Cisco Catalyst 6880-X Applications in Service Provider and Metro Ethernet Networks

White Paper

Author: Amit Singh

June 2013

Introduction

Service providers are facing vital business issues as the industry moves from service portfolios based on circuit-switched voice and time-division multiplexing (TDM)/plesiochronous digital hierarchy (PDH) based transport to converged networks employing Ethernet, Multiprotocol Label Switching (MPLS), and IP. One problem is creating revenue growth while maintaining profit margins. This can not be achieved merely by substituting higher-speed IP services for existing voice, T1/E1, and Frame Relay services. New enterprise service offerings based on Ethernet and MPLS provide capabilities to help resolve service providers' revenue and profit margin dilemmas.

Carrier Ethernet services built onthe EthernetLine (E-Line) and EthernetLAN (E-LAN) service types defined by the MetroEthernet Forum (MEF) provide the foundation for service revenue growth.They support a broad range of value-added services that can be sold at higher price points. When combined with MPLS technologies, Layer3 MPLSVPN-based services support additional service offerings and help reduce total cost of ownership (TCO), directly addressing service providers' profitability concerns.

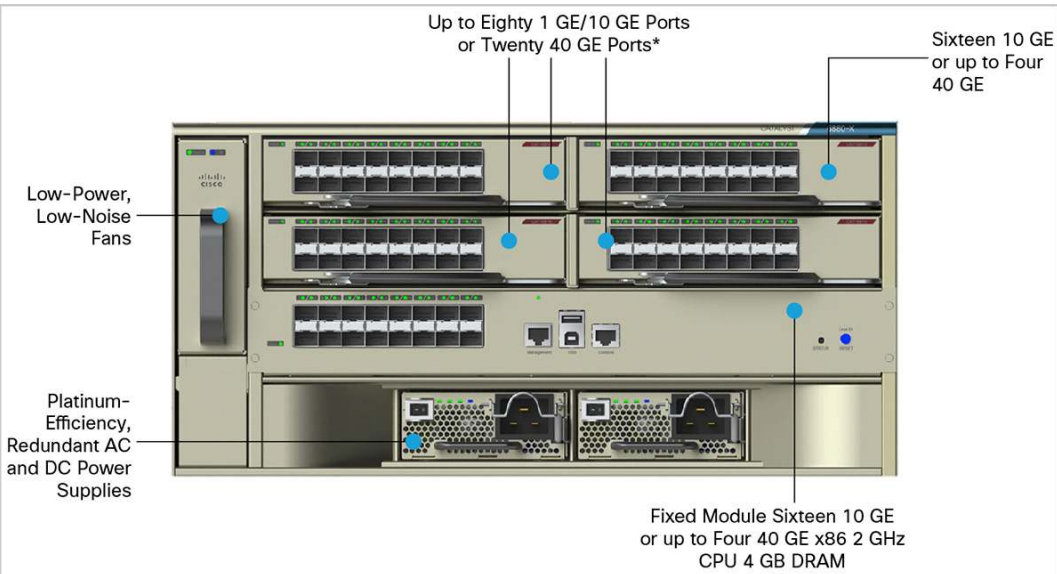
This paper describes the newly launched Cisco® Catalyst® 6880-X Switch and its applications in a Carrier Ethernet/MPLS network.

The Catalyst 6880-X Switch is a next-generation, Layer 2 and Layer 3 fixed-configuration switch built for enterprise MPLS, service provider, and Carrier Ethernet networks (Figure 1).

Based on the industry-leading Cisco Catalyst 6500 Series Supervisor Engine 2T technology,the Catalyst 6880-X is a space - and power-optimized Ethernet accesss witch that helps to cost-effectively enable hardware-based triple-play and VPN services for Ethernet-to-the-home(EttH), Ethernet-to-the-business (EttB), and DSLAM aggregation deployments.

By providing highly advanced hardware-accelerated MPLS, multicast, and IPv6 features for Carrier Ethernet access, the Catalyst 6880-X offers scalable and service-rich Gigabit Ethernet accessf or both fiber and copper deployments.

