EX8216 ETHERNET SWITCH

Product Overview

The EX8216 Ethernet Switch, a member of Juniper Networks EX Series Ethernet Switches product family, delivers the performance, scalability, and high availability required for today's high-density data center, cloud computing, and Internet exchange environments. The EX8216 modular switch scales beyond 12 terabits per second (Tbps), delivering a robust solution for today's high-performance networks while providing sufficient capacity to support the most demanding network environments in the future.

Product Description

The 16-slot Juniper Networks® EX8216 Ethernet Switch, part of the Juniper Networks EX8200 line of Ethernet Switches, offers a high-density, high-performance platform for aggregating access switches deployed in data center top-of-rack or end-of-row applications, as well as for supporting Gigabit Ethernet and 10 Gigabit Ethernet server access in data center end-of-row deployments. The EX8216 delivers approximately 1.9 billion packets per second (Bpps) of high-density, wire-speed 10-Gigabit Ethernet performance for the largest data center networks.

To maximize network investments, the EX8216 leverages the same EX8200 wire-speed line cards and power supplies used by the eight-slot Juniper Networks EX8208 Ethernet Switch, ensuring consistent performance across the entire product family. Working with the EX8208, as well as Juniper Networks EX4500, EX4200, EX3200 and EX2200 lines of Ethernet switches, which all run the same Juniper Networks Junos® operating system, the EX8216 helps reduce capital and operational expenses across the data center infrastructure.

EX8216 Ethernet Switch

The EX8216 modular switch includes an advanced set of hardware features enabled by the Juniper-designed EX-PFE2 ASICs. Working with the carrier-class Junos OS, the EX-PFE2 ASICs on each line card deliver the scalability needed to support high-performance data center networks.

The EX8216 switch can accommodate any combination of EX8200 line Ethernet line cards. Options include the following:

- **EX8200-48T**: a 48-port 10/100/1000BASE-T RJ-45 unshielded twisted pair (UTP) line card
- **EX8200-48T-ES**: a 48-port 10/100/1000BASE-T RJ-45 unshielded twisted pair (UTP) extra scale line card
- **EX8200-48F**: a 48-port 100BASE-FX/1000BASE-X SFP fiber line card
- **EX8200-48F-ES**: a 48-port 100BASE-FX/1000BASE-X SFP extra scale fiber line card
- **EX8200-8XS**: an eight-port 10GBASE-X SFP+ fiber line card
- **EX8200-8XS-ES**: an eight-port 10GBASE-X SFP+ fiber extra scale line card
- **EX8200-40XS**: a 40-port 10GBASE-X SFP+ / 1000BASE-X SFP line card

Fully configured, a single EX8216 chassis can support up to 768 Gigabit Ethernet or 128 10-Gigabit Ethernet ports at wire speed for all packet sizes, delivering one of the highest line-rate 10-Gigabit Ethernet port densities in the industry. With the EX8200-40XS, the EX8216 can also support up to 640 oversubscribed 10-Gigabit Ethernet ports in applications where high port densities are essential.

At 21 rack units (RUs) high, two EX8216 switches can fit in a standard 42 RU rack, enabling up to 1,536 Gigabit Ethernet or 1,280 10-Gigabit Ethernet ports in a single rack. In addition, the EX8216 is just 26.5 inches deep, enabling it to fit into typical data center cabinets and making it ideal for existing infrastructures or in locations where space is at a premium.

The EX8216 switch fabric is capable of delivering 320 Gbps (full duplex) per slot, enabling scalable wire-rate performance on all ports for any packet size. The pass-through midplane design supports a future capacity of up to 12.4 Tbps, providing a built-in migration path to next-generation deployments.

The base configuration of the EX8216 switch includes two side-mounted, hot-swappable fan trays with variable-speed fans, one Routing Engine module, and eight dedicated switch fabric modules (SFMs). The base EX8216 also ships with two 3,000 watt power supplies, although six power supply bays allow users to provision the chassis to provide the power and redundancy required for any type of deployment. Redundant EX8216 switch configurations are available with three power options and include a second Routing Engine module to provide hot standby resiliency. Except for the switch fabric modules, all components are accessible from the front, simplifying operations, maintenance, and upgrades.

A front-panel chassis level LCD displays Routing Engine status as well as chassis component alarm information for rapid problem identification and resolution. The LCD also provides a flexible, user-friendly interface for performing device initialization and configuration rollbacks, reporting system status and alarm notifications, or restoring the switch to its default settings.

