XENA NETWORKS

2test

traffic generation and analysis

Gbps

1GE
2.5GE
5GE
10GE
25GE
40GE
50GE
100GE

XENA LAYER 2-3
GIGABIT ETHERNET TEST PLATFORM

Xena Layer 2-3 platform – in a nutshell

Xena's L2-3 test platform is used to configure and generate Gigabit Ethernet (GE) traffic at Layers 2 & 3 with a high level of accuracy and granularity – and then analyze how network devices and services perform in response.

Xena's L2-3 test platform offers a choice of two chassis that can be equipped with an extensive range of of copper and optical Gigabit Ethernet test modules supporting all Ethernet speeds up to 100GE including the new 2.5GE, 5GE, 25GE and 50GE speeds.

The chassis and test modules are controlled via Xena Manager-2G, a free Windows GUI client provided for ad-hoc test execution, and remote management of test equipment located in multiple locations. Also included are standalone applications for automated RFC 2544, Y.1564, RFC 2889 and RFC 3918 testing.

Finally, an open TCP/IP-based text API lets users automate testing from any software environment, using Tcl, Python, Perl, VBA and Java wrappers to convert to/from the generic Xena Command Line Interface (CLI) format.
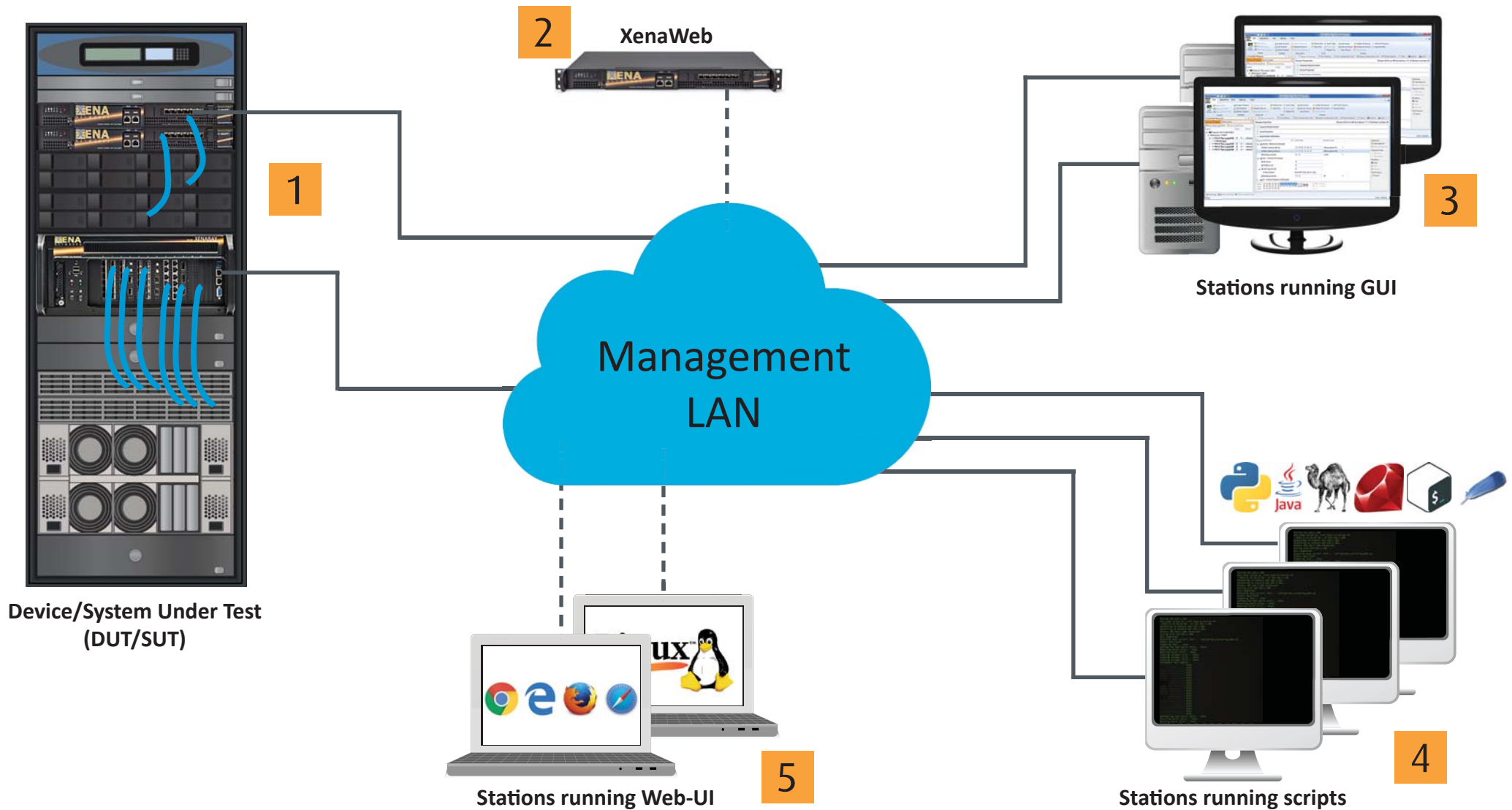
Xena's L2-3 test platform is used by hundreds of customers worldwide who value its range of features, ease-of-use, cost efficiency, interoperability, and scalability.

