Cisco ME 3800X Series Carrier Ethernet Switch Router

The Cisco® ME 3800X Series Carrier Ethernet Switch Router is a converged, full-featured aggregation platform purposely designed for the mobile, business, and residential markets. With low power consumption and high service scale, this 1-rack-unit (1RU) switch router is optimized for small aggregation and remote point-of-presence (POP) applications making it a highly cost effective option. The Cisco ME 3800X Series expands the Cisco Carrier Ethernet aggregation portfolio while complementing the Cisco 7600 Series and ASR 9000 Series routers by providing a rich and scalable feature set of Layer 2 and Layer 3 VPN services in a compact package.

The Cisco ME 3800X Series (Figure 1) is a small footprint fixed-form-factor platform that comes in the following configuration:

- Cisco ME 3800X-24FS with 24 Gigabit Ethernet SFP ports and two 10 Gigabit Ethernet SFP+ ports

Figure 1.   Cisco ME 3800X Series Carrier Ethernet Switch Router

Key Applications

Broadband Aggregation
The Cisco ME 3800X Series supports broadband aggregation for delivering "any-play" services (voice, video, data, and mobility). Designed to support thousands of subscribers, quality of service (QoS) on the Cisco ME 3800X Series is capable of scaling to 32,000 queues per device. This high number of queues combined with a more granular QoS algorithm (three-level hierarchical QoS) results in a greatly enhanced broadband user experience. This feature-rich Layer 2 and Layer 3 switch router supports a variety of broadband applications including IPTV and video on demand (VoD), enhancing and extending the Cisco IP NGN architecture.

Pre-Aggregation for Mobile Applications
Deployed as a pre-aggregation platform for mobile backhaul, the Cisco ME 3800X Series can aggregate Cisco MWR 2941 cell site routers and use MPLS as a transport for Radio Access Network (RAN) backhaul traffic. The Cisco ME 3800X Series offers timing services, allowing for mobile clocking synchronization from the core of the network toward the RAN. The Cisco ME 3800X Series can receive clocking information into its Building Integrated Timing Supply (BITS) interface. It supports synchronous Ethernet (SynchE) with Ethernet Synchronization Messaging Channel (ESMC) to allow best clock source traceability.

Metro Ethernet Aggregation

The Cisco ME 3800X Series is built to meet service provider requirements for Carrier Ethernet aggregation. It is optimized for the remote central office (CO) and smaller aggregation sites where a fully featured, small-footprint aggregation platform is needed. The Cisco ME 3800X Series offers service flexibility and delivers Layer 2, IP, and MPLS transport for advanced Layer 2 and Layer 3 VPN and multicast services.

Key Differentiators

The Cisco ME 3800X Series helps service providers deliver advanced services for residential broadband, mobile, and Metro Ethernet applications. The highlights of this aggregation platform include the following.

Cisco Carrier Ethernet ASIC

Powered by Cisco's Carrier Ethernet ASIC, designed specifically for the needs of service providers, the Cisco ME 3800X Series delivers essential Carrier Ethernet technologies including: Hierarchical QoS (H-QoS), MPLS, and Virtual Private LAN Services (VPLS). The ASIC provides line-rate performance and enables advanced services including ACL and H-QoS without impacting performance. This Carrier Ethernet ASIC incorporates innovative traffic management capabilities while providing intelligent packet switching and routing operations.

Service Richness

With the Cisco ME 3800X Series, each service is assigned enhanced QoS and security attributes. The Cisco ME 3800X Series accomplishes advanced per-traffic-class metering and offers bidirectional packets and bytes statistics. The service offering is enhanced with rich operations, administration, and management (OAM) functionality including: Layer 2 Connectivity Fault Management (CFM), IP SLA for Layer 3, and MPLS OAM.

Service Scale

The Cisco ME 3800X Series delivers unmatched service scalability in a 1RU footprint. With support for 256,000 MAC addresses and 8000 bridge domains, this switch router delivers high performance and high scale for point-to-point and multipoint VPN services. A total buffer size of 352 MB is available to provide per service advanced QoS capabilities.. Such amount of buffer is required when stringent applications like financial or video must be protected against the impact of 10 Gbps to 1 Gbps speed mismatch. The quantity of statistical counters enables the Cisco ME 3800X Series to provide a high level of service metering and monitoring throughout its range of scale.

