IxLoad Wireless

Problem: Scaling New Services, Virtualizing, and Preparing for 5G

Today's insatiable drive for more throughput and LTE penetration drives network capacity and scalability beyond what was envisioned only a few years ago. Carrier grade solutions required to carry all wireless traffic need to be characterized and validated continuously in the lab and pre-production deployments.

Challenges brought by voice over LTE (VoLTE) and video streaming need to be addressed before becoming bottlenecks in live networks. Scaling new services requires validating every level, including:

- Optimizing diversified LTE infrastructures that use equipment, systems, and applications from many different vendors
- Withstanding spikes in already-hard-to-predict signaling traffic (smartphones generate up to 20x more) that can lead to outages
- Handling simultaneous protocol requests for tunneling-, session-, or Diameter-based signaling

Understanding how to make the best of virtualization technologies—and when and where to deploy them in wireless networks—raises the bar for service providers preparing for the leap towards 5G.

Solution: Pre-Deployment Validation Using Real-World Subscriber and Channel Modeling

IxLoad Wireless is a powerful and easy-to-use solution for comprehensive performance testing of all aspects of LTE nodes and interfaces. Using IxLoad's real-world

Highlights

Ixia's IxLoad Wireless solution allows users to:

- Perform service quality validation with subscriber modeling, multiplay voice, video, and data traffic generation, and quality of experience (QoE) measurement
- Validate complex mobility scenarios, including intra-LTE and iRAT
- Simulate the behavior of several million subscribers using stateful application traffic mixes that can interact with real servers and peers
- Control test traffic mix and intensity using network objective to independently manage control and user planes
- Validate LTE networks via specialized Ixia hardware or IxLoad Virtual Edition (VE)

KEYSIGHT TECHNOLOGIES

subscriber modeling, testers do not need to be protocol experts to develop realistic test scenarios. From a single application, users can perform capacity tests, detail a device's throughput, measure voice and video quality, model a wide variety of mobility scenarios, and much more.

IxLoad is uniquely positioned in the market as the only test tool capable of simulating user equipment (UE) over the Radio and every other LTE node or interface.

Full automation via Tcl, Python, and REST APIs is available through a graphical user interface (GUI), allowing users to create regressions for continuous validation of product quality.

Real-world subscriber simulation is achieved by implementing:

- Mobile application modeling with voice, video, and data traffic, including audio quality (MOS, PESQ, POLQA) and quality of service (QoS) measurements
- Complex signaling operations, including Attach, Detach, Handover, TAU, and Idle Mode operation
- Channel modeling that allows UE cell center/edge simulation with LTE DL Fast Fading emulations including Pedestrian, Vehicle, Urban, and High-Speed Train

IxLoad Wireless Evolved Packet Core Simulation

IxLoad is the one-stop-shop for testing Evolved Packet Core. From end-to-end to node isolation, the tool simultaneously simulates multiple protocol activities, making it perfect for testing application delivery systems and components that use deep packet inspection (DPI).
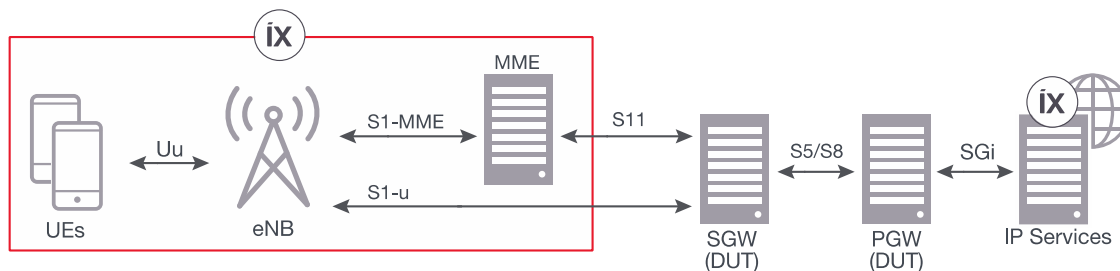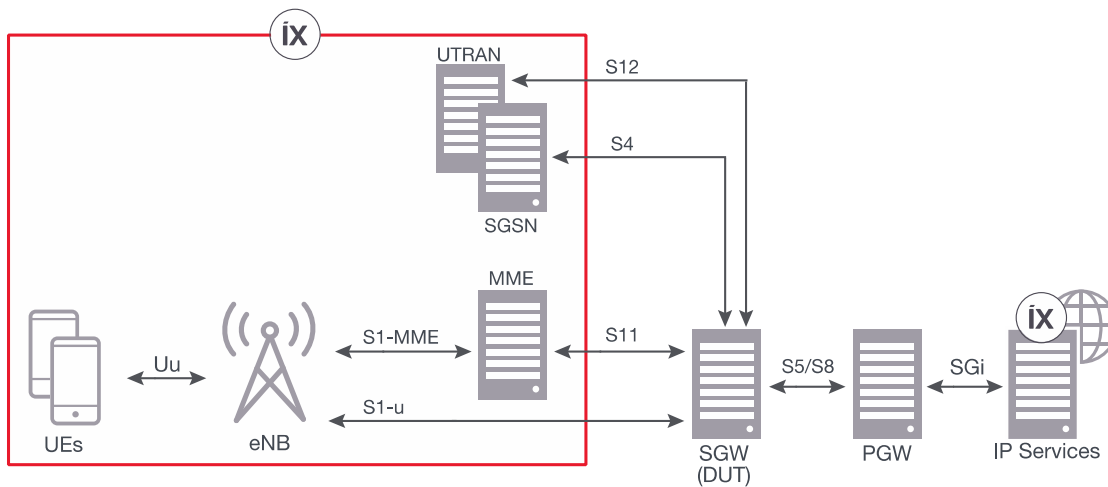