Figure 1. Catalyst 6880-X Chassis with Fully Populated Ethernet Cards



Advantages

The Cisco Catalyst 6880-X Switch enhances the industry-leading Carrier Ethernet solution portfolio from Cisco by extending hardware-enabled MPLS, quality of service (QoS), multicast, and IPv6 features into Ethernet access and aggregation networks.

The Catalyst 6880-X is capable of providing all of the services on day one, as it uses the Supervisor Engine 2T hardware and software DNA.

Scalability and Flexibility

- Operational efficiency for Carrier Ethernet access and aggregation networks requiring a small, compact form factor with lower power consumption.
- Performance is optimized for service provider access and aggregation deployments with 800-Gbps switching capacity and 300mpps for IP traffic.
- High-density Ethernet support: With up to eighty 1 Gigabit Ethernet or 10 Gigabit Ethernet ports or twenty 40 Gigabit Ethernet ports, all fiber-based, the Catalyst 6880-X can aggregate fiber-to-the-x (FTTx) customers who require 1 Gigabit Ethernet and 10 Gigabit Ethernet connectivity and provide 40 Gigabit Ethernet uplinks to the core.
- High-performance CPU for Layer 2 and Layer 3 protocols provides convergence and stability.
- Optimized switching capabilities and scalable IP routing/MPLS capabilities are delivered in hardware without performance impact (Table 1).

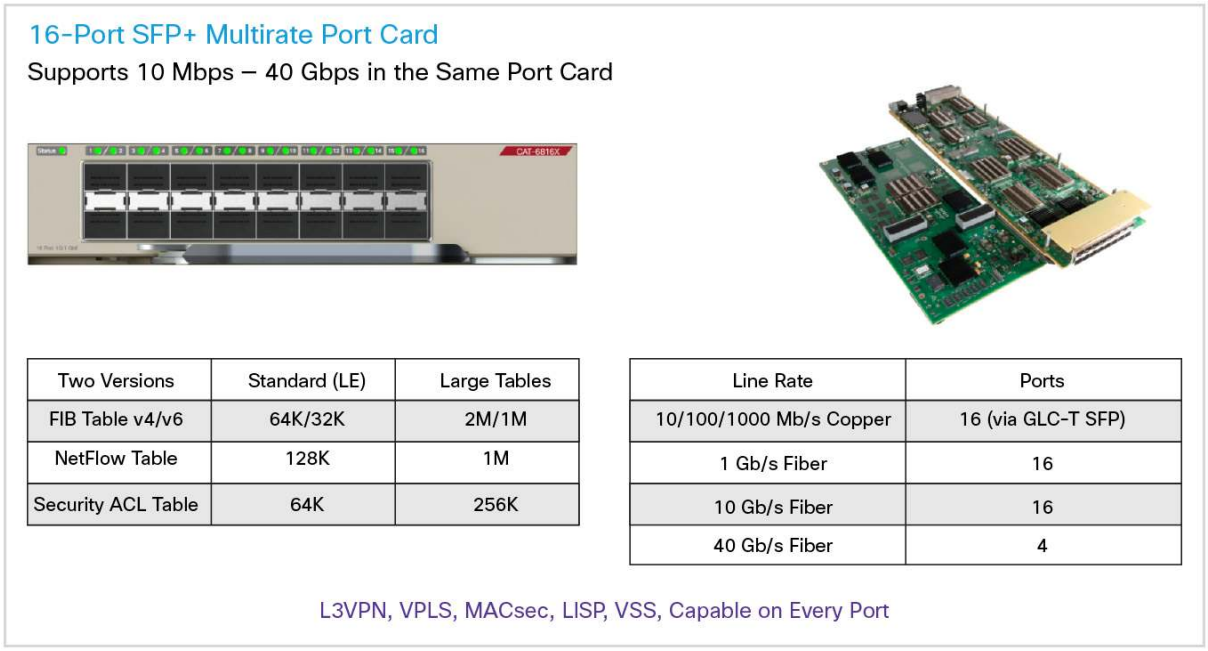
Table 1. Differences in Scalability for the Catalyst 6880-X LE and XL Models