High-Performance Hardware

The Cisco ME 3800X Series provides two slots for hot-swappable and redundant power supply. Three fans are integrated into each power supply, providing fan redundancy. High Availability is also achieved on the Cisco ME 3800X Series through proactive diagnostic tools including Generic On-Line Diagnostics (GOLD) and Onboard Failure Logging (OBFL). These tools help service providers avoid potential problems before they occur and troubleshoot and diagnose once identified.

Table 1 lists the hardware parts available for Cisco ME 3800X Series.

Table 1.   Hardware Components for Cisco ME 3800X Series

Part Number	Description
ME-3800X-24FS-M	Cisco ME 3800X-24FS Ethernet Carrier Ethernet Switch Router
ME-3800X-24FS-M=	Spare Cisco ME 3800X-24FS Ethernet Carrier Ethernet Switch Router
PWR-ME3KX-AC	Cisco ME 3600X/ME 3800X Series field- replaceable AC power supply and fan module

Part Number	Description
PWR-ME3KX-DC	Cisco ME 3600X/ME 3800X Series field- replaceable DC power supply and fan module
PWR-ME3KX-AC=	Cisco ME 3600X/ME 3800X Series spare field-replaceable AC power supply and fan module
PWR-ME3KX-DC=	Cisco ME 3600X/ME 3800X Series spare field-replaceable DC power supply and fan module
ME-FANTRAY=	Cisco ME 3600X/ME 3800X Series spare fan tray. The fan tray is required in the second slot when only one power supply is in the system.
RCKMNT-ME3KX-ETSI	ETSI Rack mount Option for the Cisco ME 3600X/ME 3800X Series
RCKMNT-ME3KX-23IN	23" Rack mount Option for Cisco ME 3600X//ME 3800X Series
RCKMNT-ME3KX-ANG	Angled Rack mount for Cisco ME 3600X/ME 3800X Series
RCKMNT-ME3KX-ETSI=	Spare ETSI Rack mount Option for the Cisco ME 3600X/ME 3800X Series
RCKMNT-ME3KX-23IN=	Spare 23" Rack mount Option for Cisco ME 3600X//ME 3800X Series
RCKMNT-ME3KX-ANG=	Spare Angled Rack mount for Cisco ME 3600X/ME 3800X Series
RCKMNT-ME3KX-19IN=	Spare 19" Rack mount Option for Cisco ME 3600X//ME 3800X Series
MEM-ME3K-2GB	Cisco ME 3600X and ME3800X SD Memory Card 2GB
MEM-ME3K-2GB=	Cisco ME 3600X and ME3800X SD Memory Card 2GB Spare
MEM-ME3K-4GB	Cisco ME 3600X and ME3800X SD Memory Card 4GB
MEM-ME3K-4GB=	Cisco ME 3600X and ME3800X SD Memory Card 4GB Spare

The Cisco ME 3800X Series supports a wide range of SFP and SPF+ optic modules. Table 2 lists their part numbers.

