ixia

IxLoad VoLTE
HD Voice and SMS over LTE Testing

IxLoad is a full-featured layer 4-7 test application that provides real-world traffic emulation testing of voice, video, and data networks and components. IxLoad simultaneously emulates multiple layer 7 protocol activities, making it perfect for testing application delivery systems and components that use QoS and policy control mechanisms.

IxLoad supports the SIP and RTP protocols as well as the 3GPP GTP-c and GTP-u protocols, enabling testing of VoLTE devices and networks. IxLoad supports three major VoLTE test configurations:

- **End-to-end system test**.
  In this scenario IxLoad supports the emulation of user equipment (UE's) with SIP agents over the Uu interface (RF), generating voice and SMS traffic into the LTE eNodeB. On the other side of the network under test, IxLoad emulates land-based SIP user agents or the PSTN.

- **Isolation of the evolved packet core (EPC)**.
  In this configuration IxLoad supports the emulation of millions of mobile subscribers and hundreds of eNodeBs generating voice and SMS traffic directly into the EPC. On the other side of the network the entire core network is emulated by replicating the behavior the P-CSSF and all other devices behind it.

- **Isolation of the combined EPC and IMS Core**.
  In this scenario mobile subscribers and eNodeBs are emulated on one side and land-based SIP user agents are emulated on the other side.

LTE Access Features

- UE Category 1 – 4
- UE Category 5 under 2x2 MIMO
- FDD and TDD
- All 3GPP R8 2009 specifications
- 3GPP R9 June and December 2010 specifications
- All LTE FDD and TDD frequency bands
- All TDD configurations and SSF configurations
- Transmission modes; SISO, Tx Diversity, 2x2 MIMO and Beamforming
- 5, 10, 15, 20 MHz channel bandwidth support
- QPSK, 16QAM and 64QAM modulation schemes
- NAS compression and ciphering
- Full DL/UL HARQ capability
- Semi-persistent scheduling
- UE power control, group hopping
- Frequency hopping modes 0, 2, 4
- Automatic configuration of MIB/SIB parameters
- Support for default and dedicated bearers, with a maximum of 11 per user equipment (UE)
- UE initiated dedicated bearer creation, modification and deletion
- Network initiated dedicated bearer creation, modification

Examples of these test scenarios are shown below:
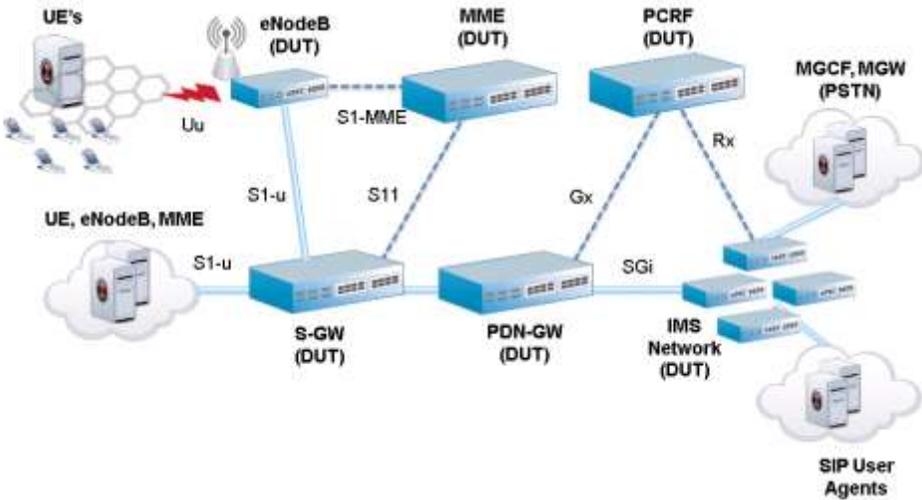

