

Cisco Catalyst 4500E Supervisor Engine 8-E: Wired and Wireless Convergence

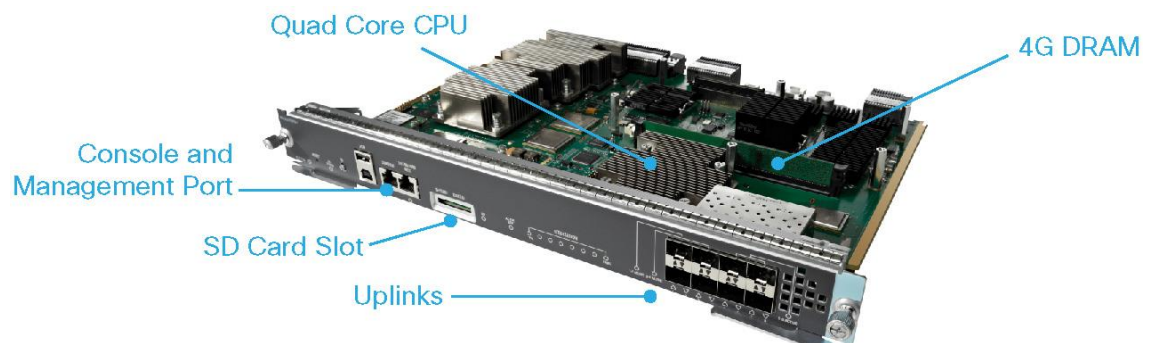
Overview

The Cisco Catalyst® 4500E Supervisor Engine 8-E (Figure 1) is the next generation of enterprise-class switching engine that provides full convergence between wired and wireless networks on a single platform. This new Cisco® Unified Access Data Plane (UADP) application-specific integrated circuit (ASIC) powers the wireless convergence and helps enable uniform wired-wireless policy enforcement, application visibility, flexibility, and application optimization.

The new Cisco Catalyst 4500E Supervisor Engine 8-E is an enterprise-class, access and aggregation supervisor engine designed to provide up to 928 Gbps of wired access per system with an E-Series chassis. The supervisor also supports up to 20 Gbps of wireless termination in a controller-less unified access deployment. Cisco Catalyst 4500E Supervisor Engine 8-E provides 48 Gbps per slot with Flexible NetFlow (FNF), integrated Wireshark, and advanced security, combined with reduced total cost of ownership (TCO) and excellent investment protection. These capabilities, along with eight 10 Gigabit Ethernet uplinks and 10/100/1000 Power over Ethernet (PoE), PoE Plus (PoEP), and Cisco Universal PoE (UPoE) ports, make this supervisor engine the leading Cisco Unified Access supervisor engine in the Cisco Catalyst Family. Supervisor Engine 8-E is built with price-performance aggregation deployments in mind, helping to enable denser Gigabit Ethernet and 10 Gigabit Ethernet fiber deployments with enterprise-class aggregation functions. Supervisor Engine 8-E facilitates user experiences for enterprise, public sector, mid-market, and commercial customer business-critical applications.

Cisco leadership in Borderless Networks is extended with important features - hardware readiness for Unified Access, Cisco TrustSec®, medianet, Flexible NetFlow, Cisco EnergyWise™, Cisco Powered Workspace, and many other feature enhancements offered by the Cisco Catalyst 4500E Supervisor Engine 8-E. Backward and forward compatibility with most existing Cisco Catalyst 4500 and 4500E line cards, and power supplies helps assure deeper customer satisfaction with an industry-leading investment protection architecture. Cisco Catalyst Supervisor Engine 8-E is supported in Cisco Catalyst 4500 E-Series chassis only.

Figure 1. Cisco Catalyst 4500E Supervisor Engine 8-E



Cisco Catalyst 4500E Supervisor Engine 8-E Feature Highlights

The Cisco Catalyst 4500E Supervisor Engine 8-E is the first Cisco Catalyst supervisor engine to bring wired and wireless convergence to a single platform. In addition, the enterprise-class Cisco Catalyst 4500E Supervisor Engine 8-E offers the following:

- Performance and capability
 - Up to 928 Gbps wired switching capacity with 250 Mpps of throughput
 - Up to 20 Gigabits of wireless termination capacity for a wireless controller-less design. Support for up to 50 access points and 2000 wireless clients on each switching entity (software roadmap)
 - Support of 250 access points and 4000 wireless clients in wireless controller-less deployments with multiple Catalyst 4500E systems forming a wireless domain (software roadmap)
 - Up to eight nonblocking 10 Gigabit Ethernet uplinks (Small Form-Factor Pluggable Plus [SFP+])
 - SFP support on uplinks to offer flexibility for up to eight Gigabit Ethernet ports
 - 384 ports of nonblocking 10/100/1000
 - Power over Ethernet Plus (PoE+; 30 W) capabilities on all ports in a line card simultaneously
 - Cisco Universal PoE (UPOE; 60 W) capabilities on all line card slots
 - Energy Efficient Ethernet (IEEE 802.3az)
 - 200 ports of nonblocking Gigabit Ethernet SFP (eight uplinks ports plus 192 line card ports)
 - 104 ports of 10 Gigabit Ethernet SFP+ (eight uplinks ports plus 96 line card ports)
 - Up to 128,000 Flexible Netflow (FNF) entries in hardware
 - Secure Digital (SD) card support for flexible storage options
 - 256,000 routing entries for high-end campus access and aggregation deployments
 - IPv6 support in hardware, providing wire-rate forwarding for IPv6 networks
 - Dual stack support for IPv4/IPv6 and Dynamic hardware forwarding-table allocations for ease of IPv4-to-IPv6 migration
 - Scalable routing (IPv4, IPv6, and multicast) tables and Layer 2 tables.
 - Scalable and dynamic allocation of access-control-list (ACL) and quality-of-service (QoS) entries to use eight queues per port and comprehensive security policies per port
- Infrastructure services
 - Cisco IOS® XE Software, the modular open application platform for virtualized borderless services
 - Maximum resiliency with redundant components, Nonstop Forwarding/Stateful Switchover (NSF/SSO), and Cisco In-Service Software Upgrade (ISSU) support
 - Network virtualization through Multi-Virtual Route Forwarding (VRF) and Easy Virtual Networking (EVN) technology for Layer 3 segmentation
 - Virtual Switching System (VSS) for simplified loop-free topologies without Spanning Tree dependencies. (software roadmap)
 - Flexible and future proofed uplinks with Field Programmable Gate Array (FPGA) to support next-generation protocols
 - Automation through Embedded Event Manager (EEM), Cisco Smart Call Home, AutoQoS, and Auto SmartPorts for fast provisioning, diagnosis, and reporting

