
Alcatel-Lucent Enterprise OmniSwitch 9900 GOLDEN RFP

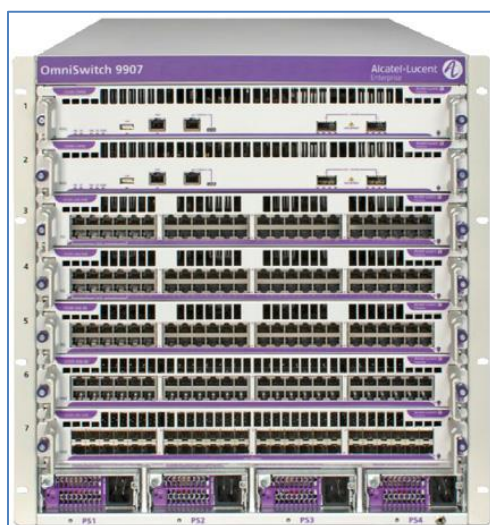
Version 8.9R3

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1. Introduction

The Alcatel-Lucent OmniSwitch® 9900 series Modular LAN chassis platform is a high-capacity, high-performance modular Ethernet LAN switch that is field-proven in enterprise and data center environments. As the OmniSwitch 9900 series runs on the Alcatel-Lucent Operating System (AOS), a state-of-the-art programmable operating system designed for Software-Defined Networking (SDN), it delivers uninterrupted network uptime with non-stop Layer-2 and Layer-3 forwarding.



The OmniSwitch 9900 is a high density, multi Terabit modular platform. The platform can linearly scale switching capacity with virtual chassis technology providing tens of Terabit of aggregate switching capacity. In particular its modular design provides investment protection allowing for scaling out with future inline upgrades offering high density 1G/2.5G/5G/10G/25G/40G/50G/100G interfaces.

The OmniSwitch 9900 series is ideally suited for enterprise core, aggregation and edge environments. Its resilient platform architecture providing control plane and data plane redundancy together with unparalleled scalability helps meet demanding resiliency and throughput requirements for evolving enterprises of all sizes. The OmniSwitch 9900 series offers a broad range of modules supporting 1 GigE, 10 GigE and 40/100 GigE ports in an 11-RU chassis form factor, and it offers highest 1 GigE/10GigE port density in its class.

The OmniSwitch 9900 offers the highest density of Power over Ethernet (PoE) in its class, scaling up to 10800 W of inline PoE power. The gigabit and multi-gigabit PoE line card supports 8 ports of HPoE (75 W) and 40 ports of 802.3at PoE (30 W). All PoE-enabled ports are IEEE 802.3af/at compliant.

The OmniSwitch 9900 leverages an energy-efficient model with leading low power consumption, making it an efficient and versatile switch.

The Alcatel-Lucent Enterprise Intelligent Fabric technology is also enabled on the OmniSwitch 9900 Modular LAN chassis. The technology brings true network flexibility ensuring business agility. It not only delivers a resilient, high capacity infrastructure, but it also delivers automated deployment and self-healing network capabilities to reduce overhead in IT operations. The technology platform is built upon standard IEEE protocols and key innovations such as Shortest Path Bridging (802.1aq/SPB-M) for bridged and routed services, Multiple VLAN Registration Protocol (MVRP), dynamic Virtual Network Profiles (vNP), 802.3ad/802.1AX (LACP) and Auto- Fabric for automatic protocol and topology discovery.

