Cisco Catalyst 4500 Series Supervisor Engine V

High Density Enterprise Wiring Closet, Supervisor Engine

The Cisco Catalyst 4500 Series integrates resiliency for advanced control of converged networks.

Overview

The Cisco Catalyst 4500 Series Supervisor Engine V continues the nonblocking, robust Layer 2/3/4 switching found in previous Catalyst 4500 Series Supervisor Engines with additional performance, features and throughput, further enhancing resilient control of converged data, voice, and video networks with high availability enabling business resiliency enterprise and metropolitan (metro) Ethernet customers.

Network control extends from the backbone to the edge with intelligent Layer 3 services such as granular QoS (Quality of Service), internet security, and network management.

Due to the modular architecture, the Cisco Catalyst 4500 Series provides scalability, flexibility, and investment protection providing a “pay as you grow” model, resulting in a reduction of operational expenses and capital expenditures. The Supervisor Engine V is backward compatible with all current Cisco Catalyst 4500 Series linecards and can be used with the Cisco Catalyst 4503, 4506, 4507R, 4510R, and 4006 chassis.

The Cisco Catalyst 4500 Supervisor Engine V, when deployed in a Catalyst 4510R, offers port scalability for resilient Layer 2/3/4 and routing for the Enterprise market segment. Optimized for the enterprise wiring closet, branch office backbones, or Layer 3 distribution points, the Cisco Catalyst 4500 Series Supervisor Engine V provides the performance and scalability to handle the network applications of today and the future.

Compatible with the widely deployed Cisco Catalyst 4006 chassis, the Cisco Catalyst 4500 Series chassis and line cards; the Cisco Catalyst 4500 Series Supervisor Engine V helps to ensure an extended window of deployment to further strengthen the scalability of the modular Cisco Catalyst 4500 Series.
## Comparison of Supervisor Engines IV and V

### Table 1  Comparison Between Supervisor Engines IV and V

<table>
<thead>
<tr>
<th>Category</th>
<th>Supervisor Engine V</th>
<th>Supervisor Engine IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chassis Support</td>
<td>Cisco Catalyst 4006, 4503, 4506, 4507R, 4510R</td>
<td>Cisco Catalyst 4006, 4503, 4506, and 4507R</td>
</tr>
<tr>
<td>Redundant Capable</td>
<td>Yes (Cisco Catalyst 4507R and 4510R only)</td>
<td>Yes (Cisco Catalyst 4507R only)</td>
</tr>
<tr>
<td>Active GE Uplinks in Redundant mode</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Switching Capacity</td>
<td>96 Gbps</td>
<td>64 Gbps</td>
</tr>
<tr>
<td>Throughput</td>
<td>72 Mpps</td>
<td>48 Mpps</td>
</tr>
<tr>
<td>Multi-layer Switching</td>
<td>Full L2/3/4 Services &amp; Routing</td>
<td>Full L2/3/4 Services &amp; Routing</td>
</tr>
<tr>
<td>(E)IGRP, OSPF, BGP, ISIS</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>DBL (Dynamic Buffer Limiting): Congestion Avoidance feature</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>QoS Sharing</td>
<td>Supported on all ports</td>
<td>Support only on Non-blocking Gig ports</td>
</tr>
<tr>
<td>Broadcast Suppression</td>
<td>Hardware&lt;sup&gt;1&lt;/sup&gt;</td>
<td>Software&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Multicast Suppression</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>QinQ</td>
<td>In Hardware</td>
<td>Pass-through</td>
</tr>
<tr>
<td>NetFlow Support</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Minimum Software Requirement</td>
<td>Cisco IOS 12.2(18)EW or later</td>
<td>Cisco IOS 12.1(12c)EW or later</td>
</tr>
<tr>
<td>CPU</td>
<td>400 Mhz</td>
<td>333 Mhz</td>
</tr>
<tr>
<td>SDRAM</td>
<td>512MB</td>
<td>512 MB</td>
</tr>
<tr>
<td>Active VLANs</td>
<td>4K</td>
<td>4K</td>
</tr>
<tr>
<td>Multicast entries</td>
<td>28K(L3) 16K (L2)</td>
<td>28K(L3) 16K (L2)</td>
</tr>
<tr>
<td>STP Instance</td>
<td>3K</td>
<td>3K</td>
</tr>
<tr>
<td>SVI</td>
<td>4K</td>
<td>4K</td>
</tr>
<tr>
<td>NVRAM</td>
<td>Yes (512KB)</td>
<td>Yes (512KB)</td>
</tr>
<tr>
<td>IGMP Snooping</td>
<td>Yes (16k)</td>
<td>Yes (16k)</td>
</tr>
</tbody>
</table>