SGW/PGW testing topology
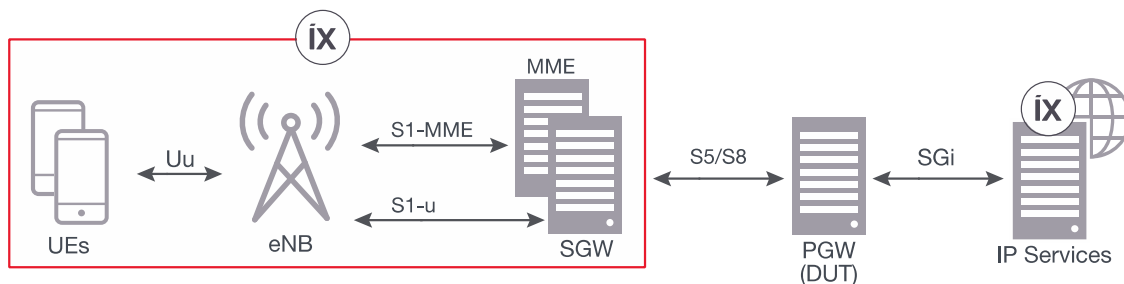
PGW testing topology
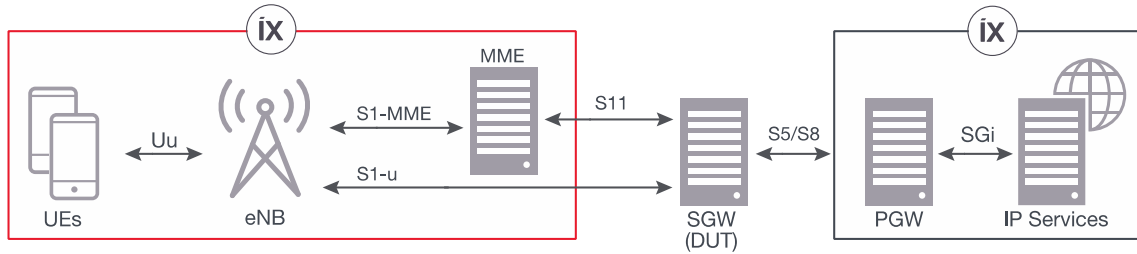
SGW isolation topology

iRAT SGW S4/S12 & S11/S1-u testing topology

Product Capabilities

GTP-C features:

- Validate default and dedicated bearers, network and UE initiated, deletion and modification of the bearers (with a maximum of 11 per UE)
- Perform handovers with configurable event intervals and mobility paths between eNodeBs (X2 and S1-Direct), plus S1-based handovers with indirect data forwarding tunnels
- Test any mix of IPv4 and IPv6 for control and user planes
- Impair GTPv2 information elements (IEs) and define negative behavior (Bearer Drop and Rejection) and node failures

GTP-U features:

- Leverage Ixia's Xcellon-Ultra™ NP and PerfectStorm™ TCP acceleration technology to achieve very high throughput rates
- Configure multiple activities per UE, each having a distinct Layer 7 (L7) protocol and data rate profile; multiple L7 activities can be mapped to distinct UE ranges, in any combination, giving each range an individual traffic profile and mix

- Validate multiple access point names (APNs) and QoS via DSCP control; Configuration of QoS and traffic flow template (TFT) per L7 activity; Prebuilt TFTs are supplied, with the ability to manually override with user defined
- Configure each L7 activity with a distinct objective consisting of:
  - Simulated users
  - Throughput
  - Connections/sec
  - BHCA
  - Concurrent connections/sessions

Specifications

Protocol	Feature
3GPP Technical Specifications	Supported 3GPP versions: Rel9 - December 2010, Rel10 – December 2011, Rel11 – March 2014 and Rel12 – June 2016 • TS 23.401 General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access • TS 29.274 3GPP Evolved Packet System (EPS); Evolved General Packet Radio Service (GPRS) Tunneling Protocol for Control plane (GTPv2-C); Stage 3 • TS 23.402 Architecture enhancements for non-3GPP accesses • TS 29.060 GPRS Tunneling Protocol (GTP) across the Gn and Gp interface • TS 36.304 Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) procedures in idle mode • TS 29.061 Interworking between the Public Land Mobile Network (PLMN) supporting packet-based services and Packet Data Networks (PDN) • TS 23.228 IP Multimedia Subsystem (IMS); Stage 2 • TS 23.292 IP Multimedia Subsystem (IMS) centralized services; Stage 2
RFC	• RFC 4862 IPv6 Stateless Address Autoconfiguration • RFC 2131 Dynamic Host Configuration Protocol • RFC 3736 Stateless Dynamic Host Configuration Protocol (DHCP) Service for IPv6 • RFC 3633 IPv6 Prefix Options for Dynamic Host Configuration Protocol (DHCP) version 6 • RFC 768 User Datagram Protocol • RFC 4861 Neighbor Discovery for IP Version 6 (IPv6) • RFC 4960 Stream Control Transmission Protocol • RFC 3927 Dynamic Configuration of IPv4 Link-Local Addresses

General Specifications	
Performance per blade: Xcellon-NP • Max active bearers: 1.2M • Procedures Rate of 6k/sec	• Up to 9.6Gbps HTTP/AppReplay TPUT (Downlink) • 96k simultaneous Volte calls (AMR-WB)
Performance per blade: PerfectStorm • Max active bearers: 2.4M • Procedures Rate of 24k/sec	• Up to 74Gbps HTTP/AppReplay TPUT (Downlink) • 144k simultaneous Volte calls (AMR-WB)
Performance per blade: CloudStorm • Max active bearers: 4.4M • Procedures Rate of 40k/sec	• Up to 180Gbps HTTP/AppReplay TPUT (Downlink) (fan-out 8x25G) • 280k simultaneous Volte calls (AMR-WB)
Performance per IxLoad VEport • Max active bearers: 150k • Procedures Rate of 1k/sec	• Up to 5Gbps HTTP/AppReplay TPUT (Downlink)

Platform Options

Visit Keysight.com for More Information on IxLoad Platform Options	
Chassis	• XGS-12 SD/HS/HSL Chassis • XGS-2 SD/HS/HSL Chassis
Load Modules	• Xcellon-Ultra NP • PerfectStorm • PerfectStorm ONE • CloudStorm
IxLoad VE	• ESXi, KVM, OpenStack

Ordering Information

944-1204

PerfectStorm 10GE 8-port Load Module, 10GE 8-port SFP+. Supports dual speed 1G/10G

941-0044

PerfectStorm ONE 1GigE, 8-port SFP+ appliance (PS1GE8)

Per interface software part numbers

925-3157

IXLOAD, ADVNET-EGTPR8-S11S1MME, MME and eNodeB simulation on the S11 and S1-U interfaces, for EPC testing (DUT = SGW)

