EPC-SIM for eNB/HeNB/ HeNB-GW Testing

VERSION 5.0

SPEC SHEET

Flexible, functional load testing tool for LTE RAN

KEY FEATURES

- Simulation of EPC, IMS and eNB in a single unit for validation of S1 and X2 interfaces
- Extensive VoLTE testing support based on IR.92 and IR.94
- Cellular IoT testing with LTE-M support
- Simulation of extremely dense heterogeneous networks for validation of X2 links and SON features
- Support of advanced features, such as IPSec, IRAT mobility and location-based services
- Extremely powerful solution with 10G line-rate user-plane capability and real-time analysis for testing the HeNB-GW over the S1 interface
- Easy-to-use graphical interface with the ultimate flexibility needed to test proprietary and negative scenarios

COMPREHENSIVE EPC SIMULATION FOR (H)eNB TESTING

EXFO's EPC-SIM evolved packet core simulator enables eNodeB (eNB) and Home eNodeB (HeNB) testing by simulating the S1 and X2 interfaces and supports testing on both the control and user planes.

EPC-SIM can effectively be used for functional and load testing of the (H)eNB. In functional testing, EPC-SIM can send or receive any protocol messages of the supported interfaces. EPC-SIM is sufficiently flexible to enable customization based on user-specific requirements.

In load testing, EPC-SIM simulates heavy loads of control- and user-plane traffic.

Transparent IP routing enables testing of the existing Internet protocol (IP) services. At the S1 interface, IP routing over the SGi interface ensures automatic mapping of the IP user plane of the user equipment (UE) to GTP-U tunnels.

Integrated with the IP multimedia subsystem (IMS) Core simulation, the EPC-SIM provides customers with a complete one-box solution for verification of Voice over LTE (VoLTE) scenarios. This single-box solution eliminates the complexity of communication between the EPC and IMS, thereby enabling focused testing on the S1 interface.

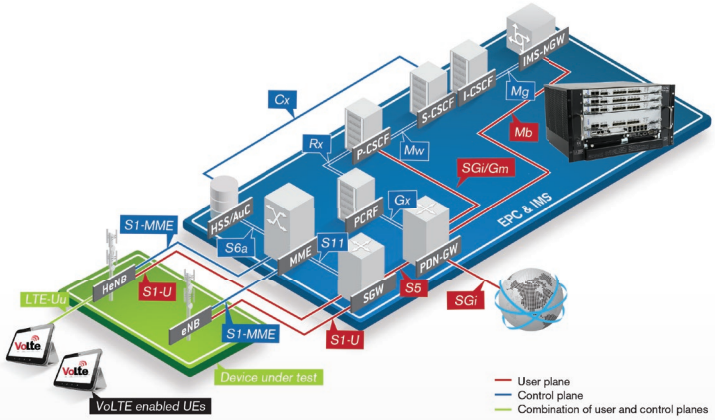

Figure 1. LTE EPC and IMS simulation by EPC-SIM

EPC-SIM can be used to verify features like Power Saving mode and Extended DRX cycles, which enable devices to have lengthier inactive periods. These are related to the LTE-M mode of cellular IoT technologies introduced by 3GPP in Rel 13, June 2016 specification.

POWERFUL SOLUTION FOR HeNB-GW TESTING

The EPC-SIM can be used along with the HeNB simulation test package to perform a complete wraparound test of the HeNB gateway (HeNB-GW). This high-capacity and high-performance solution supports the simulation of thousands of HeNBs with millions of subscribers at a very high messages-per-second rate. The purpose-built solution can pump user-plane traffic at a line rate of 10 Gbit/s to stress the HeNB-GW and measure its throughput. In addition, the real-time analysis provided by the solution can assist in verifying the HeNB-GW key performance index.

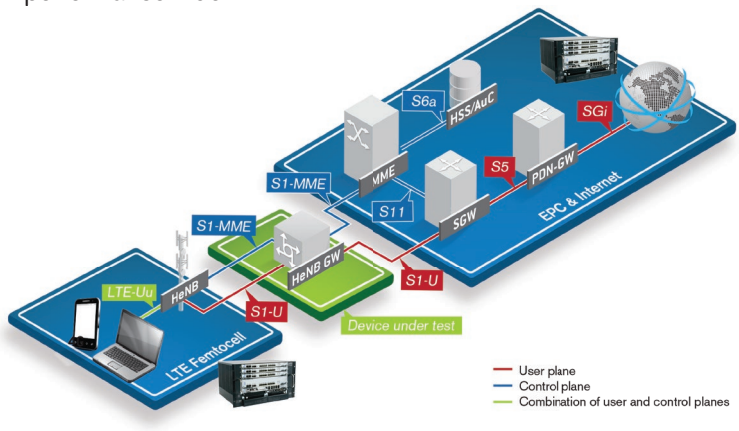

Figure 2. HeNB-GW testing solution

EPC-SIM TESTING OBJECTIVES

EPC-SIM supports comprehensive (H)eNB testing of:

