TELEDYNE LECROY
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CENTRAL OFFICE TESTING OF NETWORK SERVICES

APPLICATION NOTE

The characteristics of an Ethernet tester in the central office environment

Ethernet is rapidly becoming the predominant method for deploying new commercial services and for expanding backhaul capacity. Carriers are increasingly adopting testing schemes that focus around centralized testing from the central office, for providing visibility of Ethernet performance in order to guarantee and reinforce service-level agreements and improve problem resolution.

The XenaCompact testers are tailored for central office environments, allowing for easy integration into equipment racks in central offices or remote locations, while providing a full suite of test capabilities for end-to-end, bidirectional Ethernet testing, including RFC 2544, and advanced wire-speed traffic analysis.

This application note examines the characteristics of an Ethernet tester in the central office environment.

Characteristics of a Central Office Ethernet Tester

Test Capabilities

Centralized test equipment should provide test functions such as loopback for single-ended testing scenarios, BERT, RFC 2544, and support dual test-set unidirectional testing. For service turn-up and troubleshooting purposes, the testers should provide advanced features such as detailed analysis of traffic jitter, burstiness, and traffic filtering for fine grained QoS traffic monitoring.

Form Factor

Central offices are often cramped environments, where equipment must be securely fixed in order to prevent damage to other network equipment (such as pulling fiber cables from other equipment if test equipment falls over). A 1U rack-mountable tester is therefore ideal since it can be easily deployed and securely fixed to an equipment rack, and power can be easily provided to the tester.

Equipment Compliancy

Network equipment building system (NEBS) compliancy, which proposes a set of standard requirements for equipment in central office environments, is an important criterion for network equipment in carrier environments. NEBS was developed by Bell Labs in the 1970s to standardize equipment that would be installed in central offices, resulting in common minimum criteria for all network equipment, and covers a wide range of aspects including spatial characteristic and environmental specifics. For test and measurement equipment, NEBS level one certification is considered to be sufficient, taking into consideration that the unit does not carry live traffic and will not affect the network performance if the equipment fails.

The XenaCompact Ethernet testers

The XenaCompact Ethernet testers' wide range of test functionalities provides measurement tools for service turn-up, troubleshooting, as well as for verifying service-level agreements (SLAs) between service providers and their customers, to simplify the deployment of Ethernet services.

Two or more 1 GbE or 10 GbE Ethernet test interfaces are provided per XenaCompact tester, so that one test port can be allocated for Ethernet services testing (BERT, RFC 2544, performance analysis, etc), while the other test port can be permanently used in conjunction with a network tap or a monitor port for QoS traffic monitoring.

Ethernet Test Interfaces

The XenaCompact C-Odin-1G-3S-6P tester provides 10/100/1000 Base-T or 100Base-FX and 1000Base-X capabilities via 6-ports of SFP interfaces, allowing for flexible test points throughout the network. Each port supports auto-negotiation and flow control.

The XenaCompact C1-Odin-10G-4S-2P-Combi provides two 10GBE and four 1 GbE test ports with optical or electrical interfaces, depending on installed transceivers.

Management Interfaces

The XenaCompact testers provide two RJ-45 interfaces for management of the unit. The Mgmt port is designed for connectivity to the management network, and it is through this network that remote users connect to the device via a remote workstation. This Mgmt port provides fixed IP addressing methods and local or remote connectivity to the device from a laptop or stationary PC.

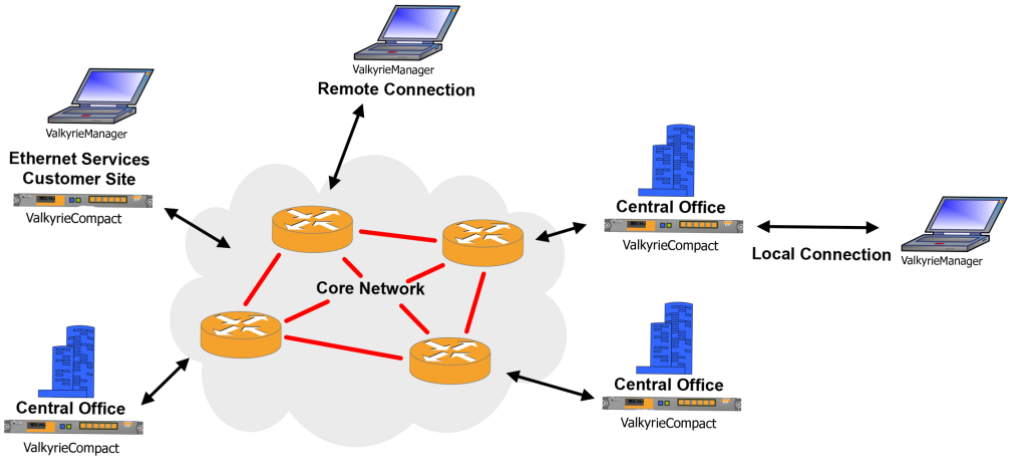
For recovery of a forgotten IP address of the management port, the Ext port provides a fixed factory defined IP address (172.16.255.200). This fixed IP address can also be used even when the Ext port is not physically connected to the management network.