Table 1: EX8216 Features at a Glance

FEATURES	DESCRIPTION
Chassis	• 21 RU; 26.5 in (67.4 cm) deep; 17.3 in (43.9 cm) wide • 16 dedicated I/O slots • 12.4 Tbps backplane capacity • Dedicated data, control, and management planes • LCD panel for system monitoring
Power	• Energy efficiency: more than 300,000 packets per second per watt, or 4.7 watts per gigabit per second • 6 load sharing power supplies • 15,000 W maximum power capacity • 220 V AC, 110 V AC and -48 V DC options for N+1 or N+N redundancy
Cooling	• Redundant variable-speed fans and controllers • Side-to-side airflow
Fabric	• 320 Gbps (full duplex) per slot fabric capacity • Eight active fabric cards for N+1 redundancy • Full line-rate forwarding even under failure conditions
Routing engine	• 1+1 redundancy • Master and backup Routing Engines • 2 gigabytes DRAM; 4 gigabytes flash memory • Console + auxiliary serial and Ethernet management ports • USB storage interface
Operating system	• Junos OS
High availability	• Hardware designed for continuous operation: • Secure, modular architecture that isolates faults • Separate control and forwarding planes that enhance scalability and resiliency • Transparent failover and network recovery • Graceful Routing Engine switchover (GRES) • Nonstop active routing (NSR)* • Non-Stop Software Upgrade (NSSU)*
Layer 2 features	• Jumbo frames (9,216 bytes maximum) • 4,096 VLANs • VLAN Registration Protocol • 802.3ad – Link Aggregation Control Protocol (LACP) • 802.1D – Spanning Tree Protocol (STP) • 802.1w – Rapid Spanning Tree Protocol (RSTP) • 802.1s – Multiple Spanning Tree Protocol (MSTP) • VLAN Spanning Tree Protocol (VSTP) • Redundant Trunk Group (RTG)

FEATURES	DESCRIPTION
Layer 3 features	• Static routing • RIP v1/v2 • OSPF v1/v2 • Filter-based forwarding • Virtual Router Redundancy Protocol (VRRP) • BGP (Advanced Feature license) • IS-IS (Advanced Feature license) • IPv6 (Advanced Feature license) • Bidirectional Forwarding Detection (BFD) • Virtual routers
Hardware tunneling	• GRE tunnels (Advanced Feature license)* • MPLS capabilities (Advanced Feature license)*
Multicast	• Internet Group Management Protocol (IGMP) v1/v2/v3 • IGMP snooping • Protocol Independent Multicast PIM-SM, PIM-SSM, PIM-DM, MSDP
Firewall filters	• Ingress and egress L2-L4 access control lists (ACLs): – Port ACLs – VLAN ACLs – Router ACLs • Control plane denial of service (DoS) protection
Quality of service (QoS)	• 2,000 policers per chassis • 8 egress queues per port • Weighted Random Early Detection (WRED) scheduling • Shaped Deficit Weighted Round Robin (SDWRR) queuing • Strict priority queuing • Multi-field classification (L2–L4) for scheduling and rewrite
Management	• Junos OS command-line interface (CLI) • Junos Script • Embedded Web-based management (Juniper Networks J-Web Software) • Network and Security Manager (NSM) support • LCD panel • SNMP v1/v2/v3 • RADIUS • TACACS+ • Extensive MIB support • Local and remote analyzer (mirroring) • Link Layer Discovery Protocol (LLDP) • Advanced Insight Solutions (AIS)

* Roadmap

Deployment Scenarios

The EX8216 modular switch is designed for a variety of data center deployments, providing a high-performance, high-density core platform that reduces cost and complexity while improving overall scalability and offering carrier-class reliability.

Populated entirely with eight-port EX8200-8XS 10-Gigabit Ethernet line cards, a single EX8216 Ethernet Switch can accommodate up to 128 high-speed, line-rate uplinks from access-layer devices such as EX4200 switches deployed in Virtual Chassis top-of-rack configurations, delivering a highly scalable solution that can support more servers with fewer switches. Using the 40-port EX8200-40XS 10-Gigabit Ethernet line card, the EX8216 can support a similar number of servers using traditional standalone or blade-server switches. A single EX8216 chassis can also support up to 768 Gigabit Ethernet ports or 640 10-Gigabit Ethernet ports to serve as a highly effective, end-of-row server access switch.

