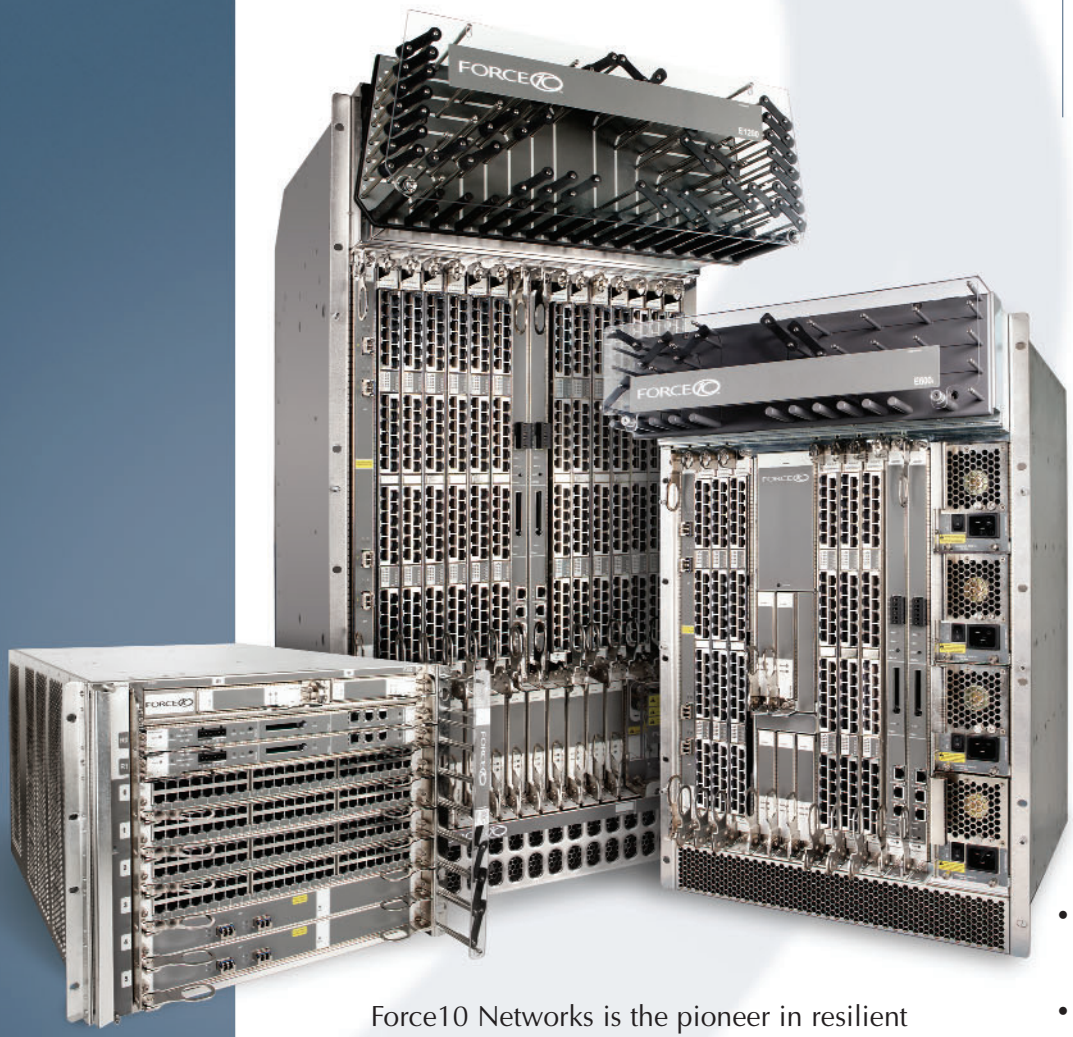
E1200 • E600 • E300

Best-in-Class Resiliency

Massive Scalability

1,260 Gigabit Ethernet or 224 Ten Gigabit Ethernet ports per chassis

Battle Tested, Full Function L2 Switching and L3 Routing



Force10 Networks is the pioneer in resilient Gigabit and 10 Gigabit Ethernet switching and routing. The Force10 E-Series switch/routers provide best-in-class resiliency, unmatched scalability, line-rate performance, and full L2 switching and L3 routing. Based on revolutionary system architecture that combines fully distributed hardware and modular software, the E-Series switch/routers ensure predictable application performance, increase network availability, and reduce operating costs.

