

**DATA SHEET**

# 3960

## Service Delivery Switch



Ciena's 3960 Service Delivery Switch is a next-generation Ethernet access system that cost-effectively delivers 10 Gigabit Ethernet (GbE) and 1 GbE business and transport Ethernet services via fiber or copper connections.

The 3960 features a high-capacity switching fabric, four 10GbE ports and eight 1GbE ports in a compact single rack unit form factor (1RU) with redundant power supply modules. This efficient packaging design enables the 3960 to be deployed in a wide variety of physical environments and service-delivery topologies supporting 10G demarcation, enterprise customers, wireless backhaul providers, and 10G/1G applications.

The 3960 is based on Ciena's field-proven packet networking technology, deployed by dozens of network operators in tens of thousands of homes and businesses. The switch combines the low cost and high capacity of Ethernet with the reliability, management, and service quality usually associated with SONET/SDH networking systems. The 3960 software architecture is based on the common service-aware operating system used in all Ciena service delivery and aggregation switches to provide operational efficiency and consistent system and service attributes.

The core of the 3960 is a highperformance switching platform that incorporates the latest innovations in Ethernet switching technology, control plane protocols, and encapsulation techniques, and Carrier Ethernet Operations, Administration, and Maintenance (OAM) mechanisms. The result of this combination is a state-of-the-art design that enables the 3960 to deliver the sophisticated Quality of Service (QoS) capabilities, superior Virtual Local Area Network (VLAN) and virtual switching functions, and robust management and performance monitoring features required to support carrier-grade Layer 2 Virtual Private Networks (L2 VPNs), mission-critical data, high-speed Internet, and high-quality IPTV and VoIP services.

### Features and Benefits

- Uses high-capacity switch fabric to enable 10G demarcation and 10G/1G service delivery applications
- Supports four 10GbE XFP ports—two configurable as NNI or UNI and two dedicated as UNI
- Supports eight 100M/GbE subscriber UNI ports with Small Form-factor Pluggable (SFP) and RJ-45 connectors
- Supports diverse network topologies, including fiber rings, point-to-point fiber, dual-homed network uplinks, 10GbE uplinks and both 10GbE and 1GbE subscriber interfaces
- Supports operational efficiency and advanced Ethernet features for highend business and transport services with modular serviceaware operating system, including PBB-TE, Ethernet Virtual Private Line/LAN/Tree, and MPLS/H-VPLS
- Provides advanced Ethernet switching, control, and VLAN features with comprehensive QoS and Ethernet OAM, for guaranteed SLAs
- Features a state-of-the-art hardware design and fieldproven, modular serviceaware operating system for reliability and resiliency
- Offers compact (1RU) ETSI form factor and dual AC or DC power supply modules for enhanced reliability

The advanced design and service-rich architecture of the 3960 enable network operators to deploy reliable and scalable offerings that leverage the inherent high capacity and cost-effectiveness of Ethernet technology to generate maximum revenue. Ethernet business and transport services can be rolled out quickly and reliably, with scalable performance that reduces operating expenses, for low cost per subscriber in the short term and high system productivity and availability over the long term.

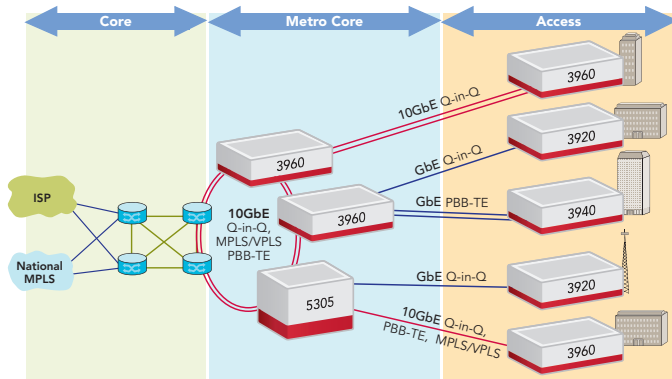


Figure 1. 3960 demarcation and aggregation

### Flexible, Cost-Effective Ethernet Service Delivery

The 3960 has the features and capabilities to thrive in diverse carrier networks and topologies, with a focus on the following applications:

- 10G demarcation
- 10G/1G enterprise services, wireless backhaul providers
- 10G/1G service aggregation

As bandwidth usage accelerates, carriers are migrating to 10GbE aggregation and introducing 10GbE service offerings to enterprise customers. Ciena's 3960 features four 10GbE ports, enabling true 10GbE service delivery and 10GbE service demarcation with 1GbE service delivery with ring topology support. With Ciena's advanced network, service, and Service Level Agreement (SLA) management, carriers can serve even the most demanding enterprise customers with confidence.