Very fast and super friendly

Xena's L2-3 test platform is the industry's easiest to deploy. Here are some examples:

- The software is native to Windows, and can be freely downloaded from the Internet. Double-click to launch, enter an IP address and a password, and you are ready to test.
- Centralized upgrades make it quick and easy to install the latest software across multiple testers for immediate access to the newest features and bug fixes.
- All devices can be administered from the same user-friendly GUI to ensure fast, efficient testing – without the big learning curve that go with our competitors' products.
- To make remote testing even easier, Xena offers XenaWeb – a browser-based (HTML5) user-interface that lets engineers access their test system from any OS.
- Xena's L-23 test solutions are also ready for virtualization ensuring low-cost future-proof migration to cloud-based testing.

2 XenaWeb

1

3

Stations running GUI

Management LAN

Device/System Under Test
(DUT/SUT)

5

Stations running Web-UI

4

Stations running scripts

1 The Xena tester is connected to the Device/System under test and accessed via an IP address

2 XenaWeb makes it easy for multiple users to access their Xena test system "anywhere, anytime".

3 XenaManager-2G is used to generate and analyse traffic. A suite of standalone applications is also available for RFC2544, RFC2889, Y.1564 and RFC3918

4 Multiple users can run scripts (e.g. Python, Java, Perl, Ruby, BASH, Tcl, and VBA) on the same chassis via a TCP connection using CLI commands.

5 Xena testers can be accessed via any web-browser using XenaWeb.

Two chassis – multiple options

Xena offers a range of advanced test modules for testing all speeds from 1GE up to 100GE – and beyond. These test modules can be mounted in either of Xena's hardware chassis – the easy-to-transport XenaCompact (with one fixed slot), or the high density 4U XenaBay which has 12 modular slots. The test modules support a variety of interfaces (SFP+, QSFP, CFP4, CXP etc.) and many are uniquely capable of handling multiple speeds via simple software settings.

Test all Gigabit Ethernet speeds

Xena's L2-3 platform supports all Ethernet speeds up to 100GE – with 400GE clearly marked on our development roadmap. Interested in 25GE/50GE and 2.5GE/5GE? You are not alone. Many datacenters are now transitioning to 25GE as a cost-effective upgrade for their existing 10GE links. Meanwhile, a lot of companies are looking to boost connection speeds on overburdened WiFi access points by using 2.5GE & 5GE so they can leverage their existing Cat5E cabling. Xena offers test modules for all these speeds, as well as 1GE, 10GE, 40GE and 100GE (see table on next page for details).

The XenaCompact lives up to its name – a 1U chassis that is quiet and easy to transport.

