



Product Overview

The Juniper Networks EX4500 line of Ethernet switches delivers a scalable, high-performance platform for supporting high-density 10 gigabit per second (Gbps) data center top-of-rack as well as data center, campus, and service provider aggregation deployments.

Product Description

Featuring 48 wire-speed 10-Gigabit Ethernet (10 GbE) ports in a two rack unit (2U) platform, the Juniper Networks® EX4500 Ethernet Switch delivers Layer 2 and Layer 3 connectivity to networked devices such as servers and other switches. The EX4500 base switch provides 40 fixed 10 GbE pluggable ports that can also support GbE connectors for added flexibility. Two optional high-speed uplink modules offer four additional 10 GbE small form-factor pluggable transceiver (SFP+) ports each for connecting to upstream devices.

By targeting high-density 10 GbE top-of-rack and aggregation deployments in the data center, campus, and service provider environments, EX4500 switches perfectly complement the Juniper Networks EX Series Ethernet Switch product family: the Juniper Networks EX2200 line and EX3200 line designed for low-density access deployments; the EX4200 line designed for data center and campus GbE access and aggregation deployments; and the EX8200 line of Ethernet switches designed for data center and campus core and aggregation environments.

Data Center Optimized

The EX4500 Ethernet Switch is designed for demanding data center applications where high performance, high availability, and energy efficiency are key requirements (see Figure 1). Operating at wire speed, the EX4500 switches deliver 714 Mpps throughput and a data rate of 960 Gbps (full duplex) for both Layer 2 and Layer 3 protocols.

Flexible deployment options enable the EX4500 to support back-to-front and front-to-back cooling, which ensures consistency with server designs for hot and cold aisle deployments. Front- and rear-facing configuration options ensure closer proximity to server ports, optimizing performance and keeping cable lengths short and manageable. The EX4500 is also environmentally conscious, drawing less than eight watts per port under maximum load.

For small data centers, the EX4500 may be deployed as the aggregation/core switch, aggregating 10 GbE uplinks from EX4200 Virtual Chassis configurations in the access layer (see Figure 2). The EX4500 offers an economical, power-efficient, and compact form factor solution for core data center and campus aggregation (see Figure 3) deployments.