<sup>1</sup> Hardware performance on all ports.

<sup>2</sup> Hardware performance for non-blocking Gigabit Ethernet (GE) ports, and software performance for all other ports.
The Supervisor Engine V can be deployed in single-chassis nonredundant mode in the Cisco Catalyst 4006, 4503, 4506, 4507R, and 4510R. Redundant mode as an option in the Cisco Catalyst 4507R/4510R chassis (slots 1 and 2 only).

**Table 2** Cisco Catalyst 4500 Series Supervisor Engine V Performance Per Chassis

<table>
<thead>
<tr>
<th></th>
<th>Cisco Catalyst 4503 Chassis</th>
<th>Cisco Catalyst 4006 Chassis</th>
<th>Cisco Catalyst 4506 Chassis</th>
<th>Cisco Catalyst 4507R Chassis</th>
<th>Cisco Catalyst 4510R Chassis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supervisor Engine V (WS-X4516)</td>
<td>Supported 28 Gbps, 21 Mpps</td>
<td>Supported 64 Gbps, 48 Mpps</td>
<td>Supported 64 Gbps, 48 Mpps</td>
<td>Supported 68 Gbps, 51 Mpps</td>
<td>Supported 96 Gbps, 72 Mpps</td>
</tr>
</tbody>
</table>

1. When Supervisor V is used in the 4510R chassis, Slot 10 (Flex-slot) will support a subset of linecards: 2-port GBIC (WS-X4302-GB) and Access Gateway Module (WS-X4604-GWY). This is due to the switching capacity of the Supervisor Engine V, and not a limitation of the 4510R chassis. Future Supervisor Engines will allow Slot 10 to accommodate any and all linecards.

**Supervisor Engine V Redundancy for Business Resiliency**

The Cisco Catalyst 4510R and 4507R chassis have been designed with an optional 1+1 redundant Supervisor capability using the Supervisor Engine IV or V for integrated resiliency. One Supervisor Engine IV/V is designated as the primary (active) Supervisor and is responsible for normal system operation. The other (secondary) can serve as a standby, monitoring the operation of the primary Supervisor.

The redundancy scheme using the Supervisor Engine V in the Cisco Catalyst 4510R is similar to that in Cisco Catalyst 6500 Series switches. When the primary Supervisor fails, the secondary Supervisor assumes control of the chassis. This algorithm prevents oscillations between primary and secondary Supervisors. Alerts are generated to the network monitoring software if either fails. In addition, the Supervisor design allows the hot swapping of Supervisor boards without disrupting system operation. A switchover of the supervisor can be forced by software, or by the user via console or the Simple Network Management Protocol (SNMP).

**Predictable Performance and Scalability**

The Cisco Catalyst 4500 Supervisor Engine V delivers a 96-Gbps switching fabric with a 72-Mpps forwarding rate in hardware for Layers 2 through 4 traffic. Switching performance is independent of the number of route entries or Layer 3 and 4 services enabled. Hardware-based Cisco Express Forwarding routing architecture allows for increased scalability and performance. Cisco Express Forwarding architecture allows for high-speed lookups while ensuring the stability and scalability necessary to meet the needs of future requirements.