- Patented multi-processor design delivers best-in-class resiliency and security
- Up to 1,260 Gigabit Ethernet ports or 224 Ten Gigabit Ethernet ports per chassis, enabling unprecedented network scalability
- Innovative Force10 ASICs and E-Series architecture deliver non-blocking, line-rate forwarding with Access Control Lists (ACLs) across all line cards
- Fault-tolerance simplifies maintenance and maximizes system availability
- Robust Force10 FTOS™ software delivers full functionality Layer 2 (L2) switching and Layer 3 (L3) routing for applications spanning the LAN, MAN, and WAN

FORCE10™

Scalable Performance

To simplify network operation and maintenance, the E1200/E600/E300 allow hot-swap of all key components and share the same Switch Fabric Modules (SFMs) and FTOS software. In addition, the E1200 and E600 share common line cards and Route Processor Modules (RPMs).

The Force10 E-Series sets a new standard for high-performance switch/routers with unmatched scalability to 1,260 Gigabit Ethernet or 224 Ten Gigabit Ethernet ports per chassis, consistent performance with ACLs on all ports, and full L2 switching and L3 routing. These groundbreaking products simplify network applications from Server/ Cluster Consolidation, Grid Computing, Campus backbones, next-generation Internet Exchanges, and Metro Ethernet services.

The Force10 E-Series E1200/E600 provides 56.25 Gigabits per second per slot and the E300 delivers 25 Gigabits per second per slot. All deliver predictable line-rate performance with any combination of features enabled, deterministic low latency and jitter, robust L2/L3 functionality, and the resiliency to thwart Denial of Service (DoS) attacks. Built upon the powerful and cost-effective Force10 architecture, the E-Series sets the industry standard both for resiliency and performance.

E1200

- 1.68 Tbps non-blocking switch fabric
- 1/2 rack chassis (19" rack width)
- 1 billion packets per second
- 14 line card slots
- 1+1 redundant RPMs
- 8:1 redundant SFMs
- 1+1 redundant DC Power Entry Modules

E600

- 900 Gbps non-blocking switch fabric
- 1/3 rack chassis (19" rack width)
- 500 million packets per second
- 7 line card slots
- 1+1 redundant RPMs
- 4:1 redundant SFMs
- 3+1 and 2+2 redundant AC power supplies
- 1+1 redundant DC Power Entry Modules

E300

- 400 Gbps non-blocking switch fabric
- 1/6 rack chassis (19" rack width)
- 196 million packets per second
- 6 line card slots
- 1+1 redundant RPMs
- 1:1 redundant SFMs
- 3+1 and 2+2 redundant AC power supplies
- 1+1 redundant DC Power Entry Modules

Highest Ethernet Density

The Force10 E-Series delivers unparalleled Gigabit Ethernet and 10 Gigabit Ethernet port densities. The E1200/E600 support 90 Gigabit Ethernet ports or 16 10 Gigabit Ethernet ports per line card slot and up to 14 and 7 line card slots per chassis respectively. The E300 supports 48 Gigabit Ethernet ports or eight 10 Gigabit Ethernet port per line card slot and up to six line card slots per chassis.