Two Hardware Options	Standard (LE)	Large Tables
IPv4/v6 routing capability	256,000/128,000	2 million/1 million

Two Hardware Options	Standard (LE)	Large Tables
Multicast routes (IPv6)	64,000	256,000
Number of adjacencies	256,000	1 million
MAC addresses	128,000	128,000
Layer 3 interfaces	128,000	128,000
Security and QoS access control lists (ACLs)	64,000	256,000
Flexible NetFlow	128,000	1 million
Microflow policers	512	512
Aggregate policers	8000	8000

- The Catalyst 6880-X supports a broad range of connectivity options by offering 10-Mbps to 40-Gbps connectivity (Figure 2).

Figure 2. Connectivity Options for the Catalyst 6880-X

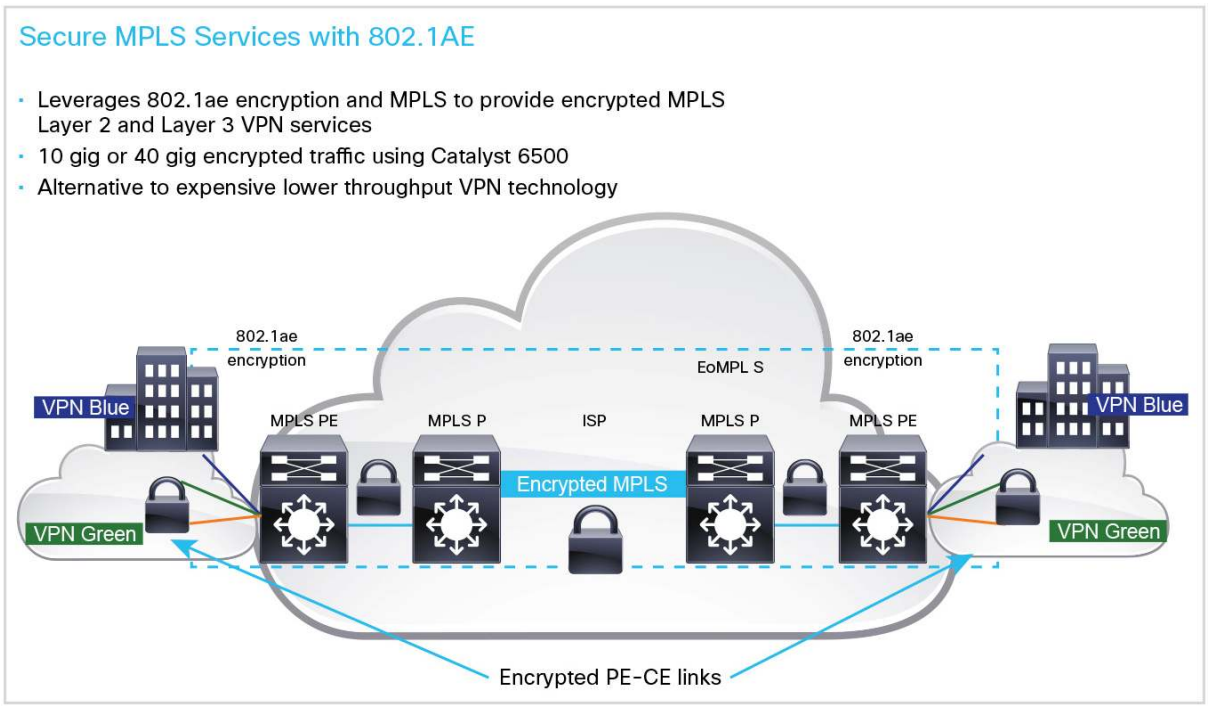


- Supports coarse wave length-division multiplexing (CWDM) and dense wavelength-division multiplexing (DWDM) optics on the uplink interfaces.
- Offers enhanced service richness by supporting standard-based Layer 2/Layer 3 and MPLS service enablers, such as access ports, 802.1Q trunk ports, hardware-enabled 802.1Q tunneling and VLAN translation, Layer 2 Tunneling Protocol, hardware-enabled MPLSVPNs, Ethernet over MPLS (EoMPLS), Virtual Private LAN Service (VPLS), Advanced VPLS (A-VPLS), and Layer 2 over multipoint Generic Routing Encapsulation (L2omGRE).
- Supports Hierarchical VPLS (H-VPLS) architecture, with Layer 2 access and MPLS access networks.

