

Cisco Catalyst 6500 Series Supervisor Engine 720

As Cisco's premier modular multilayer switch, the Catalyst® 6500 Series delivers secure, converged services from the wiring closet to the core, to the data center, to the WAN edge.

The Catalyst 6500 series equipped with Supervisor Engine 720 (Figure 1) sets the standard for multilayer switches and application delivery in enterprise campus and service provider switched networks by:

- enabling delivery of new and advanced IP services
- providing support for new high performance 3rd generation gigabit and 10Gigabit interfaces
- supporting all 3 generations of Catalyst 6500 series interface and services modules
- enabling an increase in Catalyst 6500 chassis interface port density and services module configurations
- delivering predictable and scalable system performance up to a sustained 400Mpps

By deploying the Supervisor Engine 720 in network core and distribution layers, datacenters and metro Ethernet edges, the Catalyst 6500 can help maximize user productivity, enable new revenue generating

services and enhance operational control. Additionally, the Supervisor Engine 720 provides investment protection for current Catalyst 6500 deployments by supporting existing modules while enabling new applications.

The Catalyst 6500 Supervisor Engine 720 integrates a high performance 720 Gbps switch fabric with a new routing and forwarding engine, including a third generation Policy Feature Card (PFC3) in a single module. The Supervisor 720 builds on the proven Cisco Express Forwarding (CEF) architecture, by supporting centralized forwarding (CEF), distributed forwarding (dCEF) and, now, accelerated CEF (aCEF) to provide a highly scalable and cost-effective platform that is ideal for high performance backbone and data center environments.

Supervisor Engine 720 delivers the scalable-performance, intelligence, and broad selection of features to address the most demanding service provider and enterprise deployment requirements for building modular, resilient, scalable, secure, multilayer switching solutions.

The widely deployed Supervisor Engine 1A and Supervisor Engine 2, complement the Supervisor Engine 720 by supporting wiring closet, small distribution/core, data center and WAN edge configurations. Catalyst 6500 series supervisors enable the seamless integration of

Figure 1 Cisco Supervisor Engine 720 with integrated 720Gbps switch fabric





advanced services such as security, voice and content into a converged network that reduces the total cost of ownership.

By sharing a common set of interfaces, operating system and management tools, the Catalyst 6500 Series supervisors provide operational consistency—enabling common sparing and minimizing training requirements; all modules feature predictable performance and a broad range of capabilities. Supervisor Engine 720 highlights include:

- *New services and capabilities for enterprise and service provider deployments*—Features enhanced QoS mechanisms, such as egress policing; hardware-based GRE tunneling, NAT/PAT hardware assist; and high performance hardware-accelerated MPLS-based services
- *Enhanced operational control*—Supports Microflow User Based Policing to enforce service level agreements on a per user basis, no matter the traffic type or IP address.
- *Forward-thinking architecture*—Delivers up to 200Mpps hardware-based IPv6 in distributed forwarding mode to allow a smooth transition to Internet 2 and other communications networks supporting cellular 3G and perpetually connected devices including PDAs, and Transportation Vehicles
- *Scaleable and predictable performance*—Features a flexible switch fabric and forwarding architecture delivering throughput from 30Mpps (CEF256 interface modules) up to 400Mpps sustained performance with IPv4 traffic over its 720Gbps switch fabric (dCEF720 interface modules)
- *Increased port density and slot efficiency*—Integrated switch fabric allows the Catalyst 6500 chassis to be equipped with an additional interface or services module, providing two additional slots for redundant supervisor and switch fabric configurations
- *Operational consistency*— Supports all 3 generations of Catalyst 6500 Series' interface and services modules with configuration options using the Catalyst 6500 3-, 6-, 9-, and 13-slot chassis running Cisco IOS® Software and Cisco Catalyst Operating System Software and a common set of Cisco network management tools that support the Catalyst 6500 Supervisor Engine 1A and 2 as well as many other Cisco Systems product lines
- *Choice of operating system support*—Supports both Cisco IOS® Software and Hybrid (Catalyst OS software and Cisco IOS Software for the MSFC)
- *Maximum network uptime and user productivity*—Supports new Cisco Globally Resilient IP (GRIP) features, gateway load balancing protocols, Layer 2 stateful switchover, multimodule EtherChannel, and rapid convergence protocols—allowing Catalyst 6500 users to experience seamless connectivity to networked data, voice and video applications for business critical network environments, including IP-telephony enabled wiring closets

Cisco Supervisor Engine 720 Deployment Scenarios

With a broad range of interfaces, services modules, chassis/slot configurations as well as a scalable set of supervisor engines, the Catalyst 6500 can be deployed anywhere in the network. Figure 2 depicts the Catalyst 6500 with recommended supervisor engines deployed in an end to end Catalyst 6500 switched network spanning the wiring closet, distribution, core, data center, WAN edge and Metro edge.



