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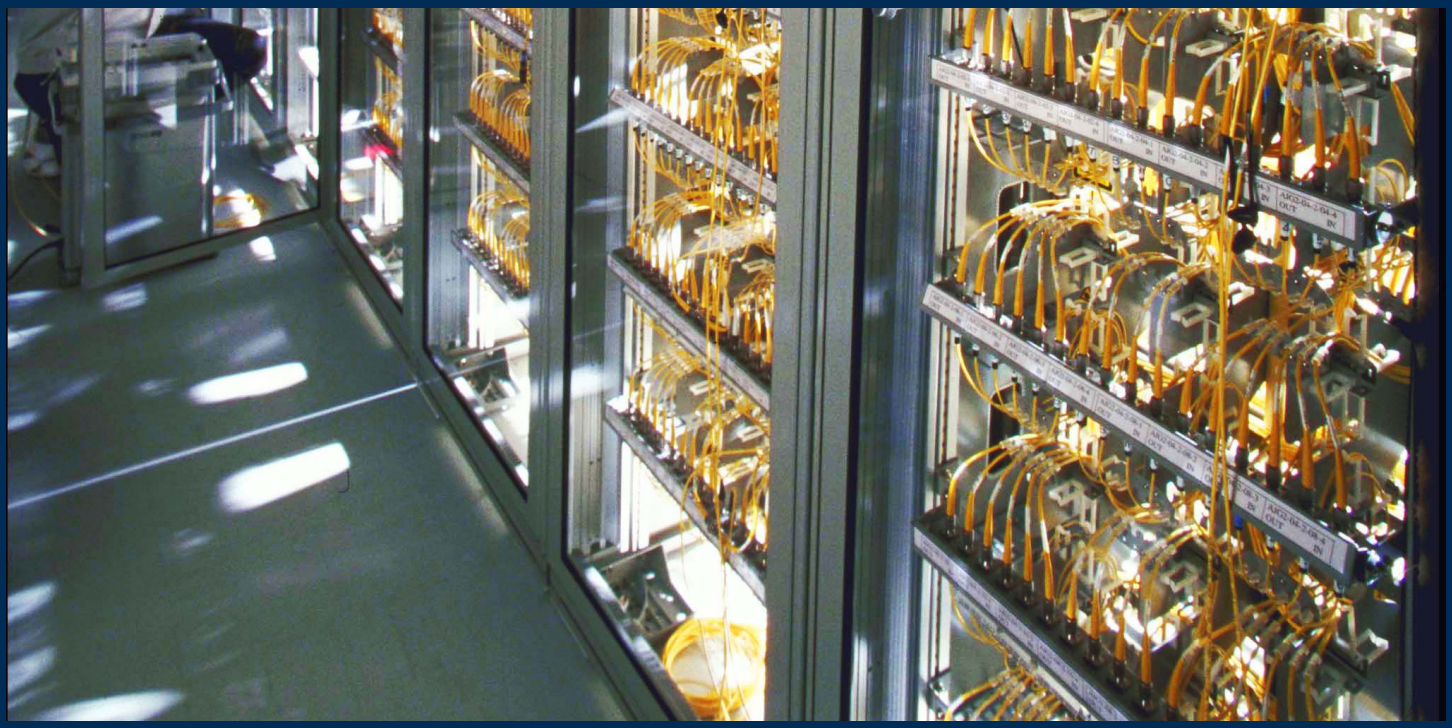
SOLUTION BRIEF



Ethernet Wide Area Networks – Extending the Enterprise

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Ethernet is rapidly becoming the primary communications technology for organizations of all sizes. Most businesses already have Ethernet-based local area networks (LANs). By extending Ethernet beyond the office or campus to the metropolitan area, region or around the globe, businesses gain greater performance, flexibility, and reliability compared to other wide area network [WAN] transport methods and, often, at lower cost.

Executive Overview

Ethernet has become the preferred transport for advanced services, such as IP telephony, video streaming, medical imaging, and data storage. Ethernet is popular because of its reliability, the ease of adding bandwidth in small increments, and interoperability with traditional broadband access technologies used over the WAN. In addition, because Ethernet is a mature technology, most enterprises already have people on staff with Ethernet management skills so they can avoid operational expenditures for training and hiring. Together, these factors typically enable enterprises to realize significant cost savings.