The XenaBay is a modular chassis that delivers high port density.

| One C4-12 XenaBay can hold up to:			
6	100GE (LR4/SR4/CDWM4/SR10/CR4) ports	144	10GE optical ports
12	50GE LR2/SR2 optical, CR2 electrical ports	72	5GE copper ports
24	40GE QSFP+ (or 6 x LR4 / 12 x SR4) ports	72	2.5GE copper ports
24	25GE LR/SR optical, CR electrical ports	72	1GE copper/optical ports

L2-3 HARDWARE

Product Number	Port Speed	Interface Form Factor	No. of Ports	Type of Interface
1GE				
M6SFP (& M6SFP-E) M2SFPT*	10M/100M 1000M/1GE	SFP	6 2	10/100/1000BASE-T 1000BASE-X 100BASE-FX/BX
10GE				
M2XFP	10GE	XFP	2	10GBASE-SR/LR/ER/DAC OTU-2e/1e
M2SFP+ M2SFP+T*	10GE	SFP+	2	10GBASE-SR/LR/ER/DAC
C1-M2SFP+4SFP**	10GE and 1GE	SFP+ SFP	2 and 4	10GBASE-SR/LR/ER/DAC 10/100/1000BASE-T 1000BASE-X 100BASE-FX/BX
M6SFP+	10GE	SFP+	6	10GBASE-SR/LR/ER/DAC
M2RJ45+ M6RJ45+	10GE	RJ45	2 6	10GBASE-T 1000BASE-T 100BASE-T
M12QSFP10	10GE	QSFP+	12	10GBASE-iSR/iLR/DAC
M6RJ45N	100M 1GE 2.5GE 5GE 10GE		6 6 6 6 6	100BASE-T 1000BASE-T 2.5GBASE-T 5GBASE-T 10GBASE-T
40GE				
M2QSFP+	40GE (or) 10GE	QSFP+	2 8	40GBASE-SR4/LR4/DAC 10GBASE-iSR/iSM/DAC
M2CFP40	40GE (or) 40GE (or) 10GE	CFP	1 2 8	40GBASE-LR4 40GBASE-SR4 10GBASE-iSR

Product Number	Port Speed	Interface Form Factor	No. of Ports	Type of Interface
100GE				
M1CFP100 3-speed	100GE (or) 40GE (or) 40GE (or) 10GE	CFP	1 1 2 8	100GBASE-SR10/LR4 40GBASE-SR4/LR4 40GBASE-SR4 10GBASE-iSR
M1QSFP28CXP 3-speed dual-media	100GE (or) 40GE (or) 100GE (or) 40GE (or) 10GE	QSFP28 QSFP28/QSFP+ CXP CXP CXP	1 1 1 2 8	100GBASE-SR4/LR4/CWDM4 40GBASE-SR4/LR4 100GBASE-SR10 40GBASE-SR4 10GBASE-iSR4
M1CFP4QSFP28CXP 3-speed triple-media	100GE (or) 100GE (or) 40GE (or) 100GE (or) 40GE (or) 10GE	CFP4 QSFP28 QSFP28/QSFP+ CXP CXP CXP	1 1 1 1 2 8	100GBASE-SR4/LR4/ 100GBASE-SR4/LR4/CWDM4 40GBASE-SR4/LR4 100GBASE-SR10 40GBASE-SR4 10GBASE-iSR
M1QSFP28SFP28 5-speed dual-media	100GE (or) 50GE (or) 40GE (or) 25GE (or) 10GE (or) 25GE (or) 10GE	QSFP28 QSFP28 QSFP28/QSFP+ QSFP28 QSFP28/QSFP+ SFP28 SFP28/SFP+	1 2 1 4 4 2 2	100GBASE-SR4/LR4/CWDM4/CR4 50GBASE-SR2/LR2/CR2 40GBASE-SR4/LR4/CR4 25GBASE-SR/LR/CR 10GBASE-iSR 25GBASE-SR/LR/CR 10GBASE-SR/LR/CR