Benefits

- Modules provide very low latency for high-performance server clusters and core connectivity over QSFP28, QSFP+, SFP+, DAC or CAT 5/6.
- Outstanding performance when supporting real-time voice, data, storage and video applications for converged scalable networks
- Modular slots offer versatility in terms of 100GigE QSFP28, 40 GigE QSFP+, 10 GigE SFP+, 10 G Base-T and 10/100/1000Base-T ports.
- Each QSFP port is capable of operating as 40 GigE or 4x10 GigE.
- Each QSFP28 port is capable of operating as 40/100 GigE or 4x10/25 GigE.
- Hardware resiliency maximizes uptime for converged mission-critical networks.
- Software virtualization, the Chassis Management Module (CMM) control plane and data plane management are virtualized and execute as virtual machines, enabling high availability during upgrades and/or during unexpected network failures.
- The OmniSwitch 9900 virtual chassis further increases system redundancy, resiliency and high availability while simplifying deployment, operations and management of the network.
- Embedded SDN integration to control virtual network profiles and policy management
- Built-in dynamic and automated policy enforcement
- Policy enforcement engine fully open for external control through RESTful northbound APIs for automation and integration of innovative applications
- Out-of-the-box flexible fabric architecture designed to automate and simplify the end-to-end deployment of campus, data center, and cloud-based services
- Prevents human mistakes by automating standardized and replicable configurations
- Prevents host address explosion and flooding with built-in SLA service support at low capital and operating costs, and based on interoperable proven standards
- Optimizes/simplifies Layer-2 and Layer-3 network designs and reduces administration overhead while increasing network capacity with resilient multipath active-active dual homing multi-chassis support
- Out-of-the-box Auto-Provisioning to simplify installation and service provisioning
- With its advanced PoE capabilities and high density of PoE ports, the OmniSwitch 9900 is ideal for converged campus deployments, as it offers deployment flexibility, simplifies the wiring and reduces the time to deploy edge devices such as VoIP phones, surveillance

cameras, 802.11ac access points, and emerging devices that require more than 30 W, such as video displays, a small network switch or a thin virtual desktop infrastructure (VDI) client.

- Unified Access and application-fluent networks provide simplified network architecture with automated controls and enhanced security for both wired and wireless users. Offers enhanced management and security for reduced operational complexity costs.
- User network profiles add intelligence to the network to automatically adapt as users move around the corporation without compromising the security
- With its advanced capabilities, the OmniSwitch 9900 brings enhanced performance when supporting real-time voice, data and video applications.
- Provides consistent and secure user experience when applications and services are accessed from wired or wireless end devices
- Offers flexible deployment options and enables the network for BYOD deployments and zero-touch guest management
- Supports dynamic change of authentication (CoA) and enforces traffic remediation or restriction for noncompliant devices
- Provides control and increased security over corporate data/applications for the mixed personal and corporate environment for improved visibility and control for IT
- Opens the door for fast deployment of new network services that meet employees' needs to continuously adopt new applications that support the business
- The support of SDN reassures customers that their investment helps them prepare for the future and enables interoperability with third-party solutions.

Features

- Wire-rate non-blocking switching and routing performance for Ethernet at 40/100 GigE, 10/25 GigE and 10/100/1000 Base-T speeds
- High port density in 11-RU:
 - Up to 288 10/100/1000Base-T triple speed ports
 - Up to 288 1000Base-X ports
 - Up to 240 SFP+ ports. Capable of 1 GigE/10 GigE
 - Up to 240 10 G Base-T ports. Capable of 1 GigE/10 GigE
 - Up to 88 1/2.5/5/10 G Base-T ports
 - Up to 4 QSFP+ ports. Capable of 40 GigE or 4x10GigE
 - Up to 40 QSFP28 ports. Capable of 40/100 GigE or 4x10/25 GigE
- Resilient hardware system and highly available virtualized software architecture
- Up to two switches can be connected using virtual chassis technology to create a single chassis-like entity with up to 480 10 GigE or 576 GigE ports
- Integral operating system advanced functions: Quality of Service (QoS), access control lists (ACLs), Layer-2/Layer-3 switching, virtual LAN (VLAN) stacking and IPv6
- Intelligent policy control through OpenFlow 1.3.1/1.0