Line-Rate Performance

With three custom Force10 ASICs and advanced Ternary Content Addressable Memory (TCAM) on every line card, the Force10 E-Series provides line-rate, non-blocking forwarding performance across all ports, even with all features enabled simultaneously. These features include:

- Extended ACLs for packet filtering and policy routing
- Multi-field packet lookup and classification for QoS
- Packet metering and marking for rate limiting and policing
- Congestion control using WRED and WFQ

Full L2 Switching and L3 Routing

Force10 ASICs, E-Series architecture and FTOS software work in unison to give robust L2 switching and L3 routing functionality to the E-Series with the scalability and security required for applications spanning the LAN, MAN, and Internet-connected WAN. The Force10 E-Series L2 and L3 features include:

- BGP, IS-IS, OSPF, and RIP routing protocols
- Prefix-based distributed forwarding table on every line card
- Forwarding table support for up to 512K IPv4 and 32K IPv6 routes
- 55 ms to 200 ms packet buffering per port
- VLAN Redundancy, Rapid Spanning Tree, VLAN Stacking

High Density Interfaces

Ports Per Chassis	E300	E600	E1200
High Density Gigabit Ethernet	288	630	1,260
Line-Rate Gigabit Ethernet	132	336	672
High Density 10 Gigabit Ethernet	48	112	224
Line-Rate 10 Gigabit Ethernet	12	28	56

Resiliency: The Force10 E-Series Architecture

With the power of the E-Series architecture, the Force10 E-Series delivers breakthrough resiliency at performance levels never before realized. The Force10 E-Series architecture is the result of patented technological innovation in switch fabric, backplane, ASIC, and system control plane design.

Separate System Control Plane

The E-Series architecture includes distinct data and control planes. The system control plane is augmented with three processors on each Route Processor Module (RPM). The first processor handles Layer 2 control protocols, the second, Layer 3, and the third, management functions. This patented architecture allows faults to be contained while protecting other parts of the system. For example, it protects against spanning tree loops and DoS attacks providing unparalleled resiliency.

Designed to meet the needs of Internet-scale networks, the E-Series system control plane supports millions of routing table entries, up to 512K IPv4 forwarding table entries, and thousands of ACLs on every line card. The RPM's innovative control traffic rate limiting and filtering functionality empowers network administrators to suppress harmful DoS attacks and prevent flooding of unwanted traffic onto the network. And dedicated 100 Mbps switched paths from the RPMs to every line card eliminate sluggish forwarding table updates that could otherwise jeopardize network stability.

Distributed ASIC-Based Forwarding

The Force10 ASICs, along with advanced TCAMs on every line card, give absolutely predictable line-rate forwarding for every packet regardless of the number, type, or complexity of features enabled across the chassis. Unlike low-performance, processor-based forwarding architectures, there is no "slow-path" or software-based forwarding in the E-Series. The Force10 ASICs look up and act upon all information related to forwarding and applying policy to a packet before the entire packet is received, independent of table lengths, IP address prefix lengths, or packet size. This hardware forwarding enables the E-Series to provide the deterministic low latency and jitter required by VoIP and streaming media applications.

Non-Blocking 1.68 Tbps Switch Fabric

The E-Series switch fabric provides non-blocking connectivity along with advanced queuing, multicast, and jumbo frame support. The E1200/E600's cost-effective N:1 redundant switch fabric design reduces SFM sparing costs while providing 56.25 Gigabits per second of non-blocking bandwidth to each line card slot.

Passive Copper Backplane

The E-Series architecture's reliable and cost-efficient backplane is the industry's first high speed, non-optical backplane to scale to 5 Tbps data rates in a single 1/2 rack E1200 switch/router chassis. Unlike optical backplane interconnect systems or active copper backplanes, the E-Series backplane has no single point of failure and eliminates costly electrical-optical-electrical conversions. The resulting system simplicity afforded by the backplane means bulletproof reliability and minimum cost — available on all three platforms. The massive backplane capacity of E-Series chassis bought today also translates to enough bandwidth per slot (E1200 and E600) to support 100 GbE when that standard becomes available.