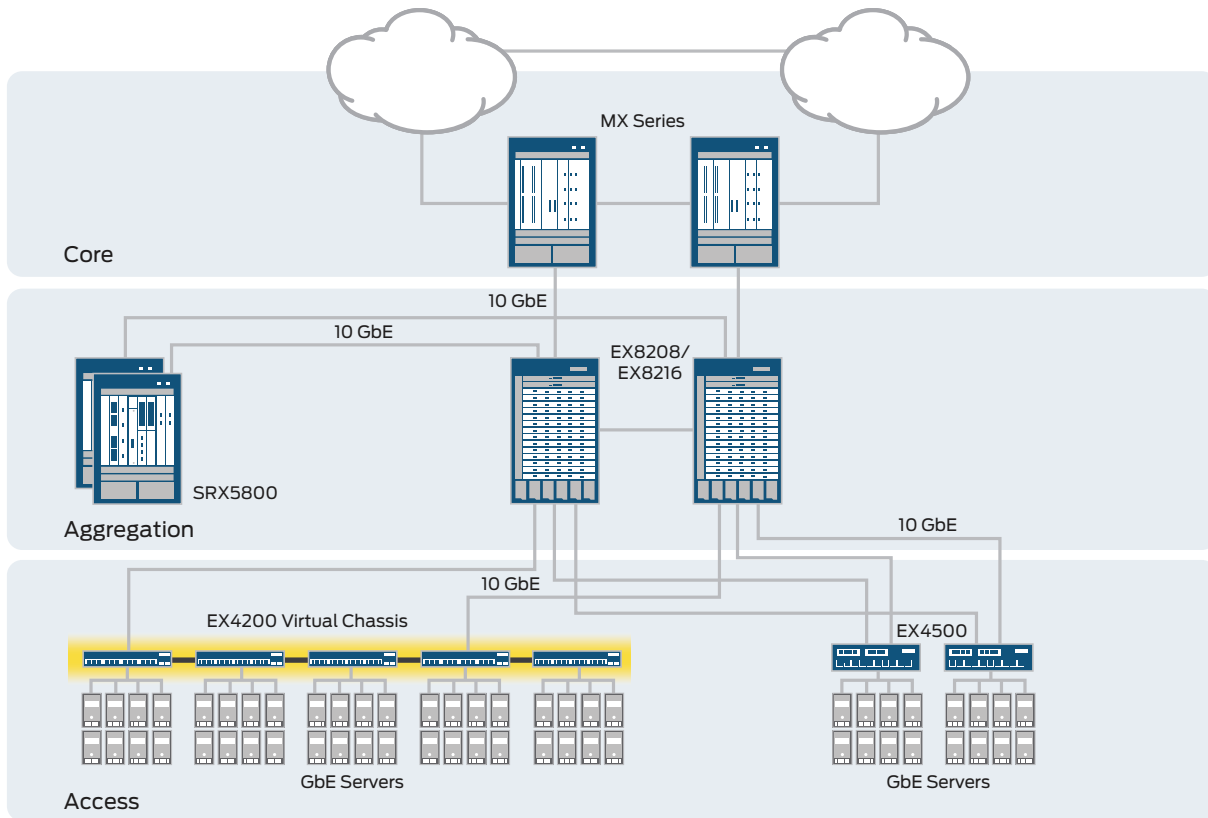


Figure 1: The EX4500 provides 10 GbE server access in the data center.

