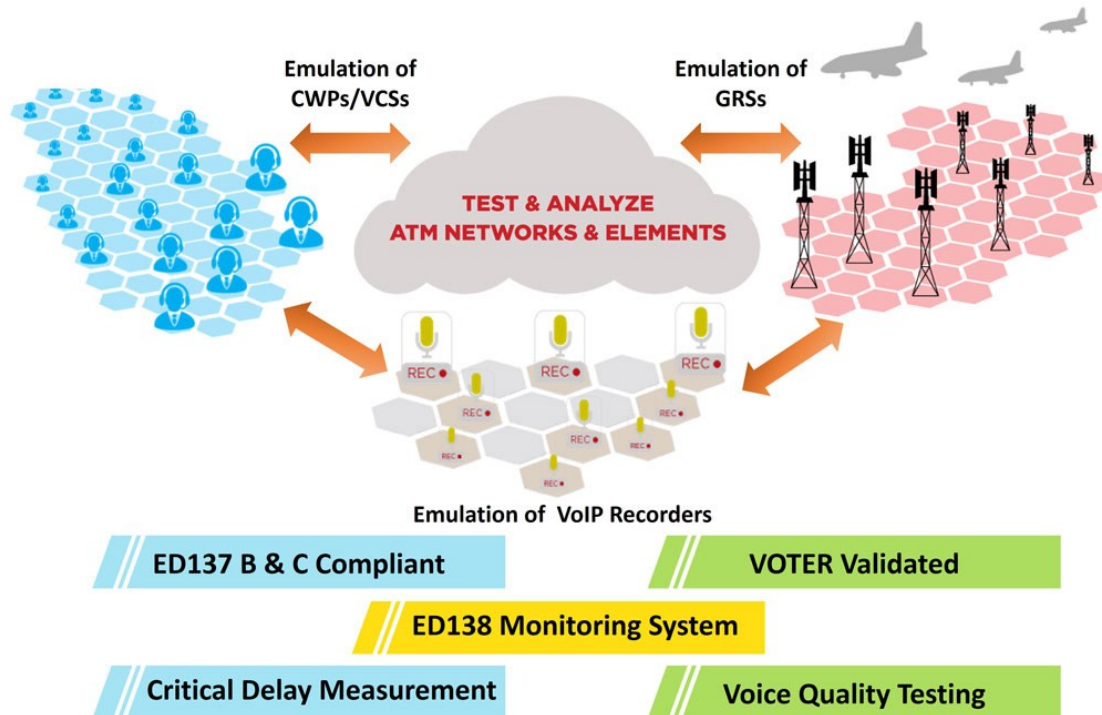# Test Solutions for Air Traffic Management (Emulation & Surveillance)

December 2021


- **MAPS™ ED137 Radio/Controller Emulator (Air-to-Ground)**
- **MAPS™ ED137 Telephone Emulator (Ground-to-Ground)**
- **MAPS™ ED137 Recorder Emulator**
- **Critical Time Delay Measurement with Audio/Packet Analyzers**
  - PacketExpert™ based modules - Packet Analyzer, TTL Signal Packetizer, and Event Data Logger
  - VQuad™ based Audio Analyzer module is capable of delay measurement, generating event driven triggers
- **Air Traffic Network Surveillance (NetSurveyorWeb™)**
  - PacketScan™
  - NetSurveyorWeb™, NetSurveyorWeb™ Lite
- **WAN Link Simulation**
- **MAPS™ CAS and ISDN**

GL Communications Inc.