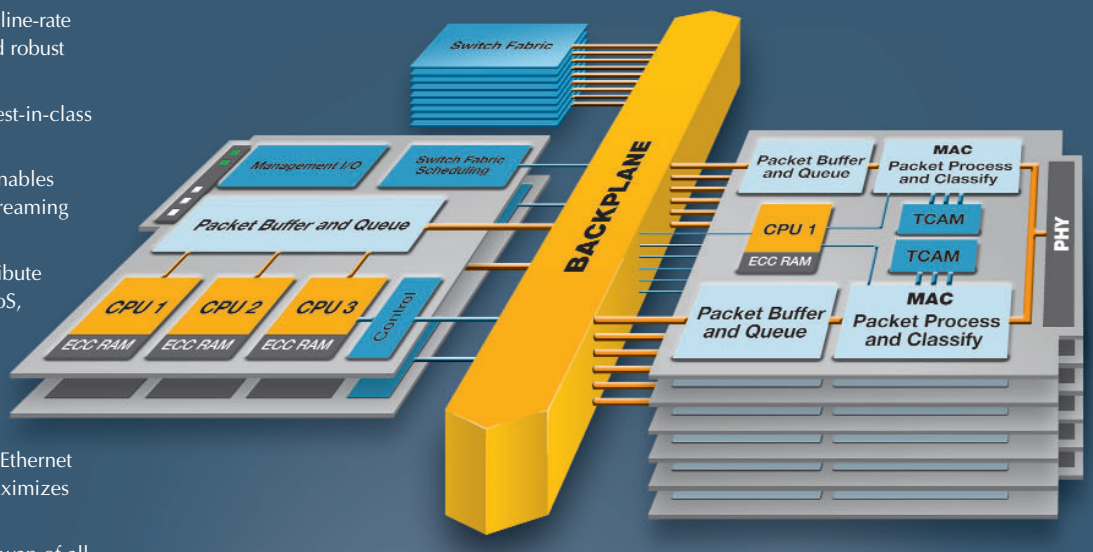
Fault Tolerance and High Availability

The E-Series architecture supports redundancy, availability, and serviceability features to maximize network uptime. All key systems in the E-Series are redundant, including the RPMs, SFMs, and power. All memory systems are ECC/parity protected. System-wide environmental monitoring and persistent configuration synchronization enable FTOS to detect, report, and correct faults with a minimum of system interruption. In addition, serviceability features include hot-swap of all key components, cable management, and front-side access to all cabling and cards minimize mean time to repair.

The Force10 E-Series Architecture

The Force10 E-Series Architecture delivers line-rate performance, cost-effective scalability, and robust L2 switching and L3 routing:

- Three CPU Route Processor delivers best-in-class resiliency and security
- Scalable, non-blocking switch fabric enables the low latency and jitter critical for streaming media applications
- High performance Force10 ASICs distribute packet forwarding, ACL processing, QoS, and buffering to every line card
- Robust L2/L3 multiprocessor control plane with innovative control traffic filtering and rate limiting capabilities
- Cost-effective, reliable — 100 Gigabit Ethernet ready — passive copper backplane maximizes system reliability and minimizes cost
- High availability features include hot-swap of all key components and system-wide environmental monitoring, maximizing system uptime and serviceability



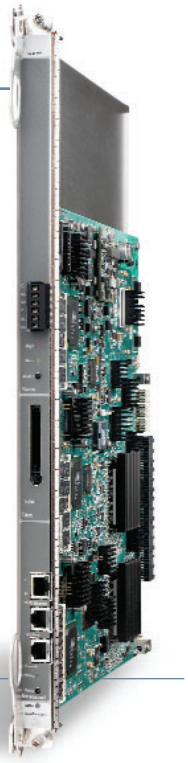
Force10 FTOS™ Software

Force10 FTOS software is purpose-built for scalable, high-performance Ethernet applications that span the LAN, MAN, and WAN. FTOS harnesses the massive performance of the Force10 E-Series and provides end users with the functionality they need to utilize the power of the E-Series architecture.

FTOS is a distributed, multi-processor operating system customized for high-availability and fault tolerance. FTOS delivers an extensive range of high-performance L2 switching and L3 routing features including robust IP routing control plane, hardware and software fault tolerance, highly granular traffic management and accounting, industry standard command line interface (CLI), and system diagnostics.

