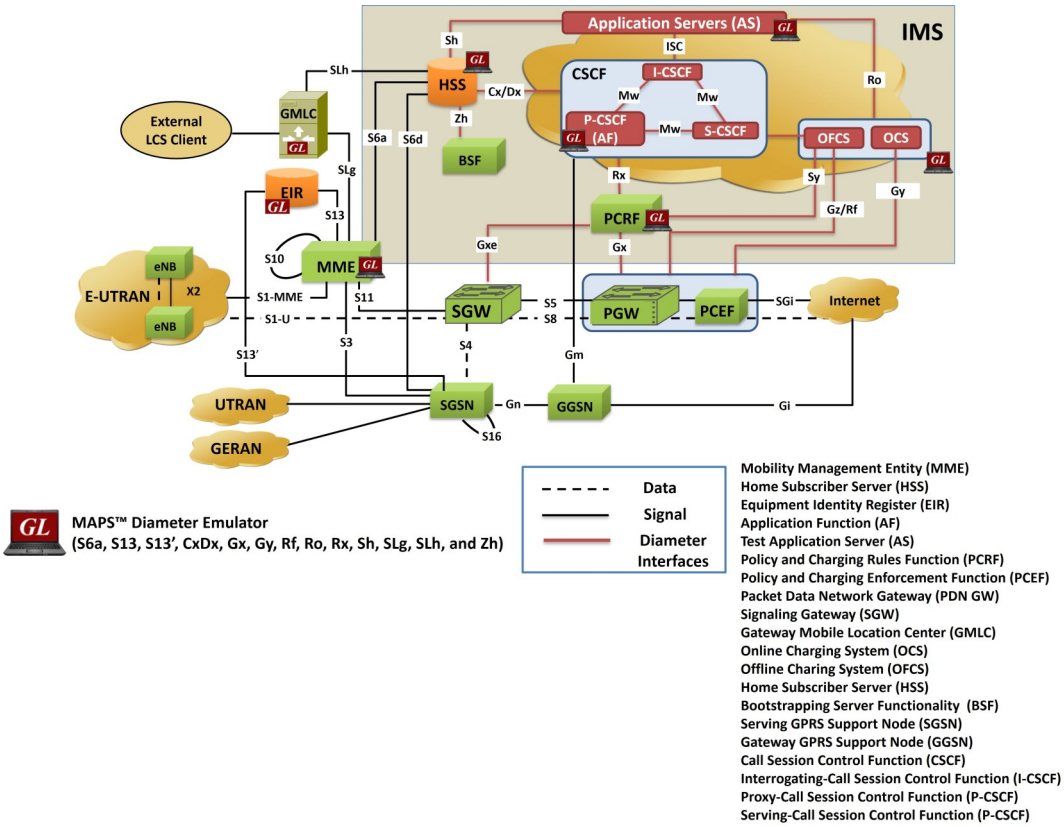
# MAPS™ Diameter Emulator

## (Diameter Interfaces Emulation)




## Overview

GL's Message Automation and Protocol Simulation (MAPS™) Diameter emulate S6a, S13, and S13' interfaces, along with LTE IMS network elements such as Mobility Management Entity (MME), Home Subscriber Server (HSS), Equipment Identity Register (EIR), and Serving GPRS Support Node (SGSN).

With its additional licensing support for interfaces such as CxDx, Gx, Gy, Rf, Ro, Rx, Sh, SLg, SLh, and Zh, the MAPS™ Diameter emulator actively emulates various nodes within the network. These nodes include MME, HSS, Application Server (AS), Serving Call State Control Function (SCSCF), Policy and Charging Rules Function (PCRF), Policy and Charging Enforcement Function (PCEF), Charging Trigger Function (CTF), Packet Data Network Gateway (PDN GW), Online Charging System (OCS), Application Function (AF), Call Session Control Function (CSCF), Bootstrapping Server Functionality (BSF), and Gateway Mobile Location Center (GMLC). This active emulation framework empowers users to thoroughly test and analyze the behavior of these network nodes and their interactions.

The additional licenses for the enhanced MAPS™ Diameter emulator enable users to actively edit messages on supported interfaces, providing them with unlimited flexibility to support various procedures. Also, supports Location Service (LCS) based SLh and SLg interfaces between the GMLC <-> HSS and GMLC <->MME defined for the Control Plane as per 3GPP TS 23.271 specifications.

MAPS™ Diameter Emulator supports communication over both Stream Control Transmission (SCTP ) and Transmission Control Protocol (TCP) transport protocol layers. The TCP used along with IP provides reliable message transfer between interconnected computer communication networks. MAPS™ Diameter also supports Transport Layer Security (TCP/TLS) for the secured information transfer.

MAPS™ Diameter Emulator supports powerful utilities like Message Editor, Script Editor, and Profile Editor which allow new scenarios to be created or existing scenarios to be modified using Diameter messages and parameters.

