Hewlett Packard Enterprise

HPE FlexFabric 5950 Switch Series

Key features

- Cut-through with ultra-low-latency and wire speed
- VXLAN, VTEP, and OVSDB support for virtualized environments
- High-density 100GbE/40GbE/25GbE/10GbE spine/top-of-rack (ToR) connectivity
- IPv6 support with full L2 and L3 features
- New HPE FlexFabric Network Analytics solution capability for real time microburst detection

Product overview

The HPE FlexFabric 5950 Switch Series is a family of high-density, ultra-low-latency, and ToR switches that is part of HPE FlexFabric solution (from the HPE FlexNetwork architecture).

Ideally suited for deployment at the aggregation or server access layer of large enterprise data centers, the HPE 5950 Switch Series is also powerful enough for deployment at the core layer of medium-sized enterprises.

With the increase in virtualized applications and server-to-server traffic, customers require a spine and ToR switches that can meet their throughput requirements. With the HPE FlexFabric 5950, **Data Center** can now support up to 100G per ports, allowing high performance server connectivity and the capabilities to handle virtual environments. This is available in the low-latency, all-in-a-single device offering—HPE FlexFabric 5950 Switch Series.

Features and benefits

Quality of service (QoS)

- Powerful QoS features
  - **Flexible queue scheduling**
    Including strict priority (SP), WRR, WDRR, WFQ, SP+WRR, SP+WDRR, SP+WFQ, configurable buffer, time range, queue shaping, and CAR with 8 kbps granularity
  - **Packet filtering and remarking**
    Packet filtering at L2 through L4; flow classification based on source MAC address, destination MAC address, source IP (IPv4/IPv6) address, and destination IP

Data center optimized

- **Flexible high-port density**
  HPE FlexFabric 5950 Series enables scaling of the server Edge, with 100GbE, 40GbE, 25GbE, and 10GbE Spine and Leaf deployment. The 5950 series comes as a high-density 32-port 100G fixed port, as a 48-port of 25G with 8-port 100G and in a 2RU modular form factor
- **High-performance switching**
  Cut-through and non-blocking architecture delivers low latency (~1 microsecond for 100GbE) for very demanding enterprise applications; the switch delivers high-performance switching capacity and wire-speed packet forwarding
- **Higher scalability**
  Intelligent Resilient Fabric (IRF) technology simplifies the architecture of server access networks; up to 10 HPE 5950 switches can be combined to deliver unmatched scalability of virtualized access layer switches and flatter two-tier networks using IRF, which reduces cost and complexity
- **Advanced modular operating system**
  Comware v7 software's modular design and multiple processes bring native high stability, independent process monitoring, and restart; the OS also allows individual software modules to be upgraded for higher availability and supports enhanced serviceability functions such as hitless software upgrades with IRF-based in services software upgrade (ISSU)
- **Reversible airflow**
  Enhanced for data center hot-cold aisle deployment with reversible airflow—for either front-to-back or back-to-front airflow
- **Redundant fans and power supplies**
  Internal redundant and hot-pluggable power supplies and dual fan trays enhance reliability and availability
- **Lower OPEX and greener data center**
  Provides reversible airflow and advanced chassis power management
- **Data center bridging (DCB) protocols**
  Provides support for IEEE 802.1Qbb priority flow control (PFC), data center bridging exchange (DCBX), IEEE 802.1Qaz enhanced transmission selection (ETS), explicit congestion notification (ECN) for converged FCoE, iSCSI, and RoCE environments
- **Jumbo frames**
  With frame sizes of up to 9,416 bytes on 100GbE ports, high-performance remote backup and disaster-recovery services to are enabled
- **VXLAN hardware support**
  VXLAN L2 gateway support for up to 2K tunnels
- **Dynamic VXLAN configuration**
  OVSDB support for dynamic VXLAN configuration

