Fast Forward to Ethernet Exchange Networks

With the rapid growth of network-intensive applications, such as video, and the expanding adoption of smartphone devices, both supported by third-generation (3G) and fourth-generation (4G) networks, carriers are tapping into the reliability and speed of Ethernet to interconnect multiple service providers beyond the boundaries of their service footprints. In this paper, you will learn three crucial factors that carriers should take into consideration when selecting an Ethernet exchange operator. Does the exchange:

- Take a **network-based** approach to extend its reach nationwide?
- Provide a highly customizable portal?
- Assist with end-to-end interconnect oversight and management?

Enterprise and Mobile Backhaul Ethernet Growth

Enterprises today are demanding greater access to Ethernet connectivity for all their bandwidth needs, especially data and video, with fiber as the preferred solution. This hunger for capacity that can accommodate blossoming amounts of data and video has moved IT organizations beyond such legacy access technologies as Frame Relay, ATM, and T1 to Ethernet. Ethernet, with its proven history of exceptionally high performance, scalability, and rapid provisioning is also valued for its suitability for all-IP next-generation network infrastructures where technologies and access modes integrate with ease.

Demand is also growing from wireless carriers that prefer Ethernet for mobile backhaul to address the dramatic increase in data traffic on mobile broadband networks. Much of this need is due to such high-functioning devices as smartphones and bandwidth-consuming mobile applications, especially video, delivered over these and other devices. Such increased data traffic places significant strains on mobile operator networks; an aging wireless backhaul network, designed primarily for voice, is ill equipped to handle this broadband data traffic and requires a speedy upgrade to support growing bandwidth requirements.

Moreover, because Ethernet demands by businesses and consumers tend to extend beyond any single provider's service footprint, the greatest challenge has been an inability for service providers to meet in a virtual, neutral environment where they can:

- Discover the locations of Ethernet circuits in buildings and other sites owned or managed by other carriers
- Compare and contrast pricing from multiple carriers
- Select and provision circuits end to end
- View uptime, faults, and performance characteristics of those provisioned circuits
- Advertise their own provisioned circuits ("lit" buildings) in specific regions to other carriers

Instead, they have been forced to locate and negotiate costly and time-consuming interconnect agreements with multiple carriers, one connection at a time. These agreements consist of proprietary legal and technical partnerships between Ethernet service providers. These cross-connects were limited to physical wire connections that required a Gigabit Ethernet port for each individual connection. This meant that service providers were forced to allocate 100 percent of a Gigabit Ethernet circuit's capacity to a single cross-connect, adding tremendous cost, inefficiency, and provisioning delay. This also meant that service providers could not access co-located Ethernet sites in a one-to-many manner, placing serious limits on their ability to scale quickly and cost effectively.

Ethernet Exchanges and the Challenges They Address

In response, some members of the Metro Ethernet Forum (MEF) created an online, carrier-neutral “exchange” to facilitate this standardization and simplification of the cross-connection function, an open and transparent marketplace where Ethernet carriers could gather to locate and negotiate Ethernet cross-connects. These Ethernet exchanges provided the opportunity for mobile operators, service providers, enterprises, and others to virtually extend their current networks to other geographically distributed locations. Of course, the entire process is faster, simpler, and less costly when interconnecting through Operator Virtual Circuits (OVCs, software-based connections), instead of physical cross-connects, to roll out Ethernet connectivity. The advantages of these first-generation Ethernet exchanges were significant, as service providers could:

- Migrate from time-consuming, one-to-one interconnects to more efficient one-to-many connections within their local markets
- Access a web-based user portal to locate “lit” buildings owned by other carriers, but perhaps as important, upload their own served building lists for other carriers to discover
- Use that same portal to initiate connections and manage their performance with expansive operations, administration, and maintenance (OAM) capabilities

As innovative and advanced as many of these exchanges are today, however, they suffer from a number of weaknesses that are impediments to faster, more cost-effective, and extended Ethernet cross-connects to multiple carriers.

