MAPS™ LTE S1 - Long Term Evolution (LTE) S1 Emulator and Conformance

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MAPS™ LTE S1 Interface and Conformance Emulator
Emulate elements in LTE network
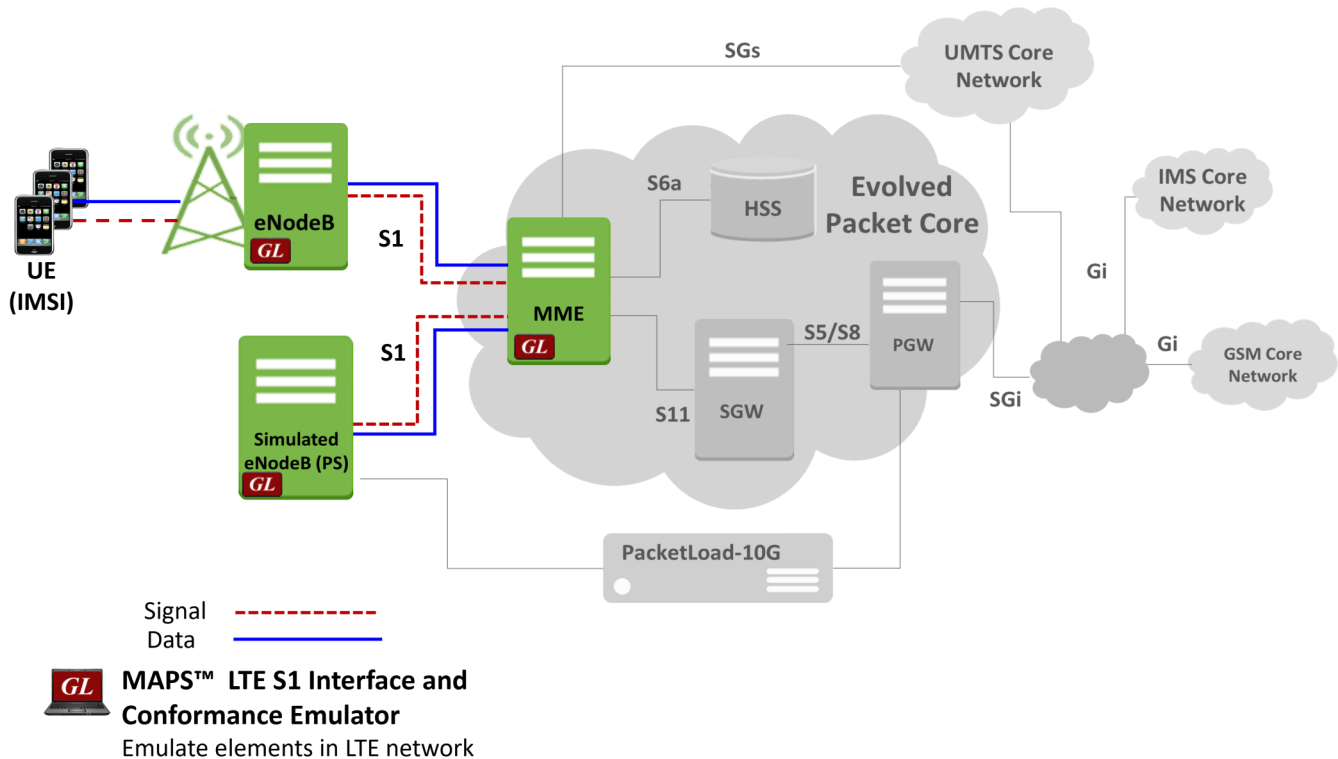
Overview

GL's **Message Automation and Protocol Simulation (MAPS)™ LTE-S1** is an advanced protocol emulator for LTE emulation over S1 interface that can emulate S1-AP/Non-Access Stratum (NAS) messages and signaling as per 3GPP standards.

MAPS™ LTE - S1 can emulate and test eNodeB (Evolved Node B), and MME (Mobility Management Entity). eNodeB is the base station in the LTE/SAE S1 interface and also includes MME (to handle signaling of control plane) as shown in the above network architecture.

GL's also offers MAPS™ LTE conformance test suite (PKS154) designed with 50+ test cases, as per 3GPP TS 36.413 specification. It includes inbuilt conformance scripts (*.gls) for eNodeB and MME nodes in S1 interface. Test cases include general Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 Application Protocol (S1AP) messaging and call flow scenarios over LTE network. Logging and pass/fail results are also reported. Test cases verify conformance of actions such as UE attach/detach, periodic updating, Handover procedure, UE context release, and error indication

GL's PacketLoad™ appliance supports massive emulation of UEs (up to 500000) with high density (up to 4 Gbps or 40 Gbps) mobile data traffic emulation over LTE network. The solution offers stateful TCP/HTTP, and PCAP Replay traffic types.

User-plane packet traffic emulation in LTE network requires additional mobile traffic core - GTP (ETH101) and mobile traffic core – Gateway (ETH102) applications.

The application also supports error tracking, regression testing, conformance testing, load testing. Test cases include general messaging and call flow scenarios for enhanced mobile radio and internet access.

For more information, visit MAPS™ LTE S1 webpage.

