

Cisco Catalyst 4500 Supervisor Engine 6L-E: High-Performance Access Supervisor

Overview

The Cisco® Catalyst® 4500 Supervisor Engine 6L-E (Figure 1) is a next-generation, Layer 3 supervisor addition to the Cisco Catalyst 4500 E-Series product line. The Supervisor 6L-E now supports full routing protocols, Open Shortest Path First (OSPF), Enhanced IGRP (EIGRP), Border Gateway Protocol (BGP), and many other advanced features with the Enterprise Services package. (Note: You must use Cisco IOS® Software Release 12.2(53)SG2 or later for Enterprise Services support).

Figure 1. Layer 3 Supervisor Engine 6L-E with TwinGig Support (Two 10 Gigabit Ethernet or Four Gigabit Ethernet)



Cisco Catalyst 4500 Supervisor Engine 6L-E Feature Highlights

- Centralized 280-Gbps switching capacity with 225 millions of packets per second (Mpps) of throughput
- IP routing protocols: EIGRP, OSPF, Routing Information Protocol (RIP), and RIPv2
- BGP Version 4 (BGPv4) and Multicast Border Gateway Protocol (MBGP)
- Virtual Route Forwarding-Lite (VRF-Lite)
- IPv6 support in hardware, providing line-rate forwarding for IPv6 packets
- Flexibility to operate at 6 or 24 Gbps per line-card slot
- Ability to mix and match 6-Gbps classic and 24-Gbps E-Series line cards with no performance degradation
- Dual 10 Gigabit Ethernet uplinks (X2 optics)
- Cisco TwinGig Converter Modules that enable flexibility for up to four Gigabit Ethernet (Small Form-Factor Pluggable [SFP]) uplinks in the X2 optic slots
- Low latency
- Hardware forwarding entries: 57,000
- Dynamic hardware forwarding table allocations for ease of IPv4-to-IPv6 migration
- Quality-of-service (QoS) services hardware entries: 16,000 per direction
- Advanced QoS support with up to eight queues per port, dynamic queue sizing, and hierarchical policing to provide flexibility and control
- Security services entries: 16,000 per direction
- Support for the following software packages: LAN Base, IP Base, and Enterprise Services (Enterprise Services support introduced with Cisco IOS Software Release 12.2(53)SG2)

The Supervisor Engine 6L-E delivers 24 Gbps per slot of switching capacity when deployed with the E-Series line cards in a Cisco Catalyst 4500 E-Series chassis. You can mix and match classic line cards and E-Series line cards within a Cisco Catalyst 4500 E-Series chassis with no performance degradation. When you deploy the Cisco Catalyst Supervisor Engine 6L-E with classic line cards, all of the new features except the 24-Gbps per-slot switching capacity are inherited. The Cisco Catalyst 4500 Supervisor Engine 6L-E is also compatible with classic Cisco Catalyst 4500 line cards, chassis (3-, 6-, and 7-slot), and power supplies, providing full investment protection.

The Cisco Catalyst Supervisor Engine 6L-E also provides flexibility and an easy migration path to 10 Gigabit Ethernet uplinks with dual-purpose X2 slots that can accommodate wire-speed 10 Gigabit Ethernet optics or Cisco TwinGig Converter Modules, enabling Gigabit Ethernet SFP optics.

The Cisco TwinGig Converter Module, which ships standard with the Supervisor Engine 6L-E (unless you order 10 Gigabit Ethernet optics on the configuration tool), converts a single 10 Gigabit Ethernet X2 interface into two Gigabit Ethernet port slots that can be populated with appropriate SFP optics, providing a total of four Gigabit Ethernet uplinks if used in both X2 interface slots. With the flexibility offered by the Cisco TwinGig Converter Module, you can initially use the gigabit uplinks, and then, as your business demands change, you can simply remove the Cisco TwinGig Converter Module and insert 10 Gigabit Ethernet X2 optics to provide full line-rate 10 Gigabit Ethernet uplinks. The ability to support both Gigabit Ethernet uplinks and 10 Gigabit Ethernet uplinks on a single supervisor engine further demonstrates the flexibility and the investment protection of the Cisco Catalyst 4500 Series.

The capabilities and investment protection provided by the Supervisor Engine 6L-E facilitate not only adequate scalability for today's network access requirements but also investment protection of your network components by providing significant software functions for future deployments.

Predictable Performance and Scalability

The Supervisor Engine 6L-E provides a fourfold increase in per-slot switching capacity from previous-generation Basic Layer 3 Cisco Catalyst 4500 supervisor engines: from 6 to 24 Gbps per slot. Table 1 highlights the performance and scalability enhancements of the Cisco Catalyst 4500 Supervisor Engine 6L-E.

