New Peering Standards for Ethernet Exchanges: Simplify Interconnections and Enable New Revenues

What You Will Learn

Service providers worldwide have increasingly turned to Ethernet technologies due to their scalability, simplicity, increasingly sophisticated management features, and lower costs as compared to older networking technologies. With the ratification of new standards, Ethernet has evolved to the point where it is now a viable carrier interconnect solution as well.

This white paper provides an overview of the new standards and technologies that enable:

- Many-to-many Ethernet interconnections among service providers with uniform handoffs that simplify provisioning, upgrades, and troubleshooting
- Uniform mapping of class-of-service (CoS) attributes end-to-end
- Cost-effective, scalable, and secure deployment of Carrier Ethernet services
- Reduced time to revenue

The Growth of Ethernet Drives Interest in Carrier Interconnects

Interest in Ethernet interconnects between service providers is a result of the growing popularity of Ethernet within enterprises and the desire to reduce the cost of bandwidth despite the use of faster data connections. As organizations migrate from older technologies – including Frame Relay, ATM, and TDM leased lines – Ethernet provides lower cost per bit, greater bandwidth scalability, and simpler operations. Ethernet services are available at Gigabit Ethernet and 10 Gigabit Ethernet speeds and in the future will reach 100 Gigabit Ethernet. Ethernet's capabilities have become indispensable as service providers move to IP networks with applications that require much higher bandwidth, flexibility, scalability, and intelligence. The move is coming as billions of people around the world adopt fixed and mobile devices with multimedia applications. According to the 2010 Cisco® Visual Networking Index (VNI) study, this in turn is having a profound impact on global IP traffic, which is forecast to grow fourfold from 2009 to 2014, when it will approach 63.9 exabytes per month, up from approximately 10 exabytes per month in 2008.

Carrier Ethernet has gained popularity over many other networking technologies. Numerous wired, mobile, and cable operators use it in their networks and to incrementally migrate from legacy transport technologies such as SONET or SDH, as illustrated in Figure 1. Ethernet over IP Multiprotocol Label Switching (MPLS) provides a much broader set of operations, administration, and maintenance (OAM) capabilities and service features as compared to traditional Ethernet, including Layer 3 VPNs, Layer 2 VPNs, traffic engineering, and quality of service (QoS) to support service-level agreements (SLAs). In addition, Ethernet over MPLS can be used with pseudowire technology to provide more efficient and cost-effective mobile backhaul.

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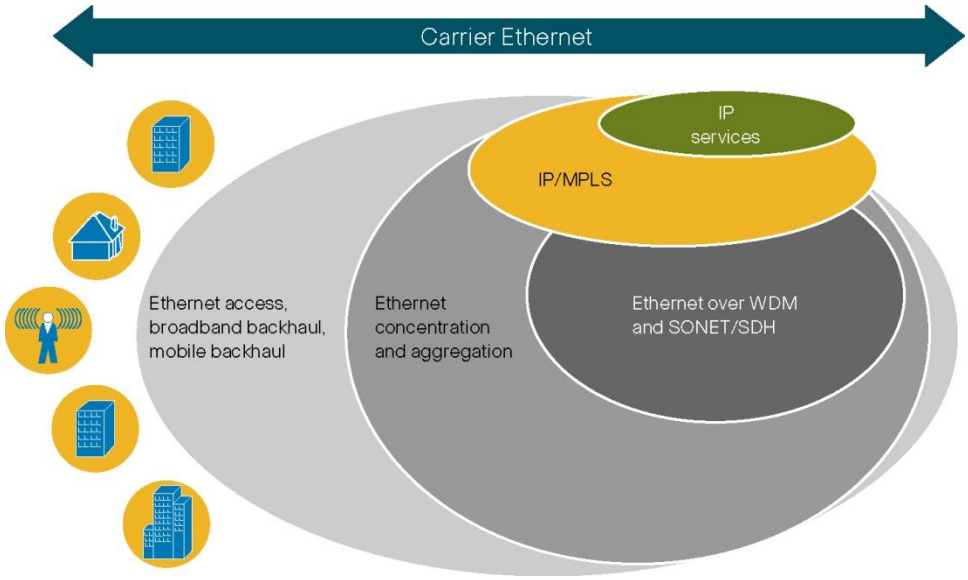
Figure 1. The Growth of Ethernet in Service Provider Network Infrastructures