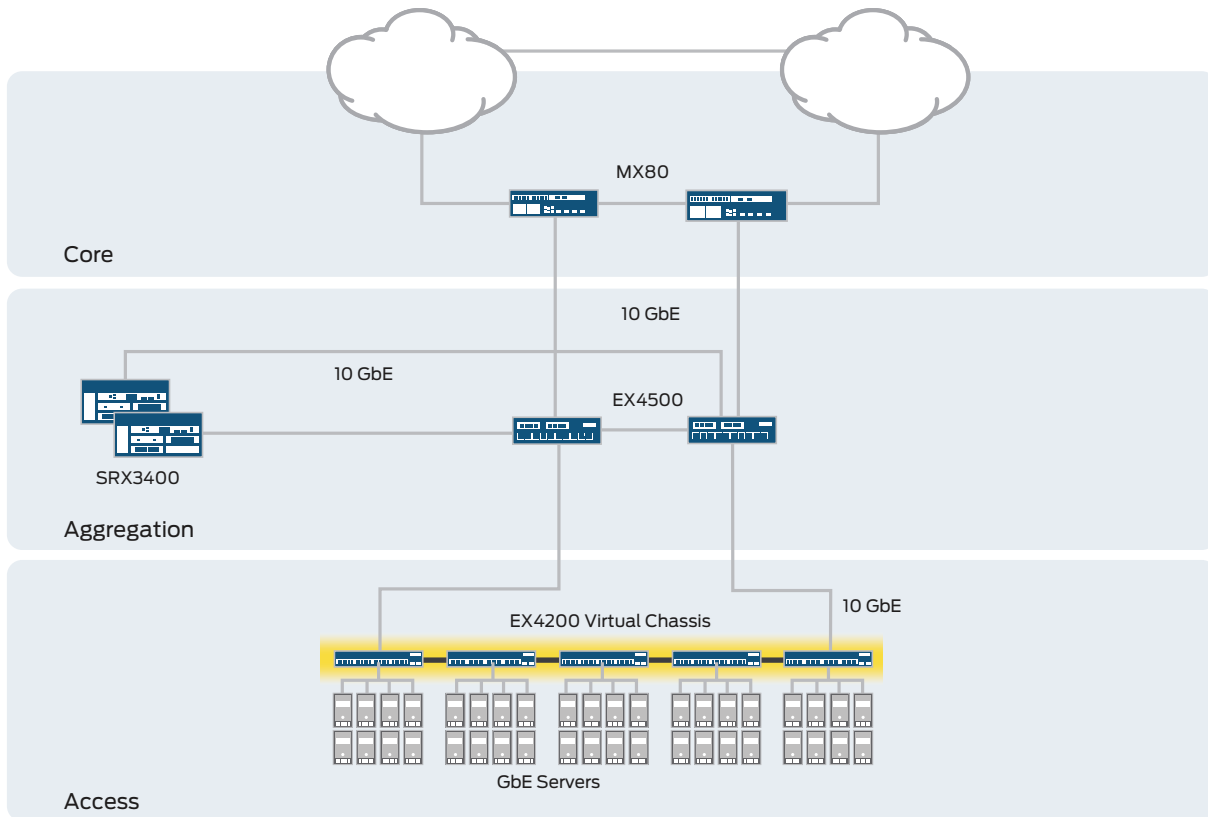


Figure 2: The EX4500 10 GbE switch is ideal for small data center core deployments.

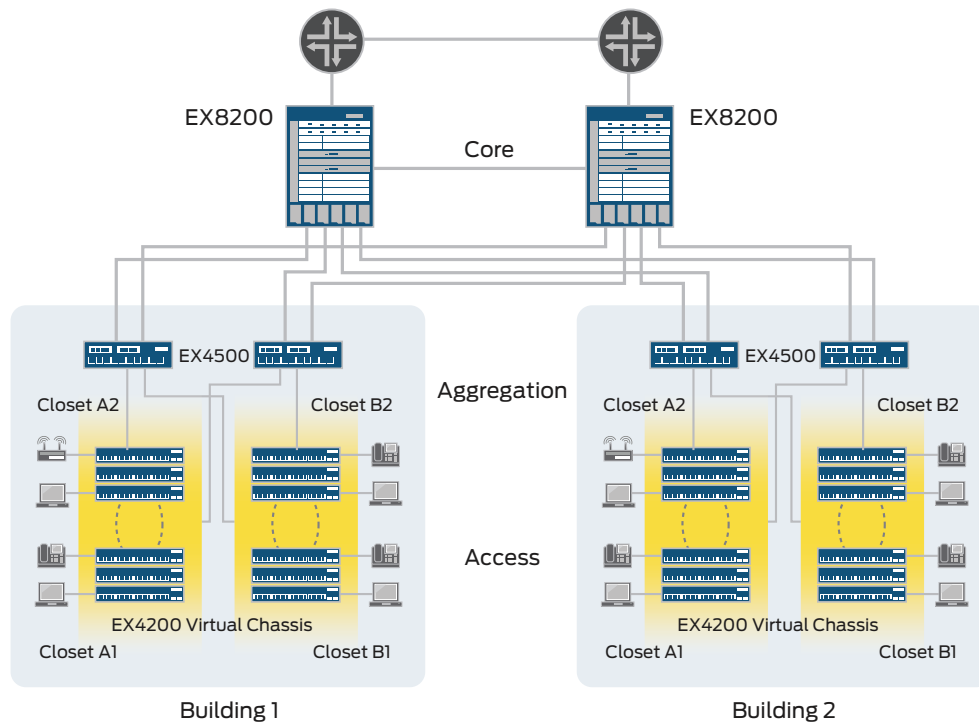


Figure 3: The EX4500 switch offers an economical, power-efficient, compact solution for campus aggregation deployments.

Junos Operating System

The EX4500 runs the same Juniper Networks Junos® operating system that is used by other EX Series Ethernet Switches, as well as all Juniper Networks routers and Juniper Networks SRX Series Services Gateways. By utilizing a common operating system, Juniper Networks delivers a consistent implementation and operation of control plane features across all products. To maintain that consistency, Junos OS adheres to a highly disciplined development process that uses a single source code, follows a single quarterly release train, and employs a highly available modular architecture that prevents isolated failures from bringing down an entire system.

