

## Cisco Catalyst 4500 Series Supervisor Engine V-10GE

High-Density Enterprise LAN Access Supervisor Engine with Dual Wire-Speed 10 Gigabit Ethernet Uplinks

The Cisco® Catalyst® 4500 Series Supervisor Engine V-10GE (Figure 1) integrates security and resiliency for advanced control of converged networks.

**Figure 1.** Cisco Catalyst 4500 Series Supervisor Engine V-10GE



### Overview

The Cisco Catalyst 4500 Series Supervisor Engine V-10GE continues the nonblocking, robust Layer 2–4 switching found in previous Cisco Catalyst 4500 Series supervisor engines with the addition of wire-speed 10 Gigabit Ethernet uplinks, 136-Gbps capacity, and 102-mpps throughput, and additional features to further enhance resilient control of converged data, voice, and video networks with high availability to help enable business resiliency for enterprise and metropolitan (metro) Ethernet customers. Network control extends from the backbone to the edge with intelligent services such as granular quality of service (QoS), Internet security, and network management. Scalability of these intelligent network services is made possible with dedicated specialized resources known as ternary content addressable memory (TCAM). Ample TCAM resources (192,000 entries) enable “high feature capacity,” which provides wire-speed routing/switching performance with concurrent provisioning of services such as QoS and security. This helps ensure scalability for today’s network requirements with ample room for future growth.

The Cisco Catalyst 4500 Series Supervisor Engine V-10GE includes dual wire-speed 10 Gigabit Ethernet ports (X2 optics) as well as 4 Gigabit Ethernet ports (Small Form-Factor Pluggable [SFP] optics) on the faceplate to maximize the flexibility of deployment options. The combination of Gigabit Ethernet and 10 Gigabit Ethernet ports on the same supervisor engine allows for network future-proofing with an easy migration path from Gigabit Ethernet to 10 Gigabit Ethernet by simply adding 10 Gigabit Ethernet optical interfaces. The ability to support both Gigabit Ethernet uplinks and 10 Gigabit Ethernet uplinks on a single supervisor engine further enhances the investment protection of the Cisco Catalyst 4500 Series architecture.

The Cisco Catalyst 4500 Series Supervisor Engine V-10GE offers port scalability for resilient Layer 2–4 and routing for both enterprise and service provider market segments. Optimized for the enterprise LAN, branch-office backbones, or Layer 3 distribution points, this supervisor engine provides the performance and scalability to handle the network applications of today and the future.

The Cisco Catalyst 4500 Series modular architecture provides a “pay-as-you-grow” model, reducing operational expenses and capital expenditures. The Supervisor Engine V-10GE is backward-compatible with all classic Cisco Catalyst 4500 Series line cards and can be used in both the classic Cisco Catalyst 4500 chassis with the Cisco

Catalyst 4503, 4506, 4507R, and 4510R Switch chassis as well as the Cisco Catalyst 4500 E-Series Chassis: Cisco Catalyst 4503-E, 4506-E, 4507R-E, 4507R+E, 4510R-E, and 4510R+E Switches.

### Predictable Performance and Scalability

The Cisco Catalyst 4500 Series Supervisor Engine V-10GE delivers a 136-Gbps switching fabric with a 102-mpps forwarding rate in hardware for Layer 2–4 traffic. Switching performance is independent of the number of route entries or Layer 3 and 4 services enabled. The hardware-based Cisco Express Forwarding routing architecture allows for increased scalability and performance. Two 10 Gigabit Ethernet ports are provided for high-speed uplinks and switch-to-switch communication. Table 1 provides a comparison of the performance and scalability features of all of the Cisco Catalyst 4500 enhanced Layer 3 supervisor engines.