Security

- Industry-leading integrated security: TheCatalyst 6880-X offers a comprehensive set of security features to mitigate denial-of-service attacks,to restrict the access to the service provider network and to safeguard subscribers' and network resources.
- Memory protection, fault containment, and improved scalability through dedicated ternary content addressable memory (TCAM) for NetFlow, ACLs, security, and QoS deployments.
- Support for complete Cisco TrustSec® solution, including MAC Security (MACsec) (802.1AE) encryption on all Catalyst 6880-X ports. 802.1AE-based encryption can also be enabled on MPLSlinks (Figure 3).

Figure 3. Secure MPLS Services Enabled by All Catalyst 6880-X MACsec (802.1AE) Capable Ports

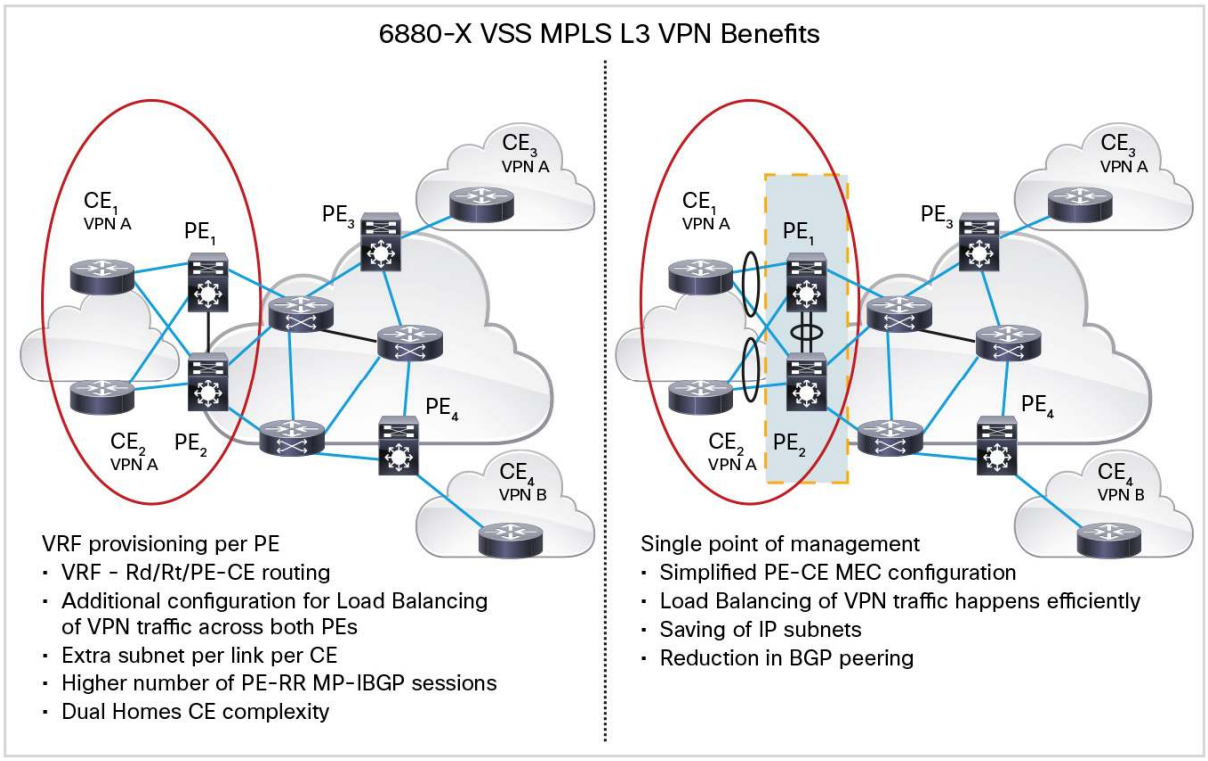


- Protects the service provider's network by enabling control-plane policing and hardware rate limiters.
- Flexible mechanisms to safeguard the service provider's MAC table and optimize MAC learning, through port security and per-VLAN MAC learning/limiting.
- Protects the service provider's CPU through port, VLAN, and MAC-based ACLs enabled in hardware.
- Protects against unauthorized end users through 802.1X, Dynamic Host Configuration Protocol (DHCP) Snooping, and Dynamic Address Resolution Protocol (ARP) Inspection.
- Protects subscribers and provides traffic isolation through private VLANs.

Service Availability