Manageability

- The HPE FlexFabric Network Analytics solution with real-time telemetry analysis provides insight into data center network operation
  - Tracks all the accounting associated with the admission and allocation process of all the buffers and queues across the ingress and egress ports
  - Microburst congestion detection
  - Rich congestion analytics
  - Buffer congestion state and statistics
  - For more information, see the **HPE FlexFabric Network Analytics data sheet** and **HPE FlexFabric Network Analytics white paper**.
- **Full-featured console**
  Provides complete control of the switch with a familiar CLI
- **Troubleshooting**
  - Ingress and egress port monitoring
    Enables network problem solving
  - Traceroute and ping
    Enables testing of network connectivity
- **Multiple configuration files**
  Allows multiple configuration files to be stored to a flash image
- **sFlow® (RFC 3176)**
  Provides wire-speed traffic accounting and monitoring
- **SNMPv1, v2c, and v3**
  Facilitates centralized discovery, monitoring, and secure management of networking devices
- **Out-of-band interface**
  Isolates management traffic from user data plane traffic for complete isolation and total reachability, no matter what happens in the data plane
- **Remote configuration and management**
  Delivered through a secure CLI over Telnet and SSH; role-based access control (RBAC) provides multiple levels of access; configuration rollback and multiple configurations on the flash provide ease of operation; remote visibility is provided with sFlow and SNMPv1/v2/v3, and is fully supported in **HPE Intelligent Management Center (IMC)**
- **ISSU and hot patching**
  Provides hitless software upgrades with IRF-based ISSU and hitless patching of the modular operating system
- **NTP support**
  Synchronizes timekeeping among distributed time servers and clients; support for network time protocol (NTP)

Resiliency and high availability

- **IRF technology**
  Enables an HPE FlexFabric to deliver resilient, scalable, and secured data center networks for physical and virtualized environments; groups up to 10 HPE 5950 switches in an IRF configuration, allowing them to be configured and managed as a single switch with a single IP address; simplifies ToR deployment and management, reducing data center deployment and operating expenses
- **IEEE 802.1w Rapid Convergence Spanning Tree Protocol (STP)**
  Increases network uptime through faster recovery from failed links
- **IEEE 802.1s Multiple Spanning Tree**
  Provides high-link availability in multiple VLAN environments by allowing Multiple Spanning Trees
- **Virtual router redundancy protocol (VRRP)**
  Allows groups of two routers to back each other up dynamically to create highly available routed environments
- **Hitless patch upgrades**
  Allows patches and new service features to be installed without restarting the equipment, increasing network uptime, and facilitating maintenance

- **Fast protocol convergence with standard-based failure detection—bidirectional forwarding detection (BFD)**
  Enables link connectivity monitoring and reduces network convergence time for RIP, OSPF, BGP, IS-IS, VRRP, MPLS, and IRF
- **Device link detection protocol (DLDP)**
  Monitors link connectivity and shuts down ports at both ends if unidirectional traffic is detected, preventing loops in STP-based networks
- **Graceful restart**
  Allows routers to indicate to others their capability to maintain a routing table during a temporary shutdown and significantly reduces convergence times upon recovery; supports OSPF, BGP, and IS-IS

L2 switching

- **Address resolution protocol (ARP)**
  Supports static, dynamic, and reverse ARP and ARP proxy
- **IEEE 802.3x Flow Control**
  Provides intelligent congestion management via PAUSE frames
- **Ethernet Link Aggregation**
  Provides IEEE 802.3ad Link Aggregation of up to 256 groups of 32 ports; support for LACP, LACP local forwarding first, and LACP short-time provide a fast, resilient environment that is ideal for the data center
- **Spanning Tree Protocol**
  Supports STP (IEEE 802.1D), Rapid STP (RSTP, IEEE 802.1w), and Multiple STP (MSTP, IEEE 802.1s)
- **VLAN support**
  Provides support for 4,096 VLANs based on port
- **IGMP support**
  Provides support for IGMP Snooping, fast-leave, and group policy; IPv6 IGMP Snooping provides L2 optimization of multicast traffic
- **DHCP support at L2**
  Provides full DHCP Snooping support for DHCP Snooping Option 82, DHCP Relay Option 82, DHCP Snooping Trust, and DHCP Snooping Item Backup

L3 services

- **Address resolution protocol**
  Determines the MAC address of another IP host in the same subnet; supports static ARPs; gratuitous ARP allows detection of duplicate IP addresses; proxy ARP allows normal ARP operation between subnets or when subnets are separated by a L2 network
- **Dynamic host configuration protocol**
  Simplifies the management of large IP networks and supports client and server; DHCP Relay enables DHCP operation across subnets
- **Operations, administration, and maintenance (OAM) support**
  Provides support for Connectivity Fault Management (IEEE 802.1AG) and Ethernet in the First Mile (IEEE 802.3AH); provides additional monitoring that can be used for fast fault detection and recovery