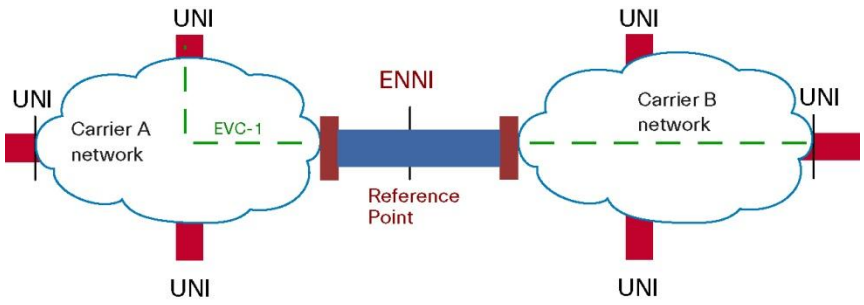
Source: Infonetics Research, 2009

Service revenues reflect the growth of Ethernet. According to a 2008 study by Infonetics*, business Ethernet connectivity services in the United States are projected to grow from US$22 billion in 2008 to $34 billion by 2013. A 2009 study by Vertical Systems Group** forecasts global business Ethernet services revenue reaching US$40.2 billion by 2014.

Ethernet External Network-to-Network Interface Standard Ratified

Until recently, network providers seeking to extend broad Ethernet coverage for their customers have forged direct interconnect relationships with other Ethernet providers. But these one-to-one interconnections have been limited in their features. They have also been based on proprietary or impromptu solutions requiring complex legal and technical agreements. These interconnect relationships have also required extensive discussions between providers to verify each other's products and operational capabilities. The Ethernet External Network-to-Network Interface (E-NNI) specification was ratified by the Metro Ethernet Forum (MEF) in January 2010, removing many obstacles that affect a service provider's ability to easily exchange data, voice, and video traffic using a common Ethernet framework with other providers at Layer 2. The E-NNI standard (known as MEF 26) originated in 2002 as a draft proposal authored by Cisco. The E-NNI specification provides a common mechanism for interconnectivity between different Carrier Ethernet service providers, using functional elements. The User-Network Interface (UNI) is the standard for user connectivity to a Carrier Ethernet service provider, Figure 2.

Figure 2. E-NNI and UNI Standards Enable Ethernet Exchanges



Source: Metro Ethernet Forum, 2009

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Benefits of the new Ethernet interconnect standard for service providers include:

- Simplified interconnect operations with new efficiencies for processes such as ordering, implementation, and billing
- Reduced operating costs through the aggregation and interoperability of multiple Carrier Ethernet services over a single standards-based physical connection
- Lower capital costs through use of logical connections, instead of more capital-intensive physical assets such as points of presence (POPs), circuits, wavelengths, and optical interfaces
- The ability to troubleshoot and manage performance and connectivity issues with robust OAM capabilities
- The opportunity to provide a broader portfolio of services to enterprise customers and to reach new markets quickly and at lower costs

The need for a dependable Ethernet peering solution is being driven by customer demand for ubiquitous service availability, with consistent on-net (directly connected to a provider) and off-net (connected through a local exchange carrier [LEC]) services. Providers want a standards-based environment for buying, selling, and wholesaling services; developing new business models; and providing services with guaranteed high uptime. With dependable Ethernet peering, customers will be able to add or change services on demand through self-service portals for rapid service initiation and time-based or volume-based billing. As with existing Carrier Ethernet services, Ethernet peering must also be able to provide service-quality differentiation; prioritize QoS on VPN, virtual private line, and LAN services; support guaranteed SLAs that can be priced based on service attributes; and allow visibility into those service levels. Efficient OAM that lowers operational costs allows service providers to offer national or global services that are competitively priced.