Main Features

- Supports complete end-to-end emulation of real-time VoLTE network using "MAPS 4G Wireless Lab Suite"
- Multiple eNodeB supports thousands of UEs
- Emulates eNodeB, and MME entities in S1 interface; Generates and process S1/NAS valid and invalid messages
- Generate thousands of VoLTE UE Signaling (Load testing)
- Supports LTE Control and GTP User Plane Data
- Traffic profiling capability: A real web browsing is supported along with generation of real-world traffic in the lab
- Massive UE emulation with Auto generation feature for high density load testing
- Supports large number of subscribers with CSV based profiles for bulk call generation
- Insertion of impairments to create invalid messages
- High Density GTP traffic emulation using PacketLoad™ and Voice traffic emulation using RTP HD appliance
- Handover S1 support including Intra/Inter MME, IRAT HO
- UE initiated signaling for CSFB and Supports PacketLoad™ PCAP playback feature
- Support for SNOW-3G, AES, 128-EEA2 and 128-EEA0
- Supports LTE S1 interface conformance test suite with 50+ test cases as per 3GPP TS 36.413 specification

Testbed Configuration

The testbed setup window allows users to setup the required test environment with SCTP configuration in S1 interface.

SCTP Configuration parameters consists of source / destination IP address, port, including stream id, payload id to configure MAPS™ to emulate eNodeB and MME entities in S1 interface. MAPS™ can then generate and receive S1AP/NAS messages to/from valid IP Address in the LTE network.

Auto Generated Users Info configuration required to emulate multiple calls. End user configuration profile used to configure MAPS™ LTE S1 with supported eNodeBs and MME parameters.
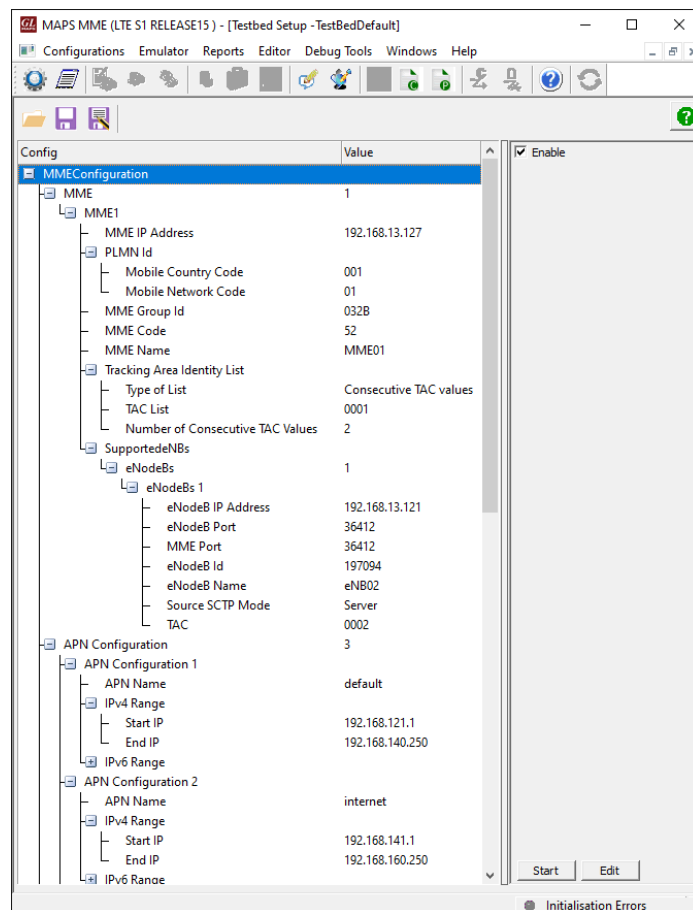

Figure: Testbed Configuration

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Pre-processing Tools

Message Editor

With message editor, users can build a template for each protocol message type. The value for each field may be changed in the message template prior to testing. The protocol fields comprises of mandatory fixed parameters, mandatory variable parameters, and optional variable parameters.
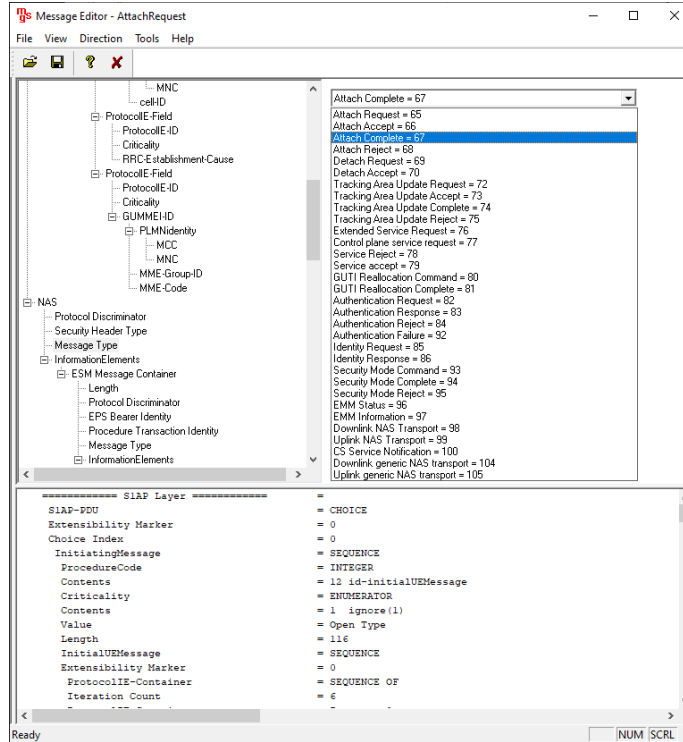