Ever-increasing demands for data storage and transport are forcing enterprises of all sizes to re-evaluate their current networks. With next-generation enterprise applications – such as disaster recovery, storage, and packet voice and video – driving steep increases in bandwidth demand, enterprise IT managers are painfully aware of the limitations of traditional data services on legacy technologies, such as private line, Frame Relay, and ATM. Traditional data services are expensive to scale, limited and inflexible in their service options, operationally complex, and painfully slow to upgrade. Enterprise IT managers have the extremely difficult task of satisfying rapidly increasing bandwidth requirements with dwindling budgets and legacy services that can no longer meet their needs efficiently or cost-effectively.

The advantages of Ethernet wide area transport solutions, including flexibility and cost effectiveness, are becoming more and more apparent to enterprises and small and medium-sized businesses (SMBs). Global Crossing is uniquely positioned to leverage its global Multi Protocol Label Switching (MPLS) network to deliver converged IP solutions including VPLS and IP Virtual Private Networks (IP VPN) via a common platform. The company's EtherSphere™ wide area network solutions meet current needs and can help enterprises and service providers move their businesses into the future.

The Business Value of Ethernet Wide Area Networks

Figure 1 shows a typical Ethernet LAN environment within a single building, serving one or multiple tenants. Figure 2 illustrates how a company might extend Ethernet across geographic regions or around the globe.