These attributes are fundamental to the core value of the software, enabling all Junos OS-powered products to be updated simultaneously with the same software release. All features are fully regression tested, making each new release a true superset of the previous version; customers can deploy the software with complete confidence that all existing capabilities will be maintained and operate in the same way.

Virtual Chassis Technology

The EX4500 is designed to support Juniper Networks' unique Virtual Chassis technology*, which enables multiple interconnected switches to operate as a single, logical device with a single IP address. When deployed in a Virtual Chassis configuration, the EX4500 switches will be connected over a 128 Gbps backplane that is compatible with the EX4200 line of Ethernet switches. Interconnected switches are monitored and

managed as a single device, enabling enterprises to separate physical topology from logical groupings of endpoints and allowing more efficient resource utilization.

Using Virtual Chassis technology at the top of rack or end of row to aggregate servers in the data center provides flexibility in the deployment of uplinks. Rather than requiring redundant links for each physical switch to ensure high availability, redundant links are only needed for each Virtual Chassis group. In the future, EX4500 and EX4200 switches may be combined within a single Virtual Chassis configuration to support environments where both GbE and 10 GbE servers are present.

The EX4500 will also seamlessly join any existing EX4200 Virtual Chassis configuration to create a single logical top-of-rack or end-of-row switch supporting both GbE and 10 GbE capabilities at price points optimized for each speed. Customers introducing 10 GbE into their racks will be able to use the EX4500 to add 10 GbE-attached servers, iSCSI, and network-attached storage (NAS) with minimal impact to the current switching infrastructure.

When deployed in the data center, Virtual Chassis technology supports low latency, server live migration between racks within as well as across data centers, dramatically reducing latency over a traditional multitier hierarchy. Traffic is routed over backplane Virtual Chassis ports for inter-switch traffic, rather than switching and flooding traffic over access ports. Another benefit of this design is that node and link failures have sub-second failover times without the need for an external Layer 2 control plane protocol like Spanning Tree Protocol (STP) to create a loop-free topology.

* Roadmap

Bandwidth availability is improved over traditional switches through the use of backplane connections for inter-switch linkage and line-rate performance for all packet sizes. These backplane inter-switch connections reduce the number of necessary devices, saving data center resources for better use.

Management Options

Three system management options are available for the EX4500 Ethernet switches.

- The standard Junos OS command-line interface (CLI) offers the same granular management capabilities and scripting parameters found in any router powered by the Junos OS.
- The EX4500 also includes the integrated Juniper Networks J-Web Software, an embedded web-based device manager that allows users to configure, monitor, troubleshoot, and perform system maintenance on individual switches via a browser-based graphical interface*.
- EX4500 performance, configuration, and fault data can also be exported to leading third-party management systems such as HP OpenView, IBM Tivoli, and Computer Associates Unicenter software, providing a complete, consolidated view of network operations.

Junos Space

Juniper also offers a comprehensive suite of network operational application tools that provide a smart, simple, and open approach for automating the deployment and operation of a Juniper infrastructure.

These tools are based on a single network application platform called Juniper Networks Junos Space, an open, programmable application platform for hosting network infrastructure and operational applications across the entire management life cycle of the network. Explicitly designed to allow partners and customers to build and deploy smart, simple, and easy-to-use applications, Junos Space provides multiple management and infrastructure applications for managing Juniper resources and assets, including inventory management, device and interface configuration, automated software management and deployment, and event-driven fault management. These platform applications are embedded within the core product, allowing users to control any part of their environment when used in conjunction with multiple add-on applications. Junos Space will support a full portfolio of applications for automating network infrastructure and operations covering the campus LAN and data center network environments.

Designed to automate the configuration, visualization, monitoring, and administration of large switch and router networks, these Junos Space applications offer predefined automation schemes and best practice templates to enable rapid and accurate deployments.

* Roadmap

Features and Benefits

The EX4500 Ethernet switches include the following key features and benefits.

