

# 5150 SERVICE AGGREGATION SWITCH



## Features & Benefits

- High-capacity switch fabric enabling 1G to 10G Ethernet aggregation to maximize network efficiency
- Supports 48 100M/GbE UNI ports with SFP connectors and up to 4 10GbE XFP ports, through 2 option module slots each providing 2 10GbE ports
- Supports diverse network topologies and flexible encapsulation techniques ensuring optimal network design and end-to-end service alignment
- Provides advanced Ethernet QoS features enabling service differentiation and extensive OAM capabilities for guaranteed SLAs
- Advanced network and service synchronization via IEEE 1588v2 Precision Time Protocol\* and ITU-T G.8262 Synchronous Ethernet\*
- Offers high-density Ethernet aggregation in a 2RU ETSI form factor with dual DC or AC power supply modules for enhanced reliability
- Extends the reach of Ethernet networks through a -40°C to +65°C operating range, enabling universal deployability

Ciena's 5150 Service Aggregation Switch is a high-density Ethernet aggregation switch that addresses the scalability and cost of the metro network to enable profitable delivery of a wide range of Ethernet services, including:

- Business connectivity services (E-Line, E-LAN and E-tree)
- Layer 2 access to IP services
- Mobile backhaul services
- Consumer and enterprise triple-play backhaul services
- Public sector network services, such as utility smart grids and private healthcare networks

The 5150 features industry-leading switching capacity and port density in a compact 2RU form factor. It supports up to four 10GbE (optional) and 48 GbE ports with redundant power supply modules.

The 5150 is based on Ciena's field-proven True Carrier Ethernet® technology, deployed globally by leading carriers and network operators. The 5150 software architecture is based on Ciena's service-aware operating system, which is used in all Ciena Service Delivery and Service Aggregation Switches to provide operational efficiency and consistent system and service attributes.

Ciena's service-aware operating system leads the industry in Carrier Ethernet Operations, Administration, and Maintenance (OAM) mechanisms, ensuring high-reliability service rollout and lowered Operating Expenses (OPEX). With this advanced service visibility and manageability, operators can offer differentiated Service Level Agreements (SLAs) that leverage the virtual switching capabilities and sophisticated Quality of Service (QoS) offerings of the 5150.

\* Denotes features available in a future release.

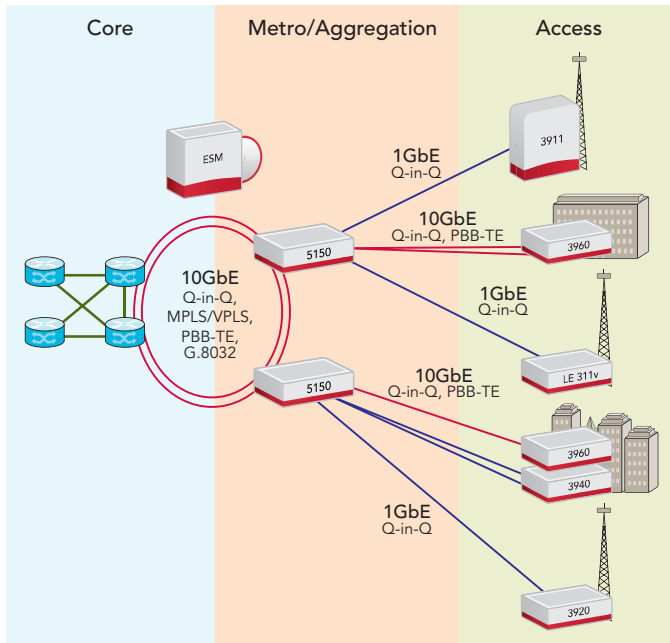


Figure 1. 5150 Ethernet aggregation

In mobile backhaul applications, the 5150 provides the ability to utilize IEEE 1588v2 Precision Timing Protocol and Synchronous Ethernet to empower carriers to migrate to pure packet architectures with confidence that the network is ready to support 4G mobile technologies, such as Long-Term Evolution (LTE).

The advanced design and service-rich architecture of the 5150 enables network operators to deploy reliable and scalable offerings that leverage the inherent elegance of Ethernet technology to generate maximum revenue.

