



# 4G UE Emulator

Emulate 4G UE and generate realistic traffic towards the eNodeB

**OVERVIEW**

The Valid8 4G UE Emulator provides a cost-effective, scalable, solution for generating realistic UE calls in testing scenarios

**WHAT IT CAN DO FOR YOU**

The 4G UE Emulator solution is capable of simulating and testing several devices individually or in parallel. It is a scalable solution that enables the generation of up to hundreds of calls over the Uu interface. It is useful for eNodeB feature and capacity testing and any use case where real call generation is needed.

- It can simulate UEs
- It can test eNodeB

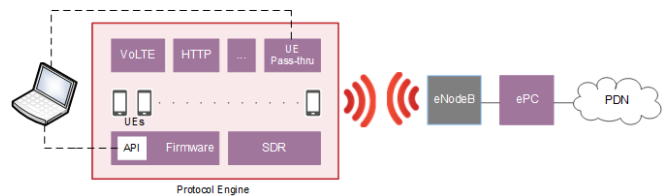
**WHY IT'S DIFFERENT**

It provides many advantages over using real UEs or basic simulators, including:

- Software based UEs are much more flexible in terms of adding new features than real UEs.
- Real UEs often become obsolete within a few years
- Easier to execute scripts over large numbers of virtual UEs than on real UEs
- The HW doesn't need to change when increasing the number of virtual UEs
- The band for software based UEs are fully configurable, unlike real UEs
- TCO (total cost of ownership) for software based UE solution is less expensive than real UEs

**FEATURES**

- Scalable architecture
- 3GPP release 8 - 12
- Includes PHY, MAC, RLC, PDCP, RRC, and NAS layers
- IP traffic generator (ping, UDP, HTTP)
- Supports Valid8 VoIP Load Tester (includes VoLTE)
- UE data pass-thru
- Automation API
- Voice Quality Measurement (VQM) for QoS
- FDD with half duplex or full duplex UEs
- TDD support now available



**M3 UE Architecture**



### SUBSYSTEMS

The Valid8 4G Network Emulator is comprised of multiple subsystems that are available individually or in parallel, and are scalable to fit your needs. The individual emulators are controllable through their call controllers, and the traffic can be captured through use of a remote capture tool such as Wireshark.

- eNodeB (femto, pico, or emulated)
- MME
- SGW
- PGW
- OCS
- HSS
- PCRF
- ePDG

### Load Application

```
PUT /apt/1/application/{PRODUCT}/{APPLICATION}/{CONFIGURATION}
```

### Start

```
PUT /apt/1/control/{ELEMENT}/start
```

### Reset Report

```
DELETE /apt/1/report
```

### Get Events

```
GET /apt/1/events
```

### KPIs

- S1 Attach Requests/Successes/Fails
- S1 Detach Requests/Successes/Fails
- S1 Dedicated Bearer Requests/Successes/Fails
- Current Active Sessions/ Bearers
- Number of Sessions/ Bearers Created
- S1 Attach Request Response Time
- S1 Dedicated Bearer Setup Request Response Time
- S1 Detach Request Response Time
- S1 Authentication Request Response Time
- S6a Authentication Request Response Time
- S1 Tracking Area Update Request Response Time

### eNodeB Controls

**Call Controller**

Start Stop Abort Events

**Volume**

1 2 4 10 100 1000

**Length**

30000 91000 [up] [down]

**Gap**

10000 15000 [up] [down]

**Stagger**

500 1500 [up] [down]

**Commands**

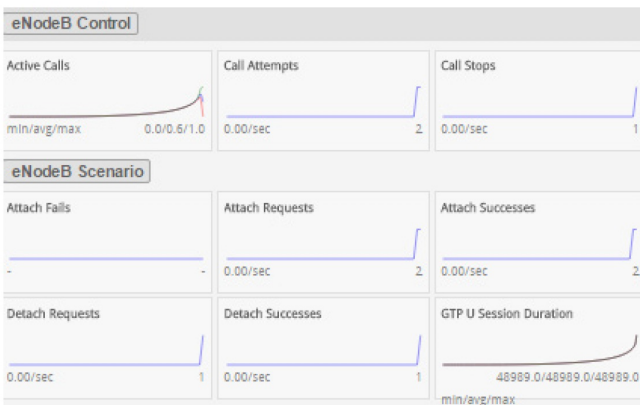
Attach Std (Next Call) Attach Emerg (Next Call) Attach Cstrn (Next Call) TAU (Next Call)

X2 HO S1 HO Hard Reset UE Service Req (Next Call) UE IPv4 UE IPv6

### Configurable Parameters

- Mobile Country Code
- Mobile Network Code
- eNodeB Type
- IP Address S1 Interface
- IP Address eNodeB
- Primary DNS Address
- Secondary DNS Address
- MAC Address Public Gateway
- GTP Tunnel IP Address and Port
- GTP Tunnel eNodeB IP Address
- Integrity Algorithm
- IP Address to assign UEs on LAN

```
"2000100000000000":
{
  "status": "granted",
  "msisdn": "2000100000",
  "nickname": "SamsungS5",
  "profileName": "Valid8profile",
  "featureId": 1,
  "op": "#####",
  "amf": "8000",
  "k": "#####",
  "apn": "internet",
  "algorithm": "milenage"
},
```



### AUTOMATION API

User commands can be fully automated using REST API. This includes performing all test control functions as well as collecting results and metrics.