- Hardware virtual routing and forwarding (VRF) support for VRF-lite and IPVPN
- Scalable network virtualization architecture with guaranteed Service Level Agreement (SLA) delivery over standard Ethernet fabric: Auto-Fabric IP routing for routed backbone and access provisioning, Shortest Path Bridging (SPB) for bridging and routed services, Edge Virtual Bridging (EVB), Multiple VLAN Registration Protocol (MVRP) and dynamic Virtual Network Profiles (vNP)
- Zero-touch provisioning and network automation with out-of-the-box plug- and-play Auto-Fabric for automatic protocol and topology discovery. Protocol auto-discovery and self-provisioning works with any Ethernet device that supports standard IEEE protocols such as 802.1aq (Shortest Path Bridging Media Access Control, SPBM), 802.1ak (MVRP), 802.3ad/802.1AX (Link Aggregation Control Protocol, LACP). Auto-Fabric operation extends to IP routing protocol provisioning and IP onboarding.
- On PoE-enabled network interface modules:
 - IEEE 802.3af and 802.3at compliant PoE of 30 W per port on all ports
 - Up to 75 W of PoE (High Power-over- Ethernet, HPoE) per port on first eight ports
 - Capacity to deliver 1800 W of PoE power
- Advanced Unified Access features providing application fluency in converged campus networks:
 - Integrated policy with dynamic User Network Profiles (UNP)
 - Extensive security features for network access control (NAC), policy enforcement and attack containment
 - Session Initiation Protocol (SIP) fluency to provision and monitor QoS treatment of SIP flows
 - AirGroup™ Network Services for Bonjour® speaking devices
- Enables deployment of comprehensive and secure bring-your-own-device (BYOD) services in enterprise networks:
 - Advanced guest management capabilities
 - Device onboarding and automated IEEE 802.1x provisioning
 - Device posture/health check and fingerprinting
 - Application management
- The OmniSwitch 9900 is SDN-ready:
 - Comprehensive northbound RESTful API to the entire AOS feature set.
 - API offers access to all AOS command line interface (CLI) commands and management information base (MIB) structures
 - AOS-embedded scripting capabilities supporting Python® and Bash programming
 - OpenFlow™ 1.0/1.3
 - OpenStack® neutron plugin

2. OmniSwitch 9900 Links to supporting documentation:

Document references:

<https://www.al-enterprise.com/-/media/assets/internet/documents/omniswitch-9900-modular-lan-chassis-datasheet-en.pdf>

<https://www.al-enterprise.com/en/products/switches/omniswitch-9900>

3. The switch must support the following hardware characteristics (OS9907)

1.	Height (19-in. and 23-in. rack mount) 11U	C/PC/NC
2.	Dimensions (HxWxD): 49.02 x 44.2 x 58.42 cm (19.3 x 17.4 x 23 in)	C/PC/NC
3.	Non-blocking switching fabric	C/PC/NC
4.	Support for hot swappable SFPs	C/PC/NC
5.	Number of modular slots: 11 (Front accessible 7 slots + Rear accessible 4 slots)	C/PC/NC
6.	Management and network interface slots (NI): 7 (Slot 1 CMM with integrated 2 x 40G NI. Slot 2 is universal; accommodates CMM or NI. CMM/NI is limited to 160 Gb/s switching capacity)	C/PC/NC
7.	Fabric module slots (CFM): 4 (Bays marked CFM 3 and CFM 4 inactive; reserved for future use)	C/PC/NC
8.	Current switching capacity per CMM (b/s /pps): 160 Gb/s Aggregate/119 Mpps	C/PC/NC
9.	Current switching capacity per 1 G NI (b/s /pps): 96 Gb/s Aggregate/71.4 Mpps	C/PC/NC
10.	Current switching capacity per 10 G NI (b/s /pps): 960 Gb/s Aggregate/714 Mpps	C/PC/NC
11.	Current switching capacity per 100 G NI (b/s /pps): 4Tb/s Aggregate/2976 Mpps	C/PC/NC
12.	Current switching capacity per CFM2: 12.8 Tb/s Aggregate (OS9907-CFM2)	C/PC/NC
13.	Chassis switching capacity: 25.6 Tb/s Aggregated (with two OS9907-CFM2 modules)	C/PC/NC
14.	Power supply (AC/DC) slots: 4	C/PC/NC
15.	Support for redundant and hot swappable power supplies	C/PC/NC
16.	Hot-swappable fan trays	
17.	Operating temperature: 0°C to 45°C (32°F to 113°F)	C/PC/NC
18.	Operating humidity: 10% to 90% (non-condensing)	C/PC/NC