* includes advanced timing features for testing SyncE
** Only available in XenaCompact chassis
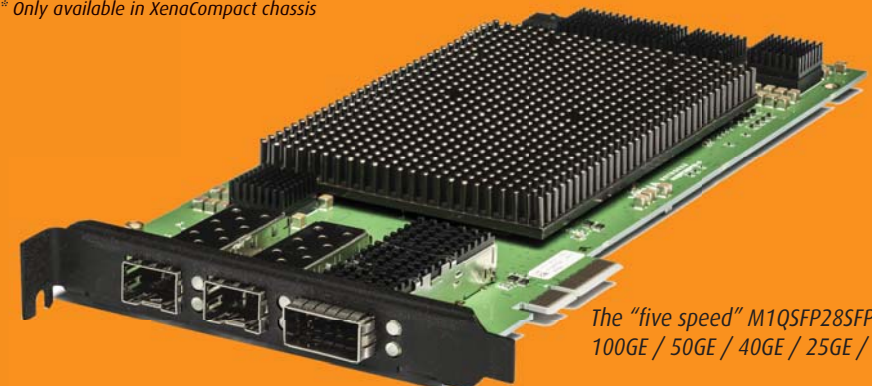
The "five speed" M1QSFP28SFP28 can test 100GE / 50GE / 40GE / 25GE / 10GE

L2-3 SOFTWARE

Included with all our hardware is a valuable portfolio of software. In addition to the core XenaManager-2G application, Xena offers standalone test suites (see below) which can be easily automated. We also include 3 years' free software maintenance and the option for extending licensing subsequently.

XenaManager-2G

XenaManager-2G is a Windows-based application used to configure and generate streams of Ethernet traffic between Xena test equipment and devices under test (DUTs)at all speeds up 100Gbps, and analyze the results. This is the software you'll use most of the time.

XenaScripting

XenaScripting is a command-line-interface (CLI) scripting API with hundreds of scriptable parameters to make test automation easier. Any client platform can be used (e.g. Tcl, Perl, Python, Java, Ruby and VBA). XenaScripting supports multiple concurrent scripting sessions by different users in different locations.

Xena2544

Xena2544 fully supports the 4 test-types specified in RFC2544. There are extensive configuration options, support for single stream and multi-stream testing and you can define protocol layers supported by the test (Ethernet, Customer and Service VLANs, IP and UDP) precisely the way you want.

Xena1564

Xena1564 makes it easy to validate Ethernet service-level agreements (SLAs) in a single test per Y.1564. It supports multiple protocols per UNI (Ethernet, Customer and Service VLANs, MPLS, IPv4, IPv6, and UDP) and you can define Per-UNI or per-CoS bandwidth profiles, and specify CoS-to-DSCP mapping.

Xena3918

Xena3918 makes it easy to do advanced IP multicast network testing using various framesizes, either as in-test variations or as multiple testruns each using a fixed frame size. Unicast and multicast traffic can be configured to use the exact protocol headers needed. All fields in the protocol headers can be modified.

Xena2889

Xena2889 lets you accurately benchmark the performance of Layer 2 LAN switches according to RFC 2889 tests incl. all throughput and forwarding rate tests, congestion control, address caching capacity, address learning rate, broadcast frame forwarding and latency, forward pressure and maximum forwarding rate.

L2-3 SOFTWARE

Easy to use "tree" structure for managing test bed of chassis, modules and ports.

Top ribbon provides instant access to most commonly used functions.

Color-coding and tool tips are included to make user-interface very intuitive.

Graphical elements help testers quickly scan results. Panels can also be dragged free of main UI for testing convenience.

Convenient reporting options make it easy to export and document results.

KEY FEATURES

Stream-oriented Traffic Generation

Users can define and generate hundreds of transmit and receive streams, each with their own unique traffic profile. Each stream can generate 100k's of unique traffic flows using programmable packet field modifiers to increment or randomize field values such as MAC addresses, IP addresses, and VLAN identifiers. This makes it easy to scale your tests beyond the maximum performance parameters of your network or device.

The stream rate can be defined as a percentage of line rate, frames per second, bit-rate, and the injection of packets can be controlled as a single-packet shot, number of packets, time duration, or in continuous mode.

Traffic profiles can be defined as uniform or bursty, and custom packet editing is facilitated by a graphically driven field editor that lets users build any packet format, in addition to predefined packet templates for Ethernet, Ethernet II, VLAN, ARP, IPv4, IPv6, UDP, TCP, LLC, SNAP, GTP, ICMP, RTP, RTCP, STP, SCTP, MPLS, PBB, FCoE, IGMPv2/3, or fully specified by user.