The E-NNI standard – combined with MEF 23, the Class of Service (CoS) Implementation Agreement (IA), and the upcoming Service OAM Fault Management (SOAM) and Performance Management specifications – addresses many issues related to the inter-operator handoff of Ethernet services, including a common way of handling OAM, CoS, and SLAs to ensure that service levels are maintained when traffic is transported across other networks.

> “By supporting standardized interconnect and Ethernet services spanning multiple-operator Ethernet networks, and bringing issues such as CoS, SLAs, and management into line, the E-NNI will have a major impact on the industry, with new global business opportunities for service providers and vendors. It will also generate even wider opportunities for world business with its promise of fast and cost effective global interconnection.”
>
> **— Metro Ethernet Forum, February 2010**

Managing Classes of Service in Ethernet Peering

The MEF has defined three general Ethernet CoS categories: real time, data, and best effort. Service providers can map frames into these service classes to facilitate interworking for end-to-end alignment of CoS at the external interface. The top of Figure 3 illustrates the mapping of classes from one service provider to another over the E-NNI, from one end of the subscriber’s WAN to the other. The lower part of the diagram shows how a customer can have different varieties of CoS within an extended network domain.

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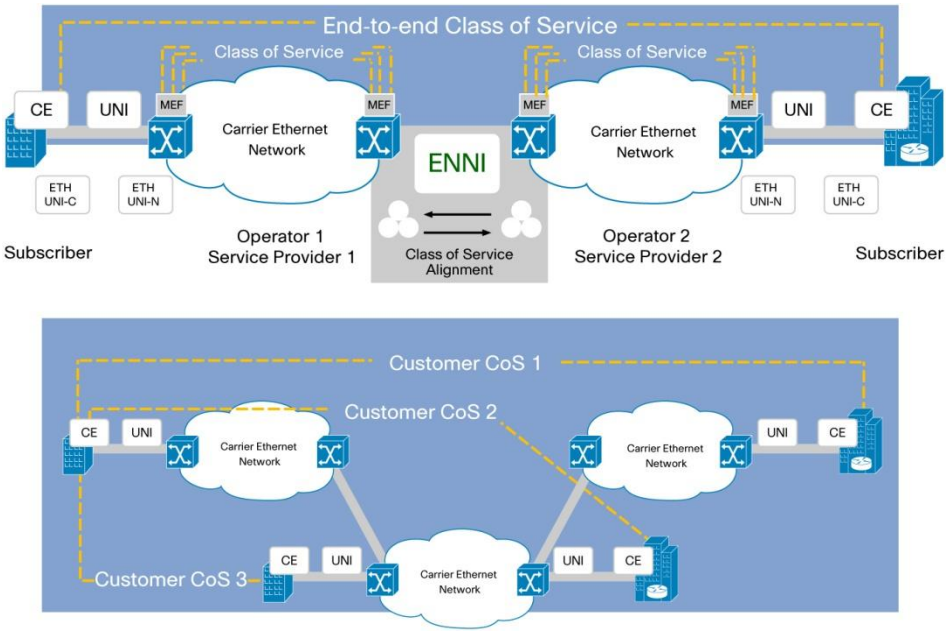
Figure 3. Class of Service Mapping with E-NNI



Source: Metro Ethernet Forum, 2009

At the interconnection of two provider networks, the E-NNI specification enables measurement of an Ethernet service stream based on CoS parameters – bandwidth profiles of either Committed Information Rate (CIR) or Excess Information Rate (EIR) and performance measured by delay, loss, and availability. This priority information is preserved across the boundary of the networks by encapsulating each Ethernet frame with an appropriate MAC header. If a stream of packets contains both high-priority traffic such as voice over IP (VoIP) calls and low-priority traffic such as overnight server backup, the E-NNI helps ensure that the critical VoIP calls receive priority.

OAM and Link Protection in Ethernet Peering

The MEF's SOAM Fault Management and Performance Management work will complement the E-NNI MEF 26 standard to integrate leading Ethernet OAM specifications to provide perhaps the most comprehensive OAM capabilities for packet-based networks. These OAM standards work together to provide connectivity fault management and performance management.