- S1 control/user-plane testing
- X2 control-plane testing
- VoLTE service testing
- Cellular IoT (LTE-M) testing
- Inter-radio access technology (iRAT) mobility test scenarios
- Handover testing
- Self-organizing network (SON) testing
- Transparent user-plane routing
- Testing of location-based services, e.g., the Earthquake and Tsunami Warning System (ETWS) and the Commercial Mobile Alert System (CMAS)
- Portable EPC for field trials
- (H)eNB stress testing under maximum load

MESSAGE LIBRARIES AND TEST CASE PACKAGES

EPC-SIM supports message libraries for the 3GPP S1-AP, NAS, X2-AP, SIP, S101AP, S102AP, Sv, LPPa, LPP, SLg, SGs and GTP-C protocols. Test case packages include the support needed to test (H)eNB through the S1and X2 interfaces.

The interoperability testing (IOT) package is used to test the iRAT mobility scenarios over 2G and 3G networks by communicating with the 1xCS interworking solution (IWS), CDMA2000 high-rate packet data (HRPD), mobile switching center (MSC) and serving GPRS support node (SGSN) using the S102, S101, SGs, Sv, S3 and S4 interfaces, respectively.

TEST PACKAGES IN DETAIL

S1 Interface Testing (EPC Simulation)

This package simulates the mobile management entity (MME) and the serving gateway (SGW) toward the (H)eNB. In addition, it is able to simulate the security gateway in order to verify the S1 procedure over Internet protocol security (IPSec).

The following procedures are enabled:

- Attach/detach
- Service request
- Tracking area update (TAU)
- Security/authentication
- Bearer (default and dedicated up to 11 bearers per UE)
- Extended Discontinuous Reception (eDRX) and Power Saving mode (PSM) for LTE-M-enabled devices.
- Support for VoLTE calls
- Evolved packet system session management (ESM) information request
- Handovers
- Emergency
  - CMAS/ETWS
- SON procedure
- Radio access network (RAN) information management (RIM) procedure
- Closed subscriber group (CSG)

VoLTE Testing

This option enables IMS simulation along with the EPC-SIM, thereby providing an all-in-one solution. Compatible with IR.92 and IR.94, the option enables validation of both audio and conversational video.

The following are enabled:

- IMS-authentication and key agreement (AKA)-based authentication
- Support of both session initiation protocol (SIP) and TEL URI
- Support of real-time transport protocol (RTP) and real-time transport control protocol (RTCP)
- Audio call
  - Audio codec: AMR, AMR-WB
- Conversational video
  - Video codec: H.264
- Both the IPv4 and IPv6 IP address
- These VoLTE procedures:
  - VoLTE UE attachment and IMS registration
  - VoLTE UE initiated detach and IMS deregistration
  - Basic VoLTE UE to VoLTE UE voice call establishment and call clearing
  - Basic VoLTE UE to VoLTE UE multimedia (voice/video) call establishment and call clearing
  - Voice loopback–UE making audio calls to the network and network sending downlink audio