Table 2.   SFP and SFP+ Modules Supported with Cisco ME 3800X Series

	Part number
SFP	GLC-FE-100FX, GLC-FE-100EX, GLC-FE-100ZX, GLC-FE-100LX, GLC-FE-100BX-U, GLC-FE-100BX-D, GLC-LH-SM, GLC-SX-MM, GLC-ZX-SM, GLC-SX-MMD, GLC-LH-SMD, GLC-EX-SMD, GLC-T, GLC-BX-U (CPN 10-2094-02), GLC-BX-D (CPN 10-2093-02),, SFP-GE-L, SFP-GE-S, SFP-GE-T, CAB-SFP-50CM, CWDM-SFP-1470, CWDM-SFP-1490, CWDM-SFP-1510, CWDM-SFP-1530, CWDM-SFP-1550, CWDM-SFP-1570, CWDM-SFP-1590, CWDM-SFP-1610, DWDM-SFP-6061, DWDM-SFP-5979, DWDM-SFP-5898, DWDM-SFP-5817, DWDM-SFP-5736, DWDM-SFP-5655, DWDM-SFP-5575, DWDM-SFP-5413, DWDM-SFP-5494, DWDM-SFP-5332, DWDM-SFP-5252, DWDM-SFP-5172, DWDM-SFP-5092, DWDM-SFP-5012, DWDM-SFP-4931, DWDM-SFP-4851, DWDM-SFP-4772, DWDM-SFP-4692, DWDM-SFP-4612, DWDM-SFP-4532, DWDM-SFP-4453, DWDM-SFP-4373, DWDM-SFP-4294, DWDM-SFP-4214, DWDM-SFP-4134, DWDM-SFP-4056, DWDM-SFP-3977, DWDM-SFP-3898, DWDM-SFP-3819, DWDM-SFP-3739, DWDM-SFP-3661, DWDM-SFP-3582, DWDM-SFP-3504, DWDM-SFP-3425, DWDM-SFP-3346, DWDM-SFP-3268, DWDM-SFP-3190, DWDM-SFP-3112, DWDM-SFP-3033, DWDM-SFP-6141
SFP+	SFP-10G-SR, SFP-10G-LR, SFP-10G-ER, SFP-10G-ZR, SFP-10G-LRM, SFP-H10GB-CUxM, DWDM-SFP10G-61.41, DWDM-SFP10G-60.61, DWDM-SFP10G-59.79, DWDM-SFP10G-58.98, DWDM-SFP10G-58.17, DWDM-SFP10G-57.36, DWDM-SFP10G-56.55, DWDM-SFP10G-55.75, DWDM-SFP10G-54.94, DWDM-SFP10G-54.13, DWDM-SFP10G-53.33, DWDM-SFP10G-52.52, DWDM-SFP10G-51.72, DWDM-SFP10G-50.92, DWDM-SFP10G-50.12, DWDM-SFP10G-49.32, DWDM-SFP10G-48.51, DWDM-SFP10G-47.72, DWDM-SFP10G-46.92, DWDM-SFP10G-46.12, DWDM-SFP10G-45.32, DWDM-SFP10G-44.53, DWDM-SFP10G-43.73, DWDM-SFP10G-42.94, DWDM-SFP10G-42.14, DWDM-SFP10G-41.35, DWDM-SFP10G-40.56, DWDM-SFP10G-39.77, DWDM-SFP10G-38.98, DWDM-SFP10G-38.19, DWDM-SFP10G-37.40, DWDM-SFP10G-36.61, DWDM-SFP10G-35.82, DWDM-SFP10G-35.04, DWDM-SFP10G-34.25, DWDM-SFP10G-33.47, DWDM-SFP10G-32.68, DWDM-SFP10G-31.90, DWDM-SFP10G-31.12, DWDM-SFP10G-30.33

Flexible Software Options

The Cisco ME 3800X Series supports the Cisco IOS® Software Activation feature. With this feature Cisco IOS Software feature sets can be activated by Cisco software licenses, enabling a "pay as services grow" model. This model allows service providers to invest in software resources only when their business needs it. The Cisco ME3800X offers four different Cisco IOS Software licenses:

- The **Metro Ethernet Services** license offers advanced QoS, Carrier Ethernet Layer 2 features, and Ethernet OAM capability.
- The **Metro IP Services** license offers advanced QoS, Carrier Ethernet Layer 2 features, Ethernet OAM, Layer 3 features for advanced IP routing protocols, multi-VPN routing, and Forwarding Customer Edge (multi-VRF CE) capabilities.
- The **Metro Aggregation Services** license adds the following capabilities to the METRO IP ACCESS image: MPLS, EoMPLS pseudowires, VPLS, MPLS traffic engineering, Fast Reroute, and MPLS VPN support.
- The **Services Scalability** license enables full scalability for Layer 2, IP routing, MPLS resources and the use of Switch Management Database (SDM) templates.

Table 3 lists the key feature in the Cisco IOS licenses for the Cisco ME 3800X Series.

Table 3.   Feature Set in Cisco ME 3800X Series Licenses

Metro Ethernet Services	Metro IP Services	Metro Aggregation Services
Layer 2: 802.1d, 802.1q	**All features in METROETHSERVICES plus:**	**All features in: METROAGGRSERVICES plus:**
Ethernet Virtual Circuit (EVC)	IP routing (RIP, OSPF, EIGRP, IS-IS, BGP)	MPLS
Ethernet OAM (802.1ag, 802.3ah, E-LMI, 1731 PM)	PIM (SM, DM, SSM), SSM mapping	MPLS traffic engineering (TE) and Fast Reroute (FRR)
MST, REP, Flexlink, G.8032	Bidirectional Forwarding Detection (BFD)	MPLS OAM
Synchronous Ethernet, Ethernet Synchronization messaging Channel (ESMC) Synchronization Status Messages (SSM)	Multi-VRF CE (VRF lite) with service awareness (ARP, ping, SNMP, syslog, traceroute, FTP, TFTP)	MPLS VPN
		Multicast VPN (MVPN)
		Ethernet over MPLS (EoMPLS)
		Virtual Private LAN Services (VPLS), Hierarchical VPLS (H-VPLS)
		Pseudowire redundancy
		Switch Database Management (SDM) templates (with the Scalability license only)