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

Test Solutions for Air Traffic Management

## Emulation of Network Elements within VoIP ATM Network
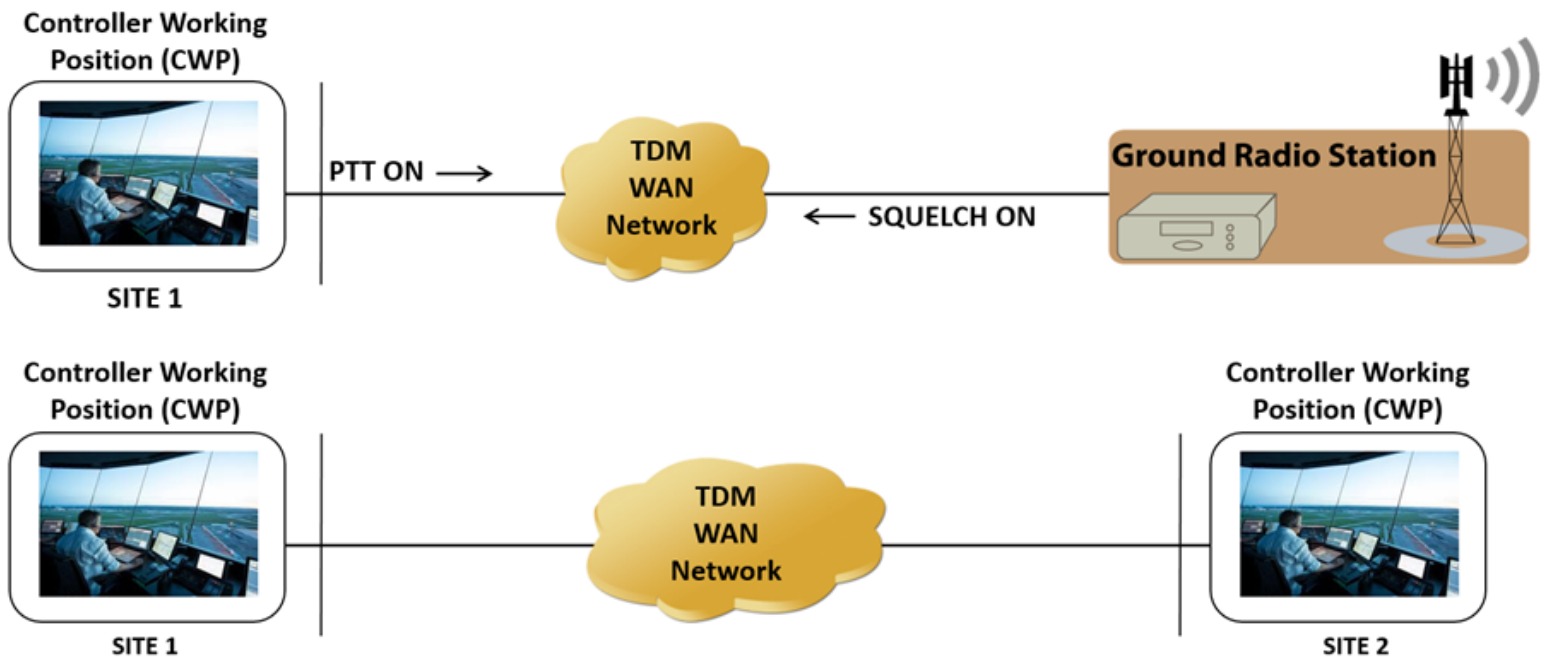
Voice communications for air traffic management, whether it is **Air-Ground (AG)** or **Ground-Ground (GG)** were predominantly over TDM based Air Traffic Management (ATM) networks. With the latest developments in EUROCAE (European Organization for Civil Aviation Equipment) ED137 inter-operability standard, it is now possible to implement VoIP technology for air traffic control communications.

Among many other solutions for testing Air Traffic Control network, GL offers **MAPS™ ED137 Radio** and **MAPS™ ED137 Telephone** software to emulate both Air-to-Ground calls (as per ED137_1B: Radio and ED137_1C: Radio) and Ground-to-Ground calls (as per ED137_2B Telephone). MAPS™ ED137 Radio emulates the functions of Controller Working Position (CWP) and Ground Radio Station (GRS) or Radio Media Gateway (RMG) entities. MAPS™ ED137 Telephone emulates the functions of the CWP in Ground-to-Ground telephone calls.

Refer to https://www.gl.com/test-solutions-for-voip-air-traffic-management.html webpage for complete information on end-to -end air traffic emulation tools.