- Cisco Services
 - Optimized application performance through deep visibility with FNF, supporting rich Layer 2, 3, and 4 information (MAC, VLAN, and TCP Flags) and synthetic traffic generation with IP service-level agreement (IP SLA-VO)
 - Medianet capabilities to enhance and simplify video QoS, monitoring, and security
 - Energy-efficient design with Cisco EnergyWise technology to manage network, PoE+, Personal Computers and Laptops
- Investment protection and reduced total cost of ownership (TCO)
 - Full backward compatibility with 6-, 24-, and 48-Gbps slot line cards with no performance degradation
 - The Supervisor Engine 8-E is compatible with classic Cisco Catalyst 4500 line cards and power supplies, providing full investment protection. It is not compatible with the classic Cisco Catalyst 4500 chassis. When you deploy the Supervisor Engine 8-E with classic line cards, all of the new features except the 24- and 48-Gbps per-slot switching capacity are inherited

Predictable Performance and Scalability

Table 1 highlights the performance and scalability enhancements of the Cisco Catalyst 4500E Supervisor Engine 8-E.

Table 1. Cisco Catalyst 4500E Supervisor Engine 8-E Performance and Scalability Features

Features	Performance and Scalability
Centralized Wired Switching Capacity	Up to 928 Gbps
Wireless Termination Capacity	Up to 20 Gbps (software Roadmap)
Per-slot Switching Capacity	48 Gbps
Throughput	<ul style="list-style-type: none"> • 250 Mpps for IPv4 • 125 Mpps for IPv6
IPv4 Routing Entries	256,000
IPv6 Routing Entries	128,000
Multicast Routes	32,000
CPU	Quad core; 2.0 GHz
CPU Queues	64
Synchronous Dynamic RAM (SDRAM)	4 GB
Nonvolatile RAM (NVRAM)	2 GB
Security and QoS Hardware Entries	128,000
Dynamic Host Configuration Protocol (DHCP) Snooping Entries	12,000
MAC Addresses	55,000
Active VLANs	4094
Address Resolution Protocol (ARP) Entries	47,000
Spanning Tree Protocol Instances	10,000
Switched Virtual Interfaces (SVIs)	4094
Switched Port Analyzer (SPAN)	Maximum of 8 bi-directional sessions

The Supervisor Engine 8-E is also optimized for multimedia applications, with its advanced multicast support offered by features such as Protocol Independent Multicast (PIM) and Source-Specific Multicast (SSM). This functionality gives your network additional scalability to support multimedia applications.

Converged Wired plus Wireless Access

The Supervisor Engine 8-E is the first Cisco Catalyst supervisor engine that enables wired plus wireless services on a single Cisco IOS XE Software-based platform. With this functionality, Cisco has pioneered a host of rich capabilities such as high availability based on stateful switchover (SSO), granular QoS, security, and Flexible Netflow (FNF) across wired and wireless networks in a seamless fashion. Also, the wired plus wireless features are bundled into a single Cisco IOS Software image, which reduces the number of software images that users have to qualify or certify before implementing them in their network. The single console port for command-line interface (CLI) management reduces the number of touch points to manage for wired plus wireless services. This reduces network complexity, simplifies network operations, and lowers TCO to manage the infrastructure.