The Cisco Catalyst 4500 Series is optimized for multimedia applications with its advanced multicast support. Like the Supervisor Engine IV, the Supervisor Engine V supports Protocol Independent Multicast (PIM), Source-Specific Multicast (SSM), and Pragmatic General Multicast (PGM) providing end users with additional scalability to support multimedia applications. Also supported is Internet Group Management Protocol (IGMP) snooping in hardware, enhancing performance and reducing network traffic by allowing a switch to dynamically add and remove hosts from a multicast group.
Integrated Cisco IOS Software Switching Solution

The Cisco Catalyst 4500 Series Supervisor Engine V supports Cisco IOS Software, providing operational ease of use by allowing customers to deploy a single network operating system across their routed and switched infrastructures. Industry-leading Cisco IOS Software integrates features for scalability, bandwidth management, security services, network resiliency, and manageability into the Cisco Catalyst 4500 Series. Cisco IOS Software provides investment protection and tight coupling of Layers 2 through 4 services into a single, unified configuration file and system image.

Intelligent Network Services with QoS (Quality of Service) and Sophisticated Traffic Management

The Cisco Catalyst 4500 Series Supervisor Engine V offers superior per-port QoS features ensuring that network traffic is classified, prioritized, and scheduled optimally to efficiently handle bandwidth-hungry multimedia, time-sensitive (voice), and mission-critical applications. Supervisor Engine V can classify, police, and mark incoming packets, allowing the administrator to differentiate between traffic flows and enforce policies. Sharing, shaping, and strict priority configurations determine scheduling of egress traffic. The Supervisor Engine V also supports DBL (Dynamic Buffer Limiting), a congestion avoidance feature. For details on the QoS features (including DBL) on the Supervisor Engine V, refer to the QoS On Cisco Catalyst 4500 Series IOS-Based Supervisor Engines overview at: http://www.cisco.com/en/US/partner/products/hw/switches/ps4324/prod_white_papers_list.html

Comprehensive Management

The Cisco Catalyst 4500 Series Supervisor Engine V features a single console port and a single IP address to manage all features of the system. Remote in-band management is available via SNMP, Telnet client, Bootstrap Protocol (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. Smarports Macro is a Catalyst solution which is also supported, simplifying the configuration of the critical features for the Ethernet networks.

The Cisco Catalyst 4500 Supervisor Engine V 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, virtual LAN (VLAN), traffic, and policy management. The LAN management solution bundle offers tools such as CiscoWorks Resource Manager Essentials and Cisco View. 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.

Advanced Security

The Cisco Catalyst 4500 Supervisor Engine V supports 802.1x, Terminal Access Controller Access Control System (TACACS+), Remote Access Dial-In User Service (RADIUS) for user authentication. It also supports Secure Shell (SSH version 1 and version 2) protocols and SNMPv3 for secure remote access and network management. The Cisco Catalyst 4500 Series Supervisor Engine V offers a rich blend of network traffic security capabilities. It can perform hardware-based filtering based on access lists used to define security policies. Packets can be filtered based on source and destination IP addresses or TCP/User Datagram Protocol (TCP/UDP) ports, so users can be restricted from sensitive portions of the network. It helps prevent the man-in-the-middle attacks and IP spoofing. All ACL lookups are done in hardware; therefore, wire-speed forwarding and routing performance are not affected when enabling ACL-based security in the network.
Support for Dynamic ARP Inspection

Because it is relatively easy for a malicious user to poison ARP tables of other hosts on the same VLAN, the Catalyst 4500 Series Supervisor V supports dynamic ARP inspection. In a typical attack, a malicious user can send unsolicited ARP replies (gratuitous ARP packets) to other hosts on the subnet with the attacker's MAC address and the default gateway's IP address. Such ARP poisoning leads to various “man-in-the-middle” attacks, posing a security threat in the network. Dynamic ARP Inspection intercepts all ARP requests and replies on the untrusted ports. Each intercepted packet is verified for valid IP-to-MAC bindings. Dynamic ARP Inspection helps prevent the man-in-the-middle attacks by not relaying invalid ARP replies out to other ports in the same VLAN. It is a solution requiring no change to the end user or host configurations.