Figure: Message Editor

Script Editor

The script editor allows the user to create / edit scripts and access protocol fields as variables for the message template parameters. The script uses pre-defined message templates to perform send and receive actions.
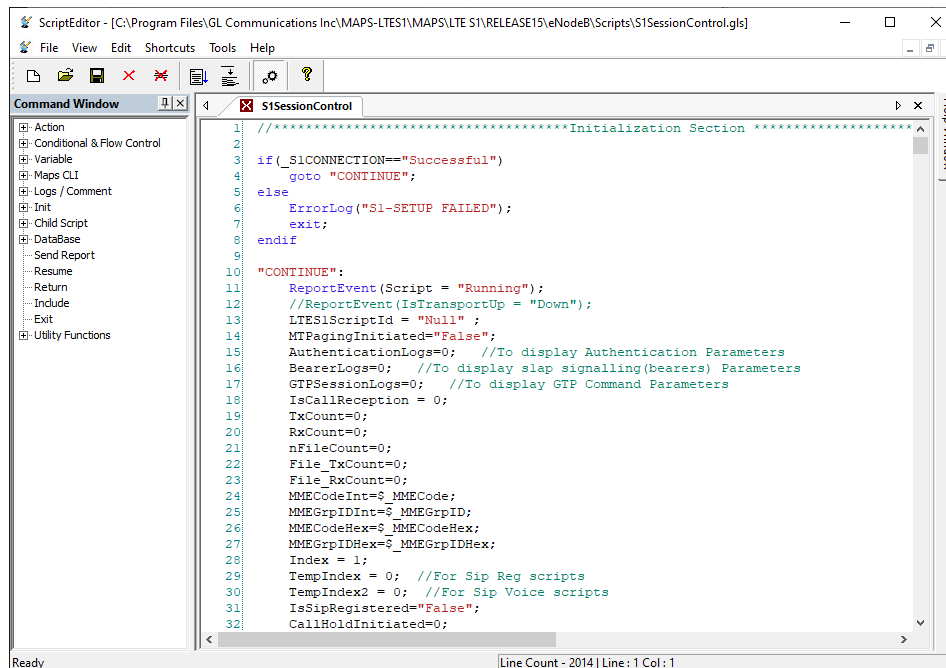

Figure: Script Editor

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Pre-processing Tools *(Contd.)*

Profile Editor

This feature allows loading profile to edit the values of the variables using GUI, replacing the original value of the variables in the message template. An XML file defines a set of multiple profiles with varying parameter values that allow users to configure call instances in call generation and to receive calls.

The UE_Profiles includes VoLTE parameter required to configure multiple UEs to emulate Voice over LTE calls.

Supports Mobile Traffic parameter settings allowing emulation of offline HTTP Traffic using Mobile IP Core TCP Client Server connections. Configurations include TCP Server IP, TCP Port for HTTP and HTTP files names.
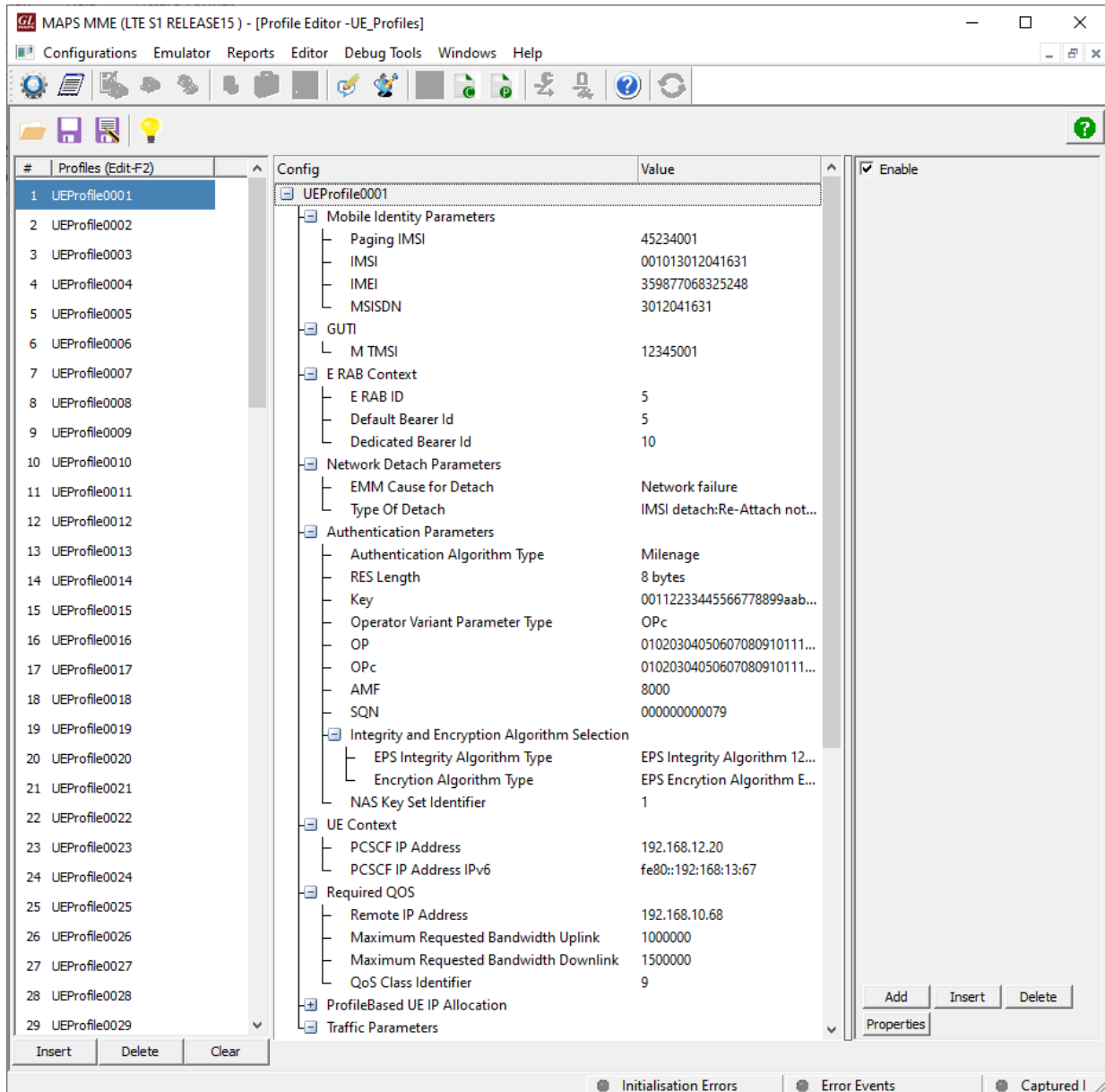