Table 4 provides brief descriptions of the Cisco ME 3800X Series software options.

Table 4.   Cisco ME 3800X Series Software Options

Part Number	Product Name
License Options	
ME3800X-E	Cisco ME3800X METRO ETHERNET SERVICES Software Paper License
ME3800X-I	Cisco ME 3800X Series METRO IP SERVICES Software Paper License
ME3800X-A	Cisco ME 3800X Series METRO AGGREGATION SERVICES Software Paper License
ME3800X-S	Cisco ME 3800X Series SCALED Software Paper License
Product Activation Keys	
ME3800X-LIC=	Product activation keys for ME3800X Series (Paper Delivery)

Part Number	Product Name
L-ME3800X-LIC=	Product activation keys for ME3800X Series (E-Delivery)

Part Number	Product Name
License Upgrade Options	
ME3800X-I-A	Cisco ME 3800X Series METRO IP2 AGGREGATION SERVICES Software Paper License
L-ME3800X-I	Cisco ME 3800X Series METRO IP SERVICES Software E License
L-ME3800X-A	Cisco ME 3800X Series METRO AGGREGATION SERVICES Software E License
L-ME3800X-I-A	Cisco ME 3800X Series METRO IP2 AGGREGATION SERVICES Software E License
L-ME3800X-S	Cisco ME 3800X Series SCALED Software E License
Software Options	
S380XVT-12252EY	Cisco ME 380X Series IOS UNI. W/O CRYPTO
S380XVK9T-12252EY	Cisco ME 380X Series IOS UNIVERSAL
S380XVT-15102EY	Cisco ME 380X Series IOS UNIVERSAL W/O CRYPTO TAR – Release 15.1(2)EY
S380XVK9T-15102EY	Cisco ME 380X Series IOS UNIVERSAL TAR – Release 15.1(2)EY
S380XVK9T-15202S	Cisco ME 380X SERIES IOS UNIVERSAL TAR – Release 15.2(2)S
S380XVT-15202S	Cisco ME 380X SERIES IOS UNIVERSAL W/O CRYPTO TAR – Release 15.2(2)S
S380XVK9T-15204S	Cisco ME 380X SERIES IOS UNIVERSAL TAR – Release 15.2(4)S
S380XVT-15204S	Cisco ME 380X SERIES IOS UNIVERSAL W/O CRYPTO TAR – Release 15.2(4)S
S380XVK9T-15301S	Cisco ME 380X SERIES IOS UNIVERSAL TAR – Release 15.3(1)S
S380XVT-15301S	Cisco ME 380X SERIES IOS UNIVERSAL W/O CRYPTO TAR – Release 15.3(1)S
S380XVK9T-15302S	Cisco ME 380X SERIES IOS UNIVERSAL TAR – Release 15.3(2)S
S380XVT-15302S	Cisco ME 380X SERIES IOS UNIVERSAL W/O CRYPTO TAR – Release 15.3(2)S

Key Features

Table 5 lists the features of the Cisco ME 3800X Series.

Table 5.   Features

Features
Ethernet Services
- Ethernet Virtual Connections (EVCs) for: - QinQ   - Selective QinQ   - Inner and Outer VLAN classification   - EVC Push and Pop rewrite   - EVC local connect   - IEEE bridging   - Layer 2 Protocol Tunneling (L2PT)   - Hierarchical VPLS (H-VPLS), Virtual Private LAN Service (VPLS), VPLS Border Gateway Protocol [BGP] signaling   - Virtual Private Wire Service (VPWS), Ethernet over MPLS (EoMPLS), pseudowire redundancy   - Ethernet Data Plane loopback (Terminal and Facility)