L3 routing

- **VRRP and VRRP extended**
  Allows quick failover of router ports
- **Policy-based routing**
  Makes routing decisions based on policies set by the network administrator
- **Equal-cost multipath (ECMP)**
  Enables multiple equal-cost links in a routing environment to increase link redundancy and scale bandwidth
- **L3 IPv4 routing**
  Provides routing of IPv4 at media speed; supports static routes, RIP and RIPv2, OSPF, BGP, and IS-IS
- **Open shortest path first**
  Delivers faster convergence; uses this link-state routing interior gateway protocol (IGP), which supports ECMP, NSSA, and MD5 authentication for increased security and graceful restart for faster failure recovery
- **Border Gateway Protocol 4 (BGP-4)**
  Delivers an implementation of the EGP utilizing path vectors; uses TCP for enhanced reliability for the route discovery process; reduces bandwidth consumption by advertising only incremental updates; supports extensive policies for increased flexibility; scales to very large networks
- **Intermediate system to intermediate system (IS-IS)**
  Uses a path vector IGP, which is defined by the ISO organization for IS-IS routing and extended by IETF RFC 1195 to operate in both TCP/IP and the OSI reference model (Integrated IS-IS)
- **Static IPv6 routing**
  Provides simple manually configured IPv6 routing
- **Dual IP stack**
  Maintains separate stacks for IPv4 and IPv6 to ease the transition from an IPv4-only network to an IPv6-only network design
- **Routing Information Protocol next generation (RIPng)**
  Extends RIPv2 to support IPv6 addressing
- **OSPFv3**
  Provides OSPF support for IPv6
- **BGP+**
  Extends BGP-4 to support multiprotocol BGP (MBGP), including support for IPv6 addressing
- **IS-IS for IPv6**
  Extends IS-IS to support IPv6 addressing
- **IPv6 tunneling**
  Allows IPv6 packets to traverse IPv4-only networks by encapsulating the IPv6 packet into a standard IPv4 packet; supports manually configured, 6 to 4, and intra-site automatic tunnel addressing protocol (ISATAP) tunnels; is an important element for the transition from IPv4 to IPv6
- **Policy routing**
  Allows custom filters for increased performance and security; supports ACLs, IP prefix, AS paths, community lists, and aggregate policies
- **Bidirectional forwarding detection (BFD)**
  Enables link connectivity monitoring and reduces network convergence time for RIP, OSPF, BGP, IS-IS, VRRP, MPLS, and IRF
- **Multicast Routing PIM dense and sparse modes**
  Provides robust support of multicast protocols

- **L3 IPv6 routing**
  Provides routing of IPv6 at media speed; supports static routing, RIPng, OSPFv3, BGP4+ for IPv6, and IS-ISv6

Additional information

- **Green IT and power**
  Improves energy efficiency through the use of the latest advances in silicon development; shuts off unused ports and utilizes variable-speed fans, reducing energy costs

Management

USB support

- **File copy**
  Allows users to copy switch files to and from a USB flash drive
- **Multiple configuration files**
  Stores easily to the flash image
- **SNMPv1, v2c, and v3**
  Facilitates centralized discovery, monitoring, and secure management of networking devices
- **Out-of-band interface**
  Isolates management traffic from user data plane traffic for complete isolation and total reachability, no matter what happens in the data plane
- **Port mirroring**
  Enables traffic on a port to be simultaneously sent to a network analyzer for monitoring
- Remote configuration and management
  Is available through a CLI
- **IEEE 802.1AB Link Layer Discovery Protocol (LLDP)**
  Advertises and receives management information from adjacent devices on a network, facilitating easy mapping by network management applications
- **sFlow (RFC 3176)**
  Provides scalable ASIC-based wire-speed network monitoring and accounting with no impact on network performance; this allows network operators to gather a variety of sophisticated network statistics and information for capacity planning and real-time network monitoring purposes
- **Command authorization**
  Leverages RADIUS to link a custom list of CLI commands to an individual network administrator's login; an audit trail documents activity
- **Dual flash images**
  Provides independent primary and secondary operating system files for backup while upgrading
- **Command-line interface**
  Provides a secure, easy-to-use CLI for configuring the module via SSH or a switch console; provides direct real-time session visibility
- **Logging**
  Provides local and remote logging of events via SNMP (v2c and v3) and syslog; provides log throttling and log filtering to reduce the number of log events generated
- **Management interface control**
  Provides management access through a modem port and terminal interface, as well as in-band and out-of-band Ethernet ports; provides access through terminal interface, Telnet, or SSH
- **Industry-standard CLI with a hierarchical structure**
  Reduces training time and expenses, and increases productivity in **multivendor** installations
- **Management security**
  Restricts access to critical configuration commands; offers multiple privilege levels with password protection; ACLs provide Telnet and SNMP access; local and remote syslog capabilities allow logging of all access
- **Information center**
  Provides a central repository for system and network information; aggregates all logs, traps, and debugging information generated by the system and maintains them in order of severity; outputs the network information to multiple channels based on user-defined rules
- **Network management**
  HPE IMC centrally configures, updates, monitors, and troubleshoots
- **Remote intelligent mirroring**
  Mirrors ingress/egress ACL-selected traffic from a switch port or VLAN to a local or remote switch port anywhere on the network