### Carrier Ethernet Services, Transport, PBB-TE

The 3960 gives service providers 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
- PBB-TE tunnels with PBB-TE Ethernet virtual circuits
- ITU-T G.8032 Ethernet Shared Protection Rings (E-SPRing)
- MPLS pseudowires, Virtual Private Wire Services (VPWS), and Hierarchical-VPLS (H-VPLS)

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

The 3960's advanced PBB-TE feature set provides a reliable, resilient, and cost-effective transport solution ideal for delivering a variety of new services to a fast-growing customer base. These capabilities include the PBB-TE tunneling protocol, with built-in backup tunnels, a dual homing tunnel option, tunnel monitoring with Ethernet OAM continuity check messages, and advanced management mechanisms that support the provisioning of PBB-TE service instances.

Based on extensions to current Ethernet standards, PBB-TE-enabled products maintain compatibility with existing Ethernet deployments, enabling the 3960 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 3960 offers superior investment protection.

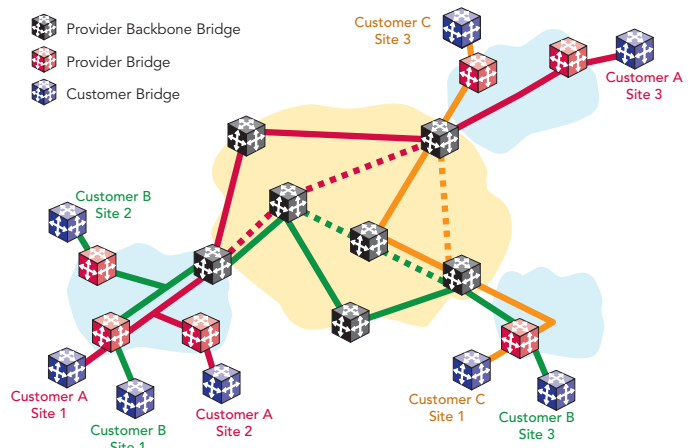


Figure 2. PBB-TE primary and backup tunnels

## Carrier-Class QoS

The 3960 implements carrier-class, MEF-14-compliant QoS mechanisms that enable 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, Layer 4 port address
- Flexible priority resolution for Class of Service mapping based on priority settings contained in VLAN, MPLS, and PBB-TE tags, as well as in 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

The 3960 software architecture is based on the common service-aware operating system used in all Ciena service delivery and aggregation switches to deliver consistent benefits across all Ethernet access and aggregation applications, including:

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

The 3960 software is designed to deliver plug-and-play activation, making new service rollout fast and easy. The switch also supports an advanced automatic activation feature that can upgrade default settings to deploy operator-specific configurations, reducing new platform integration time and enabling network operators to extend services to new subscribers rapidly and efficiently.

## Carrier-Class Ethernet OAM

The 3960 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 Connectivity Fault Management (CFM), including MAC Ping/Traceroute and Continuity Check
- ITU Y.1731 performance management
- 802.1AB Link Layer Discovery Protocol (LLDP)
- IETF Two-Way Active Management Protocol (TWAMP) with complete sender and receiver capabilities

These capabilities enable the 3960 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 (ESM)

Ciena's ESM is a groundbreaking carrier-grade, automated service activation, creation, and management platform for managing service delivery and aggregation networks and allowing users to:

- Build and deploy large-scale Carrier Ethernet networks quickly and easily
- Cut time to market for new services
- Accelerate service revenue
- Maximize service availability
- Assure service quality
- Leverage existing systems
- Enable subscriber-managed services

Each of these functions cuts total cost of ownership and allows operators to implement new services quickly and cost effectively for increased revenue and competitiveness. Ciena's Carrier Ethernet solution leverages the entire network as a programmable service-delivery engine, utilizing the ESM and service delivery and aggregation switches for efficient service creation, provisioning and activation. Ciena reduces both installation and configuration time by 75 percent, lowering costs dramatically and increasing service velocity. This speed is especially critical when delivering Ethernet business services where success based opportunities demand rapid service enablement.

## Technical Information

### Interfaces

2 x 10GbE UNI XFP ports  
2 x 10GbE NNI/UNI XFP ports  
8 x 100/1000M SFP/RJ-45 UNI ports  
1 x 10/100/1000M RJ-45 Management port  
1 x Console Port (EIA-232, DB9)

### 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 Bridging (Q-in-Q)  
VLAN full S-VLAN range  
VLAN tunneling (Q-in-Q) for Transparent LAN Services (TLS)  
Single and double VLAN tag translations on ingress and egress  
Per VLAN MAC Learning Control  
Per-Port MAC Learning Control  
IEEE 802.1s/w: Rapid/Multiple Spanning Tree  
IEEE 802.3ad Link Aggregation Control Protocol (LACP)  
Jumbo Frames to 9216 bytes  
Layer 2 Control Frame Tunneling  
ITU-T G.8032 Ethernet Rings Protection Switching

### 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  
TWAMP Responder and Receiver (RFC5618)  
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