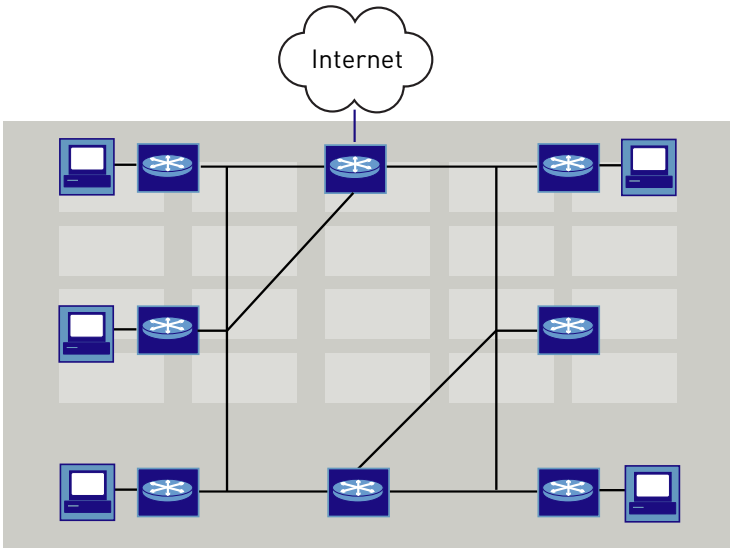

Figure 1: Typical LAN Environment

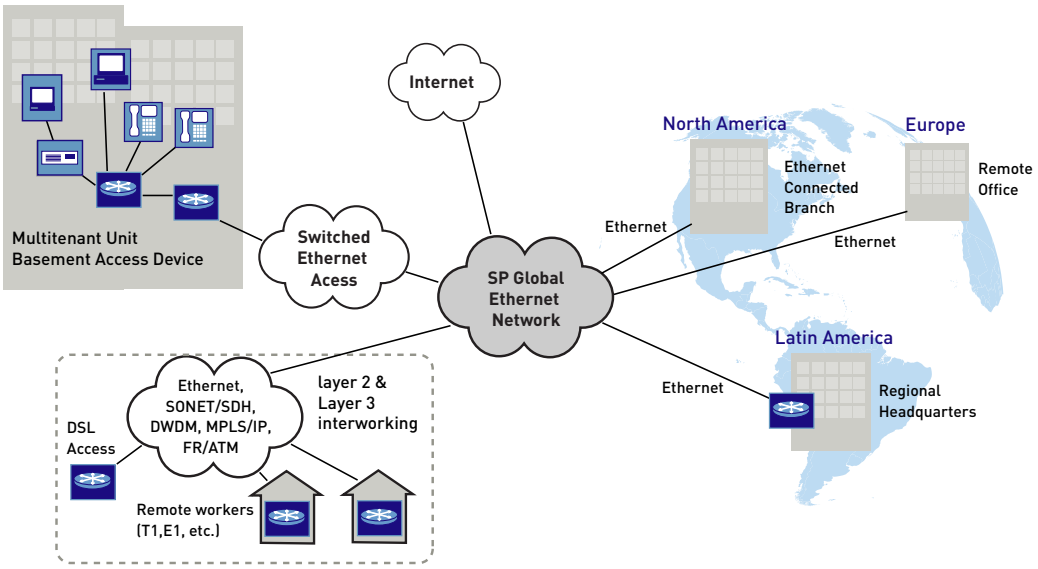

Figure 2: Extended LAN Environment

A wide area Ethernet service is a highly scalable alternative to traditional broadband transport methods, such as Frame Relay, ATM, and Time Division Multiplexing (TDM). However, Ethernet integrates well with these other broadband transport methods, extending the life of existing network investments as needed to cost-effectively connect multiple sites to each other and to the Internet. In addition, because Ethernet wide area transport is IP-compatible, companies can take advantage of IP applications for productivity and business resilience that are difficult to deploy over a TDM or Frame Relay network. These applications include:

- Hosted telephony

- Voice over IP (VoIP)
- Streaming and broadcast video
- Real-time applications, such as collaborative development
- Secure Layer 2 and Layer 3 Virtual Private Networks (VPNs)
- Business intranets and extranets
- Network security
- Storage area networking and hosting
- Disaster recovery

Defining the Ethernet Wide Area Transport Service

Wide area Ethernet transport services may be provided over a dedicated MPLS backbone network to ensure fast, reliable service. The MPLS backbone provides high-speed, region-to-region connectivity and access to the Internet. It also enables a network operations center (NOC) to have visibility into regional systems. An MPLS backbone allows the service provider to improve the customer experience by using a private, managed network to route traffic and to avoid as much of the congestion on the public Internet as possible.

Today, Ethernet wide area network transport solutions are typically provided using variations of Ethernet VPLS. VPLS is the use of Ethernet to recreate a wide area network:

- "Virtual" implies a logical separation of customer traffic.
- "Private" means there is an isolated switching domain.
- "LAN" denotes the Local Area Network that comprises a single bridged domain per customer.
- "Service" means the capability is maintained by the service provider.

VPLS incorporates the best features of IP VPNs, Frame Relay and ATM. While VPLS still relies on the service provider to manage the core of the network (as a Layer 2 technology), it enables the user to manage routing information. It also provides the mesh, hub and spoke and point-to-point technologies of Frame Relay without the excess bandwidth associated with ATM cell tax (protocol overhead).

VPLS is essentially a very large bridged domain, where all Provider Edge (PE) devices act like one big switch. A switch learns the Media Access Control (MAC) addresses of the devices connected to its ports, then stores those MAC addresses in a table that is consulted any time traffic is sent to the switch to facilitate routing.

Traditionally, Layer 2 services from service providers have been point-to-point. With new Layer 2 architectures like VPLS, the multipoint nature of the Ethernet LAN is extended over a WAN. Layer 2 VPNs appeal to subscribers who run their own Layer 3 networks over the WAN and require Layer 2 connectivity from service providers. Layer 2 VPNs also directly support multiprotocol applications (such as IPX, DecNet, Appletalk, IP multicast, and NetBIOS). Layer 3 VPNs appeal to customers who want to use IP connectivity and partner with a service provider at Layer 3 to support site routing and multicast applications within a WAN.

The Ethernet VPLS service:

- delivers Ethernet-based multipoint Layer 2 VPN service.
- enhances Layer 2 VPN scalability (based on the number of geographic sites and number of customers).
- leverages the service provider's existing MPLS-based core network.
- supports operational speeds of 1 Gbps to 10 Gbps.
- uses familiar Ethernet user network interface.

How VPLS Delivers the Business Value

Simplification
VPLS is an appropriate solution for organizations with more than one location, or those with frequent adds, moves, or changes to locations on the network. Because of the automatic discovery of locations on the network through the Border Gateway Protocol (BGP) auto-discovery capability, modifications are easier to make than changes to legacy services in a multipoint-to-multipoint network.

Security
There are many inherent benefits to security inside a Layer 2 network, much like the security that Frame Relay and ATM provide. With a Layer 2 network, the customer retains more routing control over their own network. With VPLS, all that is necessary to control the routing is a change to the Customer Edge (CE) device, which also controls the traffic flow over the same network.

The other key security benefit is the logical isolation of traffic from other customers that a Layer 2 network provides. This level of security is particularly appealing to any enterprises that are bound by federal or industry regulation to provide the highest available level of security for their data.

Service Differentiation
To deliver differentiated services, service provider networks use Quality of Service (QoS) specifications for each packet or frame. This specification can occur in different ways. One way is based on 802.1p Class of Service (CoS) bits in the Ethernet header. The network uses the QoS specification to classify, mark, shape, and police traffic and to perform intelligent queuing. In a wide area Ethernet environment, service providers can implement QoS using several techniques, including classification and marking, traffic conditioning, congestion avoidance, and congestion management.