Figure 2
Cisco Supervisor Engine 720 Deployment Scenarios

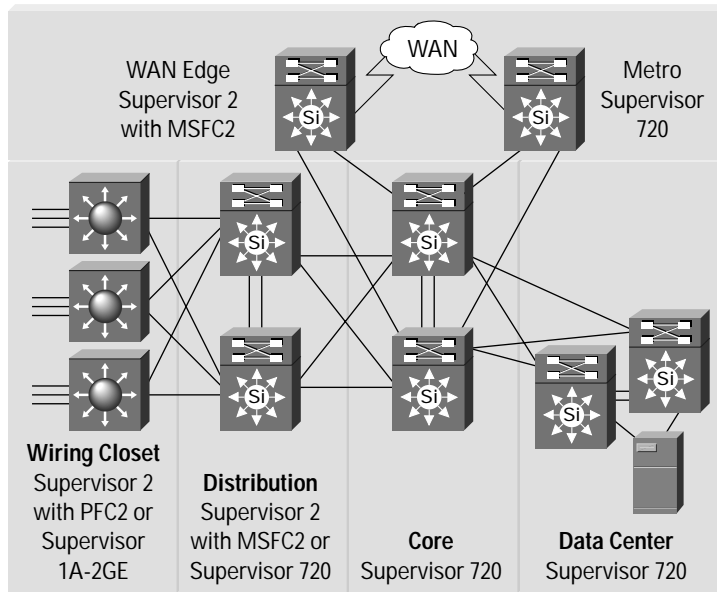




Table 1 Catalyst 6500 Supervisor Engine Deployment Scenarios

Supervisor Engine	Performance/Features	Recommended Deployments
Supervisor Engine 720	400 Mpps, 720 Gbps Layer 2–4 distributed Cisco Express Forwarding Supports new accelerated Cisco Express Forwarding 720 interface modules and distributed Cisco Express Forwarding 720 interface modules	Enterprise core, distribution, and data centers
Supervisor Engine 2 Policy Feature Card 2 (PFC2) Multilayer Switch Feature Card 2 (MSFC2)	210 Mpps, 256 Gbps (distributed forwarding with switch fabric module) 30 Mpps, 256 Gbps (with switch fabric module) Centralized Layer 2–4 forwarding Enhanced security and quality of service (QoS)	Enterprise distribution, data centers, and WAN edge
Supervisor Engine 2 PFC2	30 Mpps, 256 Gbps (with switch fabric module) Centralized Layer 2 forwarding and Layer 3–4 services Enhanced security and QoS	Premium wiring closet and data center access
Supervisor Engine 1A PFC MSFC2	15 Mpps, 32 Gbps Centralized Layer 2–4 forwarding Enhanced security and quality of service (QoS)	Distribution and core
Supervisor Engine 1A PFC	15 Mpps, 32Gbps Centralized Layer 2 forwarding and Layer 3–4 services Enhanced security and QoS	Enterprise wiring closets
Supervisor Engine 1A 2GE	15 Mpps, 32 Gbps Centralized Layer 2 forwarding	Value wiring closet

Cisco Supervisor Engine 720 Features

The Cisco Supervisor Engine 720 provides the following features:

- High availability
- Scalable performance
- Wire-rate traffic management
- End-to-end management tools
- Comprehensive security
- Advanced Layer 2–4 forwarding

High Availability

The Cisco Supervisor Engine 720 can be deployed in dual-supervisor configurations in all Cisco Catalyst 6500 Series chassis (6503, 6506, 6509, 6509-NEB, 6509-NEB-A, and 6513). The dual-supervisor configuration synchronizes protocol states between the primary and the redundant supervisor engine, provides industry-leading network availability with sub-3-second failover, and maximizes network uptime by allowing hot-swapping of standby supervisor engines. Important high-availability features include:



- *Supervisor redundancy*—With synchronization of protocol states and support for HSRP, VRRP, and Uplink Fast
- *Rapid failover rates*—Sub-3-second stateful failover and Layer 3 IP Unicast and Multicast failover
- *Hot swapping*—Supports hot-swapping of standby supervisor engines

Scalable and Predictable Performance

The Cisco Supervisor Engine 720 provides scalable performance—up to 400 Mpps with 720 Gbps bandwidth—which is required in high-throughput network cores, data centers, and GRID computing environments with multigigabit trunks.

The Supervisor Engine 720 uses the Cisco Express Forwarding routing architecture, which performs high-speed lookups even with advanced Layer 2–4 services enabled and independent of the number of flows through the switch providing up to 400 Mpps of forwarding performance.

For details, see Table 2—Supervisor Engine Feature Comparison.

Wire-Rate Traffic Management

The Supervisor Engine 720 provides wire-rate traffic management using Layer 2–4 quality of service (QoS) as well as security checks, including access-control-list (ACL) policy enforcement, as part of its forwarding process to protect and secure content. These traffic-management features efficiently handle converged networks that carry a mix of mission-critical, time-sensitive, and bandwidth-intensive multimedia applications.

- *Advanced QoS tools*—Packet classification and marking and congestion avoidance based on Layer 2–4 header information using weighted random early detection (WRED)
- *User-based rate limiting*—Enforces any of 64 policy rates at the per-user level maintaining service-level agreements on a per-user basis, independent of the traffic type or IP address
- *QoS scheduling rules with thresholds*—Configurable weighted round robin (WRR) de-queueing, based on multiple receive and transmit queues
- *Rate limiting*—Can be used to police traffic on a per-flow or aggregate basis with ultra fine granularity

For details, see Table 3—QoS Features Comparison.