Security

- **Access control lists**
  Provides IP L3 filtering based on source/destination IP, address/subnet, and source/destination TCP/UDP port number
- **RADIUS/TACACS+**
  Eases switch management security administration by using a password authentication server
- **Secure Shell**
  Encrypts all transmitted data for secure remote CLI access over IP networks
- **IEEE 802.1X and RADIUS network logins**
  Controls port-based access for authentication and accountability
- **Port security**
  Allows access only to specified MAC addresses, which can be learned or specified by the administrator

Convergence

- **LLDP-MED (Media Endpoint Discovery)**
  Defines a standard extension of LLDP that stores values for parameters such as QoS and VLAN to configure network devices such as IP phones automatically

Warranty and support

- **1-year warranty**
  See **hpe.com/networking/warrantysummary** for warranty and support information included with your product purchase
- **Software releases**
  To find software for your product, refer to **hpe.com/networking/support**; for details on the software releases available with your product purchase, refer to **hpe.com/networking/warrantysummary**

HPE FlexFabric 5950 Switch Series

Specifications



	HPE FlexFabric 5950 32QSFP28 Switch (JH321A)	HPE FlexFabric 5950 48SFP28 8QSFP28 Switch (JH402A)	HPE FlexFabric 5950 4-slot Switch (JH404A)
I/O ports and slots	32 QSFP28 100GbE ports 2 SFP+ 1/10GbE ports	48 SFP28 25GbE ports; ports 1—48 PHY-less 8 QSFP28 100GbE ports; PHY-less 2 SFP+ 1/10GbE ports (IEEE 802.3ae Type 10GBASE-ER); PHY-less, IEEE 802.3ae Type 10GBASE-LR, IEEE 802.3ae Type 10GBASE-SR, IEEE 802.3z Type 1000BASE-SX, IEEE 802.3z Type 1000BASE-LX	4 module slots 2 SFP+ 1/10GbE ports (IEEE 802.3ae Type 10GBASE-ER); PHY-less, IEEE 802.3ae Type 10GBASE-LR, IEEE 802.3ae Type 10GBASE-SR, IEEE 802.3z Type 1000BASE-SX, IEEE 802.3z Type 1000BASE-LX Supports a maximum of 32 100GbE ports or 96 10GbE ports or 64 40GbE ports or 96 converged ports, or a combination
Additional ports and slots	1 RJ-45 serial console port 1 RJ-45 out-of-band management port 1 SFP out-of-band management port 1 USB 2.0 1 micro USB 2.0 console port	1 RJ-45 serial console port 1 RJ-45 out-of-band management port 1 SFP out-of-band management port 1 USB 2.0 1 micro USB 2.0 console port	1 RJ-45 serial console port 1 RJ-45 out-of-band management port 1 SFP out-of-band management port 1 USB 2.0 1 micro USB 2.0 console port
Power supplies	2 power supply slots 1 minimum power supply required (ordered separately)	2 power supply slots 1 minimum power supply required (ordered separately)	4 power supply slots 2 minimum power supplies required (ordered separately)
Fan tray	6 fan tray slots The customer must order fan trays, as fan trays are not included with the switch. This system requires same-direction airflow fan trays to function properly. The system should not be operated with only five fan trays for more than 24 hours. The system should not be operated without a fan tray for more than two minutes. The system should not be operated outside of the temperature range of 32°F (0°C) to 113°F (45°C). Failure to comply with these operating requirements may void the product warranty.	5 fan tray slots The customer must order fan trays, as fan trays are not included with the switch. This system requires same-direction airflow fan trays to function properly. The system should not be operated with only five fan trays for more than 24 hours. The system should not be operated without a fan tray for more than two minutes. The system should not be operated outside of the temperature range of 32°F (0°C) to 113°F (45°C). Failure to comply with these operating requirements may void the product warranty.	2 fan tray slots The customer must order fan trays, as fan trays are not included with the switch. This system requires two same-direction airflow fan trays to function properly. The system should not be operated with only one fan tray for more than 24 hours. The system should not be operated without a fan tray for more than two minutes. The system should not be operated outside of the temperature range of 32°F (0°C) to 113°F (45°C). Failure to comply with these operating requirements may void the product warranty.
Physical characteristics			
Dimensions	17.32(w) x 25.98(d) x 1.72(h) in. (44.00 x 54.00 x 4.36 cm)	17.32(w) x 25.98(d) x 1.72(h) in. (44.00 x 54.00 x 4.36 cm)	17.32(w) x 25.98(d) x 3.47(h) in. (44.00 x 66.0 x 8.81 cm) (2U height)
Weight	26.46 lb (12.00 kg) shipping weight	22.49 lb (10.20 kg) shipping weight	41.23 lb (18.70 kg) shipping weight
Full configuration weight	26.44 lb (11.99 kg)	22.20 lb (10.07 kg)	41.36 lb (18.76 kg)