Table 1. Cisco Catalyst 4500 Supervisor Engine 6L-E Performance and Scalability Features

Feature and Description	Supervisor Engine 6L-E
Centralized switching capacity	280 Gbps
Throughput	225 Mpps for IPv4 110 Mpps for IPv6 225 Mpps for L2 Bridging
IPv4 Routing entries	57,000
IPv6 Routing entries	30,000
Synchronous dynamic RAM (SDRAM)	512-MB DRAM upgradable to 1 GB
Security and QoS hardware entries	64,000 (32,000 per direction)
Active VLANs	4096
Switched virtual interfaces	2048
Switched Port Analyzer (SPAN)	Maximum of 8 sessions: ingress and egress

Chassis and Line-Card Support

Already-installed Cisco Catalyst 4500 chassis with classic line cards can take advantage of the new features and functions of the Supervisor Engine 6L-E on all ports with a simple supervisor-engine upgrade. However, to take advantage of the increased switching capacity of 24 Gbps per slot, the Cisco Catalyst 4500 E-Series chassis and E-Series line cards are required. You can mix and match Cisco Catalyst 4500 E-Series line cards and classic line cards in an E-Series chassis with no performance degradation to either line-card type. Table 2 shows the supervisor-engine and line-card slot-assignment options in the Cisco Catalyst 4500 E-Series chassis.

Table 2. Cisco Catalyst 4500-E Chassis Slot-Assignment Options

Chassis	Single Supervisor Engine 6L-E Slot Assignments	Redundant Supervisor Engine 6L-E Slot Assignments	E-Series Line-Card Slot Options	Classic Line-Card Slot Options
Cisco Catalyst 4503-E	Slot 1	-	Slots 2 and 3	Slots 2 and 3
Cisco Catalyst 4506-E	Slot 1	-	Slots 2 through 6	Slots 2 through 6
Cisco Catalyst 4507R+E	Slot 3 or 4	Slots 3 or 4	Slots 1, 2, and 5 to 7	Slots 1, 2, and 5 to 7
Cisco Catalyst 4507R-E	Slot 3 or 4	Slots 3 or 4	Slots 1, 2, and 5 to 7	Slots 1, 2, and 5 to 7

Note: You can mix E-Series and classic line cards within a chassis.

Table 3 summarizes the performance capacities of the Supervisor Engine 6L-E on a per-chassis basis.

Table 3. Cisco Catalyst 4500 Supervisor Engine 6L-E Performance Capacity per Chassis

	Cisco Catalyst 4503-E Chassis	Cisco Catalyst 4506-E Chassis	Cisco Catalyst 4507R-E/4507R+E Chassis
Supervisor Engine 6L-E (WS-X45-Sup6L-E)	136 Gbps	280 Gbps	280 Gbps

High Availability and Uplinks

The Cisco Catalyst 4500 Series was designed for nonstop communications with uninterrupted hardware switching. In addition to redundant power supplies, fans, and clock modules, the Cisco Catalyst 4507R-E/4507R+E chassis model supports 1 + 1 supervisor engine redundancy, using the Supervisor Engine 6L-E. The primary supervisor engine is active and is responsible for normal system operation. The other supervisor engine serves as a secondary standby, monitoring the operation of the primary supervisor engine.

Alerts are generated to the network-monitoring software if either of the redundant supervisors fails. Hot-swapping of supervisor engines is supported without disrupting system operation. You can configure software to force switchover of supervisor engines, or you can use the Simple Network Management Protocol (SNMP) to perform switchover. The resiliency features of the Cisco Catalyst 4500 prevent network outages that could result in lost business and revenue.

Nonstop Forwarding with Stateful Switchover (NSF/SSO) offers continuous packet forwarding during supervisor engine switchover. Information is fully synchronized between supervisor engines to allow the standby supervisor engine to immediately take over in subsecond time if the primary fails. In-Service Software Upgrade (ISSU) allows you to upgrade or downgrade complete Cisco IOS Software images with minimal to no disruption to the network when using a redundant Cisco Catalyst 4500 E-Series system with dual supervisor engines. Facilitating rapid, nondisruptive software upgrade for new line cards, new power supplies, new features, or bug fixes, ISSU offers continuous packet forwarding during the supervisor engine switchover running different Cisco IOS Software releases.

NSF/SSO and ISSU dramatically improve the network reliability and availability in a Basic Layer 3 or Enhanced Layer 3 environment. NSF/SSO and ISSU are essential for business-critical applications such as voice over IP (VoIP). These features help ensure that VoIP calls are not dropped.

Table 4 shows the high-availability and uplink options for the Supervisor Engine 6L-E.

Table 4. Supervisor 6L-E Redundant Uplink

Supervisor Configurations	Front-Panel Port	Number of Uplink Ports	Oversubscribed
Active supervisor Standby supervisor	10 GE (X2) 10 GE (X2)	2 x 10 GE	No Oversubscription
Active supervisor Standby supervisor	10 GE (X2) 2 x 1 GE (SFP)	1 x 10 GE 2 x GE	No Oversubscription
Active supervisor Standby supervisor	2 x 1 GE (SFP) 10 GE (X2)	2 x GE 1 x 10 GE	No Oversubscription
Active supervisor Standby supervisor	2 x 1 GE (SFP) 2 x 1 GE (SFP)	4 x GE	No Oversubscription

IPv6 Support

IPv6 is important for the future of IP networking and is critical for the expansion of IP address space. IPv6 capability is required by many companies and is being mandated by governments worldwide. This protocol has been supported on the Cisco Catalyst 4500 Supervisor Engine II-Plus to V-10GE engines since Cisco IOS Software Release 12.2(20)EW with software forwarding. The Cisco Catalyst 4500 Supervisor Engine 6L-E supports IPv6 Unicast and Multicast in hardware for full line-rate forwarding performance of up to 110 Mpps. The Supervisor Engine 6L-E also dynamically allocates hardware table space between IPv4 and IPv6 routes to maximize table-space usage for optimal IPv4-to-IPv6 migration.