The main Ethernet OAM standards from the ITU and the IEEE used in Ethernet peering include:

- ITU-T Y.1731
- IEEE 802.3ah
- IEEE 802.1ag

There are many similarities among the ITU and IEEE Ethernet OAM standards. Both IEEE 802.1ag and ITU-T Y.1731 address OAM for end-to-end Ethernet services and infrastructure, encompassing fault management and performance monitoring. The fault management feature automatically reports network defects to the service provider. Performance monitoring provides a variety of features to help enforce customer SLAs, including features that are standard in SONET such as reporting on frame loss, frame delay, and frame delay variation. These features are especially crucial as multiple networks interconnect, sending traffic across each other's networks, Figure 4.

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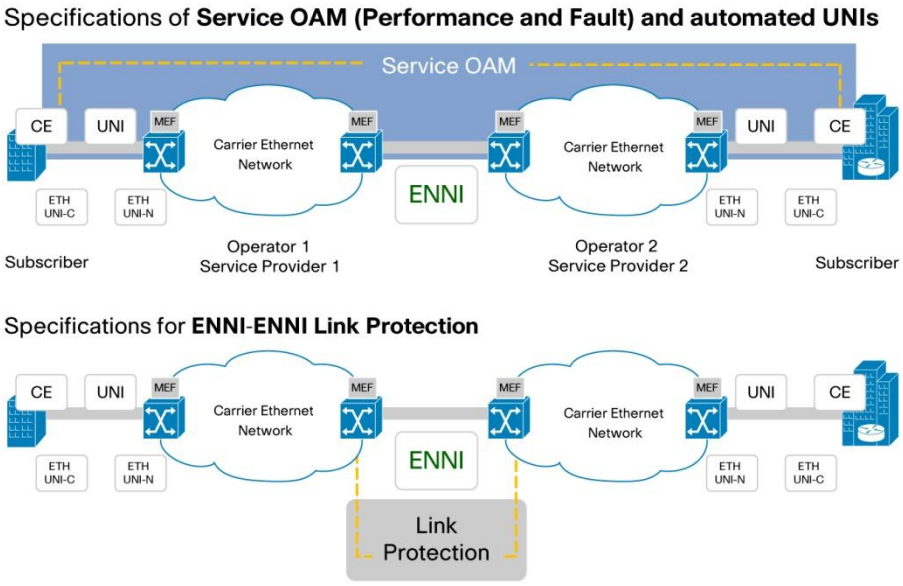
Figure 4. OAM and Link Protection with E-NNI



These features can be implemented on an integrated or standalone network interface device (NID) or integrated into other equipment.

The IEEE 802.3ad standard provides link aggregation, which uses multiple network cables or ports in parallel to increase the link speed and to increase redundancy for higher availability. Within the specification, the Link Aggregation Control Protocol (LACP) controls the bundling of several physical ports together to form a single logical channel. LACP negotiates a set of agreeable links with the peer in one or more Link Aggregated Groups (ports of the same speed set to full duplex operation). Traffic is load balanced across these ports to achieve the greatest total speed.

IEEE 802.3ad brings failover protection to links in Ethernet Exchanges. If any port goes down, traffic is forwarded on the remaining active links.

Metro Ethernet Forum Global Interconnect Initiative

The MEF Global Interconnect Initiative is dedicated to promoting “the interconnection of autonomous Carrier Ethernet networks to enable standardized and streamlined delivery of MEF-certified Carrier Ethernet services with end-to-end class of service, management, and protection.” The initiative is aimed at helping service providers to expand coverage, extend their reach, broaden their service offerings, and reduce costs through Ethernet Exchanges based on:

- **Global specifications,** such as E-NNI and UNI
- **Certification and testing** of E-NNI services and equipment, including management mechanisms, CoS, OAM, and NID
- **Tools** that include a Global Services Directory to help facilitate communication and coordination among service providers and tools to assist with interconnects (including an Interconnect Questionnaire with a set of Ethernet parameters to be considered in offering an end-to-end SLA)

Ethernet Exchanges Emerge

Several carriers have already announced plans to roll out carrier-neutral Ethernet Exchange services.