- Support for virtual switching systems (VSS) one day for redundant provider edge (PE) deployments with full nonstop forwarding (NSF) and stateful switchover (SSO) support for all MPLS services (Figure 4).

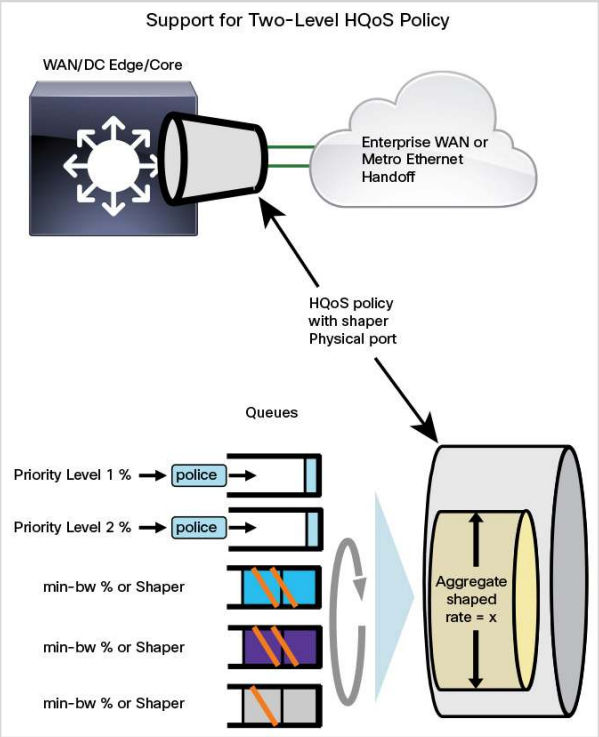
Figure 4. Redundant PE-CE Deployment Simplification with VSS



- Support for nonstop routing (NSR) for non-NSF-aware PE-CE deployments.
- Improved Layer 2 fast convergence over hub-and-spoke topologies by enabling Flexlink, to obviate the need for Spanning Tree.
- Optimized Layer 2 fast convergence by enabling IEEE 802.1w (Rapid Spanning Tree Protocol [RSTP]) and IEEE 802.1s (Multiservice Transport Platform [MSTP]).
- Increased resilience in MPLS deployments by supporting MPLSTraffic Engineering (TE) and Fast Reroute (FRR) QoS and multicast.
- Advanced QoS mechanism allows concurrent triple-play and VPN services.
- Flexible policing capabilities classify and rate-limit subscribers' traffic based on port, VLAN, and port plus VLAN information.
- Layer 3 per-port egress policing allows the delivery of multipoint services with tight service-level agreement (SLA) requirements.
- Intelligent queuing mechanism helps ensure that the highest-priority data gets services ahead of other traffic.
- Dual priority queues for voice and video traffic.
- Shaped round robin (SRR) enhances the scheduling algorithm by shaping the traffic that leaves each queue.

- Token bucket-based shaper support with the Modular QoS command-line interface (MQC).
- Two-level QoS shaping on egress ports - perqueue and perport (Figure 5).