Features at a Glance

Layer 2 Features

- Layer 2 hardware forwarding at 72 Mpps
- Layer 2 switch ports and VLAN trunks
- IEEE 802.1Q VLAN encapsulation
- Inter-Switch Link (ISL) VLAN encapsulation (excluding blocking ports on WS-X4418-GB)
- Dynamic Trunking Protocol (DTP)
- VLAN Trunking Protocol (VTP) and VTP domains
- Support for 4096 VLANs per switch
- Per-VLAN Spanning-Tree Protocol (PVST+) and Per-VLAN Rapid Spanning-Tree Protocol (PVRST)
- Spanning-tree PortFast and PortFast guard
- Spanning-tree UplinkFast and BackboneFast
- 802.1s
- 802.1w
- 802.3ad
- Spanning-tree root guard
- Cisco Discovery Protocol
- IGMP snooping v1, v2 and v3
- Cisco EtherChannel® technology, Fast EtherChannel, and Gigabit EtherChannel technology across line cards
- Port Aggregation Protocol (PAgP)
- Unidirectional link detection (UDLD) and aggressive UDLD
- Q-in-Q in hardware
- Layer 2 protocol tunneling
- Jumbo Frames (up to 9216 bytes)
- Baby Giants (up to 1600 bytes)
- Unidirectional Ethernet
- Route processor redundancy (RPR) (sub-minute failover time)
- Storm Control (formally known as Broadcast and Multicast Suppression)
Layer 3 Features

- Hardware-based IP Cisco Express Forwarding routing at 72 Mpps
- Static IP routing
- IP routing protocols: Enhanced IGRP [EIGRP], Open Shortest Path First [OSPF], Routing Information Protocol [RIP], RIP2)
- Border Gateway Protocol Version 4 (BGP4) and Multicast Border Gateway Protocol (MBGP)
- Hot Standby Router Protocol (HSRP)
- Software routing of Internetwork Packet Exchange (IPX) and AppleTalk
- Intermediate System to Intermediate System (IS-IS) routing protocol
- IGMP v1, v2, and v3
- IGMP filtering on access and trunk ports
- IP multicast routing protocols (PIM, SSM, Distance Vector Multicast Routing Protocol [DVMRP])
- Pragmatic General Multicast (PGM)
- Cisco Group Multicast Protocol (CGMP) server
- Full Internet Control Message Protocol (ICMP) support
- ICMP Router Discovery Protocol
- Policy-Based Routing (PBR)
- Full Internet Control Message Protocol (ICMP) support
- Virtual Route Forwarding-lite (VRF-lite)

Sophisticated QoS and Traffic Management

- Per-port QoS configuration
- Support for four queues per port in hardware
- Strict priority queuing
- IP differentiated service code point (DSCP) and IP Precedence
- Classification and marking based on IP type of service (TOS) or DSCP
- Classification and marking based on full Layer 3 and Layer 4 headers (IP only)
- Input and output policing based on Layer 3 and Layer 4 headers (IP only)
- Support for 1024 policers on ingress and 1024 policers on egress configured as aggregate or individual
- Shaping and sharing output queue management
- DBL (Dynamic Buffer Limiting): Congestion-avoidance feature
- No performance penalty for granular QoS functions
- Auto-QoS command-line interface (CLI) for voice-over-IP (VoIP) deployments

Predictable Performance

- 96-Gbps switching fabric
- Layer 2 hardware forwarding at 72 Mpps
- Layer 3 hardware-based IP Cisco Express Forwarding routing at 72 Mpps
- Layer 4 TCP/UDP hardware-based filtering at 72 Mpps
• No performance penalty with advanced Layer 3 and Layer 4 services enabled
• Software-based learning at a sustained rate of 1000 hosts per second
• Support for 32,768 MAC addresses
• Support for 131,072 entries in routing table (shared between unicast and multicast)
• Scalability to 4000 virtual ports (VLAN port instances)
• Bandwidth aggregation up to 16 Gbps through Cisco Gigabit EtherChannel technology
• Hardware-based multicast management
• Hardware-based ACLs

