

## Extending up to 10-Gbps Metro Ethernet Services for SONET/SDH Networks

### Growing Market Opportunity

As enterprises and consumers worldwide continue to adopt IP-based applications, service providers are rushing to meet customer demand for Ethernet services – and to capture a larger share of this lucrative and growing market. Recent research from Infonetics predicts that worldwide revenue for Ethernet services will reach nearly US\$22.5 billion by 2009, including US\$13 billion between 2006 and 2009 in the United States alone. Faced with these trends, the question for service providers is no longer whether to evolve to next-generation IP and Ethernet service networks, but how, and how quickly. Although most service providers already have standardized on IP/Multiprotocol Label Switching (MPLS) in core networks, in the access and aggregation segments of the network many carriers still use a variety of technologies.

Traditionally, service providers have had two options for provisioning metropolitan (metro) IP and Ethernet services. They can build out new IP overlay networks on top of existing time-division multiplexing (TDM) metro footprints, or they can adapt SONET or SDH infrastructures to carry Ethernet services. Many carriers already have deployed new Metro Ethernet networks in some areas, but this strategy does not deliver ideal results in all markets. In smaller markets with low density and moderate demand, the revenue that carriers can realize from Ethernet services may not justify the costs of building a new native IP network footprint. Service providers that choose to build out new IP networks in all markets may take much longer to roll out new service offerings and may lose valuable market share to competitors that are able to bring new service to market more quickly.

### Extending Metro Ethernet Services over SONET/SDH Networks

Fortunately, service providers need not lock themselves into a single overarching Metro Ethernet strategy. Instead, they can invest in new IP overlay networks in the largest markets while delivering Ethernet services to smaller markets over existing SONET/SDH footprints using multiservice provisioning platforms (MSPPs). By delivering Ethernet services to small and midsize markets over an existing SONET/SDH footprint, service providers can extend Ethernet services to all markets, more rapidly begin to capture revenue for new IP-based services, and avoid having to make enormous capital outlays in markets that are unlikely to quickly return those investments. In fact, many service providers find that an MSPP-based Ethernet solution is an ideal starting point for transitioning to an IP overlay network, and ultimately, to a next-generation all-IP network. Of course, this strategy works best when service providers partner with a vendor that offers an integrated solution that can incorporate both MSPP and next-generation IP approaches.

Using MSPPs to extend Ethernet over SONET/SDH networks in small and midsize markets makes sense from both a business and a technical perspective. From a technology standpoint, MSPPs can deliver all of the Metro Ethernet services and applications that a native IP infrastructure can provide – as well as conventional TDM services – in a single platform. Even more important, a SONET or SDH MSPP allows service providers to provision Ethernet as a true carrier-class service, with all of the traffic protection and resiliency features that service providers expect.

From a business perspective, an MSPP approach to Ethernet services delivers substantial savings over an IP network build-out in some markets. Delivering Ethernet services through SONET/SDH infrastructures allows carriers to take a measured, evolutionary approach to next-generation IP services. Carriers can begin earning revenue from Ethernet services virtually immediately using an existing footprint, and can phase in native IP infrastructure over time, as it makes sense for each market. By working with a vendor that can support both MSPP and all-IP approaches, service providers also have a clear, sensible migration path toward the ultimate goal of an end-to-end IP Next-Generation Network (IP NGN).

Of course, when considering an Ethernet-over-SONET/SDH strategy, service providers have many MSPP options. In order to realize the full capital savings and operational advantages of delivering Ethernet over a deployed SONET/SDH footprint, carriers must deploy MSPPs that meet essential requirements for service capacity, flexibility, resiliency, interoperability with IP networks, and manageability. Service providers that base their Ethernet-over-SONET/SDH strategy on the wrong multiservice platform may realize much different results in terms of the effectiveness, the speed to market, and the overall profitability of this approach.

### **Requirements for Delivering Metro Ethernet Services**

Service providers delivering Ethernet to small and midsize markets over deployed SONET/SDH footprints can realize substantial advantages – but only if the MSPPs supporting this strategy meet several fundamental requirements. To successfully extend Metro Ethernet services over SONET/SDH networks, service providers must use MSPPs that:

- Provide the density and the capacity to scale and perform service upgrades as demand grows
- Support all Metro Ethernet services and network topologies that customers demand
- Meet all appropriate industry certifications
- Support efficient provisioning Ethernet over SONET/SDH networks
- Deliver end-to-end functions and interoperability
- Support strategies for efficient bandwidth usage
- Support the provisioning of both point-to-point Layer 1 and more advanced Layer 2 Ethernet services
- Allow for streamlined, comprehensive management
- Are widely deployed, proven solutions