High Performance

Each EX4500 supports 10 Gbps of bandwidth with 14.88 Mpps per port on all 48 ports at all packet sizes.

High Availability

The EX4500 switches offer dual internal load sharing AC power supplies, and redundant variable-speed fans as standard features, protecting the switch from a single power supply or fan failure. DC power options will be available in the future.

Energy Efficient

Consuming less than eight watts per 10 GbE interface, the EX4500 offers a low power solution for 10 GbE top-of-rack, end-of-row, and aggregation deployments. The EX4500 switches also improve cooling efficiency with redundant variable-speed fans that automatically adjust their speed based on existing conditions to reduce power consumption.

Small Footprint

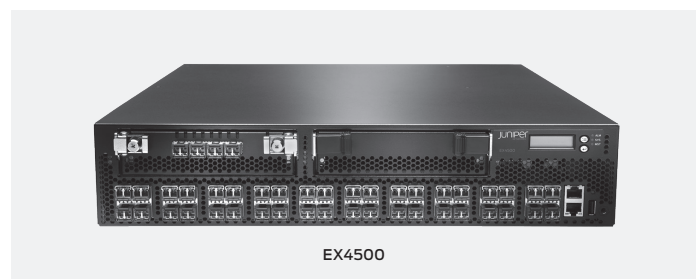
The EX4500 supports up to 48 wire-speed 10 GbE ports in a single 2U platform.

Additional Features

- System status LEDs
- LCD status display
- Versatile two- and four-post rack mounting options
- Front-to-back and back-to-front airflow options
- Support for Jumbo frames (9,000)
- Quality of service (IEEE 802.1p marking)
- Multicast (IGMP v1/v2/v3 snooping)
- Layer 2 features including support for 4,096 VLAN IDs, Spanning Tree (802.1s and 802.1w), bridge protocol data unit (BPDU) guard, 802.3as Link Aggregation
- Management features including Telnet and SSH v1/v2, SNMP v1-v3, RADIUS, TACACS+, and RMON

Table 1: EX4500 Power Consumption

CONFIGURATION	POWER CONSUMPTION
No uplinks installed; 40 USR ports in base, all ports forwarding (line rate)	328 W
One uplink module (4 x 10 GbE SFP+ ports) installed; 40 USR ports in base, all ports forwarding (line rate)	346 W
Two uplink modules (8 x 10 GbE SFP+ ports) installed; 40 USR ports in base, all ports forwarding (line rate)	364 W



EX4500 10 GbE Ethernet Switch Specifications

Hardware

Interface Options

- 40 GbE/10 GbE small form-factor pluggable transceiver (SFP/SFP+) fiber connectors
- Eight 10 GbE SFP+ uplink ports (via two optional four-port uplink modules)
- 1 x 10/100/1000 Ethernet RJ-45 ports for management
- Console port for management

Supported Optics

- 10 GbE SFP+ LC connector type: short reach (SR) (multimode), long reach (LR) (single mode), ultra short reach (USR) (multimode)
- 10 GbE SFP+ copper: Direct-attached copper (1/3/7 m)
- 1 GbE SFP LC connector type: LX (single mode), 1000BASE-T (only 1,000 M supported)

Dimensions

- Height: 3.5 in (8.9 cm); 2U
- Width: 17.25 in (43.8 cm)
- Depth: 21.1 in (53.6 cm)
- Weight: 37 lbs (17 kg) with one AC power supply

Rack Installation Kit

- Versatile two- and four-post mounting options for 19-in server rack or datacom rack

LEDs

- System LEDs that indicate status

Airflow

- Front-to-back or back-to-front cooling
- Redundant variable-speed fans reduce power draw

Power

- Dual hot-swappable load sharing AC power supplies

Software

Security

- RADIUS
- TACACS+
- Access control lists (ACLs): Allow and deny
- SSH v1, v2
- Secure interface login and password
- Local proxy Address Resolution Protocol (ARP)
- Static ARP support