Additionally, the efficient architecture, extended temperature range, and compact packaging design enable deployment of the 5150 in a wide variety of physical environments, providing Ethernet aggregation exactly where maximum efficiency of bandwidth and valuable optical fiber resources may be achieved. By coupling this deployment flexibility with the range of Ethernet encapsulation options supported by the virtual switching architecture, the 5150 excels in a wide range of carrier networks, both large and small.

### High Density Ethernet Service Aggregation

The 5150 Service Aggregation Switch has the capacity and feature capabilities to thrive in diverse operator networks to create a bandwidth-efficient aggregation layer before traffic enters the network core:

- 1GbE
- 10GbE service aggregation

\* Denotes features available in a future release.

→ 1GbE > 1GbE service aggregation with 10GbE deferral

→ Synchronous Ethernet service distribution

As Ethernet services extend farther into the access network and service penetration grows, managing the scalability and cost of the metro and core networks requires a highly efficient aggregation tier. The 5150 provides high-density aggregation to drive bandwidth efficiency and squeeze maximum use out of expensive core router ports, dramatically reducing network costs.

The 5150 enables the recovery of valuable optical fiber in the access network. The ability to deploy high-density aggregation in a wide variety of physical environments ensures that operators can maximize the effectiveness of the Ethernet access network.

### Synchronization and Timing

The cost-effectiveness and versatility of Carrier Ethernet is driving the convergence of services. Many services place new timing and synchronization requirements onto the Ethernet network. The 5150 enables carriers to provide SONET/SDH-like Layer 1 timing throughout the network via Synchronous Ethernet. The 5150 also provides IEEE 1588v2 Packet Timing Protocol to distribute timing through mixed networks and architect an LTE-ready network where both frequency and phase are required.

- IEEE 1588v2 Precision Time Protocol\*
- ITU-T G.8262 Synchronous Ethernet\*
- Stratum-3 Holdover

### Carrier-Class QoS

The 5150 implements carrier-class MEF-14-compliant QoS mechanisms that enable the delivery of a wide range of traffic types and rates over a single access infrastructure without degradation.

- Rich classification of traffic flows based on Layer 1 through Layer 4 parameters, including physical port, MAC address, VLAN tag, IP address, and L4 port address
- Flexible priority resolution for Class of Service mapping based on priority settings contained in VLAN, MPLS, PBB-TE tags, and IP packet headers
- Sophisticated Ingress metering for Committed Information Rate (CIR), Excess Information Rate (EIR), Committed Burst Size (CBS), and Excess Burst Size (EBS) service delivery
- Two-rate Three-Color Marking (trTCM) and Random Early Drop (RED) for sophisticated congestion handling

## Proven Service-Aware Operating System

Ciena's service-aware operating system is used in all Ciena Service Delivery and Service Aggregation Switches to deliver consistent benefits across all Ethernet access and aggregation applications, including:

- Rapid implementation of the latest advances in Ethernet technologies, as well as new services and standards proposed by the IEEE, the IETF, and MEF
- Interoperability with Ethernet equipment from other vendors
- Improved efficiency and cost savings resulting from a common deployment and service provisioning model
- Service offering ubiquity, permitting rapid rollout of new services across the entire network

The 5150 software is designed to deliver plug-and-play activation and supports an advanced automatic activation feature that can upgrade the default settings to deploy operator-specific configurations, reducing new platform integration time and enable network operators to extend services to new subscribers rapidly and efficiently.

## Ethernet Transport Options

The 5150 gives operators a variety of Carrier Ethernet transport options, including 802.1q VLANs, 802.1ad Provider VLANs (Q-in-Q); MEF Ethernet connections including Ethernet Virtual Private Line/LAN/Tree services; MPLS Virtual Circuits; VPLS/H-VPLS Layer 2 VPNs; and PBB-TE Tunnels with PBB-TE Ethernet Virtual Circuits.

The 5150 supports interworking between Q-in-Q VLANs, MPLS Virtual Circuits, VPLS/H-VPLS L2VPNs, and PBB-TE connections with a sophisticated virtual switching architecture for complete service flexibility and optimal utilization of network resources.

Ciena is an industry leader in the implementation of PBB-TE, which extends Ethernet to provide carrier-grade transport over Metro and Wide Area Networks.