FTOS Provides:

- Stable, scalable L2 switching and L3 routing in a protected environment
- Fault tolerance with modular processes allocated to multiple system processors
- Simplified management with SNMP and an industry-standard CLI
- Full suite of debug and Syslog capabilities



E-Series Route Processor Module

E-Series Switch Fabric Module

FTOS Key Features

L2 Switching
- 4,096 VLANs
- 16M VLANs with VLAN stacking
- Up to 896K MAC addresses per system
- Link aggregation
- 802.1p prioritization
- Resilient ring protocal (FRRP)
- MSTP (802.1s)/RSTP (802.1w)

L3 Routing
- Robust protocols: BGP, IS-IS, OSPF and RIP
- Multicast with IGMP, PIM-DM, PIM-SM, PIM-BSR, MBGP, and MSDP
- Full Internet route table support
- VRRP
- Dual stack IPv4 and IPv6 forwarding
- Graceful restart of BGP and OSPF

Services
- Congestion control with WRED and WFQ
- QoS for L2 and L3
- Egress rate shaping, ingress rate policing
- Committed access rate support — two-rate, three-color model
- Port mirroring

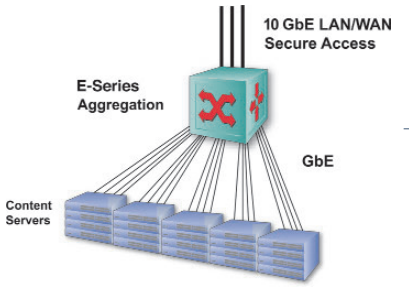
Management
- Ping, Traceroute, Telnet
- RADIUS, TACACS+, SSH, SCP
- FTP, TFTP client
- DNS client, BootP/DHCP relay
- Accounting and statistics
- SNMP v1, v2c, v3, HP OpenView support
- RMON
- Out of band console/AUX and FE management ports
- GUI-based EMS

The New Standard of Scalability and Performance

From Server/Cluster Consolidation and Grid Computing to Campus Backbones, next-generation Internet Exchanges and Metro Ethernet services, the breakthrough Force10 E-Series ensures predictable application performance, increases network availability, and reduces operating costs. The Force10 E-Series provides an unprecedented combination of resiliency, scalable performance, and full-featured routing and switching.

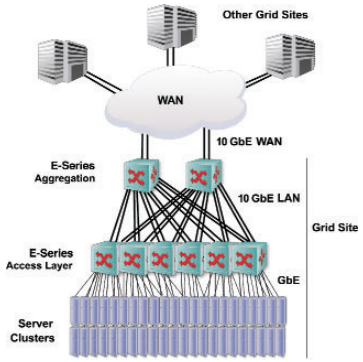
Force10 E-Series Applications

The Force10 E-Series simplifies high-speed enterprise and service provider applications spanning the LAN, MAN, and WAN. With its resiliency, its high density of Gigabit and 10 Gigabit Ethernet, line-rate performance, and robust L2/L3 feature set, the Force10 E-Series reduces total cost of ownership (TCO) and increases network scalability for Server/Cluster Consolidation, Grid Computing, Campus Backbones, Metro Ethernet services, and Internet Exchanges (IXs).



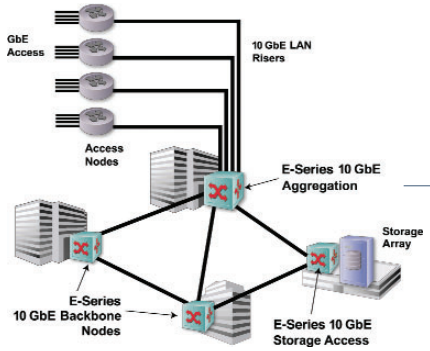
Server Consolidation

Server consolidation within the enterprise can dramatically lower TCO. Lower powered servers with 10/100 connections are being replaced by high-performance servers that provide Gigabit Ethernet connectivity and are co-located in fewer data centers. Aggregating these Gigabit Ethernet servers requires a next-generation platform that delivers high capacity, high port density, and bulletproof reliability. Aggregating these densities of Gigabit Ethernet links implies 10 Gigabit Ethernet in the trunk connections. The Force10 E-Series provides the highest-density platform for Gigabit Ethernet and line-rate, 10 Gigabit Ethernet to most cost-effectively address data center and server consolidation network requirements.