Air Traffic Control Recording Solution
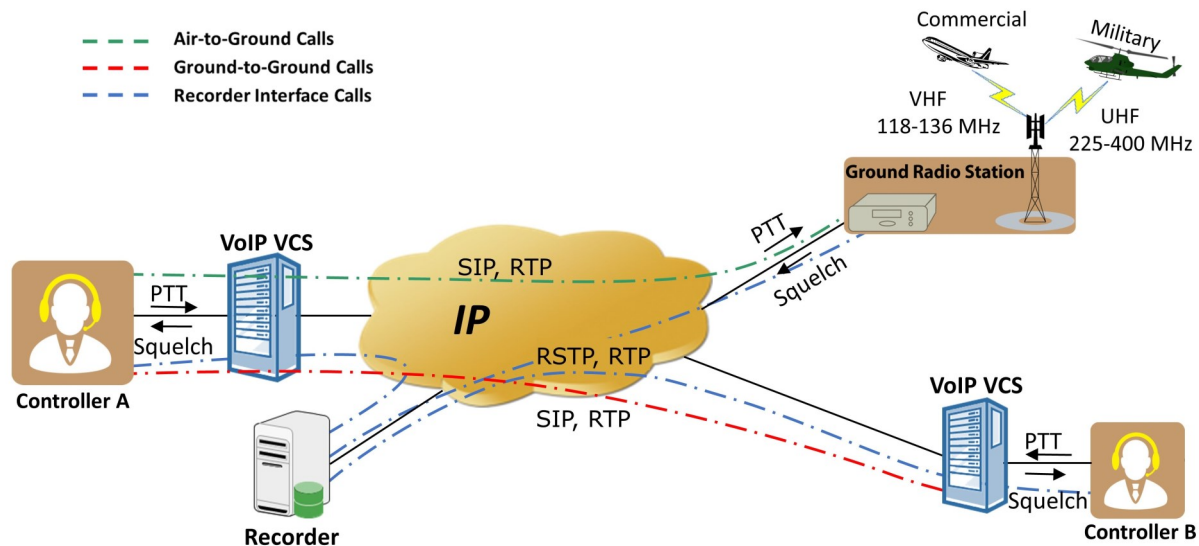
GL's **MAPS™ ED137 Recorder** software emulates Recorder interface at multiple CWPs, Radios and Recorder endpoints in accordance with **ED137-4B** and **ED137-4C** standards. Supports Recorder interface for both Air-to-Ground and Ground-to-Ground calls. Its features include -

- Emulates both ED137-4B and ED137-4C versions of Recorder Interface
- Emulates recording interface at CWP, VCS, GRS and Recorder end points
- Supports all three media transport methods: Embedded Binary Data, RTP over TCP and RTP over UDP
- Recorder node records the voice on sessions to audio files and saves Call Record Data to CSV files
- Hundreds of recording sessions can be made to Recorder to verify performance and load testing
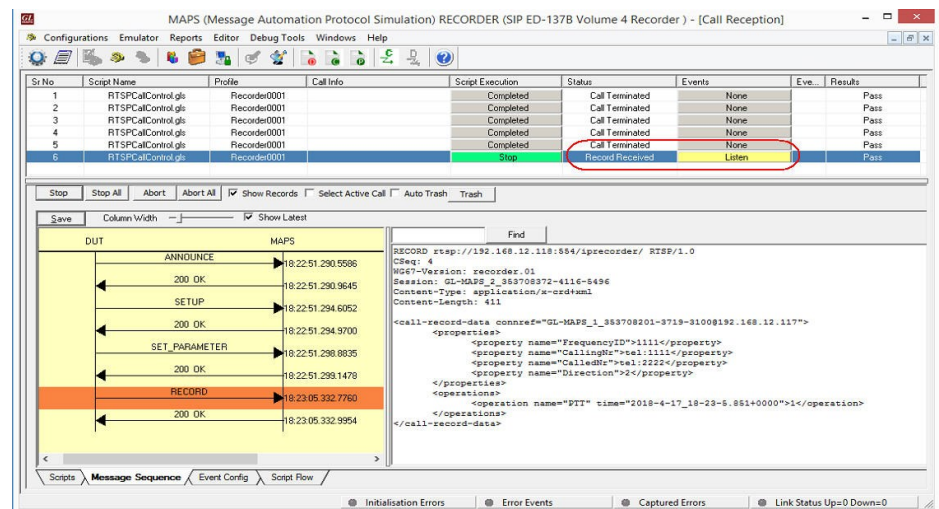

- Supported codecs include G711 A-law, U-law and G729
- Scripts to automate PTT and Squelch operations on recording sessions
- GUI provides custom Call Record Data and Operations configurations, Call Graphs and Message decodes
- Incredibly flexible architecture for customizing testing scenarios

Refer to https://www.gl.com/test-solutions-for-voip-air-traffic-management.html webpage for complete information on Recorder emulator.