Figure: Profile Editor

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Call Generation and Call Reception

In call generation, MAPS™ is configured for the out going messages, while in call receive mode, it is configured to respond to incoming messages. Tests can be configured to run once, multiple iterations and continuously. Also, allows users to create multiple entries using quick configuration feature.

The editor allows to run the added scripts sequentially (order in which the scripts are added in the window) or randomly (any script from the list of added script as per the call flow requirements).

The test scripts are started manually at call generation; and at the call reception, the script is automatically triggered by incoming messages**.**
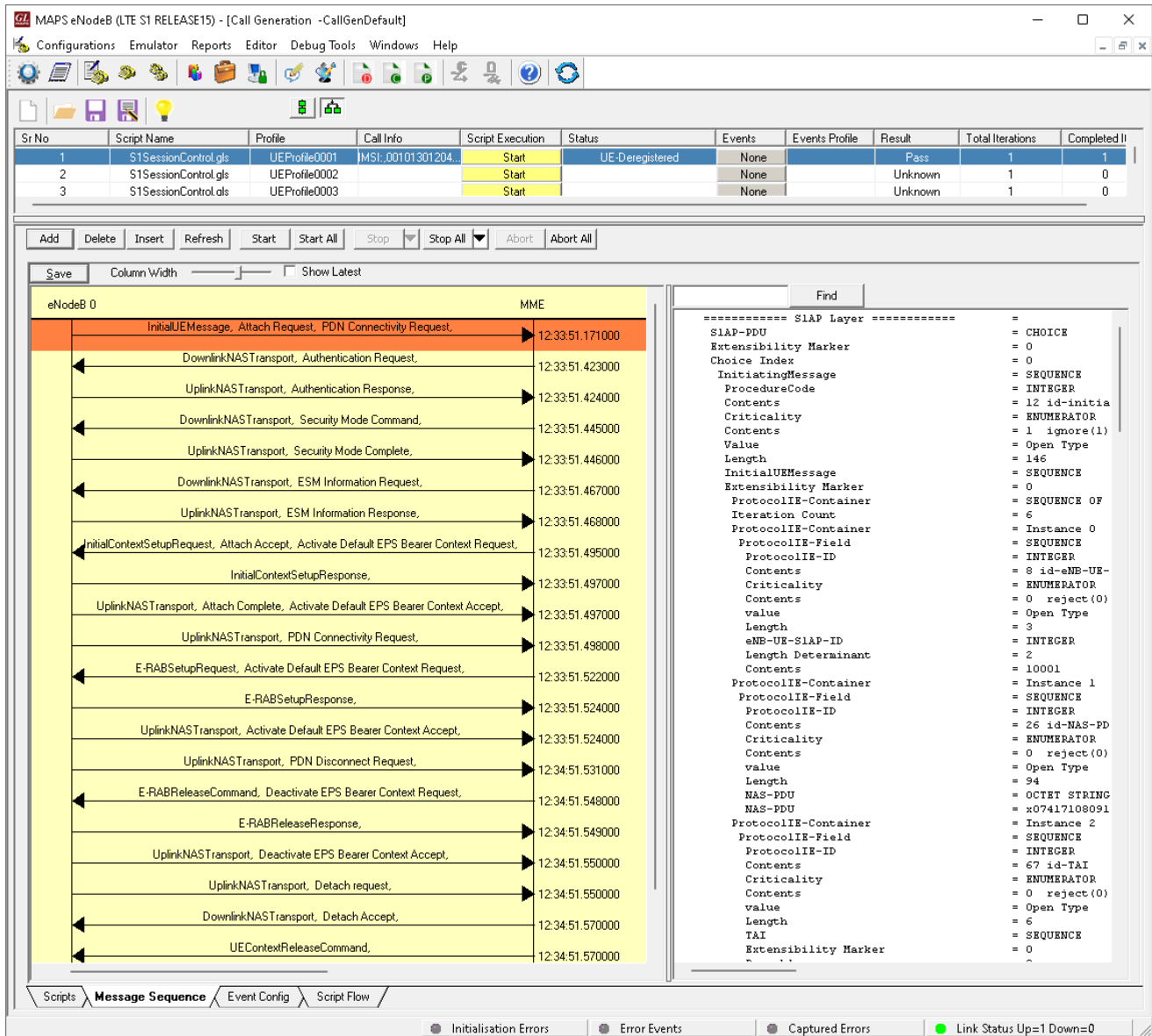

