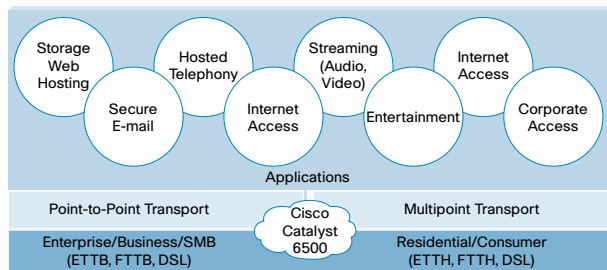


Carrier Ethernet Requirements

Service providers offering Carrier Ethernet target two market segments, corporate and residential customers (Figure 1).

Figure 1. Carrier Ethernet Market Segments and Applications



The evolving services and network convergence of service providers require a network infrastructure able to fulfill the following requirements:

- **Scalability**— Offer high switching performance and bandwidth availability to support bandwidth-intensive applications and enable new services without operational impact.
- **Flexibility**— Offer flexibility of port densities, and various connector types with long-reach optics. Offer the ability to integrate “Triple-Play” and TLS services based on Layer 2, IP, and MPLS technologies.
- **Feature Richness**— Offer differentiators to enable metropolitan services, such as MPLS, IPv6, and Multicast.
- **Security**— Protect service provider resources and guarantee subscribers’ traffic isolation and authentication.
- **High Availability**— Maximize service uptime and reduce MTTR and MTBF, through hardware redundancy, software rapid failover and subsystem

In Service Software Upgrade (ISSU) with software modularity.

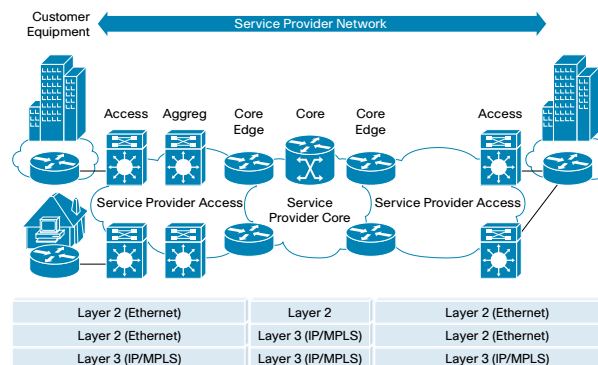
- **QoS**— Enable voice, video, and data on the same platform, with jitter, latency, and packet loss guarantees.
- **Manageability**— Ease service provisioning, improve operational efficiency, and reduce OpEx.

Carrier Ethernet Network Architecture

Carrier Ethernet service providers can choose the following three architectures for offering Triple-Play and TLS services to residential and corporate customers (Figure 2):

- End-to-end Layer 2
- Layer 2 in the metropolitan area and IP/MPLS in the core or backbone
- End-to-end Layer 3

Figure 2. Carrier Ethernet Architecture Options

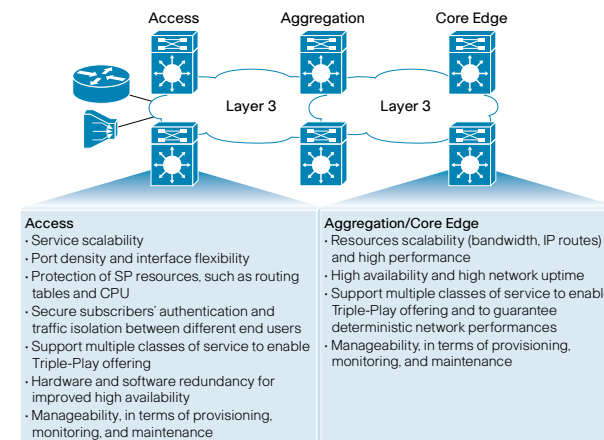


The focus of this At-a-Glance is the end-to-end Layer 3 architecture.

A Layer 3 Carrier Ethernet network can be segmented into an access and an aggregation or core edge layer

with the following requirements for enabling services (Figure 3):

Figure 3. Carrier Ethernet Access and Aggregation and Core Edge Requirements



Cisco Catalyst 6500 Series: The Foundation

The Cisco® Catalyst® 6500 and Cisco ME 6524 Series switches form the foundation of Carrier Ethernet architectures by providing leading IP routing, hardware-enabled MPLS, and high performance integrated in a single platform. The Cisco Catalyst 6500 Series is the premier Cisco Layer 3 switching platform for the access, aggregation, and core edge of the service provider network with the following key advantages.

Scalability and Flexibility

- **720-Gbps integrated switch fabric capacity** with Cisco Catalyst 6500 Series Supervisor Engine 720
- **Ability to scale up to 400 IPv4 and 230 IPv6 Mpps** switching performance with distributed forwarding
- **High-density Gigabit and 10-Gigabit Ethernet** support

- **High-performance CPU** for Layer 3 protocols convergence and stability
- High-performing **IPv6 forwarding in hardware** (Figure 4):

Figure 4. IPv6 Switching on Supervisor Engine 720

IPv6 Hardware Features on PFC3	IPv6 Software Features
<ul style="list-style-type: none"> • 128K FIB entries • IPv6 Load Sharing up to 6 paths • Etherchannel hash across 48 bits • IPv6 Policing/Netflow/Classification • STD and EXT V6 ACLs • IPv6 QoS lookups • IPv6 Multicast • V6 to V4 Tunneling • IPv6 Edge over MPLS (6PE) 	<ul style="list-style-type: none"> • IPv6 Addressing • ICMP for IPv6 • DNS for IPv6 • V6 MTU Path Discovery • SSH for IPv6 • IPv6 Traceroute • dCEF for IPv6 • RIP for IPv6 • IS-IS for IPv6 • OSPF V3 for IPv6 • BGP for IPv6