925-3171

IXLOAD, ADVNET-EGTPR8-S11S1SGW, SGW simulation on the S11 and S1-U interfaces (DUT = MME)

925-3158

IXLOAD, ADVNET-EGTPR8-S5SGW, Optional Software, Layer 4-7 Performance Test Application; SGW simulation on the S5/S8 interface (DUT = PGW)

925-3159

IXLOAD, ADVNET-EGTPR8-S5PGW, Optional Software, Layer 4-7 Performance Test Application; PGW simulation on the S5/S8 interface (DUT = SGW)

925-3180

IXLOAD, ADVNET-EPCR8-S4SGSN, Optional Software, Enables SGSN/RNC simulation on the S4/S12 interfaces (DUT = SGW)

925-3298

IXIA IXLOAD, WRLS-EPC-IMPAIR Evolved Packet Core (EPC). Test Application for Negative Behavior and Message Impairment

IxLoad Wireless eNodeB Simulation

IxLoad supports the 3GPP S1-AP and NAS protocols (from 3GPP Release9 through Release12) as well as the GTP-U protocol, enabling testing of the wireless evolved packet core (EPC). This is accomplished through the emulation of the:

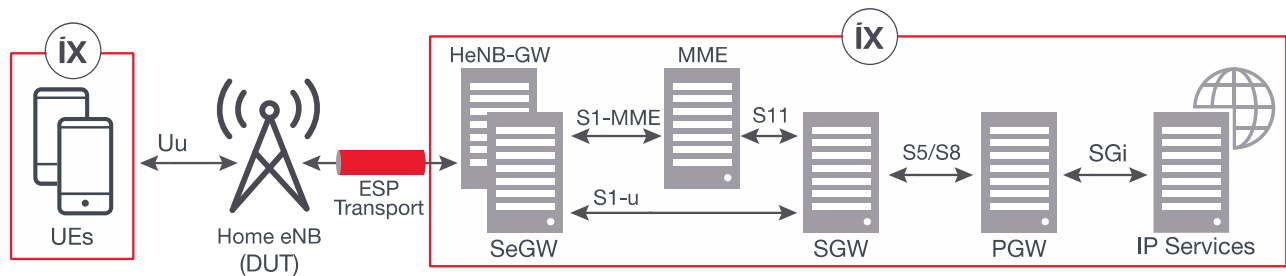- eNodeB on the S1-MME and S1-U interfaces
- EPC when (Home or Macro) eNodeB wrap-around topology is needed
- Home eNodeB (Secured) when traffic is running over secure tunnels towards the system under test (an HeNB Gateway and a Secure Gateway)
- Security Gateway (SeGW) connected to EPC
- eNodeB on the X2 interface
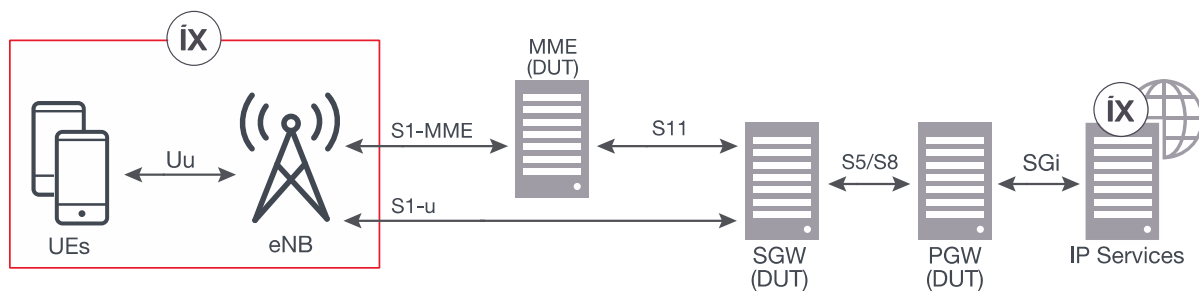
Macro eNB simulation topology
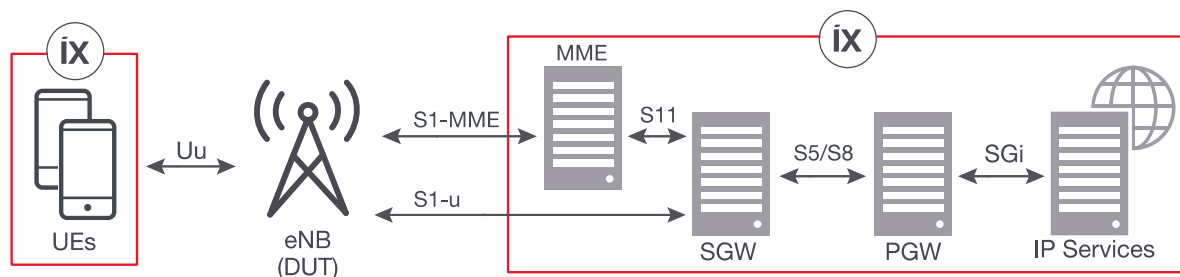
eNodeB isolation topology

Home eNodeB isolation topology

Product Capabilities

Control plane features

- Support for default and dedicated bearers, with a maximum of 11 per UE
- UE and network initiated dedicated bearer creation and deletion
- Support for IDLE state (S1 Release), Paging and TAU procedures
- Dynamic IPv6 address allocation during session establishment
- Supports X2 handovers with configurable event intervals and mobility paths between simulated eNodeBs; supports S1-based handovers with indirect data forwarding; supports MME and/or SGW relocation for all handover types
- Configuration of QoS parameters (QCI included) and TFT per L7 activity
- Prebuilt TFTs are supplied, with the ability to manually override with user TFT definition
- Configurable APNs per subscriber range, with support for multi-APN per subscriber
- Support for IPv4, IPv6, and IPv4v6 (dual stack) PDN connections, in any combination for multi-APN configurations
- Support for authentication, integrity protection, and ciphering
- Support for MME pooling and network sharing
- Support for message Impairment at S1-NAS and S1-AP protocols level

User plane features

- Leverages Xcellon-Ultra NP and PerfectStorm/CloudStorm TCP acceleration technology to achieve very high throughput rates
- Multiple activities can be configured per UE, each having a distinct L7 protocol and data rate profile
- Support for IPv4 and IPv6 traffic activities
- Each L7 activity can be configured with a distinct objective consisting of:
  - Simulated users
  - Throughput
  - Connections/sec
  - Connection attempts/sec
  - Layer 7 transactions/sec
  - Concurrent connections/sessions