Figure: Call Generation

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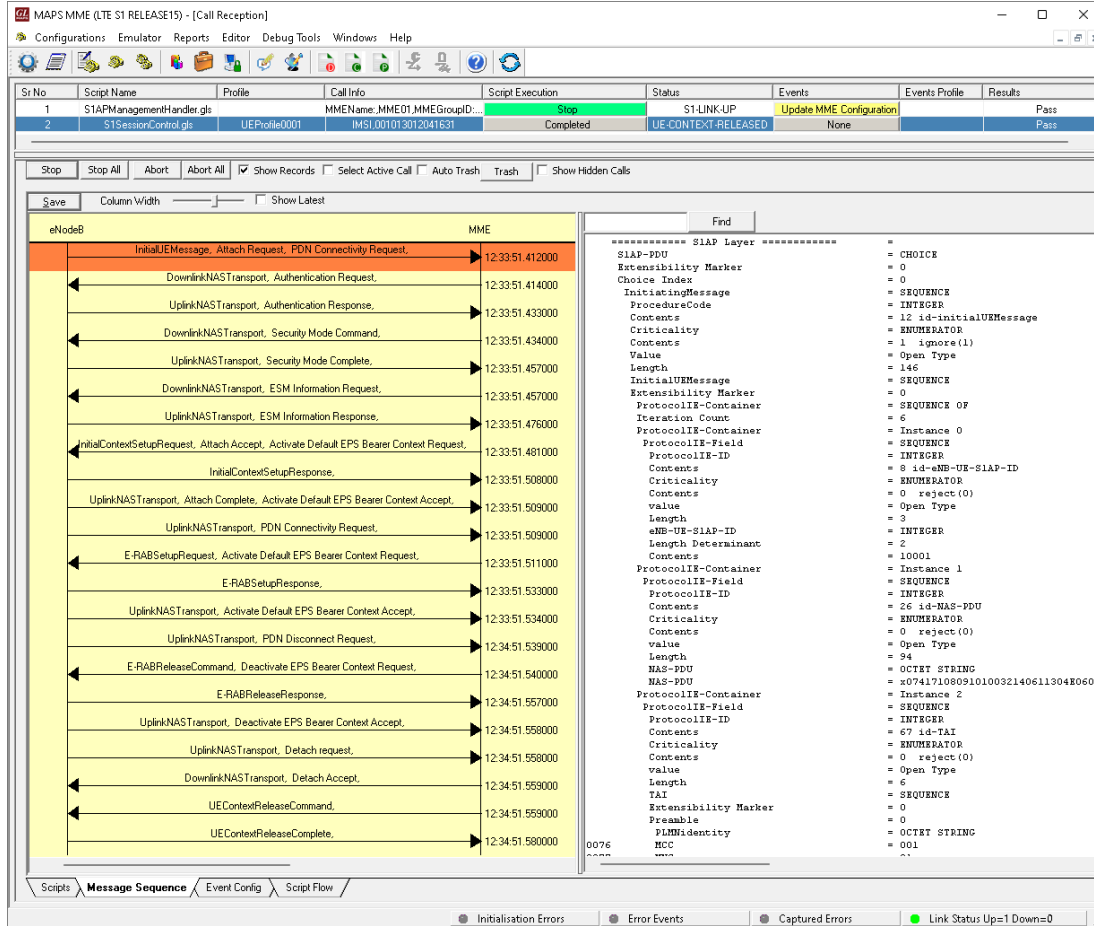
Call Generation and Reception (*Contd.*)

Figure: Call Reception

Capture Event Log

MAPS™ provides Events, Error Events, and Captured Errors log encountered during the progress of the call. The events are saved in the database which can be accessed via web interface.