HPE FlexFabric 5950 Switch Series (continued)

	HPE FlexFabric 5950 32QSFP28 Switch (JH321A)	HPE FlexFabric 5950 48SFP28 8QSFP28 Switch (JH402A)	HPE FlexFabric 5950 4-slot Switch (JH404A)
Memory and processor	1 GB flash; packet buffer size: 16 MB, 4 GB SDRAM	1 GB flash; packet buffer size: 16 MB, 4 GB SDRAM	1 GB flash; packet buffer size: 16 MB, 4 GB SDRAM
Performance			
Latency	10 Gbps	10 Gbps	10 Gbps
Throughput	< 1 µs (64-byte packets) up to 2796 Mpps	< 1 µs (64-byte packets) up to 2796 Mpps	< 1 µs (64-byte packets) up to 2796 Mpps
Routing/Switching capacity	3200 Gbps	3200 Gbps	3200 Gbps
Routing table size	128000 entries (IPv4), 64000 entries (IPv6)	128000 entries (IPv4), 64000 entries (IPv6)	128000 entries (IPv4), 64000 entries (IPv6)
MAC address table size	136000 entries	136000 entries	136000 entries
Environment			
Operating temperature	32°F to 113°F (0°C to 45°C)	32°F to 113°F (0°C to 45°C)	32°F to 113°F (0°C to 45°C)
Operating relative humidity	10% to 95%, noncondensing	10% to 95%, noncondensing	10% to 90%, noncondensing
Acoustic	Low-speed fan: 62.9 dB, High-speed fan: 78.2 dB	Low-speed fan: 62.4 dB, High-speed fan: 79.6 dB	Low-speed fan: 70.8 dB, High-speed fan: 83.2 dB
Electrical characteristics			
Frequency	50/60 Hz	50/60 Hz	50/60 Hz
Maximum heat dissipation	955/1689 BTU/hr (1007.53/1781.9 kJ/hr)	955/1689 BTU/hr (1007.53/1781.9 kJ/hr)	
Voltage	90–264 VAC, rated -40 to -75 VDC, rated (depending on power supply chosen)	90–264 VAC, rated -40 to -75 VDC, rated (depending on power supply chosen)	90–264 VAC, rated -40 to -75 VDC, rated (depending on power supply chosen)
Maximum power rating	409W	515W	888W
Idle power	280W	280W	139W
Notes	Idle power is the actual power consumption of the device with no ports connected. Maximum power rating and maximum heat dissipation are the worst-case theoretical maximum numbers provided for planning the infrastructure with fully loaded PoE (if equipped), 100% traffic, all ports plugged in, and all modules populated.	Idle power is the actual power consumption of the device with no ports connected. Maximum power rating and maximum heat dissipation are the worst-case theoretical maximum numbers provided for planning the infrastructure with fully loaded PoE (if equipped), 100% traffic, all ports plugged in, and all modules populated.	Idle power is the actual power consumption of the device with no ports connected. Maximum power rating and maximum heat dissipation are the worst-case theoretical maximum numbers provided for planning the infrastructure with fully loaded PoE (if equipped), 100% traffic, all ports plugged in, and all modules populated.
Safety	UL 60950-1; EN 60825-1 Safety of Laser Products-Part 1; EN 60825-2 Safety of Laser Products-Part 2; IEC 60950-1; CAN/CSA-C22.2 No. 60950-1; Anatel; ULAR; GOST; EN 60950-1/A11; FDA 21 CFR Subchapter J; NOM; RoHS Compliance	UL 60950-1; EN 60825-1 Safety of Laser Products-Part 1; EN 60825-2 Safety of Laser Products-Part 2; IEC 60950-1; CAN/ CSA-C22.2 No. 60950-1; Anatel; ULAR; GOST; EN 60950-1/A11; FDA 21 CFR Subchapter J; NOM; RoHS Compliance	UL 60950-1; EN 60825-1 Safety of Laser Products-Part 1; EN 60825-2 Safety of Laser Products-Part 2; IEC 60950-1; CAN/ CSA-C22.2 No. 60950-1; Anatel; ULAR; GOST; EN 60950-1/A11; FDA 21 CFR Subchapter J; NOM; RoHS Compliance
Emissions	VCCI Class A; EN 55022 Class A; ICES-003 Class A; ANSI C63.4 2003; AS/NZS CISPR 22 Class A; EN 61000-3-2:2006; EN 61000-3-3:1995 +A1:2001+A2:2005; EMC Directive 2004/108/EC; FCC(CFR 47, Part 15) Class A; ANSI/TIA-1057 LLDP Media Endpoint Discovery (LLDP-MED)	VCCI Class A; EN 55022 Class A; ICES-003 Class A; ANSI C63.4 2003; AS/ NZS CISPR 22 Class A; N 61000-3- 2:2006; EN 61000-3-3:1995 +A1:2001+A2:2005; EMC Directive 2004/108/EC; FCC (CFR 47, Part 15) Class A; ANSI/TIA-1057 LLDP Media Endpoint Discovery (LLDP-MED)	VCCI Class A; EN 55022 Class A; ICES-003 Class A; ANSI C63.4 2003; AS/ NZS CISPR 22 Class A; N 61000-3- 2:2006; EN 61000-3-3:1995 +A1:2001+A2:2005; EMC Directive 2004/108/EC; FCC (CFR 47, Part 15) Class A; ANSI/TIA-1057 LLDP Media Endpoint Discovery (LLDP-MED)