APN, QoS, and TFT configuration when using a dedicated bearer

Specifications

Protocol	Feature
3GPP Technical Specifications	Supported 3GPP versions: Rel9 - December 2010, Rel10 – December 2011, Rel11 – March 2014 and Rel12 – June 2016 • 3GPP TS 36.410 S1 General Aspects and Principles • 3GPP TS 23.401 General Packet Radio Service (GPRS) enhancements for E-UTRAN access • 3GPP TS 36.413 v9.3.0 (R9 June 2010) Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 Application Protocol (S1AP) • 3GPP TS 24.301 v9.3.0 (R9 June 2010) Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3 • 3GPP TS 36.414 Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 data transport • 3GPP TS 29.281 GPRS Tunneling Protocol User Plane (GTPv1-U) • 3GPP TS 36.304 Evolved Universal Terrestrial Radio Access (E-UTRA), User Equipment (UE) procedures in idle mode • 3GPP TS 36.423 Evolved Universal Terrestrial Radio Access Network (E-UTRAN); X2 Application Protocol (X2AP)
RFC	• RFC 4862 IPv6 Stateless Address Autoconfiguration

Protocol	Feature
	• RFC 2131 Dynamic Host Configuration Protocol • RFC 3736 Stateless Dynamic Host Configuration Protocol (DHCP) Service for IPv6 • RFC 3633 IPv6 Prefix Options for Dynamic Host Configuration Protocol (DHCP) version 6 • RFC 768 User Datagram Protocol • RFC 4861 Neighbor Discovery for IP Version 6 (IPv6) • RFC 4960 Stream Control Transmission Protocol • RFC 3927 Dynamic Configuration of IPv4 Link-Local Addresses

Platform Options

Visit www.keysight.com for More Information on IxLoad Platform Options	
Chassis	• XGS-12 SD/HS/HSL Chassis • XGS-2 SD/HS/HSL Chassis
Load Modules	• Xcellon-Ultra NP (*except Home eNodeB) • PerfectStorm • PerfectStorm ONE • CloudStorm
IxLoad VE	• ESXi, KVM, OpenStack

Performance for Macro eNodeB

Metric	Per Xcellon-Ultra NP Blade	Per PerfectStorm Blade (PS10GE8NG)	Per CloudStorm Blade (2x100G)	Per IxVM port
Max session activation rate/sec	2,500	8,000	16,000	800
Max amount of bearers	720k	1.9M	3,8M	110k
Max amount of eNodeBs	1,200	64,000	96,000	2,000
Max handover rate – X2 handover/sec	3,600	8,000	16,000	800
Max throughput – HTTP (Downlink)	9.4Gbps	72Gbps	196Gbps	4.2Gbps

Performance for Home eNodeB

Metric	Per PerfectStorm Blade (PS10GE8NG)	Per CloudStorm Blade (2x100G)	Per IxVM port
Max Procedures rate/sec	8,000	16,000	800
Max amount of bearers	1.9M	3,8M	110k
Max amount of eNodeBs	64,000	96,000	2,000
Max IPsec tunnel setup rate/sec	2,000	8,000	800
Max throughput – HTTP (Downlink)	11Gbps	26Gbps	150Mbps

Ordering Information

944-1204

PerfectStorm 10GE 8-port Load Module, 10GE 8-port SFP+; supports dual speed 1G/10G

941-0044

PerfectStorm ONE 1GigE, 8-port SFP+ appliance (PS1GE8)

Per interface software part numbers

925-3167

IxLoad ADVNET-EGTPR8-S1ENB, Optional Software, Enables eNodeB simulation on the S1-MME and S1-U interfaces

925-3290

IxLoad ADVNET-LTE-EPC Emulation, Optional Software, Enables MME and SGW simulation on the S1-MME and S1-U interface

925-3297

IxLoad WRLS-EPC-ENB-IPSEC, Evolved Packet Core (EPC) simulation for S1-MME/S1-U over IPsec

925-3918

IxLoad WRLS-EPCSim-IPSEC IPSec support for the EPCSim (MME/SGW, S1-MME and S1-u interfaces)

925-4422

IXIA IXLOAD-WRLS, EPC support for eNB simulation on S1-Lite interface and MME - SGW simulation on S11u interface. Support for PSM and eDRX mechanisms
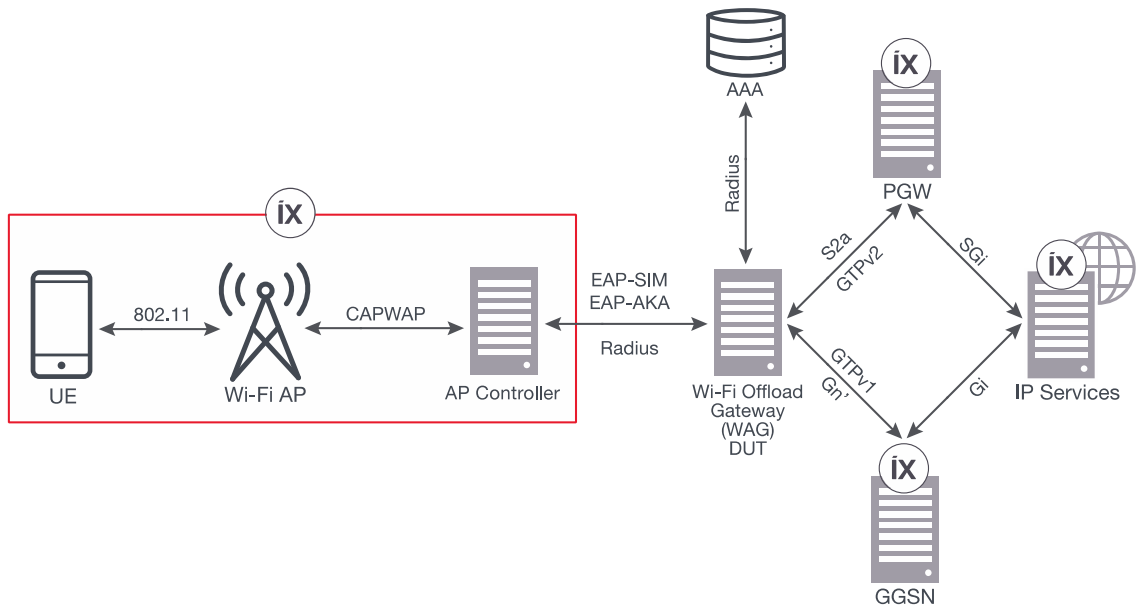
IxLoad Wi-Fi Offload

Wi-Fi offload appeals to many operators as a cost-effective means of offloading large amounts of mobile data traffic while delivering a variety of new services. Moving data traffic to Wi-Fi networks stands to optimize bandwidth utilization, lower cost, and preserve the quality of voice calls on the traditional network.