Protocol specific signaling events and the traffic events are logged along with the Call Trace ID, Script Name, Script ID, and the Timestamp of the occurred event.
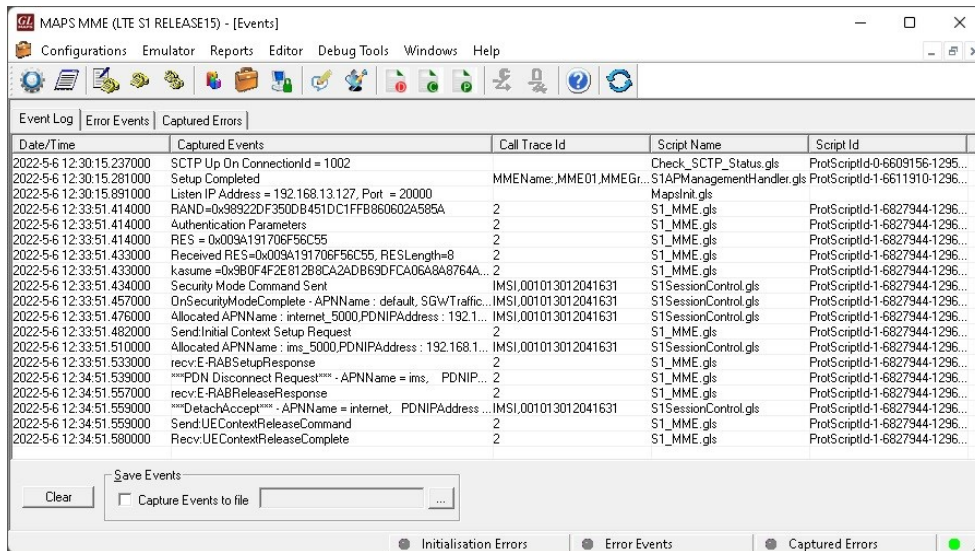

Figure: Events Log

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Emulation of LTE S1 Signaling Procedure

Given below is a general LTE-S1 signaling scenario, the messages between eNB and MME are emulated using MAPS™ application.
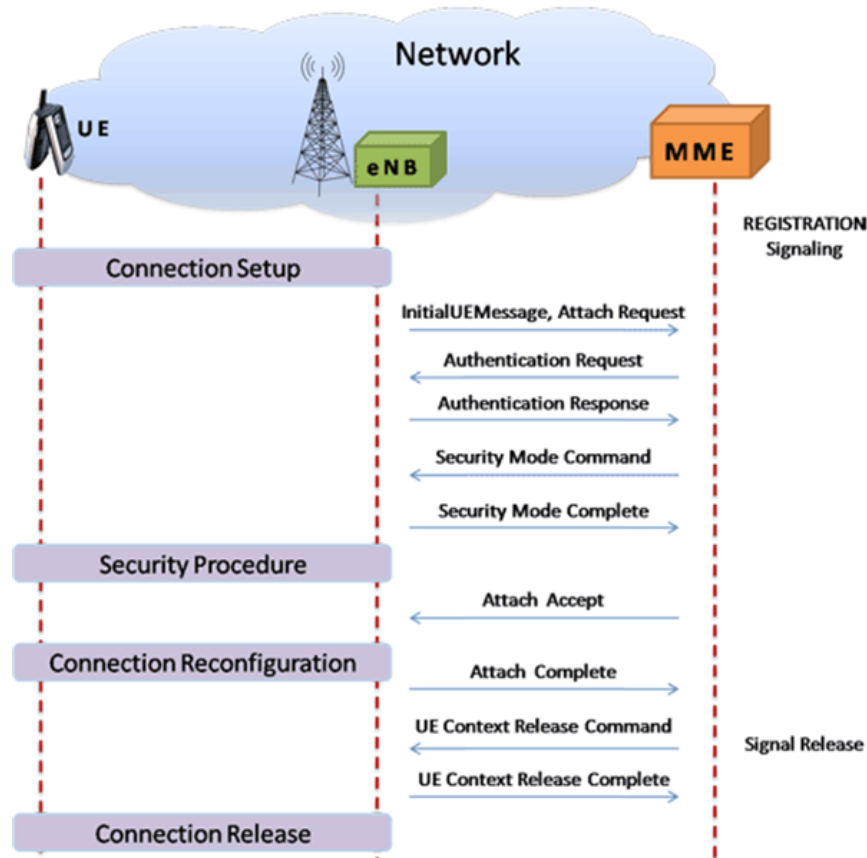

Figure: LTE S1 Signaling Procedure

Incoming Call Handler

The Incoming Call Handler contains a list of message types, each with a corresponding script. At the receiving end the expected initial message is compared with this list of messages, and if a match is found, the corresponding script is executed. Loaded answer scripts against the messages expected from the DUT:

- PDN Connectivity Request message: S1SessionControl.gls script
- Tracking Area Update Request message: S1SessionControl.gls script
- S1SetupRequest message: S1APManagementHandler.gls script used to respond to management procedures by sending S1 Setup Response Message
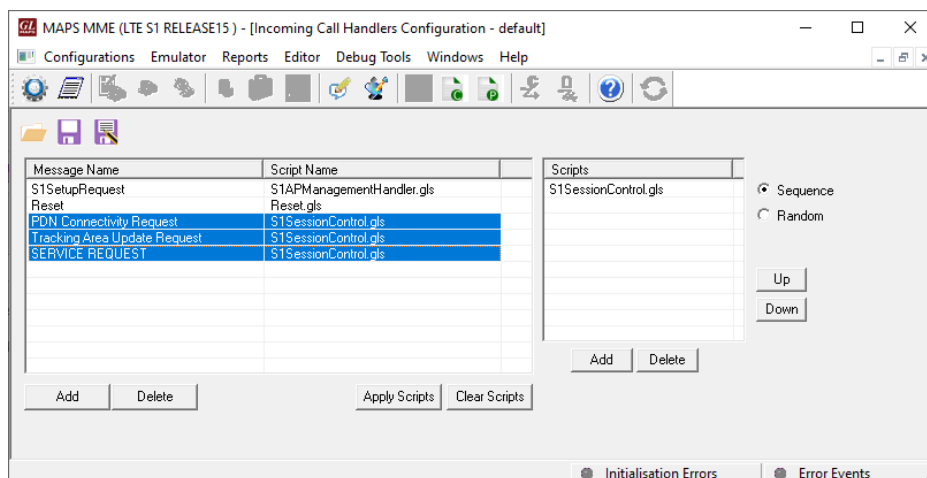

Figure: Incoming Call Handler

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End-to-End VoLTE Call Emulation

The VoLTE Lab setup can be operated in real-time for making VoLTE calls and also for interworking with PSTN and VoIP networks as depicted in the below diagram. The VoLTE Lab Test Suite supports emulation of several LTE interfaces (S1, X2-AP, S3, S4, S5, S8, S10, S11 and S16), and IMS interfaces (Cx/Dx, Rx, Gx, Gm, SGi, Mw, Mi, Mj).

The test suite supports generation and verification of traffic over LTE, including VoLTE (Voice), Web (HTTP), and more with additional licenses. It can be integrated with High Density RTP appliance to emulate high volume calls with traffic. MAPS™ HD RTP (PKS109) is a special purpose rackmount network appliance with 4x1GigE NIC capable of bulk call generation with traffic.

Following are typical applications of VoLTE Lab Setup -

- Authenticate and confirmation of security procedures
- QoS requests for greater or lesser bandwidth
- Temporary addressing management for mobility and security
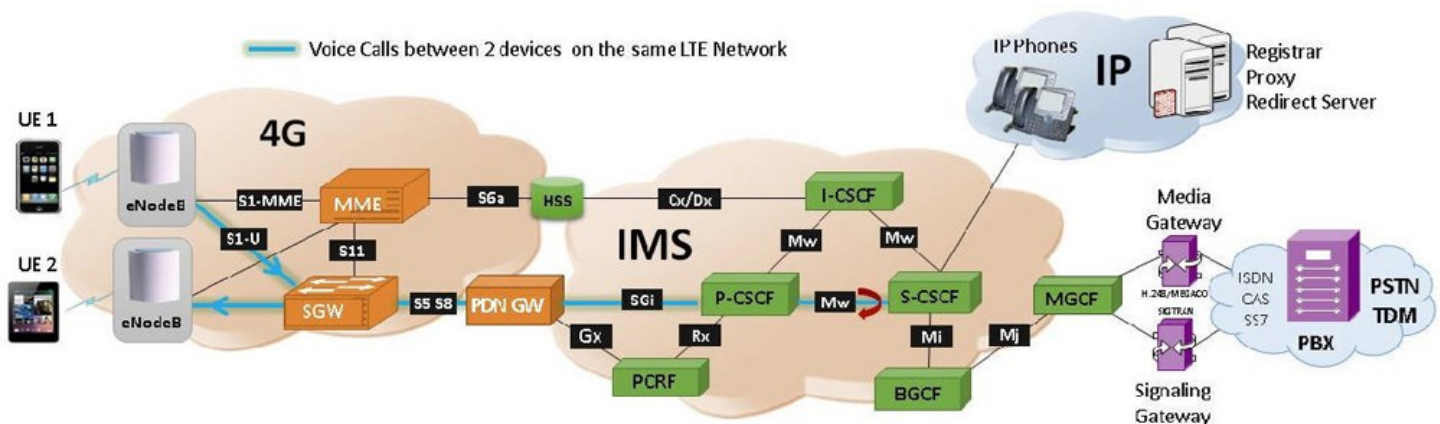
For more information, visit VoLTE Lab Test Suite webpage.

Figure: VoLTE Emulation using GL's Complete Wireless Lab Test Suite

LTE S1 Conformance Suite

MAPS™ LTE S1 emulator can be configured as MME with a conformance script to emulate network side procedures conforming various success/failure test cases and automating the entire eNodeB (DUT) testing. This conformance test suite requires additional license (PKS154) to perform testing which allows user to test for selected testcase.