Table 5 highlights the IPv6 capabilities of the Supervisor Engine 6L-E.

Table 5. Summary of Supervisor Engine 6L-E IPv6 Capabilities

Feature Description	Supervisor Engine 6L-E
IPv6 support	Unicast and Multicast forwarding done in hardware
IPv6 performance	110 Mpps
IPv6 Routing entries	30,000
Dynamic Hardware Route Table allocations	Yes

For more information about IPv6 feature support and configuration, please refer to the Cisco Catalyst 4500 with Cisco IOS Software Release 12.2(40)SG release notes at http://www.cisco.com/en/US/products/hw/switches/ps4324/prod_release_notes_list.html.

Intelligent Network Services with QoS and Sophisticated Traffic Management

The Cisco Catalyst 4500 Supervisor Engine 6L-E provides enhanced QoS features to help ensure that network traffic is classified, prioritized, and scheduled optimally to efficiently deploy a unified communications network that comprises bandwidth-hungry multimedia, time-sensitive (voice), and mission-critical applications. This type of network allows the administrator to differentiate between traffic flows and enforce policies. QoS capabilities include sharing, shaping, and strict-priority configurations for optimal scheduling of egress traffic as well as Dynamic Buffer Limiting (DBL), a flow-based congestion-avoidance feature. The Supervisor Engine 6L-E extends the capabilities of

previous-generation supervisor engines by providing flexible queuing with up to 8 transmit queues per port with dynamic queue sizing for greater flexibility in classifying and prioritizing traffic.

Classification has also been enhanced by providing configurable classification mapping tables applied on a per-port basis, providing greater flexibility in marking traffic. Policing has also been enhanced to include 2-Rate, 3-Color Policing for more granular control and enforcement of traffic policies. Table 6 summarizes the enhanced QoS features of the Supervisor Engine 6L-E.

Table 6. Summary of Supervisor Engine 6L-E Enhanced QoS Features

Feature Description	Supervisor Engine 6L-E
QoS hardware entries	16,000 per direction (32,000 total)
Number of Tx queues	Fixed queues up to 8
Maximum Tx queue size	Dynamic 16 to 8184 packets per queue, depending on the number and type of line card and the number of queues configured on the port (refer to documentation for more details)
Dynamic queue sizes	Yes
Configurable classification mapping tables	Yes
Match IP or MAC header	Yes
Modular QoS compliant	Yes
DBL: Congestion-avoidance feature	Yes
QoS sharing	Supported on all ports
Shaping	Yes, per Tx queue
Broadcast suppression	Supported in hardware for all ports
Multicast suppression	Supported in hardware for all ports

Comprehensive Security with Cisco TrustSec

The Cisco Catalyst 4500E Supervisor Engine 6L-E is a validated component of the Cisco TrustSec[®] 2.1 architecture. This allows the Cisco Catalyst 4500E Supervisor Engine 6L-E to be transparently integrated into campus switching environments for a comprehensive security solution based on Cisco TrustSec. The Cisco Catalyst Supervisor Engine 6L-E is a foundational element of the Cisco TrustSec architecture with support for the following functionalities:

- Device sensor:** The device sensor on the Cisco Catalyst 4500E Supervisor Engine 6L-E enables the ability to recognize the devices connected to the switch. This feature also interoperates with the Cisco Identity Services Engine, providing for a centralized view of all devices access the network in a scalable manner. When combined with AutoSmartPorts (ASP), it also provides the ability to dynamically apply policies on the switch based on the device type. For more information, visit http://www.cisco.com/en/US/docs/ios-xml/ios/sec_usr_aaa/configuration/15-1sg/sec-dev-sensor.html.
- Identity-based networking:** The Cisco Catalyst 4500E Supervisor Engine 6L-E has the most rich and robust set of IEEE 802.1X-based identity features to provide the right level of authenticated access to users. It also simplifies identity deployments with features such as Flexible Authentication, WebAuth, and MAC Authentication Bypass (MAB), as well as Open Mode for uninterrupted operations while providing visibility of network access. The identity features also provide integrated support for IP telephony. It also provides for flexible authorization policies with VLAN assignment and dynamic ACLs.

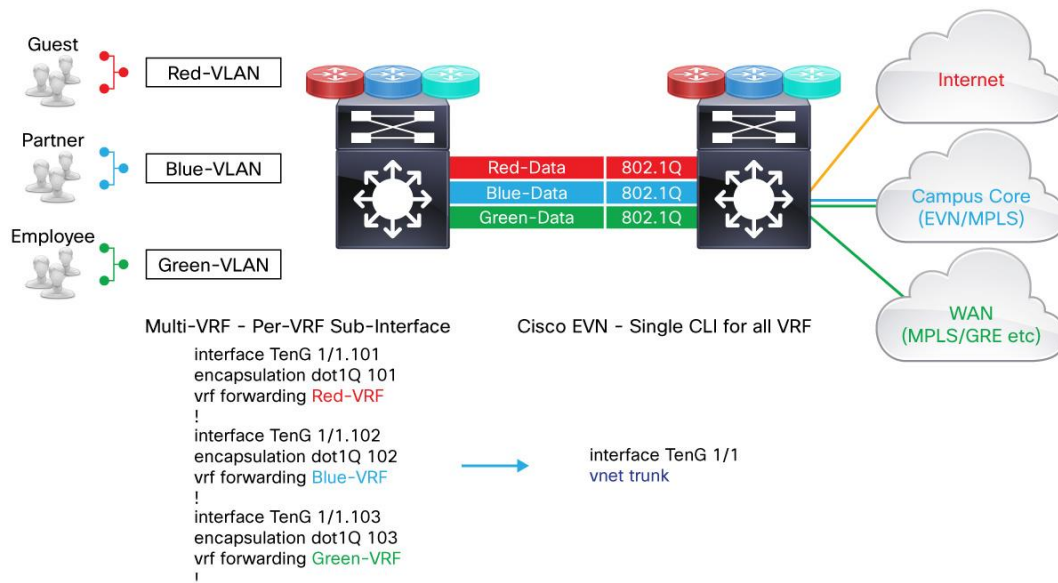
For more information, visit:

http://www.cisco.com/en/US/docs/switches/lan/catalyst4500/15.1/XE_330SG/configuration/guide/dot1x.html
<http://www.cisco.com/go/trustsec>.

Simplified and Scalable Network Virtualization with Easy Virtual Network (EVN)

Enterprise networks use single foundational infrastructure to build multiple logical overlay networks for diversified closed usergroups, regulatory, secure IT applications, etc. On campuses the traditional Multi-VRF solution is widely adopted and deployed to solve such network segmentation challenges. The Cisco Catalyst 4500E Series platform simplifies virtual network operation and maximizes scalability with the Cisco campus end-to-end Easy Virtual Network (EVN) technology (Figure 2).

Figure 2. Simplified Campus Network Virtualization with Cisco EVN



Cisco EVN is a successor solution that offers numerous advantages over traditional Multi-VRF technology:

- Simplified: To simplify campus virtual-network solutions, the Cisco EVN is designed with following three major components:
 - Virtual network (VNET) trunk: The Cisco EVN solution reduces 98 to 99 percent of configuration complexities.
 - Route replication: A simplified unicast and multicast route-leaking capability enables shared network and application services to virtual-network users. It replaces traditional Border Gateway Protocol (BGP)-based route-leaking mechanics.
 - Routing context: Simplified and optimized virtual-network operation and troubleshooting are supported on a per-VRF basis.

- Scalable: Cisco EVN enables flexibility to scale up to 32 virtual network solutions - operationally 4x virtual-network scalability capacity over Multi-VRF technology.
- Interoperable: Cisco EVN provides network topology isolation based on an RFC-defined control plane; for example, Enhanced IGRP (EIGRP), Open Shortest Path First (OSPF), Multicast etc. The data-plane security and protection are maintained through industry-standard IEEE 802.1Q. In addition, the Cisco EVN-supported system interoperates with peer Cisco EVN, Multi-VRF, and MPLS systems.

Comprehensive Centralized Management

The Cisco Catalyst Supervisor Engine 6L-E features a single console port and a single IP address to manage all system features. Remote in-band management is available with SNMP, Telnet client, BOOTP, and Trivial File Transfer Protocol (TFTP). Support for local or remote out-of-band management is delivered through a terminal or modem attached to the console interface. The Cisco Smartports macro for Cisco Catalyst switches is also supported, simplifying the configuration of the critical features for Ethernet networks.

The Cisco Catalyst 4500 Supervisor Engine 6L-E is also FAT file system-capable, allowing images to be copied, saved, and so on with Windows-based machines with a Compact Flash.

Table 7. Key Supervisor Engine 6L-E Management Features

Feature and Description	Supervisor Engine 6L-E
Compact Flash Support	Yes, 64 and 128 MB options
FAT file system Support	Yes
SPAN	Up to 8 sessions; ingress and/or egress

The Cisco Catalyst 4500 Supervisor Engine 6L-E also delivers a comprehensive set of management tools to provide the required visibility and control in the network. Managed with CiscoWorks solutions, Cisco Catalyst switches can be configured and managed to deliver end-to-end device, VLAN, traffic, and policy management. The CiscoWorks LAN Management Solution (LMS) bundle offers tools such as CiscoWorks Resource Manager Essentials and CiscoView. These web-based management tools offer several services, including automated inventory collection, software deployment, easy tracking of network changes, views into device availability, and quick isolation of error conditions.

Lower Total Cost of Ownership and Ease of Use with Smart Install Director

Smart Install Director simplifies management of images and configurations for enterprise switches in campus and branch networks. The Cisco Catalyst 4500E, now acting as Smart Install Director, provides a single management point for images and configuration of directly or indirectly connected Cisco Catalyst 2960, 3560, 3750, and 3850 Series Switches. It provides for:

- Plug and play in switch deployment
- Zero-touch replacement of switches with the same configuration and image as the switch it is replacing
- Single point of image and configuration management, in which configuration and image management are centralized
- On-demand image and configuration updates across all downstream switches from a single touchpoint

Smart Install Director reduces the customer's TCO and operational expense, while providing ease of use to the user.

For details about Smart Install, go to

http://www.cisco.com/en/US/docs/switches/lan/smart_install/configuration/guide/concepts.html.