### **Scaling with Customer Demand**

Customer applications and demands change constantly, so service providers need a network infrastructure that can quickly and cost-effectively adapt to new requirements. When delivering Ethernet over a SONET or SDH footprint, carriers need MSPPs that provide the density and capacity to allow continuous network scalability as bandwidth requirements grow. To ensure optimal scalability and provide a long-lasting solution, MSPPs should support:

- High-bandwidth Ethernet modules scalable to 10G (OC-192 bandwidth)
- High port counts
- Multiple Ethernet line rates (10/100/1000 Mbps) with a single card
- Pluggable optics to support multiple line rates and services with fewer line cards
- Advanced aggregation capabilities to accommodate all current and future network services

## Delivering All Metro Ethernet Services

The most basic requirement for any Ethernet-over-SONET/SDH strategy is that the MSPPs at the heart of this approach can deliver all the Ethernet services customers demand. That means that the MSPP must support the full range of network topologies that customers may require, including point-to-point, point-to-multipoint, and multipoint-to-multipoint Ethernet networks. For optimal flexibility, scalability, and bandwidth efficiency, service providers also should choose a platform that is capable of supporting dedicated or shared Ethernet services.

The Metro Ethernet Forum (MEF) certifies MSPPs for four different types of “Carrier Ethernet” solutions, collectively referred to as the MEF9 certification. These include:

- *E-LINE Ethernet Private Line (EPL)* – EPL services, consisting of one point-to-point connection per port, provide simple, straightforward Ethernet connectivity ideal for basic network segments such as connecting two business sites or backhauling wireless Ethernet traffic from a cell site.
- *E-LINE Ethernet Virtual Private Line (EVPL)* – EVPL services allow carriers to multiplex point-to-point Ethernet connections. Service providers can use EVPL services to provide connectivity among headquarters and branch locations for a small or medium-sized company, to aggregate several types of traffic in a metro network, or simply to support multiple point-to-point connections per port.
- *E-LAN Ethernet Private LAN (EPLAN)* – EPLAN services provide dedicated connectivity for multipoint LANs. Carriers might use EPLAN services for enterprise WANs, or for video or voice-over-IP (VoIP) networks.
- *E-LAN Ethernet Virtual Private LAN (EVPLAN)* – With EVPLAN services, each port may support multiple VLANs, as well as both point-to-point and multipoint connections. Carriers can use EVPLAN services to multiplex enterprise WAN connections with other services, or to support multiple services (such as video, VoIP, and data connectivity) per port.

To ensure the greatest flexibility for metro services, carriers also should choose an MSPP that supports a broad range of non-Ethernet services that customers may require. In addition to basic TDM services, the most versatile metro networks are built with MSPPs that can support services such as cellular backhaul traffic and efficient multicast capabilities.

Service providers that base Ethernet-over-SONET/SDH strategies on platforms that can support only a subset of these services risk losing new revenue and business opportunities to carriers with more flexible metro infrastructures.

## Industry Certifications and Standards

Choosing MSPPs that have met industry standards such as MEF9 offers several advantages. Carrier Ethernet-certified platforms save service providers substantial costs for in-house compliance testing, while accelerating new service deployments. Carriers using MEF9-certified platforms also can be confident that these network segments will fully interoperate with other Carrier Ethernet technologies and networks.

In addition to MEF9 certification, service providers should choose MSPPs that have been certified under the MEF14 standard to support end-to-end quality of service (QoS). A MEF14-certified MSPP is pretested and certified to provide consistent QoS capabilities throughout core, access, aggregation, and edge networks, and remote customer sites. This capability is essential for delivering delay-sensitive services such as VoIP, cell traffic, and IP video. As with MEF9-certified

Ethernet services, using a MEF14-certified platform saves carriers significant cost and time commitments by eliminating the need for most in-house compliance testing.

### **End-to-End Interoperability**

Supporting consistent QoS capabilities is only one facet of ensuring end-to-end interoperability. For many carriers, MSPPs deployed in a SONET or SDH access or aggregation network may be operating between an IP/MPLS core network and a Layer 2 multipoint customer LAN. In order to extend Ethernet services over the SONET/SDH footprint, the MSPP must be able to fully interoperate with each of these environments.

To ensure end-to-end interoperability, service providers should choose MSPPs from a vendor that is capable of building and testing solutions in an end-to-end fashion – rather than choosing platforms from a provider with expertise in only IP or only SONET/SDH services. Otherwise, carriers must perform extensive interoperability testing. And, if a problem arises during testing, service providers will need to work with multiple vendors to identify and resolve the problem.

Carriers also should use MSPPs from a vendor that offers a broad portfolio of interoperable MSPP options. Service providers may require a range of solutions, from small platforms designed to serve as customer premises equipment to full-featured, high-density metro access and aggregation platforms. Choosing a vendor that offers solutions at all scales means that MSPPs can be implemented and managed in the same way, using common tools and interfaces, regardless of where they are deployed in the network.