Features

Layer 3 Services

- Layer 3 Routing
- IPv4 Routing (Border Gateway Protocol [BGP], Intermediate System-to-Intermediate System [IS-IS], and Open Shortest Path First [OSPF]), Hot Standby Router Protocol (HSRP), Virtual Router Redundancy Protocol (VRRP)
- IPv6 Unicast Routing (Border Gateway Protocol [BGP], Intermediate System-to-Intermediate System [IS-IS], and Open Shortest Path First [OSPF])
- IPv6 Provider Edge (6PE)
- IPv6 VPN over MPLS (6VPE)
- MPLS
- Label Distribution Protocol (LDP), Targeted LDP (T-LDP), Resource Reservation Protocol (RSVP), Differentiated Services (DiffServ)-aware traffic engineering, MPLS L3VPN
- MPLS traffic engineering (including TE-FRR)
- Carrier Supporting Carrier (CsC) with BGP as CE-PE routing protocol
- BGP with label distribution (RFC3107)
- Routed Pseudowire
- Integrated Routing and Bridging (IRB)
- Policy Based Routing (PBR)

QoS

- Up to 32,000 egress queues per system
- Class-Based Weighted Fair Queuing (CBWFQ)
- Priority Queuing
- 2-rate 3-color (2R3C) ingress Policing, Egress Policing (1R2C) for LLQ
- Ingress and Egress marking (CoS, DSCP, MPLS Experimental Bits)
- Egress shaping per port and per queue
- Modular QoS CLI (MQC)
- 3-level H-QoS
- Classification based on inner and outer class of service (CoS) or VLAN ID
- Copy inner to outer CoS
- WRED
- IPV6 QoS
- Table Map

Multicast

- IPv4 Multicast
- Protocol Independent Multicast sparse mode (PIM-SM), PIM Source Specific Multicast (PIM SSM), PIM SSM mapping
- Internet Group Management Protocol Versions 1, 2, and 3 (IGMPv1, v2, and v3)
- IGMPv1, v2, and v3 snooping on switchport, EVC interfaces and Pseudowires
- PIM Snooping
- IPv4 multicast per VRF lite
- Multicast VPN (MVPN)

Security

- Authentication, authorization, and accounting (AAA); TACACS+; Secure Shell (SSH) Protocol; MAC limiting per Ethernet flow point (EFP) or bridge domain; unicast, multicast, and broadcast storm control blocking on any interface or port
- Layer 2 ACLs
- Layer 3 ACLs for IPv4 and IPv6
- ACL on switchport, EVC and routed interfaces
- Control Plane Policing
- DHCP snooping with option 82
- Dynamic Arp Inspection (DAI)
- SPAN
- 802.1x Authenticator

Features
Availability
• Resilient Ethernet Protocol (REP) • ITU-T G.8032 Ethernet Ring Protection Switching • IEEE 802.1w Rapid Spanning Tree Protocol (RSTP) • IEEE 802.1s Multiple Spanning Tree Protocol (MST) • Per-VLAN Rapid Spanning Tree (PVRST+) • MPLS TE Fast Reroute • BFD triggered Fast Reroute • Flexlink • BFD for Static,ISIS, OSPF, BGP • BFD over Switched Virtual Interface (SVI) • 802.3ad Link Aggregation Bundles • MPLS IGP-LDP Synchronization • LACP 1-1 redundancy with Fast Switchover • EoMPLS Link Path Through
OAM
• CFM (802.1ag) • Link OAM (802.3ah) • MPLS OAM • E-LMI (CE and PE) • 1731 Performance Monitoring (ETH-DM , ETH-SLM) with concurrent and on demand operations
Manageability
• Simple Network Management Protocol (SNMP) • MIBs • RMON • Cisco Active Network Abstraction (ANA) 3.7.1: physical and logical inventory, service-level views with support for the following technologies: OSPF, BGP, EtherChannel, routing, Link Aggregation Group (LAG), ACL, Cisco Discovery Protocol, Address Resolution Protocol (ARP) • CiscoWorks Lan Management Solution (LMS) 3.2 • Embedded Event Manager (EEM 4.0) • 60 days build-in evaluation licenses • Switch Database Management (SDM) • External SD Flash Cards support
Timing
• ITU-T Synchronous Ethernet (syncE) with Ethernet Synchronization Messaging Channel (ESMC) • Synchronization Status Messages (SSM)

Product Specifications

Tables 6 through 8 list product, power, and environmental specifications for the Cisco ME 3800X Series. Table 9 lists standards and protocols, and Table 10 gives safety and compliance information.