Figure 5. Advanced Two-Level Shaping and Dual Priority Queues Supported on All Ports



Class-Based Queuing, LLQ, Two PQs, and Two-Level HQoS Example
type = [2p6q4t]

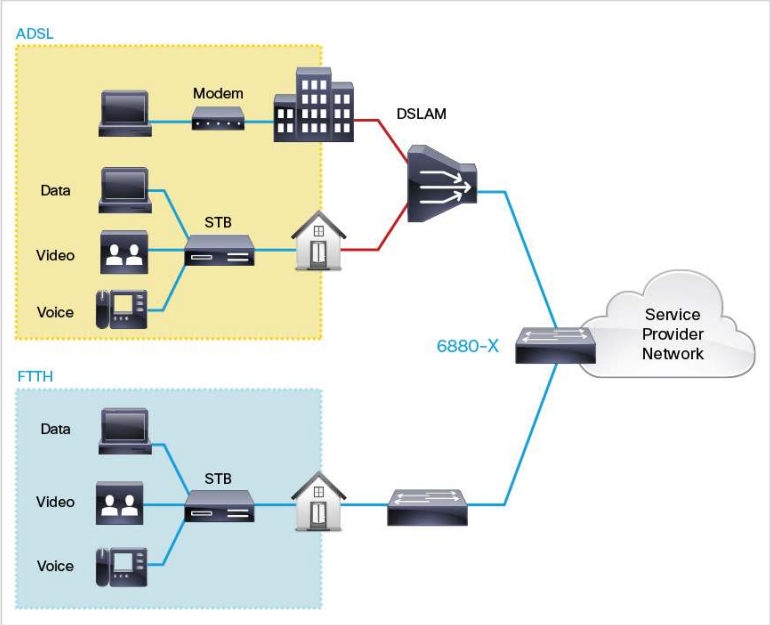
Class-Based Queuing and Port-Level Shaping

```
class-map type lan-queuing match-all cs1
  match  dscp cs1
class-map match-any class-copp-mcast-copy
class-map type lan-queuing match-all cs2
  match  dscp cs2
class-map type lan-queuing match-all cs3
  match  dscp cs3
class-map type lan-queuing match-all cs4
  match  dscp cs4
class-map type lan-queuing match-all cs5
  match  dscp cs5
class-map type lan-queuing match-all cs6
  match  dscp cs6
class-map type lan-queuing match-all cs7
  match  dscp cs7
```

```
policy-map type lan-queuing ab1
  class cs2
    bandwidth remaining percent 10
  class cs3
    bandwidth remaining percent 10
  class cs4
    bandwidth remaining percent 10
  class cs6
    bandwidth remaining percent 10
  class cs7
    bandwidth remaining percent 10
  class cs1
    priority level 2 percent 1
  class cs5
    priority level 1 percent 20
policy-map type lan-queuing abc1
  class class-default
    shape average percent 5
   service-policy ab1
```

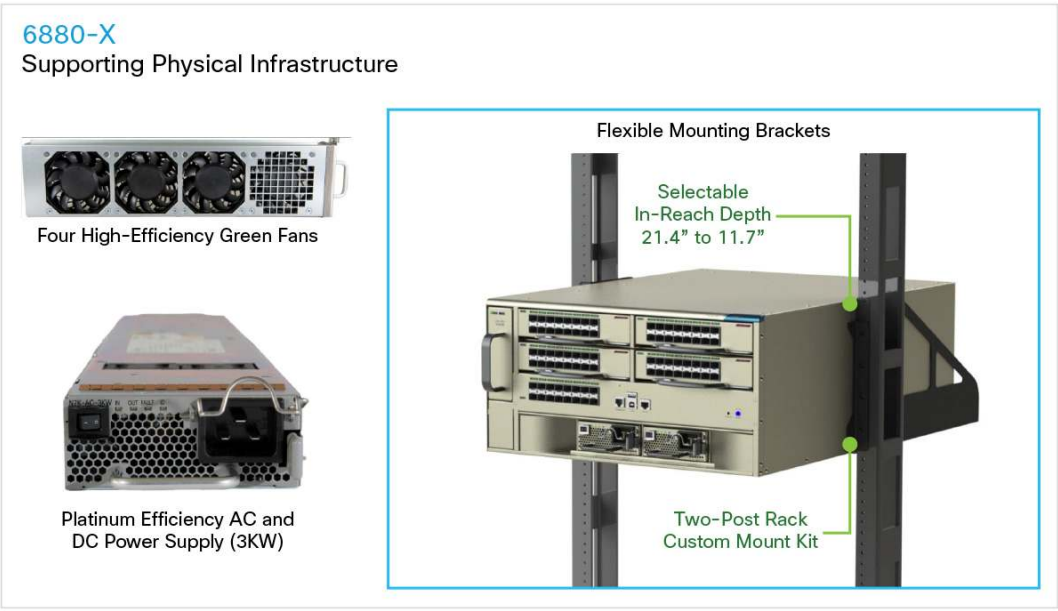
- Hardware-accelerated multicast protocols for efficient and scalable video application delivery.
- Scalable multicast-enabled deployment of triple-play services (Figure 6).