Scalable IP routing and MPLS functions in hardware, without performance impact (Table 1):

Table 1. IP and MPLS Scalability Figures

	Up to a Maximum of
IPv4 Routes	1,000,000
IPv6 Routes	500,000
MPLS VPNs	1000
EoMPLS Tunnels	4096

- **Support for a broad range of connectivity options** by offering 10/100, 100BASE-X SFP, 10/100/1000, Gigabit Ethernet SFP, and 10-Gigabit Ethernet line cards
- **Enhanced service richness** in the same platform by enabling on regular Ethernet line cards all the

- MPLS service enablers, such as hardware-based EoMPLS, MPLS VPN, and multicast VPN
- **IETF compliancy** by supporting natively EoMPLS virtual circuit types 4 and 5
- **Support for multipoint connectivity** through VPLS and 10-Gigabit Ethernet VPLS architecture, enabled on CWAN modules (SIPs and SPAs) or Ethernet Services Plus (ES+) line cards
- **End-to-end architecture and features consistency** with Cisco ME 6524, Cisco Catalyst 6500 Supervisor Engine 32, and Supervisor Engine 720

Security

- **Memory protection, fault containment, and improved scalability** through dedicated TCAMs for NetFlow, ACLs, security, and QoS deployments
- **Protection of service provider's network** against DoS attacks, enabling control plane policing and hardware rate limiters
- **Protection of service provider's CPU** through protocol-independent MAC ACLs enabled in hardware
- **Protection from unauthorized end users** through 802.1x, DHCP Snooping, Dynamic ARP Inspection, and IP Source Guard

High Availability

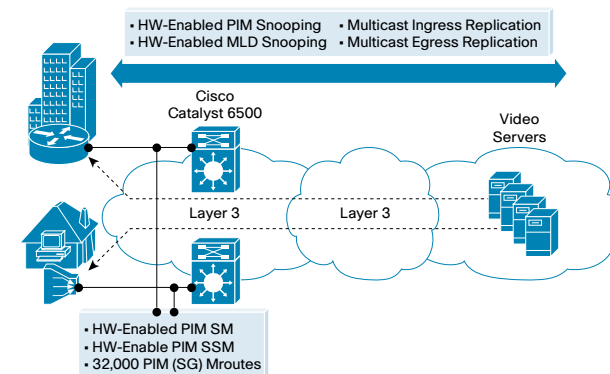
- **Hardware redundancy** for fans, power supplies, fabrics, and clocks for nonstop operation
- **Complete separation of control and data planes** for enhanced resiliency
- **Leadership in high availability and service uptime:** Nonstop forwarding (NSF) and stateful switchover (SSO) help ensure minimal traffic loss and

- subsecond recovery in IP networks upon primary supervisor failure
- **Increased data path protection** through MPLS Fast Reroute (FRR) and MPLS Traffic Engineering (TE)
- **Cisco IOS® Software modularity** to deliver fault containment, memory protection, process restartability, and In Service Software Upgrade (ISSU) for patch fixes

QoS and Multicast

- **Advanced quality-of-service mechanism** to enable Triple Play and TLS services on the same infrastructure, such as per-port policing and DSCP/VLAN-based traffic classification
- **Granular traffic queuing and congestion avoidance** and management mechanisms such as Priority Queuing, WRED, and SRR to guarantee low jitter, low latency, and minimal or null packet loss for sensitive and real-time classes of service
- **Advanced and innovative IP Multicast features** to support Triple-Play services and optimize Video delivery (Figure 5):

Figure 5. Advanced Multicast features to enable TriplePlay





Manageability

- **Enhanced and scalable network monitoring**, traffic profiling, and capacity planning by enabling hardware-based Netflow, up to a maximum of 256,000 entries with Cisco Catalyst 6500 Series Supervisor Engine 720-3BXL
- **Increased end-to-end service operational efficiency** through management and monitoring features such as MPLS LSP ping and traceroute
- **Flexible and comprehensive network monitoring capabilities** through SNMP MIBs for interface management, traffic monitoring, routing protocol management, and features management

Table 2 gives the key features of the Cisco Catalyst 6500 Carrier Ethernet IP/MPLS solution.

Table 2. Key Carrier Ethernet IP/MPLS Features on Cisco Catalyst 6500

	Access	Aggregation	Core Edge
10 GE	X	X	X
Hardware-enabled IPv6	X	X	X
Hardware-enabled MPLS	X	X	X
Hardware-enabled EoMPLS	X	X	X
8021x	X		
DHCP Snooping	X		
IP Source Guard	X		
HW-enabled Control Plane Policing	X		

	Access	Aggregation	Core Edge
Hardware Rate Limiters	X		
SSO/NSF	X	X	X
MPLS TE and MPLS FRR	X	X	X
Software Modularity	X	X	X
Per Port Policing	X		
HW-enabled PIM Snooping and IGMP Snooping	X	X	X
HW-enabled PIM SM and PIM SSM	X		
MPLS LSP Ping and Traceroute	X	X	X