Table 6.   Product Specifications

Description	Cisco ME 3800X-24FS
Performance	Forwarding bandwidth full duplex: Cisco ME 3800X-24FS AC or DC: 44 Gbps Forwarding rate: Cisco ME 3800X-24FS AC or DC: 65 Mpps Configurable maximum transmission unit (MTU) of up to 9,800 bytes, for bridging on Gigabit and 10 Gigabit
Memory	DRAM: 1GB Flash: 64MB Packet buffer: 352MB External SD Flash: 2GB and 4GB SD Flash cards (optional)

Description	Cisco ME 3800X-24FS
Connectors and cabling	SFP ports: • 10/100/1000BASE-T SFP-based ports: RJ-45 connectors, 4-pair Category 5 UTP cabling • 100BASE-FX and -LX: Duplex LC receptacle fiber connectors (multimode and single-mode) • 100BASE-BX: Single-fiber LC receptacle connector (single-mode fiber) • 100BASE-EX: SFP module for 100 Mb port, 1310 nm wavelength, 40 km over single-mode fiber • 100BASE-ZX: SFP module for 100 Mb port, 1550 nm wavelength, 80 km over single-mode fiber • 1000BASE-BX: Single-fiber LC receptacle connector (single-mode fiber) • 1000BASE-SX, -LX/LH, -EX and -ZX and CWDM and DWDM: Duplex LC receptacle fiber connectors (multimode and single-mode fiber) SFP+ port: • 10GBASE-LR, -SR, -ER, -ZR, –LRM, DWDM and -H10GB-CUxM where x = 1, 3, 5 meters • SFP+ port supports 1000BASE-X except 1000BASE-T. Management console port: RJ-45-to-DB9 cable for PC connections Management 10/100/1000 Ethernet: RJ-45 connector BITS and alarm ports: RJ-45 connector
Indicators	Per-port status LEDs: Link integrity, port disabled, and activity indications Power input /output status LED Alarm status LED SynchE status LED System status LED
Dimensions	All SKUs 1.72-in. x 17.50-in. x 20.33-in. (H x W x D)
Weight	ME-3800X-24FS-M 14.50 lb (6.57 kg) PWR-ME3KX-AC 2.90 lb (1.31 kg) PWR-ME3KX-DC 3.10 lb (1.40 kg) ME-FANTRAY 1.65 lb (0.74 kg)
Mean time between failure (MTBF)	ME3800X-24FS-M: 185,349 hours PWR-ME3KX-DC: 319,000 hours (48V input at 40ºC) PWR-ME3KX-AC: 328,000 hours (120V at 40ºC), 342,000 hours (230V at 40ºC) ME-FANTRAY: 2,177,000 hours (12V input at 40ºC)

Table 7. Power Specifications

Description	Cisco ME 3800X-24FS
Power consumption	Cisco ME 3800X-24FS, one AC and one FT: 155W (typical), 228W (maximum), 530 Btus per hour (typical), 779 Btus per hour (maximum) Cisco ME 3800X-24FS, two AC: 163W (typical), 233W (maximum), 557 Btus per hour (typical), 796 Btus per hour (maximum) Cisco ME 3800X-24FS, one DC and one FT: 156W (typical), 246W (maximum), 533 Btus per hour (typical), 840 Btus per hour (maximum) Cisco ME 3800X-24FS, two DC: 161W (typical), 238W(maximum), 550 Btus per hour (typical), 813 Btus per hour (maximum)
AC input voltage and frequency	100–240VAC, 50–60Hz
DC input voltages	18V to 32VDC, 36V to 72VDC

Table 8.   Environmental Specifications

Cisco ME 3800X Series Environment Specification (NEBS)	
Operating environment and altitude[1]	Normal operating temperature and altitudes: 0 to +50ºC, up to 1000 feet (300m) 0 to +45ºC, up to 6000 feet (1800m) 0 to +40ºC, up to 10,000 feet (3000m) Short-term[2] exceptional conditions: 0 to +60ºC, up to 1000 feet (300m) 0 to +55ºC, up to 6000 feet (1800m) 0 to +50ºC, up to 10,000 feet (3000m) 0 to +45ºC, at sea level with single fan failure
Relative humidity[3]	5% to 95%, non-condensing
Acoustic noise [4]	LpA: 43 dB typical, 45 dB maximum LwA: 5.4 Bel typical, 5.6 Bel maximum
Storage environment	Temperature: –25 to +70ºC altitude: 15,000 ft