For more information, refer to MAPS™ Diameter Protocol Emulator webpage.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## Main Features

- Supports emulation of real-time LTE network using MAPS 4G Wireless Lab Suite
- Allows users to configure MAPS™ Diameter emulator as MME, HSS, PCRF, PCEF, CSCF, SGSN, PDN GW, EIR, AF, BSF, and AS entities to emulate a variety of interfaces such as S6a, S6d, S13, Cx/Dx, Gx, Gy, Rf, Ro, Rx, Sh, SLg, SLh, and Zh
- Emulate thousands of smartphones (UEs) powering up and down
- Authenticate and confirm security procedures
- Manages temporary addressing for mobility and security purposes
- Supports Command Line Interface (CLI) based on a client-server model, allowing users to control all features through Python APIs
- Provides support for TCP/TLS for the secured information transfer
- Generates hundreds of UE Signaling (Load testing)
- Ready scripts for procedures over interfaces such as -
  - **S6a** interface - Location Management, Subscriber Data Handling, Authentication, Fault Recovery, and Notification procedures
  - **S13/S13'** interface - Mobile Equipment Identity Check procedure
  - **CxDx** interface – Server and User Authentication procedures
  - **Gx** interface - IP-CAN Session Establishment and Modification procedures
  - **Gy/Ro** interface - Online Credit Control procedure
  - **Rf** interface - Offline Charging procedure
  - **Rx** interface - Initial Provisioning, Modification of Session Information and AF Session Termination procedures
  - **Sh** interface - User Data Handling (User-Data-Update, Subscriber-Notification, User-Data-Pull) procedures
  - **SLg** interface - Subscriber Location procedures
  - **SLh** interface - Location Service Routing Information procedures
  - **Zh** interface - Bootstrapping- procedure
- Provides call statistics and associated events status
- Supports large number of subscribers with CSV based profiles for bulk call generation
- Software architecture is script-based and protocol independent
- During call generation, the emulator provides call statistics along with associated captured events and error events
- Supports real-time applications of location-based services, providing up-to-date information for vehicle tracking, stolen assets tracking, temperature monitoring, traffic services, and emergency services
- Users can apply impairments to messages in the emulator to emulate error conditions

# Testbed Configuration

The testbed setup window allows users to setup the required test environment with SCTP configuration in Diameter interface. SCTP Configuration parameters consists of Source / Destination IP address, Port, to configure MAPS™ to emulate MME, HSS, PCRF, PCEF, CSCF, SGSN, PDN GW, EIR, AS, AF, CTF, OCS, BSF, and GMLC entities to emulate S6a, S6d, S13, Cx/Dx, Gx, Gy, Rf, Ro, Rx, Sh, SLg, SLh, and Zh interfaces. End user configuration profile used to configure MAPS™ Diameter with supported node parameters.

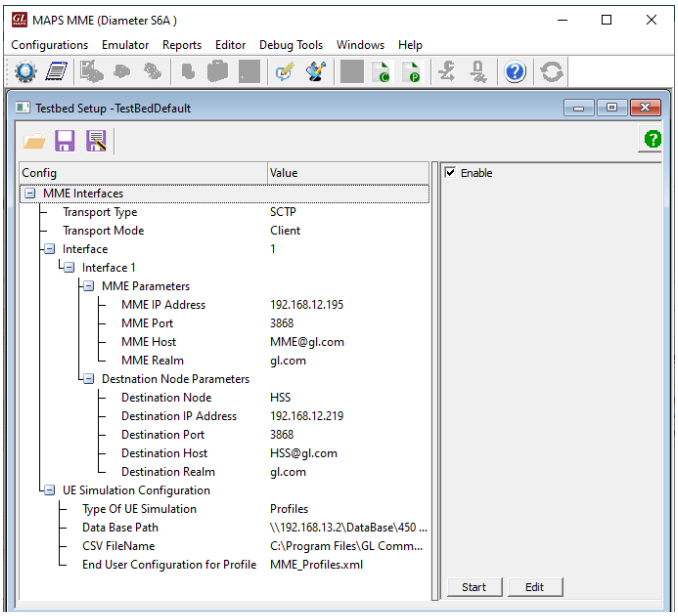



**Figure: Testbed Configuration**

# Pre-processing Tools

### Profile Editor

The profile editor allows user to edit or create profiles in order to define run-time values to the variables for the message templates. The users can edit the values of the variables thus 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.