Timing Measurements in Air Traffic Management (TM-ATM)
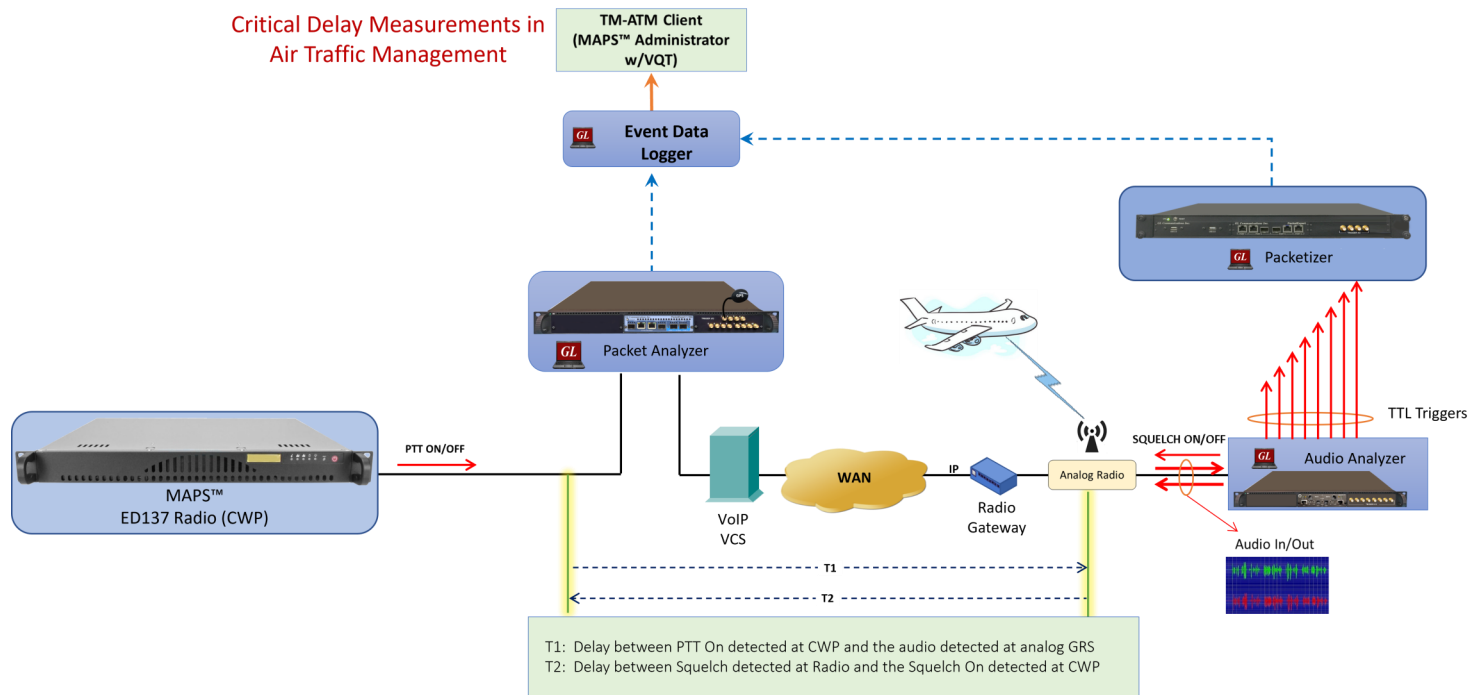
GL has developed TM-ATM (Timing Measurements in Air Traffic Management), a client server model which provides critical timing measurements for various types of delay occurrences in signaling and voice transmission through the network. MAPS™ Administrator is a centralized client component which controls multiple server components in the network.

The TM-ATM server components can be broadly categorized into two sets:

- Packet based - Packet Analyzer, Packetizer, Discrete Signal Logger, and Event Data Logger
- Analog/4 Wire - Audio Analyzer

A brief description of GL Tools used and their functionalities for Timing Measurement:

Audio Analyzer – The Audio Analyzer is a 4-wire audio device which includes 2 audio channels and 8 TTL triggers. It can connect to a CWP and simulate a controller by activating PTT and transmitting audio. It supports PTT interfaces to connect to CWP Dual Jack Module and other 4-wire interfaces. The analyzer can generate TTL for different actions (PTT ON, PTT OFF, Send Audio, Detect Audio).

TTL Signal Packetizer – works in tandem with the Audio Analyzer to convert analog events into packet events. The Packetizer monitors the TTL output from the Audio Analyzer, and for every trigger pulse received, it generates and transmits a timestamped IP packet indicating a certain event has occurred.