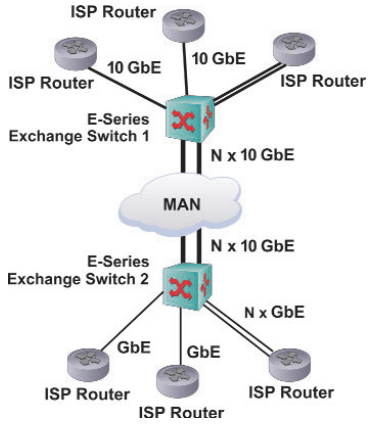
Cluster/Grid Computing

As they did with the Internet, research institutions are driving the creation of the next IT revolution: the Grid. Ultimately the Grid will create enormous "virtual supercomputers" providing CPU cycles on demand. Today the Grid is being built using native 10 Gigabit Ethernet connections between geographically disbursed Gigabit Ethernet attached server clusters. Similarly, many enterprises are clustering their servers into pools of computing resources to give users supercomputing power on the desktop. For both Grid and Cluster computing, the Force10 E-Series has the high-density and non-blocking performance needed to interconnect thousands of servers, and the L3 robustness needed to provide scalable, controlled access to them.



Campus Backbone

As with 10/100 Base-T before it, an explosion of 10/100/1000 Base-T at the desktop is underway, driving the need for 10 Gigabit Ethernet-attached servers and backbone trunks. Multiplying bandwidth requirements are IP-PBXs that put voice traffic onto the data network, new video and streaming media applications, and daily desktop backups to IP-connected storage arrays. The Force10 E-Series has the 10 Gigabit Ethernet density needed to contain the explosion of Gigabit Ethernet at the desktop, and the deterministic low latency and jitter characteristics required to deliver these new multimedia applications and storage services. Moreover, the Force10 E-Series delivers the economics expected of Ethernet to ease the introduction of 10 Gigabit Ethernet into the Enterprise.



Internet Exchange

Internet traffic continues to double every 18 months. Consequently, IXs find themselves at the nexus of a storm. IXs have turned to 10 Gigabit Ethernet for connections within and between exchange points to keep up with ever-increasing demands for L2 customer connections at Gigabit Ethernet speeds and beyond. With secure 10 Gigabit Ethernet interconnections across the MAN and WAN, the Force10 E-Series is helping IXs create virtual exchanges that bring the exchange closer to the customer. Moreover, the Force10 E-Series rich L2 services enable secure internet working between exchange point customers operating at Gigabit Ethernet speeds and up.

E-Series Specifications

Chassis

E1200 – 14 line card slots
Size: 36.75 h x 17.4 w x 24" d (93.3 x 44.2 x 61 cm)
Weight (factory-installed components): 99 lbs (44.9 kg)
Weight fully loaded: 321 lbs (145.6 kg)
Maximum thermal output: 6,700W (22,860 BTU/hour)
Maximum current draw per DC PEM: 150A
Maximum power consumption: 7,200W

E600 – 7 line card slots
Size: 28 h x 17.4 w x 24" d (71.1 x 44.2 x 61 cm)
Weight (factory-installed components): 81 lbs (36.7 kg)
Weight fully loaded: 242 lbs (109.8 kg)
AC Power
- Nominal input voltage: 120-240 VAC 50/60 HZ
- Maximum thermal output:
  - 4,550W (15,800 BTU/hour) 100/120 VAC
  - 4,250W (14,500 BTU/hour) 200/240 VAC
- Maximum input current per module:
  - 16A 100 VAC 13A 120 VAC
  - 13A 200 VAC 11A 240 VAC
- Maximum system power input:
  - 4.8 KVA 100/120 VAC, 4.5 KVA 200/240 VAC