The high Gigabit Ethernet and 10-Gigabit Ethernet port densities on the EX8216 enable the consolidation of aggregation and core layers, dramatically simplifying data center architectures and reducing total cost of ownership (TCO) while lowering power, space, and cooling requirements.

Virtual Chassis Technology

The EX8216 supports Juniper Networks' unique Virtual Chassis technology, which enables two interconnected EX8200 chassis—any combination of EX8208s or EX8216s—to operate as a single, logical device with a single IP address. Deployed as a collapsed aggregation or core layer solution, an EX8200 Virtual Chassis configuration creates a network fabric for interconnecting access switches, routers, and service-layer devices such as firewalls and load balancers using standards-based Ethernet LAGs.

In a Virtual Chassis configuration, EX8200 switches can be interconnected using either single line-rate 10GbE links or a LAG with up to 12 10GbE line-rate links. Since the Virtual Chassis intra-connections use small form SFP+ interfaces, Virtual Chassis member switches can be separated by distances of up to 40 km. If the EX8200 Virtual Chassis switch members are located in the same or adjacent racks, low cost direct attach cables (DACs) can be used as the interconnect mechanism.

Since the network fabric created by an EX8200 Virtual Chassis configuration prevents loops, it eliminates the need for protocols such as Spanning Tree. The fabric also simplifies the network by eliminating the need for Virtual Router Redundancy Protocol (VRRP), increasing the scalability of the network design. In addition, since the Virtual Chassis Control Protocol (VCCP) used to form the EX8200 Virtual Chassis configuration does not affect the function of the control plane, Junos OS control plane protocols such as 802.3ad, OSPF, Internet Group Management Protocol (IGMP), Physical Interface Module (PIM), BGP and others running on an EX8200 Virtual Chassis system behave in exactly the same way as when running on a standalone chassis.

EX8200 Virtual Chassis configurations are highly resilient, with no single point of failure, ensuring that no single element—whether a chassis, a line card, a Routing Engine, or an interconnection—can render the entire fabric inoperable following a failure. Virtual Chassis technology also makes server virtualization at scale feasible by providing simple L2 connectivity over a very large pool of compute resources located anywhere within a data center.