4. The switch must support the following hardware characteristics (OS9912)

19.	Height (19-in. and 23-in. rack mount) 17.25U	C/PC/NC
20.	Dimensions (HxWxD): 76.6 x 44.2 x 58.42 cm (30.1 x 17.4 x 23 in)	C/PC/NC
21.	Non-blocking switching fabric	C/PC/NC
22.	Support for hot swappable SFPs	C/PC/NC
23.	Number of modular slots: 16 (Front accessible 12 slots + Rear accessible 4 slots)	C/PC/NC
24.	Management and network interface slots (NI): 12 (Slot 1 and 2 are reserved for CMM with integrated 4 x 40G NI).	C/PC/NC
25.	Fabric module slots (CFM): 4 (Bays marked CFM 3 and CFM 4 inactive; reserved for future use)	C/PC/NC
26.	Current switching capacity per CMM (b/s /pps): 800 Gb/s Aggregate/595.2 Mpps	C/PC/NC
27.	Current switching capacity per 1 G NI (b/s /pps): 96 Gb/s Aggregate/71.4 Mpps	C/PC/NC
28.	Current switching capacity per 10 G NI (b/s /pps): 960 Gb/s Aggregate/714 Mpps	C/PC/NC
29.	Current switching capacity per 100 G NI (b/s /pps): 4Tb/s Aggregate/2976 Mpps	C/PC/NC
30.	Current switching capacity per CFM2: 25.6 Tb/s Aggregate	C/PC/NC
31.	Chassis switching capacity: 25.6 Tb/s Aggregated (with two OS9907-CFM2 modules)	C/PC/NC
32.	Power supply (AC/DC) slots: 4	C/PC/NC
33.	Support for redundant and hot swappable power supplies	C/PC/NC
34.	Hot-swappable fan trays	
35.	Operating temperature: 0 °C to 45 °C (32 °F to 113 °F)	C/PC/NC
36.	Operating humidity: 10% to 95% (non-condensing)	C/PC/NC

5. The switch must support the following NI modules:

37.	CMM: USB Type-A, EMP** RJ-45, Console RJ-45/ micro-USB, 2x 40 GigE QSFP+	C/PC/NC
38.	Gigabit network interface card offers 48 wire-rate RJ-45 10/100/1000M Base-T ports. This interface card is MPLS ready, supports MACSEC, and provides large table support for L2, L3, and ACL policies.	C/PC/NC
39.	Gigabit network interface card offers 48 unpopulated wire rate SFP 1000Base-X ports. This interface card is MPLS ready, supports MACSEC, and provides large table support for L2, L3, and ACL policies.	C/PC/NC
40.	Gigabit network interface card offers 48 wire-rate RJ-45 10/100/1000M Base-T ports with PoE. This interface card is MPLS ready, supports MACSEC, and provides large table support for L2, L3, and ACL policies.	C/PC/NC
41.	10 Gigabit network interface card offers 48 wire-rate RJ-45 10GBase-T ports. This interface card is MPLS ready, supports MACSEC, and provides large table support for L2, L3, and ACL policies.	C/PC/NC

42.	10 Gigabit network interface card offers 48 wire-rate unpopulated SFP+ 1/10 GbE ports. This card is MPLS ready, supports MACSEC, and provides large table support for L2, L3, and ACL policies.	C/PC/NC
43.	10 Gigabit network interface card offers 24 wire-rate unpopulated SFP+ 1/10 GbE ports. This interface card is MPLS ready, supports MACSEC, and provides large table support for L2, L3, and ACL policies.	C/PC/NC
44.	10 Gigabit network interface card offers 12 wire-rate unpopulated SFP+ 1/10 GbE ports and 1 wire-rate unpopulated QSFP+ 40 GbE port. This interface card is MPLS ready, supports MACSEC, and provides large table support for L2, L3, and ACL policies.	C/PC/NC
45.	Multi-Gigabit network interface card offers 32 RJ-45 10G Base-T and 16 RJ-45 1/2.5/5/10G Base-T wire-rate PoE ports. This interface card is MPLS ready, supports MACSEC, and provides large table support for L2, L3, and ACL policies.	C/PC/NC
46.	Multi-Gigabit network interface card offers 16 RJ-45 10G Base-T and 8 RJ-45 1/2.5/5/10G Base-T wire-rate PoE ports. This interface card is MPLS ready, supports MACSEC, and provides large table support for L2, L3, and ACL policies.	C/PC/NC
47.	10 Gigabit network interface card offers 12 wire-rate unpopulated SFP+ 1/10 GbE ports, 12 wire-rate RJ-45 10GBase-T ports and 2 wire-rate unpopulated QSFP+ 40 GbE ports. This interface card is MPLS ready, supports MACSEC, and provides large table support for L2, L3, and ACL policies.	C/PC/NC
48.	100 Gigabit network interface card offers 8 unpopulated QSFP28 40/100GE ports. This interface card is MPLS ready, and provides large table support for L2, L3, and ACL policies.	C/PC/NC
49.	100 Gigabit network interface card offers 20 unpopulated QSFP28 40/100GE ports. This interface card is MPLS ready, and provides large table support for L2, L3, and ACL policies.	C/PC/NC
50.	CMM: USB Type-A, EMP** RJ-45, Console RJ-45/ micro-USB, 2x 40 GbE QSFP+	C/PC/NC