DC Power
- Max. thermal output: 3,750W (12,800 BTU/hour)
- Maximum current draw per DC PEM: 100A
- Maximum power consumption: 4,000W

E300 – 6 line card slots
Size: 14 h x 17.4 w x 24" d (35.6 x 44.2 x 61 cm)
Weight (factory-installed components): 55 lbs (25 kg)
Weight fully loaded: 185 lbs (84.1 kg)
AC Power
- Nominal input voltage: 100–240 VAC 50/60 HZ
- Maximum thermal output:
  - 2900W (9,900 BTU/Hour) 100/120 VAC
  - 2700W (9,900 BTU/Hour) 200/220 VAC
- Maximum input current per module:
  - 10A 100 VAC 8.3A 120 VAC
  - 7A 200 VAC 5.8A 240 VAC
- Maximum system power input:
  - 3 KVA 100/120 VAC, 2.8 KVA 200/240 VAC

DC Power
- Max. thermal DC output: 2,300W (7,850 BTU/hour)
- Maximum current draw per DC PEM: 60A
- Maximum power consumption: 2,400W

Common

19" front, 19" middle (optional) and 23" middle (E1200/E600 only) rack mountable
Maximum Operating Specifications:
- Temperature: 32° to 104°F (0° to 40°C)
- Altitude: no degradation to 10,000 feet (3,048 m)
- Relative humidity: 5 to 85 percent, noncondensing
- Shock and vibration: Bellcore GR-63

Maximum Non-operating Specifications:
- Temperature: -40° to 158°F (-40° to 70°C)
- Maximum altitude: 15,000 feet (4,572 meters)
- Relative humidity: 5 to 95 percent, noncondensing
- Vibration: Bellcore GR-63

E1200/E600 Redundancy/Availability

1+1 redundant Route Processor Modules (RPM)
N:1 redundant Switch Fabric Modules (SFM) (E1200 8:1, E600 4:1)
1+1 redundant DC Power Entry Modules (PEM)
2+2 redundant AC power supplies (E600 only, high line operation)
3+1 redundant AC power supplies (E600 only, low line and high line operation)
Online insertion and removal of all components
Built-in cable management
Environmental self-monitoring

E300 Redundancy/Availability

1+1 redundant Route Processor Modules (RPM)
1:1 redundant Switch Fabric Modules
1+1 redundant DC Power Entry Modules (PEM)
2+2 redundant AC power supplies (E300 high line operation only)
3+1 redundant AC power supplies (low line and high line operation)
Online insertion and removal of all components
Built-in cable management
Environmental self-monitoring

IEEE Compliance

802.3ae	10 Gigabit Ethernet
802.3ab	1000Base-T
802.1p/Q	VLAN Tagging
802.1s	Multiple Spanning Tree Protocol
802.1w	Rapid Spanning Tree Protocol
802.3ad	Link Aggregation with LACP
802.1D	Bridging
802.3x	Flow Control
802.1ac	Frame Extension for VLAN tagging

RFC Compliance

BGP4

1771	BGP v4
1772	Application of BGP4 in the Internet
1997	BGP Communities Attribute
1998	Application of BGP Community Attribute
2385	TCP MD5
2439	BGP Route Flap Damping
2519	Route Aggregation
2796	BGP Route Reflection
2842	Capabilities advertisement with BGP4
2858	Multi-protocol Extensions for BGP4 (MBGP)
2918	Route Refresh
3065	Autonomous System Confederations for BGP
ietf-draft	Graceful BGP restart

OSPF

1587	NSSA option	2370	Opaque LSA option
2154	OSPF MD5	3623	Graceful OSPF Restart
2328	OSPF v2		

RIP

1058	RIP v1	2453	RIP v2

IS-IS

1142	Intra-domain Routing Protocol
1195	Routing for TCP/IP
2763	Dynamic Hostname Exchange
2966	Domain-wide Prefixes
3373	Three-Way Handshake
3567	Cryptographic Authentication
ietf-draft	Point-to-point operation over LAN
ietf-draft	Maintaining more than 255 circuits in IS-IS
ietf-draft	Extended Ethernet Frame Size support
ietf-draft	Extensions for Traffic Engineering (wide metrics)