End-to-End VoLTE System Test Configuration
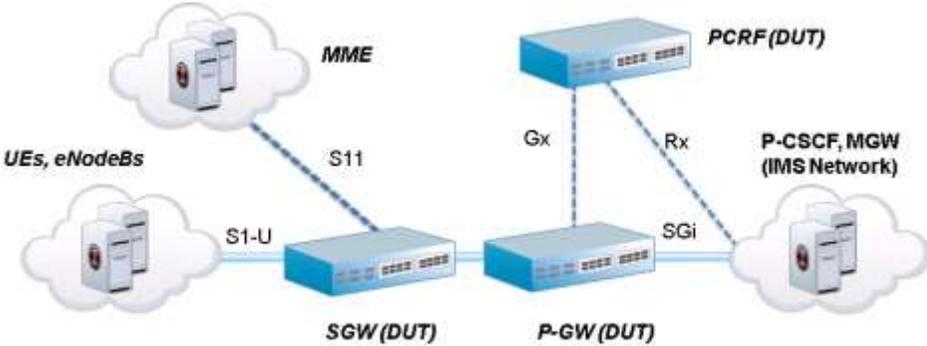
EPC Isolation Test Configuration
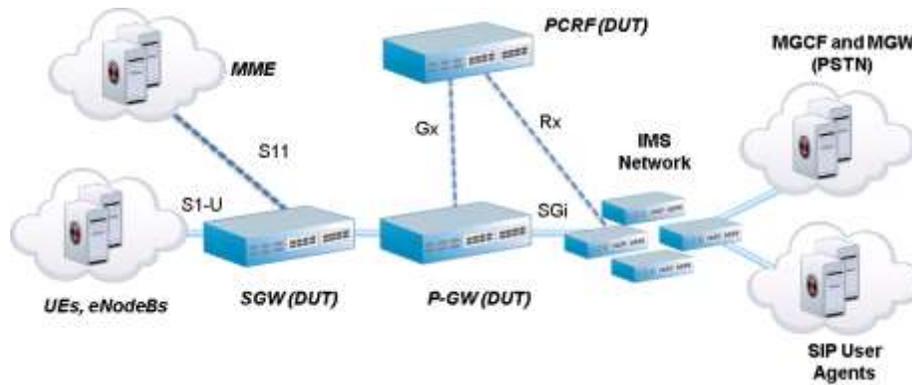
EPC and IMS Core Isolation Test Configuration

IxLoad's intuitive GUI greatly simplifies test construction by providing the full functionally components to build the test configuration:

- GTP implementation is a complete state machine that exposes many options for configuration and flexibility.

- SIP UEs implementation is based on a Scenario Editor that allows the user to create the desired call flow by combining predefined functions and procedures. The embedded SIP state machine assures the messages are properly built and the predefined call flows simplify the process of creating new configurations