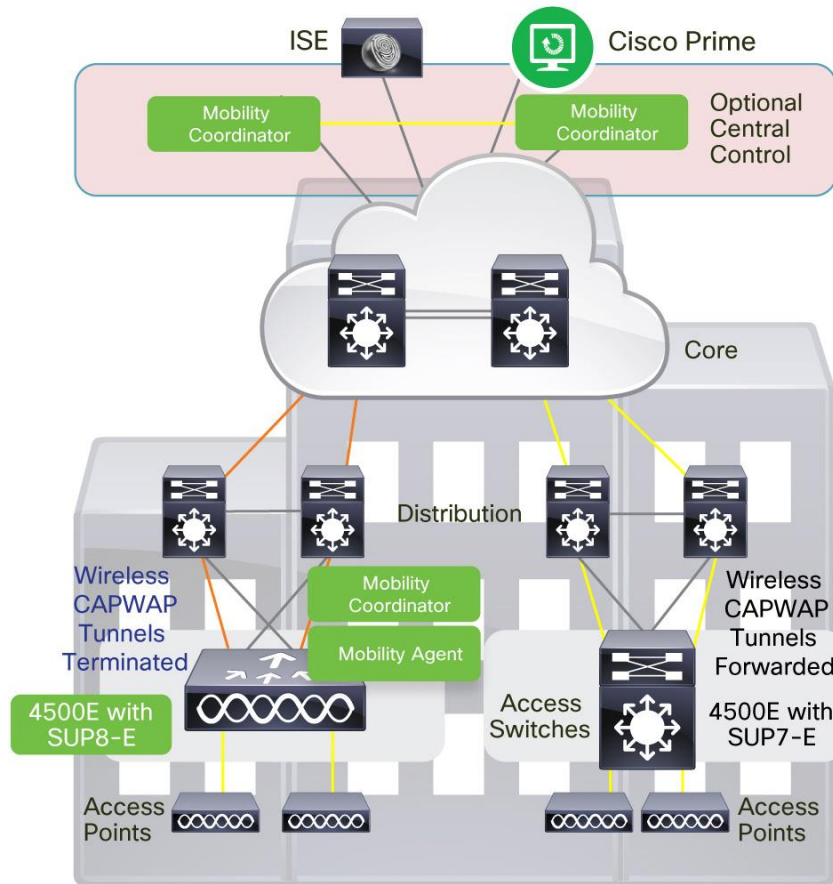
Converged wired plus wireless not only improves wireless bandwidth across the network but also the scale of wireless deployment. A Supervisor Engine 8-E-enabled Catalyst 4500E provides up to 20 Gbps of wireless throughput. This wireless capacity increases with the number of additional Catalyst 4500E members in the wireless domain. This ability helps ensure that the network can scale with current wireless bandwidth requirements, as dictated by IEEE 802.11n-based access points and with future wireless standards such as IEEE 802.11ac. Additionally, the Supervisor Engine 8-E distributes the wireless controller functions to achieve better scalability. With Supervisor Engine 8-E each Cisco Catalyst 4500E switch can operate as the wireless controller in two modes. They include:

Mobility agent (MA) - In this mode the switch is capable of terminating the Control and Provisioning of Wireless Access Points protocol (CAPWAP) tunnels from the access points and providing wireless connectivity to wireless clients. Maintaining wireless client databases, and configuring and enforcing security and QoS policies for wireless clients and access points can be enforced in this mode. No additional license on top of IP Base is required to operate in the mobility agent mode.

Mobility controller (MC) - In this mode, the switch performs all the mobility agent tasks in addition to mobility coordination, radio resource management (RRM), and Cisco CleanAir[®] coordination within a mobility subdomain. The mobility controller mode can be enabled on the switch CLI. IP Base or Enterprise Image license level is required when the switch is acting as the mobility controller. A centrally located Cisco 5508 Wireless Controller, Cisco Wireless Services Module 2 (WiSM2) (when running AireOS Version 7.3 or higher), and Cisco 5760 Wireless LAN Controller can also perform this role for larger deployments.

With mobility agents located in the wiring closets providing 20 Gbps of wireless per switch and mobility controllers managing some of the central wireless functions, the converged access-based wireless deployment provides best-in-class scalability for wireless and significantly improved wireless throughput.

Figure 2. Unified Access with Cisco Catalyst 4500E Supervisor Engine 8-E



Best-in-Class Resiliency

The Cisco Catalyst 4500E Series is designed for excellent nonstop communications with noninterrupted hardware switching. With Cisco IO XE Software, customers continue to reap the benefit of this best-in-class resiliency in various ways.

ISSU allows you to upgrade or downgrade complete Cisco IOS Software images with minimal (less than 200 msec) to no disruption to the network when using a redundant Cisco Catalyst 4500E Series system with dual Supervisor Engines 8-E. Facilitating rapid, non-disruptive software upgrades 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 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 engine fails.

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). These features help ensure that VoIP calls are not dropped.

In addition to redundant power supplies, fans, and clock modules, the Cisco Catalyst 4510R+E, 4507R+E, 4510R-E, and 4507R-E chassis models support 1 + 1 supervisor-engine redundancy, using the Supervisor Engine 8-E. The primary supervisor engine is active and is responsible for normal system operation. The secondary supervisor engine serves as a standby, monitoring the operation of the primary supervisor engine. The resiliency features of the Cisco Catalyst 4500E prevent network outages that could result in lost business and revenue.

Apart from the features previously mentioned, Supervisor Engine 8-E has resiliency built into its uplinks. Table 2 shows the uplink options and associated bandwidth allocation on Supervisor Engine 8-E.