Comprehensive Management
• Single console port and single IP address to manage all features of the system
• Software configuration management, including local and remote storage
• Optional Compact Flash memory card to store software images for backup and easy software upgrades
• 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
• Support for all nine RMON groups through the use of a Cisco SwitchProbe® analyzer (Switched Port Analyzer [SPAN]) port, which permits traffic monitoring of a single port, a group of ports, or the entire switch from a single network analyzer or RMON probe
• Analysis support, including ingress port, egress port, and VLAN SPAN
• NetFlow VLAN Statistics (NetFlow Services card required)
• Layer 2 traceroute
• Remote SPAN (RSPAN)
• Smartports Macros

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 VLAN assignment, port security and Guest VLAN extensions)
• 802.1x accounting
• Trusted Boundary
• Router ACLs (RACLs) on all ports (no performance penalty)
• VLAN ACLs (VACLs)
• Port ACLs (PAACLs)
• Private VLANs (PVLANs) on access and trunk ports
• Dynamic Host Configuration Protocol (DHCP) snooping and Option82 insertion
• Port Security
• Sticky Port Security
• Secure Shell version 1 and 2 (SSHv1 and SSHv2)
• VLAN Management Policy Server (VMPS) Client
• Unicast MAC filtering
• Unicast port flood blocking
• Dynamic Address Resolution Protocol (ARP) inspection
• IP source guard

Cisco Catalyst 4500 Series NetFlow Services Card for Supervisor Engine V

The Cisco Catalyst 4500 Series NetFlow Services Card is an optional daughter card for the Cisco Catalyst 4500 Series Supervisor Engine IV or V. It adds IP statistics and enhanced VLAN statistics without affecting the forwarding performance rates.

Figure 2
NetFlow Services Card

NetFlow Services Card Product Description

The NetFlow Services Card supports statistics capture in hardware for flow-based and VLAN-based statistics monitoring. NetFlow services capture and cache detailed information about each data flow (a stream of packets traveling in one direction from one endpoint to another across the network). Data in the NetFlow cache includes information with regard to specific flows including details such as IP addresses, packet and byte counts, timestamps, and application ports. This data can be exported, collected, and analyzed for numerous purposes. More information about NetFlow technology is available at:

NetFlow Services Card Applications

NetFlow technology efficiently provides the metering base for critical applications, including network traffic accounting, usage-based network billing, network planning, network monitoring, and data mining capabilities for both service provider and enterprise customers.

An enterprise customer might use the information for departmental charge-backs, cost allocation, network budget justification, network monitoring and planning, application monitoring and planning, use monitoring and planning, enterprise accounting, usage-based billing, data warehousing, or management reports.

A service provider customer might use the information to charge customers according to bandwidth, application usage, QoS, or distance, rather than at a flat rate.

A more detailed list of general NetFlow applications is available at:


NetFlow Service Card Features

With Cisco IOS Software Release 12.2(18)EW, the Cisco Catalyst 4500 Series with the Supervisor Engine V supports NetFlow statistics. The NetFlow daughter card provides line-rate flow statistics as well as Layer 2 VLAN statistics without a performance penalty. NetFlow Data Export versions 1, 5, and 8 are supported in Cisco IOS Software Release 12.2(18)EW.

The default is NetFlow Statistics Collection and NetFlow Data Export versions 1 and 5. The supported fields within NDE Version 5 with Cisco IOS Software Release 12.2(18)EW are identified below:

- Source and destination IP address (hardware)
- IP Protocol (hardware)
- Layer 4 source and destination ports (for TCP/UDP or 0 otherwise) (hardware)
- Start and end timestamps (hardware)
- Packet counts and byte counts (hardware)
- Input/output interface (software)
- Next-hop router (software)
- Source/destination autonomous system number (software)
- Source/destination prefix mask (software)
- VLAN statistics collection
- Command-line interface (CLI) support for NetFlow and VLAN statistics
- SNMP support for VLAN statistics
- NetFlow Aggregation Support (NFX) (NetFlow Version 8)