The 5150's advanced PBB-TE feature set delivers a reliable, resilient, and cost-effective connection-oriented transport solution ideal for delivering a variety of new services to a fast-growing customer base. Dual homing, built-in backup tunnels, and 50 ms failover capabilities ensure rapid and deterministic recovery of critical services.

Based on extensions to current Ethernet standards, PBB-TE enabled products maintain compatibility with existing Ethernet deployments. This broad compatibility enables the 5150 to

deliver a wide range of connectivity services with guaranteed QoS, while interoperating seamlessly with an installed base of multi-vendor switching and routing systems that do not support PBB-TE. Because the advantages of PBB-TE are available without major changes to existing network equipment or architectures, the 5150 offers superior investment protection.

The 5150 offers a comprehensive set of MPLS, VPLS, and H-VPLS features that support resilient MPLS L2VPNs and enable service providers to offer MPLS-based connectivity services on metro Ethernet networks, extending the functionality and scalability of MPLS core networks.

These MPLS features include:

- MPLS Pseudowire Emulation Edge-to-Edge (PWE3), which supports MPLS Virtual Private Wire Services (VPWS), sometimes called MPLS Virtual Leased Lines. VPWS enables the provisioning of MPLS-based Ethernet Virtual Circuits (EVCs) and supports MPLS-based Ethernet Private Line and Ethernet Virtual Private Line services
- Virtual Private LAN Services (VPLS) and Hierarchical-VPLS (H-VPLS) based on MPLS Label Switched Paths (LSPs) and MPLS Virtual Circuits (VCs). 5150 VPLS capabilities support Layer 2 VPNs that are based on Ethernet transport, with the benefits of an MPLS/VPLS control plane. This control plane includes Label Distribution Protocol (LDP) for VPLS VC signaling; OSPF-TE and IS-IS-TE for MPLS Tunnel Routes; and RSVP-TE for the establishment of the LSPs that constitute the VPLS
- MPLS label edge router functionality, which enables the 5150 to function as a VPLS/H-VPLS Provider Edge switch (PE-rs) and as an H-VPLS MTU-s customer edge switch. The 5150 also supports H-VPLS Dual Homing, which provides resiliency by enabling spoke connections from an MTU-s to two different PE Hub switches. For additional flexibility, H-VPLS spoke connections can be implemented using MPLS pseudowires (VCs), Q-in-Q Ethernet VLAN Virtual Circuits, Ethernet Private Lines, Ethernet Virtual Private Lines, and PBB-TE service instances
- MPLS tunnel groups can be configured on the 5150 to support LSP redundancy
- MPLS FRR further enhances resiliency for MPLS/VPLS services by enabling LSPs to be restored within 50 ms in case of physical or logical link failure
- MPLS OAM capabilities include LSP Ping and LSP Traceroute, which can be used to verify the LSP status and topology

## Carrier-Class Ethernet OAM

The 5150 supports a rich set of OAM features defined in the latest versions of IEEE, ITU, and IETF standards, including:

- IEEE 802.3ah Ethernet in the First Mile (EFM) physical layer OAM, including link events and remote loopback
- IEEE 802.1ag CFM, including MAC Ping/Traceroute and Continuity Check
- ITU-T Y.1731 Ethernet OAM, including performance monitoring
- RFC 2544 Performance Benchmarking Test Reflection
- 802.1AB Link Layer Discovery Protocol (LLDP)
- IETF RFC 5618 Two-Way Active Management Protocol (TWAMP) with complete sender and receiver capabilities

These capabilities enable the 5150 to monitor the status of system and network links; measure the performance of customer Ethernet Services; confirm that link and service

throughput and quality conform to SLAs; and distribute this management information across point-to-point, point-to-multipoint, and multipoint-to-multipoint connections.

## Ethernet Services Manager

Ciena's Ethernet Services Manager (ESM) is a groundbreaking carrier-grade, automated service activation, creation, and management platform for managing a service provider's service delivery and service aggregation networks. ESM lets users build and deploy large-scale Carrier Ethernet networks quickly and easily; cuts time to market for new services; accelerates service revenue; maximizes service availability; assures service quality; leverages existing systems; and enables subscriber-managed services. All of these functions cut total cost of ownership and reduce time to market and revenue. The ESM also paves the way to implement new, yet unimagined services quickly and cost-effectively for increased revenue and competitiveness.