Figure 6. Triple-Play Services



- Hardware-accelerated label switched multicast with Multicast Label Distribution Protocol (MLDP) for fast multicast convergence and a protocol independent multicast (PIM) free core network.
- Redundant 300W AC and DC power supplies, field replaceable and hot swappable to reduce service outages in case of a power supply failure (Figure 7).

Figure 7. Highly Efficient and Redundant Power Supply and Fans

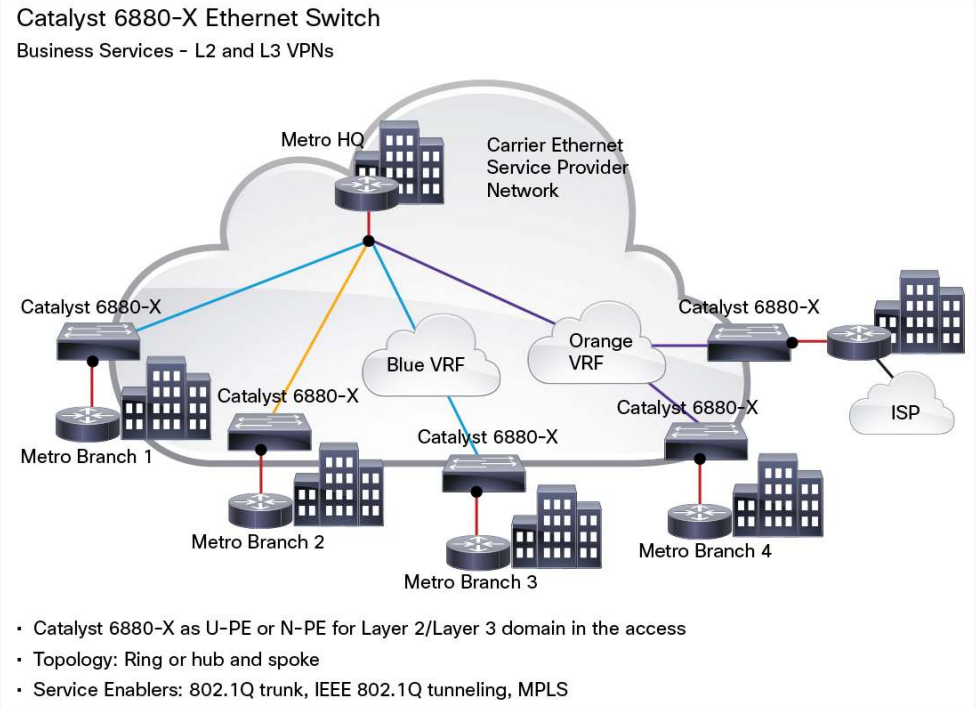


Applications

The Cisco Catalyst 6880-X helps Carrier Ethernet service providers offer hardware-accelerated VPN services for EttB, EttH, and DSLAM aggregation deployments.

- Key service enablers are hardware-enabled multicast protocols for intelligent video distribution, security features to isolate subscriber traffic streams and to protect against malicious user attacks, and QoS features to concurrently support multiple classes of service and prioritize traffic that is sensitive to drops, delays, and jitter.
- The Catalyst 6880-X also supports complete Layer 2 VPN options: EoMPLS, VPLS, A-VPLS and L2omGRE (a non-MPLS-based native Layer 2 over IP technology).
- MPLS VPN in hardware is scalable for greater service breadth and network flexibility.
- The Catalyst 6880-X supports 4000 virtual routing and forwarding (VRF) tables and 1.6 million VPNv4 routes, providing tremendous scale in a small form factor (Figure 8).