Layer 2 Switching

- Maximum media access control (MAC) addresses per system: 24,000
- Static MAC entries: 24,000
- Jumbo frames: 9,216 bytes
- Number of VLANs: 4,096
- Port-based VLAN
- 4,096 VLAN IDs supported
- Routed VLAN interface (RVI)

Link Aggregation

- 802.3ad support
 - Number of Link Aggregation Groups (LAGs) supported: 64
 - Maximum number of ports per LAG: 8
- LAG load-sharing algorithm—bridged or routed (unicast or multicast) traffic:
 - IP: S/D IP
 - TCP/UDP: S/D IP, S/D Port
 - Non-IP: S/D MAC
 - Tagged ports support in LAG

Spanning Tree

- Spanning Tree Protocol (802.1D)
- Multiple Spanning Tree Protocol (MSTP) (802.1s)
- Rapid Spanning Tree Protocol (RSTP) (802.1w)
- Per VLAN Rapid Spanning Tree (PVRST+)
- BPDU guard
- Loop, root protect

Quality of Service (QoS)

- Layer 2 QoS
- Layer 3 QoS
- Ingress policing: 1 rate 2 color
- Eight hardware queues per port
- Scheduling methods (egress): Strict priority (SP), shaped deficit weighted round-robin (SDWRR)
- 802.1p, DiffServ code point (DSCP)/IP precedence trust and marking
- Layer 2-4 classification criteria: Interface, MAC address, Ethertype, 802.1p, VLAN, IP address, DSCP/IP precedence, TCP/UDP port numbers, etc.
- Congestion avoidance capabilities: Tail drop eight queues

L3 Features—IPv4

- Routing protocols: RIPv1/v2, OSPF
- Static routing
- Routing policy
- Virtual Router Redundancy Protocol (VRRP)
- Bidirectional Forwarding Detection (BFD) protocol

Multicast

- Internet Group Management Protocol (IGMP): v1, v2, v3
- IGMP snooping
- PIM-SM, PIM-SSM
- Multicast Source Directory Protocol (MSDP)

Access Control Lists (ACLs) (Junos OS firewall filters)

- Port-based ACL (PACL)—ingress and egress
- VLAN-based ACL (VACL)—ingress and egress
- Router-based ACL (RACL)—ingress and egress
- ACL entries (ACE) in hardware per system: 1,500
- ACL counter for denied packets
- ACL counter for permitted packets
- Ability to add/remove/change ACL entries in middle of list (ACL editing)
- Layer 2-L4 ACL

- Trusted Network Connect (TNC) certified
- MAC authentication (RADIUS)
- Control plane denial-of-service (DoS) protection

Supported RFCs

- RFC 2925 MIB for Remote Ping, Trace
- RFC 1122 Host Requirements
- RFC 768 UDP
- RFC 791 IP
- RFC 783 Trivial File Transfer Protocol (TFTP)
- RFC 792 ICMP
- RFC 793 TCP
- RFC 826 ARP
- RFC 894 IP over Ethernet
- RFC 903 RARP
- RFC 906 TFTP Bootstrap
- RFC 1027 Proxy ARP
- RFC 2068 HTTP server
- RFC 1812 Requirements for IP Version 4 Routers
- RFC 1519 Classless Interdomain Routing (CIDR)
- RFC 1256 IPv4 ICMP Router Discovery (IRDP)
- RFC 1058 RIP v1
- RFC 2453 RIP v2
- RFC 1112 IGMP v1
- RFC 2236 IGMP v2
- RFC 3618 MSDP
- RFC 4915 MT-OSPF
- RFC 3376 IGMP v3
- RFC 1492 TACACS+
- RFC 2138 RADIUS Authentication
- RFC 2139 RADIUS Accounting
- RFC 3579 RADIUS EAP support for 802.1x
- RFC 5176 Dynamic Authorization Extensions to RADIUS
- RFC 2267 Network Ingress Filtering
- RFC 2030 SNTP, Simple Network Time Protocol
- RFC 854 Telnet client and server
- RFC 951, 1542 BootP
- RFC 2131 BOOTP/DHCP relay agent and Dynamic Host Configuration Protocol (DHCP) server
- RFC 1591 Domain Name System (DNS)
- RFC 2338 VRRP
- RFC 2328 OSPF v2 (edge mode)
- RFC 1587 OSPF not-so-stubby area (NSSA) Option
- RFC 2154 OSPF w/Digital Signatures (Password, MD-5)
- RFC 2370 OSPF Opaque link-state advertisement (LSA) Option
- RFC 3623 OSPF Graceful Restart
- RFC 2362 PIM-SM (edge mode)
- RFC 3569 draft-ietf-ssm-arch-06.txt PIM-SSM PIM Source Specific Multicast
- RFC 2474 DiffServ Precedence, including 8 queues/port
- RFC 2598 DiffServ Expedited Forwarding (EF)
- RFC 2597 DiffServ Assured Forwarding (AF)
- RFC 2475 DiffServ Core and Edge Router Functions