**Table 1.** Cisco Catalyst 4500 Enhanced Layer 3 Supervisor Engine Performance and Scalability Features

Feature and Description	Cisco Catalyst 4000/4500 Supervisor Engine IV	Cisco Catalyst 4000/4500 Supervisor Engine V	Supervisor Engine V-10GE	Cisco Catalyst 4500 Series Supervisor Engine 6-E
<b>Total Centralized Switching Capacity</b>	64 Gbps	96 Gbps	102 mpps and 136 Gbps	320 Gbps
<b>Per Slot Switching Capacity</b>	6 Gbps	6 Gbps	6 Gbps	24 Gbps
<b>Throughput</b>	48 mpps	72 mpps	102 mpps	250 Mpps
<b>IP v4 Routing Entries</b>	128,000	128,000	128,000	256,000
<b>IP v6 Routing Entries</b>	1000	1000	1000	128,000
<b>Multicast Entries</b>	28,000 (Layer 3) 16,000 (Layer 2)	28,000 (Layer 3) 16,000 (Layer 2)	28,000 (Layer 3) 16,000 (Layer 2)	128,000 for IP v4 64,000 for IPv6. 16,000 (Layer 2) L2 Shared between IPv4/IPv6
<b>CPU</b>	333 MHz	400 Mhz	800 MHz	1.3 Ghz
<b>CPU Queues</b>	32	32	32	64
<b>Synchronous Dynamic RAM (SDRAM)</b>	512 MB	512 MB	512 MB	512 MB upgradeable to 1 GB
<b>NVRAM</b>	Yes (512 KB)	Yes (512 KB)	No via Bootflash (128 Mb)	No via Bootflash (64 MB)
<b>Security/QoS Entries</b>	64,000	64,000	64,000	128,000
<b>Network Admission Control/Dynamic Host Configuration Protocol (NAC/DHCP) Snooping Entries</b>	3000/3000	3000/3000	6000/6000	12,000/12,000
<b>Mac Addresses</b>	32,000	32,000	55,000	55,000
<b>Active Virtual LANs (VLANs)</b>	4000	4000	4000	4000
<b>Spanning Tree Protocol Instance</b>	10000	10000	10000	10000
<b>Switched Virtual Interfaces (SVIs)</b>	4000	4000	4000	4000
<b>SPAN</b>	2 ingress and 4 egress	2 ingress and 4 egress	2 ingress and 4 egress	Max of 8: ingress and /or egress
<b>Minimum Software Requirement</b>	Cisco IOS <sup>®</sup> Software Release 12.1(12c)EW or later	Cisco IOS Software Release 12.2(18)EW or later	Cisco IOS Software Release 12.2(25)EW or later	Cisco IOS Software Release 12.2(40)SG or later

The Cisco Catalyst 4500 Series is optimized for multimedia applications with its advanced multicast support. The Supervisor Engine V-10GE supports Protocol Independent Multicast (PIM), Source-Specific Multicast (S SM), and Pragmatic General Multicast (PGM), providing end users with additional scalability to support multimedia

applications. Also supported is IGMP snooping in hardware, enhancing performance and reducing network traffic by allowing a switch to dynamically add hosts to and remove hosts from a multicast group.

### Chassis and Line-Card Support

The Supervisor Engine V-10GE is backward-compatible with all classic Cisco Catalyst 4500 Series line cards and can be deployed in single-chassis, nonredundant mode in the Cisco Catalyst 4503, 4503-E, 4506, and 4506-E or in redundant mode as an option in the Cisco Catalyst 4507R, 4507R-E, 4510R, and 4510R-E chassis. (See Table 2.)

**Table 2.** Cisco Catalyst 4500 Series Supervisor Engine V-10GE Performance per Chassis

	Cisco Catalyst 4503/4503-E Chassis	Cisco Catalyst 4506/4506-E Chassis	Cisco Catalyst 4507R/4507R-E/4507R+E Chassis	Cisco Catalyst 4510R/4510R-E/4510R+E Chassis
<b>Supervisor Engine V-10GE (part number WS-X4516-10GE)</b>	Supported 72 Gbps and 54 mpps	Supported 108 Gbps and 81 mpps	Supported 108 Gbps and 81 mpps	Supported 136 Gbps and 102 mpps

**Note:** The Supervisor Engine V-10GE allows slot 10 on the Cisco Catalyst 4510R to accommodate any and all line cards. However, in a 4510R and 4510R-E only, if the option to simultaneously provision both 10 Gigabit Ethernet uplinks and four Gigabit SFP uplinks is enabled, then slot 10 becomes a flex slot.

### High Availability and Uplinks

The Cisco Catalyst 4500 Series was designed for nonstop communications with noninterrupted hardware switching. In addition to redundant power supplies, fans, and clock modules, the Cisco Catalyst 4510R, 4510R-E, 4507R, 4507R-E, and 4507R+E chassis support 1+1 supervisor redundancy. The primary supervisor is active and is responsible for normal system operation. The other supervisor serves as a secondary standby, monitoring the operation of the primary supervisor.

Alerts are generated to the network-monitoring software if either of the redundant supervisors fails. Hot-swapping of supervisor engines is supported and does not disrupt system operation. Switchover of supervisor engines can be forced by software, or by the user with Simple Network Management Protocol (SNMP). 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 supervisors to allow the standby supervisor to immediately take over in subsecond time if the primary fails. In-Service Software Upgrade (ISSU) allows customers 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 supervisors. It enables 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 versions.