Packet Analyzer - Functions as a highly precise Ethernet tap, filtering packets of interest from a bidirectional Ethernet link without disturbing the traffic. The filtered packets are modified (Timed Events) and forwarded to Event Data Logger. It also generates output TTL signal pulses for every filter match, which can be processed using an external device like Oscilloscope.
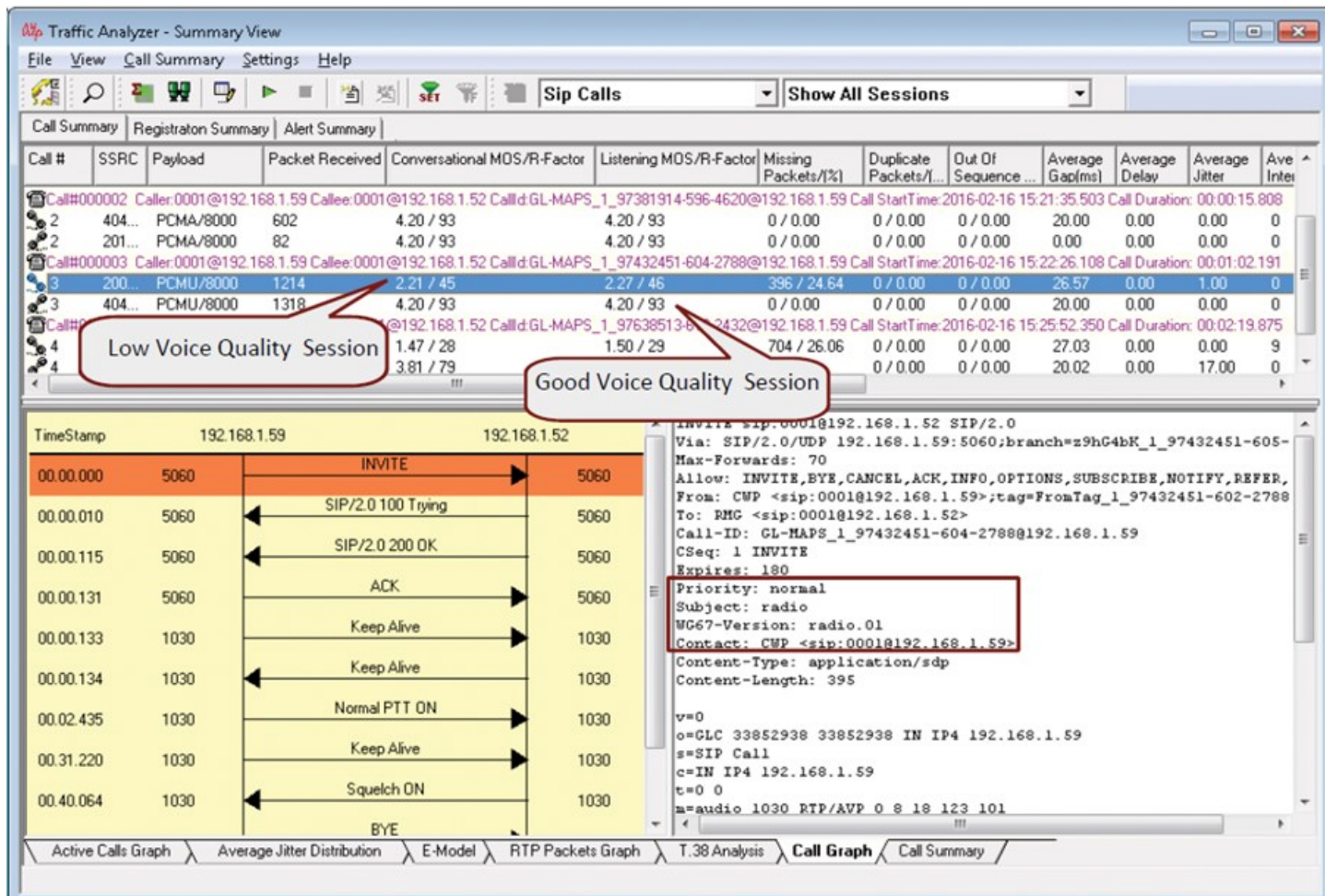
Event Data Logger– Receives the Discrete event packets forwarded from Packetizers and the Timed event packets from Packet Analyzer systems throughout the network. It timestamps each received packet, decodes the packet to extract information, and updates both the Events to the MAPS™ Administrator.

MAPS™ Administrator - is a control/logging client application, which uses TCP/IP to send commands to and receive notifications from all the above-mentioned server tools. MAPS™ Administrator will calculate the time difference between posted events, i.e., Discrete Events (from the Packetizer) and Timed Events (from Packet Analyzer) and reports precise measured delay at different points in the network. MAPS™ Admin is script based and API driven products that can be reused for various purposes during test cycles.

Refer to https://www.gl.com/vquad-probe.html and https://www.gl.com/optical-and-ethernet-testing-packetexpert.html webpages for complete information on audio and packet analyzers.