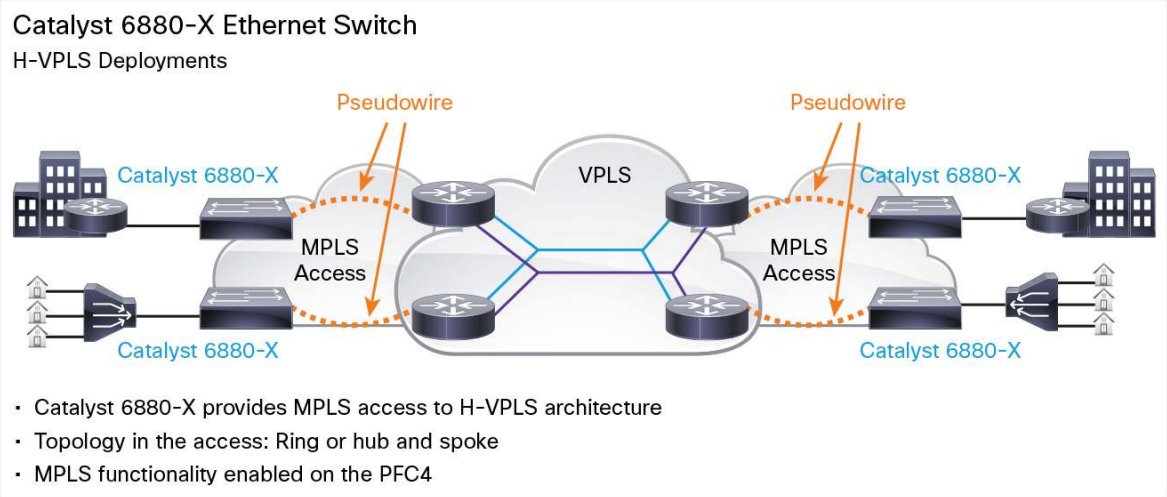
Figure 8. Layer 2 and Layer 3 VPNs



- Layer 3 VPN over mGRE (L3VPNomGRE) solution provides the ability for multiple service providers to cooperate and offer a joint VPN service with traffic tunneled directly from the ingress PE router at one service provider directly to the egress PE router at a different service provider site.

- EoMPLS virtual circuit (VC) Type 4 or Type 5, MPLSEXP bit marking, and MPLSTE and FRR enhance flexibility in H-VPLS deployments while strengthening QoS and resilience (Figure 9).

Figure 9. H-VPLS Deployments



Summary

The next-generation Cisco Catalyst 6800 Series Switches enable service providers and Metro Ethernet providers to offer a rich set of services for residential and business services customers (Figure 10). The Catalyst 6880-X provides a rich set of Cisco IOS® Software features, with more than 3000 features supported on day one.Itoffers the highest-density 10Gigabit Ethernet switch with MPLS support in the Cisco fixed switching portfolio and provides a new level of price to performance.

Figure 10. Business and Residential Services with the Catalyst 6880-X

Business and Residential Services

Business Services	Topology Options
Layer 2 VPN Layer 3 VPN	Layer 2 in the access Layer 3 in the access MPLS to the edge
Residential Services	**Topology Options**
Internet Access, Voice, Video on Demand, IPTV Broadcast	Layer 2 in the access MPLS to the edge

Americas Headquarters
Cisco Systems, Inc.
San Jose, CA

Asia Pacific Headquarters
Cisco Systems (USA) Pte. Ltd.
Singapore

Europe Headquarters
Cisco Systems International BV Amsterdam,
The Netherlands

Cisco has more than 200 offices worldwide. Addresses, phone numbers, and fax numbers are listed on the Cisco Website at www.cisco.com/go/offices.

Printed in USA C11-728541-00 07/13