- LLDP Media Endpoint Discovery (LLDP-MED), ANSI/TIA-1057, draft 08
- PIM-DM Draft IETF PIM Dense Mode draft-ietf-idmr-pim-dm-05.txt, draft-ietf-pim-dm-new-v2-04.txt
- Draft-ietf-bfd-base-05.txt Bidirectional Forwarding Detection

Supported MIBs

- RFC 1155 SMI
- RFC 1157 SNMPv1
- RFC 1905 RFC 1907 SNMP v2c, SMIv2 and Revised MIB-II
- RFC 2570 – 2575 SNMPv3, user based security, encryption and authentication
- RFC 2576 Coexistence between SNMP Version 1, Version 2, and Version 3
- RFC 1212, RFC 1213, RFC 1215 MIB-II, Ethernet-Like MIB and TRAPs
- RFC 2578 SNMP Structure of Management Information MIB
- RFC 2579 SNMP Textual Conventions for SMIv2
- RFC 2925 Ping/Traceroute MIB
- RFC 2665 Ethernet-like interface MIB
- RFC 1643 Ethernet MIB
- RFC 1493 Bridge MIB
- RFC 2096 IPv4 Forwarding Table MIB
- RFC 2011 SNMPv2 for Internet protocol using SMIv2
- RFC 2012 SNMPv2 for transmission control protocol using SMIv2
- RFC 2013 SNMPv2 for user datagram protocol using SMIv2
- RFC 2863 Interface MIB
- RFC 3413 SNMP Application MIB
- RFC 3414 User-based Security Model for SNMPv3
- RFC 3415 View-based Access Control Model for SNMP
- RFC 3621 PoE-MIB (Power over Ethernet switches only)
- RFC 1724 RIPv2 MIB
- RFC 2863 Interface Group MIB
- RFC 2932 IPv4 Multicast MIB
- RFC 2787 VRRP MIB
- RFC 1850 OSPFv2 MIB
- RFC 2819 RMON MIB
- RFC 2287 System Application Packages MIB
- RFC 4188 STP and Extensions MIB
- RFC 4363 Definitions of Managed Objects for Bridges with Traffic Classes, Multicast Filtering, and VLAN extensions
- RFC 2922 LLDP MIB
- Draft – blumenthal – aes – usm - 08
- Draft – reeder – snmpv3 – usm - 3desede -00
- Draft – ietf-idmr-igmp-mib-13
- Draft – ietf-idmr-pim-mib-09
- Draft – ietf-bfd-mib-02.txt

Troubleshooting

- Debugging: CLI via console, Telnet, or SSH
- Diagnostics: Show and debug command, statistics
- Traffic monitoring/mirroring (port, VLAN)
- IP tools: Extended ping and trace
- Junos OS commit and rollback