Limitations to the Current Ethernet Exchange Model

It is important to note that these exchanges tend to be located in large, self-contained markets where service providers interconnect, for example, within the Chicago or New York markets; the result is discrete and isolated exchange “islands.” Lacking a network-based approach, these islands cannot link service providers on any one exchange to service providers on another exchange, an option that could serve to greatly expand service providers’ footprints. In addition, while many of today’s Ethernet exchanges now have the ability to dynamically scale up bandwidth with logical circuits (OVCs), accessing only a portion of a port’s capacity, they still require separate ports for each exchange in each market, which does not fully address the challenges of cost, inefficiency, and delay.

In a typical scenario, an Ethernet service provider may win a contract to deploy Ethernet connectivity in 20 customer buildings, with each building located in a separate city, nationwide and distant from the other 19 buildings. Due to a limited footprint, the service provider may have existing Ethernet connectivity co-located in only half of those buildings. Without access to an exchange that connects to a network of exchanges, the service provider is still required to pursue complex, time-consuming, and customized off-net interconnection agreements with numerous third parties, in order to access circuits in the remaining 10 buildings. Depending on the scenario, that could easily mean negotiating complex and time-consuming agreements with up to 10 other service providers, each with its own legal contracts, technical requirements, Network-to-Network Interface (NNI), testing and turn up procedures, and more. The most likely result is that the service provider defaults all off-net locations to one other provider, adding greater cost to the interconnections than if they were negotiated separately in an open, transparent, network-based exchange.

Moreover, today’s Ethernet exchanges lack a means by which members can, in one easily accessed and managed portal, locate, sell or buy, track, and manage the interconnection end to end. That generally includes placing an order for the OVC and tail circuit; working offline with the party from whom the tail was ordered to get the service provisioned, tested, and turned up; then communicating that information to the provisioning team so that all parties to the interconnect are aware of its status. As well, even among those exchanges that provide users with a web-based portal, most lack the ability to customize the interface, the types and amount of data presented, the reports generated, and more.

Network-Based Approach to Ethernet Exchanges

To avoid the cost and time-consuming limitations of today's current Ethernet exchange model, service providers, enterprises, mobile operators, and others need to consider exchanges that take a network-based approach to the exchange model. Such exchanges deliver services over a nationwide IP/MPLS meshed network backbone that offers a more efficient and simplified method of interconnecting Ethernet for businesses and mobile backhaul on a virtual, multimarket, many-to-many basis.

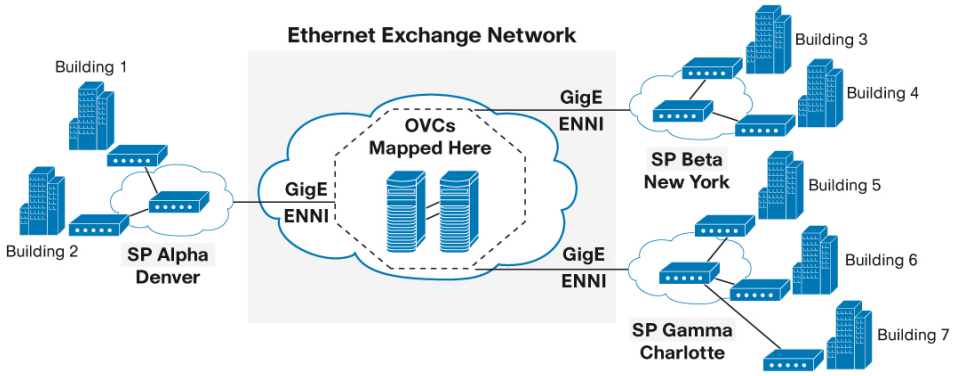
- Such a nationwide IP/MPLS meshed network backbone allows service providers to expand their service area beyond their existing service footprint, leaving behind the "island" approach taken by other exchanges
- An all-IP environment offers the kind of visibility and control exchange members require to customize critical functions related to:
  - Discovering Ethernet sites, such as "lit" buildings and cell towers
  - Advertising their own available circuits
  - Requesting and receiving quotes from multiple service providers
  - Placing orders for both OVCs and individual tail circuits
  - Service-level agreement (SLA) monitoring and assurance, and more
- With the enhanced visibility offered by IP/MPLS, exchanges are better able to engage in tracking and managing the interconnect from end to end, from OVC to tail circuit

All of these features make it easier, more efficient, and more cost-effective for Ethernet service providers to enter new markets and grow their businesses.