NSF/SSO and ISSU dramatically improve the network reliability and availability in a Layer 2 or Layer 3 environment. NSF/SSO and ISSU are essential for business-critical applications such as voice over IP (VoIP). As a result, VoIP calls are not dropped.

Table 3 shows the high-availability and uplink options for all of the Cisco Catalyst 4500 enhanced Layer 3 supervisor engines.

**Table 3.** Cisco Catalyst 4500 Enhanced Layer 3 Supervisor Engines High Availability and Uplink Options

Feature and Description	Supervisor Engine IV	Supervisor Engine V	Supervisor Engine V-10GE	Supervisor Engine 6-E
<b>Redundant Capable</b>	Yes Cisco Catalyst 4507R or 4507R-E or 4507R+E	Yes Cisco Catalyst 4507R or 4507R-E or 4507R+E Cisco Catalyst 4510R or 4510R-E or 4510R+E	Yes Cisco Catalyst 4507R or 4507R-E or 4507R+E Cisco Catalyst 4510R or 4510R-E or 4510R+E	Yes Cisco Catalyst 4507R or 4507R-E or 4507R+E Cisco Catalyst 4510R or 4510R-E or 4510R+E
<b>Active Supervisor Uplinks in Redundant Mode</b>	2 Gigabit Ethernet	Up to 4 Gigabit Ethernet	Up to 4 Gigabit Ethernet and 2 10 Gigabit Ethernet*	Two 10 Gigabit Ethernet (wire-speed) or Four Gigabit Ethernet (Cisco Twin Gig Converter Module) or Four 10 Gigabit Ethernet (2:1 oversubscribed)* or Eight Gigabit Ethernet (Cisco Twin Gig Converter Module)*
<b>Active Supervisor Engine Uplinks (Nonredundant Mode)</b>	2 Gigabit Ethernet	2 Gigabit Ethernet	4 Gigabit Ethernet and 2 10 Gigabit Ethernet <sup>1</sup>	2 10 Gigabit or 1 10 Gigabit and 2 Gigabit (Cisco Twin Gig Converter Module) or 4 Gigabit (Cisco Twin Gig Converter Module)
<b>TwinGig Converter Support</b>	No	No	No	Yes
<b>Uplink Optic Types</b>	GBIC	GBIC	SFP (Gigabit Ethernet) or X2 optics (10 Gigabit Ethernet ports)	SFP (Gigabit Ethernet) with Twin Gig Converter or X2 optics (10 Gigabit Ethernet ports)
<b>SSO/NSF/ISSU</b>	Yes	Yes	Yes	Yes**

\* Simultaneous use of Gigabit Ethernet and 10 Gigabit Ethernet is supported in Cisco IOS Software Release 12.2(25) SG and later.

\*\* NSF/SSO and ISSU will be supported in a CY Q1 2008 Cisco IOS Software Release.

Please refer to the “Features at a Glance” section of this data sheet for a complete listing of supported features.

## IP v6 Support

The Internet Protocol Version 6 (IPv6) is important for the future of IP networking and is critical for the expansion of IP address space in the future. IPv6 capability is required by many companies and is being mandated by governments worldwide. IPv6 has been supported on the Cisco Catalyst 4500 Series Supervisor Engine V-10GE since Cisco IOS Software Release 12.2(20) EW with software-based forwarding. Please refer to the “Features at a Glance” section of this data sheet for a complete listing of supported features.

## Intelligent Network Services with QoS and Sophisticated Traffic Management

The Cisco Catalyst 4500 Series Supervisor Engine V-10GE offers superior per-port QoS features to help ensure that network traffic is classified, prioritized, and scheduled optimally to efficiently handle bandwidth-hungry multimedia, time-sensitive (voice), and mission-critical applications. The Supervisor Engine V-10GE 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-10GE also supports Dynamic Buffer Limiting (DBL), a congestion-avoidance feature. For details about the QoS features (including DBL) on the Supervisor Engine V-10GE, refer to the QoS on Cisco Catalyst 4500 Series Cisco IOS

Software-Based Supervisor Engines overview at [http://www.cisco.com/en/US/products/hw/switches/ps4324/prod\\_white\\_papers\\_list.html](http://www.cisco.com/en/US/products/hw/switches/ps4324/prod_white_papers_list.html).

Table 4 provides QoS feature highlights for all of the Cisco Catalyst 4500 enhanced Layer 3 supervisor engines.