Traffic Mirroring

- Port-based
- VLAN-based
- ACL-based mirroring
- Mirroring destination ports per system: 1
- LAG port monitoring
- Multiple destination ports monitored to 1 mirror (N:1)
- Maximum number of mirroring sessions: 1
- Mirroring to remote destination (over L2): 1 destination VLAN

Safety and Compliance

Safety Certifications

- UL-UL60950-1 (First Edition)
- C-UL to CAN/CSA 22.2 No.60950-1 (First Edition)
- TUV/GS to EN 60950-1, Amendment A1-A4, A11
- CB-IEC60950-1, all country deviations

Electromagnetic Compatibility Certifications

- FCC 47CFR Part 15 Class A
- EN 55022 Class A
- ICES-003 Class A
- VCCI Class A
- AS/NZS CISPR 22 Class A
- CISPR 22 Class A
- EN 55024
- EN 300386
- CE

Environmental

- Reduction of Hazardous Substances (ROHS) 5

Telco

- CLEI code

Environmental Ranges

- Operating temperature: 32° to 113°F (0° to 45°C)
- Storage temperature: -40° to 158°F (-40° to 70°C)
- Operating altitude: up to 10,000 ft (3,048 m)
- Non-operating altitude: up to 16,000 ft (4,877 m)
- Relative humidity operating: 10% to 85% (noncondensing)
- Relative humidity non-operating: 0% to 95% (noncondensing)

Juniper Networks Services and Support

Juniper Networks is the leader in performance-enabling services and support, which are designed to accelerate, extend, and optimize your high-performance network. Our services allow you to bring revenue-generating capabilities online faster so you can realize bigger productivity gains and faster rollouts of new business models and ventures. At the same time, Juniper Networks ensures operational excellence by optimizing your network to maintain required levels of performance, reliability, and availability. For more details, please visit www.juniper.net/us/en/products-services/.

Ordering Information

BASE UNIT*	DESCRIPTION
EX4500-40F-FB	40-port GbE/10 GbE SFP/SFP+ front-to-back airflow
EX4500-40F-BF	40-port GbE/10 GbE SFP/SFP+ back-to-front airflow

Accessories

EX4500-PWR1-AC-FB	EX4500 1200 W AC (1000 W at 110 V) power supply – front-to-back airflow
EX4500-PWR1-AC-BF	EX4500 1200 W AC (1000 W at 110 V) power supply – back-to-front airflow
EX4500-UM-4XSFP	EX 4500 4-Port 10 GbE SFP+ uplink module (optics sold separately)

Pluggable Optics

EX-SFP-10GE-T	SFP 10/100/1000BASE-T copper; RJ-45 connector; 100 m reach on UTP
EX-SFP-10GE-LX	SFP 1000BASE-LX; LC connector; 1310 nm; 10 km reach on single mode fiber
EX-SFP-10GE-SR	SFP+ 10GBASE-SR; LC connector; 850 nm; 300 m reach on 50 microns multimode fiber; 33 m on 62.5 microns multimode fiber
EX-SFP-10GE-LR	SFP+ 10GBASE-LR; LC connector; 1310 nm; 10 km reach on single mode fiber
EX-SFP-10GE-DAC-1M	SFP+ 10 GbE Direct Attach Copper (twinax copper cable) 1 m
EX-SFP-10GE-DAC-3M	SFP+ 10 GbE Direct Attach Copper (twinax copper cable) 3 m
EX-SFP-10GE-DAC-7M	SFP+ 10-GbE (twinax copper cable) 7 m
EX-SFP-10GE-USR	10 GbE Ultra Short Reach; 850 nm; 10 m on OM1, 30 m on OM2, 100 m on OM3 multimode fiber

* EX4500 base unit includes chassis, fan tray, intraconnect module, AC power supply, power cord, power supply cover panel, and two uplink module cover panels

About Juniper Networks

Juniper Networks, Inc. is the leader in high-performance networking. Juniper offers a high-performance network infrastructure that creates a responsive and trusted environment for accelerating the deployment of services and applications over a single network. This fuels high-performance businesses. Additional information can be found at www.juniper.net.

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