General Routing Protocols

768	UDP	1305	NTP v3
783	TFTP	1519	CIDR
791	IP	1542	BootP (relay)
792	ICMP	1591	DNS client
793	TCP	1812	IP v4 routers
826	ARP	2131	BootP/DHCP helper
854	Telnet	2236	IGMP v1 and v2
959	FTP	2338	VRRP
1027	Proxy ARP	2787	VRRP MIB

IPv6

2460	Specification	2464	Transmission of IPv6
2461	Neighbor Discovery		Packets
		3513	Addressing
2463	ICMPv6	3587	Unicast Address Format

IP Multicast

1112	IGMP
2236	IGMP v2
2362	PIM SM
2858	Multi-protocol Extensions for BGP4 (MBGP)
3618	Multicast Source Discovery Protocol (MSDP)
3973	PIM-DM
ietf-draft	PIM – SM v2
ietf-draft	PIM BSR
ietf-draft	IGMP Snooping

Security

1492	TACACS+
2865	RADIUS
3128	Protection Against a Variant of the Tiny Fragment Attack, Secure Copy (SCP), SSH v1/v2

SNMP/MIBs

1157	SNMP v1
1213	SNMP v2 (MIB-II)
1215	Traps for use with SNMP
1493	Bridges
1573	Interfaces group MIB
1657	BGP
1724	RIP v2 MIB extension
1757	RMON
1850	OSPF v2 MIB
1907	MIB for SNMPv2
2011	SNMPv2 IP MIB
2012	SNMPv2 TCP MIB
2013	SNMPv2 UDP MIB
2096	IP forwarding table MIB
2233	Interfaces MIB
2665	Ethernet-like interfaces
2787	VRRP MIB
ietf-draft	BGP4 MIB
ietf-draft	IS-IS MIB
	Fault management (alarms & status reporting)
	Force10 Link aggregation MIB
	Force10 chassis MIB
	Force10 SNMP copy MIB
	Force10 monitoring MIB

QoS

QoS mapping (Ethernet 802.1p and IP DiffServ)
Traffic conditioning for 8 traffic classes/port
Programmable WRED drop thresholds per queue
Egress rate-shaping
Weighted Fair Queuing
Committed Access Rate support—2-rate, 3-color model

Management

Industry-standard CLI
XML configuration and command output
Telnet, FTP, TFTP
Secure Copy (SCP)
NTP v3 Client, Server
Secure Shell support (SSH)
SNMP v1, v2c, v3
HP OpenView support
RADIUS/TACACS+ -based authentication
RMON
Port mirroring
Out of band console/AUX and FE management ports

Designed for NEBS

On board thermal and voltage monitoring
GR-63-Core: NEBS, physical protection
GR-1089-Core: EMC and Electrical Safety for Network Telecommunications Equipment
SR-3580 NEBS criteria levels (Level 3 compliance)

Safety

UL listed (UL 60950, 3rd Edition)
CUL CSA 22.2 #60950
CDRH 21
CFR 1040
EN 60950
EN 60825-1 Safety of Laser Products – Part 1: Eqpt. Classification Reqmts / User's Guide
EN 60825-2 Safety of Laser Products – Part 2: Safety of Optical Fiber Comm. Systems

EMC

USA: FCC CFR47 Part 15, Subpart J, Class A
Canada: ICES-003, Issue-2, Class A
Europe: EN 55022 1998 (CISPR 22: 1997), Class A
Japan: VCCI V3/01.4 Class A

Immunity

EN 300 386 V1.3.1 (2001-09) EMC for Network Eqpt.
EN 55024 1998
- EN61000-4-2/IEC-1000-4-2
- EN61000-4-3/IEC-1000-4-3
- EN61000-4-4/IEC-1000-4-4
- EN61000-4-5/IEC-1000-4-5
- EN61000-4-6/IEC-1000-4-6

All E-Series components are RoHS compliant

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