- SIP Proxy implementation is based on user defined profiles and routing rules, and encapsulates the SIP state machine.
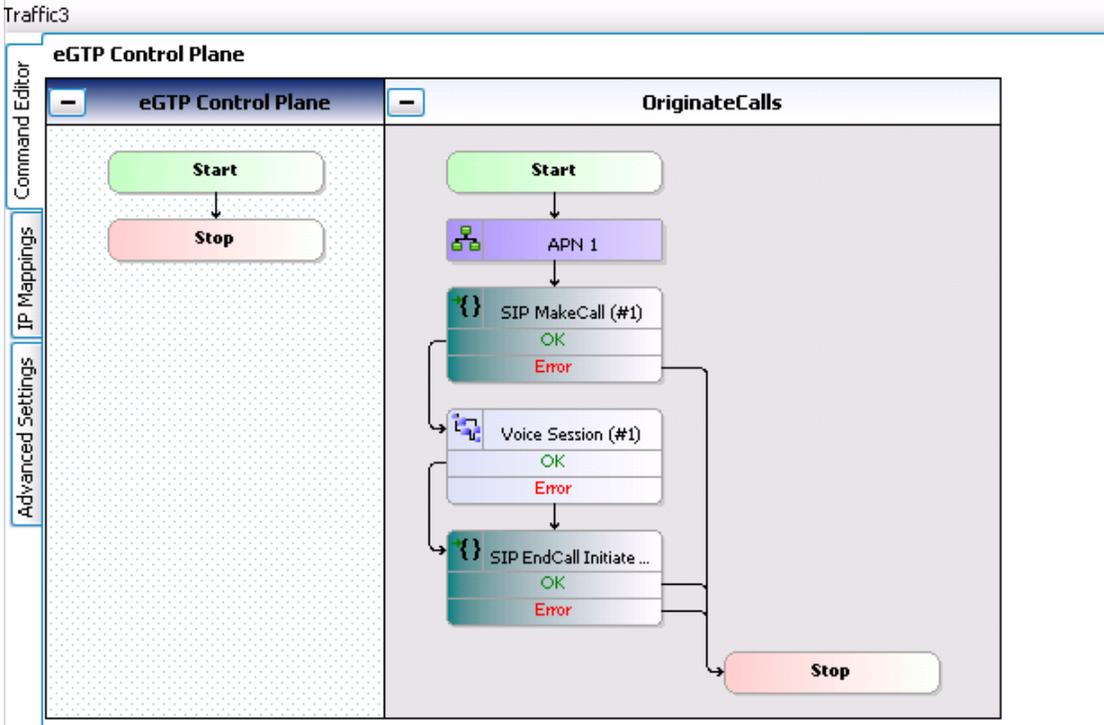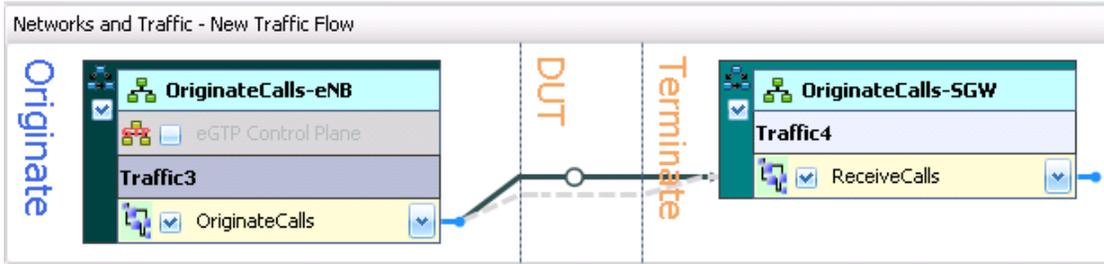
eGTP and SIP configuration

IxLoad's complete automation facilities allow regression tests to run unattended. A fully-featured TCL interface provides access to all IxLoad functions. In addition, a test configuration created with the IxLoad GUI can be turned into an automation TCL script with a single click of the mouse. In this way IxLoad tests can be run without GUI interaction, and without any required programming.

Protocols

Control plane

- 3GPP TS 29.274 Evolved General Packet Radio Service (GPRS) Tunnelling Protocol for Control plane (GTPv2-C)
- 3GPP TS 29.281 GPRS Tunneling Protocol User Plane (GTPv1-U)
- IPv4 transport

User Plane

- SIP over UDP or TCP
- RTP
- SMS

In addition to VoIP protocols, IxLoad supports true stateful emulation of other layer 7 protocols over eGTP; see the *IxLoad: Wireless Enhanced Packet Core Testing Data Sheet* for details.

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- Full DL/UL HARQ capability
- Semi-persistent scheduling
- UE power control, group hopping
- Frequency hopping modes 0, 2, 4
- Automatic configuration of MIB/SIB parameters
- Support for default and dedicated bearers, with a maximum of 11 per user equipment (UE)
- UE initiated dedicated bearer creation, modification and deletion
- Network initiated dedicated bearer creation, modification
- Dynamic IP address allocation during session establishment
- Supports all LTE handover types
- Configuration of QoS and TFT per layer 7 activity.

GTP-c Features

- Support for default and dedicated bearers, with a maximum of 11 per user equipment (UE)
- UE/MME initiated dedicated bearer creation, modification and deletion
- Network initiated dedicated bearer creation, modification
- Echo request and response
- Dynamic IP address allocation during session establishment
- Ability to configure the number of simulated MMEs and eNodeBs
- Supports eNodeB (X2) handovers with configurable event intervals and mobility paths between eNodeBs
- Supports S1-based handovers with indirect data forwarding tunnels
- Configuration of IMSI, MSISDN, IMEISV, RAC/LAC/TAC, MCC/MNC
- Configuration of QoS and TFT per layer 7 activity.
- Prebuilt TFTs are supplied, with the ability to manually override with user TFT definition.