Monitoring Probes for VoIP ATM Network

GL's PacketScan™ software offers powerful features to capture and monitor live signaling and traffic over IP. It captures, segregates, monitors and collects statistics on all Ground-to-Ground calls and Air-to-Ground sessions

- All traffic supported – Digits, Tones, Voice, Video, Fax

- Live monitoring of IPv4 and IPv6 networks, including the ability to play recorded voice files

- Decodes signaling, traffic and extended RTP headers as per ED-137/1B

- Measures Voice Quality statistics such as MOS/R-Factor, Packet Loss, Jitter, Delay, and many more for each call

- Permits analysis of adherence to protocol standards for the system under test or observation

- Provides graphical representation of signaling analysis including protocol ladder diagrams
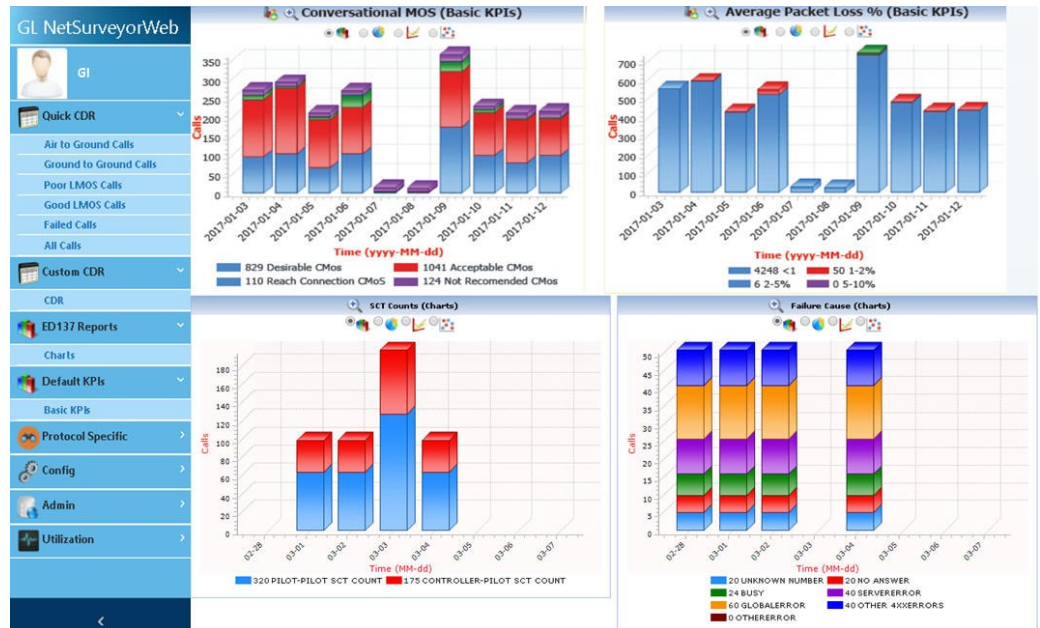
Refer to https://www.gl.com/packetscan-all-ip-packet-analyzer.html webpages for complete information on packet monitoring.

Air Traffic Control Monitoring Solution (NetSurveyorWeb™)

Multiple **PacketScan™** probes can be deployed at remote locations to non-intrusively monitor VoIP ATM network. **GL's NetSurveyorWeb™** is a web-based network surveillance system that works with PacketScan™ probes for controlling, collecting, and analyzing call data records. It provides a centralized web-based dashboard to users. NetSurveyorWeb™ is based on a scalable and flexible architecture and is widely used to non-intrusively monitor from one or many testing locations.

GL also offers **NetSurveyorWeb™ Lite** as a simple all-in-one integrated monitoring PC containing a web server, database, and protocol analyzer probe. This system comes with all applications built-in so that users can immediately start monitoring the ATM networks.

Both applications provide a convenient display of call data records by connecting to PacketScan™ probes.

- Provides database query methods in order to query captured results, and gather status, statistics, and events.
- Results are displayed both in tabular and graphical formats.
- Provides protocol signaling, traffic, and call detail records.
- Perform filter and/or search for specific information.
- Generate reports and alarms.