NetFlow Services Card Hardware and Software Requirements

The NetFlow Services Card is supported on the Supervisor Engine IV and V with Cisco IOS Software and is not supported in the Cisco CatOS Software.
Software Requirements

- The minimum software version for the NetFlow Services Card with Supervisor Engine V are as follows:
  - Cisco IOS Software Release 12.2(18)EW or later
- NetFlow Collection (NFC) and Network Data Analyzer (NDA) requirements:
  - Cisco CNS NetFlow Collection Engine (NFC) Version 3.5 or higher
  - Cisco Network Data Analyzer (NDA) Version 3.6 or higher

Hardware Requirements

- Supervisor Engine IV or V
- Redundant Supervisor Engine IV or V daughter card configurations must match. If a NetFlow Services Card is deployed on a primary supervisor engine, then a second NetFlow Services Card must be deployed on a secondary Supervisor V in the same chassis.

The NetFlow Services Card can be shipped pre-installed with a Supervisor Engine IV or V from the factory or as a separate, field-replaceable unit. The Supervisor Engine V must be removed from the chassis to install the NetFlow Services Module; it is not hot-swappable.

Technical Specifications

Supervisor Engine V Performance and Switching Specifications

- 96-Gbps nonblocking switch fabric
- 72-M pps Layer 2 Forwarding (hardware)
- 72-M pps Layer 3 and Layer 4 forwarding-IP routing, Cisco Express Forwarding-based (hardware)
- Layers 2–4 hardware-based switch engine (application-specific integrated circuit [ASIC]-based)
- Centralized design
- Unicast and multicast routing entries: 131,072
- Layer 2 multicast addresses: 16,384
- MAC addresses: 32,768
- VLANs: 4096 supported in hardware
- Uplinks: Dual 1000-M bps Gigabit Ethernet (Gigabit Interface Converter [GBIC])

Traffic and Congestion Management

- Number of queues: four queues per port
- Type of buffers: dynamic

Switch Architecture Specifications

- Store-and-forward switching, fast 1.4-microsecond latency
- Functionally transparent line card architecture
- Packet buffering: dynamic, 16-M B shared memory
Management

- CiscoWorks/LAN Management Solutions (LMS); includes CiscoWorks Resource Manager Essentials
- Cisco View
- 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
- OSPF-MIB
- CISCO-ENTITY-VENDORTYPE-OID-MIB
- CISCO-SYSLOG-MIB
• BGP4-MIB
• CISCO-BULK-FILE-MIB
• CISCO-CLASS-BASED-QOS-MIB
• CISCO-FTP-CLIENT-MIB
• CISCO-HSRP-MIB
• CISCO-IGMP-FILTER-MIB
• CISCO-IPM ROUTE-MIB
• CISCO-PORT-SECURITY-MIB
• CISCO-IGMP-FILTER-MIB
• CISCO-IPM ROUTE-MIB
• CISCO-PORT-SECURITY-MIB
• CISCO-PORT-STORM-CONTROL-MIB

Industry Standards
• Ethernet: IEEE 802.3, 10BASE-T
• Fast Ethernet: IEEE 802.3u, 100BASE-TX, 100BASE-FX
• Gigabit Ethernet: IEEE 802.3z, 802.3ab
• IEEE 802.3af Power over Ethernet (PoE)
• IEEE 802.1D Spanning-Tree Protocol
• IEEE 802.1w rapid reconfiguration of spanning tree
• IEEE 802.1s multiple VLAN instances of spanning tree
• IEEE 802.3ad Link Aggregation Control Protocol (LACP)
• IEEE 802.1p class-of-service (CoS) prioritization
• IEEE 802.1Q VLAN
• IEEE 802.1x user authentication
• 1000BASE-X (GBIC)
• 1000BASE-X (small form-factor pluggable [SFP])
• 1000BASE-SX
• 1000BASE-LX/LH
• 1000BASE-ZX
• RMON I and II standards