Table 2. High-Availability, Uplink and Wireless Options for Supervisor Engine 8-E

Supervisor Configurations	Uplink Ports	Wireless Termination (Software Roadmap)	Linecard/Chassis Considerations	Notes
Single Supervisor	4x10 GE	-	10 Slot Chassis: None	Feature Roadmap ¹
			3,6 and 7 Slot Chassis: None	
Single Supervisor	4x10 GE	20GE	10 Slot Chassis: Last Slot Restricted to 47XX linecards	Wireless Roadmap ²
			3,6 and 7 Slot Chassis: None	
Single Supervisor	8x10 GE	-	10 Slot Chassis: Last Slot Restricted to 47XX linecards	Supported
			3,6 and 7 Slot Chassis: None	
Single Supervisor	8x10 GE	20GE	10 Slot Chassis: Mode Disabled (Wireless Disable)	Wireless Roadmap ²
			3,6 and 7 Slot Chassis: No Restriction	
Dual Supervisor	Active Supervisor: 2x10GE	-	10 Slot Chassis: None	Feature Roadmap ¹
	Standby Supervisor: 2x10GE		7 Slot Chassis: None	
Dual Supervisor	Active Supervisor: 2x10GE	20GE	10 Slot Chassis: Last Slot Restricted to 47XX linecards	Wireless Roadmap ²
	Standby Supervisor: 2x10GE		7 Slot Chassis: None	
Dual Supervisor	Active Supervisor: 4x10GE	-	10 Slot Chassis: Last Slot Restricted to 47XX linecards	Supported
	Standby Supervisor: 4x10GE		7 Slot Chassis: No Restriction	
Dual Supervisor	Active Supervisor: 4x10GE	20GE	10 Slot Chassis: Mode Disabled (Wireless Disable)	Wireless Roadmap ²
	Standby Supervisor: 4x10GE		7 Slot Chassis: None	

¹ Applicable for Uplink Ports

² Applicable for Wireless Termination

Simplified Operations through Automation

As campus switching has grown to support increasing enterprise demands, so has the need to deploy and manage new and evolving technologies. Simplified operations are critical in meeting these challenges and achieving increased operational efficiency through proactive management and reduction in unplanned network downtime.

The Cisco Catalyst Supervisor Engine 8-E offers the following rich set of capabilities for simplified operations:

- Auto-Install and AutoQoS for fast deployment
- Config rollback for improved configuration management
- EEM, Smart Call Home, Generic On-Line Diagnostics (GOLD), and Time Domain Reflectometry (TDR) for simplified operations
- FNF and IP SLA for enhanced visibility

- Cisco EnergyWise technology for simplified power management
- ISSU for simplified change management

Comprehensive Security with Cisco TrustSec

The Cisco Catalyst 4500E Supervisor Engine 8-E is a validated component of the Cisco TrustSec® 2.1 architecture. This allows the Supervisor Engine 8-E to be transparently integrated into campus switching environments for a comprehensive security solution based on Cisco TrustSec. The Supervisor Engine 8-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 8-E helps enable 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 Supervisor Engine 8-E currently contains 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 into network access. The identity features provide integrated support for IP telephony. It also provides for flexible authorization policies with virtual LAN (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.
- **Network device authentication** - Cisco TrustSec network device authentication provides for an authenticated network infrastructure, minimizing the risk of rogue access to the network using unauthorized network devices.
- **Data confidentiality and integrity** - The Supervisor Engine 8-E supports line-rate 10 G MACsec encryption based on IEEE 802.1ae with no additional latency. It supports both switch-to-switch and host-to-switch hardware-based encryption on all uplink ports and all WS-X47xx series line cards. For more information, visit http://www.cisco.com/en/US/docs/switches/lan/catalyst4500/15.1/XE_330SG/configuration/guide/swmacsec.html.
- **Role-based access control** - The Supervisor Engine 8-E has hardware support for Cisco TrustSec Secure Group Access (SGA). TrustSec SGA simplifies access control security by defining it in terms of user roles instead of topology-based IP ACLs. The Supervisor Engine 8-E has hardware support for secure group tagging (SGT) for classifying traffic from users based on roles, as well as SGA control lists (SGACLs), which are role-based ACLs to apply access control to traffic with the SGT. For more information, visit: <http://www.cisco.com/go/trustsec>
<http://www.cisco.com/en/US/docs/switches/lan/trustsec/configuration/guide/config.html>
http://www.cisco.com/en/US/netsol/ns744/networking_solutions_program_home.html

Optimized Application Visibility with Flexible NetFlow

Cisco IOS Flexible NetFlow is the next generation in flow technology, allowing optimization of the network infrastructure, reducing operation costs, and improving capacity planning and security incident detection with increased flexibility and scalability. The Supervisor Engine 8-E is the first Cisco Catalyst supervisor engine to provide optimized application visibility with FNF with a capability of 128,000 FNF entries. The Supervisor Engine 8-E, with a custom-built ASIC, delivers next-generation flow technology with superior flexibility and comprehensive visibility extending from Layer 2 (MAC and VLAN) to Layer 4 (TCP, User Datagram Protocol [UDP] flags, etc).

The flow data collected by FNF can be exported to an external collector for analysis and reporting, or tracked by the EEM. The Cisco Catalyst 4500E Supervisor Engine 8-E can enable powerful, on-box, and customizable event correlation and policy actions with EEM, allowing the switches to trigger customized event alarms or policy actions when the predefined condition is met. With no external appliance required, customers are able to use existing infrastructure to perform traffic monitoring, making traffic analysis economical even on a large IP network.

Details about Cisco Flexible NetFlow are available at

http://www.cisco.com/en/US/prod/collateral/iosswrel/ps6537/ps6555/ps6601/ps6965/product_data_sheet0900aecd804b590b.html.