SIP & RTP (User Plane) Features

- Emulates real-world traffic using Ixia's highly scalable test platform
- Leverages Xcellon-Ultra™ NP RTP acceleration technology to achieve very high performance for media traffic
- Simultaneously supports data, voice, and video protocols to emulate a multiplay subscriber environment
- Simulates SIP endpoints, SIP Proxies and SIP endpoints behind a cloud of SIP Proxies
- Maintains full control over SIP state machines, messages, and contents. Allows the creation of any call flow including negative testing.
- Drag and drop GUI permits functional building blocks to be easily assembled into test cases and call flows with automatic protocol rules enforcement
- Includes IMS call profiles
- Graceful stop at ramp-down to end all the active calls at the end of test
- Test cases built for functional and feature testing can be reused for stress testing
- Supports a multitude of voice codecs, including AMR-NB and AMR-WB
- Provides voice quality metrics using the E-Model or PESQ algorithms.
- Fully automates feature and regression testing using the IxLoad Tcl API or Test Conductor™
- Tests a device's ability to sustain designed load levels or connection rate
- Supports custom load profiles, which contains individual settings for each call mix element
- Supports call feature testing under load
- Performs call feature interoperability testing
- Provides ladder diagrams and media decoding with built-in packet capture and analyzer for in-depth SIP and RTP stream analysis
- Ships with library of pre-built test cases and call flows for easier startup

LTE EPC Performance		
	Per Port CPU Xcellon-Ultra NP	Per Load Module Xcellon-Ultra NP
Max GTP-c transaction rate	500 transactions/second	6000 transactions/second
Max UEs–SIP signaling only (no media)	15K	180K
Max UEs–SIP & RTP (ptime = 20ms)	8K	96K
Max Call Rate (calls with 1 sec media)	500 cps	6000cps

Statistics and Measurements

All statistics and measurements listed below are available in real time, as well as in comma separated value (CSV) format at the end of a test.
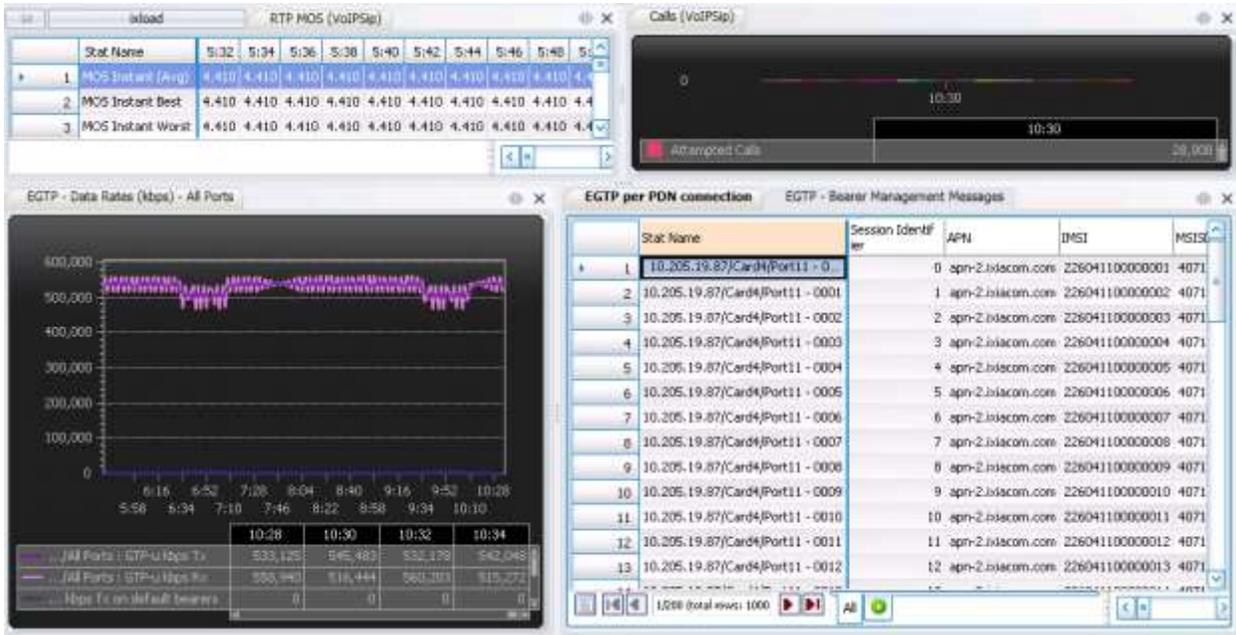
Real time statistics displayed during the execution of the test