## Technical Information

### Interfaces

48 x 100/1000M SFP UNI ports  
2 x 10GbE Module Slots, 2 x 10GbE XFP ports per module  
1 x 10/100/1000M RJ-45 Management port  
1 x Console Port (RJ-45, EIA-561)  
5 x External Alarm Inputs (DE-15)

### Ethernet

IEEE 802.3 Ethernet  
IEEE 802.3u Fast Ethernet  
IEEE 802.3z Gigabit Ethernet  
IEEE 802.1D MAC Bridges  
IEEE 802.1Q VLANs - Including .1p Priority  
IEEE 802.1ad Provider - full S-VLAN range  
VLAN tunneling (Q-in-Q) for Transparent LAN Services (TLS)  
Per VLAN MAC Learning Control  
Per-Port MAC Learning Control  
IEEE 802.1w Rapid Spanning Tree (RSTP) - now in .1D  
IEEE 802.3ad Link Aggregation Control Protocol (LACP)  
ITU-T G.8032 Ethernet Rings Protection Switching  
Jumbo Frames to 9216 bytes  
Layer 2 Control Frame Tunneling

### Quality of Service

8 Hardware Queues per Port  
Committed and Excess Information Rate (CIR and EIR)  
Classification based on IEEE 802.1D priority  
Classification based on VLAN, source port, destination port, TCP/UDP port  
Classification based on IP Precedence and IP DSCP  
Layer 2, 3, 4 Quality of Service  
Ingress metering per-port  
Ingress metering per-port per-CoS  
Ingress metering per-port per-VLAN  
Up to 512 Ingress Meters per port  
Up to 4096 Ingress Meters per system  
C-VLAN Priority to S-VLAN Priority Mapping  
S-VLAN Priority based on C-VLAN ID  
Per-VLAN Classification, Metering, and Statistics  
Per-port per-VLAN QoS with CIR and EIR traffic on Egress Queues

### MPLS/VPLS

RFC 2205, 3031, 3036, 3985 MPLS Pseudowire Emulation Edge-to-Edge (PWE3)  
RFC 3916, 3985, 4446, 4447, 4448 Pseudowires  
RFC 5654 MPLS-Transport Profile  
MPLS Virtual Private Wire Service (VPWS)  
RFC 4664, 4665 L2VPNs

RFC 4762 VPLS (Virtual Private LAN Service) and Hierarchical VPLS (H-VPLS)  
Provider Edge (PE-rs) Functionality for VPLS and H-VPLS  
PE-rs Functionality with Spoke and Mesh Virtual Circuits  
MTU-s Functionality for H-VPLS deployment  
MTU-s Multihoming (redundant VCs to different PE-s switches)  
MPLS Virtual Circuit as H-VPLS spoke Virtual Circuit  
PBB-TE Service Instance as H-VPLS spoke Virtual Circuit  
Q-in-Q Ethernet Virtual Circuit as H-VPLS spoke Virtual Circuit  
MPLS Label Switch Path (LSP) Tunnel Redundancy  
Layer 2 Control Frame Tunneling over MPLS Virtual Circuits  
RFC 3209 RSVP-TE (for MPLS Tunnel Signaling)  
RFC 3630 OSPF-TE (for MPLS Tunnel Routes)  
RFC 3784 IS-IS-TE (for MPLS Tunnel Routes)  
RFC 3036 Targeted LDP (for VPLS VC signaling)  
RFC 4090 MPLS Fast ReRoute (via RSVP-TE)  
MPLS Performance Monitoring  
RFC 4379 LSP Ping  
RFC 4379 LSP Traceroute  
RFC 5085 LSP Ping and Traceroute extensions to work over Pseudowires (PW VCCV)

\* Denotes features available in a future release.