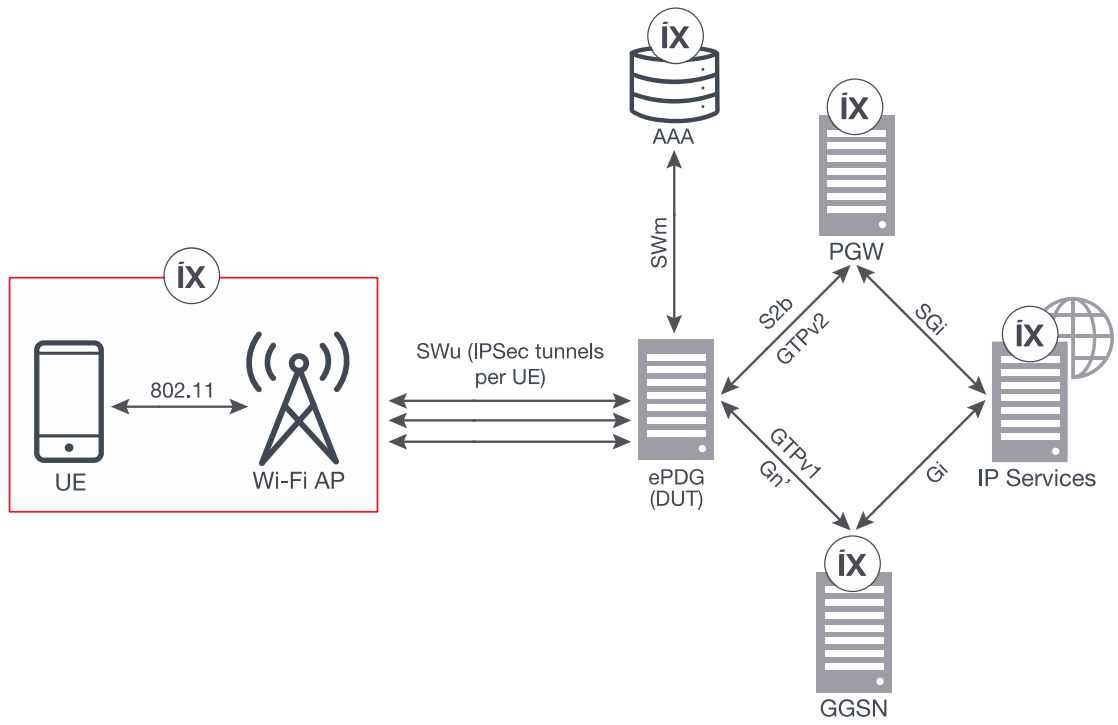Ixia's Wi-Fi offload solution allows users to:

- Emulate, isolate, and assess new Wi-Fi offload network devices such as TWANs and TWAGs using PMIP- or GTP-based interfaces
- Emulate core network elements like PGWs to better isolate access and offload components
- Support EAP-SIM and EAP-AKA authentication methods

Product capabilities

- Simulate multiple UEs, APs, and controller for testing Wi-Fi access gateways using encapsulated DHCP and L7 traffic over plain-IP (v4/v6), L2oGRE, L3oGRE, and VLANs/QinQ
- Support DHCP IP address allocation for UE
- Simulate multiple UEs and APs over the CAPWAP protocol to test access point controllers; customize and adapt configuration of TLVs and AVPs via dedicated user interface
- Emulates mobile access gateways (MAGs) to assess the scalability of local mobility anchor (LMA) while measuring QoE for differentiated services provided through the EPC; provides coordinated simulation between Radius (towards AAA Server) and PMIPv6 (towards LMA) interfaces
- Supports PGW emulation on S2a and S2b (GTPv2 or PMIPv6 based) for isolating WAG (trusted) or ePDG (untrusted)
- Supports HSGW-coordinated simulation over PMIPv6 and STa (Diameter based)
- Validate ePDG by simulating UEs and APs over SWu or SWn interfaces
- Supports Vo-WiFi (Voice over SWu, including Volte 3GPP IPSec over SWu); perform service quality validation with voice, video, and data traffic generation, and asses QoE
- Handovers from Wi-Fi (SWu) to/from LTE (S11/S1u) or 3G (S4/S12)

IxLoad solution for trusted Wi-Fi offload

IxLoad solution for untrusted Wi-Fi offload

Specifications

Protocol	Feature
3GPP Technical Specifications	- TS 23.401 General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network - TS 29.274 Evolved General Packet Radio Service (GPRS) Tunnelling Protocol for Control plane (GTPv2-C); Stage 3 - TS 23.402 Architecture enhancements for non-3GPP accesses - TS 29.275 Technical Specification Group Core Network and Terminals; Proxy Mobile IPv6 (PMIPv6) based Mobility and Tunnelling protocols; Stage 3 - TS 23.060 Technical Specification Group Services and System Aspects; General Packet Radio Service (GPRS); Service description; Stage 2 - TS 29.060 General Packet Radio Service (GPRS); GPRS Tunneling Protocol (GTP) across the Gn and Gp interface - TR 23.834 Study on General Packet Radio Service (GPRS) Tunneling Protocol (GTP) based S2b; Stage 2
RFC	- RFC2865 Remote Authentication Dial In User Service (RADIUS) - RFC3748 Extensible Authentication Protocol (EAP) - RFC4186 Extensible Authentication Protocol Method for Global System for Mobile Communications (GSM) Subscriber Identity Modules (EAP-SIM) - RFC4187 Extensible Authentication Protocol Method for 3rd Generation Authentication and Key Agreement (EAP-AKA) - RFC2131 Dynamic Host Configuration Protocol - RFC2784 Generic Routing Encapsulation (GRE) - RFC5145 Control and Provisioning of Wireless Access Points (CAPWAP) Protocol Specification - RFC5213 Proxy Mobile IPv6 - RFC3588 Diameter Base Protocol