Flexibility
VPLS enables the flexibility of the LAN to be extended to the WAN by using the any-to-any connectivity. VPLS has the ability to support other non-IP traffic types, such as IPX, SNA, to bridge traffic and higher layer protocols. Additionally, VPLS offers flexible smaller bandwidth increments vs. traditional legacy data networking technologies.

Cost Effectiveness
VPLS wide area network solutions deliver cost efficiencies in several dimensions:

- Low-cost interfaces, for both the customer and the service provider, help contribute

to the cost-effectiveness of the solution.

- Scalable bandwidth provides the customer with the ability to dynamically allocate bandwidth between locations as needed, from a few megabits to a few Gigabits with very few changes to the physical topology. Essentially, a customer can scale an organization and stay within the chosen family of products.

- Allowing customers to burst within their committed information rate (CIR) tier provides freedom to increase traffic without fear of performance degradation induced by full network pipes. This becomes even more important when supported by a usage-based billing component.

- Most enterprise users and service providers have existing staff with in-depth Ethernet knowledge and familiarity with their respective networks. Therefore, little additional training or skills development is needed to implement wide area Ethernet transport solutions such as VPLS.

- Ethernet is easy to manage. From the network perspective, the customer simply connects to the WAN and starts sending traffic to it; similar to setting up a LAN by connecting the computers to the switch, the network does all the learning.

Global Crossing EtherSphere™ Wide Area Network Solutions – Flexibility and Global Reach

Global Crossing's EtherSphere portfolio delivers worldwide Ethernet-based wide area network solutions. EtherSphere's VPLS provides the flexibility needed to decrease network management costs, to provide diversity, and to improve connectivity among geographically dispersed locations. EtherSphere is a complementary service to Global Crossing's MPLS IP VPN service and offers enterprises and service providers a complete solution set for extending network reach. As an Ethernet service, EtherSphere is a readily-understood technology that leverages the knowledge and skills of today's enterprise IT organizations.

Network Reach and Performance
The EtherSphere WAN portfolio is delivered on a common Cisco-powered platform around the globe. Customers experience the same features and capabilities, regardless of location.

Reach –With worldwide service availability in more than 690 cities in more than 60 countries over six continents, Global Crossing's extensive footprint provides more options for wide area network solutions, including EtherSphere, MPLS and SONET/SDH services.

Ethernet Access – In combination with Global Crossing's EtherExtend Flex Access Service, EtherSphere delivers an end-to-end Ethernet solution in more than 150 locations around the world.

Common Global Architecture – Uniform global architecture is applied in all WAN points-of-presence (PoPs) and Inter-PoP connections, using the Cisco 7600 series. The

network is engineered with redundancy and capacity to ensure the optimal performance and survivability expected from carrier-class Ethernet services.

Scalability – As a network designed for converged IP services, Global Crossing's EtherSphere can support a broad range of business applications to improve business efficiency at speeds from 1 Mbps to 2 Gbps (> 2Gbps upon request).

Ethersphere Features and Capabilities

Global Crossing's EtherSphere portfolio reflects Metro Ethernet Forum (MEF) recommendations for service configuration by using a familiar group of service topologies. Additionally, EtherSphere incorporates market-leading features that further improve service efficiency.

Multipoint-to-Multipoint: Provides any-to-any multi-point data connectivity where all sites appear on same Ethernet bridged domain. (Figure 3)