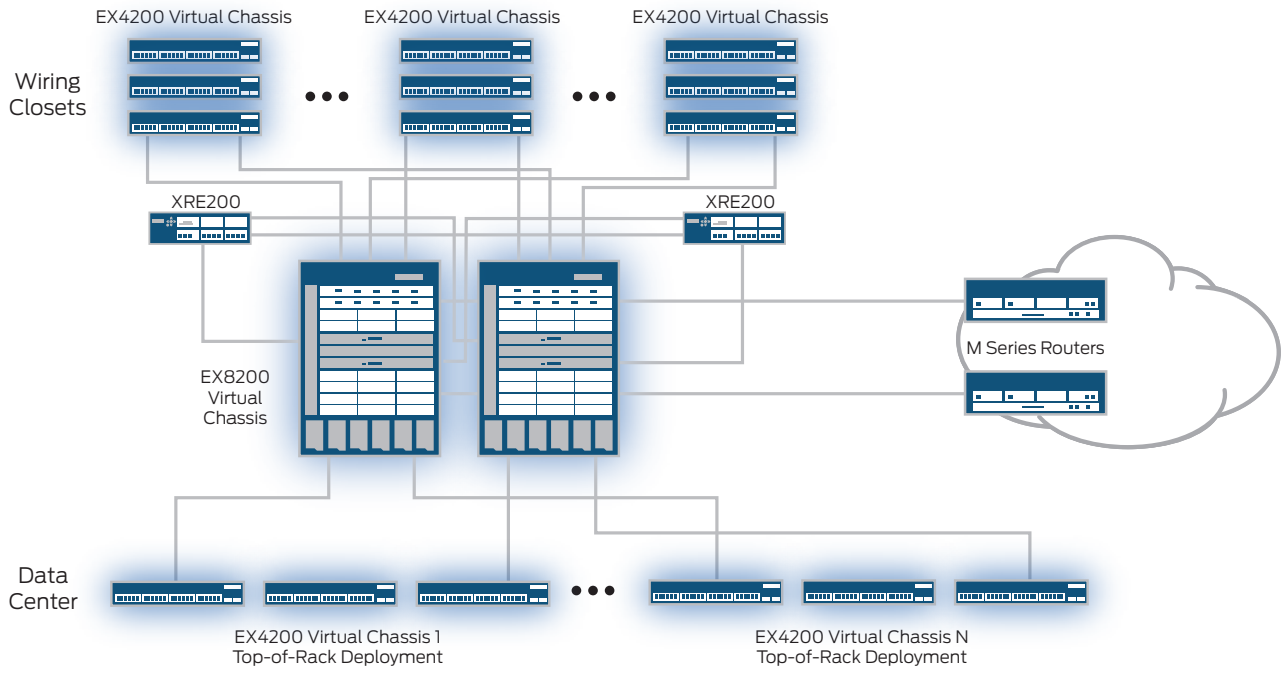

Figure 1: EX8216 modular switch offers a high-density, scalable solution for aggregating 10-Gigabit Ethernet uplinks from access-layer devices in the data center, as well as a combined core in consolidated network deployments.

Virtual Chassis technology can also be used to extend EX8200-based VLANs between data centers by placing an equal number of switches in both data centers, or by interconnecting two separate Virtual Chassis configurations using a simple L2 trunk.

XRE200 External Routing Engine

In an EX8200 Virtual Chassis configuration, the Routing Engine functionality is externalized to a purpose-built, server-class appliance, the XRE200, which supports control plane processing requirements for large-scale systems and provides an extra layer of availability and redundancy.

All control protocols such as OSPF, IGMP, Link Aggregation Control Protocol (LACP), 802.3ah and VCCP, as well as all management plane functions, run or reside on the XRE200. Junos OS high availability (HA) features can be enabled on the two XRE200s required in a redundant EX8200 Virtual Chassis configuration. In the event of an active XRE200 failure, the standby XRE200 takes over and Junos OS HA features ensure that the state of the Virtual Chassis, L2/L3 protocols, and forwarding information are not lost. See the XRE200 data sheet for more information.

Architecture and Key Components

Juniper Networks EX8200 line of Ethernet switches, including the EX8216 and EX8208, share a number of distinct architectural elements. The Routing Engines employed by these switches run Junos OS, which processes all Layer 2 and Layer 3 protocols and manages individual chassis components, while the switch fabrics provide the central crossbar matrix through which all data traffic passes.

The EX8200 line cards, which are common across all EX8200 platforms, include ASIC-based packet forwarding engines—the EX-PFE2—that process network traffic at wire rates, as well as a line-card processor that provides scalable local control.

The EX8216 architecture was designed for very large data center deployments, with no head-of-line blocking, a single-tier low-latency switch fabric, efficient multicast replication handling, and deep buffering to ensure performance at scale. The EX8216 chassis midplane distributes the control and management signals over independent paths to the various system components and distributes power throughout the system. Data plane signals pass directly from the EX8200 line cards to the EX8216 switch fabric modules via a unique pass-through connector system that provides unparalleled signal quality for future generations of fabric ASICs.

To maintain uninterrupted operation, the EX8216 switch's two fan trays cool the line cards, Routing Engine, and switch fabric modules with redundant, variable speed fans. The EX8200 line's power supplies convert building power to the internal voltage required by the system.

All EX8216 components are hot-swappable, and all central functions are available in redundant configurations, providing high operational availability by allowing continuous system operation during maintenance or repairs.

Routing Engine Module

The EX8216 Routing Engine module supports control and management plane functionality with an integrated Routing Engine that features a 1.2 GHz PowerPC processor with 2 gigabytes of DRAM and 4 gigabytes of flash storage. A dedicated front-panel RJ-45 Gigabit Ethernet port on the Routing Engine module supports out-of-band system management and monitoring, while an external USB port allows easy uploading and storage of software images, configuration files, and logs. Direct console access is available through a dedicated serial port, while an auxiliary console interface can support remote modem access to the switch.

The EX8216 switch's Routing Engine is based on the same field-proven hardware architecture used by Juniper Networks routers, bringing the same carrier-class performance and reliability to the EX8216 that Juniper's routers bring to the world's largest service provider networks. The Routing Engine's central CPU performs all system control functions and maintains hardware forwarding table and routing protocol states for the EX8216 switch. Dedicated hardware on the Routing Engine module supports chassis management functions such as environmental monitoring, while communication between Routing Engine modules and individual line cards takes place over a dedicated internal Gigabit Ethernet out-of-band control interface.

