MAPS™ LTE S1

LTE S1 Interface Emulation
LTE S1 Architecture
Main Features

- Setup a virtual real-time network simulating 4G-LTE network elements using ‘MAPS™ 4G Wireless Lab Suite’
- Simulates eNodeB and MME
- Supports LTE Control plane
- Generates hundreds of UE Signaling (Load Testing)
- Generates and process S1/NAS (valid and invalid) messages
- Supports GTP Traffic (GTP User Plane Data) which includes: verification like BERT testing, HTTP traffic generation capability, GGSN can actually be connected to real IP network to simulate Gateway testing
- Ready-to-use scripts for quick testing
- Automation, Remote access, and Schedulers to run tests 24/7
- Supports scripted call generation and automated call reception.
Applications

• Provides fault insertion, and erroneous call flows testing capability
• Performance testing, Load testing, Functional testing, Regression testing and Conformance testing of network elements
• Ready scripts makes testing procedure simpler, less time consuming and hence time to market products
• Simulate up to 500 Smartphones (UEs) powering up and down
• Authenticate and confirm security procedures
• QoS requests for greater or lesser bandwidth
• Temporary addressing management for mobility and security
### Supported Protocol Stack & Standards

<table>
<thead>
<tr>
<th>Supported Protocols</th>
<th>Standard / Specification Used</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1 Application Protocol (S1-AP)</td>
<td>3GPP 36.413 9.0.0 (2009-09)</td>
</tr>
<tr>
<td>SCTP</td>
<td>RFC 4960</td>
</tr>
<tr>
<td>Non-Access-Stratum (NAS)</td>
<td>3GPP TS 24.301 V9.0.0 (2009-09)</td>
</tr>
</tbody>
</table>
S1AP/NAS Procedures

MAPS (eNodeB) → DUT (MME)
- InitialUEMessage, Attach Request
  - Authentication Request
  - Authentication Response
  - Security Mode Command
  - Security Mode Complete
  - Attach Accept
  - Attach Complete
- UE Registration Signaling

MAPS (eNodeB) → DUT (MME)
- UplinkNASTransport,
  - Bearer Resource Allocation Request
  - E-RABSetupRequest,
  - Activation Deactivated EPS Bearer Context Request
  - E-RABSetupResponse
  - UplinkNASTransport,
  - Activation Deactivated EPS Bearer Context Accept
- Dedicated Bearer Context

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Procedures....

Modify EP Bearer Context Procedure

MAPS (eNodeB)
- UplinkNASTransport,
- Bearer Resource Allocation Request
- Modify EPS Bearer Context Request
- E-RABSetupResponse
- UplinkNASTransport,
- Modify EPS Bearer Context Accept

DUT (MME)
- Identity Request
- DownlinkNASTransport,
- GUTI Reallocation Command
- UplinkNASTransport,
- Identification & GUTI Reallocation Procedure

MAPS (eNodeB)
- UplinkNASTransport,
- Identity Request
- DownlinkNASTransport,
- GUTI Reallocation Command
- UplinkNASTransport,
- GUTI Reallocation Complete
Procedures....

MAPS (eNodeB)

UplinkNASTransport, Detach Request
DownlinkNASTransport, Detach Accept

Detach Procedure

DUT (MME)

UEContextReleaseCommand
UEContextReleaseComplete

UE Context Release Procedure

MAPS (eNodeB)

DUT (MME)
MAPS™ LTE S1 Call Reception

Call Results

Message Sequence

Decode Message
MAPS™ LTE S1 Testbed Setup
MAPS™ LTE S1 Profile Editor
MAPS™ LTE S1 Incoming Call Handler Configuration
Load Generation

- Stability/Stress and Performance testing using Load Generation
- Different types of Load patterns to distribute load
- User can load multiple patterns for selected script
- User configurable Test Duration, CPS, Maximum and Minimum Call Rate etc

**Fixed**

**Ramp**

- Ramp Duration
- Time (sec)