6. The switch must support the following Simplified manageability protocols and features:

51.	The switch must support intuitive CLI in a scriptable Python and Bash environment through console, Telnet or Secure Shell (SSH) v2 over IPv4/IPv6	C/PC/NC
52.	Powerful WebView Graphical Web Interface via HTTP and HTTPS over IPv4/IPv6	C/PC/NC
53.	This feature allows for a USB-to-Ethernet interface for switches that lack an OOB management port. This interface is treated just like an OOB interface. All functions and CLIs related to an OOB management port are applicable to the USB-to-Ethernet dongle.	C/PC/NC
54.	This feature allows for applying an ACL on the EMP port of the switch. It enables policy-based routing on the EMP ports. The configuration is enabled using the empacl policy-list type.	C/PC/NC
55.	Multiple units can be stacked to create a Virtual Chassis (VC) for configuration and management as a single logical entity, supporting high resiliency software and hardware features for multi-home backbone connectivity using standard link aggregation protocol (LACP) for enabling a non-blocking network backbone architecture.	C/PC/NC
56.	Multiple Virtual Routing and Forwarding (VRF) to segment Layer 3 traffic into virtual routing domains on the same switch. Each routing instance independently maintains its own routing and forwarding table, peer, and interface information.	C/PC/NC
57.	Dynamic Host Configuration Protocol (DHCP) relay for IPv4/IPv6	C/PC/NC
58.	Link Layer Discovery Protocol (LLDP) for exchanging information with neighbor - 802.1AB.	C/PC/NC
59.	Switch must be able to synchronize the date and time with an external time source using protocol like NTP. This is to ensure all switches are having the same time and help in troubleshooting.	C/PC/NC
60.	The switch must support built-in DHCP server providing IPv4 and IPv6 address to end devices.	C/PC/NC

7. The switch must support the following Monitoring and troubleshooting protocols and features:

61.	Port mirroring (one to one, many to one, many to many) which allows monitoring of traffic on one or more ports and send the monitored traffic to a destination port.	C/PC/NC
62.	Remote Port Mirroring which expands the port mirroring functionality by allowing mirrored traffic to be carried over the network to a remote switch.	C/PC/NC
63.	sFlow v5 and Remote Network Monitoring (RMON)	
64.	SFLOW can be configured on non-default VRF. The OmniSwitch allows configuration of non-default VRF on SFLOW receiver, sampler, and poller.	C/PC/NC

65.	Unidirectional Link Detection Protocol (UDLD) that allows unidirectional links caused by incorrect fiber-optic wiring or port faults to be detected and disabled on fiber-optic interfaces.	C/PC/NC
66.	Allows the switch to be authenticated as a supplicant device using X.509 certificates.	C/PC/NC

8. The switch must support the following Resiliency and high availability protocols and features:

67.	Unified management, control and fabric- mesh virtual chassis technology	C/PC/NC
68.	In-Service Software Upgrade (ISSU)	
69.	Smart continuous switching technology	C/PC/NC
70.	ITU-T G.8032/Y1344 2010: Ethernet Ring Protection	C/PC/NC
71.	IEEE 802.1s Multiple Spanning Tree Protocol (MSTP), IEEE 802.1D Spanning Tree Protocol (STP) and IEEE 802.1w Rapid Spanning Tree Protocol (RSTP)	C/PC/NC
72.	IEEE 802.3ad/802.1AX Link Aggregation Control Protocol (LACP) and static link aggregation (LAG) groups across modules	C/PC/NC
73.	Virtual Router Redundancy Protocol (VRRP) with tracking capabilities	C/PC/NC
74.	IEEE protocol auto-discovery	C/PC/NC
75.	Bidirectional Forwarding Detection (BFD)	C/PC/NC
76.	Built-in CPU protection against malicious attacks	C/PC/NC
77.	Split virtual chassis protection: Autodetection and recovery of virtual chassis splitting due to Virtual Fabric Link (VFL) failures	C/PC/NC