Statistics Charting and Logging

Statistics Charting allows real-time charts of a number of monitored parameters. Multiple charts can be displayed in one panel. Each panel can optionally display two different parameters where each parameter is associated with its own Y-axis. Statistics Logging allows periodically polling counters for all ports in a testbed and logging them to a CSV or XML file.

Scheduling

Each testbed can contain several schedules – a collection of operations that will be execut-

ed sequentially, with looping support. Common usage of Stream Scheduler includes start-and-stop traffic, changing packet rate, changing operations orders, adding loop section, etc.

Real-time Analysis and Reporting

Packet flow statistics are tracked per stream, or per-user defined filters which can include any combination of programmable field values. Incoming packet streams are automatically identified using optionally auto inserted Test Payload fields. Analysis of traffic throughput, latency, jitter, loss, sequence, and misorder errors is performed real-time per received stream with 16/32 ns accuracy depending on the interface type (optical/electrical).

Users can capture packets at wire speed on each port for detailed analysis and hot-button export packet analysis tool WireShark, which in conjunction with event triggering and programmable filters provides a unique ability to identify and isolate performance issues.

One Way Latency Measurements

Another valuable Xena feature is Xena TimeSynch which enables multiple Xena testers to synchronize their local time to each other. This can be used for One-Way Latency (OWL) measurements between two test chassis, synchronized traffic start between multiple chassis and accurate timestamping of captured packets in exported PCAP files.

Scripting & Test Automation

To make scripting and test automation as easy as possible, Xena offers a simple, open-spec text-based Command Line interface (CLI) API called XenaScripting that supports text and line-based TCP/IP communication for test automation in any tool and scripting environ-

ment. XenaScripting lets you control very aspect of the chassis, module, port, stream, filter, capture, statistics etc – with any changes being automatically reflected on the GUI.

This uniquely user-friendly "scripting-from-anywhere" concept makes it simple to access Xena's L2-3 test platform from any proprietary or commercial scripting environment based on languages such as Tcl, Python, Perl, VBA, or Java development environments, using wrappers to convert existing script APIs to the generic Xena API hosted on Github for easy integration.

Unique Eye Diagram

Xena's latest generation of multi-speed 100GE test modules support a unique feature for analyzing signal quality called the "eye diagram". Accessed via XenaManager-2G, these bit-error-rate (BER) eye diagrams provide a direct visual representation of signal quality after RX equalization.

The eye-diagram is formed by changing the time dimension (sampling delay) and the am-plitude dimension (0/1 threshold) of the sampling point of the PHY step-by-step. For each sampling point (x,y), 1 million bits are measured, the number of bit-errors are counted and a simple division gives the BER. The result is the BER eye-diagram (see below).

The color map shows the measured bit-error rate for each point going from 1 million (maxi-mum red) to zero (black). The color scale is logarithmic. Higher resolutions give a clearer diagram and higher values of X and Y will also give a higher precision in the vertical and horizontal bathtub curve estimations, respectively.
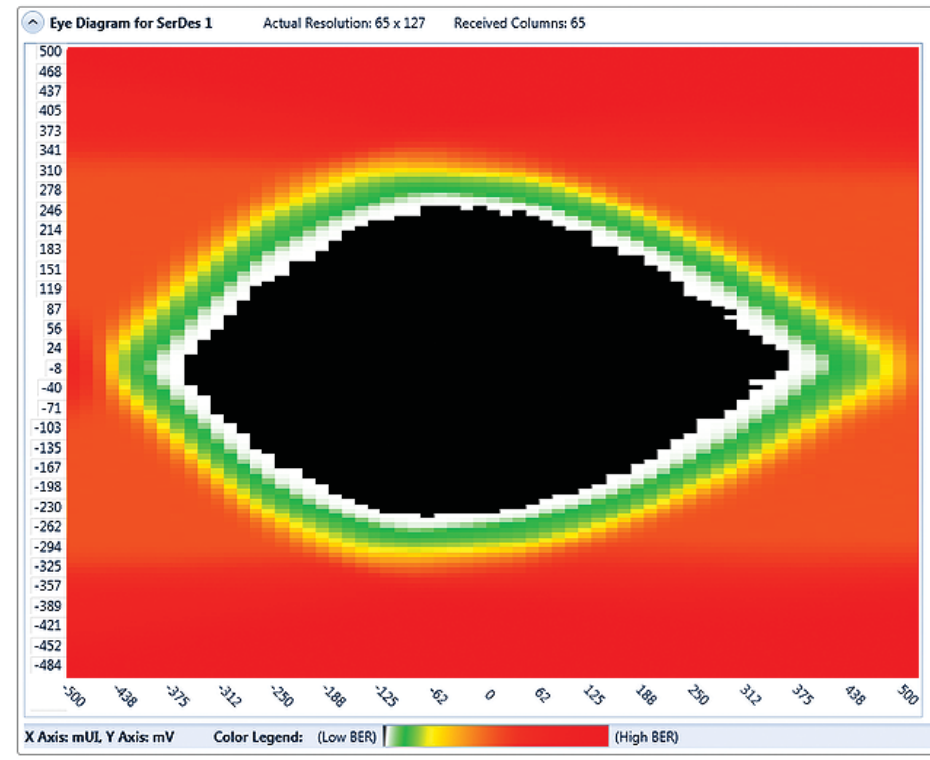
The eye-diagram is a unique feature for analyzing signal quality. It provides an estimate of parameters including width, height and jitter in a convenient graphical format.