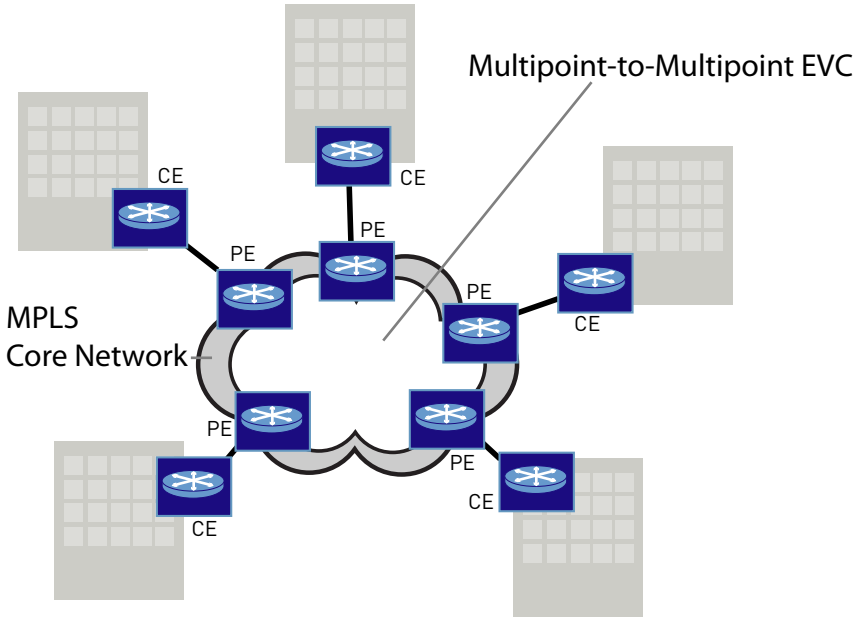

Figure 3: Multipoint-to-Multipoint Topology

Point-to-Point: Provides site-to-site connectivity similar to Ethernet private lines. (Figure 4)

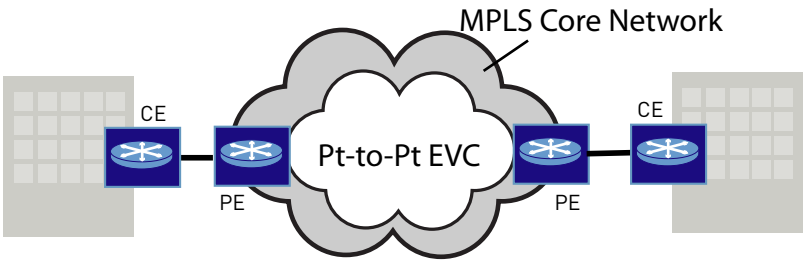

Figure 4: Point-to-Point Topology

Point-to-Multipoint: Provides hub and spoke site connectivity for service multiplexing, allowing more than one Ethernet virtual connection at the user-to-network interface; similar to traditional private line fan-out service. (Figure 5)

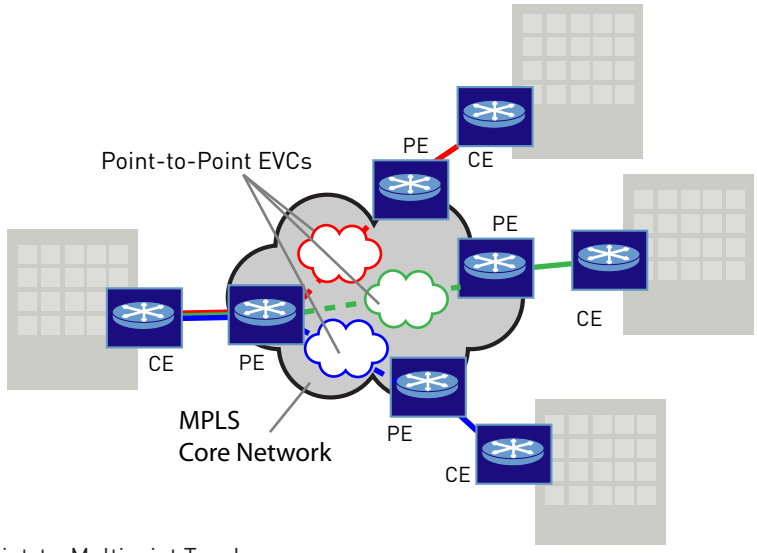

Figure 5: Point-to-Multipoint Topology

Six Classes of Service : EtherSphere offers an industry-leading six Classes of Service that enable users to prioritize traffic to maximize bandwidth use and efficiency.

Service Class	Description	Service Type
Premium Plus	Traffic that has significant sensitivity to delay, loss, and jitter must be protected at the expense of all lower priority traffic.	Real-time data traffic: • VoIP/Video
Premium	Traffic that has also has significant sensitivity to delay, loss, and jitter that must be protected at the expense of all lower priority traffic, but will be dropped when network is congested in favor of Premium Plus traffic.	Video
Enhanced Plus	Traffic that has moderate SLA bounding delay and loss and is distinguishable from traffic that is Best Effort.	Business critical data traffic (e.g., SAP, ERP and CRM)
Enhanced	Traffic has moderation SLA bounding delay and loss and is distinguishable from traffic that is Best Effort, but traffic will be dropped when network is congested in favor of Enhanced Plus traffic.	Intranet Applications; e.g., document management; Web applications
Basic Plus	Normal data traffic with best effort delivery traffic, including a lightweight SLA based on delay and loss.	Data Traffic (high); e.g., Email
Basic	Normal data traffic with best effort delivery traffic, including a lightweight SLA based on delay and loss, but traffic will be dropped when network is congested in favor of Basic Plus traffic.	Data Traffic (low); e.g., File sharing

Flexible Billing : While most VPLS offers require committed bandwidth, Global Crossing's EtherSphere provides more flexibility by offering a usage-based billing component that accommodates dynamic scalability of the service, making it an appropriate choice for backup and disaster recovery implementations.