HPE FlexFabric 5950 Switch Series (continued)

	HPE FlexFabric 5950 32QSFP28 Switch (JH321A)	HPE FlexFabric 5950 48SFP28 8QSFP28 Switch (JH402A)	HPE FlexFabric 5950 4-slot Switch (JH404A)
Immunity			
Generic	ETSI EN 300 386 V1.3.3	ETSI EN 300 386 V1.3.3	ETSI EN 300 386 V1.3.3
EN	EN 55024:1998+ A1:2001 +	EN 55024:1998+ A1:2001 +	EN 55024:1998+ A1:2001 +
ESD	A2:2003 EN 61000-4-2; IEC 61000-4-2	A2:2003 EN 61000-4-2; IEC 61000-4-2	A2:2003 EN 61000-4-2; IEC 61000-4-2
Radiated EFT/Burst	EN 61000-4-3; IEC 61000-4-3	EN 61000-4-3; IEC 61000-4-3	EN 61000-4-3; IEC 61000-4-3
Surge	EN 61000-4-4; IEC 61000-4-4	EN 61000-4-4; IEC 61000-4-4	EN 61000-4-4; IEC 61000-4-4
Conducted	EN 61000-4-5; IEC 61000-4-5	EN 61000-4-5; IEC 61000-4-5	EN 61000-4-5; IEC 61000-4-5
Power frequency magnetic field	EN 61000-4-6; IEC 61000-4-6	EN 61000-4-6; IEC 61000-4-6	EN 61000-4-6; IEC 61000-4-6
Voltage dips and interruptions	IEC 61000-4-8; EN 61000-4-8	IEC 61000-4-8; EN 61000-4-8	IEC 61000-4-8; EN 61000-4-8
Harmonics	EN 61000-4-11; IEC 61000-4-11	EN 61000-4-11; IEC 61000-4-11	EN 61000-4-11; IEC 61000-4-11
Flicker	EN 61000-3-2; IEC 61000-3-2	EN 61000-3-2; IEC 61000-3-2	EN 61000-3-2; IEC 61000-3-2
	EN 61000-3-3; IEC 61000-3-3	EN 61000-3-3; IEC 61000-3-3	EN 61000-3-3; IEC 61000-3-3
Management	Intelligent Management Center (IMC); Command-line interface; Out-of-band management; SNMP manager; Telnet; FTP	IMC; Command-line interface; Out-of-band management; SNMP manager; Telnet; FTP	IMC; Command-line interface; Out-of-band management; SNMP manager; Telnet; FTP
Notes	The customer must order a power supply, as the device does not come with one. At least one JC680A or JC681A is required.	The customer must order a power supply, as the device does not come with one. At least one JC680A or JC681A is required.	The customer must order power supplies, as the device does not come with any. At least two JC680A or JC681A are required.
Services	Refer to the Hewlett Packard Enterprise website at **hpe.com/networking/services** for details on the service-level descriptions and product numbers. For details about services and response times in your area, please contact your local Hewlett Packard Enterprise sales office.	Refer to the Hewlett Packard Enterprise website at **hpe.com/networking/services** for details on the service-level descriptions and product numbers. For details about services and response times in your area, please contact your local Hewlett Packard Enterprise sales office.	Refer to the Hewlett Packard Enterprise website at **hpe.com/networking/services** for details on the service-level descriptions and product numbers. For details about services and response times in your area, please contact your local Hewlett Packard Enterprise sales office.

