

ACTIVEDGE 3940 SERVICE DELIVERY SWITCH



Features and Benefits

- Offers high-density, high-capacity all-GbE in compact 1RU form factor
- Provides bandwidth and scalability to support thousands of services on a single system using Carrier Ethernet business, residential and transport applications, including wireless backhaul
- Features state-of-the-art hardware design, including copper and optical interfaces for all interface ports, a wire-speed 24 Gb/s full duplex switching fabric, enhanced CPU and system memory, redundant fans, and redundant AC or DC power supplies
- Supports operational efficiency and advanced Ethernet features for highend business and transport services with modular serviceaware operating system, including PBB-TE and Ethernet Virtual Private Line/LAN/Tree
- Provides MAC address and VLAN scalability, interworking flexibility between disparate encapsulation formats, and improved security for customer L2VPNs through sophisticated virtual switching software architecture
- Helps ensure SLAs with carrier-class, MEF-14- compliant QoS features for broad service stratification and robust bandwidth allocation

Ciena's ActivEdge 3940 Service Delivery Switch is a next-generation Ethernet access system that cost-effectively delivers sophisticated business, transport, and residential Ethernet services via fiber or copper connections.

The 3940 features a high-capacity switching fabric with 24 Gigabit Ethernet (GbE) ports in a compact single rack unit (1RU) form factor, allowing front access to all data and management interfaces. This efficient packaging design provides both SFP and RJ-45 connectors for each of the 24 user ports, enabling deployment of the 3940 for service demarcation, aggregation, and transport applications in a wide variety of physical environments and network topologies, including fiber and microwave rings, point-to-point fiber, microwave mesh, and fiber or copper to subscriber.

The 3940 is based on Ciena's field-proven True Carrier Ethernet® technology, deployed by dozens of network operators in tens of thousands of homes, businesses, and mobile base station cell sites. 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 3940 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 3940 is a high-performance 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 these combined capabilities is a state-of-the-art design that enables the 3940 to deliver the sophisticated Quality of Service (QoS), 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 (L2VPNs), mission-critical data, high-speed Internet, and high-quality IPTV and VoIP services.

The advanced design and service-rich architecture of the 3940 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, transport, wireless backhaul, and residential services can be rolled out quickly and reliably, with low cost per subscriber and optimum utilization of network resources.

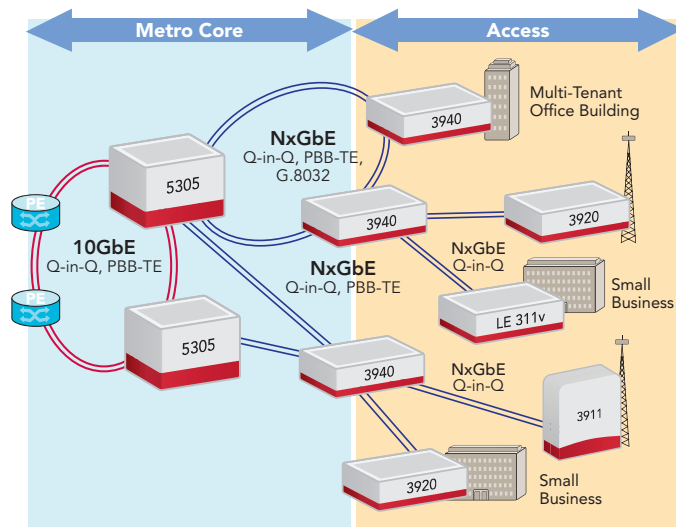


Figure 1. 3940 demarcation and aggregation

Key Element of 4G Mobile Backhaul

The rapid expansion of wireless networks and evolution to 3G and high-bandwidth WiMax and 4G services means network providers must be prepared to support new mobile backhaul traffic patterns and application requirements. This readiness includes the ability to support dark fiber and microwave ring-based topologies with backup paths and sub-50 ms link restoration. The 3940 is the ideal Ethernet access and aggregation system to address these needs. The switch's True Carrier Ethernet feature set—including advanced OAM, G.8032 Ethernet rings, PBB-TE-based protection schemes, and dual homing capabilities—help create the foundation of a resilient and robust Ethernet transport infrastructure that can support simplified service architectures for 3G and 4G wireless IP and Ethernet services and facilitate seamless migration to 4G networks.

Flexible, Cost-Effective Ethernet Service Delivery

Advanced features and an efficient physical design enable network operators to deploy the 3940 as a cost-effective access/demarcation system for business services and data transport applications. The 3940 also can be configured as an MTU/MDU aggregation switch to concentrate and integrate Ethernet traffic from other business and residential service delivery switches.

The 3940 provides an additional level of utility and flexibility because all 24 ports can be utilized as either UNI subscriber or NNI uplink ports to support VLAN, Q-in-Q provider VLAN, and MEF Ethernet Virtual Private Line/LAN/Tree services.

