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

White Paper

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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 on the 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 access switch 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 access for 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>
<thead>
<tr>
<th>Two Hardware Options</th>
<th>Standard (LE)</th>
<th>Large Tables</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPv4/v6 routing capability</td>
<td>256,000/128,000</td>
<td>2 million/1 million</td>
</tr>
<tr>
<td>Multicast routes (IPv6)</td>
<td>64,000</td>
<td>256,000</td>
</tr>
<tr>
<td>Number of adjacencies</td>
<td>256,000</td>
<td>1 million</td>
</tr>
<tr>
<td>MAC addresses</td>
<td>128,000</td>
<td>128,000</td>
</tr>
<tr>
<td>Layer 3 interfaces</td>
<td>128,000</td>
<td>128,000</td>
</tr>
<tr>
<td>Security and QoS access control lists (ACLs)</td>
<td>64,000</td>
<td>256,000</td>
</tr>
<tr>
<td>Flexible NetFlow</td>
<td>128,000</td>
<td>1 million</td>
</tr>
<tr>
<td>Microflow policers</td>
<td>512</td>
<td>512</td>
</tr>
<tr>
<td>Aggregate policers</td>
<td>8000</td>
<td>8000</td>
</tr>
</tbody>
</table>
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

**16-Port SFP+ Multirate Port Card**
Supports 10 Mbps – 40 Gbps in the Same Port Card

<table>
<thead>
<tr>
<th>Two Versions</th>
<th>Standard (LE)</th>
<th>Large Tables</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIB Table v4/v6</td>
<td>64K/32K</td>
<td>2M/1M</td>
</tr>
<tr>
<td>NetFlow Table</td>
<td>128K</td>
<td>1M</td>
</tr>
<tr>
<td>Security ACL Table</td>
<td>64K</td>
<td>256K</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Line Rate</th>
<th>Ports</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/100/1000 Mbps Copper</td>
<td>16 (via GLC-T SFP)</td>
</tr>
<tr>
<td>1 Gb/s Fiber</td>
<td>16</td>
</tr>
<tr>
<td>10 Gb/s Fiber</td>
<td>16</td>
</tr>
<tr>
<td>40 Gb/s Fiber</td>
<td>4</td>
</tr>
</tbody>
</table>

L3VPN, VPLS, MACsec, LISP, VSS, Capable on Every Port

- 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: The Catalyst 6880-X offers a comprehensive set of security features to mitigate denial-of-service attacks, to restrict 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 MPLS links (Figure 3).

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

Secure MPLS Services with 802.1AE

- Leverages 802.1ae encryption and MPLS to provide encrypted MPLS Layer 2 and Layer 3 VPN services
- 10 gig or 40 gig encrypted traffic using Catalyst 6500
- Alternative to expensive lower throughput VPN technology

- 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 MPLS Traffic 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
● 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

6880-X Supporting Physical Infrastructure

Four High-Efficiency Green Fans

Platinum Efficiency AC and DC Power Supply (3kW)
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

![Catalyst 6880-X Ethernet Switch](image)

- Catalyst 6880-X provides MPLS access to H-VPLS architecture
- Topology in the access: Ring or hub and spoke
- MPLS functionality enabled on the PFC4

**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. It offers 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**

<table>
<thead>
<tr>
<th>Business Services</th>
<th>Topology Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Layer 2 VPN</td>
<td>- Layer 2 in the access</td>
</tr>
<tr>
<td>- Layer 3 VPN</td>
<td>- Layer 3 in the access</td>
</tr>
<tr>
<td></td>
<td>- MPLS to the edge</td>
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</table>

<table>
<thead>
<tr>
<th>Residential Services</th>
<th>Topology Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Internet Access, Voice, Video on Demand, IPTV Broadcast</td>
<td>- Layer 2 in the access</td>
</tr>
<tr>
<td></td>
<td>- MPLS to the edge</td>
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