Last 10 commands

```
GET /api/1/control {}
GET /api/1/control {}
GET /api/1/history {}
GET /api/1/report {}
PUT /api/1/application/fixd/networkTester/selftest {"traceFlags":319,"development":false}
```

Raw
Close

### Load Application

```
PUT /api/1/application/{PRODUCT}/{APPLICATION}/{CONFIGURATION}
```

### Start

```
PUT /api/1/control/{ELEMENT}/start
```

### Reset Report

```
DELETE /api/1/report
```

### Get Events

```
GET /api/1/events
```

### SCRIPTING

The application's subsystems can be edited directly in the browser using Javascript or by using the graphical tools seen below. The Message Workshop allows for creating of test scenarios directly from the hex stream of a remote capture, while the Graphical Editor allows for creating customized call scenarios by dragging and dropping the call flow to meet your test needs.

The Packet Builder tool interface includes tabs for Packet Builder, MSC Builder, Base Converter, Data Rate Converter, and Help. It features a Mode selector (Native or TShark) and a Protocol dropdown (gtp). The Input field contains a hex stream, and the Output field shows a corresponding JSON structure for a GTP message.

The Wireshark interface shows a network capture with a list of packets and a detailed view of a DNS query response. The packet list shows a standard query A for www.cnn.com. The packet details pane shows the transaction ID, flags, and the query response structure, including the answer section with the host address for www.cnn.com.

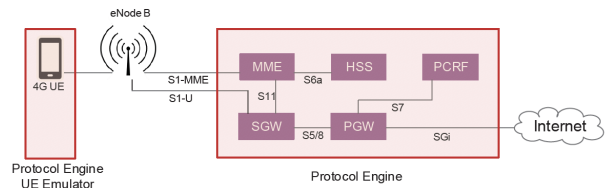
# USE CASES

## ENODEB UNDER TEST

In the scenario where the eNodeB is to be tested, it can be tested by the Valid8 4G Network Emulator emulating the core network. Additionally, load and conformance tests are available for interfaces S1-MME and S1-U. In the case where the eNodeB needs to be tested on the RF side, it can be tested by the Valid8 4G UE Emulator.

**Supported Scenarios:**

- Power on / Start up
- 4 Attach
- 4 TAU
- 4 Attach
- 4 eRAB Setup
- 4 Detach
- **UE Under**



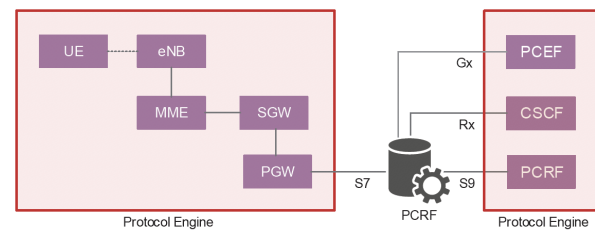
- Emulates MME (for S1-MME) and SGW (for S1-U) along with all other needed core network elements, exposing all internal interfaces
- Conformance tests available for S1-MME, S1-U, and X2

## PCRF UNDER TEST

For testing the PCRF, the 4G Network Emulator can wrap around the PCRF with the core network and IMS.

**Supported Scenarios:**

- CC-Request / Answer (CCR / CCA)
- 4 Re-Auth-Request / Answer (RAR / RAA)
- 4 Capability-Exchange-Request / Answer (CER / CEA)
- 4 Session-Termination-Request / Answer (STR / STA)
- 4 Abort-Termination-Request / Answer (ASR / ASA)
- 4 Device-Watchdog-Request / Answer (DWR / DWA)
- 4 Disconnect-Peer-Request / Answer (DPR / DPA)



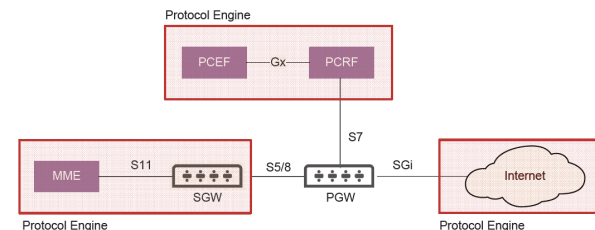
- Emulates core network, Diameter, and IMS nodes as needed for testing the PCRF, exposing all internal interfaces
- Conformance tests available for each interface (S7, S9, Rx, Gx)

## PGW UNDER TEST

For testing the PGW, the 4G Network Emulator can wrap around the node using the S5/8, S7, and SGi interfaces. Traffic can be originated from real or emulated UE and IoT devices.