End-to-End Management Tools

Managed with CiscoWorks, Cisco Catalyst 6500 Series switches can be configured and managed to deliver end-to-end device, VLAN, traffic, and policy management. Cisco Resource Manager, a Web-based management tool that works with CiscoWorks, provides: automated inventory collection, software deployment, easy tracking of network changes, views into device availability, and quick isolation of error conditions.

The Supervisor Engine 720 provides a comprehensive set of management tools to provide the required visibility and control in the network.

- *Console management*—Provides shared interface to the Supervisor Engine 720 and the Multilayer Switch Feature Card 3 (MSFC3) available out-of-band from a local terminal or remote terminal connected through a modem to the console or auxiliary interface
- *In-band management*—Provides shared interface to the Supervisor Engine 720 and the MSFC3 available in-band via SNMP, Telnet client, Bootstrap Protocol (BOOTP), and Trivial File Transfer Protocol (TFTP)
- *Switched Port Analyzer (SPAN)*—Allows management and monitoring of switch traffic
- *Remote Switched Port Analyzer (RSPAN)*—Allows centralized management and monitoring by aggregating and directing traffic from multiple distributed hosts and switches to a remotely located switch via trunk link



- *VLAN access-control-list (VACL) capture*—Directs traffic to a network-analysis or intrusion-detection port via an ACL.

For details, see Table 7—Management Tools Comparison.

Comprehensive Security

The advanced security capabilities of the Supervisor Engine 720 can reduce the threat of malicious network attacks while enabling authentication, authorization, and accounting (AAA). With support for up to 32K ACL entries and advanced features such as port security, the Supervisor Engine 720 offers an unmatched set of Layer 2–4 network traffic security capabilities:

- *Layer 2 security*—Includes private VLANs, AAA, IEEE802.1x, and port security to help the network architect properly partition and control the switch resources
- *Layer 2–4 hardware filters*—Can work on the forwarding engine and in conjunction with optional integrated services modules to inspect each forwarded packet and permit or deny all the streams of traffic according to the network administrator’s rules, rate limiting functionality can also be used for protection against denial-of-service attacks

For details, see Table 4—Security Features Comparison.

Advanced Layer 2–4 Forwarding

The Supervisor Engine 720 provides the advanced Layer 2–4 features that network designers require to build advanced network designs:

- *MPLS*—Baseline capabilities enable the use of VPNs and Layer 2 tunneling while improving traffic engineering for QoS and adding multiprotocol support
- *IPv6*—Expands the number of available IP addresses, enabling better address allocation and address aggregation and supporting greater end-to-end connectivity and services, including mobile network-computing capabilities (Enabled with Cisco IOS 12.2(17a)SX and later).
- *Generic Routing Encapsulation (GRE)*—Scalable hardware-based support for GRE tunnels for IP traffic
- *Network Address Translation (NAT)*—Translates addresses for inbound and outbound traffic in hardware, allowing a clean separation between internal and external networks in the use of RFC 1918 (address space management)

For details, see Table 5—Layer 3 Switching Feature Comparison.

Supervisor Engine 720 Architecture

Cisco Catalyst 6500 Series supervisor engines 1A, 2, and 720 manage the system: storing and running the system software, controlling the various modules in the chassis, performing Layer 2–4 forwarding, and feature two gigabit Ethernet ports for additional connectivity.



The Supervisor Engine 720 enables multiple forwarding architectures, including distributed Cisco Express Forwarding (dCEF) and accelerated Cisco Express Forwarding (aCEF) in addition to Cisco Express Forwarding (CEF). As Table 2 illustrates, the Supervisor Engine 720 offers significant enhancements to Catalyst 6500 deployments.