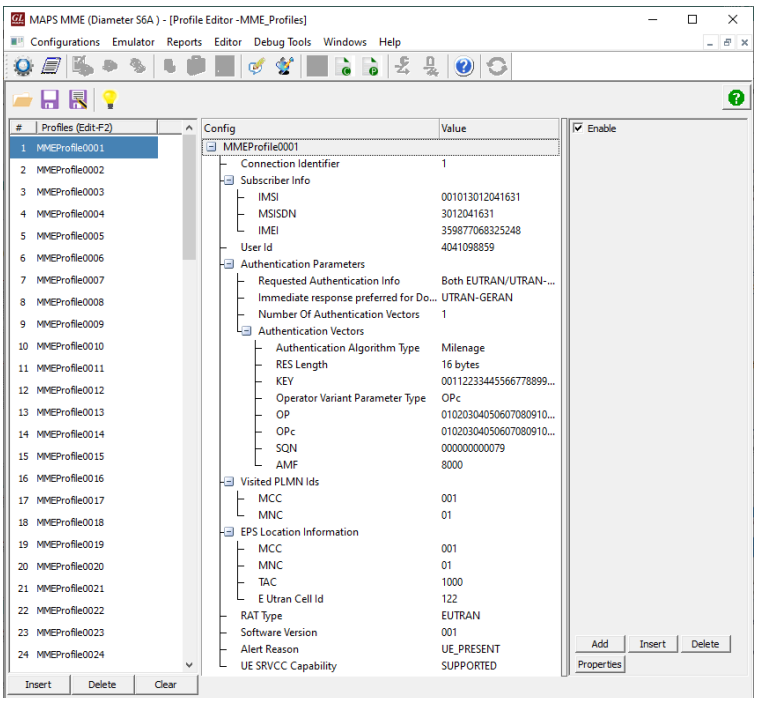



**Figure: Profile Editor**

# Pre-processing Tools *(Contd.)*

## 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, & optional variable parameters.

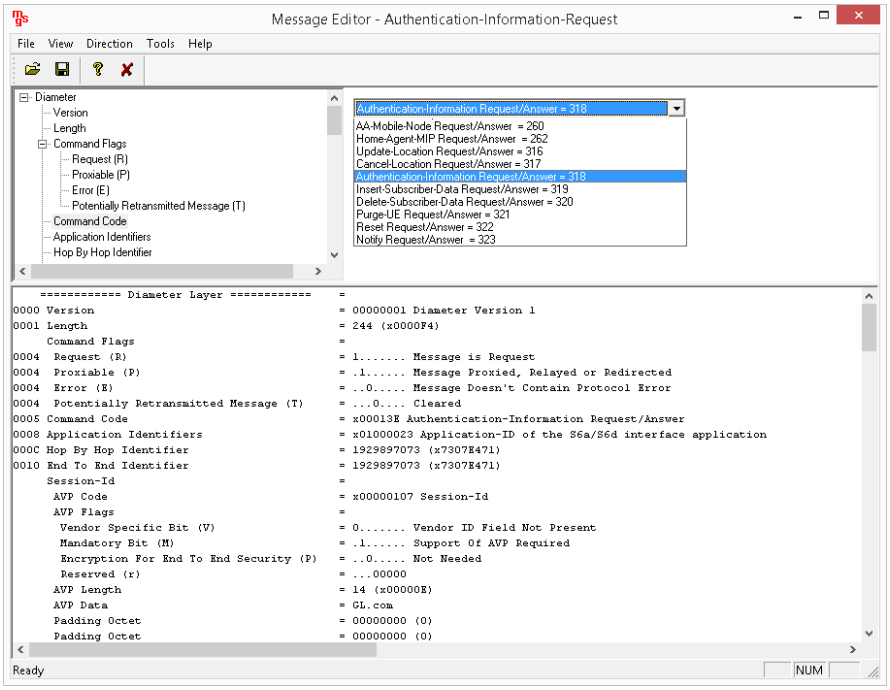



**Figure: Message Editor**

## Script Editor

The script editor allows the user to create / edit scripts and also import/export files that define variables for the message template parameters. The script uses pre-defined message templates to perform send and receive actions. The editor allows to run the added scripts sequentially (in-order) or randomly (any script from the list of added scripts as per the call flow requirements).

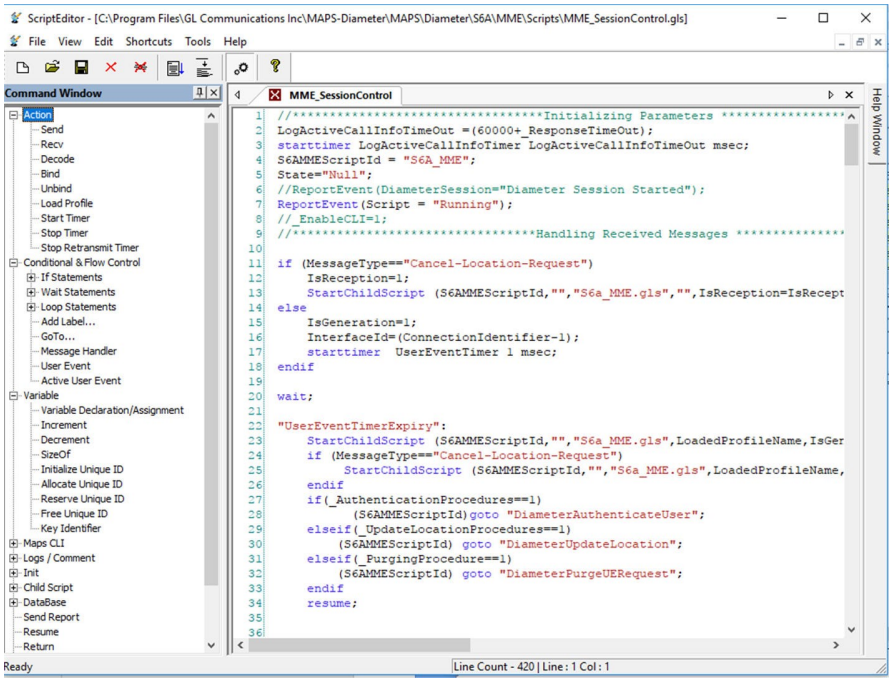



**Figure: Script Editor**

# Call Generation and Call Reception

In call generation, MAPS™ is configured for the outgoing calls, and in call receive mode, it is configured to respond to incoming calls. Tests can be configured to run once, multiple iterations or continuously. Scripts can be set to run sequentially according to a call scenario or randomly.