**Uniform**

**Normal**

**Saw-tooth**

**Step**

- Time Step
- Time (sec)
MAPS™ LTE S1 Bulk Call Generation

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### MAPS™ LTE S1 Events Log

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Captured Events</th>
<th>Call Trace Id</th>
<th>Script Name</th>
<th>Script Id</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017-3-27 13:01:40</td>
<td>SCTP Up On ConnectionId = 10C1</td>
<td></td>
<td>Check_SCTP_Status.gis</td>
<td>ProtScriptId_2_2506643134-58984-4552</td>
</tr>
<tr>
<td>2017-3-27 13:01:40</td>
<td>Setup Completed</td>
<td></td>
<td>S1APManagementHandler.gis</td>
<td>ProtScriptId_9_250650453-58937-4552</td>
</tr>
<tr>
<td>2017-3-27 14:45:16</td>
<td>FAND = 0x4E4E3A90691FBD377B56E16... 2</td>
<td></td>
<td>S1_MME.gis</td>
<td>ProtScriptId_10_256867575-5939-4652</td>
</tr>
<tr>
<td>2017-3-27 14:45:16</td>
<td>Authentication Parameters</td>
<td>2</td>
<td>S1_MME.gis</td>
<td>ProtScriptId_10_256867575-5939-4652</td>
</tr>
<tr>
<td>2017-3-27 14:45:16</td>
<td>RES = 0x439BE2EB07C857E</td>
<td>2</td>
<td>S1_MME.gis</td>
<td>ProtScriptId_10_256867575-5939-4652</td>
</tr>
<tr>
<td>2017-3-27 14:45:16</td>
<td>kaseume = 0xDAFFE.EF5.3677F832F1BFE... 2</td>
<td>2</td>
<td>S1_MME.gis</td>
<td>ProtScriptId_10_256867575-5939-4652</td>
</tr>
<tr>
<td>2017-3-27 14:45:16</td>
<td>Security Mode Command Sent</td>
<td>IMSI,001013012041631</td>
<td>S1SessionControl.gis</td>
<td>ProtScriptId_10_256867575-5939-4652</td>
</tr>
<tr>
<td>2017-3-27 14:45:16</td>
<td>Send Initial Context Setup Request</td>
<td>2</td>
<td>S1_MME.gis</td>
<td>ProtScriptId_10_256867575-5939-4652</td>
</tr>
<tr>
<td>2017-3-27 14:45:17</td>
<td>GTP-U Mobile-Traffic Started</td>
<td>IMSI,001013012041631</td>
<td>S1SessionControl.gis</td>
<td>ProtScriptId_10_256867575-5939-4652</td>
</tr>
<tr>
<td>2017-3-27 14:45:24</td>
<td>SendUENotification</td>
<td>2</td>
<td>S1_MME.gis</td>
<td>ProtScriptId_10_256867575-5939-4652</td>
</tr>
<tr>
<td>2017-3-27 14:45:24</td>
<td>PecvUEContextReleaseCommand</td>
<td>2</td>
<td>S1_MME.gis</td>
<td>ProtScriptId_10_256867575-5939-4652</td>
</tr>
</tbody>
</table>

**Save Events:**
- Clear
- Capture Events to file

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### Schedule Test to Run Automatically

#### MAPS™ Features

In the MAPS™ software, scheduling tests to run automatically can be performed using the Scheduler module. The following table illustrates how tests can be configured to run at specific intervals:

<table>
<thead>
<tr>
<th>S No</th>
<th>Config</th>
<th>Process</th>
<th>Start Time</th>
<th>Duration (Hr:Min)</th>
<th>Emulator</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>master config</td>
<td>Daily</td>
<td>15:23</td>
<td>1:0</td>
<td>Load Generation</td>
</tr>
<tr>
<td>2</td>
<td>config1</td>
<td>Daily</td>
<td>15:23</td>
<td>1:0</td>
<td>Manual Call Generation</td>
</tr>
<tr>
<td>3</td>
<td>config2</td>
<td>Daily</td>
<td>15:24</td>
<td>1:0</td>
<td>Manual Call Generation</td>
</tr>
<tr>
<td>4</td>
<td>master config</td>
<td>Daily</td>
<td>15:24</td>
<td>1:0</td>
<td>Load Generation</td>
</tr>
<tr>
<td>5</td>
<td>test config</td>
<td>Daily</td>
<td>15:26</td>
<td>1:0</td>
<td>Manual Call Reception</td>
</tr>
</tbody>
</table>

The Duration settings allow for configuring the duration of test runs, as shown in the second window of the Scheduler tool. Users can select from various durations and apply the settings to ensure tests run as intended.

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Customizations - Call Flow (Scripts)
Customizations - Protocol Messages
Customizations - Subscriber Profiles

MAPS™ Features

Profile Editor - UE_Profiles

- Mobile Identity
  - Type Of Identity: IMSI
  - IMSI: 001013012041631
- Tracking Area Information
- Authentication Parameters
  - NAS Key Set Identifier: 1
  - APN Name: default
  - MultipleAPN Name: internet
- ESM Message Parameters
- SMS Call Parameters
- Traffic Parameters
  - PacketCheck Traffic Parameters
  - Mobile Traffic Parameters
    - TCP Server ip: 192.168.20.65
    - TCP port for HTTP: 80
    - Transmission Type: Once
    - Start File Count: 1
    - Traffic File Name: www.etsi.org
- VolTE Parameters

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Customizations - Statistics and Reports

MOS, R-Factor

Packet Loss

Packets Discarded

Duplicate Packets

Out-Of-Sequence

Packets

Jitter Statistics

Call Stats provide a running tabular log of system level stats, tracked stats include: Total Calls, Active Calls, Completed Calls, Passed Calls, Failed Calls, Instantaneous Calls/Sec
• API wraps our proprietary scripting language in standard languages familiar to the user:
  ➢ Python
  ➢ Java
  ➢ VB Scripts
  ➢ TCL

• Clients and Servers support a “Many-to-Many” relationship, making it very easy for users to develop complex test cases involving multiple signaling protocols.
Thank You