### **Single-Vendor Approach**

Service providers should consider the advantages of choosing MSPPs from the same vendor that provides the native IP platforms in the network. By working with a single provider for both IP and SONET/SDH solutions, carriers can ensure that the same QoS tools and capabilities extend across both native IP routers and SONET/SDH platforms – including end-to-end IP service-level agreement (SLA) monitoring tools or operations, administration, and maintenance (OA&M) capabilities. Using a single IP and SONET/SDH network provider also reduces operational costs by providing a single-vendor point of contact if any problem with any segment of the service network occurs.

An added benefit of working with a single network provider that can support both MSPP and next-generation IP solutions is that MSPP-based Ethernet solutions can be fully converged over time with the service provider's all-IP networks. When service providers work with a provider that has designed MSPP solutions to integrate with an IP NGN, they can continually augment SONET/SDH-based Ethernet approaches with new IP technologies and processes, innovative multiservice solutions, a straightforward convergence strategy, and embedded intelligence and security throughout all layers of the network. As a result, a vendor that can support integrated MSPP and all-IP approaches can deliver ideal solutions for any stage in a service provider's evolution to an IP NGN.

### **Bandwidth Efficiency**

Any MSPP deployed as part of an Ethernet-over-SONET/SDH strategy must support the latest techniques and technologies for delivering Ethernet efficiently. To deliver mission-critical customer data, VoIP, and video applications, the MSPP should support advanced QoS capabilities. However, to provision even basic Ethernet services efficiently, MSPPs should support:

- *Generic Framing Protocol (GFP)* – GFP provides a universally operable means of mapping Ethernet over SONET or SDH. MSPPs that employ GFP help provide end-to-end interoperability by ensuring that IP traffic is provisioned in a way that can be supported by any GFP standards-based platform across the network.
- *Virtual Concatenation (VCAT)* – VCAT allows service providers to provision Ethernet circuits in increments of 10, 100, or 1000 Mbps, as opposed to the standard bandwidth units used in SONET and SDH, which were designed for fixed-bandwidth voice circuits. MSPPs that support low-order VCAT and high-order VCAT let service providers provision circuits in 1.5- or 50-Mbps increments, respectively, and customize Ethernet connections to match customers' bandwidth needs.
- *Link Capacity Adjustment Scheme (LCAS)* – MSPPs that support LCAS let service providers dynamically adjust the bandwidth of a circuit with no effect on existing service. As a result, carriers can fulfill customer requests for bandwidth upgrades in minutes, instead of requiring days or weeks as with traditional point-to-point Ethernet services.
- *Resilient Packet Ring (RPR)* – Service providers supporting Layer 2 Ethernet services need techniques to guarantee the uptime of multipoint Ethernet circuits just as effectively as SONET and SDH protection schemes, without requiring the same reserve bandwidth. (Because SONET/SDH protects traffic at the physical layer, carriers must maintain a "reserve" circuit for all "working" circuits, meaning that half of the available bandwidth in the network is rarely if ever used.) MSPPs that support RPR use physical-layer alarm information and Layer 2 communications to detect failures and restore service with the same sub-50-ms resiliency as SONET/SDH protection – allowing carriers to make much more efficient use of available bandwidth.

### **Supporting Multiple Ethernet Provisioning Strategies**

Service providers deploying Ethernet services over a SONET/SDH network need long-lasting solutions that can adapt to changing customer demands. For optimal flexibility and scalability, carriers should choose MSPPs that can support both Layer 1 and Layer 2 Ethernet services. Whether rolling out basic point-to-point EPL services with guaranteed SLAs or offering customers more flexible Layer 2 multipoint options, carriers can reduce capital and operational costs by choosing a solution that can support either approach with a single platform. Such solutions allow carriers to provision either Layer 1 or Layer 2 Ethernet services with a simple line card change (instead of a costly platform overhaul) and manage both types of services using common processes and a common management interface.

By choosing an MSPP with Layer 1 and Layer 2 flexibility, service providers also can take an evolutionary approach to the roll-out of new Ethernet services. Carriers can begin capturing market share by offering basic point-to-point Ethernet connectivity, and can migrate some segments of the network to more flexible Layer 2 services – and ultimately, to all-IP next-generation architectures – over time, to meet changing customer demand.

### **Managing the Network**

The ideal MSPP solution should support the provisioning and management of all network services – including TDM, point-to-point Ethernet, and Layer 2 multipoint Ethernet services – with a single management solution that is fully interoperable with Transaction Language 1 (TL1)-based third-party management systems. Carriers also can benefit from the ability to manage all IP and SONET/SDH network elements with a single management platform and a common command-line interface (CLI). By choosing a platform that provides streamlined, end-to-end manageability,

service providers also can employ simplified A-to-Z provisioning tools that represent a substantial operational cost savings over conventional network circuit-provisioning techniques.