APPLICATIONS

QoS Solutions

Traffic is typically given a priority depending on its importance. In addition some types of traffic are more sensitive to latency, jitter and packet loss than other. Xena offers QoS validation solutions in accordance with RFC 2544 and Y.1564, as well as advanced statistics functions that help users track, analyze and troubleshoot QoS to maintain a high service quality guarantee.

Benchmark Testing

Benchmark testing will highlight the performance of a DUT identifying parameters like maximum throughput, latency and jitter. Testing can be done with different frame sizes to check how this affects the performance. The DUT can be loaded beyond its throughput capacity to see how this affects frame loss, latency and jitter.

Functional Testing

Functional Ethernet testing can cover many parameters and depends on the DUT and the application. The testing will verify the basic functionality of the DUT. Functional testing can be performed during development, quality assurance and production.

Convergence

Many network topologies provide resiliency to protect network services. This typically means re-routing traffic away from a faulty line section. However frame loss will occur if a connection is re-routed. When traffic with a given transmitted frame rate is sent through the connection during re-routing, packet loss can be measured and the convergence time can be calculated.

Service Validation

Testing that link performance complies with a Service Level Agreement (SLA) includes verifying Frame Transfer Delay (FTD), Frame Delay Variation (FDV) and Frame Loss Ratio (FLR) at the Committed Information Rate (CIR) defined in the SLA. Verifying the SLA with the Xena1544 allows doing the test on a line simultaneously loaded with traffic from other services.

Security/Negative testing

Security/negative testing is typically conducted during development to highlight how a DUT handles abnormal conditions like very high traffic load, different frame sizes including undersized and oversized frames, framed with different IFG settings, various types of errors and deviation of the signal frequency and even various types of DDoS attacks.

Open Flow

For Software Defined Networking (SDN) products it is important that they meet the Open Networking Foundation (ONF) OpenFlow specifications. It is also important to know the OpenFlow performance of the SDN products like switches performance testing will include processing time for messages sent to the switch to add, modify or delete OpenFlow rules from the switch's forwarding table ("Flow-Mod" messages).

Conformance

Conformance testing determines whether a DUT complies with the requirements stated in a given specification/standard. As an example G.8031 and G.8032 Ethernet Protection Switching typically require that switching from a faulty line to a backup line is completed in less than 50 msec. This can be verified as a part of a conformance test.

Check the table on the next page to find the type of testing you do.