Standards and protocols
(applies to all products in series)

BGP	RFC 1163 Border Gateway Protocol (BGP) RFC 1771 BGPv4 RFC 1997 BGP Communities Attribute	RFC 2918 Route Refresh Capability RFC 3392 Capabilities Advertisement with BGP-4 RFC 4271 A Border Gateway Protocol 4 (BGP-4)	RFC 4360 BGP Extended Communities Attribute RFC 4456 BGP Route Reflection: An Alternative to Full Mesh Internal BGP (IBGP) RFC 4760 Multiprotocol Extensions for BGP-4
Device management	RFC 1157 SNMPv1/v2c RFC 1305 NTPv3 RFC 1591 DNS (client) RFC 1902 (SNMPv2)	RFC 1908 (SNMPv1/2 Coexistence) RFC 2573 (SNMPv3 Applications) RFC 2576 (Coexistence between SNMPv1, v2, v3 RFC 2819 RMON	Multiple Configuration Files Multiple Software Images SSHv1/SSHv2 Secure Shell TACACS/TACACS+
General protocols	IEEE 802.1ad Q-in-Q IEEE 802.1AX-2008 Link Aggregation IEEE 802.1D MAC Bridges IEEE 802.1p Priority IEEE 802.1Q VLANs IEEE 802.1s Multiple Spanning Trees IEEE 802.1w Rapid Reconfiguration of Spanning Tree IEEE 802.3ad Link Aggregation Control Protocol (LACP) IEEE 802.3ae 10-Gigabit Ethernet IEEE 802.3ag Ethernet OAM IEEE 802.3ah Ethernet in First Mile over Point to Point Fiber—EFMF IEEE 802.3x Flow Control RFC 768 UDP RFC 783 TFTP Protocol (revision 2) RFC 791 IP RFC 792 ICMP RFC 793 TCP RFC 826 ARP RFC 854 TELNET RFC 856 TELNET RFC 868 Time Protocol RFC 896 Congestion Control in IP/TCP Internetworks RFC 950 Internet Standard Subnetting Procedure RFC 1027 Proxy ARP RFC 1058 RIPv1 RFC 1091 Telnet Terminal-Type Option RFC 1141 Incremental updating of the Internet checksum RFC 1142 OSI IS-IS Intra-domain Routing Protocol RFC 1191 Path MTU discovery	RFC 1213 Management Information Base for Network Management of TCP/IP-based Internets RFC 1253 (OSPFv2) RFC 1531 Dynamic Host Configuration Protocol RFC 1533 DHCP Options and BOOTP Vendor Extensions RFC 1534 DHCP/BOOTP Interoperation RFC 1541 DHCP RFC 1542 Clarifications and Extensions for the Bootstrap Protocol RFC 1591 DNS (client only) RFC 1624 Incremental Internet Checksum RFC 1723 RIP v2 RFC 1812 IPv4 Routing RFC 2030 Simple Network Time Protocol (SNTP) v4 RFC 2131 DHCP RFC 2236 IGMP Snooping RFC 2338 VRRP RFC 2453 RIPv2 RFC 2581 TCP Congestion Control RFC 2644 Directed Broadcast Control RFC 2767 Dual Stacks IPv4 & IPv6 RFC 2865 Remote Authentication Dial In User Service (RADIUS) RFC 2868 RADIUS Attributes for Tunnel Protocol Support RFC 2890 Key and Sequence Number Extensions to GRE RFC 3046 DHCP Relay Agent Information Option RFC 3411 An Architecture for Describing Simple Network Management Protocol (SNMP) Management Frameworks RFC 3412 Message Processing and Dispatching for the Simple Network Management Protocol (SNMP)	RFC 3413 Simple Network Management Protocol (SNMP) Applications RFC 3416 Protocol Operations for SNMP RFC 3417 Transport Mappings for the Simple Network Management Protocol (SNMP) RFC 3418 Management Information Base (MIB) for the Simple Network Management Protocol (SNMP) RFC 3768 Virtual Router Redundancy Protocol (VRRP) RFC 4250 The Secure Shell (SSH) Protocol Assigned Numbers RFC 4251 The Secure Shell (SSH) Protocol Architecture RFC 4252 The Secure Shell (SSH) Authentication Protocol RFC 4253 The Secure Shell (SSH) Transport Layer Protocol RFC 4254 The Secure Shell (SSH) Connection Protocol RFC 4292 IP Forwarding Table MIB RFC 4293 Management Information Base for the Internet Protocol (IP) RFC 4364 BGP/MPLS IP Virtual Private Networks (VPNs) RFC 4419 Diffie-Hellman Group Exchange for the Secure Shell (SSH) Transport Layer Protocol RFC 4594 Configuration Guidelines for DiffServ Service Classes RFC 4601 Protocol Independent Multicast-Sparse Mode (PIM-SM): Protocol Specification (Revised) RFC 4604 Using Internet Group Management Protocol Version 3 (IGMPv3) and Multicast Listener Discovery Protocol Version 2 (MLDv2) for Source-Specific Multicast RFC 4607 Source-Specific Multicast for IP RFC 4941 Privacy Extensions for Stateless Address Autoconfiguration in IPv6 RFC 5340 OSPF for IPv6 RFC 5905 Network Time Protocol Version 4: Protocol and Algorithms Specification RFC 2929 RADIUS Support DS for RADIUS