### Using a Proven Solution

Service providers cannot afford to risk their Ethernet strategy on an unproven multiservice platform. Carriers should ensure that the MSPP vendor they choose has extensive experience with Metro Ethernet and IP services, as well as SONET/SDH technologies. The ideal vendor should have a large installed base in the field, and should have deployed MSPPs to a wide range of customers in diverse markets and environments.

### Extending Ethernet over SONET/SDH Networks with Cisco MSPPs

Delivering Ethernet services over a deployed SONET/SDH footprint can provide enormous capital savings and operational efficiencies in many small and midsize markets. However, to successfully apply this strategy, service providers need MSPPs that can deliver all services customers may require, while providing proven service capacity, interoperability, scalability, and manageability.

Cisco® provides a family of MSPPs, Metro Ethernet platforms, and network management solutions that meet all the requirements for extending Ethernet services over SONET/SDH networks, and can help service providers achieve all the advantages of this approach.

### Cisco ONS Solutions

The Cisco ONS Family of MSPPs provides scalable, carrier-class solutions for delivering the full range of Ethernet services, network topologies, and customer applications. These MEF9- and MEF14-certified platforms were designed and tested by Cisco to interoperate as an end-to-end solution, based on extensive engineering and field experience in both IP and SONET/SDH networks. Because Cisco is an industry leader in IP networking technology and one of the largest global providers of SONET/SDH platforms, Cisco MSPPs have become the first choice in hundreds of the world's largest and most successful service networks.

The Cisco ONS Family includes the following optical platforms and Ethernet interface cards:

- *Cisco ONS 15454 Multiservice Provisioning Platform* – The industry-leading Cisco ONS 15454 MSPP combines SONET or SDH with Layer 2 and Layer 3 packet-processing functions and intelligent IP and storage functions in a single, cost-effective platform. The solution allows service providers to eliminate the costs and complexity of maintaining multiple overlay networks for each service type, and extend advanced IP services as far as the existing SONET or SDH infrastructure reaches. At the same time, enterprises can use the Cisco ONS 15454 MSPP to aggregate data, voice, video, and storage services into a single optical infrastructure, simplifying network management and laying a robust foundation for the applications of the future.
- *Cisco ONS 15310-MA SONET Multiservice Platform* – Deployed as a metro access or edge device, the Cisco ONS 15310-MA provides much of the scalability, flexibility, and grooming and aggregation capabilities of the Cisco ONS 15454 MSPP in a smaller, 6-rack-unit (6RU) platform.
- *Cisco ONS 15310-CL SONET Multiservice Platform* – Often referred to as a Micro-MSPP, the Cisco ONS 15310-CL is an economical, 1RU high-delivery multiservice SONET platform optimized for linking LAN equipment in the customer premises.

- *Cisco ONS 15305 Multiservice Customer Access Platforms* – The Cisco ONS 15300 Series includes two smaller-scale solutions that extend the intelligence and functions of Cisco ONS 15454 platforms to the network edge, providing an ideal solution for the customer premises in multiservice SDH networks.
- *Cisco ONS CE-Series Carrier Ethernet cards* – Cisco Carrier Ethernet interface cards, multirate and scalable up to 10-Gbps bandwidth, provide fast, efficient mapping of Ethernet onto SONET or SDH payloads for point-to-point connections. The cards allow carriers to provision point-to-point Ethernet circuits the same way they historically provisioned TDM voice circuits, while employing modern techniques to improve the efficiency of delivering Ethernet over circuit-switched infrastructures. The cards are available for Cisco ONS 15454 and 15310 platforms.
- *Cisco ONS ML-Series Multilayer cards* – Cisco Multilayer Ethernet interface cards, multirate and scalable up to 10-Gbps bandwidth, bring unparalleled Layer 2 switching and Layer 3 routing intelligence to service provider networks. The cards allow service providers to deploy intelligent multipoint networks over multiservice SONET and SDH infrastructures, maximize network bandwidth usage, and support advanced IP and Ethernet applications, including services that require end-to-end QoS. The cards are available for Cisco ONS 15454 and 15310 platforms.

These MSPP platforms and Ethernet interface cards can help service providers deliver a compelling, cost-effective Ethernet offering in smaller markets. However, these solutions also offer native intelligence and interoperability with Cisco next-generation Layer 2 and Layer 3 IP networking products. As a result, Cisco ONS solutions can provide a comprehensive, lasting solution. As Cisco continues to deliver new networking capabilities and features to MSPP and all-IP environments, carriers can use Cisco MSPP solutions as both an effective Ethernet solution for smaller markets in the short term, and ultimately, as the ideal bridge to an end-to-end IP NGN.

### For More Information

For more information about Cisco MSPP and Cisco Metro Ethernet solutions, visit <http://www.cisco.com/en/US/products/hw/optical/index.html> or contact your local Cisco account representative.



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