EX8216 Switch Fabric

The switch fabric for the EX8216, distributed across eight rear-accessible switch fabric modules, serves as the central non-blocking matrix through which all network data passes. All eight SFMs in the EX8216 are always active, providing ample capacity to deliver line-rate Layer 2 and Layer 3 switching on all ports for packets of any size. If one switch fabric module were to fail, the remaining modules gracefully load-balance the data traffic to maintain line-rate performance on all 10-Gigabit ports without dropping packets. The SFMs are hot-swappable and field-replaceable, enabling failed units to be easily replaced without service interruption.

The eight active, load-sharing switch fabric modules collectively deliver up to 320 Gbps (full duplex) of packet data bandwidth per line-card slot, providing sufficient capacity to support future 100-Gigabit Ethernet deployments. The EX8216 backplane connector system is designed to support switch fabric bandwidth of more than 12.4 Tbps—enabling the capacity of the EX8216 to potentially more than double in the future.

Power

The EX8216 chassis contains six power supply bays, providing complete flexibility for both provisioning and redundancy. The standard EX8200 AC power supply delivers 3,000 watts (W) of power at high-line (200 V – 240 V) to the chassis. The EX8216 also supports a 2,000 W power supply for high/low-line operation at 2,000/1,200 W. A redundant-input 3,000 W DC power supply is also available for central office deployments. The EX8200

power supplies are more than 90 percent efficient at a wide range of loads, minimizing building power requirements and reducing overall power consumption. These power supplies are interchangeable across the EX8200 line, simplifying maintenance and sparing.

Although only two power supplies are required for basic EX8216 configuration and power-up, the six power supply bays provide the capacity required to power all possible line-card configurations, and to support N+1 or N+N power redundancy to protect against both component and line input failures. The actual number of power supplies required depends on the combination of line cards installed and the desired level of redundancy (see table). For example, 9,000 W is required to support a chassis fully populated with 128 line-rate 10-Gigabit Ethernet ports.

Table 2: EX8216 Power Capacity

SYSTEM POWER CONSUMPTION	RESERVED POWER	TYPICAL POWER
Base system (one Routing Engine; eight switch fabric modules; two fan trays)	1,080 W	2,280 W
Redundant system (two Routing Engines; eight switch fabric modules; two fan trays)	1,180 W	2,380 W
LINE CARD POWER CONSUMPTION	**RESERVED POWER**	**TYPICAL POWER**
EX8200-8XS 8-port 10-Gigabit Ethernet SFP+ line card	450 W	299 W
EX8200-48T 48-port 10/100/1000BASE-T RJ-45 line card	350 W	194 W
EX8200-48F 48-port 100FX/1000BASEX SFP line card	330 W	185 W
EX8200-40XS 40-port 10GBASE-X SFP+ / 1000BASE-X SFP line card	550 W	427 W
POWER CAPACITY		
3 kW 220 V AC 5+1 power supply redundancy	15,000 W	
3 kW 220 V AC 3+3 power supply redundancy	9,000 W	
2 kW 220 V AC 5+1 power supply redundancy	10,000 W	
2 kW 110 V AC 5+1 power supply redundancy	6,000 W	
3 kW -48 V DC (5+5)+1 power supply redundancy	15,000 W	
3 kW -48 V DC (3+3)+1 power supply redundancy	9,000 W	

Features and Benefits

High Availability

The EX8216 switch delivers a number of high availability features to ensure uninterrupted, carrier-class performance, and also includes an extra slot to accommodate a redundant Routing Engine module. When a second Routing Engine module is present, it serves as a backup in hot standby mode, ready to take over in the event of a master Routing Engine failure. If the master fails, the integrated Layer 2 and Layer 3 graceful Routing Engine switchover (GRES) feature of Junos OS ensures the seamless transfer of control to the backup, maintaining uninterrupted access to applications, services, and IP communications.

Carrier-Class Operating System

The EX8216 runs the same Junos OS used by the EX3200 and EX4200 lines of switches, as well as the Juniper Networks routers that power the world's largest and most complex networks.

By using 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.

Simplified Management and Operations

A range of system management options are available for the EX8216 Ethernet switches.

The standard Junos OS CLI provides the same granular management capabilities and scripting parameters found in all Junos OS-powered devices. The EX8216 switches also include the integrated J-Web management tool, an embedded device manager that allows users to configure, monitor, troubleshoot, and perform device-level maintenance on individual switches via a browser-based graphical interface. In addition, integrated Junos Script Automation tools provide early detection and automatic resolution of potential problems related to the operating system.