Superior Customer Experience

Many companies talk about "customer service," "customer satisfaction," and the "customer experience" as ways to differentiate themselves from their competitors. Global Crossing takes a different and highly unique approach: It asks customers to define what the customer experience means to them and then implements changes, programs and technology based on this input and collaboration.

From initial delivery through the life of the service, Global Crossing's approach to the customer experience is second to none. The vision is simple: to delight our customers. The company offers customers visibility and control coupled with world-class customer support. It is focusing much of its innovation on tools that will enable customers to access real-time information, analyze network performance on-the-fly, and instantaneously execute business-impacting decisions. Recent enhancements to an overall improved customer experience with Global Crossing include:

Global Crossing Service Express™ – Global Crossing's best-in-class service delivery program means EtherSphere services will be delivered ready for use on the dates expected. Dedicated project managers guide each implementation to its successful completion.

uCommand® – Global Crossing's electronic portal directly provides 24X7 online access to provision, troubleshoot, control, monitor, support, and manage Global Crossing services and network.

Summary

Global Crossing recognized early on that customers wanted the benefits of Ethernet in wide area networking with true global reach to achieve a flexible and scalable approach to network extensibility. EtherSphere inherently meets this market need. Because all locations on the WAN appear to be on the same domain, enterprise IT teams can leverage current skill sets and resources. Further, as a Layer 2 service, EtherSphere provides privacy and security while giving the customer full routing control, supporting non-IP protocols.

Global Crossing also understands that enterprises seldom use a single technology to interconnect all sites on the network. By offering both MPLS IP VPN and Ethernet WAN transport solutions, Global Crossing delivers a wide range of flexibility to its customers. If customers do not want to manage their own routing, Global Crossing has a long history of providing managed Layer 3 or IP VPN services. If customers prefer to self-manage Ethernet WANs with controlled routing and bandwidth allocations on a much more granular basis, they have that option as well. Taking this one step further, Global

Crossing enables enterprises to combine both network management approaches, supporting Layer 2 and Layer 3 coexistence to ensure that the optimal transport solution is available to meet the needs of a specific application or location.

Global Crossing is an active member of the Metro Ethernet Forum (MEF) and supports emerging standards while maintaining the flexibility necessary to meet unique requirements for specific regions, countries and customers. By working with the MEF, Global Crossing is well prepared to help customers determine what mix of technologies is best suited to meet their particular needs around the world. The company's network, architecture and deployment methodology is easily adaptable to a wide variety of situations. Global Crossing continually invests in its network to ensure that its customers have the options they need to meet current and future business demands.

Focusing on Quality of Experience

Ultimately, the focus is on the end user's Quality of Experience, which is the critical success factor for everyone involved in the service delivery chain. Service providers must maintain compliance with evolving scalability, reliability and QoS standards, while operating intelligently and delivering the immediate benefits of Ethernet.

Moving forward, Global Crossing envisions a ubiquitous transport network that supports a wide range of Ethernet topologies (Point-to-Point, Point-to-Multipoint and Multipoint-to-Multipoint) and services (QoS, QnQ, Converged Services, Layer2 and Layer 3 coexistence, etc.). As the rate of adoption for end-to-end Ethernet transport medium accelerates, Global Crossing's MPLS-based infrastructure gives enterprises the advantage of Ethernet and provides the flexible bandwidth increments, scaling and service-level support required to meet evolving demands.

Customers can deploy a flexible solution to meet the specific needs of global applications. Key capabilities include:

- IP routing control and the benefits of MPLS.
- support for legacy non-IP protocols.
- the appearance of all sites on a single Ethernet LAN.
- ease of implementation.
- More efficient use of bandwidth.

For more information about Global Crossing's EtherSphere services or other wide area transport solutions, visit www.globalcrossing.com or contact your Global Crossing Account Manager.

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