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Neutral Tandem, Inc., a leading provider of tandem interconnection services, announced that it is introducing a new "Ethernet eXchange" service offering designed to meet the needs of Ethernet service providers. The initial 2010 market deployment schedule of the Ethernet eXchange offering is planned for Atlanta, Boston, Chicago, Dallas, Denver, Detroit, Houston, Los Angeles, Miami, New York, Philadelphia, San Francisco, Seattle, and Washington, D.C. Additional market deployments, both domestic and international, are being planned.

Telx, another U.S. provider of interconnection services, announced the Telx Ethernet Exchange in June 2010, with locations in New York, Atlanta, and San Francisco and service covering all 50 states. The Exchange provides cost-effective, reliable, and secure access to an ecosystem of more than 750 telecommunications carriers, ISPs, content providers, and enterprises. With more than 28,000 direct connections providing lower costs, near zero latency, and fewer points of failure, the Telx Ethernet Exchange allows organizations to improve network performance, reduce time to market, and tap into new business opportunities to build a competitive advantage. Telx promotes these benefits to enterprise customers:

- A network-neutral ecosystem for mission-critical applications
- The ability to choose telecommunication providers quickly and efficiently
- Services available at wholesale rates
- Substantial savings on costs associated with local loops
- Centralized procurement for voice and data services
- Reduced latency associated with procurement of IP transit services

CENX, Inc. is another Carrier Ethernet Exchange provider delivering carrier-neutral, location-neutral, Carrier Ethernet Exchange services to global telecom and Internet service providers. In 2010 Verizon began offering its certified Carrier Ethernet services to its global wholesale customers through the CENX Carrier Ethernet Exchange in New York City.

Equinix, Inc., a leading provider of global data center services, launched the Equinix Carrier Ethernet Exchange, a global service that provides a multi-carrier environment for the exchange of data traffic between providers of Ethernet services. The Equinix Carrier Ethernet Exchange development program included several large telecommunications companies such as Hibernia Atlantic, KPN International, Level 3 Communications, PCCW Global, and Reliance Globalcom, among others.

In Europe, the Advanced Global Interconnect Test Program, a joint initiative of the journal **Light Reading**, independent test lab European Advanced Networking Test Center (EANTC AG), and carrier interconnect company ancotel conducted a successful test of secure point-to-point connectivity of Ethernet services between carriers. A second phase of testing verified that with the new MEF standards, service providers could interconnect and retain their service-level management features, including CoS mapping. Participating service providers included Belgacom SA, Equinix, Expereo International, Level 3 Communications, P&T Luxembourg, Teragate, Tinet, and Ucomline.

Conclusion

The growth of Carrier Ethernet services has led to the establishment of robust carrier interconnect standards by the MEF that enable many-to-many connections and a common, reliable framework for providing end-to-end CoS, OAM, and SLAs. With the ratification and adoption of the E-NNI specification in particular, interconnect providers now see a viable new market for extending Ethernet networks nationally and internationally. The resulting new interconnect business, the Ethernet Exchange, is an exciting opportunity for interconnect providers to grow their businesses, for service providers seeking to cost-effectively scale Ethernet deployments and expand services for customers, and for businesses that need to scale networks to keep up with application and bandwidth demands.

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Cisco, a long-standing MEF partner, offers platforms and technologies that are compliant with Ethernet Exchange specifications, enabling the end-to-end delivery of highly scalable, manageable, and secure services that empower service providers to generate new revenue with expanded coverage.

For More Information

Cisco Managed Metro Ethernet Services
http://www.cisco.com/en/US/netsol/ns341/ns121/ns389/ns308/networking_solutions_solution_category.html

Metro Ethernet Forum
http://metroethernetforum.org

Neutral Tandem Ethernet Exchange
http://www.neutraltandem.com

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