

Verifying Metro Ethernet Quality of Service

Introduction

Metro Ethernet is widely accepted as a cost-effective, resilient, and scalable switching and transport technology. Used for delivery of next generation IP-based services, including triple play, it facilitates the availability of affordable bandwidth on demand and highly secure private network communication. Yet despite the lucrative and strategic advantages it brings, many providers are reluctant to embark on full implementation to bring carrier-grade Ethernet offerings to market. This is due, in part, to the inherently greater complexity of maintaining carrier-class quality at the node and network levels. The hesitancy also stems from a lack of standardized test and monitoring tools and procedures.

Compounding the challenge of rolling out and maintaining carrier-grade Ethernet are stringent Service Level Agreements (SLAs) that specify, in granular detail, performance parameters for acceptable Quality of Service (QoS). As triple-play services delivery gains greater market presence, its service component offerings—particularly Voice over IP (VoIP) and Internet Protocol Television (IPTV) which carry very high Quality of Experience (QoE) expectations—will introduce additional scrutiny to network performance. In this competitive market, providers may get only one chance to earn customer loyalty. If services are not delivered satisfactorily the first time, the provider risks the customer churning quickly to another vendor.

Even with these significant challenges, demand for Metro Ethernet networks is increasing. This, coupled with providers' rapid adoption of triple-play services delivery strategy, is mitigating the build out and maintenance of rapidly expanding and increasingly complex Metro Ethernet networks. The upshot of this evolution is that service providers need a suite of comprehensive Metro Ethernet testing solutions. These solutions must offer providers a competitive edge for gaining and maintaining market share. Integrated field-portable test tools and centralized service assurance capability are key. A complete strategy should encompass a range of applications and requirements. These include:

- The ability to rapidly turn up and verify new links and services
- The need to reduce repeat repair rates
- The need to reliably maintain networks, ensuring that technician dispatch is to fix, not find, errors
- The need to perform these activities from a centralized location

In addition, the equipment must be easy to use and offer straightforward repeatability and testing consistency. Combining a range of instruments, systems, and software into an integrated test suite creates problem-solving capabilities that can generate consistent and repeatable processes for turning up new services in the field, facilitate problem detection, expedite fault isolation for the maintenance of service integrity, and greatly reduce operations costs.

Characteristics of Test Solutions

For previous generation service delivery technologies such as T/E-carrier and SONET/SDH services, technicians often used a straight-forward process to verify circuit performance and service viability: perform testing at the electrical/optical signal level, then take bit error rate (BER) measurements. Common methods and procedures for verifying connectivity and physical plant viability included simply looping up the far-end network interface unit or multiplexer, sending various BER patterns, inserting errors, and looking at the return signal. If results were within accepted parameters, the circuit was released for service. SLAs were not prevalent.

Metro Ethernet, with its expanded next-generation functionality, introduces new variables technicians must evaluate and necessitates new procedures test equipment must perform. Building on established methodologies for connectivity and viability testing, advanced test solutions for Metro Ethernet allow providers to ensure that the infrastructure will withstand the stress of broadband service delivery and verify stringent SLA requirements. At minimum, the solution should perform three primary procedures:

Signal level testing

As providers move to Ethernet/IP delivery, verification of traditional parameters such as level measurements and receive frequency continue to be vital considerations.

Connectivity testing

In Metro Ethernet service delivery, verification of end-to-end connectivity is important because it confirms the correct baseline network provisioning. In a switched network, connectivity testing is accomplished by sending Ethernet frames, while in a routed network, IP ping is used.

RFC 2544 testing

RFC 2544 is an industry-standard benchmarking methodology for network interconnect devices, which has become a de-facto standard for testing Ethernet/IP networks. The process encompasses throughput testing with various frame sizes to verify that the physical plant/circuit/network topology can sustain prescribed traffic requirements; verifies no loss of frames on the network; and measures round-trip delay.

When developing a comprehensive strategy to verify Metro Ethernet QoS, it is important to note that the solution should go well beyond these minimum service installation considerations to encompass integrated field and centralized components, as well.