**Supported Scenarios:**

- Create Session
- 4 Delete Session
- 4 Create Bearer
- 4 Modify Bearer
- 4 Delete Bearer
- 4 Echo



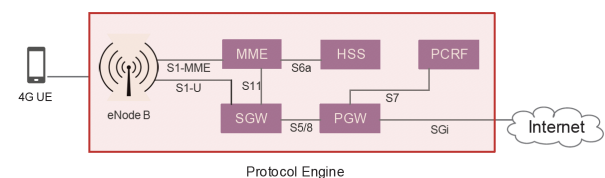
- Emulates all required nodes for wrapping around, including MME and PCRF for testing over interfaces S5/8, S7, and SGi
- Exposes all internal interfaces
- Conformance tests available for each interface (S5/8, S7, SGi)

## UE UNDER TEST

For testing UE or IoT devices, the 4G Network Emulator can provide the entire 4G core network as well as an emulated or real eNodeB depending on your test needs.

**Supported Scenarios:**

- Power on
- 4 Attach
- 4 Detach
- 4 TAU
- 4 Data Connection
- 4 VoLTE Call



- End to end VoLTE test capability
- Includes real femto, pico, or microcell eNodeB
- Emulates all core network nodes and allows for data connection to external networks

## SUMMARY OF SPECIFICATIONS

The Valid8 4G Network Emulator is capable of simulating and testing several devices individually or in parallel and is scalable to fit your needs.

### SPECIFICATIONS

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<b>Protocols</b>	<ul style="list-style-type: none"> <li>3GPP TS 23.401 (EUTRAN)</li> <li>3GPP TS 24.301 (NAS)</li> <li>3GPP TS 29.060 (GTPv1)</li> <li>3GPP TS 29.274 (GTPv2-C)</li> <li>3GPP TS 29.281 (GTPv1-U)</li> <li>3GPP TS 36.413 (S1AP)</li> <li>3GPP TS 36.414 (S1-U)</li> <li>IETF RFC5246 (TLS, Protocol (1.0, 1.1, 1.2))</li> <li>IETF RFC6101 (SSL, Protocol Version 3.0)</li> <li>IETF RFC793 (TCP)</li> <li>IETF RFC768 (UDP)</li> <li>IETF RFC4960 (SCTP)</li> <li>IETF RFC791 (IPv4)</li> <li>IETF RFC2460 (IPv6)</li> <li>IETF RFC3711 (SRTP)</li> <li>IETF RFC1035 (DNS)</li> <li>IETF RFC2131 (DHCP)</li> <li>IETF RFC3550 (RTP/RTCP)</li> <li>IETF RFC3261 (SIP)</li> </ul>
<b>UE</b>	<ul style="list-style-type: none"> <li>Internal femtocell: 400 - 6000 Mhz; including Bands 1 - 44 plus unlicensed 5Ghz band and others</li> <li>Includes CBRS band</li> <li>Duplex: FDD &amp; TDD</li> <li>Interface Uu to UE</li> <li>SIMs are software-based and configurable</li> </ul>
<b>UEs Emulated</b>	<ul style="list-style-type: none"> <li>Scalable; up to 256 per unit</li> </ul>
<b>UE Configuration</b>	<ul style="list-style-type: none"> <li>IMSI</li> <li>IMEISV</li> <li>Secret key</li> <li>UE category</li> <li>Duplex mode</li> <li>Default APN</li> <li>Tunnel setup script</li> <li>Power on/off via script</li> <li>Simulation on user plane</li> </ul>
<b>Scenarios</b>	<ul style="list-style-type: none"> <li>HTTP</li> <li>Ping</li> <li>Flooding</li> <li>VoLTE</li> </ul>
<b>MIMO</b>	<ul style="list-style-type: none"> <li>2X2: requires additional Valid8 unit with RF module</li> </ul>

## PRODUCT DETAILS

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<b>Hardware</b>	□ Intel-based; scalable to meet performance needs
<b>Options</b>	□ P5088/O1 includes base kit (simulated eNB) □ P5089/O1 includes LTE pico eNB (single band) □ P8110/O2 includes LTE femto eNB (multi band) □ Conformance tests available for each interface (S1, S5, S6a, S7, S11, Rx, Gx, Gy, Ro)
<b>Operating System</b>	□ Protocol Engine (Linux-based)
<b>User Interface</b>	□ Browser-based, touch-optimized graphical user interface
<b>Automation</b>	□ HTTP API
<b>Max output power</b>	□ 31 mW (femto RF module option) □ 1000 mW per Tx (external picocell option)
<b>Connector types</b>	□ Femtocell: SMA female □ Picocell: N-type female
<b>Hardware dimensions</b>	□ M1: 4.5" x 4.5" x 1.75" □ M3: 19" x 15.75" x 3.5"; appx. 16.7lb
<b>Power supply</b>	□ M3: 520W AC to DC, 100 - 240v