Juniper Networks Network and Security Manager provides system-level management across all EX8200, EX4200, and EX3200 lines of Ethernet switches, as well as other Juniper Networks products deployed throughout the network—all from a single console.

Performance data from EX8216 switches can be exported to leading third-party management systems such as HP OpenView, IBM Tivoli, and Computer Associates Unicenter, where it can be combined with management data from other network components to provide a complete, consolidated view of network operations.

In addition, the EX8200 line supports Juniper Networks Advanced Insight Solutions (AIS), a comprehensive set of tools that enable Juniper Networks Technical Services to automate the delivery of tailored, proactive network intelligence and support services.

EX8216

EX8216 Modular Switch Specifications

Physical Specifications

Dimensions (W x H x D):

- 17.3 x 36.5 x 26.5* in (43.9 x 92.7 x 67.4* cm)
  * 28.2 in / 71.6 cm depth including all hardware

Weight:

- Base configuration: 270 lb (122.5 kg)
- Redundant configuration: 318 lb (144 kg)
- Chassis with midplane: 142 lb (64 kg)
- Fully loaded chassis: 422 lb (191 kg)

Hardware Specifications

- Analyzer sessions: 7 (local or remote)
- Queues per port: 8
- Policers: 2,000 per chassis
- Media access control (MAC) addresses: 160,000
- VLANs: 4,096
- Firewall filters (ACLs–security and QoS): 54,000
- Link aggregation group (LAG) (ports/groups): 12/255
- GRE tunnels: 2,000
- IPv4 unicast routes*: 500,000 maximum/1 million†
- IPv4 multicast routes: 120,000 maximum
- IPv6 unicast routes*: 250,000 maximum/500,000†
- IPv6 multicast routes: 120,000 maximum
- Number of multicast groups: 16,000
- Address Resolution Protocol (ARP) entries: 100,000
- L3 next hops: 150,000
- Jumbo frames: 9,216 bytes maximum
- Buffer per 10-Gigabit Ethernet port: 512 MB
- Buffer per Gigabit Ethernet port: 42 MB

EX8216 System Capacity

- Maximum backplane capacity: 12.4 Tbps
- Maximum system throughput: 1.92 Bpps

* Shared route table—actual capacity depends on prefix distribution
† Requires extra-scale line cards

IEEE Compliance

- IEEE 802.1AB: Link Layer Discovery Protocol (LLDP)
- IEEE 802.1D-2004: Spanning Tree Protocol (STP)
- IEEE 802.1p: Class-of-service (CoS) prioritization
- IEEE 802.1Q-2006: VLAN tagging
- IEEE 802.1s: Multiple Spanning Tree Protocol (MSTP)
- IEEE 802.1w: Rapid Spanning Tree Protocol (RSTP)
- IEEE 802.3: 10BASE-T
- IEEE 802.3u: 100BASE-T
- IEEE 802.3ab: 1000BASE-T
- IEEE 802.3z: 1000BASE-X
- IEEE 802.3ae: 10-Gigabit Ethernet
- IEEE 802.3x: Pause Frames/Flow Control
- IEEE 802.3ad: Link Aggregation Control Protocol (LACP)

RFC Compliance

- RFC 1122: Host Requirements
- RFC 768: UDP
- RFC 791: IP
- RFC 783: Trivial File Transfer Protocol (TFTP)
- RFC 792: Internet Control Message Protocol (ICMP)
- RFC 793: TCP
- RFC 826: ARP
- RFC 894: IP over Ethernet
- RFC 903: Reverse Address Resolution Protocol (RARP)
- RFC 906: TFTP Bootstrap
- RFC 1027: Proxy ARP
- RFC 2068: HTTP server
- RFC 1812: Requirements for IP Version 4 Routers
- RFC 1519: Classless Inter-Domain Routing (CIDR)
- RFC 1256: IPv4 ICMP Router Discovery Protocol (IRDP)
- RFC 1058: RIP v1
- RFC 2453: RIP v2
- RFC 1112: IGMP v1
- RFC 2236: IGMP v2
- RFC 3376: IGMP v3
- RFC 1492: TACACS+
- RFC 2138: RADIUS Authentication
- RFC 2139: RADIUS Accounting
- RFC 2267: Network Ingress Filtering
- RFC 2030: Simple Network Time Protocol (SNTP)
- RFC 854: Telnet client and server
- RFC 951, 1542: BootP
- RFC 2131: BOOTP/Dynamic Host Configuration Protocol (DHCP) relay agent and DHCP server
- RFC 1591: Domain Name System (DNS)
- RFC 2338: VRRP
- RFC 2328: OSPF v2 (Edge-mode)
- RFC 1587: OSPF NSSA Option
- RFC 1765: OSPF Database Overflow
- RFC 2154: OSPF w/Digital Signatures (Password, MD-5)
- RFC 2370: OSPF Opaque LSA Option
- RFC 3623: OSPF Graceful Restart
- RFC 2362: PIM-SM (Edge-mode)
- PIM-DM Draft IETF PIM: Dense Mode draft-ietf-idmr-pim-dm-05.txt, draft-ietf-pim-dm-new-v2-04.txt
- RFC 3569: Draft-ietf-ssm-arch-06.txt PIM-SSM PIM Source Specific Multicast
- RFC 1771: Border Gateway Protocol 4
- RFC 1965: Autonomous System Confederations for BGP
- RFC 2796: BGP Route Reflection (supersedes RFC 1966)
- RFC 1997: BGP Communities Attribute