Table 2 Supervisor Engine Feature Comparison

Feature	Supervisor Engine 720	Supervisor Engine 2 MSFC2	Supervisor Engine 1A PFC/MSFC2
Maximum bandwidth	720 Gbps	256 Gbps (with Switch Fabric Module)	32 Gbps
Performance	30Mpps Centralized, Up to 400 Mpps for CEF720 interface modules equipped with dCEF (DFC3) or aCEF daughter cards	30 Mpps Centralized Up to 210 Mpps—with Switch Fabric Module (SFM) and dCEF (DFC) daughter cards	15 Mpps Centralized
Hardware-based forwarding engine	Field-upgradable PFC3 on board	PFC2 on board; <i>not field-upgradable</i>	PFC on board; <i>not field-upgradable</i>
MSFC daughter card version	MSFC3 on board	MSFC2 optional	MSFC2 optional; <i>not field upgradable</i>
Switch Fabric Module (SFM) supported	Integrated 720Gbps switch fabric	Yes, uses SFM module - 256Gbps switch fabric	No
Distributed Cisco Express Forwarding (dCEF)	With dCEF720 and dCEF256 interface modules or optional DFC3 equipped interface modules	With dCEF256 interface modules or optional DFC equipped interface modules	No
Accelerated Cisco Express Forwarding (aCEF)	With aCEF daughter cards on CEF720 interface modules	No	No
Cisco Express Forwarding (CEF)	With CEF256 and Classic interface modules	With CEF256 and Classic interface modules	With CEF256 and Classic interface modules (in software)
Dynamic RAM (DRAM)	512 MB, 1 GB	128 MB, 256 MB, 512 MB	128 MB
Onboard Flash (BootFlash)	64 MB	32 MB	16 MB
Integrated Gigabit Ethernet Ports	2 configured, select from 3 ports (2 SFP-based, 1 10/100/1000 RJ-45)	2 GBIC-based ports	2 GBIC-based ports
Chassis supported	6503, 6506, 6509, 6509-NEB, 6509-NEB-A, 6513; 7603, 7606, 7609, OSR-7609, 7613	6006, 6009, 6503, 6506, 6509, 6509-NEB, 6509-NEB-A, 6513; 7603, 7606, 7609, OSR-7609, 7613	6006, 6009, 6503, 6506, 6509, 6509-NEB; 6509-NEB-A, 7603, 7606, 7609, OSR-7609

The Supervisor Engine 720's Policy Feature Card 3 (PFC3) and Multilayer Switch Feature Card 3 (MSFC3) daughter cards provide the following functions:

- *PFC3*—Performs hardware-based Layer 2–4 packet forwarding as well as packet classification, traffic management, and policy enforcement
- *MSFC3*—Performs Layer 3 control-plane functions, including address resolution and routing protocols



Policy Feature Card3 (PFC3)

The Supervisor Engine 720 features a field-upgradable Policy Feature Card providing additional investment protection and flexibility in supporting a range of hardware accelerated features. The PFC3 for the Supervisor Engine 720 supports routing and bridging functionality, quality of service (QoS) and policy based intelligent networking capabilities and multicast packet replication for the Catalyst 6500 Series. The PFC identifies and classifies traffic applying the appropriate QoS priority level and security policies as defined by the network administrator configured ACLs. The PFC also helps to prevent unauthorized applications from being allowed on the network.

The Supervisor Engine 720's PFC3 makes the packet-forwarding decision in its application-specific integrated circuit (ASIC) complex. In distributed forwarding configurations, an identical ASIC complex located on an interface module (DFC3 daughter card) allows the interface module to make packet-forwarding decisions locally. After the PFC3 or DFC3 makes the forwarding decision for the interface module, it forwards the packets with full L2-4 policy applied.

In addition to packet forwarding, the PFC3A features wire-rate support for:

- 256,000 IPv4 routes and 32,000 multicast routes
- Layer 2–4 packet classification—Using QoS access-control entries
- Traffic management (rate limiting)—Using ingress and egress policing
- Security policy enforcement—Within subnets or VLANs
- Intelligent multicast forwarding—Efficient replication of multicast streams, supplied to appropriate end-user stations
- NetFlow data export—Collecting IP flow statistics for inter and intra-subnet flows
- IPv4, IPv6, baseline MPLS capabilities, GRE, and NAT traffic acceleration—High performance hardware acceleration of these common traffic types and functions/services

Quality of Service

Table 3 compares the QoS features of Supervisor Engine 720 with other Cisco Catalyst 6500 Series supervisor engines.

Table 3 QoS Features Comparison

Feature	PFC3A Supervisor Engine 720	PFC2 Supervisor Engine 2 MSFC2	PFC Supervisor Engine 1A PFC/MSFC2
Layer-3 classification and marking Access Control Entries (ACEs)	32K dedicated for QoS	32K dedicated for QoS	16K
Aggregate Rate-limiting location	Ingress port or VLAN and egress VLAN or Layer-3 port	Ingress port or VLAN	Ingress port or VLAN
Rate-limiting level types <i>Committed Information Rate (CIR)</i> <i>Peak Information Rate (PIR)</i>	CIR, PIR	CIR, PIR	CIR
Aggregate traffic rate-limiting policers	1023	1023	1023
Flow-based rate-limiting method; number of rates	Per source address, destination address, or full flow; 64 rates	Full flow; 64 rates	Full flow; 64 rates



Security

Table 4 compares the security features of the Supervisor Engine 720 with other Cisco Catalyst 6500 Series supervisor engines.