9. The switch must support the following Access control protocols and features:

78.	Autosensing IEEE 802.1X multi-client, multi-VLAN support	C/PC/NC
79.	Media Access Control (MAC)- based authentication for non-IEEE 802.1X hosts	C/PC/NC
80.	Web-based authentication (captive portal): a customizable web portal residing on the switch	C/PC/NC
81.	User Network Profile (UNP) simplifies NAC by dynamically providing predefined policy configuration to authenticated clients: VLAN, ACL, bandwidth	C/PC/NC
82.	Secure Shell (SSH) with public key infrastructure (PKI) support	C/PC/NC
83.	Terminal Access Controller Access-Control System Plus (TACACS+) client	C/PC/NC
84.	Centralized Remote Access Dial-In User Service (RADIUS) and Lightweight Directory Access Protocol (LDAP) administrator authentication	C/PC/NC
85.	Centralized RADIUS for device authentication and network access control authorization	C/PC/NC
86.	Learned Port Security (LPS) or MAC address lockdown	C/PC/NC
87.	ACLs; flow-based filtering in hardware (Layer 1 to Layer 4)	C/PC/NC
88.	DHCP Snooping, DHCP IP and Address Resolution Protocol	C/PC/NC
89.	(ARP) spoof protection	C/PC/NC
90.	ARP poisoning detection	C/PC/NC
91.	IP source filtering as a protective and effective mechanism against ARP attacks	C/PC/NC
92.	LLDP Security mechanism for rogue device detection and restriction	C/PC/NC
93.	BYOD provides on-boarding of guest, IT/non-IT issued and silent devices.	C/PC/NC
94.	The minimum password size range is 1-30 characters.	C/PC/NC

10. The switch must support the following MACsec protocols and features:

95.	Provides secure communication for traffic on all ethernet links, using MACSec technology	C/PC/NC
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11. The switch must support the following Quality of Services (QoS) protocols and features:

96.	Priority queues: Eight hardware-based queues per port	C/PC/NC
97.	Traffic prioritization: Flow-based QoS	C/PC/NC
98.	Flow-based traffic policing and bandwidth management	C/PC/NC
99.	Egress traffic shaping	C/PC/NC
100	Congestion avoidance: IEEE 802.3x Flow Control (FC)	C/PC/NC
101	SIP detection, session monitoring and tracking	C/PC/NC
102	Provides real-time conversation quality information contained in the SIP packets concerning packet loss, delay, jitter, mean opinion score (MOS), R-Factor in real time	C/PC/NC
103	SIP profile for QoS, priority tuning for end-to-end processing	C/PC/NC
104	Multicast DNS Relay: Bonjour protocol support for wired AirGroup	C/PC/NC
105	LLDP network polices for dynamic designation of VLAN-ID and Layer-2/Layer-3 priority for IP phones	C/PC/NC
106	Auto-QoS for switch management traffic as well as traffic from IP phones	C/PC/NC

12. The switch must support the following IPv4 routing protocols and features:

107	Multiple Virtual Routing and Forwarding (VRF)	C/PC/NC
108	Static routing with route labeling	C/PC/NC
109	Routing Information Protocol (RIP) v1 and v2	C/PC/NC
110	Open Shortest Path First (OSPF) v2 with graceful restart	C/PC/NC
111	Intermediate System to Intermediate System (IS-IS) with graceful restart	C/PC/NC
112	Border Gateway Protocol (BGP) v4 with graceful restart	C/PC/NC
113	Generic Routing Encapsulation (GRE) and IP/IP tunneling	C/PC/NC
114	Virtual Router Redundancy Protocol (VRRPv2)	C/PC/NC
115	DHCP relay, including generic User Datagram Protocol (UDP) relay	C/PC/NC
116	Address Resolution Protocol (ARP)	C/PC/NC
117	DHCPv4 server	C/PC/NC
118	Export/Import IPv4 routes across VRFs	C/PC/NC

13. The switch must support the following IPv6 routing protocols and features:

119	Multiple Virtual Routing and Forwarding (VRF)	C/PC/NC
120	Internet Control Message Protocol version 6 (ICMPv6)	C/PC/NC
121	Static routing	C/PC/NC
122	Routing Information Protocol Next Generation (RIPng)	C/PC/NC
123	Open Shortest Path First (OSPF) v3 with graceful restart	C/PC/NC
124	Intermediate System to Intermediate System (IS-IS) with graceful restart	C/PC/NC
125	Multi-Topology IS-IS	C/PC/NC
126	BGP v4 multiprotocol extensions for IPv6 routing (multiprotocol Border Gateway Protocol, MP-BGP)	C/PC/NC
127	Virtual Router Redundancy Protocol (VRRPv3)	C/PC/NC
128	Neighbor Discovery Protocol (NDP)	C/PC/NC
129	DHCPv6 server	C/PC/NC
130	Export/Import IPv6 routes across VRFs	C/PC/NC