1. Switch supports –5ºC operation provided that it powers up at ambient equal to or greater than 0ºC. SFP-1 0G-LRM SFP+ module may only be used from 0ºC. GLC-T SFP may only be used from 0 to +50ºC, up to 1000 feet (300m), for normal operating and short-term conditions

2. Not more than the following in a one-year period: 96 consecutive hours, or 360 hours total, or 15 occurrences

3. This may be limited by specification of optical modules

4. Acoustic noise is measured per ISO 7779 and declared per ISO 9296

Table 9.   Standards and Protocols

Standards and protocols	
• IEEE 802.1s • IEEE 802.1w • IEEE 802.3ad • IEEE 802.3ah • IEEE 802.1ag • IEEE 802.3x full duplex on 10BASE-T, 100BASE-TX, and 1000BASE-T ports • IEEE 802.1D Spanning Tree Protocol • IEEE 802.1p CoS classification	• IEEE 802.1Q VLAN • IEEE 802.3 10BASE-T • IEEE 802.3u 100BASE-T • IEEE 802.3ab 1000BASE-T • IEEE 802.3z 1000BASE-X • BFD for OSPF, IS-IS, BGP, HSRP, EIGRP • IP routing: Static, RIP versions 1 and 2, EIGRP, OSPF, BGPv4, PIM-SM, and PIM-DM (metro IP access only) • Management: SNMP versions 1, 2, and 3 • MEF 9 & 14 certified • MEF CE 2.0 certified (E-LINE, E-LAN, E-TREE)

Table 10.   Safety and Compliance

Type	Standards
Electromagnetic	FCC Part 15 Class
Emissions Compliance	• EN 55022 Class A (CISPR22 Class A) • EN 55024 • EN 300 386 • VCCI Class A • AS/NZS 3548 Class A or AS/NZS CISPR22 Class A • KCC • CE Marking

Type	Standards
Safety	• UL 60950-1 • UL to CAN/CSA 22.2 No.60950-1 • TUV/GS to EN 60950-1 with all Amendments • CB to IEC 60950-1 with all country deviations • NOM to NOM-019-SCFI (through distributors) • CE Marking • CCC
NEBS	GR-63-CORE, GR-1089-CORE – Level 3, Type 2 Verizon's FOC Certification on optical SFPs
ETSI	EN 300 019 – Storage: Class 1.2, Transportation: Class 2.3, In-Use: Class 3.2

Service and Support

Cisco offers a wide range of services programs to accelerate customer success. These innovative services programs are delivered through a unique combination of people, processes, tools, and partners, resulting in high levels of customer satisfaction. Cisco services help you protect your network investment, optimize network operations, and prepare your network for new applications to extend network intelligence and the power of your business. For more information about Cisco services, refer to Cisco Technical Support Services or Cisco Advanced Services.

Cisco is committed to minimizing your total cost of ownership. Cisco offers a portfolio of technical support services to help ensure that Cisco products operate efficiently, remain highly available, and benefit from the most up-to-date system software. The services and support programs described in Table 11 are available as part of the Cisco Carrier Ethernet Switching Service and Support solution and are available directly from Cisco and through resellers.

Table 11. Service and Support

Advanced Services	Features	Benefits
Cisco Total Implementation Solutions (TIS), available directly from Cisco Cisco Packaged TIS, available through resellers	• Project management • Site survey, configuration, and deployment • Installation, text, and cutover • Training • Major moves, adds, and changes • Design review and product staging	• Supplement existing staff • Help ensure functions meet needs • Mitigate risk
Cisco SP Base Support and Service Provider-Based Onsite Support, available directly from Cisco Cisco Packaged Service Provider- Based Support, available through resellers	• 24-hour access to software updates • Web access to technical repositories • Telephone support through the Cisco Technical Assistance Center (TAC) • Advance Replacement of hardware parts	• Facilitate proactive or expedited problem resolution • Lower total cost of ownership by taking advantage of Cisco expertise and knowledge • Minimize network downtime

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