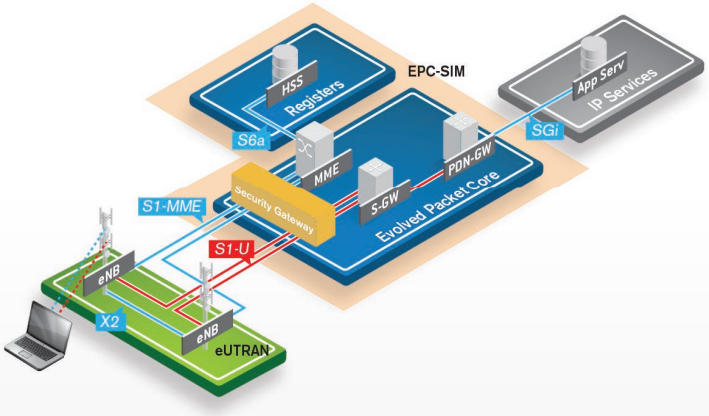

Figure 3. EPC-SIM deployment

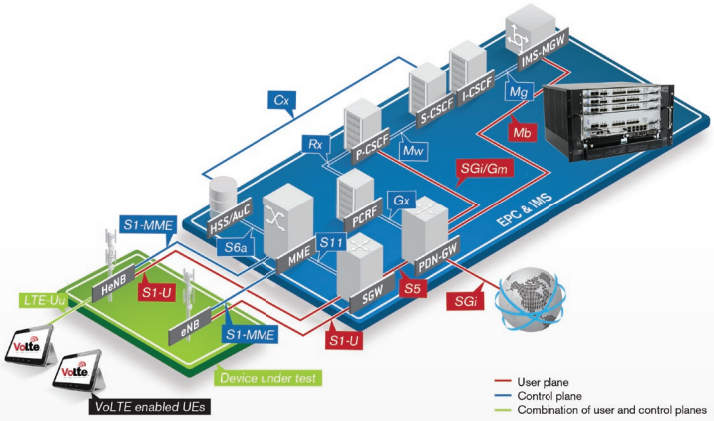

Figure 4. EPC and IMS simulation for VoLTE

IOT/IRAT Testing

This package simulates MME and SGW toward the HeNB and communicates with 1xIWS, HRPD, MSC and SGSN using the S102, S101, SGs, Sv, S3 and S4 interfaces, respectively.

The following procedures are supported:

› Circuit-switched (CS) fallback

› Single radio voice call continuity (SRVCC)

› Inter-radio access technology (inter-RAT) handover

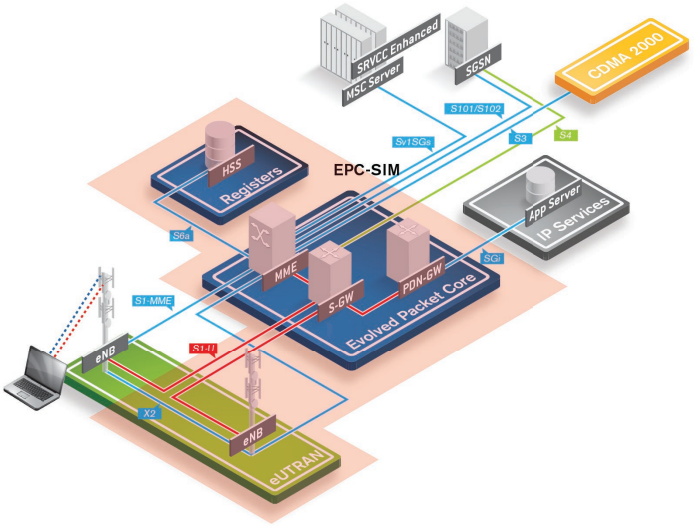

Figure 5. EPC-SIM for IRAT testing

X2 Interface Testing (HeNB)

This package simulates dense heterogeneous networks of multiple eNBs and HeNBs to test the (H)eNB under test on the X2 interface. This package is also useful for verifying SON procedures such as PCI planning, mobility load balancing (MLB), mobility robustness optimization (MRO) and energy saving (ES).

The following procedures are supported:

› Mobility procedures
  › Handover preparation
  › SN status transfer
  › UE context release
  › Handover cancellation

› Load management
  › Load indication
  › Resource status reporting initiation
  › Resource status reporting

› Setting and resetting the X2
  › X2 setup
  › Reset

› eNB configuration update and energy saving
  › eNB configuration update
  › Cell activation

› Mobility parameters management
  › Mobility settings change

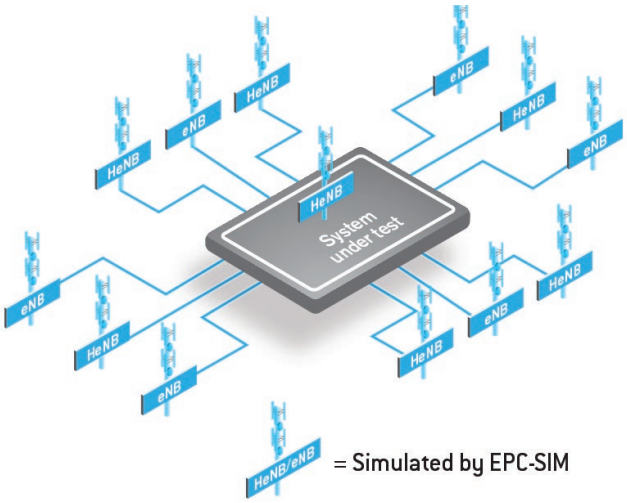

Figure 6. Heterogeneous network simulated by EPC-SIM

Generic EPC-SIM Features

The EPC-SIM also enables the following functionalities:

› Continuous data transfer during handovers

› Mobile-to-mobile call

› Multiple dedicated bearers with traffic flow template (TFT) filtering
  › Support of IPv4 and IPv6 UEs
  › Support of IPv4 and IPv6 eNBs

› Multiple tracking area codes (TACs); 3 TACs

› Support of multiple SGWs per eNB under one MME

› Support of X2 HO, with and without SGW relocation

› Support of S1 HO, with and without SGW relocation

› IPSec support for signaling (S1-MME) and bearer (S1-U)

› IKEv1 and IKEv2 support for both IPv4 and IPv6

› Support of X2-based handover over IPSec for IPv4 and IPv6

› IPSec NAT support with dynamic IP assignment to the endpoint

› HeNB requesting for IPSec security association can be any IP

› Jumbo frames

› Fragmentation and reassembly

Supported Statistics

- Calls in progress
- Completed calls
- Graceful completed
- Successful calls
- Busy-hour call attempts (BHCA)
- Failed calls
- Average successful calls per second (CPS)
- Average successful call attempts
- Current successful CPS
- Current successful call attempts per second
- Success rate
- Failure rate
- L3 messages per second
- Active stream count, Rx and Tx data rate
- Messages sent
- Messages received
- Messages decoded
- Call state
- Call status
- Counters for failure causes, e.g., lost message or timeout
- Total number of active service flows at any given time for uplink and downlink
- Call rate at any given time; success and failure calls

PRODUCT PLATFORM

The EPC-SIM is available on high-performance advanced telecom computing architecture (ATCA) hardware and scalable software.

ATCA

- Scalable platform
- High-packing density and reliability
- Multi-user functionality
- Upgradable to a larger testing system

QA Platforms

QA-805: Small ATCA platform

QA-805: Small ATCA platform

- Supports up to 5 general processing units (GPUs)
- Up to 20 simultaneous users for functional testing

QA-813

- Supports up to 13 general graphics processing units (GGPUs)
- High-performance and stress testing

PEv2

PEv2: Control plane blade

PEv2: Control-Plane Module

- Processor blade dedicated to control plane
- Single-slot ATCA module
- Intel Xeon-based eight-core processor
- 128 GB RAM
- One adaptive modulation and coding (AMC) slot

W²CM

W²CM and W²CM Lite: User plane blades

W²CM and W²CM Lite: User-Plane Blades

- Suitable for HeNB-GW testing
- User-plane module based on field-programmable gate array (FPGA) technology
- Two 10 GigE ports and eight 1 GigE ports
- W²CM: 10 GigE module emulates tens of millions of subscribers
- Generates real-world traffic (voice/video calls, web browsing, downloads, emails, audio/video streaming)
- Also available as W²CM Lite with reduced capacity
- Available for both the QA-805 and QA-813 platforms

NPU

- Suitable for HeNB performance test under maximum load
- Accelerates high user-plane traffic using network processors
- Multiple network-processing-unit (NPU) cores ensure GTP-U, IP routing and IPSec

USER INTERFACE

EPC-SIM has both a graphical user interface (GUI) and command-line interface (CLI). The comprehensive solution includes tools for configuration, test-case editing, message library editing, test-case execution, logging and reporting. The servers and their status and logging can be followed and monitored via the EPC-SIM's GUI.

Configuration

The EPC-SIM has a new, enhanced GUI for test configuration that enables users to correctly configure different entities.