Table 4 Security Features Comparison

Feature	PFC3A Supervisor Engine 720	PFC2 Supervisor Engine 2 MSFC2	PFC Supervisor Engine 1A PFC/ MSFC2
Port security	Yes	Yes	Yes
Transmission Control Protocol (TCP) intercept hardware acceleration	Yes	Yes	No
IEEE 802.1x and 802.1x extensions	Yes	Yes	Yes
VLAN and router ACLs	Yes	Yes	Yes
Security ACL entries	32K	32K	16K
Reflexive ACLs	128K	128K	512
Unicast Reverse Path Forwarding (uRPF) check in hardware	Up to 6 paths	Single path only	N/A
Multipath uRPF checking hardware	Yes	No	N/A
CPU rate limiters (DoS protection)	12 special case rate limiters	No	
Private VLANs	Yes	Yes	Yes

Multi-layer Switch Feature Card 3 (MSFC3)

The MSFC3 is an integral part of the Supervisor Engine 720, providing the high performance, multilayer switching and routing intelligence in a Catalyst 6500 series chassis. Equipped with a high performance processor, the MSFC runs Cisco IOS® software to provide an unparalleled array of layer 3 and above services. These include

- Routing Protocol Support—including BGP4, IS-IS, OSPF, RIP, and more
- Traditional protocols including IP, IPX, AppleTalk, DECnet, VINES, XNS, OSI, CLNS
- Multimedia services—Protocol-Independent Multicast (PIM) (both sparse and dense mode), and Cisco Group Management Protocol (CGMP) and Internet Group Management Protocol (IGMP) snooping
- Security services—Access lists, encryption, lock and key

The MSFC builds the CEF Forwarding Information Base (FIB) table in software and then downloads this table to the hardware (ASICs) on the PFC and DFC (if present) that make the forwarding decisions for IP unicast and IP multicast traffic. This approach, using Cisco Express Forwarding, separates control and data planes, enabling highly scalable, high performance packet forwarding capabilities. For more information, see the later section on “How Cisco Express Forwarding Works.”



Layer 2–4 Switching

The Supervisor Engine 720 supports a wide range of layer 2 through 4 services enabled by Cisco IOS and/or Cisco Catalyst OS. The Supervisor Engine 720 with the PFC3 provides hardware-acceleration or hardware-assist for several of these functions, see table 5 below.

Note: Some features, such as IPv6 and MPLS, may require the use of a premium Cisco IOS feature set.

Table 5 Catalyst 6500 Supervisor Layer 3 Switching Feature Comparison

Feature	Supervisor Engine 720 with MSFC3 and PFC3A	Supervisor Engine 1A PFC/MSFC2 Supervisor Engine 2 MSFC2
IPv4 routing	In hardware	In hardware
MPLS	Baseline features in PFC3A hardware ¹	Using optical switch module (OSM)
IPv6	In hardware ²	In software (Supervisor Engine 2 MSFC2)
GRE	In hardware	In software
NAT	Hardware assisted	In software

1. MPLS support will be offered in a forthcoming Cisco IOS maintenance release for the Supervisor 720 equipped with PFC3A. Baseline MPLS features do not include EoMPLS. Additional MPLS capabilities may be added via software releases or field-upgradable PFC daughter cards.

2. IPv6 support will be enabled in a forthcoming Cisco IOS maintenance releases for the Supervisor 720.

Refer to the release notes for up-to-date software version information and feature support details.

Multi Protocol Label Switching (MPLS)

MPLS is a category of features that enable a variety of service provider and enterprise network services. The Catalyst 6500 series supports a wide range of MPLS features. These functions are supported in hardware and software by the Supervisor Engine 720's MSFC3 and PFC3 as well as the Optical Services Modules (OSMs) shared by the Cisco 7600 series router and Catalyst 6500 series multilayer switch. Some MPLS features are specific to a given WAN interface, while other features can be used in LAN-based environments. Not all MPLS features are required for a given MPLS service. Table 6, below, highlights some of these features.

Table 6 MPLS feature overview

MPLS Feature	Supervisor Engine 720 with PFC3A (baseline MPLS support ¹)	Optical Services Modules and FlexWAN
Interface Support	LAN and WAN interface modules as applicable	OSM only
Label Imposition/Disposition (MPLS-PE), Swapping (MPLS-P)	Yes	Yes
Label Distribution Protocol (LDP)	Yes	Yes
Tag Distribution Protocol Support (TDP)	Yes	Yes
MPLS VPN	Yes	Yes



Table 6 MPLS feature overview

MPLS Feature	Supervisor Engine 720 with PFC3A (baseline MPLS support ¹)	Optical Services Modules and FlexWAN
ISL and 802.1Q to VRF Mappings	Yes	Yes
VRF-Select	Yes	Yes
QoS mechanisms using EXP bits	Yes	Yes
MPLS-RSVP-TE	Yes	Yes
MPLS-DS-TE (Diff-Serve Aware Traffic Engineering)	Yes	Yes
MPLS over GRE (PE-PE)	No	Yes
MPLS traceroute	Yes, see release notes for details	Yes
IP Options in MPLS	No, see release notes for details	Yes
Any Transport over MPLS (AToM), including EoMPLS	No ²	Yes
VPLS	No	Yes

1. MPLS support will be offered in a forthcoming Cisco IOS maintenance release for the Supervisor 720 equipped with PFC3A. Additional MPLS capabilities may be added via software releases or field-upgradable PFC daughter cards

2. Use of OSM or FlexWAN interfaces for connection to MPLS core can support many configuration requirements.

Management Tools

The Catalyst 6500 series and the Supervisor Engine 720 are supported by a number of network management tools, including CiscoWorks. The Supervisor Engine 720 features several tools for system management and network management as well. Table 7 compares these Cisco Catalyst 6500 Series supervisor engine-based system / network management tools.