Refer to https://www.gl.com/web-based-network-monitor-analysis-wireless-ip-tdm.html webpages for complete information on Network Monitoring and Diagnostic Systems.
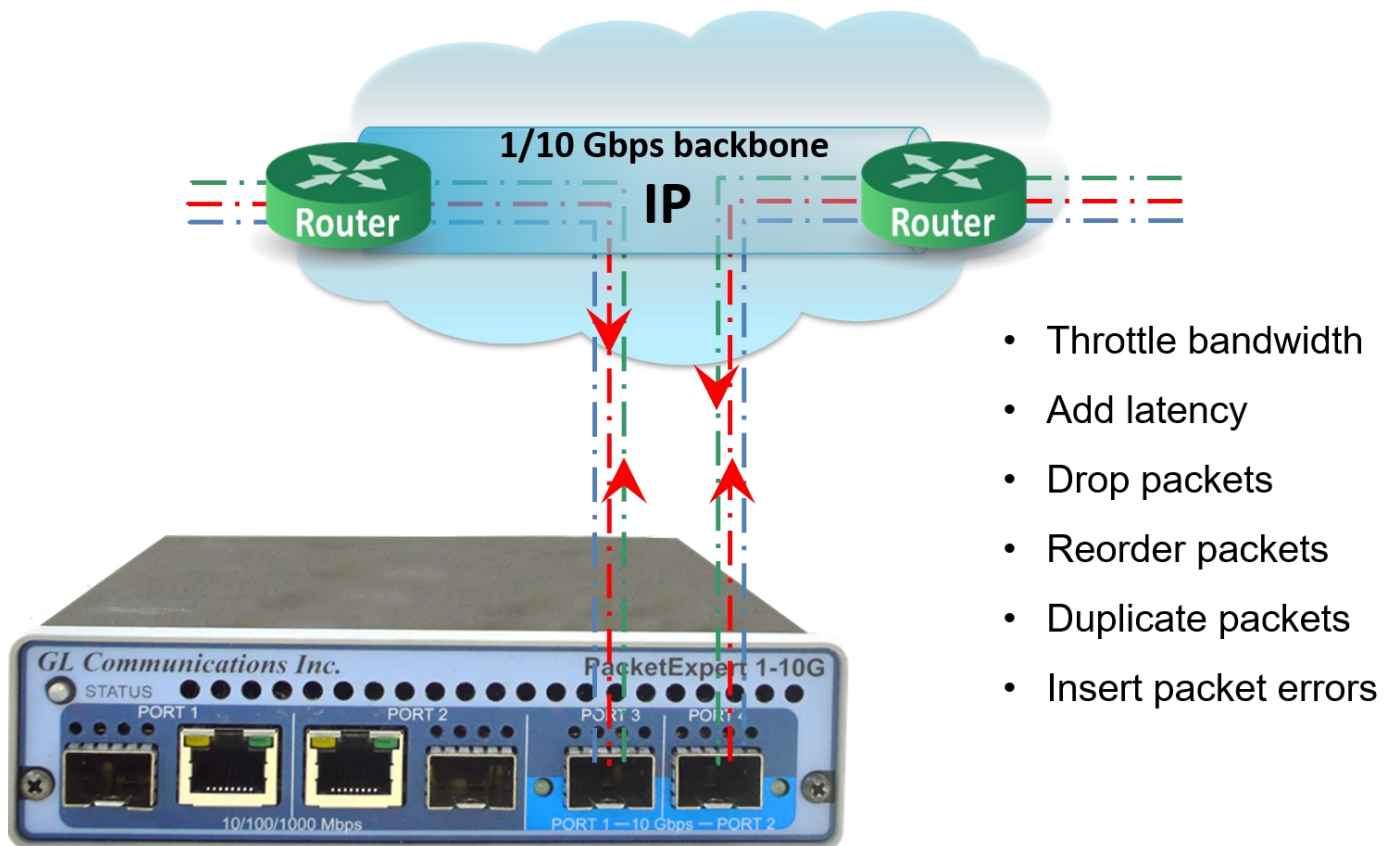
Wide Area Network (WAN) Simulation

GL can simulate real world WAN impairments in order to safely test applications in the lab.