Advanced Security

The Cisco Catalyst 4500 Supervisor Engine 6L-E also increases network security with a rich set of Cisco NAC capabilities and 802.1X-based user authentication, authorization, and accounting (AAA). The security policy enforcement is uncompromised with the wire-rate, dedicated access control lists (ACLs) to fend off ever-increasing virus and security attacks. The Cisco Catalyst 4500 Supervisor Engine 6L-E offers powerful, easy-to-use tools to effectively prevent untraceable man-in-the-middle attacks, control-plane resource exhaustion, IP spoofing, and flooding attacks, without any change to the end-user or host configurations. Secure remote access, file transfers, and network management are accomplished with the Secure Shell (SSH Versions 1 and 2) Protocol, Secure Copy Protocol (SCP), and SNMPv3, respectively. (Refer to Table 8)

Table 8. Supervisor Engine 6L-E Security Features

Feature and Description	Supervisor Engine 6L-E
Security hardware entries	16,000 per direction (32,000 total)
Cisco NAC and DHCP Snooping entries	3072
802.1x	Yes
802.1x extensions	Yes
IP Source Guard, Dynamic ARP Inspection (DAI), and DHCP Snooping	Yes
Cisco NAC	Yes

Features at a Glance

- Layer 2 hardware forwarding at 225 Mpps
- Layer 2 switch ports and VLAN trunks
- IEEE 802.1Q VLAN Encapsulation
- Dynamic Trunking Protocol (DTP)
- VLAN Trunking Protocol (VTP) and VTP domains
- VTP Pruning
- Port Security on trunk port
- Port Security on Private VLAN
- Port Security on Voice VLAN
- QinQ Passthrough
- Support for 4096 VLANs per switch
- Per-VLAN Spanning Tree Plus (PVST+) and Per-VLAN Rapid Spanning Tree (PVRST)
- Spanning Tree PortFast and PortFast Guard
- Spanning Tree UplinkFast and BackboneFast
- 802.1s
- 802.1w
- 802.3ad
- 802.3af (PoE)

- Spanning Tree Root Guard
- Cisco Discovery Protocol
- Internet Group Management Protocol (IGMP) Snooping v1, v2, and v3
- IPv6 MLD Snooping v1 and v2
- Cisco EtherChannel technology, Cisco Fast EtherChannel technology, and Cisco Gigabit EtherChannel technology across line cards
- Port Aggregation Protocol (PAgP)
- Link Aggregation Control Protocol (LACP)
- IGMP Querier
- IGMP Fast Leave
- VMPS client
- Unidirectional Link Detection (UDLD) and aggressive UDLD
- Voice VLAN and VLAN ID (VVID)
- Jumbo Frames (up to 9216 bytes)
- Baby Giants (up to 1600 bytes)
- Traffic Storm Control (formally known as Broadcast/Multicast Suppression)
- Forced 10/100 Autonegotiation
- Bridge Protocol Data Unit (BPDU) Guard
- Link Layer Discovery Protocol (LLDP)

Layer 3 Features

- Hardware-based IP Cisco Express Forwarding routing at 225 Mpps
- IP routing protocols: EIGRP, OSPF, RIP, and RIPv2
- Static Routing
- Inter-VLAN Routing
- BGPv4 and MBGP
- VRF-Lite
- Software-based Generic Routing Encapsulation (GRE) Tunneling
- IGMP Filtering on access and trunk ports
- IP Multicast routing protocols: Protocol Independent Multicast (PIM), SSM, and Distance Vector Multicast Routing Protocol (DVMRP)
- Pragmatic General Multicast Source Discovery Protocol (MSDP)
- Internet Control Message Protocol (ICMP)
- ICMP Router Discovery Protocol
- DHCP Server
- Per-port Multicast Suppression
- IP Service-Level Agreement (SLA)

IPv6 Support in Hardware

- IPv6 Unicast and Multicast Forwarding (done in hardware)
- IPv6 route entries: 30,000
- IPv6 addressing architecture
- IPv6: Cisco Discovery Protocol IPv6 address family
- IPv6: Cisco Express Forwarding in hardware
- IPv6: Extended ACL
- IPv6: ICMP Rate Limiting
- IPv6: ICMPv6
- IPv6: ICMPv6 Redirect
- IPv6 over IEEE 802.1Q
- IPv6: Loopback
- IPv6: Multicast Forwarding Information Base (MFIB) for IPv6
- IPv6: MLDv1 and v2
- IPv6: Maximum Transmission Unit (MTU) Path Discovery for IPv6
- IPv6: Ping
- IPv6: Router Alert Option
- IPv6: SSH over an IPv6 Transport
- IPv6: Stateless Autoconfiguration
- IPv6: Static routes within IPv6
- IPv6: AAA
- IPv6: Telnet
- IPv6: TFTP
- IPv6: Traceroute
- IPv6: Duplicate Address Detection
- IPv6: Standard ACL
- IPv6: Hop-by-hop option header: Done in software
- IPv6: Unicast Reverse Path Forwarding (URPF) strict mode
- PIMv6 (Sparse Mode)