14. The switch must support the following IPv4/IPv6 multicast protocols and features:

131	Internet Group Management Protocol (IGMP) v1/v2/v3 snooping	C/PC/NC
132	Protocol Independent Multicast - Sparse- Mode (PIM-SM), Source Specific Multicast (PIM-SSM)	C/PC/NC
133	Protocol Independent Multicast - Dense- Mode (PIM-DM), Bidirectional Protocol Independent Multicast (PIM-BiDir)	C/PC/NC
134	Distance Vector Multicast Routing Protocol (DVMRP)	C/PC/NC
135	Multicast Listener Discovery (MLD) v1/v2 snooping	C/PC/NC
136	PIM to DVMRP gateway support	C/PC/NC

15. The switch must support the following Advanced Layer-2 services protocols and features:

137	Up to 4094 IEEE 802.1Q VLANs	C/PC/NC
138	Ethernet services support using IEEE 802.1ad Provider Bridges (also known as Q-in-Q or VLAN stacking)	C/PC/NC
139	Fabric virtualization services IEEE 802.1aq Shortest Path Bridging (SPB-M)	C/PC/NC
140	SPB: Ethernet Virtual Connection (EVC) support for transparent LAN services such as E-LAN, E-Line and E-Tree	C/PC/NC
141	SPB: Ethernet network-to-network interface (NNI) and user network interface (UNI)	C/PC/NC
142	SPB: Service Access Point (SAP) profile identification	C/PC/NC
143	Hybrid access port feature allows a single port to function both as an access port and a bridging port. Hybrid configured port can be understood as a bridge port with a default VLAN and tagged VLAN for bridging and the user can configure SAPs for services with mapped tagged VLANs.	C/PC/NC
144	SPB: Service VLAN (SVLAN) and Customer VLAN (CVLAN) support	C/PC/NC
145	SPB: VLAN translation and mapping including CVLAN to SVLAN	C/PC/NC
146	SPB: C-tag to S-tag priority mapping	C/PC/NC
147	AOS functionality of advertising SPB L3VPN routes is extended to exchange and inject the route-tag field to be carried across the SPB-ISIS network.	C/PC/NC
148	DHCP Option 82: Configurable relay agent information	C/PC/NC
149	Multicast VLAN Registration Protocol (MVRP)	C/PC/NC
150	High-availability VLAN (HA-VLAN) for Layer-2 clusters such as Microsoft® Network Load Balancing (MS-NLB) and active-active firewall clusters	C/PC/NC
151	Jumbo frame support up to 9216 bytes	C/PC/NC
152	Spanning Tree Protocol (STP) Root Guard prevents edge devices from becoming STP root nodes	C/PC/NC
153	MAC-Forced Forwarding support according to RFC 4562	C/PC/NC
154	Private VLAN feature for user traffic segregation	C/PC/NC
155	TR-101 Point-to-Point Protocol over Ethernet (PPPoE) Intermediate Agent allowing for the PPPoE network access methodology	C/PC/NC
156	TACACS+ client allows for authentication authorization and accounting (AAA) with a remote TACACS+ server	C/PC/NC

16. The switch must support the following PoE protocols and features:

157	Dynamic PoE allocation delivers only the power needed by the attached device up to the total power budget for most efficient power consumption	C/PC/NC
158	PoE models support IP phones and WLAN access points, as well as any IEEE 802.3af-compliant end device	C/PC/NC

159	Configurable per-port PoE priority and max power for power allocation	C/PC/NC
160	Negotiation for Additional PoE Power using LLDP Power-via- MDI TLV	C/PC/NC

17. The switch must comply with the following Certifications:

161	The switch proposed must hold a valid Federal Information Processing Standards (FIPS) certification, meeting the designated FIPS publication 140-2.	C/PC/NC
162	The switch proposed must possess a Common Criteria certification, ensuring compliance with internationally recognized security standards.	C/PC/NC
163	JITC	C/PC/NC
164	Trade Agreements Act	C/PC/NC

18. Video surveillance

The switch must support the following:

165	The switch support plugins that enable remote troubleshooting for common camera issues directly from the video surveillance management system.	C/PC/NC
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