GL's WAN link emulators support both electrical (RJ-45) and optical (single mode and multi-mode) interfaces, with capacity ranging from 10 Kbps to 10Gbps.
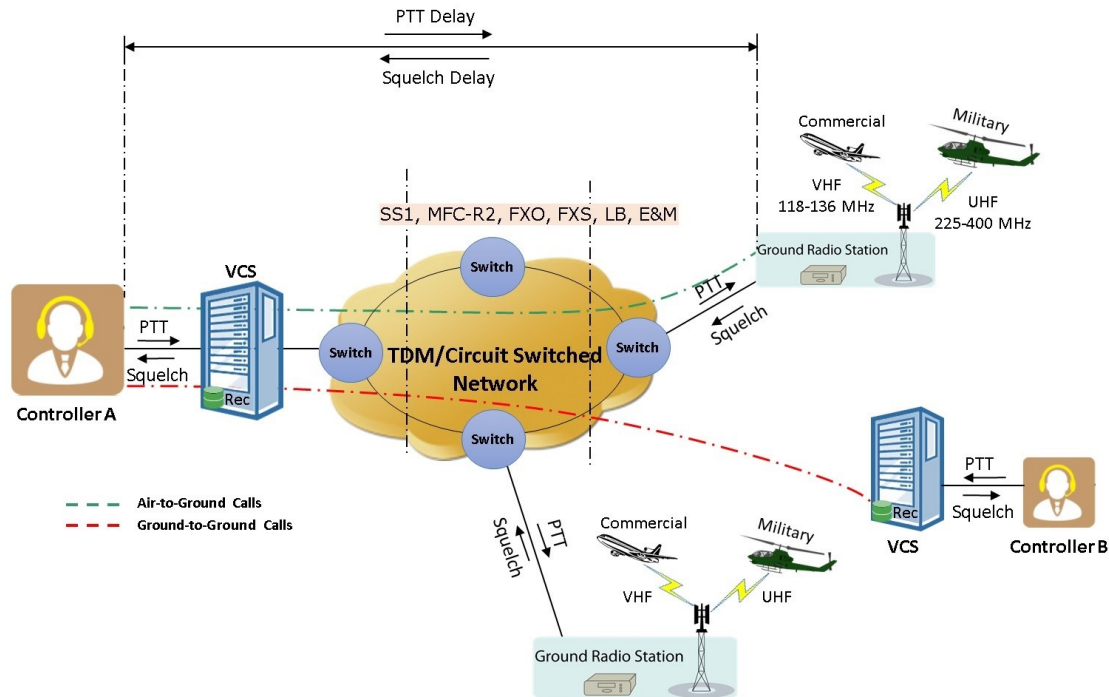
- Simulates impairments such as bandwidth throttling, latency, packet loss, packet reordering, packet duplication and byte errors.

- Provides a visual display of the current traffic conditions including throughput graphs and link statistics.

- Acts as a transparent bi-directional Ethernet link.

- Automate stream impairments using pre-defined CSV file.

- Allows bandwidth control from 10 Kbps to 10 Gbps to emulate various WAN link speeds.

Refer to https://www.gl.com/wan-link-emulation-ipnetsim.html webpages for complete information on WAN Simulation.

- Throttle bandwidth
- Add latency
- Drop packets
- Reorder packets
- Duplicate packets
- Insert packet errors

Test Solutions for Legacy TDM ATM Network

TDM Record and Playback Applications

GL's Synchronous Trunk Record/Playback (or STRP) application offers both Record and Playback features on T1 E1. For large capacity, GL's **Octal T1 E1 boards** can record and playback on up to 192 T1 channels and 256 E1 channels per board. More scalability can be achieved with multiple boards. This application is most valuable for critical data analysis in defense and research activities.

The application permits the user to synchronously record any type of traffic (voice, digits, and tones) on multiple complete T1 or E1 lines (trunks) with accurate timestamp. It also allows to playback some or all of the recorded data to recreate the live transmission exactly as it occurred. Refer to https://www.gl.com/synchronous-trunk-record-playback.html webpages for complete information on STRP application.

Protocol Emulators and Analyzers

ISDN

GL's **MAPS™ ISDN** is an advanced protocol simulator/tester for ISDN simulation over TDM (T1 E1) and generates high volumes of ISDN traffic. The tester can emulate ISDN signaling as defined by ITU-T, 5ESS, 4ESS, BELL, DMS-100, DMS-250, and QSIG ECMA standards. Refer to https://www.gl.com/maps-isdn.html webpage for complete information on MAPS™ ISDN.

CAS

GL's **MAPS™ CAS** is used to perform testing using CAS signaling and transmission and detection of TDM traffic over T1/E1 using scripts, and offers a complete solution for testing, troubleshooting, and maintenance of devices and networks implementing CAS. Typical CAS signaling methods are: Loop Start, R1, E1 MFC-R2, E1 Digital E & M, SS5, Sweden P7, FGD, CAMA, and other variants of these methods. Refer to https://www.gl.com/maps-cas-emulator.html webpage for complete information on MAPS™ CAS.

SS1

GL's **SS1 Analyzer** detects and analyzes tone sequences that make up SS1 dial digits. Sequences of pulse and guard tones are detected, decoded, and assembled into their corresponding dial digits. The tone sequences are also verified for compliance against a "specification" parameter file which can correspond to published standards or user criteria. The **SS1 Emulator (Dialer)** application provides the ability to setup and dial tone sequences that make up SS1 dial digits. The applications' interface includes options to setup Dial Code, and control Mask (pulse) and Space (guard) frequencies and duration, Initial, Nominal, and Final Durations, Timeout definitions, Transmit Channel, and other similar parameters related to the dial code. Refer to https://www.gl.com/ss1analyzer.html webpage for more information on SS1 Analyzer.