Field Portable Testing

QoS verification begins during service installation and commissioning. Providers must certify, from the moment service is turned up, that the network can perform to meet the parameters agreed upon in the SLA. A portable test set configured to interface with a deployed probe can run suites of automated tests to allow providers to achieve consistent and accurate results with minimum resource investment for each new test. A test set that can, for example, run the full range of RFC 2544 tests at the push of a button saves time and money. Not only can the provider dispatch a single technician to perform the task, but the technician will not require in-depth training to operate the tester. Additionally, when a single test set can perform tests from the physical layer through the data and network layers, the solution brings even more cost savings because technicians do not need to carry multiple instruments

Field Testing Tasks Defined

Connectivity

Prior to testing throughput in a network, the provisioned service path must be verified. This is accomplished via a specific VLAN circuit setup, or by performing a ping test in a routed network. If connectivity problems with the far end exist, it may be necessary to verify the route between the source and destination host by running a Traceroute application. Traceroute is used as a tool to facilitate an understanding of where problems in the network may occur, and it is useful for gaining a sense of a particular route behavior in the network itself.

Throughput

In order for a new service hand-off to take place, proof must be provided that the circuit can handle the service it will carry. During service installation it is therefore required to measure throughput and verify that the network can deliver the bandwidth allocated to the end customer. On a live network, congestion may occur and prevent the subscribed service from running properly. To prove the service level agreement, line-rate traffic must be generated to stress the circuit. Moreover, an additional purpose of this test is to verify that no data is lost or corrupted as it travels the network.

Frame loss

A frame loss test determines the utilization rate at which no frame loss is present on the customer's circuit. The test is performed by generating traffic at the assigned service line-rate in order to verify that this bandwidth allocation does not cause problems in the network path. The test takes into consideration network buffering issues and verifies that traffic is not lost due to potential congestion issues in the service path.

Round-trip delay (latency)

To determine the average round-trip delay of the network, latency testing is performed using a circuit terminated in a loop-back. During this test, traffic is generated at the service line-rate, and the measurements are performed continuously on the received traffic. Determining circuit latency at the time of installation is an important step because the data captured may be needed as a bench-mark for subsequent network performance.

to perform their job. A comprehensive field test solution can perform all required installation and commissioning tests. [See Sidebar: Field Testing Tasks Defined]

Verifying the Ethernet services in this way assures the customer that the link meets the agreed SLA requirements and, of equal importance, creates a base line of performance against which the network can be subsequently measured. Accurate testing and the correct recording of results can thereby supply both a reference for potential maintenance issues and a method of reducing dispatches to rectify incorrect installations.

Centralized Testing

A centralized test and management strategy is key to support the varying requirements of a rapidly growing customer base and to maintain a Metro Ethernet network capable of reliably delivering next-generation IP services that meet stringent QoS agreements. Fundamental strategy requirements are QoS monitoring and data consolidation. Ultimately, the system should examine customer traffic; gather, capture, and access data from multiple points in the network; and isolate faults between the customer premises and the service provider as part of the service assurance process.

Using distributed IP test heads—located at Ethernet aggregation switches or at routers in the network as close to the edge as possible—can provide in-depth testing and data analysis with respect to the requirements stated in the SLA. An IP test head that supports multiple, simultaneous services testing enables installation and commissioning to be carried out in parallel, thus reducing testing time and increasing efficiency. If the process is automated from a centralized location, the ability for multiple technicians to work simultaneously will produce significant cost savings when new, high density locations are activated.