Performance for Wi-Fi Offload

Trusted Wi-Fi Offload
Trusted Wi-Fi Performance per blade: Xcellon-NP   600k simultaneous connected UEs (distributed across 1200 APs)   - Attach Rate of 1200/sec (EAP & DHCP)   256k APs (with 1x UE per AP)   - Up to 10Gbps HTTP/AppReplay TPUT   - S2a/S2b: 1M Bearers, 6k/sec Attach rate; 96k VoWiFi simultaneous calls

Trusted Wi-Fi Offload
Trusted Wi-Fi Performance per blade: PerfectStorm • 1.2M simultaneous connected UEs (distributed across 60k APs) • Attach Rate of: ◦ 4800/sec (EAP/SIM, EAP/AKA or no auth) • 800/sec (EAP/TLS, EAP/TTLS) • S2a: 2.4M Bearers, 24k/sec Attach rate; 144k VoWiFi simultaneous calls • Up to 10 Gbps TPUT with StatelessUDP
Trusted Wi-Fi Performance per blade: CloudStorm (2x100G) • 2M UEs • Attach Rate of 7000 (L2VLAN encapsulation) • Up to 98Gbps TPUT with HTTP (L2VLAN encapsulation) • Up to 22Gbps TPUT with HTTP (EoGRE/L2TP encapsulation)

Untrusted Wi-Fi Offload
Untrusted Wi-Fi Performance per blade: PerfectStorm • 1M simultaneous connected UEs (i.e. IPsec tunnels) • Attach Rate of 20k/sec • S2b: 2.4M Bearers, 24k/sec Attach rate; 144k VoWiFi simultaneous calls • Up to 80Gbps TPUT with StatelessUDP

Platform Options

Visit www.keysight.com for More Information on IxLoad Platform Options	
Chassis	• XGS-12 SD/HS/HSL Chassis • XGS-2 SD/HS/HSL Chassis
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941-0044

PerfectStorm ONE 1GigE, 8-port SFP+ appliance (PS1GE8)

## All-inclusive software bundles

925-3190

Trusted WiFi Offload bundle: EAP SIM/AKA Radius authentication for simulated UEs; encapsulated traffic over L2/L3oGRE PGW and WAG simulations over S2A interface GGSN simulation over Gn interface MAG simulation over PMIPv6 CAPWAP protocol for AP simulation HSGW simulation over PMIPv6 with STa (Diameter) authentication

925-3912

Untrusted WiFi Offload: UE simulation over SWu interface (IPSec); Requires PerfectStorm hardware platform UE simulation over SWn; Requires PerfectStorm hardware platform PGW and ePDG simulations over S2b interface

Ixload 3G Testing

IxLoad supports the 3G testing via GTPv1 protocol, enabling IxLoad to simulate serving GPRS support nodes (SGSNs) and user equipment, thus permitting test engineers to perform highly scalable and flexible testing on gateway GPRS support nodes (GGSNs). RNC IuPS simulation is another option available for assessing 3G networks performance.
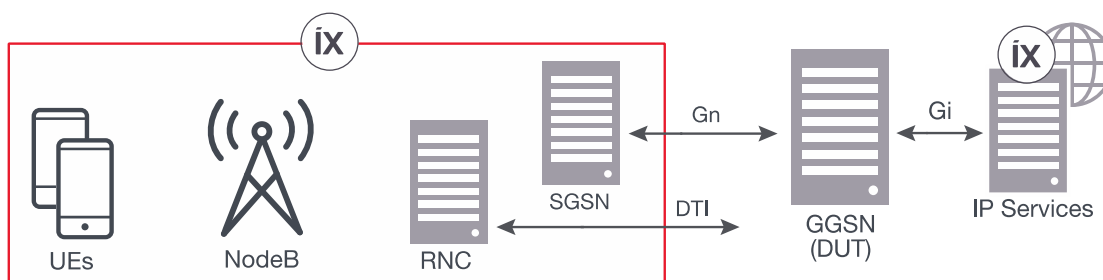
GGSN testing topology supported by IxLoad
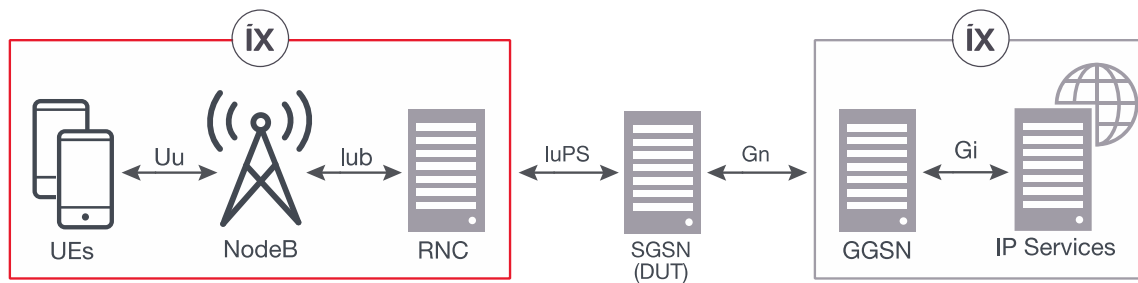
SGSN testing topology supported by IxLoad

Product Capabilities

Control plane features for SGSN/GGSN Gn interface

- Create/Delete/Update PDP contexts

- Echo Request and Response

- Primary and secondary PDP context support (maximum 11 contexts per UE)

- Direct Tunnel Interface (DTI)

- Supports mobility between SGSNs with configurable event intervals and mobility paths, including mobility concurrently with DTI

- Support iRAT mobility between:
  - SGSN and eNB/MME
  - RNC IuPS and eNB

- Configuration of QoS and TFT per L7 activity. Prebuilt TFTs are supplied, with the ability to manually override with user TFT definition

- Configurable APNs per L7 activity and unique APNs per subscriber, with auto-generated APNs

- Configurable, multiple control and user-plane IP addresses and ports for each SGSN

- Dynamically negotiated QoS parameters are respected by the L7 protocol activities: the UE will not exceed allocated bandwidth and will adjust dynamically when the QoS is modified