Table 7 Management Tools Comparison

Feature	PFC3A Supervisor Engine 720	PFC2 and PFC Supervisor Engine 2 MSFC2 Supervisor Engine 1A PFC/MSFC2
SPAN	Yes	Yes
RSPAN	Yes	Yes
VACL capture	Yes	Yes

Switch Fabric

The Supervisor Engine 720 features an integrated 720Gbps switch fabric. This high bandwidth fabric enables the Catalyst 6500 series to support high density non-blocking gigabit Ethernet and 10 gigabit Ethernet aggregation configurations. By integrating the switch fabric with the supervisor function, the Catalyst 6500 series eliminates the need for a separate payload slot-consuming switch fabric module. As result, additional interface or services modules can be deployed, resulting in higher Catalyst 6500 system port densities and / or reducing the need for external security, content switching, network analysis or



voice gateway appliances. Slot efficiency is further enhanced in high availability configurations that require redundant supervisors and switch fabrics, saving two slots for interface modules or services modules that would otherwise require two switch fabric modules.

Switch Fabric Module Architecture

The Supervisor Engine 720 integrated switch fabric is comprised of an eighteen channels providing 720Gbps of bandwidth to the Catalyst 6500 series chassis. Each channel features a dedicated 20Gbps of ingress and 20Gbps egress (total of 40Gbps per customary industry practices) connection to the switch fabric. The Catalyst 6503, 6506, and 6509 chassis have two dedicated channels allocated to each slot, enabling true 40Gbps (2 channels/slot x 20Gbps / channel = 40Gbps) per slot performance for high throughput multigigabit and 10 Gigabit non-blocking capabilities.

Note: In a Catalyst 6513, slots one through eight are allocated one channel with slots nine through thirteen allotted two channels (a total of 18 channels).

The Supervisor 720's switch fabric uses a 3X over-speed architecture to support efficient packet forwarding for unicast, broadcast, and multicast traffic. The dedicated dual or single channel bandwidth is delivered to each slot in the chassis via the chassis' highly scalable passive backplane.

By using auto-sensing and auto-negotiation, the Supervisor 720 switch fabric is fully interoperable with the 8- and 16-Gbps switch fabric interconnections used by the CEF256 and dCEF256 modules. When a CEF256 or dCEF256 module is detected, the switch fabric will automatically connect those modules by offering 8-16Gbps of bandwidth to each module, as applicable.

Classic modules continue to use the 32Gbps shared bus which is also fully supported by the Supervisor Engine 720 and provides interoperability with all 3 generations of bus and switch fabric based modules.

Support for High-Bandwidth Applications

The Supervisor 720 switch fabric architecture, coupled with multicast replication performed in hardware on Supervisor 720 and on interface modules, handles high-bandwidth interactive and broadcast video applications without any performance penalty.

High Availability

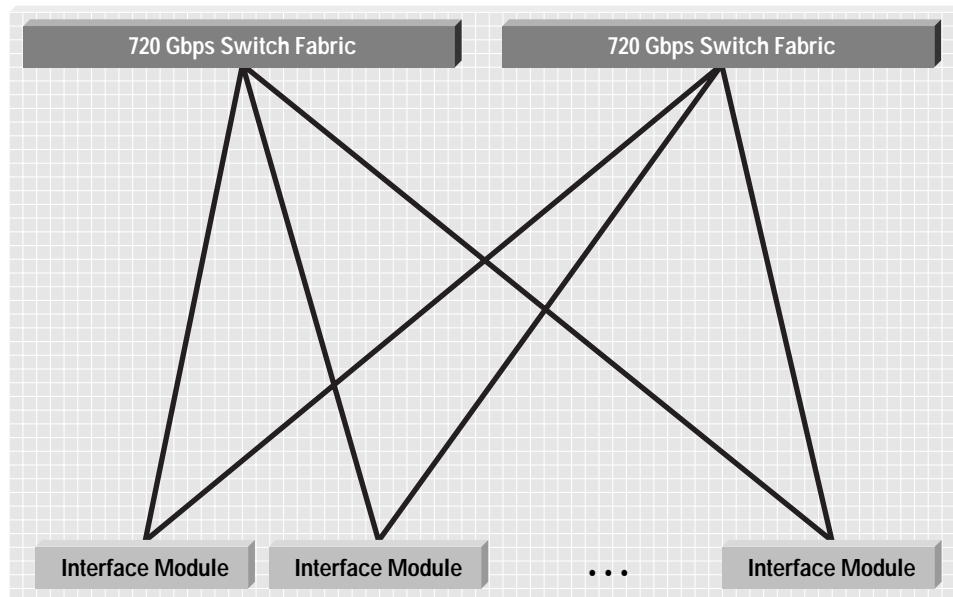
Two Supervisor Engine 720s can be configured in a system providing redundant high-availability switch fabric configuration allowing the system to failover to the redundant switch fabric of the secondary Supervisor Engine 720 and providing protection for mission-critical applications (Figure 3).