The test scripts may be started manually or they can be automatically triggered by incoming messages. In receive mode, MAPS™ can be automated to respond to messages using script configuration dialog, where a receive script is preset against particular message expected to arrive.

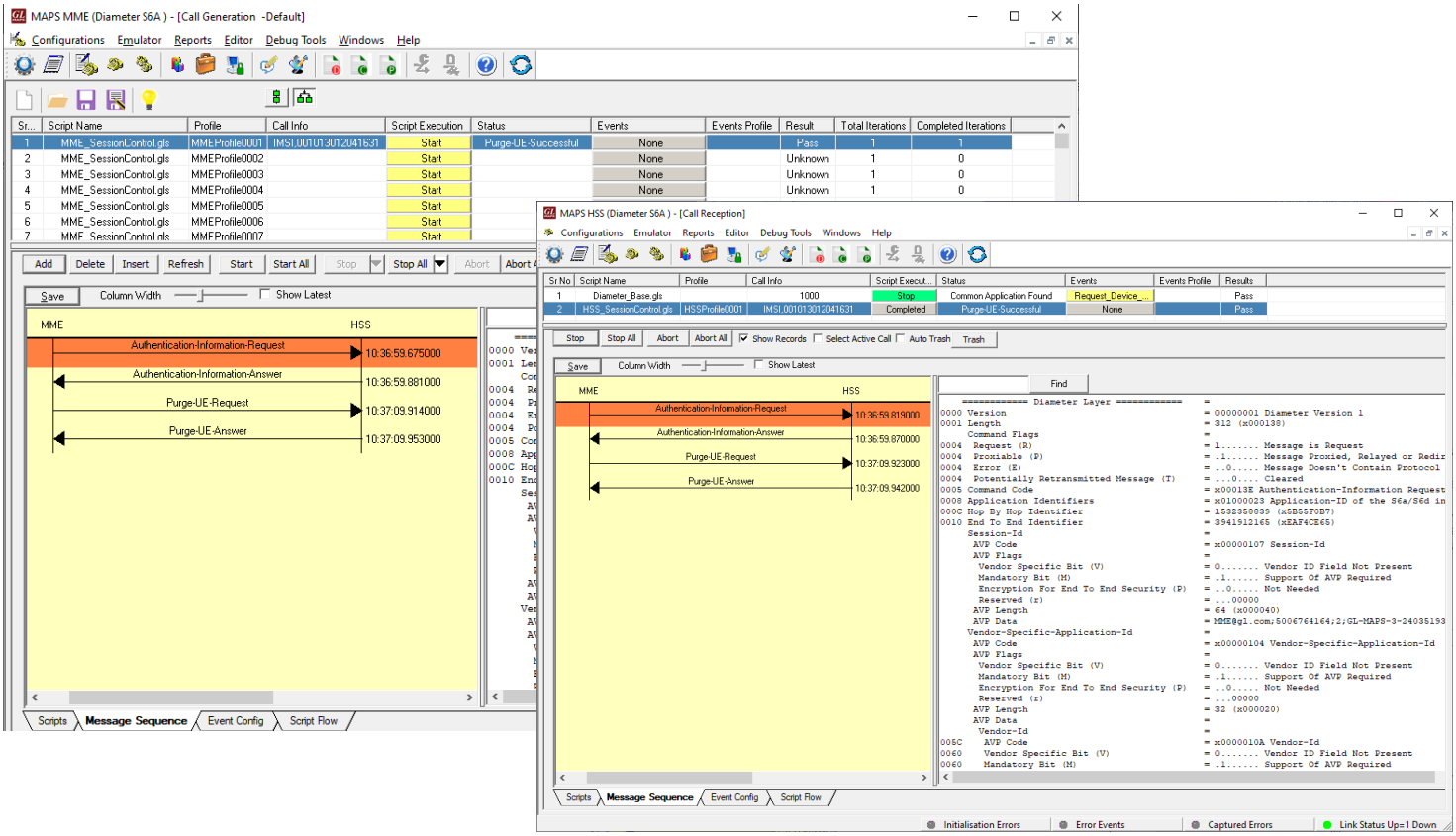



**Figure: Call Generation and Reception**

# 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.

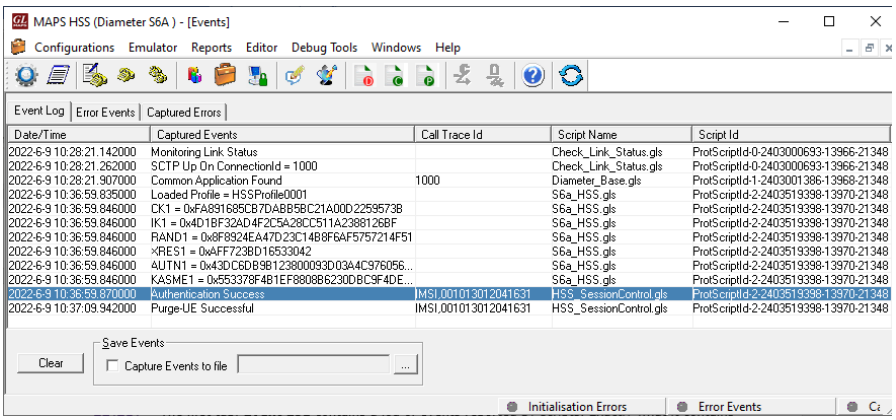



**Figure: Capture Event Log**

# Diameter Procedures

Supported procedures over Diameter interfaces are -

- S6a interface
  - Location Management, Subscriber Data Handling, Authentication, Fault Recovery, and Notification procedures
- Rx interface
  - AA-Request/Answer, Re-Auth-Request/Answer, Abort-Session-Request/Answer, and Session-Termination-Request/Answer procedures
  - See Rx Interface Call Generation screenshot
  - See Rx Interface Call Reception screenshot
- Gx interface
  - IPCAN Session Establishment and Modification procedures
- S13/S13' interface
  - ME (Mobile Equipment) Identity Check procedure
- Cx Dx interface