Supported Line Cards and Modules
• WS-F4531—Cisco Catalyst 4500 NetFlow Services Daughter Card
• WS-X4148-FL-E-LX-MT—Cisco Catalyst 4500 Fast Ethernet Switching Module, 48-port 100BASE-LX10 single-mode fiber (SMF) (M T-RJ)
• WS-X4148-FX-MT—Cisco Catalyst 4500 Fast Ethernet Switching Module, 48-port 100BASE-FX multimode fiber (MMF) (M T-RJ)
• WS-X4148-RJ — Cisco Catalyst 4500 10/100 Module, 48 ports (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-Ports(RJ21)
• WS-X4148-RJ45V — Cisco Catalyst 4500 Prestandard PoE 10/100, 48 ports (RJ-45)
• WS-X4248-RJ45V — Cisco Catalyst 4500 PoE 802.3af 10/100, 48-Ports(RJ45)
• WS-X4232-GB-RJ — Cisco Catalyst 4500 32-port 10/100 (RJ-45), 2-Gigabit Ethernet (GBIC) Module
• WS-X4232-RJ-XX — Cisco Catalyst 4500 32-port 10/100 (RJ-45), plus modular uplink slot
• WS-X4302-GB — Cisco Catalyst 4500 Gigabit Ethernet Module, 2 ports (GBIC)
• WS-X4306-GB — Cisco Catalyst 4500 Gigabit Ethernet Module, 6 ports (GBIC)
• WS-X4418-GB — Cisco Catalyst 4500 Gigabit Ethernet Module, server switching 18 ports (GBIC)
• WS-X4424-GB-RJ45 — Cisco Catalyst 4500 24-port 10/100/1000 Module (RJ-45)
• WS-X4448-GB-LX — Cisco Catalyst 4500 48-port 1000BASE-LX (SFP)
• WS-X4448-GB-RJ45 — Cisco Catalyst 4500 48-port 10/100/1000 M odule (RJ-45)
• WS-X4548-GB-RJ45 — Cisco Catalyst 4500 Enhanced 48-port 10/100/1000 M odule (RJ-45)
• WS-X4454-RJ45V — Cisco Catalyst 4500 PoE 802.3af 10/100/1000, 48-Ports(RJ45)
• WS-U4504-FX-M T — Cisco Catalyst 4500 Fast Ethernet Uplink Daughter Card, 4-port 100BASE-FX (M T-RJ)
• WS-X4604-GWY — Cisco Catalyst 4500 Access Gateway Module with IP and firewall software
• WS-X4124-FX-M T — Cisco Catalyst 4000 Fast Ethernet Switching Module, 24-port 100BASE-FX (M T-RJ)
• WS-G5483 — Cisco 1000BASE-T GBIC
• WS-G5484 — Cisco 1000BASE-SX Short-Wavelength GBIC (multimode only)
• WS-G5486 — Cisco 1000BASE-LX/LH Long-Haul GBIC (single mode or multimode)
• WS-G5487 — Cisco 1000BASE-ZX Extended-Reach GBIC (single mode)
• Cisco coarse wavelength-division multiplexing (CWDM) GBIC solution

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

Software Requirements
The Cisco Catalyst 4500 Series Supervisor Engine V is supported only in Cisco IOS Software and is not supported in the Cisco CatOS Software. The minimum software versions are as follows:
• Supervisor Engine V, Cisco IOS Software Release 12.2(18)EW or later
• Supervisor Engine V with the NetFlow daughter card, Cisco IOS Software Release 12.2(18)EW
Environmental Conditions