When installed in a redundant configuration, failover time between switch fabrics occurs in a few seconds and the full 720 Gbps system bandwidth remains available following the failure of the active switch fabric module. This high availability feature minimizes the impact of outages on mission-critical applications in different network environments. In a single switch-fabric configuration with modules supporting both bus and high performance switch fabric interfaces, the system can fail over to the 32-Gbps backplane bus if the switch fabric fails, providing a highly available platform to host mission-critical applications.

Note: The Switch Fabric Module (SFM) and SFM2 cannot operate in the same chassis with a Supervisor Engine 720 and it not required in any supervisor engine 720 based configuration.



Figure 3
Switch Fabric-to-Interface Module Connection – Redundant Supervisor Engine 720 Configuration





Supervisor Engine 720

Suited for deployment in the distribution/core and the data center, the Supervisor Engine 720 supports all Cisco Catalyst 6500 Series interface module classes (Classic, CEF256, dCEF256, CEF720, and dCEF720) while providing the following operational characteristics and advantages:

- *Forwarding architecture*—Supports centralized CEF, and distributed forwarding with dCEF, and aCEF
- *Layer 2–4 forwarding*—Support for Layer 2–4 forwarding and Layer 2–4 services
- *MAC addresses*—Up to 64K
- *Forwarding rate*—Up to 400 Mpps per system
- *Bandwidth*—720 Gbps, integrated switch fabric
- *Layer 2–3 traffic classification and marking*—Layer 2 and Layer 3 QoS mechanisms, (see Table 3—QoS Features Comparison for details)
- *Multilayer (Layer 3) switching*—IPv4, IPv6, and baseline MPLS switching support in hardware with PFC3A(See Table 6—Layer 3 Switching Feature Comparison for details)
- *Operating system*—Cisco IOS, Catalyst OS software including Hybrid mode operation
- *Management tools*—CiscoWorks, SPAN, RSPAN, VACL capture and more
- *Dynamic RAM (DRAM)*—512 MB, 1 GB
- *Compact removable Flash memory*—128 MB, 256 MB, 512 MB, 1GB Microdrive
- *Onboard flash (BootFlash)*—64 MB
- *Integrated gigabit Ethernet ports*—configure 2 out of 3 ports (2 SFP-based, 1 10/100/1000 RJ-45)
- *Chassis supported*—6503, 6506, 6509, 6509-NEB, 6509-NEB-A, and 6513; 7603, 7606, 7609, OSR-7609, and 7613
- *Slot requirements*—Occupies the switch fabric slots in the chassis: slots 1 and 2 in a 3-slot chassis, slots 5 and 6 in a 6- or 9-slot chassis, and slots 7 and 8 in a 13-slot chassis

Figure 4

Cisco Catalyst 6500 Series Supervisor Engine 720



Software Requirements

The Supervisor Engine 720 can be used with one of the following operating systems:



- Cisco IOS Software for the supervisor engine
- Catalyst OS and Cisco IOS Software for the MSFC (aka hybrid); does not support dCEF forwarding

Note: Refer to the release notes for up-to-date software version information.

How Cisco Express Forwarding Works

Cisco Express Forwarding (CEF) is a Layer 3 technology that provides increased forwarding scalability and performance to handle many short-duration traffic flows common in today's enterprise and service provider networks. To meet the needs of environments handling large amounts of short-flow, Web-based, or highly interactive types of traffic, CEF forwards all packets in hardware, and maintains its forwarding rate completely independent of the number of flows going through the switch.

On the Cisco Catalyst 6500 Series, the CEF Layer 3 forwarding engine is located centrally on the supervisor engine's PFC2 or PFC3—the same device that performs hardware-based Layer 2 and 3 forwarding, ACL checking, QoS policing and marking, and NetFlow statistics gathering.

Using the routing table that Cisco IOS Software builds to define configured interfaces and routing protocols, the CEF architecture creates CEF tables and downloads them into the hardware-forwarding engine before any user traffic is sent through the switch. The CEF architecture places only the routing prefixes in its CEF tables—the only information it requires to make the Layer 3 forwarding decisions—relying on the routing protocols to do route selection. By performing a simple CEF table lookup, the switch forwards packets at wire-rate, independent of the number of flows transiting the switch.

CEF-based forwarding requirements: Requires a Cisco Catalyst Supervisor Engine 2 or Catalyst Supervisor Engine 720.