  - Server Assignment Request and Server Assignment Answer procedures
- Gy/Ro interface
  - Credit Control-Request/Answer, Re-Auth-Request for Session based Charging and One-time Event based Charging procedures
- SLh, SLg interfaces
  - Location Request/Response procedure
  - Emergency Location Request/Response procedure
  - Repeated Location Report procedure
  - See SLh Interface Call Generation screenshot
  - See SLg Interface Call Generation screenshot
- Zh interface
  - Bootstrapping procedure

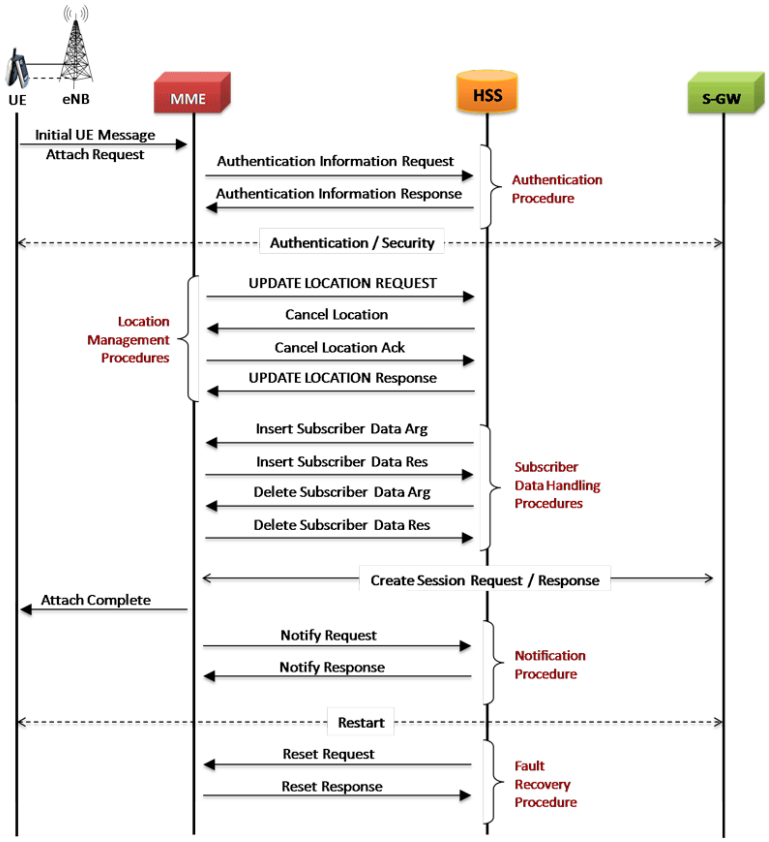
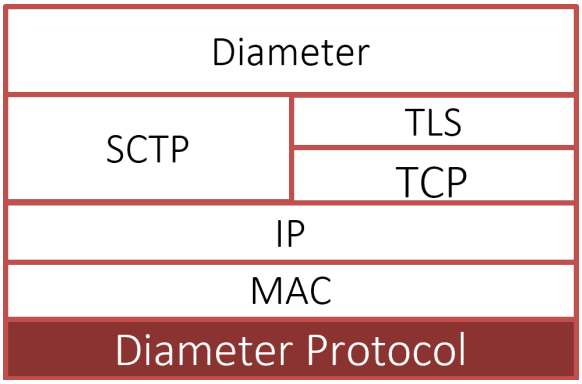



**Figure: S6a Interface Procedure**

# Supported Protocols and Specifications




| Supported Protocols | Standard / Specification Used |
|---|---|
| Diameter | IETF RFC 3588<br>S6a, S13, S13' - 3GPP TS 29.272 V10.3.0<br>Rx - 3GGP TS 29214-b10<br>Cx/Dx - 3GPP TS 29.228 & TS29.229<br>Gx - 3GPP TS 29.212 & TS 23.203<br>Gy/Ro (DCCA)- 3GGP TS 32.225, 3GPP TS 32.299 and IETF RFC 4006<br>Sh - 3GPP TS 29.328<br>SLg - 3GPP TS 29.172<br>SLh - 3GPP TS 29.173<br>Zh - 3GPP TS 29.109 |
| SCTP | RFC 4960 |
| TCP | RFC793 |
| TLS | RFC5246 |