**Table 4.** Cisco Catalyst 4500 Enhanced Layer 3 Supervisor Engine QoS Feature Summary

Feature and Description	Supervisor Engine IV	Supervisor Engine V	Supervisor Engine V-10GE	Supervisor Engine 6-E
<b>QoS Hardware Entries</b>	32,000	32,000	32,000	64,000
<b>Policers</b>	8,000 input 8,000 output	8,000 input 8,000 output	8,000 input 8,000 output	16,000 with flexible assignment for input/output
<b>Hierarchical Policers</b>	No	No	Yes. microflow policing with onboard NetFlow	Yes- 2 rate 3 color
<b>Number of Tx Queues</b>	4	4	4	Flex queues up to 8*
<b>Max Tx Queue Size</b>	1920 packets per tx queue	2336 packets per tx queue	2336 packets per tx queue	Dynamic: 56-8192 packets per queue depending on the number and type of line cards and the number of queues configured on the port. See documentation for more details
<b>Dynamic Queue Sizes</b>	No	No	No	Yes
<b>Configurable Classification Mapping Tables</b>	No	No	No	Yes
<b>Match IP on MAC Header</b>	No	No	No	Yes
<b>Modular QoS Compliant</b>	No	No	No	Yes
<b>DBL: Congestion-Avoidance Feature</b>	Yes	Yes	Yes	Yes
<b>QoS Sharing</b>	Support only on nonblocking Gigabit Ethernet ports	Supported on all ports	Supported on all ports	Supported on all ports
<b>Shaping</b>	Yes per tx queue	Yes per tx queue	Yes per tx queue	Yes per tx queue
<b>Broadcast Suppression</b>	Software**	Hardware for all ports	Hardware for all ports	Hardware for all ports
<b>Multicast Suppression</b>	No	Hardware for all ports	Hardware for all ports	Hardware for all ports

\* Supported in Q1 CY '08 Release.

\*\* Hardware performance for nonblocking Gigabit Ethernet ports and software performance for all other ports.

Please refer to the "Features at a Glance" section of this data sheet for a complete listing of supported features.

## Comprehensive Management

The Cisco Catalyst 4500 Series Supervisor Engine V-10GE 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 Cisco Catalyst solution is also supported, simplifying the configuration of the critical features for the Ethernet networks.

The Cisco Catalyst 4500 Series Supervisor Engine V-10GE 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. (See Table 5.)

**Table 5.** Cisco Catalyst 4500 Enhanced Layer 3 Supervisor Engines- Management Feature Highlights

Feature and Description	Supervisor Engine IV	Supervisor Engine V	Supervisor Engine V-10GE	Supervisor Engine 6-E
<b>USB Drive Support</b>	No	No	No	Yes: future software release
<b>Compact Flash Support</b>	Yes. 64 MB or 128 MB options	Yes. 64 MB or 128 MB options	Yes. 64 MB or 128 MB options	Yes. 64 MB or 128 MB options
<b>FAT File System Support</b>	No	No	No	Yes
<b>SPAN</b>	2 ingress and 4 egress	2 ingress and 4 egress	2 ingress and 4 egress	Max of 8: ingress and or 8

Please refer to the “Features at a Glance” section of this data sheet for a complete listing of supported features.

### Advanced Security

The Cisco Catalyst 4500 Series offers a rich set of industry-leading, integrated security features to proactively lock down your critical network infrastructure. It reduces network security risks with a rich set of Network Admission Control (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 Series 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 Version 1 and Version 2) Protocol, Secure Copy Protocol (SCP), and SNMPv3, respectively. (See Table 6.)

**Table 6.** Cisco Catalyst 4500 Enhanced Layer 3 Supervisor Engines: Security Feature Highlights

Feature and Description	Supervisor Engine IV	Supervisor Engine V	Supervisor Engine V-10GE	Supervisor Engine 6-E
<b>Security Entries</b>	32,000	32,000	32,000	64,000
<b>NAC/DHCP Snooping Entries</b>	3000/3000	3000/3000	6000/6000	12,000/12,000
<b>uRPF</b>	No	No	No	Yes in hardware
<b>Control Plane Policing</b>	No	No	Yes in hardware	Yes in hardware
<b>802.1X</b>	Yes	Yes	Yes	Yes
<b>802.1X Extensions</b>	Yes	Yes	Yes	Yes*
<b>IP Source Guard, Dynamic ARP Inspection, DHCP Snooping</b>	Yes	Yes	Yes	Yes
<b>Network Admission Control</b>	Yes	Yes	Yes	Yes*

\* This will be supported in a Q1 CY'08 Release.

Please refer to the “Features at a Glance” section of this data sheet for a complete listing of supported features.

### Netflow Services on the Supervisor Engine V-10GE

The Supervisor Engine V-10GE provides the highest level of NetFlow support among Cisco Catalyst 4500 supervisor engines with integrated, built-in NetFlow functions. The Supervisor Engine V-10GE supports additional NetFlow

features as well as delivering higher performance over the Cisco Catalyst 4500 NetFlow daughter-card offering. The Cisco Catalyst 4500 NetFlow daughter card is not required for the Supervisor Engine V-10GE to enable NetFlow services. (See Table 7.)