APPLICATIONS

QoS Testing

- Network application emulation
- Charting and histograms
- Background traffic injection
- Jitter analysis
- One-way latency analysis
- Inline measurements mode
- TCP response time and performance
- HTTP performance testing
- Latency monitoring

Benchmark Testing

- RFC2889
- RFC2544
- RFC3918
- VSperf (Virtual Switch Performance)
- G.FAST per ID-337
-

Functional Testing

- Multicast
- 40/100G PCS and PMA Layer
- Transparent Transport
- Energy Efficient Ethernet (EEE)
- Microbursts and random IFG
- Synchronous Ethernet
- Automotive Ethernet
- 1588v2 Performance Testing
- Regression testing
- Kernel drivers and NIC testing
- Hardware emulation (ASIC)

Convergence

- Spanning (xSTP) and Routing
- G.8031/G.8032
- MPLS

Service Validation

- ITU-T Y.1564
- Live Monitoring
- Proactive Testing
- Wholesale Ethernet
- Performance Logging

Security/Negative Testing

- Firewall Performance testing
- L2/3/4 Errors
- PCS Layer Errors
- Fragment Overlap
- DDoS / Protocol Fuzzing

Open Flow

- Table Capacity
- Flow-Mod
- Packet In/Out

Conformance

- Spanning (xSTP) and Routing
- G.8031/G.8032
- MPLS

SPECIFICATIONS

Stream and Flow Generation

Transmission Mode
- Interleaved or sequential stream scheduling
- Continuous, or a specified number of packets sent once, between 1 and 4G packets
- Latency measurements across multiple ports with 16/32 ns accuracy depending on interface type (optical/electrical)

Bandwidth distributions
- Constant (100% uniform) and burst distributions.
- All loads can be specified in percentage of line rate, frames/s, or Mb/s
- Burst parameters specified by burst length, and burst density

Packet headers
- Completely specified by the user, or Ethernet, Ethernet II, VLAN, ARP, IPv4, IPv6, UDP, TCP, LLC, SNAP, GTP, ICMP, RTP, RTCP, STP, SCTP, MPLS, PBB, FCoE, IGMPv2/3, or fully specified by user.
- Any field in a packet template can be set to an invalid value for negative testing

Packet payloads
- An incrementing 8 bit pattern
- PRBS-31
- Autofill with a user-specified pattern

Field modifiers
- Up to five field modifiers can be applied to any field in a packet, per streams. The modifiers can be chained together.
- A field modifier can be set to increment or decrement or be random within a specified range. For example, increment VLAN ID, and traversing the IP ToS field in a chained order.

Packet length distributions
- Fixed - all frames belonging to the stream are sent with same length
- Incrementing/decrementing - from a specified minimum and maximum length
- Random - randomly selected between a specified minimum and maximum length.
- Butterfly - uniform selecting between a specified minimum and maximum length.
- MIX - approximates typical traffic on Internet with packet lengths between 56 - 1518 bytes

Test payload
- A proprietary test payload can optionally be automatically placed into packets. This allows the test platform to provide per-stream packet loss, min/max/average latency, payload integrity, out of sequence, and misorder statistics.

Checksum calculations
- FCS and CRC values in packet templates can be automatically calculated or set to errored values

Per-Port Statistics
- Packets/octets per port, FCS errors, packet/octets for traffic with and without a test payload
- Packets/octets for up to 6 user specified traffic filters. Filters fully specified by user, using up to 6 custom pattern and length match terms.

Per-Stream Statistics
- Packets must contain a test payload for per-stream transmit and receive statistics to be reported. Statistics will be reported on streams, even if the packet encapsulation changes through a device under test, or if it receives packets with different encapsulations or modified header fields.
- Test packets/octets, sequence errors, misordered packets, payload integrity, minimum latency, average latency, maximum latency, minimum jitter, average jitter, maximum jitter.

Packet Capture
- Triggers and filters can be set up to trigger on specific events, and to capture packets meeting particular criteria.
- Multiple capture criteria can be specified using AND/OR expressions.
- Criteria can be fully specified by the user, or using predefined filters
- Hotbutton export to WireShark analysis tool

Capture Criteria
- Any combination of multiple packet field values specified by the user
- FCS errored packets
- Packets belonging to a specific stream
- Packet matching a user defined filter such as IPv4, IPv6, UDP, or VLAN packets

Capture Triggers
- Any frame received
- Packet matching a user defined filter such as IPv4, IPv6, UDP, or VLAN packets
- Packet with a FCS errors