- Figure 1: XenaCompact are available with a variety of test modules that can test all speeds up to 400GE.

Remote Control

The XenaCompact easily be remote controlled via the XenaManager application. XenaManager is started on any local workstation that is connected to the same management network as the XenaCompact, or remotely via the allocation of a public IP address for the XenaCompact tester.

The XenaManager software provides the user with full remote control of the unit with fast response through an IP network, and an unlimited number of users can connect to a single XenaCompact tester, where each user has full control to execute tests and gather statistics.



- Figure 2 Central Office Test Application

Compact Form Factor

The XenaCompact series comes in a standard 1U rack-mount chassis with an integrated power supply. The tester can easily and securely be integrated to any central office equipment rack and mounted either in a normal or a recessed position. The power supply is a standard 110/220V AC for easy integration into existing central office power architecture. It is available with a wide selection of test modules that can test speeds up to 400GE (please see here for information).

Ethernet Test Applications

The XenaCompact testers can support a number of Ethernet test scenarios as described in the following.

Loopback Options

In typical testing scenarios, test frames must be generated and analyzed from the same test point in order to gather statistics on the network under test. A number of options exist, such as the use of physical or intelligent loopbacks.

Physical loopback provides a quick and easy solution for transparent networks but cannot be used over layer 2 and layer 3 networks since frames are looped back without MAC or IP addresses being swapped.

Software-based solutions can provide the important MAC or IP addresses swapping, but often induce jitter and latency during the treatment of the test frames. Also, these solutions are not designed to handle wire-speed traffic and can lead to frame losses at high data rates, which affect the accuracy of the test results.

Dedicated loopback devices are a good solution for providing MAC or IP address swapping and wire-speed capabilities, but they come with the disadvantage of having a single test application at high costs, plus they do not provide any testing or traffic monitoring capabilities like a fully featured XenaCompact tester.

The XenaCompact series provides loopback capabilities at full line rates with address swapping capabilities, while offering a full suite of Ethernet and IP test capabilities for troubleshooting. This allows for single-ended test scenarios where test equipment located at different locations send test packets to the XenaCompact at the central location, which is returned with the MAC and IP addresses swapped.

The Smart Loopback application automatically supports all test frames, allowing for multiple tests to be run which include the bit error-rate test, RFC 2544, and network load testing.

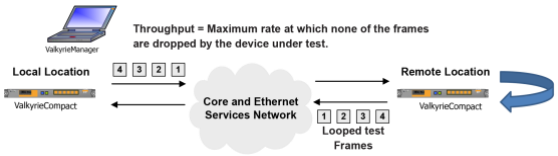
BERT

The bit error-rate test (BERT) is for testing service integrity. These tests consist of sending test patterns from the local device with either MAC or MAC/IP/UDP encapsulation to the centralized test point, which then returns traffic and the swapped addresses. Test analysis is performed at the local device with the collection of FCS errors, throughput statistics and payload pattern-integrity check. This test is ideal for construction and service turn-up testing, as well as for long-term integrity testing such as 24 or 72 hour BER tests.

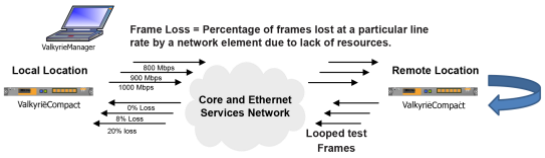
RFC 2544–Benchmarking Methodology for Network Interconnect Devices

The RFC 2544 test is a series of performance measurement tests based on the RFC 2544 recommendations. These tests consist of four subtests whose results establish the performance measurements of the network under test, which consist of the throughput, latency, frame loss and back-to-back tests.

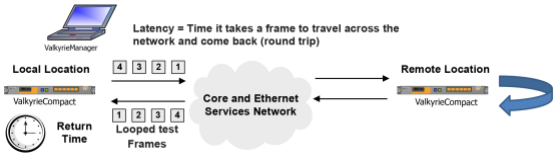
In this test scenario, test packets are sent from the local device to the centralized test points, which are then returned to the local device after the addresses have been swapped. Test analysis is performed at the local device and statistics are gathered as round-trip measurement, i.e., they characterize both directions from local to the looping test point and back. This test is typically used for SLA and for performance assessment of a network.