**Table 7.** Additional NetFlow Features Using the Supervisor Engine V-10GE

NetFlow Features	Supervisor Engine IV/V	Supervisor Engine V-10GE
Daughter Card	Required	Not required (integrated into supervisor)
Flow-Table Size	64,000	85,000
Aggregate Policers	1000 ingress; 1000 egress	8000 ingress; 8000 egress
User-Based Rate-Limiting Profiles	Not supported	512
User-Based Rate-Limiting Flows	Not supported	85,000

### NetFlow Services Product Description

NetFlow allows customers to monitor traffic flows and gather statistics for many applications such as usage-based billing, network-capacity planning, and security. Integrated NetFlow on the Supervisor Engine V-10GE supports per-packet capture for flow- and VLAN-based statistics. Detailed information of each flow (a stream of packets traveling in one direction from one endpoint to another across the network) is cached such as the IP address, packet and byte count, time stamp, and application port. This data is then exported, collected, and analyzed for numerous purposes such as virus and denial-of-service detection and mitigation, departmental billing, and traffic monitoring. All NetFlow processing on the Supervisor Engine V-10GE is performed in hardware without any performance degradation to Layer 2 and Layer 3 switching. More information about NetFlow technology is available at [http://www.cisco.com/en/US/products/ps6601/products\\_ios\\_protocol\\_group\\_home.html](http://www.cisco.com/en/US/products/ps6601/products_ios_protocol_group_home.html).

### NetFlow Service Features

NetFlow on the Supervisor Engine V-10GE is supported with Cisco IOS Software Release 12.2(25)EW or greater. NetFlow Data Export Versions 5 and 8 are supported. The supported fields within NetFlow Data Export Version 5 with Cisco IOS Software Release 12.2(25)EW follow:

- Source and destination IP address
- IP
- Layer 4 source and destination ports (for TCP/UDP or 0 otherwise)
- Start and end time stamps
- Packet and byte counters
- I/O interface
- Next-hop router
- Source and destination autonomous-system number
- Source and destination prefix mask
- VLAN statistics collection
- SNMP support for VLAN statistics
- NetFlow aggregation support (Version 8)

Cisco NetFlow Collection (NFC) and Cisco Network Data Analyzer (NDA) requirements:

- Cisco CNS NetFlow Collection Engine (NFC) Version 3.5 or higher
- Cisco NDA Version 3.6 or higher

## Features at a Glance

### Layer 2 Features

- Layer 2 hardware forwarding at 102 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 Plus (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 EtherChannel<sup>®</sup> technology, Cisco Fast EtherChannel technology, and Cisco Gigabit EtherChannel technology across line cards
- Port Aggregation Protocol (PAgP)
- Link Aggregation Control Protocol (LACP)
- Unidirectional link detection (UDLD) and aggressive UDLD
- 802.1-in-802.1 (QinQ) in hardware
- Layer 2 protocol tunneling
- Jumbo Frames (up to 9216 bytes)
- Baby Giants (up to 1600 bytes)
- Unidirectional Ethernet
- Forced 10/100 autonegotiation
- Web Content Communication Protocol (WCCP) Version 2 Layer 2 Redirect
- Private VLAN Promiscuous Trunk
- Match class of service (CoS) for non-IPv4 traffic
- Layer 2 Protocol Tunneling (L2PT) over trunk port
- Class of Service (CoS) mutation
- Per VLAN Control Traffic Intercept

### Layer 3 Features

- Hardware-based IP Cisco Express Forwarding routing at 102 mpps
- IGP routing protocols: EIGRP, OSPF, IS-IS, Routing Information Protocol (RIP), and RIP2
- Inter-VLAN routing
- BGP4 and Multicast Border Gateway Protocol (MBGP)
- BGP route-map Continue Support for Outbound Policy



- Unidirectional link routing (UDLR)
- Software-based GRE Tunneling
- Software routing of Internetwork Packet Exchange (IPX) and AppleTalk
- Full Internet Control Message Protocol (ICMP) support
- ICMP Router Discovery Protocol
- Policy-based routing (PBR)
- Unicast Virtual Route Forwarding lite (VRF-lite)
- DHCP Server
- DHCP option 82 with Circuit ID and Remote ID suboptions
- IP unnumbered for SVI
- SVI Autostate Exclude
- IGMP v1, v2, and v3
- IGMP snooping v1, v2, and v3
- IGMP filtering on access and trunk ports
- IP Multicast routing protocols: PIM (Sparse Mode and Dense Mode), SSM, and Distance Vector Multicast Routing Protocol (DVMRP)
- Pragmatic General Multicast (PGM)
- Cisco Group Membership Protocol (GMP) server
- Multicast Source Discovery Protocol (MSDP)
- Auto RP Listener (Multicast)