Carrier-Class QoS

The 3940 switch 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 interference or degradation. 3940 QoS capabilities support enhanced revenue generation by ensuring the efficient utilization of available network resources and delivering customer satisfaction based on enforceable and reliable Service Level Agreements (SLAs). These capabilities include:

- Rich classification of traffic flows based on Layer 1 through Layer 4 parameters, including physical port, MAC address, VLAN tag, and IP or L4 port address
- Flexible priority resolution for Class of Service mapping based on priority settings contained in IP packet headers and VLAN, and PBB-TE tags
- 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

Carrier Ethernet Services, Transport, PBB-TE

The 3940 offers a variety of Carrier Ethernet transport options, including:

- 802.1q VLAN
- 802.1ad provider VLAN (Q-in-Q)
- MEF Ethernet—including Ethernet Virtual Private Line/LAN/Tree services
- 802.1Qay PBB-TE tunnels with PBB-TE Ethernet Virtual Circuits
- ITU-T G.8032 Ethernet Ring Protection Switching

Ciena is an industry leader in the implementation of PBB-TE, which extends and adapts Ethernet to provide carrier-grade transport over Metro and Wide Area Networks (MANs and WANs). The 3940's advanced PBB-TE feature set delivers a reliable, resilient, and cost-effective transport solution, ideal for delivering a variety of new services to a fast-growing customer base. This feature set includes 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.

Layer 3 SLA Monitoring & Metrics: Delay, Jitter	IETF RFC 5618 TWAMP Two-Way Active Measurement Protocol
Layer 2 SLA Monitoring & Metrics: Delay, Jitter, Frame Loss	ITU-T Y.1731 Ethernet OAM
Service Heartbeats, End-to-End & Hop-by-Hop fault detection	IEEE 802.1ag CFM Connectivity Fault Management
Enhanced Troubleshooting, Rapid Network Discovery	IEEE 802.3ah Link Layer OAM

Figure 2. Complete Operations, Administration, and Maintenance offering

Based on extensions to current Ethernet standards, PBB-TE-enabled products maintain compatibility with existing Ethernet deployments. This broad compatibility enables the 3940 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 necessitating changes to existing network equipment or architectures, the 3940 offers superior investment protection.

Proven Service-Aware Operating System

The 3940 software architecture is based on the common service-aware operating system used in all Ciena service delivery and aggregation switches. This operating system delivers consistent benefits across all Ethernet access and aggregation applications, including:

- Rapid implementation of the latest advances in Ethernet technologies and 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

Carrier-Grade Ethernet OAM

The 3940 supports a rich set of OAM features as defined in the latest versions of IEEE, ITU, and IETF standards. Operators are provided extensive visibility of network health, ensuring customer SLAs are met while lowering operating costs. OAM features include:

- 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
- IETF RFC 5618 Two-Way Active Management Protocol (TWAMP) Layer 3 performance measurement mechanisms

Reliability and Resiliency

The 3940 delivers carrier-class reliability and availability based on the following design elements and capabilities:

- A modular software architecture with a real-time kernel that delivers reliability and high availability by protecting against complete operating system failures
- State-of-the-art hardware design, including redundant power supplies, industrial temperature components, and highreliability techniques to achieve extended MTBF ratings
- Carrier Ethernet OAM features that monitor physical and logical link status and support 50 ms link and service restoration from fault conditions
- PBB-TE dual homing and backup tunnels, which support immediate service switchover (sub-50 ms) in event of primary tunnel failure
- Advanced optimization of the IEEE 802.1w Rapid Spanning Tree Protocol (RSTP) to deliver sub-50 ms failover times
- Support for the IEEE 802.3ad link aggregation control protocol, which ensures customer traffic is not disrupted by the failure of one or more physical ports
- Ethernet Shared Protection Rings (E-SPRing) compliant to ITU-T G.8032 providing highly scalable ring architectures with rapid (sub-50ms) service restoration

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.

Technical Information

Interfaces

4 x 100/1000M SFP/RJ-45 NNI/UNI ports
20 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)
VLANs with 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 802.3ad Link Aggregation Control Protocol (LACP)
Jumbo Frames to 9216 bytes
Layer 2 Control Frame Tunneling
ITU-T G.8032 Ethernet "Ring" 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
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

Quality of Service

8 Hardware Queues per Port
Committed and Excess Information Rate (CIR and EIR)
Per-port per-VLAN QoS with CIR and EIR traffic on Egress Queues
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 64 Ingress Meters per port
Up to 512 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 priority 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

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 - inc. 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
Secure File Transfer Protocol (SFTP)
RFC 1350 Trivial File Transfer Protocol (TFTP)
Secure Shell (SSHv2)
Syslog with Syslog Accounting
Port State Mirroring
Local Console Port
Comprehensive Management via Ethernet Services Manager
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, 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)

MAC Address Table Capacity

16,000 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: 110 W
DC Input: -48V, -60V DC (nominal)

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
+A11:1996+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: 5% to 90%
Non-Condensing

Physical Characteristics

Dimensions: 1.75 in (H) x 17.5 in (W) x 14.6 in (D);
44.5 mm (H) x 444.5 mm (W) x 371 mm (D)
Weight: 15 lbs; 6.9 kg (maximum)

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1201 Winterson Road
Linthicum, MD 21090
1.800.207.3714 (US and Canada)
1.410.865.8671 (outside US and Canada)
+44.20.7012.5555 (international)
www.ciena.com