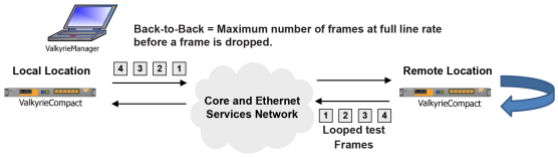
- Figure 3 RFC 2544 Throughput Test



- Figure 4 RFC 2544 Frame Loss Test



- Figure 5 RFC 2544 Latency Test



- Figure 6 RFC 2544 Back-to-Back Test

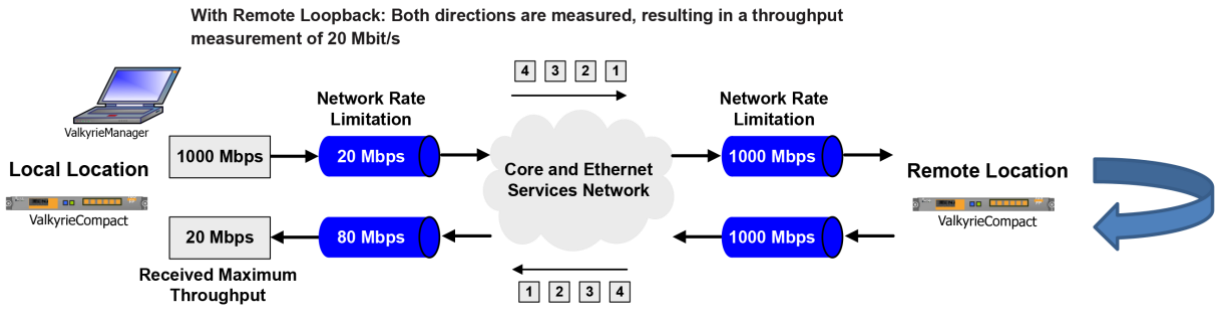
Network Loading

In a network-loading scenario, the local XenaCompact tester sends traffic with different parameters to the remote test equipment, which is then looped back. The test traffic can be sent with different frame sizes, throughput, MAC, VLAN, IP and UDP parameters.

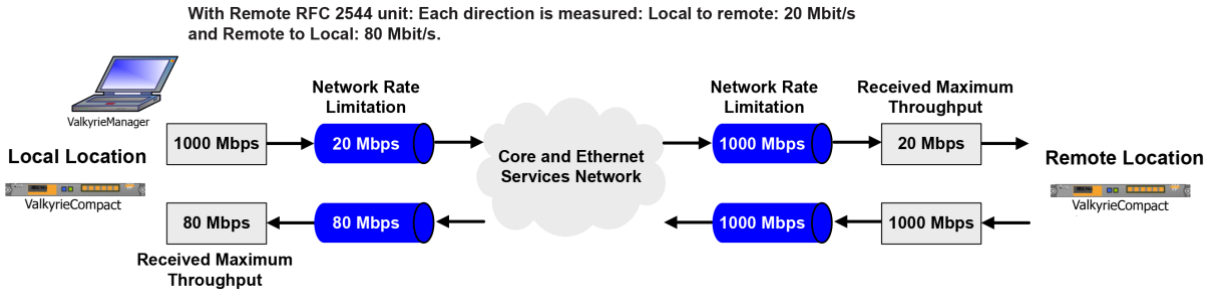
This test is ideal for quality of service (QoS) testing where the test point sends frames with different QoS profiles to ensure that the network properly queues and forwards the traffic. The centralized test point loops back traffic and can also be used to measure statistics of the incoming traffic.

RFC-2544 Dual Test Set Remote Unit

An RFC 2544 test can be executed with the XenaCompact in Loopback mode, which will provide round-trip results that describe measurement for both directions at the same time (Figure 7). However, some cases may require RFC 2544 performance evaluation on a per-direction basis, allowing the capability to measure throughput, frame loss and back-to-back statistics—either from the local-to-remote direction or the remote-to-local direction, independently (Figure 8). The XenaCompact series can be set as a far-end remote unit in order to engage an RFC 2544 dual test set exchange with a local XenaCompact test device.