#### **Sophisticated QoS and Traffic Management**

- Per-port QoS configuration
- Per-port per VLAN QoS configuration
- Support for four queues per port
- Strict priority queuing
- IP differentiated services code point (DSCP)
- Classification and marking based on IP type of service (ToS) or DSCP
- Classification and marking based on full Layer 3 and Layer 4 headers
- Input and output policing based on Layer 3 and Layer 4 headers
- Microflow Policing
- Support for 8000 policers on ingress and 8000 policers on egress configured as aggregate or individual
- Shaping and sharing output queue management
- DBL: Congestion-avoidance feature
- No performance penalty for granular QoS functions
- Auto-QoS command-line interface (CLI) for VoIP deployments
- Selective DBL

#### **Predictable Performance**

- 136-Gbps switching fabric
- Layer 2 hardware forwarding at 102 mpps

- Layer 3 hardware-based IP Cisco Express Forwarding routing at 102 mpps
- Layer 4 TCP/User Datagram Protocol (UDP) hardware-based filtering at 102 mpps
- No performance penalty with advanced Layer 3 and Layer 4 services enabled
- Software-based learning at a sustained rate of 10,000 hosts per second
- Support for 55,000 unicast + 16,000 multicast MAC addresses
- Support for 131,072 entries in routing table (shared between unicast and multicast)
- Scalability to 4,000 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 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
- 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
- Show commands for granular monitoring and troubleshooting
- 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<sup>®</sup> 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
- Smartports macros
- NetFlow statistics
- Cisco Discovery Protocol v1, v2
- Network Timing Protocol
- Layer 2 traceroute
- Remote SPAN (RSPAN)
- Cisco Smartports macros
- SPAN ACL filtering
- Dynamic Host Configuration Protocol (DHCP) client autoconfiguration
- Enhanced SNMP MIB support
- MAC Address Notification

### **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, voice VLAN, 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 (PACLs)
- Private VLANs (PVLANS) on access and trunk ports
- DHCP snooping and Option 82 insertion and pass through
- Port security
- Sticky port security
- 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
- Community PVLAN
- HTTPS
- 802.1X Inaccessible Authentication Bypass
- MAC Authentication Bypass
- Control Plane Policing
- 802.1X Unidirectional Controlled Port
- Voice VLAN Sticky Port Security
- Secure Copy Protocol (SCP)
- EtherChannel Trunk Port security
- Storm control (formally known as broadcast and multicast suppression)
- IEEE 802.1X Multi Domain Authentication
- IP Source Guard for Static Hosts

**High Availability**

- Nonstop Forwarding with Stateful Switchover (NSF/SSO)
- In-Service Software Upgrade (ISSU)
- NSF awareness
- SSO in subsecond failover time
- Hot Standby Router Protocol (HSRP)
- SSO-Aware HSRP
- Virtual Router Redundancy Protocol (VRRP)
- Gateway Load Balancing Protocol (GLBP)
- OSPF fast convergence: incremental SPF and LSA throttling
- Cisco Generic Online Diagnostics (GOLD)

**IPv6 (Software Based Forwarding)**

- Packets are forwarded in software
- Support for IPv6 addressing
- Cisco Discovery Protocol for IPv6
- IPv6 DNS resolver for AAA over an IPv6 and IPv4 transport
- Extended ACL
- IPv6: Extended ACL
- IPv6: ICMP Rate Limiting
- IPv6: ICMPv6
- IPv6: ICMPv6 Redirect
- IPv6: IP MIB
- IPv6: IPv6 over IEEE 802.1Q
- IPv6: IPv6 over IPv4 GRE tunnel
- IPv6: ISATAP
- IPv6: Loopback
- IPv6: MLDv1/v2
- IPv6: MTU Path Discovery for IPv6
- IPv6: Multicast in IPv6 tunnel
- IPv6: OSPFv3
- 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 Access Control List (ACL)
- IPv6 Tunnels in software
- IPv6: Hop-by-Hop option header: done in software
- IPv6: RIP next generation for IPv6
- PIM v6 (Sparse Mode)

**Technical Specifications****Management**

- CiscoWorks LMS; includes CiscoWorks Resource Manager Essentials
- CiscoView
- 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-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 802.3af 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 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