The Cisco Catalyst 4500E Series Switches with the Supervisor 8-E offer built in Wireshark. With this capability the user has the ability to capture control and data packets traversing through the system. The user has the option to display the captured packets on the screen using CLI commands or view them on a traditional Wireshark GUI installed on a standalone processing machine by moving the PCAP files from an SD card. With the introduction of quad-core CPU on Cisco Catalyst 4500E Supervisor Engine 8-E, Wireshark capture performance is greatly enhanced from earlier generations of supervisors and is ideal for proactive debugging in today's networking deployments. The analyzer can be used in conjunction with Flexible Netflow and Embedded Event Manager to start packet capture in response to selected networked conditions such as SYN flood attack or higher usage of bandwidth by a user.

Modular Open Application Platform - Cisco IOS XE Software

Cisco IOS XE Software is the next-generation operating system for Cisco Catalyst 4500E Supervisor Engines, beginning with the Supervisor 8-E. Cisco continues to evolve Cisco IOS Software to support next-generation switching hardware and provide increased architectural flexibility to deliver quick adoption of future Cisco Borderless Networks services, while increasing customer investment protection in Cisco IOS Software.

Cisco IOS XE Software provides the following customer benefits:

- Cisco IOS XE Software provides a modern operating system that can take advantage of the multicore CPU architecture of the next-generation Cisco Catalyst 4500E system with Supervisor 8-E.
- Cisco IOS XE Software promotes customer investment protection in existing Cisco IOS Software. With Cisco IOS XE Software, existing Cisco IOS Software becomes a "Cisco IOS Software package" with a consistent feature set and similar operational user interface allowing a transparent migration experience.

- Cisco IOS XE Software supports service virtualization capabilities that allows the Cisco Catalyst 4500E to host applications other than Cisco IOS Software, such as customer-written applications or third-party applications in parallel with Cisco IOS Software. The hosted application can communicate with Cisco IOS Software to use its rich feature sets. This benefit allows a customer to quickly adopt new technologies using proven code, while keeping Cisco IOS Software simple and robust. Cisco IOS XE Software helps enable the Cisco Catalyst 4500E to be an open service platform and is a primary anchor to support future Cisco Borderless Networks innovations.

IPv6 Support

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. The Cisco Catalyst 4500 Supervisor Engine 8-E supports IPv6 Unicast and Multicast in hardware for full line-rate forwarding performance of up to 125 Mpps. The Supervisor Engine 8-E also dynamically allocates hardware table space between IPv4 and IPv6 routes to increase table-space usage for optimal IPv4-to-IPv6 migration. The Supervisor Engine 8-E supports Multicast Listener Discovery (MLD) snooping for IPv6, enhancing performance and reducing network traffic by allowing a switch to dynamically add and remove hosts from a multicast group.

Table 3 highlights the IPv6 capabilities of the Supervisor Engine 8-E.

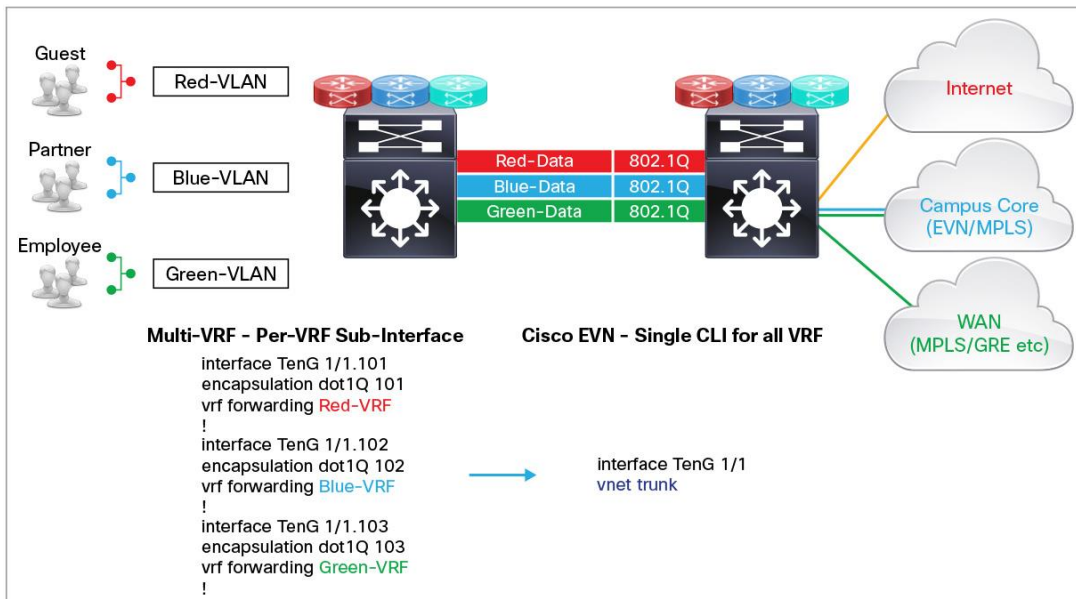
Table 3. Summary of Supervisor Engine 8-E IPv6 Capabilities

Feature and Description	Capabilities
IPv6 Support	Unicast and Multicast forwarding done in hardware
IPv6 Performance	125 Mpps
IPv6 Routing Entries	128,000
Dynamic Hardware Route Table Allocations	Yes
MLD Snooping for IPv6	Yes, in hardware
Unicast Reverse Path Forwarding Version 6 (URPFv6): Strict Mode	Yes, in hardware

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; and more. 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 increases scalability with the Cisco campus end-to-end Easy Virtual Network (EVN) technology (see Figure 3).