Standards and protocols (continued)
(applies to all products in series)

IPv6	RFC 2080 RIPng for IPv6 RFC 2460 IPv6 Specification RFC 2461 IPv6 Neighbor Discovery RFC 2462 IPv6 Stateless Address Autoconfiguration RFC 2463 ICMPv6 RFC 2464 Transmission of IPv6 over Ethernet Networks RFC 2473 Generic Packet Tunneling in IPv6 RFC 2545 Use of MP-BGP-4 for IPv6	RFC 2563 ICMPv6 RFC 2711 IPv6 Router Alert Option RFC 2740 OSPFv3 for IPv6 RFC 2767 Dual stacks IPv4 & IPv6 RFC 3315 DHCPv6 (client and relay) RFC 3484 Default Address Selection for IPv6 RFC 3810 Multicast Listener Discovery Version 2 (MLDv2) for IPv6	RFC 4213 Basic Transition Mechanisms for IPv6 Hosts and Routers RFC 4291 IP Version 6 Addressing Architecture RFC 4443 ICMPv6 RFC 4552 Authentication/Confidentiality for OSPFv3 RFC 4862 IPv6 Stateless Address Autoconfiguration RFC 5095 Deprecation of Type 0 Routing Headers in IPv6
MIBs	RFC 1213 MIB-II RFC 1907 SNMPv2 MIB RFC 2571 SNMP Framework MIB RFC 2572 SNMP-MPD MIB	RFC 2573 SNMP-Notification MIB RFC 2573 SNMP-Target MIB RFC 2574 SNMP USM MIB RFC 2737 Entity MIB (Version 2)	RFC 3414 SNMP-User based-SM MIB RFC 3415 SNMP-View based-ACM MIB LLDP-EXT-DOT1-MIB LLDP-EXT-DOT3-MIB LLDP-MIB
Network management	RFC 2580 Conformance Statements for SMIv2	RFC 3164 BSD syslog Protocol	
OSPF	RFC 1587 OSPF NSSA RFC 2328 OSPFv2 RFC 3101 OSPF NSSA	RFC 3137 OSPF Stub Router Advertisement RFC 3623 Graceful OSPF Restart RFC 4577 OSPF as the Provider/Customer Edge Protocol for BGP/MPLS IP Virtual Private Networks (VPNs)	RFC 4811 OSPF Out-of-Band LSDB Resynchronization RFC 4812 OSPF Restart Signaling RFC 4813 OSPF Link-Local Signaling
QoS/CoS	IEEE 802.1p (CoS) RFC 2475 DiffServ Architecture	RFC 2597 DiffServ Assured Forwarding (AF)	RFC 3247 Supplemental Information for the New Definition of the EF PHB (Expedited Forwarding Per-Hop Behavior) RFC 3260 New Terminology and Clarifications for DiffServ
Security	RFC 1321 The MD5 Message-Digest Algorithm RFC 2818 HTTP Over TLS	RFC 6192 Partial Support—Protecting the Router Control Plane	Access Control Lists (ACLs) SSHv2 Secure Shell

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