High-Availability Features

- NSF/SSO
- Full-image ISSU
- NSF capable

QoS Features

- Sophisticated QoS and Traffic Management
- Modular QoS CLI (MQC)
- Per-port, per-VLAN QoS
- Eight queues per port
- Dynamic Tx Queue Sizing
- Strict Priority Queuing
- IP differentiated services code point (DSCP)
- 802.1p: Class of service
- Flexible Classification Marking
- Classification and marking based on full Layer 3 and Layer 4 headers
- Input and output policing based on Layer 3 and Layer 4 headers
- Support for 16,000 policers with flexible assignment for input and output
- 2-Rate, 3-Color Policing
- Shaping and sharing output queue management
- DBL: Congestion-avoidance feature
- Auto-QoS command-line interface (CLI) for VoIP deployments
- Table Map Support

Predictable Performance

- 280 Gbps switching fabric
- Layer 2 hardware forwarding at 225 Mpps
- No performance penalty with advanced Layer 3 and Layer 4 services enabled
- Software-based learning at a sustained rate of 8,800 hosts per second
- Support for 55,000 unicast MAC addresses
- Support for 16,000 multicast MAC addresses
- Support for 57,000 entries in routing table (shared between unicast and multicast)
- Scalability to 4,096 virtual ports (VLAN port instances)
- Bandwidth aggregation up to 16 Gbps through Cisco Gigabit EtherChannel technology
- Bandwidth aggregation up to 160 Gbps for 10 Gigabit Ethernet through 10 Gigabit Ethernet Cisco EtherChannel technology
- Hardware-based multicast management
- Hardware-based ACLs

Comprehensive Management

- Single console port and single IP address to manage all system features
- Software configuration management, including local and remote storage
- Optional Compact Flash memory card to store software images for backup and easy software upgrades
- FAT file system support
- Manageable through CiscoWorks Windows network-management software on a per-port and per-switch basis, providing a common management interface for Cisco routers, switches, and hubs
- SNMP v1, v2, and v3 instrumentation, delivering comprehensive in-band management
- CLI-based management console to provide detailed out-of-band management
- Remote Monitoring (RMON) software agent to support four RMON groups (history, statistics, alarms, and events) for enhanced traffic management, monitoring, and analysis
- Analysis support, including ingress port, egress port, and VLAN SPAN
- Layer 2 Traceroute
- Cisco Smartports macros
- SPAN ACL filtering
- Enhanced SNMP MIB support
- Network Timing Protocol (NTP)

Advanced Security

- TACACS+ and RADIUS, which enable centralized control of the switch and restrict unauthorized users from altering the configuration
- Standard and extended ACLs on all ports
- 802.1x user authentication (with port security)
- 802.1x with VLAN assignment, voice VLAN
- Router ACLs (RACLs) on all ports (no performance penalty)
- VLAN ACLs (VACLs)
- Port ACLs (PACLs)
- Private VLANs (PVLANS) on access and trunk ports
- DHCP Snooping and Option 82 insertion
- Port Security
- Sticky Port Security on Voice VLAN
- SSHv1 and v2
- Unicast Port Flood Blocking
- DAI
- IP Source Guard
- VLAN Management Policy Server (VMPS) client
- Cisco NAC Layer 2 802.1X
- Cisco NAC LAN Port IP

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- 802.1X Inaccessible Authentication Bypass
 - Voice VLAN Sticky Port Security
 - SCP
 - uRPF Strict Mode (in hardware)

Management

- SNMP v1, v2, and v3
- RMON I and II
- RFC 1213-MIB (MIB II)
- UDP-MIB
- TCP-MIB
- CISCO-FLASH-MIB
- CISCO-IMAGE-MIB
- RFC 2233 (IF-MIB)
- CISCO-CONFIG-MAN-MIB
- CISCO-MEMORY-POOL
- CISCO-CDP-MIB
- RMON-MIB lite (RFC 1757)
- RMON2-MIB lite (RFC 2021)
- HC-RMON-MIB
- SMON-MIB
- ENTITY-MIB (V1-RFC 2037) (V2-RFC 2737)
- CISCO-PROCESS-MIB
- CISCO-CONFIG-COPY-MIB
- CISCO-ENTITY-EXT-MIB
- CISCO-ENTITY-ASSET-MIB
- CISCO-ENTITY-FRU-CONTROL-MIB
- CISCO-ENTITY-SENSOR-MIB
- CISCO-ENVMON-MIB
- BRIDGE-MIB (RFC 1493)
- CISCO-PAGP-MIB
- CISCO-PRIVATE-VLAN-MIB
- CISCO-STP-EXTENSIONS-MIB
- CISCO-VLAN-MEMBERSHIP-MIB
- CISCO-VLAN-IFTABLE-RELATIONSHIP-MIB
- IGMP-MIB
- PIM-MIB
- CISCO-ENTITY-VENDORTYPE-OID-MIB

- CISCO-SYSLOG-MIB
- CISCO-BULK-FILE-MIB
- CISCO-CLASS-BASED-QOS-MIB
- CISCO-FTP-CLIENT-MIB
- CISCO-IGMP-FILTER-MIB
- CISCO-IPMROUTE-MIB
- CISCO-PORT-SECURITY-MIB
- CISCO-RMON-CONFIG-MIB
- CISCO-VTP-MIB
- ETHERLIKE-MIB
- EXPRESSION-MIB
- CISCO-PORT-STORM-CONTROL-MIB