RFC Compliance (continued)

- RFC 1745: BGP4/IDRP for IP-OSPF Interaction
- RFC 2385: TCP MD5 Authentication for BGPv4
- RFC 2439: BGP Route Flap Damping
- RFC 2918: Route Refresh Capability for BGP-4
- RFC 3392: Capabilities Advertisement with BGP-4
- RFC 2796: Route Reflection
- RFC 4360: BGP Extended Communities Attribute
- RFC 4486: Subcodes for BGP Cease Notification message
- RFC 1195: Use of Open Systems Interconnection (OSI) IS-IS for Routing in TCP/IP and Dual Environments (TCP/IP transport only)
- 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
- Draft-ietf-idr-restart-10.txt: Graceful Restart Mechanism for BGP
- Draft-ietf-isis-restart-02: Restart Signaling for IS-IS
- Draft-ietf-bfd-base-05.txt: Bidirectional Forwarding Detection

Services and Manageability

- Junos OS CLI
- Juniper Networks J-Web Software (embedded Web-based management)
- Out-of-band management: Serial; 10/100/1000BASE-T Ethernet
- ASCII configuration file
- Rescue configuration
- Configuration rollback
- Image rollback
- LCD management
- Element management tools: Network and Security Manager
- Proactive services support via Advanced Insight Solutions (AIS)
- SNMP: v1, v2c, v3
- RMON (RFC 2819) Groups 1, 2, 3, 9
- Network Time Protocol (NTP)
- DHCP server
- DHCP relay with Option 82
- RADIUS
- TACACS+
- SSHv2
- Secure copy
- HTTP/HTTPs
- DNS resolver
- Syslog logging
- Environment monitoring
- Temperature sensor
- Config-backup via FTP/secure copy

Network Management—MIB support

- RFC 1155: Structure of Management Information (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

Network Management—MIB support (continued)

- RFC 2011: SNMPv2 for IP 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: Power over Ethernet (PoE)-MIB (PoE 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 1657: BGP-4 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-ietf-idr-bgp4-mibv2-02.txt: Enhanced BGP-4 MIB
- Draft-ietf-isis-wg-mib-07
- 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, debug, and statistics commands
- Analyzer session: Ingress and/or egress traffic on multiple source ports monitored to one destination port or VLAN
- Local port and remote VLAN analyzers (up to seven sessions)
- IP tools: Extended ping and trace
- Juniper Networks commit and rollback

Environmental Ranges

- Operating temperature: 32º to 104º F (0º to 40º C)
- Storage temperature: -40º to 158º F (-40º to 70º 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: 5% to 90% (noncondensing)
- Relative humidity non-operating: 0% to 95% (noncondensing)
- Acoustic noise: 62 dBA (based on operational tests taken from bystander position [front] and performed at 23º C in compliance with ISO 7779)

Safety and Compliance

- CSA 60950-1 (2003) Safety of Information Technology Equipment
- UL 60950-1 (2003) Safety of Information Technology Equipment
- EN 60950-1 (2001) Safety of Information Technology Equipment
- IEC 60950-1 (2001) Safety of Information Technology Equipment (with country deviations)
- EN 60825-1 +A1+A2 (1994) Safety of Laser Products—
- Part 1: Equipment Classification
- EN 60825-2 (2000) Safety of Laser Products—Part 2: Safety of Optical Fiber Comm. Systems
- 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
- CE