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

Regulatory Standards Compliance

Table 3  Cisco Catalyst Supervisor Engine V Regulatory Standards Compliance

<table>
<thead>
<tr>
<th>Specification</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulatory compliance</td>
<td>CE marking</td>
</tr>
<tr>
<td>Safety</td>
<td></td>
</tr>
<tr>
<td>• UL 60950</td>
<td>• IEC 60950</td>
</tr>
<tr>
<td>• CAN/CSA-C22.2 No. 60950</td>
<td>• TS 001</td>
</tr>
<tr>
<td>• EN 60950</td>
<td>• AS/NZS 3260</td>
</tr>
<tr>
<td>EMC</td>
<td></td>
</tr>
<tr>
<td>• FCC Part 15 (CFR 47) Class A</td>
<td>• EN 55022</td>
</tr>
<tr>
<td>• ICES-003 Class A</td>
<td>• EN 55024</td>
</tr>
<tr>
<td>• EN55022 Class A</td>
<td>• EN 61000-6-1</td>
</tr>
<tr>
<td>• CISPR22 Class A</td>
<td>• EN 50082-1</td>
</tr>
<tr>
<td>• AS/NZS 3548 Class A</td>
<td>• EN 61000-3-2</td>
</tr>
<tr>
<td>• VCCI Class A</td>
<td>• EN 61000-3-3</td>
</tr>
<tr>
<td></td>
<td>• ETS 300 386</td>
</tr>
<tr>
<td>Industry EMC, safety, and environmental standards</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• GR-63-Core Network Equipment Building Systems (NEBS) Level 3</td>
</tr>
<tr>
<td></td>
<td>• GR-1089-Core Level 3</td>
</tr>
<tr>
<td></td>
<td>• ETS 300 019 Storage Class 1.1</td>
</tr>
<tr>
<td></td>
<td>• ETS 300 019 Transportation Class 2.3 (pending)</td>
</tr>
<tr>
<td></td>
<td>• ETS 300 019 Stationary Use Class 3.1</td>
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<tr>
<td></td>
<td>• ETS 300 386</td>
</tr>
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</table>

Table 4  Ordering Information

<table>
<thead>
<tr>
<th>Product Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WS-X4516(=)</td>
<td>Cisco Catalyst 4500 Supervisor Engine V, 2 GE, Console RJ -45</td>
</tr>
<tr>
<td>WS-X4516/2</td>
<td>Cisco Catalyst 4500 Redundant Supervisor Engine V, (2 GE), Console RJ -45</td>
</tr>
<tr>
<td>WS-F4531(=)</td>
<td>Cisco Catalyst 4500 NetFlow Services Card</td>
</tr>
<tr>
<td>S4KL3-12218EW</td>
<td>Cisco IOS Software: Basic Layer 3 software image (RIP, static routes, IPX, AppleTalk)</td>
</tr>
<tr>
<td>S4KL3K91-12218EW</td>
<td>Cisco IOS Software: Basic Layer 3 software image, (RIP, static routes, IPX, AppleTalk, 3DES)</td>
</tr>
<tr>
<td>S4KL3E-12218EW</td>
<td>Cisco IOS Software: Enhanced Layer 3 software image, (OSPF, EIGRP, and IS-IS)</td>
</tr>
<tr>
<td>S4KL3EK91-12218EW</td>
<td>Cisco IOS Software: Enhanced Layer 3 software image, (OSPF, EIGRP, and IS-IS, 3DES)</td>
</tr>
</tbody>
</table>
Licensing

Use of RMON on the Cisco Catalyst 4006 and 4500 Series switches requires the purchase of the RMON agent license. Use of BGP4 on the Supervisor Engine V requires an InterDomain Routing license. Only one RMON agent license or InterDomain Routing license is required per chassis.

Warranty

The warranty for the Supervisor Engine V is 90 days and it includes hardware replacement with a 10-day turnaround from receipt of a return materials authorization (RMA).

Service and Support

Cisco is committed to maximizing your network investment. Cisco offers a portfolio of technical support services to help ensure that your Cisco products operate efficiently, remain highly available, and benefit from the most up-to-date system software. Technical support services include Cisco SMARTnet® support and Software Application Services.

For more information, visit the Cisco Technical Assistance Center Web site: http://www.cisco.com/tac/

For additional information on the Cisco Catalyst 4500, visit: http://www.cisco.com/go/catalyst4500

For information about Cisco Catalyst 4500 Series line cards, chassis, and other supervisor engines, refer to the Cisco Catalyst 4500 Series data sheet at: http://www.cisco.com/warp/public/cc/pd/si/casi/ca4000/prodlit/c4000_ds.htm