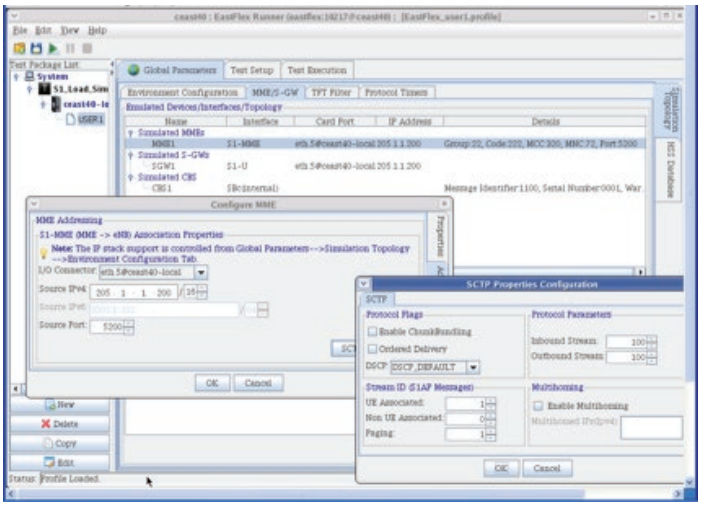

Figure 7. Configuration of network nodes

Test Execution

For test-case execution, this solution supports capabilities that profile the execution of several instances simultaneously. Statistical tables and graphs can also be used to monitor test progress. The simulation can be monitored through message-sequence charts, textual traces and state-machine execution path follow-ups.

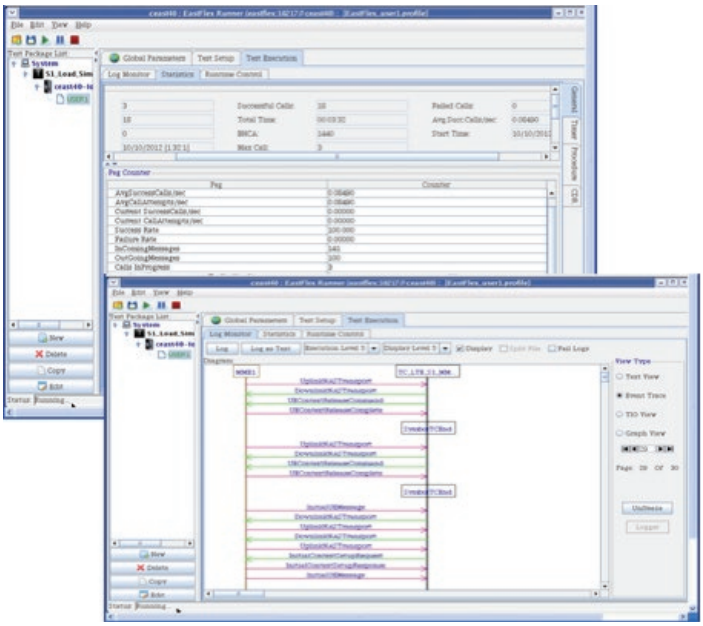

Figure 8. Test execution and analysis

Test Case and Message Editing

EPC-SIM test cases are defined using a graphical test-case language that resembles specification and description language (SDL), a well-known language used to define state machines in telecommunications.

The message libraries are delivered with EPC-SIM according to the configuration. To update the libraries or to create a specific protocol (for instance, to control the system under test or other test instruments), the EPC-SIM provides graphical message-library editing tools that allow users to add, delete and modify message structures and information element fields and immediately use the modified message templates in the test cases.

SUPPORTED PROTOCOLS

- NAS 3GPP 24.301 v13.6.0, 10.5.0, v9.9.0
- S1AP 3GPP 36.413 v13.3.0, v10.4.0, v9.8.0
- X2AP 3GPP 36.423 v.10.4.0, v.9.6.0
- S101AP 3GPP 29.276 v.10.3.0, v.9.5.0
- S102AP 3GPP 29.277 v.10.0.0, v.9.2.0
- LPPa 3GPP 36.455 v.10.2.0, v.9.4.1
- LPP 3GPP 36.355 v.10.4.0, v.9.8.0
- GTP-C 3GPP 29.274 v.9.10.0, v.9.8.0
- GTPv2 3GPP 29.274 v.10.5.0
- Sv 3GPP 29.280 v.10.3.0, v.9.8.0
- SLg 3GPP 29.172 v.10.1.0, v.9.4.0
- SGsAP 3GPP 29.118 v.10.6.0, v.9.7.0
- RIM 3GPP 48.018 v10.4.0, v9.7.0
- TCP
- SIP (RFC 3261, 3GPP TS 24.229)
- IMS Profile for voice (IR.92)
- IMS Profile for Conversational Video (IR.94)
- IPv4 (RFC 791)
- IPv6
- SCTP (RFC 2960 and RFC 3309)
- GTP-U
- GTPv1 (3GPP TS 29.281 v.8.2.0)
- IPSec (RFC 4301)

EXFO Headquarters > Tel.: +1 418 683-0211 | Toll-free: +1 800 663-3936 (USA and Canada) | Fax: +1 418 683-2170 | info@EXFO.com | **www.EXFO.com**

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