Industry Standards

- Ethernet: IEEE 802.3 and 10BASE-T
- Fast Ethernet: IEEE 802.3u, 100BASE-TX, and 100BASE-FX
- Gigabit Ethernet: IEEE 802.3z and 802.3ab
- 10 Gigabit Ethernet: IEEE 802.3ae
- IEEE 802.1D Spanning Tree Protocol
- IEEE 802.1w Rapid Reconfiguration of Spanning Tree
- IEEE 802.1s Multiple VLAN Instances of Spanning Tree
- IEEE 802.3 ad LACP
- IEEE 802.1p CoS Prioritization
- IEEE 802.1Q VLAN
- IEEE 802.1X User Authentication
- 1000BASE-X (GBIC)
- 1000BASE-X (SFP)
- 1000BASE-SX
- 1000BASE-LX/LH
- 1000BASE-ZX
- RMON I and II standards

LAN Base Image

Cisco IOS Software Release 12.2(53)SG also has a LAN Base Software image with an IP Base image upgrade option. These images will complement the existing IP Base and Enterprise Services images. The LAN base image is supported on the Supervisor 6L-E bundles (WS-C4506E-S6L-96V and WS-C4503E-S6L-48V+) only. It is primarily focused on customers Layer 2 requirements and therefore many of the IP Base features have been removed. For comparison of packages, visit the Cisco Feature Navigator at <http://tools.cisco.com/ITDIT/CFN/>.

The minimum Cisco IOS Software for Supervisor 6L-E and related bundles is Cisco IOS Software 12.2(53)SG. Enterprise Services support was introduced with 12.2(53)SG2.

Table 9 shows supported Cisco Catalyst 4500 E-Series line cards and modules.

Table 9. Supported Cisco Catalyst 4500 E-Series Line Cards and Modules

Line-Card PID	Description
WS-X4648-RJ45V-E	Cisco Catalyst 4500 E-Series, 48-port 802.3af PoE 10/100/1000 (RJ-45)
WS-X4648-RJ45V+E	Cisco Catalyst 4500 E-Series, 48-port PoEP ready 10/100/1000 (RJ-45)
WS-X4624-SFP-E	Cisco Catalyst 4500 E-Series, 24-port GE (SFP)
WS-X4606-X2-E	Cisco Catalyst 4500 E-Series, 6-port 10 Gigabit Ethernet (X2)
CVR-X2-SFP	Cisco TwinGig Converter Module

Table 10 shows supported Cisco Catalyst 4500 classic line cards and modules.

Table 10. Supported Cisco Catalyst 4500 Classic Line Cards and Modules

Line-Card PID	Description
WS-X4548-GB-RJ45V+	Cisco Catalyst 4500 PoEP ready 10/100/1000, 48-port (RJ-45)
WS-X4548-GB-RJ45V	Cisco Catalyst 4500 PoE 802.3af 10/100/1000, 48-port (RJ-45)
WS-X4148-FE-BD-LC	Cisco Catalyst 4500 Fast Ethernet Switching Module, 48-port 100BASE-BX-D SMF (LC)
WS-X4124-FX-MT	Cisco Catalyst 4000 Fast Ethernet Switching Module, 24-port 100BASE-FX (MT-RJ)
WS-X4148-FX-MT	Cisco Catalyst 4500 Fast Ethernet Switching Module, 48-port 100BASE-FX multimode fiber (MMF)
WS-X4124-RJ45	Cisco Catalyst 4500 10/100 Module, 24-port (RJ-45)
WS-X4148-RJ	Cisco Catalyst 4500 10/100 Module, 48-port (RJ-45)
WS-X4148-RJ21	Cisco Catalyst 4500 10/100 Module, 48-port telco (4 x RJ-21)
WS-X4248-RJ21V	Cisco Catalyst 4500 PoE 802.3af 10/100, 48-port (RJ-21)
WS-X4224-RJ45V	Cisco Catalyst 4500 PoE 803.3af 10/100, 24-port (RJ-45)
WS-X4248-RJ45V	Cisco Catalyst 4500 PoE 802.3af 10/100, 48-port (RJ-45)
WS-X4248-FE-SFP	Cisco Catalyst 4500 Fast Ethernet Switching Module, 48-port 100BASE-X (SFP)
WS-X4232-GB-RJ	Cisco Catalyst 4500 32-Port 10/100 (RJ-45), 2 Gigabit Ethernet (GBIC) modules
WS-X4302-GB	Cisco Catalyst 4500 Gigabit Ethernet Module, 2-port (GBIC)
WS-X4306-GB	Cisco Catalyst 4500 Gigabit Ethernet Module, 6-port (GBIC)
WS-X4506-GB-T	Cisco Catalyst 4500 Gigabit Ethernet Module, 6-port 10/100/1000 802.3af PoE or 1000BASE-X (SFP)
WS-X4418-GB	Cisco Catalyst 4500 Gigabit Ethernet Module, server switching 18 ports (GBIC)
WS-X4448-GB-SFP	Cisco Catalyst 4500 Gigabit Ethernet Module, 48-port 1000BASE-X (optional SFPs)
WS-X4424-GB-RJ45	Cisco Catalyst 4500 24-Port 10/100/1000 Module (RJ-45)
WS-X4548-GB-RJ45	Cisco Catalyst 4500 Enhanced Module, 48-port 10/100/1000 (RJ-45)
WS-X4524-GB-RJ45V	Cisco Catalyst 4500 PoE 802.3af 10/100/1000, 24-port (RJ-45)