EMC

- EN 300 386 V1.3.3 (2005) Telecom Network Equipment—EMC requirements
- FCC Part 15 Class A (2007) USA Radiated Emissions
- EN 55022 Class A (2006) European Radiated Emissions
- VCCI Class A (2007) Japanese Radiated Emissions
- ICES-003 Class A
- AS/NZS CISPR 22 Class A
- CISPR 22 Class A

Immunity

- EN 55024 +A1+A2 (1998) Information Technology Equipment Immunity Characteristics
- EN-61000-3-2 (2006) Power Line Harmonics
- EN-61000-3-3 +A1 +A2 +A3 (1995) Power Line Voltage Fluctuations
- EN-61000-4-2 +A1 +A2 (1995) Electrostatic Discharge
- EN-61000-4-3 +A1+A2 (2002) Radiated Immunity
- EN-61000-4-4 (2004) Electrical Fast Transients
- EN-61000-4-5 (2006) Surge
- EN-61000-4-6 (2007) Immunity to Conducted Disturbances
- EN-61000-4-11 (2004) Voltage Dips and Sags

Customer-Specific Requirements

- GR-63-Core (2006) Network Equipment, Building Systems (NEBS) Physical Protection
- GR-1089-Core (2006) EMC and Electrical Safety for Network Telecommunications Equipment
- SR-3580 (1995) NEBS Criteria Levels (Level 3)

Environmental

- Reduction of Hazardous Substances (ROHS) 5/6

Telco

- Common Language Equipment Identifier (CLEI) code

Ordering Information

MODEL NUMBER	DESCRIPTION
Hardware	
EX8216-BASE-AC	Base AC-powered EX8216 system configuration: 16-slot chassis with passive midplane and 2x fan trays, 1x routing engine, 8x switch fabric modules, 2x 3,000 W AC PSUs with power cords, and all necessary blank panels
EX8216-REDUND-AC	Redundant AC-powered EX8216 system configuration: 16-slot chassis with passive midplane and 2x fan trays, 2x routing engines, 8x switch fabric modules, 6x 3,000 W AC PSUs with power cords, and all necessary blank panels
EX8216-REDUND-AC2	Redundant 2 kW AC-powered EX8216 system configuration: 16-slot chassis with passive midplane and 2x fan trays, 2x routing engines, 8x switch fabric modules, 6x 2,000 W AC PSUs with power cords, and all necessary blank panels
EX8216-REDUND-DC	Redundant DC-powered EX8216 system configuration: 16-slot chassis with passive midplane and 2x fan trays, 2x routing engines, 8x switch fabric modules, 4x 3,000 W DC PSUs, and all necessary blank panels
EX8216-RE320	Routing Engine for EX8216, redundant
EX8216-SF320-S	Switch Fabric module for EX8216, spare
EX8216-CHAS-S	EX8216 chassis with midplane, spare
EX8216-FAN-S	EX8216 fan tray, spare
EX8200-PWR-AC3K	AC power supply, 3,000 W at 220 V, redundant (AC power cords sold separately)
EX8200-PWR-AC2K	AC power supply, 2,000 W at 220 V (1,200 W at 110 V), redundant (AC power cords sold separately)
EX8200-PWR-DC3KR	DC power supply, 3,000 W at -48 V, dual-input, redundant
EX8200 Line Cards	
EX8200-48T	48-port 10/100/1000BASE-T RJ-45 line card
EX8200-48T-ES	48-port 10/100/1000BASE-T RJ-45 extra scale line card
EX8200-48F	48-port 100FX/1000BASEX SFP line card; requires SFP optics sold separately
EX8200-48F-ES	48-port 100FX/1000BASE-X SFP extra scale line card; requires SFP optics sold separately
EX8200-8XS	8-port 10 GbE SFP+ line card; requires SFP+ optics sold separately
EX8200-8XS-ES	8-port 10GbE SFP+ extra scale line card; requires SFP+ optics sold separately
EX8200-40XS	40-port GbE / 10GbE line card; requires SFP and/or SFP+ optics sold separately
Clustering Licenses	
EX8216-AFL	EX8216 Advanced Feature License

About Juniper Networks

Juniper Networks is in the business of network innovation. From devices to data centers, from consumers to cloud providers, Juniper Networks delivers the software, silicon and systems that transform the experience and economics of networking. The company serves customers and partners worldwide. Additional information can be found at **www.juniper.net**.

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