### Supported Cisco Catalyst 4500 Classic Line Cards and Modules

- 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) (MT-RJ)
- WS-X4124-RJ45: Cisco Catalyst 4500 10/100 Module, 24 ports (RJ-45)
- 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 (RJ-21)
- WS-X4224-RJ45V: Cisco Catalyst 4500 PoE 803.3af 10/100, 24 ports (RJ-45)
- WS-X4248-RJ45V: Cisco Catalyst 4500 PoE 802.3af 10/100, 48 ports (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) module
- 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-X4506-GB-T: Cisco Catalyst 4500 Gigabit Ethernet Module, 6 ports 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 ports 1000BASE-X (optional SFPs)
- WS-X4424-GB-RJ45: Cisco Catalyst 4500 24-Port 10/100/1000 Module (RJ-45)
- WS-X4448-GB-RJ45: Cisco Catalyst 4500 48-Port 10/100/1000 Module (RJ-45)
- WS-X4548-GB-RJ45: Cisco Catalyst 4500 Enhanced 48-Port 10/100/1000 Module (RJ-45)
- WS-X4524-GB-RJ45V: Cisco Catalyst 4500 PoE 802.3af 10/100/1000, 24 ports (RJ-45)
- WS-X4548-GB-RJ45V: Cisco Catalyst 4500 PoE 802.3af 10/100/1000, 48 ports (RJ45)
- GLC-T: 1000BASE-T SFP
- GLC-SC-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) 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

#### 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-10GE is supported only in Cisco IOS Software and is not supported in the Cisco Catalyst Operating System Software. The minimum software versions are as follows:

Supervisor Engine V-10GE, Cisco IOS Software Release 12.2(25)EW or later

#### 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

### Regulatory Standards Compliance

Table 8 shows regulatory standards compliance, and Table 9 shows ordering information.

**Table 8.** Cisco Catalyst 4500 Series Supervisor Engine V-10GE Regulatory Standards Compliance

Specification	Standard
<b>Regulatory Compliance</b>	CE marking
<b>Safety</b>	<ul style="list-style-type: none"> <li>• UL 60950CAN/CSA-C22.2 No. 60950</li> <li>• EN 60950</li> <li>• IEC 60950</li> <li>• TS 001</li> <li>• AS/NZS 3260</li> </ul>
<b>EMC</b>	<ul style="list-style-type: none"> <li>• FCC Part 15 (CFR 47) Class A</li> <li>• ICES-003 Class A</li> <li>• EN55022 Class A</li> <li>• CISPR22 Class A</li> <li>• AS/NZS 3548 Class A</li> <li>• VCCI Class A</li> <li>• ETS 300 386</li> <li>• EN 55022</li> <li>• EN 55024</li> <li>• EN 61000-6-1</li> <li>• EN 50082-1</li> <li>• EN 61000-3-2</li> <li>• EN 61000-3-3</li> </ul>
<b>Industry EMC, Safety, and Environmental Standards</b>	<ul style="list-style-type: none"> <li>• GR-63-Core Network Equipment Building Systems (NEBS) Level 3</li> <li>• GR-1089-Core Level 3</li> <li>• ETS 300 019 Storage Class 1.1</li> <li>• ETS 300 019 Transportation Class 2.3 (pending)</li> <li>• ETS 300 019 Stationary Use Class 3.1</li> <li>• ETS 300 386</li> </ul>

**Table 9.** Ordering Information

Product Number	Description
<b>WS-X4516-10GE(=)</b>	Cisco Catalyst 4500 Series Supervisor Engine V-10GE, 2x10GE (X2) or 4X1GE (SFP), Console RJ-45
<b>WS-X4516-10GE/2</b>	Cisco Catalyst 4500 Redundant Supervisor Engine V-10GE, (2X10GE (X2) or 4X1GE (SFP), Console RJ-45
<b>S4KL3-12231EW</b>	Cisco IOS Software: Basic Layer 3 software image (RIP, static routes, IPX, AppleTalk)
<b>S4KL3K9-12231EW</b>	Cisco IOS Software: Basic Layer 3 software image, (RIP, static routes, IPX, AppleTalk, Triple Digital Encryption Standard [3DES])
<b>S4KL3E-12231EW</b>	Cisco IOS Software: Enhanced Layer 3 software image (OSPF, EIGRP, and IS-IS)
<b>S4KL3EK9-12231EW</b>	Cisco IOS Software: Enhanced Layer 3 software image (OSPF, EIGRP, IS-IS, and 3DES)
<b>MEM-C4K-FLD64M</b>	Cisco Catalyst 4500 Cisco IOS Software-Based Supervisor, Compact Flash memory, 64-MB option
<b>MEM-C4K-FLD128M</b>	Cisco Catalyst 4500 Cisco IOS Software-Based Supervisor, Compact Flash memory, 128-MB option

### Licensing

Use of BGP4 on the Supervisor Engine V-10GE requires a Cisco Interdomain Routing license. One Interdomain Routing license is required per chassis. (See Table 10.)