Supported Pluggables

- GLC-T: 1000BASE-T SFP
- GLC-SX-MM: Gigabit Ethernet SFP, LC connector, SX transceiver
- GLC-LH-SM: Gigabit Ethernet SFP, LC connector, LX/LH transceiver
- GLC-ZX-SM: 1000BASE-ZX SFP
- Cisco Coarse Wavelength-Division Multiplexing (CWDM) Gigabit Interface Converter (GBIC) solution
- Cisco CWDM SFP solution
- X2-10GE-LR: 10GBASE-LR X2 module
- X2-10GE-CX4: 10GBASE-CX4 X2 module
- X2-10GE-LX4: 10GBASE-LX4 X2 module
- X2-10GE-SR: 10GBASE-SR X2 module
- X2-10GE-ER: 10GBASE-ER X2 module
- X2-10GE-LRM: 10GBASE-LRM X2 module
- X2-10GB-DWDM: 10GBASE-DWDM X2 module
- X2-10GB-ZR: 10GBASE-ZR X2 module

Indicator and Port Specifications

- System status: Green (operational); red (faulty)
- Switch usage load: 1 to 100 percent aggregate switching usage
- Console: RJ-45 female
- Reset (switch recessed protected)
- Uplinks: Link and active
- Image management port: 10/100/1000 BASE-TX (RJ-45 female) data terminal equipment (DTE); green (good); orange (disabled); off (not connected)

Software Requirements

The Cisco Catalyst 4500 Series Supervisor Engine 6L-E is supported only in Cisco IOS Software and is not supported in the Cisco Catalyst Operating System Software. LAN Base, IP Base, and Enterprise Services packages are supported.

The minimum software versions for the IP Base and LAN Base packages are as follows:

- Supervisor Engine 6L-E, Cisco IOS Software Release 12.2(53)SG or later

For the Enterprise Services package the minimum software versions are as follows:

- Supervisor Engine 6L-E, Cisco IOS Software Release 12.2(53)SG2 or later

Table 11 provides ordering information.

Table 11. Ordering Information

Product Number	Description
WS-X45-Sup6L-E (=)	Cisco Catalyst 4500 E Series Supervisor Engine 6L-E, 2x10GE (X2) or 4x1GE (SFP), Console RJ-45
S45EES_12253SG(=)	Cisco Catalyst 4500E Cisco IOS Software ENTERPRISE SERVICES W/O CRYPTO
S45EESK9_12253SG(=)	Cisco Catalyst 4500E Cisco IOS Software ENTERPRISE SERVICES SSH
S45EIPB-12253SG (=)	Cisco Catalyst 4500E Cisco IOS Software IP BASE W/O CRYPTO
S45EIPBK9-12253SG (=)	Cisco Catalyst 4500E Cisco IOS Software IP BASE SSH

Cisco Catalyst 4500 E-Series and Cisco Catalyst 4500 switches are covered by the Cisco Limited Lifetime Hardware Warranty. For more information, please visit:

http://www.cisco.com/en/US/docs/general/warranty/English/LH2DEN_.html.

Note: If you purchased the Cisco Catalyst 4500 Supervisor Engine 6L-E before May 1, 2009, it is covered by the Cisco 90-Day Limited Hardware Warranty. For more information, visit:

http://www.cisco.com/en/US/docs/general/warranty/English/901DEN_.html.

Environmental Conditions

- Operating temperature: 32 to 104°F (0 to 40°C)
- Storage temperature: -40 to 167°F (-40 to 75°C)
- Relative humidity: 10 to 90 percent, noncondensing
- Operating altitude: -60 to 2000m

ROHS Compliance

ROHS5

Cisco Technical Support Services

Cisco Technical Support Services help to ensure that your products from Cisco operate efficiently, remain highly available, and benefit from current system software to assist you in effectively managing your network service while controlling operational costs.

Cisco Technical Support Services provide significant benefits that go beyond what is offered under the Cisco warranty policy. Services available under a Cisco SMARTnet[®] service contract that are not covered under a warranty include the following:

- Latest software updates
- Rapid replacement of hardware in next-day, 4-hour, or 2-hour dispatch options
- Ongoing technical support through the Cisco Technical Assistance Center (TAC)
- Registered access to <http://www.cisco.com>

Cisco and Partner Services: Essential to Campus Success

Cisco and our certified partners can help you prepare your network and teams as you adopt new technologies to transform your business. We can help you establish a secure, resilient architecture and successfully integrate Cisco Unified Communications, security, and mobility technologies. Planning and design services align technology with business goals and can increase the accuracy, speed, and efficiency of deployment. Technical services help maintain operational health, strengthen software application functions, solve performance problems, and lower expenses. Optimization services are designed to continually improve performance and help your team succeed with new technologies. For more information, visit <http://www.cisco.com/go/services>.

For More Information

To learn more about how you can take advantage of Cisco Technical Support Services, talk to your Cisco representative or visit Cisco Technical Support Services at:

http://www.cisco.com/en/US/products/svcs/ps3034/ps2827/serv_category_home.html.

For additional information about the Cisco Catalyst 4500, visit <http://www.cisco.com/go/catalyst4500> or for additional information about Cisco products, contact:

- United States and Canada: 800 553-NETS (6387)
- Europe: 32 2 778 4242
- Australia: 612 9935 4107
- Other: 408 526-7209
- <http://www.cisco.com/>



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