- Support for testing of various GGSN Restart procedures

Control plane features for RNC IuPS interface

- Support for UE-initiated procedures: GPRS Attach, Combined SPRS/IMSI Attach, Detach, Iu Release, Intra SGSN RAU, Serving RNS Relocation procedure, MS Initiated Service request, UE PDP Context Activation for Iu mode, UE Secondary PDP Context Activation, MS-Initiated PDP Context Modification

- Support for network-initiated procedures: Identity Request/response, UMTS Authentication, P-TMSI Reallocation, Network Initiated Service Request, Network Requested PDP Context Activation, Network Requested Secondary PDP Context Activation, SGSN-Initiated PDP Context Modification, SGSN-initiated PDP Context Deactivation Procedure

- SGSN pooling

- SCTP MultiHoming

- RNC to RNC handovers and inter-RAT handovers when using combined RNC/eNodeB plugin

- ANSI and IUT variants

User plane features

- Multiple activities can be configured per UE, each with a distinct L7 protocol and data rate profile
- Each L7 activity may have a distinct objective consisting of:
  - Simulated users
  - Throughput
  - Connections/sec
  - Connection attempts/sec
  - Layer 7 transactions/sec
  - Concurrent connections/sessions
- Activities can also be mapped to distinct UE ranges, giving each range an individual traffic profile
- Multiple activities mapped to a single UE range can be configured to request secondary PDP contexts or to share the existing primary PDP context

Performance

SGSN/GGSN GN	Per Xcellon-Ultra NP Blade	Per PerfectStorm Blade (PS10GE8NG) – iRAT Plugin	Per CloudStorm Blade (8x10G) - iRAT Plugin
Max GTP-C transactions/sec	2,400	24,000	40,000
Max PDP Contexts – HTTP	1.2M	2.4M	4,4M
Max throughput – HTTP	9.6Gbps	74Gbps	74Gbps
RNC IuPS			
Max transactions/sec	800	NA	NA
Max PDP Contexts – HTTP	720k	NA	NA
Max throughput – HTTP	9.6Gbps	NA	NA

Ordering Information

925-3145

IXLOAD-ADVNET-GTP, Optional Software, Enables the GPRS Tunneling Protocol (GTP) for SGSN emulation over Gn interface

925-3166

IXLOAD-ADVNET-GTP, Optional Software, Enables the GPRS Tunneling Protocol (GTP) for GGSN emulation over Gn interface

925-3168

IxLoad ADVNET-UMTS-IUPSRNC, Optional Software, Enables R7 UMTS (3G) RNC simulation on the IuPS interface

IxLoad Diameter and Radius Testing

Introduction of new services in LTE networks brings a new challenge for network operators and vendors alike: exponential increase in control plane signaling via Diameter-based interfaces. Benchmarking the Diameter routing agent (DRA) becomes mandatory for assessing the desired level of network capacity and elasticity.
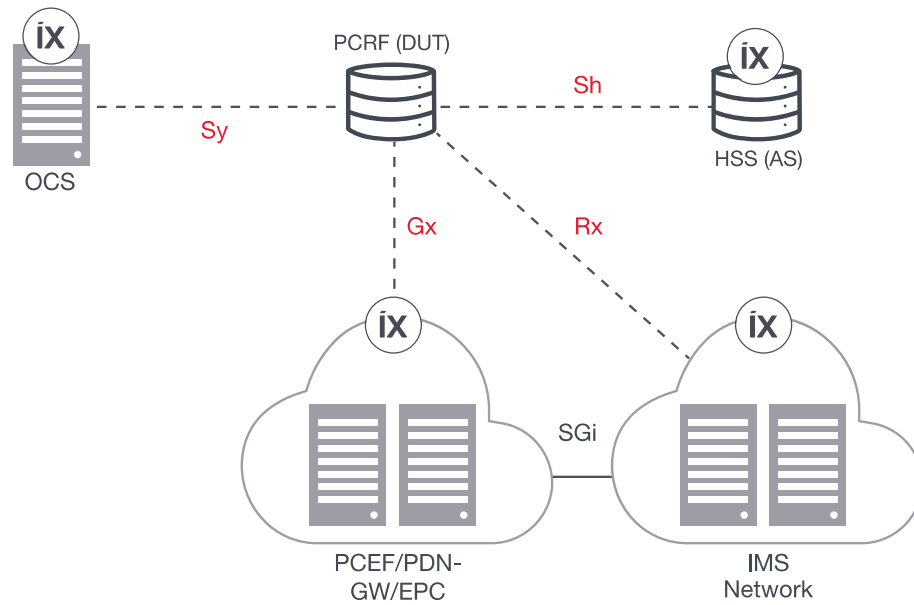
Product capabilities

- Support for Diameter client and server functional, negative, and performance testing
- SmartAVP™ enables users to add, remove, or configure mandatory and custom AVPs, define proprietary signaling, and alter AVPs for negative testing
- SmartEvents™ enable users to configure subscribers' state machine
- Support for transaction rate test objective
- Support for both TCP and SCTP as transport layer; support for both IPv4 and IPv6
- Perform EPC isolation testing by simulating any Diameter node (PCRF, HSS, etc.)
- Provides the high performance needed for DRA testing
- Coordinated simulation across multiple nodes or interfaces

Ixia's Diameter test solution is powered by technology from Developing Solutions. SmartEvents™ and SmartAVP™ are trademarks of Developing Solutions.
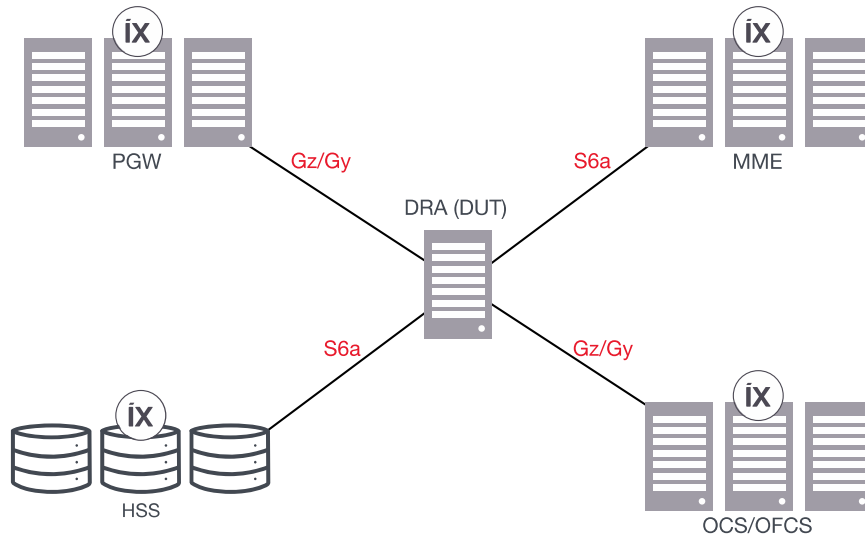
IxLoad solution for DRA testing