Following are the supported test cases -

- Paging success/failure
- Paging via IMSI success/failure
- UE attach success, UE detach, UE tracking area update
- Periodic updating
- Service Request
- E-RAB Setup procedures
- Setup context – Fail, Success
- UE Context Release, Modification
- Handover success, failure S1 interface
- S1 Setup success, failure and resend setup
- Reset all resource, partial resource
- Error Indication
- Location report

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LTE S1 Conformance Suite *(Contd.)*

Test cases include general Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 Application Protocol (S1AP) messaging and call flow scenarios over LTE network. Logging and pass/fail results are also reported. Test cases verify conformance of various actions as listed above.
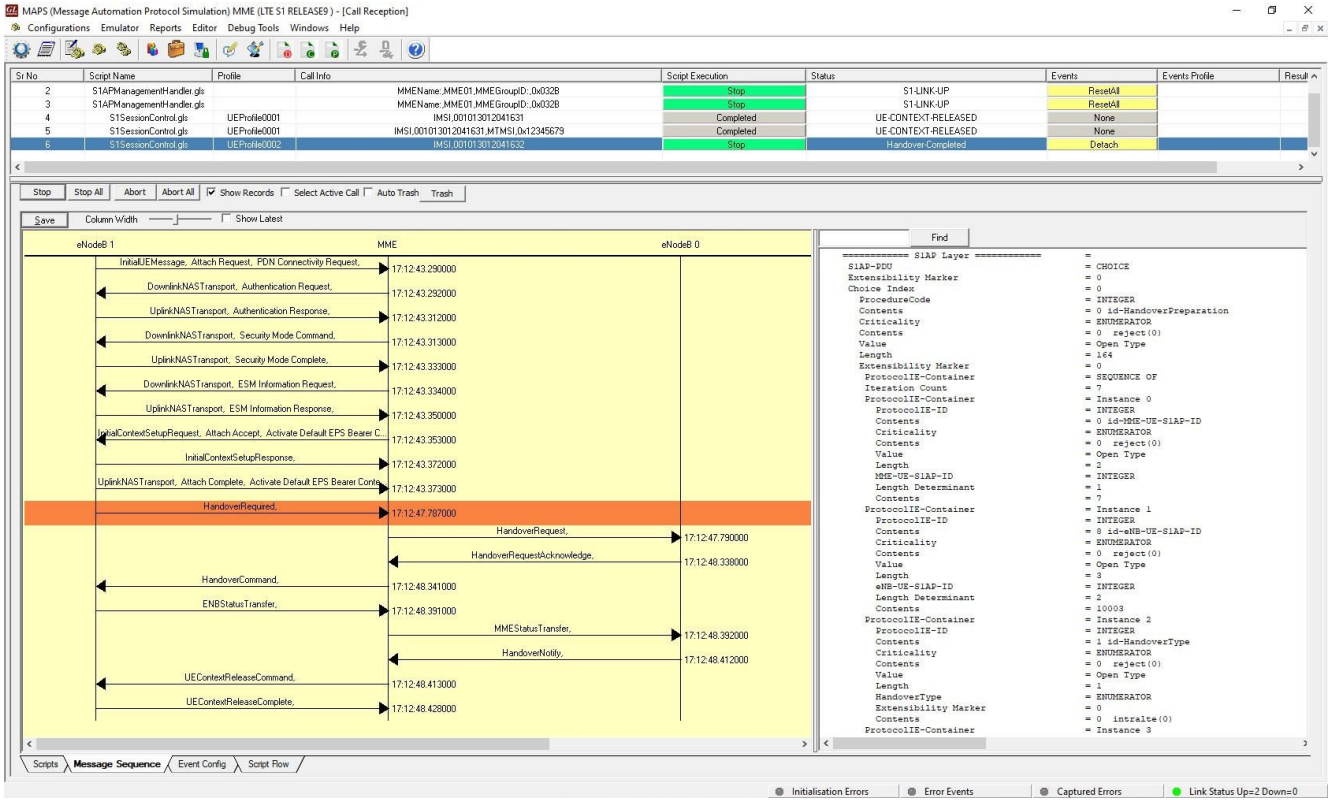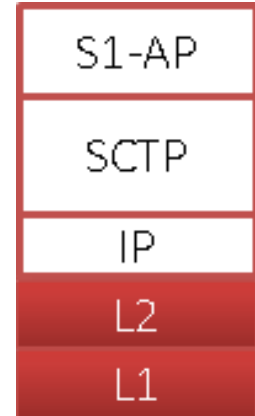

Figure: LTE S1 Handover Procedure Conformance

Supported Protocols and Specifications

Supported Protocols	Standard / Specification Used
S1 Application Protocol (S1-AP)	3GPP 36.413 9.0.0 (2009-09)
SCTP	RFC 4960
Non-Access-Stratum (NAS)	3GPP TS 24.301 V9.0.0 (2009-09)

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Buyer's Guide

Item No	Product Description
PKS140	MAPS™ LTE S1 Interface Emulator
ETH100	Mobile Traffic - PacketCheck™
ETH101	MobileTrafficCore - GTP
ETH102	MobileTrafficCore - Gateway
PKS154	LTE S1 Conformance Test Suite

Item No	Related Software
PKS127	MAPS™ IMS Emulator
PKS139	MAPS™ Diameter Emulator
PKS142	MAPS™ LTE eGTP (S3, S4, S5, S8, S10, S11 and S16) interfaces
PKS164	MAPS™ UMTS Iu-PS Interface Emulation
PKS160	MAPS™ UMTS Iu-CS and Iuh Interface Emulation
PKV100	PacketScan™ (Online and Offline)

For more information, visit Signaling and Traffic Simulator webpage.