## Technical Information continued

### Carrier Ethernet OAM

IEEE 802.1ag Connectivity Fault Management (CFM)  
IEEE 802.3ah Ethernet in the First Mile (EFM)  
IEEE 802.1AB Link Layer Discovery Protocol (LLDP)  
ITU-T Y.1731 Ethernet OAM - Performance Monitoring  
RFC 2544 Performance Benchmarking Test Reflection  
RFC 5618 TWAMP Responder and Receiver TWAMP Sender  
TWAMP +/- 1ms timestamp accuracy  
Dying Gasp with Syslog and SNMP Traps

### PBB-TE (Provider Backbone Bridging-Traffic Engineering)

IEEE 802.1Qay PBB-TE  
IEEE 802.1ah PBB frame format  
PBB-TE Multi-homed Protection Failover  
IEEE 802.1ag CFM for PBB-TE Tunnels  
IEEE 802.1ag CFM for PBB-TE Service  
PBB-TE Full B-VID & I-SID address ranges  
PBB-TE Tunnel & Service metering

### Multicast Management

RFC 2236 IGMPv2 Snooping  
IGMP Domains  
IGMP Message Filtering  
IGMP Inquisitive Leave  
Broadcast/Multicast Storm Control  
Unknown Multicast Filtering  
Well-known Protocol Forwarding

### Network Management

Enhanced CLI  
CLI-based configuration files  
SNMP v1/v2c/v3  
SNMPv3 Authentication and Message Encryption  
RFC 1213 SNMP MIB II  
RFC 1493 Bridge MIB  
RFC 1643 Ethernet-like Interface MIB  
RFC 1573 MIB II interfaces

RFC 1757 RMON MIB - including persistent configuration  
RFC 2021 RMON II and RMON Statistics Per-VLAN Statistics  
RADIUS Client and RADIUS Authentication  
TACACS + AAA  
RFC 2131 DHCP Client  
RFC 1305 NTP Client  
RFC 1035 DNS Client  
Telnet Server  
RFC 1350 Trivial File Transfer Protocol (TFTP)  
RFC 959 File Transfer Protocol (FTP)  
Secure File Transfer Protocol (SFTP)  
Secure Shell (SSHv2)  
Syslog with Syslog Accounting  
Port State Mirroring  
Local Console Port  
Comprehensive Management via Ethernet Services Manager  
Remote Autoconfiguration via TFTP, SFTP  
Software download/upgrade via TFTP, SFTP

### MAC Address Table Capacity

32,000 MAC addresses

### Timing Synchronization

IEEE 1588v2 Precision Time Protocol\*  
ITU-T G.8262 Synchronous Ethernet\*

### Service Security

Layer 2, 3, 4 Protocol Filtering  
Broadcast Containment  
User Access Rights  
Per-port or per-VLAN Service Access Control  
Hardware-based DOS Attack Prevention  
Hardware-based Access Control Lists (ACLs)  
Egress Port Restriction  
IEEE 802.1X Port-Based Network Access Control (RADIUS/MD5)

### Power Requirements

DC Input: -48, -24, +24 VDC (nominal)  
AC Input: 100V, 240V AC (nominal)  
AC Frequency: 50/60 Hz  
Maximum Power Input: 250 W

### Agency Approvals

**Safety:** European Union, CE mark (Declaration of Conformity); UL 60950 IEC 60950 (CB); EN 60950; CAN/CSAC22.2 No. 60950-00 (Canadian Safety)

**Emissions:** FCC Part 15:1998 Class B; EN55022 (1994) Class B (with amendments A1 and A2); EN61000-3-2 (1995) Harmonic current emissions; EN61000-3-3 (1995) Voltage fluctuations and flicker

**Telecom:** FCC Part 68: Subpart D; Industry Canada (CS-03, Issue 8, Part 1)

**Environmental:** WEEE 2002/96/EC RoHS 2002/95/EC

**Immunity:** ETSI/EN 300 386:V1.3.2 (2003-05) (EU Telecommunication Emissions and Immunity)

**Laser Safety:** CDRH Letter of Approval (US FDA Approval); Europe: EN60825- 1:1994 +A11:1996+A2:2001 (European Safety of Lasers)

### Environmental Characteristics

**Operating Temperature:** -40°F to +149°F (-40°C to +65°C)

**Storage Temperature:** -40°F to +158°F (-40°C to +70°C)

**Relative Humidity:** 5% to 90% (non-condensing)

### Physical Characteristics

**Dimensions:** 17.5" (W) x 10.0" (D) x 3.5" (H);  
444.5mm (W) x 254.0mm (D) x 89.0mm (H)

**Weight:** 24 lbs; 10.9 kg

\* Denotes features available in a future release.

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Networks that change  
the way you compete.

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