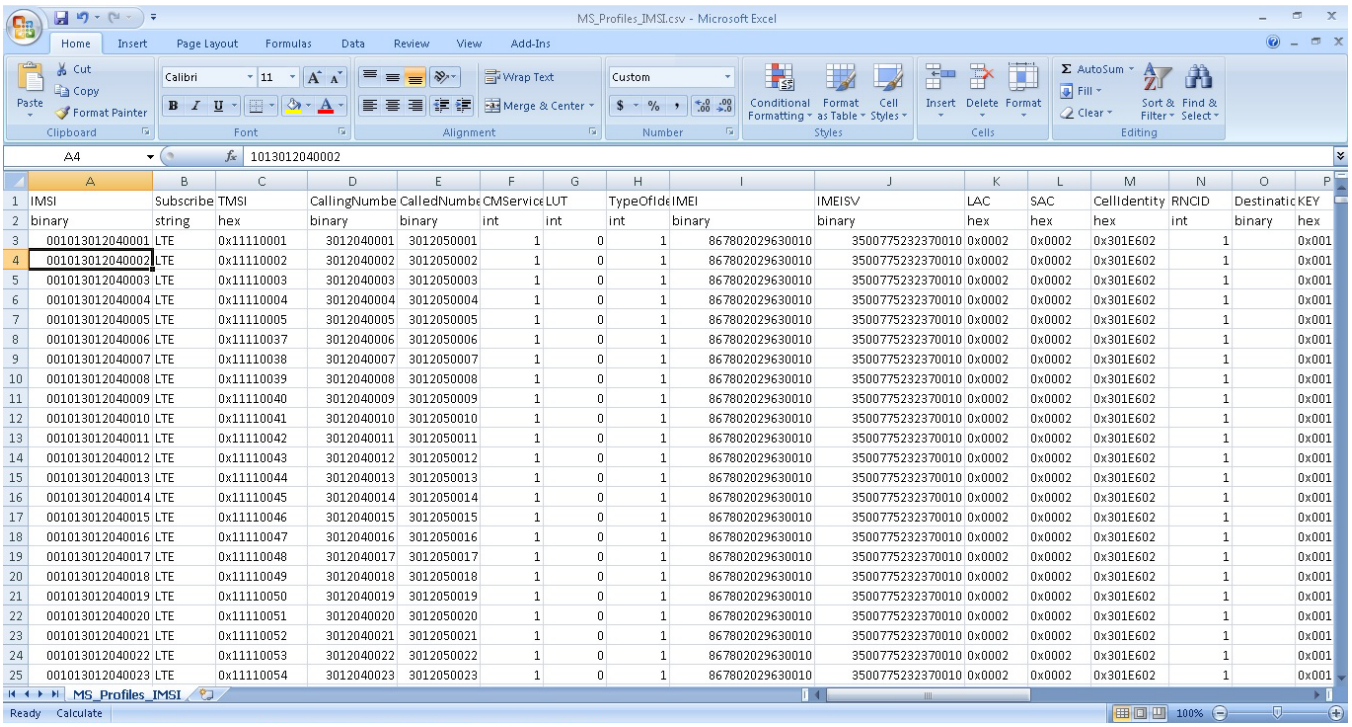
# MAPS™ CSV Support

MAPS™ is enhanced with CSV database system to support massive number of subscriber profiles. Note that, even with CSV based profiles, the maximum simultaneous calls that can be emulated is approximately about 2000.

CSV database system used with MAPS™ is a simple Excel® file format, which can be used to create ***N*** number of UE entries each with unique UE parameters such as IMSI, MSISDN as in real-time bulk call generation.

CSV files are saved in working directory of the emulated Diameter and is loaded in MAPS™.