SIP		
SIP Channels	Completed channels	Aborted channels
	Warning channels	Total channels
	Failed channels	

SIP Loops	Completed channel loops	Aborted channel loops
	Warning channel loops	Total channel loops
	Failed channel loops	Interloop duration (avg)
SIP Calls	Attempted calls	Calls with authentication required
	Connected calls	Calls over UDP
	Received calls	Calls over TCP
	Answered calls	Calls over mixed transport
	Rejected calls	Active calls
	Transferred calls	End calls initiated / received / completed
	Busy calls	
	Redirected calls	
SIP Call Rates	Attempted calls/s	Busy calls/s
	Connected calls/s	Redirected calls/s
	Received calls/s	Calls with authentication required/s
	Answered calls/s	Calls over UDP/s
	Rejected calls/s	Calls over TCP/s
	Transferred calls/s	
SIP Call Times	Call setup time (avg)	Call end time (avg)
	Talk time (avg)	Total call duration (avg)
SIP Delays	Post-dial delay (avg)	Media delay RX (max)
	Media delay TX (avg)	Media delay RX (min)
	Media delay TX (max)	Post-pickup delay (avg)
	Media delay TX (min)	Post-pickup delay (max)
	Media delay RX (avg)	Post-pickup delay (min)
SIP Registrations	Attempted registrations	Successful deregistrations
	Successful registrations	Failed deregistrations
	Failed registrations	Registration time (avg)
	Attempted deregistrations	Deregistration time (avg)
SIP Registration Rates	Attempted registrations/sec	Attempted / Successful deregistrations/sec
	Successful registrations/sec	
SIP Messages	The aggregated number of SIP messages sent, parsed, matched grouped on types of Requests and Responses	
VoIP/SIP Errors	Transport errors	Trigger errors

	SIP call flow errors	RTP errors
	SIP parser errors	Internal errors
	SIP SDP errors	Timeout errors
	SIP internal errors	
SIP Cloud / Proxy	**Dispatched Messages**	**Send Messages**
	Undispatched Messages	**Parsed Messages**
	Throughput BYTES SENT	**Parser Errors**
	Throughput BYTES RECEIVED	

RTP		
RTP Audio QoS	Packets Sent, Received	Consecutive Lost
	Packets Sent, Received /sec	Duplicate Packets Received
	Bytes Sent, Received	Late Packets Received
	Throughput Outbound	Misordered Packets Received
	Throughput Inbound	One Way Delay (Avg, Max)
	Lost Packets	Talk Time (Avg) [ms]
Delays	Media Delay TX(Min, Avg, Max)	Post-Pickup Delay(Min, Avg, Max)
	Media Delay RX(Min, Avg, Max)	
RTP Audio Advanced QoS	Delay Variation Jitter (Avg, Max)	Bytes Lost Percentage
	Interarrival Jitter (Avg, Max)	Packet Size Mismatched
		Packet Codec Mismatched
RTP Audio MOS	MOS Instant(Avg, Best, Worst)	MOS Per Call (Avg, Best, Worst)
	MOS (Best, Worst)	
Jitter Distribution	Packets with Jitter Up To 1ms, 3ms, 5ms, 10ms, 20ms, 40ms or greater	
R-Factor and MOS degradation	R-Factor Instant (Avg, Best, Worst)	Jitter Degradation
	Loss Degradation	Codec Degradation
		Delay Degradation
PESQ	Instant PESQ Listening Effort (Min, Avg, Max)	Instant PESQ Listening Quality (Min, Avg, Max)
	Overall PESQ Listening Effort (Min, Avg, Max)	Overall PESQ Listening Quality (Min, Avg, Max)

	No. of Channels with PESQ between -5 and 1, 1 and 2, 2 and 3, 3 and 4, 4 and 4.5	
	P.56 active level, activity factor and peak level (Min, Avg, Max)	
AMR Codec	Rate change sent, received AMR wrong change	AMR illegal frame type AMR invalid mode
RTP Playbacks and Records	**Successful Records** **Failed Playbacks** **Successful Playbacks**	**Failed Records** **RTP Skipped Functions**