Figure 3. Simplified Campus Network Virtualization with Cisco EVN



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

- **Simplification** - To simplify campus virtual-network solutions, 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 helps enable 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.
- **Scalability** - Cisco EVN promotes flexibility to scale up to 32 virtual network solutions; operationally it offers four times the virtual-network scalability capacity over Multi-VRF technology.
- **Interoperability** - 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.

Investment Protection with Chassis and Line-Card Support

Previously installed Cisco Catalyst 4500E chassis with classic and E-Series line cards can take advantage of the new features and functions of the Supervisor Engine 8-E on all ports with a simple supervisor engine upgrade. However, to take advantage of the increased switching capacity of 48 Gbps per slot, the Cisco Catalyst 4500E Series chassis (including R+E chassis) and the select new E-Series line cards are required. You can mix and match Cisco Catalyst 4500E Series line cards and classic line cards in an E-Series chassis with no performance degradation to either line card type. Table 4 shows the supervisor engine and line card slot assignment options in the Cisco Catalyst 4500E Series chassis.

Table 4. Cisco Catalyst 4500E Chassis Slot-Assignment Options

Chassis	Single Supervisor Engine 8-E Slot Assignments	Redundant Supervisor Engine 8-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 4510R+E	Slots 5 or 6	Slots 5 or 6	Slots 1 to 4, and 7 to 10	Slots 1 to 4, and 7 to 10
Cisco Catalyst 4507R-E (Software Roadmap)	Slot 3 or 4	Slots 3 or 4	Slots 1, 2, and 5 to 7	Slots 1, 2, and 5 to 7
Cisco Catalyst 4510R-E (Software Roadmap)	Slots 5 or 6	Slots 5 or 6	Slots 1 to 4, and 7 to 10	Slots 1 to 4, and 7 to 10

Table 5 summarizes the performance capacities of the Supervisor Engine 8-E on a per-chassis basis.

Table 5. Cisco Catalyst 4500 Supervisor Engine 8-E Bandwidth per Slot for different Chassis

	Cisco Catalyst 4503-E Chassis	Cisco Catalyst 4506-E Chassis	Cisco Catalyst 4507R+E Chassis	Cisco Catalyst 4510R+E Chassis	Cisco Catalyst 4507R-E Chassis	Cisco Catalyst 4510R-E Chassis
Supervisor Engine 8-E (WS-X45-Sup8-E)	48 Gbps per slot	48 Gbps per slot	48 Gbps per slot	48 Gbps per slot	24 Gbps per slot (software roadmap)	24 Gbps per slot (software roadmap)

Features at a Glance

Cisco IOS XE Software LAN Base: This feature set on the Supervisor 8-E-based bundles provides Layer 2 features for access.

Cisco IOS XE Software IP Base: This feature set is upgradable with a software activation license (SAL). It includes all Layer 2 features and some basic Layer 3 features. ISSU/SSO is supported in this package.

Cisco IOS XE Software Enterprise Services: This feature set is upgradable with a SAL; it supports full Layer 3 protocols and advanced features such as complete routing scalability (256,000), BGP, VRF, Policy-Based Routing (PBR), and so on.

These features can be enabled using the software-licensing mechanism. For details about software licensing, refer to the “Licensing” section later in this document or visit <http://www.cisco.com/go/sa>.

Industry Standards

- Ethernet: IEEE 802.3
- 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 802.3ad LACP
- IEEE 802.1p CoS Prioritization
- IEEE 802.1Q VLAN
- IEEE 802.1X User Authentication
- RMON I and II standards

Supported Cisco Catalyst 4500E Series Line Cards and Modules

- WS-X4748-12X48U+E: Cisco Catalyst 4500E Series 48-Port (RJ-45) Line Card with 12 Multigigabit Ports and 36 10/100/1000 Ports with 802.3af PoE, 802.3at PoEP, and UPOE
- WS-X4748-UPOE+E: Cisco Catalyst 4500E Series, 48-port 802.3af PoE, 802.3at PoEP, and UPOE 10/100/1000
- WS-X4748-RJ45-E: Cisco Catalyst 4500E Series, 48-port 10/100/1000 (RJ-45)
- WS-X4748-RJ45V+E: Cisco Catalyst 4500E Series, 48-port PoE 802.3at 10/100/1000 (RJ-45)
- WS-X4712-SFP+E: Cisco Catalyst 4500E Series, 12-port 10 Gigabit Ethernet (SFP+)
- WS-X4748-SFP-E: Cisco Catalyst 4500E Series, 48 port Gigabit Ethernet Fiber Line Card
- WS-X4724-SFP-E: Cisco Catalyst 4500E Series, 24 port Gigabit Ethernet Fiber Line Card
- WS-X4712-SFP-E: Cisco Catalyst 4500E Series, 12 port Gigabit Ethernet Fiber Line Card
- WS-X4648-RJ45V-E: Cisco Catalyst 4500E Series, 48-port 802.3af PoE 10/100/1000 (RJ-45)
- WS-X4648-RJ45V+E: Cisco Catalyst 4500E Series, 48-port Premium PoE 10/100/1000 (RJ-45)
- WS-X4648-RJ45-E: Cisco Catalyst 4500E Series, 48-port 10/100/1000 (RJ-45)
- WS-X4640-CSFP-E: Cisco catalyst 4500E Series, 40- and 80-port SFP/CSFP Gigabit Ethernet line card
- WS-X4606-X2-E: Cisco Catalyst 4500E Series, 6-port 10 Gigabit Ethernet (X2)
- WS-X4624-SFP-E: Cisco Catalyst 4500E Series, 24-port Gigabit Ethernet (SFP)
- WS-X4612-SFP-E: Cisco Catalyst 4500E Series 12-port Gigabit Ethernet (SFP)
- CVR-X2-SFP: Twin gigabit converter module

