Leveraging GMPLS to Deliver End-to-End Ethernet Services

Leveraging GMPLS to Deliver End-to-End Ethernet Services

In order to make Ethernet services ubiquitous, service providers must be able to offer standardized services that are scalable, reliable and manageable with the quality of service (QoS) that their subscribers demand. These requirements place significant demands on network operations and service provisioning.

Service providers today are increasing their deployments of Ethernet services, and Ethernet-based access to IP services, while they also continue to offer high-margin TDM services. Due to the diversity of services offered, service providers have until recently used purpose built or overlay networks that rely on a plethora of networking technologies such as SONET/SDH, Frame Relay, ATM, IP, MPLS and Ethernet. As subscribers migrate to IP-based applications, and as service providers transition more services to IP (e.g., VoIP and IPTV), "IP-friendly" Ethernet has become the ubiquitous service delivery technology that can be supported over any transport network.

Because service providers are at various stages of migration from their TDM-based networks to Ethernet as a service delivery technology, packet services must co-exist with TDM services, and may need to be transported over SONET, SDH, wavelength, Ethernet, or IP/MPLS networks. This blend of different services and transport options introduces unique challenges in operations, administration and maintenance (OAM) because Ethernet/IP services are provisioned and deployed quite differently than TDM services.

Packet-based Ethernet services, unlike TDM services, incorporate the concepts of bandwidth oversubscription, a committed information rate (CIR), and the ability to offer multiple services (service multiplexing) over a single port using Ethernet virtual connections (EVCs). Because of these differences, service providers familiar with TDM service provisioning need to adopt a new service provisioning paradigm to deploy Ethernet-based access to IP services as well as the range of E-Line (point-to-point) and E-LAN (multipoint) Ethernet services.

For example, to set up an end-to-end Ethernet service, the service provider might need to provision several network topologies:

- Setting up Low-order SONET (VT 1.5 / 1.5 Mbps) or high-order SONET (STS channels in increments of 50 Mbps) channels, or aggregating multiple low-order or high-order SONET channels into a virtual concatenation group (VCG) to match the bandwidth needs for the services
- Configuring Ethernet switches to support a specific bandwidth (CIR) and class of service (CoS)
- Aggregating multiple wavelengths over the WDM network

Provisioning an end-to-end service over a multi-transport network is difficult and costly because most service providers have specialized provisioning and management systems for each type of network: it may be necessary to involve several different organizations and systems to provision just one end-to-end service – a process that can take weeks.

The variety of transport networks that may be involved in an end-to-end service also makes it very difficult to make the most efficient use of available bandwidth. For example, if a portion of the network supports only high-order SONET channels, the service provider would have to use 50Mbps of SONET bandwidth to provision a 0Mbps Ethernet service, stranding 30Mbps of capacity that could be used for other services.

About GMPLS

Generalized Multi-Protocol Label Switching (GMPLS) is a common networking control plane that benefits service providers in the creation, management and maintenance of services and network infrastructure. GMPLS is a superset of MPLS that uses the same basic technologies as MPLS, but is better suited for SONET/SDH, WDM and Ethernet networks in addition to IP networks.

Unlike MPLS, GMPLS allows for the separation of control and data channels. This is particularly important to support for widely deployed transport technologies such as SONET/SDH, where network control traffic is sent via the SONET/SDH Data Communications Channel (DCC) that is specifically designed for such usage. This enables the SONET/SDH channels to be fully utilized for subscriber traffic rather than sharing the bandwidth with the service provider's network control traffic.

While traditional MPLS supports unidirectional service path creation, GMPLS supports the establishment of bidirectional paths, resulting in increased service velocity and a reduced amount of bandwidth required for network control traffic.

When a service request is initiated at one of the service end points, GMPLS searches for the path between it and the other service endpoint(s) to minimize the number of connections while satisfying network operator policies and constraints. These constraints can include avoiding or including specific network nodes and optical links, meeting certain delay and delay variation SLA objectives, or using specific topologies such as specific SONET/SDH rings.

The entire process takes place in a matter of seconds, enabling near-real-time service provisioning. After setup, GMPLS continually monitors the paths over which the services are being delivered to react to and repair changing network conditions such as fiber cuts or other network outages. Additionally, the network operator may require GMPLS to select protection paths to take pre-provisioned (strict) routes to traverse particular network nodes or optical connections or allow GMPLS to select the protection path based on some network policy constraints.

GMPLS and Ethernet – A Perfect Match for Service Flexibility with Transport Technology Independence

GMPLS facilitates and improves network and service scalability, reliability and OAM. It provides bandwidth management and traffic engineering (QoS) capabilities commonly associated with MPLS, but with the ability to deliver these capabilities end-to-end over any type of transport network. By hiding the inherent differences in the various transport technologies and their physical and logical topologies, GMPLS simplifies end-to-end services provisioning and management for TDM and Ethernet services.

For example, let's assume the provider wants to provision an Ethernet service that begins on an Ethernet-over-fiber connection, traverses a SONET/SDH metro network, then traverses to a DWDM long-haul network to, another SONET/SDH metro network and ends with an Ethernet connection at the destination (Figure 1). In this case, GMPLS would set up an end-to-end service using a VLAN ID label for the Ethernet network, followed by a Channel label for the SONET/SDH network, followed by a Wavelength label for the WDM network, ending with a VLAN ID label.

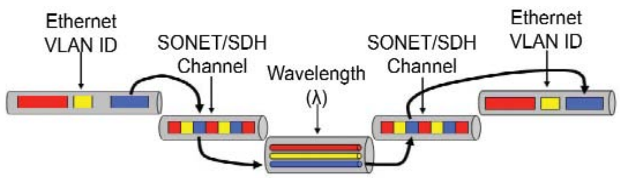

Figure 1. GMPLS labels used to set up an end-to-end Ethernet service

GMPLS offers dynamic bandwidth allocation by automatically selecting the most efficient optical or wavelength connections for an end-to-end service, and it greatly reduces provisioning time and costs by implementing a common model regardless of the transport networks involved. GMPLS also offers the potential for cost-effective, point-and-click multipoint (E-LAN) services that would have previously been prohibitively complex and expensive to deploy over a multi-transport infrastructure.

In addition to easing provisioning, GMPLS helps eliminate stranded bandwidth. It can be used to determine if excess bandwidth is available in a given SONET/SDH channel and then multiplex additional Ethernet services to optimize use of the remaining bandwidth.

Conclusion

Today, GMPLS simplifies end-to-end service provisioning of TDM, Ethernet and optical wavelength services, enabling service providers to provision a new service in minutes instead of days. There is no need to learn the underlying infrastructure of GMPLS set of technologies, since it allows provisioning via existing network and element management systems. Properly implemented, GMPLS won't even require operational changes, so it requires no new training.

GMPLS has now also been proposed as the control plane used for IEEE 80 .1ah Provider Backbone Transport (PBT) – also known as Provider Backbone Bridging – Traffic Engineering (PBB-TE). PBT/PBB-TE is the basis for improving scalability, reliability and manageability in next-generation carrier Ethernet transport networks. With PBB-TE, service providers deploying PBT will realize the same benefits GMPLS provides for Ethernet and TDM services over SONET/SDH and WDM networks. As service providers search for better methods to rapidly deploy new services such as Ethernet while migrating to more efficient packet network infrastructures, GMPLS will play an even larger role in the solution.

Force10 Networks, Inc.
350 Holger Way
San Jose, CA 95134 USA
www.force10networks.com

408-571-3500 PHONE
408-571-3550 FACSIMILE

WP34 309 v1.0