Network-Based Ethernet Exchange Scenario

The following scenario (see Figure 1) best describes how a network-based approach to extended, virtual interconnection works. Ethernet service provider A ("SP Alpha") is located in Denver, CO; Ethernet service provider B ("SP Beta") is located in New York, NY; and Ethernet service provider C ("SP Gamma") is located in Charlotte, NC. All three Ethernet service providers connect through an IP/MPLS backbone to a network of Ethernet exchanges through a Gigabit Ethernet port.

Figure 1. Sample Scenario Using a Network-Based Approach to an Ethernet Exchange



SP Alpha in Denver has just acquired the contract to provide Ethernet services for an enterprise ("Top Enterprise"), which has seven buildings located in Denver, New York, and Charlotte. The New York locations require 100 Mb bandwidth connectivity, while Charlotte and Denver each require 50 Mb. SP Alpha has a strong footprint in Denver but no presence in New York or Charlotte.

SP Alpha accesses the web-based customer portal of a network-based Ethernet exchange provider and looks up information about the seven buildings in the three cities using street addresses. Immediately available through the portal are names of Ethernet service providers that serve buildings 3 through 7 and connect to the exchange. Data included in the profile may include access method, available bandwidth, SLAs, standard pricing, and more. Based on this information, SP Alpha selects SP Beta for service to the buildings in New York, SP Gamma for service to the buildings in Charlotte, and requests tail-circuit provisioning for each building.

The connection between Top Enterprise, building 1 in Denver and Top Enterprise building 7 in Charlotte requires 50 Mb, which in the past would have required that SP Alpha dedicate an entire Gigabit Ethernet circuit to the physical cross-connect. However, because an Ethernet exchange with an IP/MPLS meshed backbone network approach relies on **virtual**, rather than **physical**, cross-connects, only 50 Mb of capacity is taken from the Gigabit Ethernet port. This leaves the remaining bandwidth available for additional connections to service providers (such as the 50 Mb connection between building 2 in Denver and building 3 in New York through SP Beta). The connection is tested and Ethernet services are available for Top Enterprise in Charlotte. The process repeats for the New York locations, using the same SP Alpha Gigabit Ethernet port in Denver to establish two cross-connects.

After a few months serving the Top Enterprise contract, Top Enterprise requests that SP Alpha increase the bandwidth available to its buildings in Charlotte from 50 Mb to 100 Mb. SP Alpha returns to the exchange portal and increases Charlotte's available bandwidth, virtually and quickly, without adding circuits or physically connecting wires.

In virtually every scenario, this networked exchange supports two geographically distant locations on a single Gigabit Ethernet port. Equally important is the faster customer provisioning. In the past, service providers would have been required to locate, negotiate, and order each of these physical Gigabit Ethernet cross-connects on a one-to-one basis. The cost savings of requiring fewer circuits as well as much faster provisioning makes a compelling case for an "exchange of exchanges" built over an all-IP/MPLS backbone network.

Users have access to a far greater number and variety of exchange members throughout the United States, including many secondary markets currently underserved by traditional exchanges. The result is far greater reach for enterprise and mobile operators, as well as lower cost and faster provisioning.

Elements of an IP/MPLS Meshed Backbone Network: An "Exchange of Exchanges"

Critical elements to the success of an Ethernet exchange based on an IP/MPLS meshed backbone are the underlying technologies that allow it, such as the Cisco® Carrier Routing System (CRS) and the Cisco ASR 9000 Series Ethernet Switch.

In the case where Top Enterprise requests an upgrade to 100 Mb in its Charlotte building, the following occurs:

- SP Alpha connects to the Ethernet exchange network in Denver through a Cisco ASR 9000 Ethernet Switch.
- The Cisco ASR 9000 Ethernet Switch connects to a Cisco CRS-1 across the MPLS network.
- The first Cisco CRS-1 connects to a second Cisco CRS-1 in Charlotte.
- The connection from the second Cisco CRS-1 in Charlotte is to a Cisco ASR 9000 in Charlotte.
- The Charlotte Cisco ASR 9000 hands off the interconnect to SP Gamma, who connects to building 7 and turns up the Ethernet service to Top Enterprise.