Supported Cisco Catalyst 4500 Classic Line Cards and Modules

- WS-X4148-FX-MT: Cisco Catalyst 4500 Fast Ethernet Switching Module, 48-port 100BASE-FX multimode fiber (MMF)
- WS-X4148-RJ: Cisco Catalyst 4500 10/100 Module, 48 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-X4306-GB: Cisco Catalyst 4500 Gigabit Ethernet Module, 6 ports (GBIC)

- WS-X4448-GB-SFP: Cisco Catalyst 4500 Gigabit Ethernet Module, 48 ports 1000BASE-X (optional SFPs)
- WS-X4548-GB-RJ45: Cisco Catalyst 4500 Enhanced 48-Port 10/100/1000 Module (RJ-45)
- WS-X4548-GB-RJ45V: Cisco Catalyst 4500 PoE 802.3af 10/100/1000, 48 ports (RJ-45)
- WS-X4548-RJ45V+: Catalyst 4500 PoE+ Ready 10/100/1000, 48 ports (RJ-45)

Supported Pluggables

For details about the different optical modules and the minimum Cisco IOS Software release required for each of the supported optical modules, visit:

http://www.cisco.com/en/US/products/hw/modules/ps5455/products_device_support_tables_list.html.

Software Requirements

The Cisco Catalyst 4500E Series Supervisor Engine 8-E is supported only in Cisco IOS Software and is not supported in the Cisco Catalyst Operating System Software. The minimum software version is:

- Supervisor Engine 8-E, Cisco IOS XE Software Release IOS XE 3.3.0XO

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 3000 m

Power and Mean Time between Failure (MTBF) Information

Active supervisor power: 400W

Standby supervisor power: 265W

This result is not indicative of the actual power draw during operation. It is the absolute maximum value recommended for facility power and cooling capacity planning. Typical power draw is about 20 percent lower than the maximum value shown.

MTBF: 309,906 hours

Regulatory Standards Compliance

Table 6 shows regulatory standards compliance information, and Table 7 provides ordering information.

Table 6. Cisco Catalyst 4500 Supervisor Engine 8-E Regulatory Standards Compliance

Specification	Standard
Safety	<ul style="list-style-type: none"> • UL 60950-1 Second Edition • CAN/CSA-C22.2 No. 60950-1 Second Edition • EN 60950-1 Second Edition • IEC 60950-1 Second Edition • AS/NZS 60950-1
EMC	<ul style="list-style-type: none"> • 47CFR Part 15 (CFR 47) Class A • AS/NZS CISPR22 Class A • CISPR22 Class A • EN55022 Class A • ICES003 Class A • VCCI Class A

Specification	Standard
	<ul style="list-style-type: none"> • EN61000-3-2 • EN61000-3-3 • EN55024 • CISPR24 • EN300386
ROHS Compliance	<ul style="list-style-type: none"> • ROHS5

Table 7. Ordering Information

Product Number	Description
WS-X45-SUP8-E	Cisco Catalyst 4500E Series Unified Access Supervisor, 928 Gbps
WS-C4510RE-S8+96V+	4510R+E Chassis, two WS-X4748-RJ-45V+E, Supervisor 8-E
S845EU-33-1511XO	Cisco Catalyst 4500 Supervisor Engine 8-E Cisco IOS® XE Software Release 3.3.0XO noncrypto universal
S845EUK9-33-1511XO	Cisco Catalyst 4500 Supervisor Engine 8-E Cisco IOS XE Software Release 3.3.0XO crypto universal
S845EULPE-33-1511XO	Cisco Catalyst 4500 Supervisor Engine 8-E Cisco IOS XE Software Release 3.3.0XO universal LPE image
C4500E-LB	LAN BASE software license
C4500E-IPB	IP BASE software license
C4500E-LIC=	Base product ID for paper delivered software upgrade licenses
C4500E-LB-IPB	LAN BASE to IP BASE upgrade license (paper delivery)
C4500E-LB-ES	LAN BASE to Enterprise Services upgrade license (paper delivery)
C4500E-IP-ES	IP BASE to Enterprise Services upgrade license (paper delivery)
C4500E-LIC-PAK	Base product ID for paper delivered software licenses for spare Supervisor Engine 8-E
C4500E-IP-ES-S	IP BASE to Enterprise Services upgrade license for spare Supervisor Engine 8-E (paper delivery)
C4500E-IPB-S	IP BASE software license for spare Supervisor Engine 8-E (paper delivery)
L-C4500-LIC=	Base product ID for electronically delivered software upgrade licenses
L-C4500E-LB-IP	LAN BASE to IP BASE upgrade license (electronically delivered)
L-C4500E-IP-ES	IP BASE to Enterprise Services upgrade license (electronically delivered)
L-C4500E-LB-ES	LAN BASE to Enterprise Services upgrade license (electronically delivered)
SD-X45-2GB-E	Cisco Catalyst 4500 2 GB SD Memory Card for Supervisor 8-E
USB-X45-4GB-E	Cisco Catalyst 4500 4 GB USB device for Supervisor 8-E (Future Roadmap)

Licensing

Software Activation Licensing

The Cisco Catalyst 4500E platform with Supervisor 8-E enables software activation licensing. Each Supervisor 8-E will ship with a universal image containing all feature sets, LAN Base, IP Base, and Enterprise Services. The level of functions is determined by the license applied.