SMS		
SMS Messages	Tx, Rx SMS Submit Tx, Rx SMS Submit Report Tx, Rx SMS Deliver	Tx, Rx SMS Command Tx, Rx Status Report
SMS Responses	Tx, Rx responses on category of responses 2xx, 3xx, 4xx, 5xx, 6xx	
SMS Errors	**Tx, Rx SMS Submit Failed** **Tx, Rx SMS Submit Report Failed**	**Tx, Rx SMS Deliver Failed** **Tx, Rx SMS Command Failed** **Tx, Rx Status Report Failed**

Ordering Information

Chassis Licenses:

925-3342

IxLoad Voice over LTE-2015, Software Bundle, Layer 4-7 Performance Test Application; Enables VoIP protocols for VoLTE testing. It includes: Advanced SIP & RTP, Audio Codecs, and VoLTE extensions. Also includes 925-3528 Voice Quality engine for up to 10Gbps, 925-3512 Video Quality engine for up to 10Gbps conversational video traffic, AVDNET-DHCP to emulate DHCP enabled clients and Software Impairment on selected hardware.

925-3359

IxLoad Multiplay-2015, Software Bundle, Layer 4-7 Performance Test Application; Data-Video-Voice package includes:
Data: Enables support for HTTP, HTTPS, TCP Session, FTP, DNS, Mail (SMTP, POP3 and IMAP), SSH, RADIUS, TFTP, Application-Replay, DHCP, LDAP, Telnet, Stateless-Peer and StreamBlaster emulations;
Video: Enables support for basic RTSP, IPTV (Multicast), Video-ADVANCED (VoD), Adobe Flash Client, Apple HLS Client, Microsoft Silverlight Client, Adobe HDS Client and DASH Client emulations. Includes 925-3189 Video Quality VQMON engine for up to 10Gbps and 925-3193 TCP VQ – Video quality for TCP video traffic for up to 10 Gbps;

Voice: Advanced VoIP SIP & RTP, Audio Codecs, H.323, VoLTE extensions, and Bulk SIP & MGCP. Also includes 925-3528 Voice Quality engine for up to 10Gbps, 925-3512 Video Quality engine for up to 10Gbps conversational video traffic;

Access: Enables support for Advanced Access networking protocols such as DHCP for IP address acquisition, DHCP Server, PPP, L2TP and IPsec.

Note: StreamBlaster, H.323 and Bulk SIP & MGCP are supported on selected load modules

Appliance Licenses:

925-6113

IxLoad PerfectStorm ONE VOICE, Software Bundle, Layer 4-7 Performance Test Application. Includes: Advanced SIP: SIP endpoint, Proxy and Cloud emulation TLS, SRTP Audio, Video Conference, Telepresence, MSRP 925-3528 Voice Quality engine for up to 10Gbps 925-3512 Video Quality engine for up to 10Gbps conversational video traffic

925-6321

IxLoad, PerfectStorm ONE Multiplay, Software Bundle, Layer 4-7 Performance Test Application; Data, Voice, Video, Access, VPN and Storage bundle for PerfectStorm ONE appliances. Includes: 925-6111 IxLoad PerfectStorm ONE DATA, 925-6112 IxLoad PerfectStorm ONE VIDEO, 925-6113 IxLoad PerfectStorm ONE VOICE, 925-6114 IxLoad PerfectStorm ONE AUTH, 925-6115 IxLoad PerfectStorm ONE VPN/ACCESS, and 925-6116 IxLoad PerfectStorm ONE STORAGE

IxVM License:

939-9513

IxVM, IxLoad Tier-3 FLOATING Subscription license. Includes the following IxLoad protocols supported on IxVM for the purchased term (List price is per unit, per year). HTTP, HTTPS, FTP, DNS, DHCP, LDAP, TFTP, Radius, Mail (IMAP, POP3, SMTP), Storage, IxLoad-Attack and AppLibrary. REQUIRES: License term to be specified (MUST be purchased in multiples of years). Enables 1Gig throughput per unit. INCLUDES IxVM Software Platform Framework, FLOATING. Enables support for IxVM IxServer