## MPLS/VPLS

MPLS Pseudowire Emulation Edge-to-Edge (PWE3)  
MPLS Virtual Private Wire Service (VPWS)  
VPLS (Virtual Private LAN Service) and Hierarchical VPLS (H-VPLS)  
RSVP-TE (for MPLS Tunnel Signaling)  
OSPF-TE (for MPLS Tunnel Routes)  
IS-IS-TE (for MPLS Tunnel Routes)  
LDP & Targeted LDP (for VPLS VC signaling)  
MPLS Fast ReRoute (via RSVP-TE)  
LSP Ping  
LSP Traceroute

### 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 DiffServ Code Point (DSCP)  
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  
Configurable metering burst size  
Configurable L2 frame bandwidth calculation  
Per-Port RED Egress Queuing  
Egress Shaping and Scheduling  
Traffic Profile on Port/C-VLAN ID/C-VLAN Priority Marking  
L2 Priority mapping from IP DSCP/TOS  
IP DSCP/TOS mapping from L2 Priority  
C-VLAN Priority to S-VLAN Priority Mapping  
S-VLAN Priority based on C-VLAN ID  
Per-VLAN Classification, Metering, and Statistics

### Multicast Management

IGMPv2 Snooping (RFC 2236)  
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  
SNMP MIB II (RFC 1213)  
Bridge MIB (RFC 1493)  
Ethernet-like Interface MIB (RFC 1643)  
MIB II interfaces (RFC 1573)  
RMON MIB (RFC1757) - inc. persistent configuration  
RMON II (RFC 2021) and RMON Statistics  
Per-VLAN Statistics  
RADIUS Client and RADIUS Authentication  
TACACS+ AAA  
DHCP Client (RFC 2131)  
NTP Client (RFC 1305)  
DNS Client (RFC 1035)  
Telnet Server  
Secure File Transfer Protocol (SFTP)  
Trivial File Transfer Protocol (TFTP)  
Secure Shell (SSHv2)  
Syslog with Syslog Accounting  
Port State Mirroring  
Local Console Port  
Comprehensive Management via Ethernet Services Manager (ESM)  
Remote Autoconfiguration via FTP, TFTP, SFTP  
Software download/upgrade via FTP, TFTP, SFTP

### Service Security

802.1x Port-based Network Access Control  
Egress Port Restriction  
Layer 2, 3 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)

### MAC Address Table Capacity

32,000 MAC addresses

### Power Requirements

Redundant hot-swappable AC or DC power supplies  
AC Input: 100V to 240V AC (nominal)  
AC Frequency: 50/60 Hz  
Maximum Power Input: 173 W  
DC Input: -48V, -60V DC (nominal)

## Technical Information continued

### Agency Approvals

#### Safety Certifications:

NRTL (TUV Rheinland)  
European Union CE mark (Declaration of Conformity)  
UL 60950-1 (US)  
IEC 60950-1 (International)  
EN 60950-1 (EU)  
AS/NZS 60950-1:2003 (Australia and New Zealand)  
CAN/CSA 22.2 No. 60950-1-03 (Canada)

#### Emissions:

FCC 47CFR Part 15 Class B  
FCC Part 15:1998 Class B  
EN55022 (1994) Class B (with amendments A1 and A2)  
EN 55022 (1998) + A1 + A2 Class B (EU)  
EN 55022 (1998) + A1 + A2 Class AB (EU)  
EN55022 (2006) Class B; VCCI Class B;  
AS/NZ CISPR22: 2004

EN61000-3-2 (1995) Harmonic current emissions

EN61000-3-3 (1995) Voltage fluctuations and flicker

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

#### Immunity:

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

EN 55024 1998 + A1:2001 + A2:2003  
CISPR 24 (International)

NEBS Level 3

#### Environmental:

RoHS 2002/95/EC  
WEEE 2002/96/EC

#### Laser Safety:

FCC 21 CFR subpart (J) (Safety of Laser Products)

Europe: EN60825-1:1994

+A1 1:1996+A2:2001 (European Safety of Lasers)

## Environmental Characteristics

#### Operating Temperature:

+32°F to +122°F (0°C to +50°C)

#### Storage Temperature:

-40°F to +158°F (-40°C to +70°C)

#### Relative Humidity:

Non-Condensing 5% to 90%

## Physical Characteristics

#### Dimensions:

1.75 in (H) x 17.5 in (W) x 14.5 in (D); 44.5 mm (H) x 444.5 mm (W) x 368.3 mm (D)

Weight: 15 lbs; 6.9 kg

## Ordering Information

3960, (8) 100/1000M SFP/RJ-45, (4) 10G XFP, ext. features, (2) slots AC or DC pluggable power sup.; Part/Kit#: 170-3960-902  
3940/3960, AC pluggable power supply; Part/Kit#: 170-0100-901  
3940/3960, DC pluggable power supply; Part/Kit#: 170-0101-901

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