Software activation licensing allows customers to:

- Speed deployment and roll out new Cisco software activation feature sets across your global networks
- Centrally and more accurately manage and track software and license compliance
- Easily conduct software compliance audits to meet regulations without affecting network operations

Simplify operations:

- Simplified upgrades and license transfers save time and improve productivity; you can add new capabilities simply by using a license file
- You can easily track software assets, licenses, and feature set status
- A single software image improves service delivery

Ease the ordering process:

- “Try and buy” lets you use a temporary license to try and evaluate new Cisco IOS Software functions before purchasing them
- A pay-as-you-grow software key supports new features incrementally without service calls

For more information about Cisco software licensing, visit <http://www.cisco.com/go/sa>.

Cisco Limited Lifetime Hardware Warranty

The Cisco limited lifetime hardware warranty (LLW) includes 10-day advance hardware replacement for as long as the original end user owns the product. Table 8 describes the limited lifetime hardware warranty.

Your formal warranty statement, including the warranty applicable to Cisco software, appears in the Cisco information packet that accompanies your Cisco product. We encourage you to review carefully the warranty statement shipped with your specific product before use.

For additional information about warranty terms, visit <http://www.cisco.com/go/warranty>.

Adding a Cisco technical services contract to your device coverage provides benefits not available with a warranty, including access to the Cisco Technical Assistance Center (TAC), a variety of hardware replacement options to meet critical business needs, updates for licensed Cisco IOS Software, and registered access to the extensive Cisco.com knowledge base and support tools. Table 9 describes the benefits and features of Cisco technical services.

For information about Cisco Technical Services, go to <http://www.cisco.com/go/ts>.

Table 8. Limited Lifetime Hardware Warranty

	Cisco Limited Lifetime Hardware Warranty ¹
Warranty Duration	The warranty lasts as long as the original end user continues to own or use the product, except for the fan and power supply, which are limited to five years.
End-of-Life Policy	In the event of discontinuance of product manufacture, Cisco warranty support is limited to five years from the announcement of discontinuance.
Hardware Replacement	Cisco or our service center will use commercially reasonable efforts to ship a replacement part within 10 business days after receipt of the RMA request and confirmation that a replacement part is the appropriate response. Actual delivery times may vary depending on customer location.
Effective Date	Hardware warranty commences from the date of shipment to the customer (and in case of resale by a Cisco reseller, not more than 90 days after original shipment by Cisco).
Cisco TAC Support	None.
Cisco.com Access	The warranty allows guest access only to Cisco.com.

¹ Cisco reserves the right to refund the purchase price as its exclusive warranty remedy.

Cisco and Partner Services

Deploy the innovative, highly secure, intelligent edge in the Cisco Borderless Networks Architecture using personalized services from Cisco and our partners. Through a discovery process that begins with understanding your business objectives, we help you integrate the next-generation Cisco Catalyst 4500-E Series Switches into your architecture and incorporate network services onto that platform. Sharing knowledge and leading practices, we support your success every step of the way as you deploy, absorb, manage, and scale new technology. Choose from a flexible suite of support services designed to meet your business needs and help you maintain high-quality network performance while controlling operational costs. Table 9 shows the Cisco technical services available for Cisco Catalyst 4500-E Series Switches.

For additional information about Cisco services, visit <http://www.cisco.com/go/services>.

Table 9. Cisco Technical Services for Cisco Catalyst 4500-E Series Switches

Technical Services
Cisco Smart Net Total Care™ Service <ul style="list-style-type: none">• 24-hour global access to the Cisco TAC• Unrestricted access to the extensive Cisco.com resources, communities, and tools• Next-business-day (NBD), 8 x 5 x 4, 24 x 7 x 4, and 24 x 7 x 2 advance hardware replacement² and onsite parts replacement and installation available• Ongoing operating system software updates within the licensed feature set¹• Proactive diagnostics and real-time alerts on Smart Call Home-enabled devices
Cisco Smart Foundation Service <ul style="list-style-type: none">• NBD advance hardware replacement as available• Business hours access to the Cisco TAC for small and medium-sized businesses (SMBs) (access levels vary by region)• Access to Cisco.com SMB knowledge base• Online technical resources through Smart Foundation Portal• Operating system software bug fixes and patches
Cisco Focused Technical Support Services <p>Three levels of premium, high-touch services are available:</p> <ul style="list-style-type: none">• Cisco High-Touch Operations Management Service• Cisco High-Touch Technical Support Service• Cisco High-Touch Engineering Service <p>Valid Cisco Smart Net Total Care or Cisco SP Base contracts on all network equipment are required</p>

Footnotes:

¹ Cisco operating system updates include maintenance releases, minor updates, and major updates within the licensed feature set.

² Advance hardware replacement is available in various service-level combinations. For example, 8 x 5 x NBD indicates that shipment will be initiated during the standard eight-hour business day, five days a week (the generally accepted business days within the relevant region), with NBD delivery. Where NBD is not available, same-day shipment is provided. Restrictions apply; please review the appropriate service descriptions for details.

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