- Figure 7 Bi-Directional RFC2544 Testing



- Figure 8 Uni-Directional RFC2544 Testing (Dual Test Set)

QOS Traffic Monitoring QOS

Monitoring via advanced traffic filters and histograms

When used in conjunction with a network tap or a monitor port, the XenaCompact can be used for QoS traffic monitoring by using its advanced filter and histograms test feature. In such cases, the network operator can configure the XenaCompact with up to 6 filters per Ethernet test port and collect bandwidth and Ethernet error and statistics on a per-filter basis. The network operator can also configure the XenaCompact with 2 real-time histograms per Ethernet test port and collect frame length, and frame inter-packet-gap distribution.

This provides operators with the capability to monitor and characterize the traffic flowing through their network, ensuring that QoS enforcement or bandwidth assignment is properly performed on their network.

VoIP and Real-Time Testing

With real-time applications, such as voice and video, which are sensitive to packet jitter and frame loss and out-of-sequence delivery, networks, must be tested, to ensure that they meet the minimum thresholds set for these requirements in order to ensure a high quality of experience for the end user. The XenaCompact provides advanced packet jitter (latency) histograms, out-of-sequence, misorder,

and frame loss test capabilities. These statistics can be measured in head-to-head scenarios with test packets being generated from another XenaCompact unit, or by using a remote XenaCompact unit as a loopback device.

Carrier Ethernet Technologies

Veryx (a technology partner of Teledyne LeCroy Xena) offers its ATTEST Carrier Ethernet test solutions for automated testing of Provider Edge devices and Customer Premise Equipment (CPE) supporting Carrier Ethernet services. The ATTEST-XP CFM and EFM-OAM test suites provide Comprehensive verification for Service OAM (CFM - IEEE 802.1ag) and Link OAM (EFM-OAM - IEEE 802.3ah) functionality.

The XenaCompact can also be used in multiprotocol label switching (MPLS) and carrier-grade provider backbone bridging with traffic engineering (PBB-TE) environments, where pre-defined filter configurations can be imported to provide PBB-TE and MPLS-specific RX/TX throughput statistics, and be used as a MPLS/PBB frame generator and analyzer.

IPv6 Roadmap Ready

With the depletion of IPv4 addresses, service providers must rely on network address translation in order to maintain their existing IP infrastructure. This in turn breaks the end-to-end model of IP, while adding complexity and introducing scaling limits to the current IPv4 networks. IPv6 was created to provide a very large number of addresses, while returning IP to its end-to-end model and maintaining the advantages of IPv4. The XenaCompact series can be field-upgraded to support IPv6 networks with IPv6 capabilities, making this solution a scalable and financially suitable solution for next generation IP validation.

Fibre Channel SAN Analysis

Disaster recovery and remote data archiving are the main applications of Fibre Channel—a high performance data transfer technology. This protocol, deployed between stations and server farms, relies on low overhead, high data rates and an integrated flow control mechanism to enable storage area networks (SAN). The performance of these networks is usually dependant on resource availability and latency, as each transmission must be acknowledged by the remote end. The XenaCompact series provides BERT and round-trip latency measurement in order to qualify the SAN network and to measure the optimum transfer performance.

Scripting Capabilities

For sequencing and test repetition, the XenaCompact provide scripting capabilities. Scripts and XenaManager test case configurations are fully interchangeable, which allows for easy generation of the basic script traffic configuration functionality.

Conclusion

The XenaCompact testers provide the industry's most cost-effective Ethernet test solution for central office Ethernet network services testing. It is the industry's only two-port 10 G Ethernet test head, which supports that one test port is allocated for Ethernet services testing (BERT, RFC 2544, performance analysis, etc), while the other test port can be permanently used in conjunction with a network tap or a monitor port for QoS traffic monitoring.

The XenaCompact testers provide a fixed testing point for service turn-up, troubleshooting or SLA validation. Additional advantages include the fact that the units are physically bolted to an equipment rack, so they are always 'on' and guaranteed to be ready when needed, and the tester deliver the ideal form factor for central office applications (1U high, rack mount, and AC power supply).

The XenaCompact series is designed to help guarantee and reinforce customer SLAs by providing test features such as asymmetrical RFC 2544 testing in one step, as well as eliminating commissioning errors and protecting carrier service revenues and SLA reinforcement for Ethernet services via full wire-speed testing. Advanced filtering for fine granularity and always 'on' QoS testing of services provides faster problem resolution.

The XenaCompact delivers 'one person' testing to fully qualify Ethernet services with bi-directional end-to-end testing. Using the dual-test set feature, the XenaCompact increases technician autonomy and productivity with solo control of remote XenaCompact units, since no remote end-technician is required. This approach gives service providers access to test results for each test direction, which is essential to fully qualify Ethernet services.

End-to-end testing by using the Smart Loopback mode simplifies testing with the remote unit set to Smart Loopback, returning test traffic back to the local unit by swapping the appropriate packet overhead.