The Cisco ASR 9000 Ethernet Switch forms the core of the exchange, performing all virtual cross-connect functions between carrier ports, and uses the same Cisco XR IOS® Software that powers the Cisco CRS-1, providing the foundation for network and service convergence. Cisco XR IOS Software is a fully distributed, microkernel-based architecture that modularizes the important functions required of the Cisco ASR 9000, which allows for upgrades and changes only to those processes affected by the change.

For example, if a security issue is discovered in the Open Shortest Path First (OSPF) process, that process can be stopped, upgraded, and restarted with no effect on other routing or switching functions being handled by the Cisco ASR 9000. Cisco XR IOS Software also provides the important characteristics required of the Ethernet exchange network for manageability, availability, and scalability.

In addition to an IP/MPLS meshed backbone and reliable switching fabric, it is important that the exchange selected provide a completely customizable, web-based, customer portal that provides discovery and advertising, order management and provisioning, and order management services. In discovery and advertising, members might perform detailed queries and searches for buildings and member service providers with service in those buildings, as well as advertise their own “lit” buildings. Members can transparently share quoting and pricing, and agree on terms of service. In the order function, members request Ethernet OVC and tail-circuit provisioning. Though the circuit is provisioned by the service provider from whom it is ordered, the exchange initiates the order through the portal, then remains available to advise when the circuit is ready for commercial turn up. Finally, the reporting function offers a full view of key performance indicators (KPIs), order status, trouble-ticket status, and more. These functions are fully integrated with a multiservice and multi-technology network management system, the Cisco Active Network Abstraction (ANA), which serves as the element manager for alarms, monitoring, and provisioning the configuration of those services.

IP/MPLS Network Differentiates an Ethernet Exchange

An IP/MPLS network approach offers Ethernet service providers a more efficient and simplified method of interconnecting Ethernet for businesses and mobile backhaul on a virtual, nationwide, many-to-many basis, allowing service providers to expand their service area beyond their existing service footprint. Easing the virtual interconnect process is a fully customizable web-based customer portal, which makes it easier, more efficient, and more cost effective for Ethernet service providers to enter new markets and grow their business.

An enterprise, Ethernet service provider, mobile operator, or other party, should take these three vital factors (see Table 1) into consideration when selecting an Ethernet exchange operator. Does the exchange:

- Take a **network-based** approach to extend its reach nationwide?
- Provide a highly customizable portal?
- Assist with end-to-end interconnect oversight and management?

Table 1. Critical Considerations for Selecting an Ethernet Exchange

Does the exchange you are considering take a **network-based** approach to extend its reach nationwide?
Does the exchange you are considering provide a highly customizable user portal?
Does the exchange you are considering assist with end-to-end interconnect oversight and management?

For More Information

To learn more about the latest standards and technologies adopted for Ethernet exchange peering, read the Cisco White Paper, “New Peering Standards for Ethernet Exchanges: Simplify Interconnections and Enable New Revenues” at http://www.cisco.com/en/US/prod/collateral/routers/ps9853/c11-609224-00_ethernet_exchanges_wp.pdf.

To learn more about how Cisco products and technologies are helping to activate the Neutral Tandem network approach to Ethernet exchanges, read the press release, “Solution Helps Service Providers Accelerate Revenue in the Rapidly Growing Ethernet Market” at http://newsroom.cisco.com/dlls/2010/prod_031510c.html.

To learn more about the Cisco ASR 9000 Series, visit http://www.cisco.com/en/US/products/ps9853/. To learn more about the Cisco Carrier Routing System, visit http://www.cisco.com/en/US/products/ps5763/index.html. And to learn more about Cisco XR IOS Software, go to http://www.cisco.com/en/US/products/ps5845/.

To learn more about the Cisco ASR 9000 Series and its place in service provider networks for delivering business Ethernet and mobile backhaul capacity, read the Cisco white paper, “Cisco ASR 9000-Based Next-Generation Mobility Services Infrastructure” at http://www.cisco.com/en/US/prod/collateral/routers/ps9853/white_paper_c11-501763_ns523_Networking_Solutions_White_Paper.html.

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Printed in USA C22-621991-00 09/10