**MS_Profiles_IMSI.csv** file for key=IMSI,




| IMSI | Subscribe | TMSI | CallingNumbe | CalledNumbe | CMService | LUT | TypeOfIde | IMEI | IMEISV | LAC | SAC | CellIdentity | RNCID | Destinatic | KEY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| binary | string | hex | binary | binary | int | int | int | binary | binary | hex | hex | hex | int | binary | hex |
| 001013012040001 | LTE | 0x11110001 | 3012040001 | 3012050001 | 1 | 0 | 1 | 867802029630010 | 3500775232370010 | 0x0002 | 0x0002 | 0x301E602 | 1 | | 0x001 |
| 001013012040002 | LTE | 0x11110002 | 3012040002 | 3012050002 | 1 | 0 | 1 | 867802029630010 | 3500775232370010 | 0x0002 | 0x0002 | 0x301E602 | 1 | | 0x001 |
| 001013012040003 | LTE | 0x11110003 | 3012040003 | 3012050003 | 1 | 0 | 1 | 867802029630010 | 3500775232370010 | 0x0002 | 0x0002 | 0x301E602 | 1 | | 0x001 |
| 001013012040004 | LTE | 0x11110004 | 3012040004 | 3012050004 | 1 | 0 | 1 | 867802029630010 | 3500775232370010 | 0x0002 | 0x0002 | 0x301E602 | 1 | | 0x001 |
| 001013012040005 | LTE | 0x11110005 | 3012040005 | 3012050005 | 1 | 0 | 1 | 867802029630010 | 3500775232370010 | 0x0002 | 0x0002 | 0x301E602 | 1 | | 0x001 |
| 001013012040006 | LTE | 0x11110037 | 3012040006 | 3012050006 | 1 | 0 | 1 | 867802029630010 | 3500775232370010 | 0x0002 | 0x0002 | 0x301E602 | 1 | | 0x001 |
| 001013012040007 | LTE | 0x11110038 | 3012040007 | 3012050007 | 1 | 0 | 1 | 867802029630010 | 3500775232370010 | 0x0002 | 0x0002 | 0x301E602 | 1 | | 0x001 |
| 001013012040008 | LTE | 0x11110039 | 3012040008 | 3012050008 | 1 | 0 | 1 | 867802029630010 | 3500775232370010 | 0x0002 | 0x0002 | 0x301E602 | 1 | | 0x001 |
| 001013012040009 | LTE | 0x11110040 | 3012040009 | 3012050009 | 1 | 0 | 1 | 867802029630010 | 3500775232370010 | 0x0002 | 0x0002 | 0x301E602 | 1 | | 0x001 |
| 001013012040010 | LTE | 0x11110041 | 3012040010 | 3012050010 | 1 | 0 | 1 | 867802029630010 | 3500775232370010 | 0x0002 | 0x0002 | 0x301E602 | 1 | | 0x001 |
| 001013012040011 | LTE | 0x11110042 | 3012040011 | 3012050011 | 1 | 0 | 1 | 867802029630010 | 3500775232370010 | 0x0002 | 0x0002 | 0x301E602 | 1 | | 0x001 |
| 001013012040012 | LTE | 0x11110043 | 3012040012 | 3012050012 | 1 | 0 | 1 | 867802029630010 | 3500775232370010 | 0x0002 | 0x0002 | 0x301E602 | 1 | | 0x001 |
| 001013012040013 | LTE | 0x11110044 | 3012040013 | 3012050013 | 1 | 0 | 1 | 867802029630010 | 3500775232370010 | 0x0002 | 0x0002 | 0x301E602 | 1 | | 0x001 |
| 001013012040014 | LTE | 0x11110045 | 3012040014 | 3012050014 | 1 | 0 | 1 | 867802029630010 | 3500775232370010 | 0x0002 | 0x0002 | 0x301E602 | 1 | | 0x001 |
| 001013012040015 | LTE | 0x11110046 | 3012040015 | 3012050015 | 1 | 0 | 1 | 867802029630010 | 3500775232370010 | 0x0002 | 0x0002 | 0x301E602 | 1 | | 0x001 |
| 001013012040016 | LTE | 0x11110047 | 3012040016 | 3012050016 | 1 | 0 | 1 | 867802029630010 | 3500775232370010 | 0x0002 | 0x0002 | 0x301E602 | 1 | | 0x001 |
| 001013012040017 | LTE | 0x11110048 | 3012040017 | 3012050017 | 1 | 0 | 1 | 867802029630010 | 3500775232370010 | 0x0002 | 0x0002 | 0x301E602 | 1 | | 0x001 |
| 001013012040018 | LTE | 0x11110049 | 3012040018 | 3012050018 | 1 | 0 | 1 | 867802029630010 | 3500775232370010 | 0x0002 | 0x0002 | 0x301E602 | 1 | | 0x001 |
| 001013012040019 | LTE | 0x11110050 | 3012040019 | 3012050019 | 1 | 0 | 1 | 867802029630010 | 3500775232370010 | 0x0002 | 0x0002 | 0x301E602 | 1 | | 0x001 |
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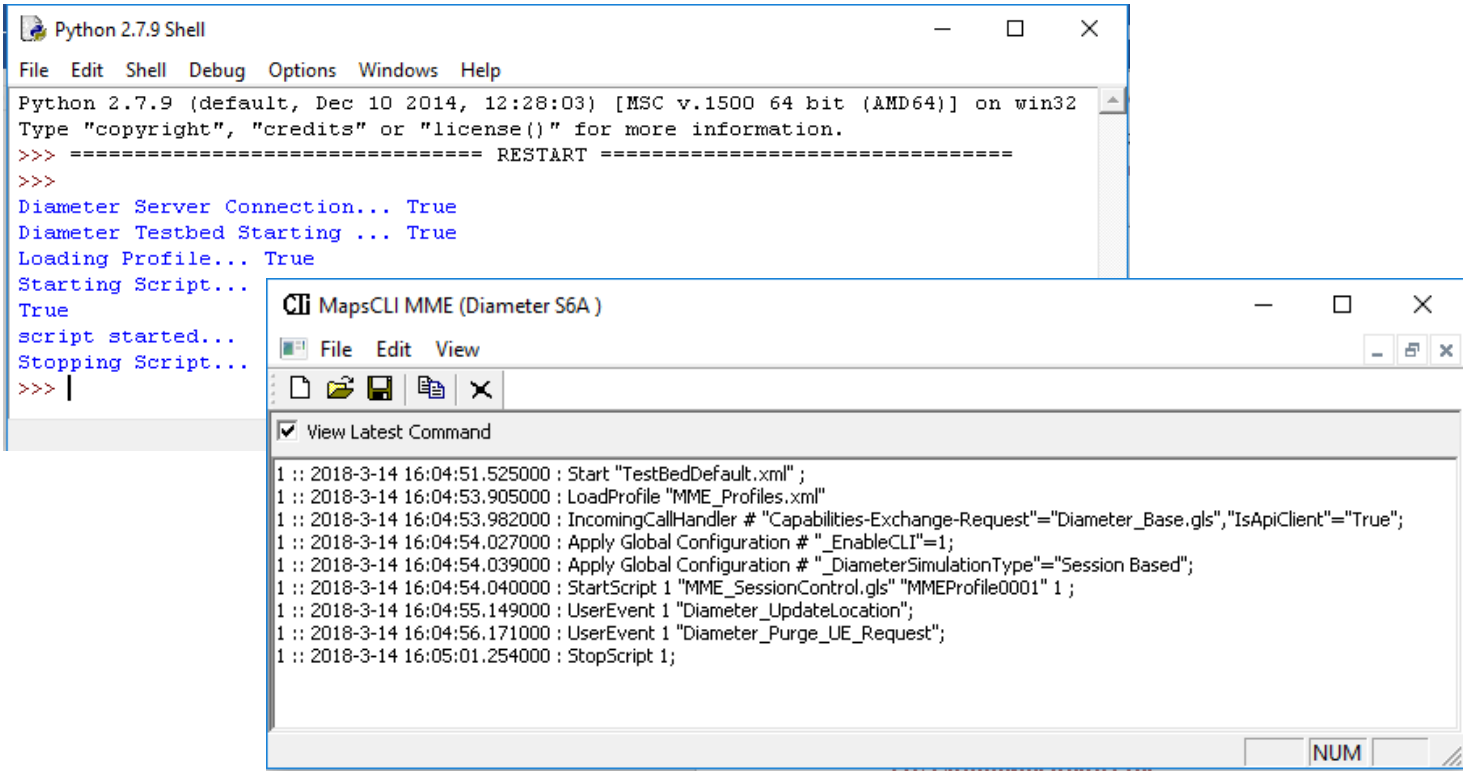
| 001013012040021 | LTE | 0x11110052 | 3012040021 | 3012050021 | 1 | 0 | 1 | 867802029630010 | 3500775232370010 | 0x0002 | 0x0002 | 0x301E602 | 1 | | 0x001 |
| 001013012040022 | LTE | 0x11110053 | 3012040022 | 3012050022 | 1 | 0 | 1 | 867802029630010 | 3500775232370010 | 0x0002 | 0x0002 | 0x301E602 | 1 | | 0x001 |
| 001013012040023 | LTE | 0x11110054 | 3012040023 | 3012050023 | 1 | 0 | 1 | 867802029630010 | 3500775232370010 | 0x0002 | 0x0002 | 0x301E602 | 1 | | 0x001 |