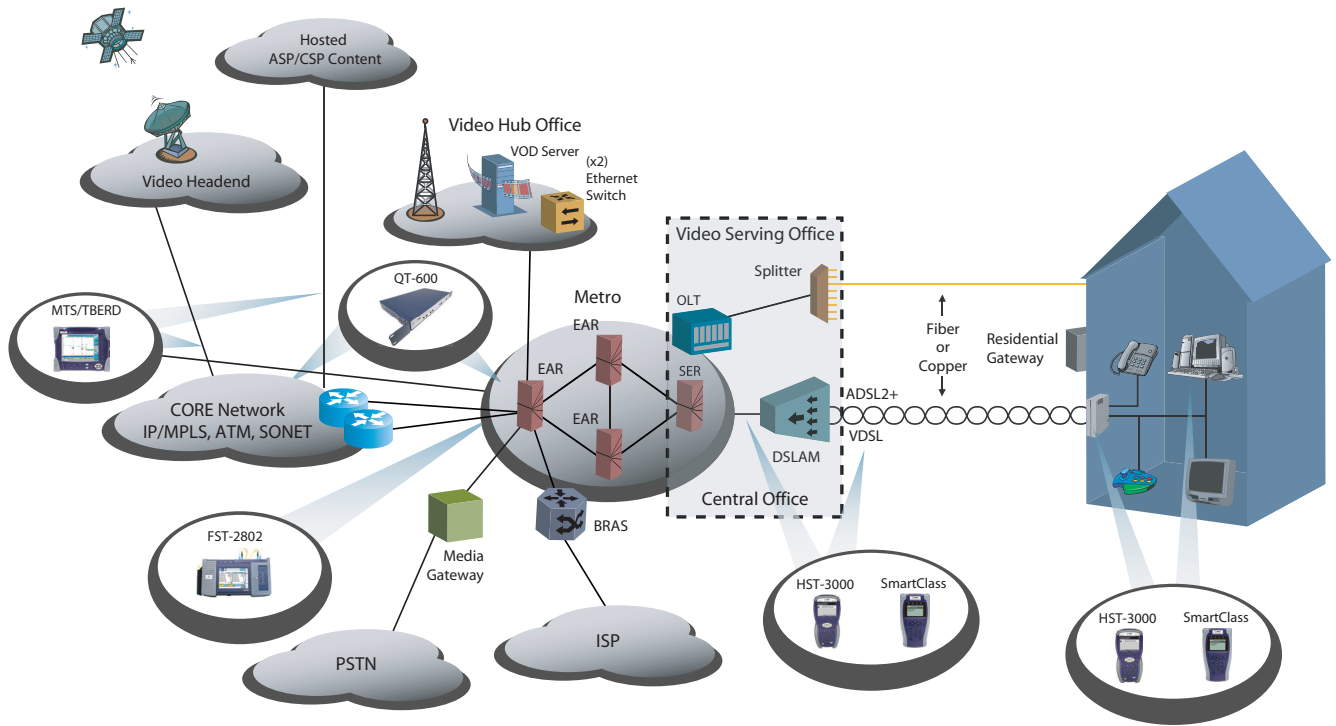
Furthermore, an increasing number of companies operate from multiple physical locations. Therefore, it is essential that service providers have the ability to provide the additional assurance of end-to-end service verification. This can be achieved by installing test heads at two of the customer sites to prove full end-to-end connectivity and perform detailed fault finding in both directions of the service.

Metro Ethernet Test Solution

Given the competitive environment in which service providers exist and the level of QoS that an increasingly sophisticated customer base demands, it is imperative that the chosen test solution meets stringent requirements. This choice can mean the difference between meeting and missing QoS targets.

The challenges service providers face after turn-up are dominated by the need to adhere to SLAs. Through remote testing, automated data capturing, and active and passive monitoring, service providers can gain a coherent view of network performance, customer traffic, and usage patterns. Complemented by the full-featured portable test equipment, the centralized solution can reduce unnecessary technician dispatches by performing fault isolation when network problems occur. Network technicians can quickly determine whether the problem lies between the core and the edge, the access point and the edge, or between any two points on the network. Effective portable tools can also allow a single technician to identify and analyze the faults once they are isolated.

Ongoing analysis of the consolidated data will reveal usage trends, link statistics, and traffic distributions, allowing service providers to identify degradations before quality of service becomes unacceptable.




JDSU solutions provide test and monitoring functionality throughout the IP services network to help providers meet customers' QoE expectations.

Conclusion

As Metro Ethernet networks continue to evolve, and next generation IP-based deployment begins to increase in volume, essential testing applications are becoming increasingly more complex and varied. The goals of the service provider remain unchanged—installing the service correctly the first time; limiting errors in the field; decreasing the technology learning curve; reducing mean time to repair; limiting technician dispatches, and optimising bandwidth utilization for maximum profitability.

For providers today, the ability to meet these goals and maintain on-going compliance with stringent Metro Ethernet SLAs depends on deploying an effective, comprehensive service assurance strategy—one that utilizes integrated portable test sets and distributed network probes to enable a single technician to verify service, sectionalize errors, and resolve trouble. This proven approach provides a powerful solution for service maintenance and issue resolution. Not only does it minimize travel time required for locating field problems, but it also reduces the number of dispatches, cuts the number of technicians to close out each ticket, and lessens the skill level needed by the technician. This winning combination yields greater operational efficiency and much needed cost control for providers as they work to address the ever increasing complexity of maintaining high QoS on Metro Ethernet networks.



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