Server testing topology

Specifications

Specification	Feature
Architectural Specifications	All Diameter interfaces support 3GPP Release 9/10/11/12 versions • 3GPP TS 23.203 Policy and charging control architecture • 3GPP TS 32.240 Telecommunication management; Charging management; Charging architecture and principles

Specification	Feature
	3GPP TS 23.402 Architecture enhancements for non-3GPP accesses 3GPP TS 23.228 IP Multimedia Subsystem (IMS); Stage 2
Protocol Specifications	- RFC 6733, RFC 3588 Diameter Base Protocol - RFC 5516 Diameter Command Code Registration for the Third Generation Partnership Project (3GPP) Evolved Packet System (EPS) - RFC 6737 The Diameter Capabilities Update Application - S6a/S6d interface: 3GPP TS 29.272 Evolved Packet System (EPS); Mobility Management Entity (MME) and Serving GPRS Support Node (SGSN) related interfaces based on Diameter protocol - Gx interface: 3GPP TS 29.212 Policy and Charging Control (PCC); Reference points - Ro/Gy interface: 3GPP TS 32.299 Telecommunication management; Charging management; Diameter charging applications - S6b interface: 3GPP TS 23.402 Architecture enhancements for non-3GPP accesses and TS 29.273 Evolved Packet System (EPS) - STa interfaces: 3GPP TS 29.273 Evolved Packet System (EPS) and TS 29.273 Evolved Packet System (EPS) - Rx interface: 3GPP TS 29.214 Policy and charging control over Rx reference point - Sh interface: 3GPP TS 29.328 IP Multimedia (IM) Subsystem Sh interface; Signaling flows and message contents - Sy interface: 3GPP TS 29.219 Policy and charging control: Spending limit reporting over Sy reference point - Cx interface: 3GPP TS 29.228 IP Multimedia (IM) Subsystem Cx and Dx Interfaces; Signaling flows and message contents - SWm interface: 3GPP TS 23.402 Architecture enhancements for non-3GPP accesses and TS 29.273 Evolved Packet System (EPS) - SWa interface: 3GPP TS 23.402 Architecture enhancements for non-3GPP accesses and TS 29.273 Evolved Packet System (EPS) - Rf/Gz interface: 3GPP TS 32.251 Telecommunication management; Charging management; Packet Switched (PS) domain charging and TS 32.299 Telecommunication management; Charging management; Diameter charging applications - SGs interface: 3GPP TS 23.272 Circuit Switched Fallback in Evolved Packet System and 3GPP TS 29.118 SGsAP - S9 interface: 3GPP TS 23.203 Policy and charging control architecture, TS 29.212 Policy and Charging Control (PCC); Reference points and TS 29.215 Policy and Charging Control (PCC) over S9 reference point; Stage 3 - SWx/Wx interface: 3GPP TS 23.402 Architecture enhancements for non-3GPP accesses and TS 29.273 Evolved Packet System (EPS) - S13/S13' interface: 3GPP TS 29.272 Evolved Packet System (EPS); Mobility Management Entity (MME) and Serving GPRS Support Node (SGSN) related interfaces based on Diameter protocol

Specification	Feature
	- Gxx (Gxc & Gxa) interface: 3GPP TS 23.203 Policy and charging control architecture and TS 29.212 Policy and Charging Control (PCC); Reference points - Sd interface: 3GPP TS 29.212 Policy and Charging Control (PCC); Reference points - Ga interface (GTP'): 3GPP TS 32.240 Telecommunication management; Charging management; Charging architecture and principles, and TS 32.295 Telecommunication management; Charging management; Charging Data Record (CDR) transfer - Radius interface: RFC 2865, RFC 2866 - 3GPP Radius interface: TS 29.061 Interworking between the Public Land Mobile Network (PLMN) supporting packet based services and Packet Data Networks (PDN), RFC 2865, RFC 2866, RFC 3162, RFC 4818 - Wa (Radius) interface: TS 29.274, TS 29.234, RFC 3579 (EAP), RFC 2865, RFC 2866 (Radius) - D/D' interface: 3GPP TS 29.002 Mobile Application Part (MAP) specification, ITU-T Q.773 TCAP, ITU-T Q.711-714 SCCP, RFC 4666 M3UA - Gr/Gr' interface: 3GPP TS 29.002 Mobile Application Part (MAP) specification - E interface: 3GPP TS 23.040 & TS 23.204 (SMS), TS 29.002 Mobile Application Part (MAP) specification, ITU-T Q.773 TCAP, ITU-T Q.711-714 SCCP, RFC 4666 M3UA

IxLoad Diameter Performance

Platform	Performance Per Blade
Xcellon-Ultra NP	40k TPS and up to 3M subscribers
PerfectStorm (PS10GE8)	200k TPS and up to 12M subscribers
CloudStorm (2x100G)	200k TPS and up to 30M subscribers
IxVM port	4k TPS and up to 250k subscribers

Diameter Ordering Information

Diameter Bundle	Chassis (NP/PS/CS)	IxLoad VE
One Diameter Client interface (any of the available), 1k UEs and 100 TPS	925-3938	939-9546
One Diameter Server interface (any of the available), 1k UEs and 100 TPS	925-3939	939-9547
Performance Level-1: 100k UEs and 1k TPS	925-3942	939-9548
Performance Level-2: 500k UEs and 10k TPS	925-3943	939-9545
Performance Level-3: 1M UEs and 1k TPS	925-3944	939-9549
Performance Level-4: 10M UEs and 10k TPS	925-3945	939-9550

For more information, visit www.ixiacom.com/products/ixload-wireless

Learn more at: www.keysight.com

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