# MAPS™ CLI Support

MAPS™ Diameter can be configured as server-side application, to enable remote controlling through multiple command-line based clients. Supported clients include Python. The Diameter APIs allows for programmatic and automated control over all Diameter protocols. Each MAPS™ Diameter server can receive multiple client connections and offer independent execution to each client. Likewise, a single client can connect to multiple MAPS™ Diameter servers, including servers running different protocols, permitting complex cross-protocol test cases.



# Buyer's Guide

| Item No | Product Description |
|---|---|
| PKS139 | MAPS™ Diameter Emulator |
| PK1390 | MAPS™ Diameter CxDx Interface Emulator (requires PKS139) |
| PK1391 | MAPS™ Diameter Gx Interface Emulator (requires PKS139) |
| PK1392 | MAPS™ Diameter Gy Interface Emulator (requires PKS139) |
| PK1393 | MAPS™ Diameter Rf Interface Emulator (requires PKS139) |
| PK1394 | MAPS™ Diameter Ro Interface Emulator (requires PKS139) |
| PK1395 | MAPS™ Diameter Rx Interface Emulator (requires PKS139) |
| PK1396 | MAPS™ Diameter Sh Interface Emulator (requires PKS139) |
| PK1397 | MAPS™ Diameter SLg Interface Emulator (requires PKS139) |
| PK1398 | MAPS™ Diameter SLh Interface Emulator (requires PKS139) |
| PK1399 | MAPS™ Diameter Zh Interface Emulator (requires PKS139) |
| ETH100 | Mobile Traffic - PacketCheck™ |
| ETH101 | MobileTrafficCore - GTP |
| ETH102 | MobileTrafficCore - Gateway |
| PKS170 | CLI Support for MAPS™ |

| Item No | Related Software |
|---|---|
| PKS132 | MAPS™ MAP Protocol Emulation over IP |
| PKS147 | MAPS™ Lb Interface Emulator |
| PKS148 | MAPS™ LTE SLs Interface Emulator |
| PKS164 | MAPS™ UMTS – Iu-PS Interface Emulation |

For more information, refer to MAPS™ Diameter Protocol Emulator webpage.

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