**Table 10.** Cisco Catalyst 4500 Routing License Ordering Information

Product Number	Description
FR-IRC4(=)	Cisco Catalyst Supervisor Engine IV, V, or V 10 Gigabit Ethernet Interdomain Routing feature license (BGP4)

## Warranty

Cisco Catalyst 4500 E-Series and Cisco Catalyst 4500 switches are covered by the Cisco Limited Lifetime Hardware Warranty. For more information, see this document on Cisco.com:

[http://www.cisco.com/en/US/docs/general/warranty/English/LH2DEN\\_.html](http://www.cisco.com/en/US/docs/general/warranty/English/LH2DEN_.html).

**Note:** If you purchased the Cisco Catalyst 4500 Series Supervisor Engine V-10GE before May 1, 2009, it is covered by the Cisco 90-Day Limited Hardware Warranty. For more information, see this document on Cisco.com:

[http://www.cisco.com/en/US/docs/general/warranty/English/901DEN\\_.html](http://www.cisco.com/en/US/docs/general/warranty/English/901DEN_.html).

## Cisco Technical Support Services

Cisco Technical Support Services (see Tables 11 and 12) 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<sup>®</sup> 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 Cisco Technical Assistance Center (TAC)
- Registered access to <http://www.cisco.com/>

**Table 11.** Technical Support Services: Components

Service Feature Overview	Benefit or Advantage
<b>Software Support</b>	Software support offers maintenance and minor and major updates for licensed feature sets. Downloading new maintenance releases, patches, or updates of Cisco IOS Software helps to enhance and extend the useful life of Cisco devices. Through major software updates, it is possible to extend the life of equipment and maximize application technology investments by: <ul style="list-style-type: none"> <li>• Adding new functions that, in many cases, require no additional hardware investment</li> <li>• Increasing the performance of current functions</li> <li>• Enhancing network or application availability, reliability, and stability</li> </ul>
<b>Cisco TAC Support</b>	With more than 1000 highly trained customer support engineers, 390 CCIE <sup>®</sup> experts, and access to 13,000 R&D engineers, Cisco TAC complements your in-house staff with a high level of knowledge in data, voice, and video communications networking technology. Its sophisticated call-routing system quickly routes calls to the correct technology personnel. The Cisco TAC is available 24 hours a day, 365 days a year.
<b>Cisco.com</b>	This award-winning Website provides 24-hour access to an extensive collection of online product and technology information, interactive network management and troubleshooting tools, and knowledge-transfer resources that can help customers reduce costs by increasing staff self-sufficiency and productivity.
<b>Advance Hardware Replacement</b>	Advance replacement and onsite field engineer options supply fast access to replacement hardware and field resources for installing hardware, minimizing the risk of potential network downtime.

**Table 12.** Technical Support Services: Competitive Differentiators

Service Feature Overview	Benefit or Advantage
<b>Worldwide Virtual Lab</b>	This extensive lab of Cisco equipment and Cisco IOS Software versions provides an invaluable engineering resource and knowledge base for training, product information, and recreation and testing of selected network issues to help decrease time to resolution.

Service Feature Overview	Benefit or Advantage
<b>Cisco TAC Training</b> <ul style="list-style-type: none"> <li>• Boot Camps</li> <li>• Tech Calls</li> <li>• Tech Forums</li> </ul>	Cisco is committed to providing customers the latest in technology support. These TAC training programs assist customers in case avoidance as well as provide knowledge transfer of Cisco networking expertise.
<b>Cisco Live</b>	A powerful suite of Internet-enabled tools with firewall-friendly features, these secure, encrypted Java applets can turn a simple phone call into an interactive collaboration session, allowing a customer and Cisco TAC support engineer to work together more effectively.
<b>Global Logistics</b>	This feature delivers award-winning, worldwide hardware-replacement support with 650 depots, covering 120 countries, at a \$2.3 billion investment in inventory, taking advantage of 10,000 onsite field engineers.
<b>Cisco IOS Software</b>	Cisco IOS Software employs 100 discrete technologies with more than 2000 features. Each year 400 new features are added. Cisco IOS Software is installed in more than 10 million devices and is running on more than 10,000 networks worldwide. It operates on the world's largest IPv6 and VoIP networks and in all major service provider networks worldwide.

### 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](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>.

For additional information about Cisco products, contact:

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



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