How Distributed Cisco Express Forwarding (dCEF) Works

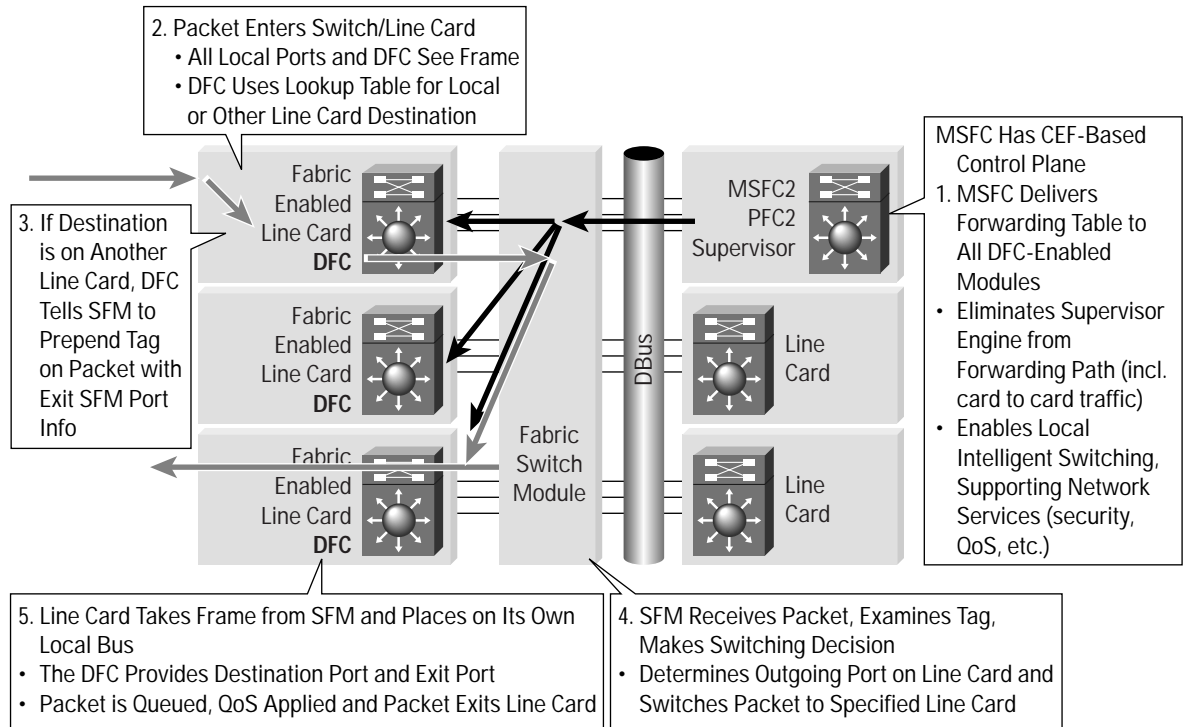
With Distributed Cisco Express Forwarding (dCEF), forwarding engines located on the interface modules make forwarding decisions locally and in parallel, allowing the Cisco Catalyst 6500 Series to achieve the highest forwarding rates in the industry. With dCEF, forwarding occurs on the interface modules in parallel and system performance scales up to 400 Mpps—the aggregate of all forwarding engines working together.

Using the same ASIC engine design as the central PFCx, DFCs located on the interface modules forward packets between two ports, directly or across the switch fabric, without involving the supervisor engine (Figure 5). With the DFC, each interface module has a dedicated forwarding engine complete with the full forwarding tables. dCEF forwarding works like this:

- As in standard CEF forwarding, the central PFC3 located on the supervisor engine and the DFC engines located on the interface modules are loaded with the same CEF information derived from the forwarding table before any user traffic arrives at the switch.
- As a packet arrives at an interface module, its DFC engine inspects the packet and uses the information in the CEF table (including Layer 2, Layer 3, ACLs, and QoS) to make a completely hardware-based forwarding decision for that packet.
- The dCEF engine handles all hardware-based forwarding for traffic on that module, including Layer 2 and Layer 3 forwarding, ACLs, QoS policing and marking, and NetFlow.
- Because the DFCs make all the switching decisions locally, the supervisor engine is freed from all forwarding responsibilities and can perform other software-based functions, including routing, management, and network services.



Figure 5
Distributed Cisco Express Forwarding Packet Flow



dCEF-based forwarding requirements: Requires a Cisco Catalyst Supervisor Engine 720 for dCEF720 interface modules; requires either a Catalyst Supervisor Engine 720 or a Catalyst Supervisor Engine 2-MSFC2 and a SFM for dCEF256 interface modules.

How Accelerated Cisco Express Forwarding (aCEF) Works

Accelerated Cisco Express Forwarding (aCEF) technology uses two forwarding engines working together in a master-slave relationship to accelerate high-rate traffic flows through the switch—a central CEF engine located on the Supervisor Engine 720's PFC3 and a scaled-down distributed aCEF engine daughter card supported on various CEF720 (WS-X67xx) interface modules, planned for future availability.

The central PFC3 makes the initial forwarding decision, with the aCEF engine storing the result and making subsequent packet-forwarding decisions locally. aCEF forwarding works as follows:

- As in standard CEF forwarding, the central PFC3 is loaded with the necessary CEF information before any user traffic arrives at the switch.
- As traffic arrives on a CEF720 interface module equipped with an aCEF daughter card, the aCEF engine inspects the packet, and finding that no specific packet forwarding information exists, consults the central PFC3.
- The PFC3 makes a hardware-based forwarding decision for this packet (including Layer 2, Layer 3, ACLs, and QoS).
- The aCEF engine stores the forwarding decision results and makes forwarding decisions locally for subsequent packets based on packet-flow history.
- The aCEF engine handles hardware-based Layer 2 and Layer 3 IPv4 and IPv6 forwarding, ACLs, QoS marking, and NetFlow.



- The central PFC3 processes any forwarding decisions that the interface module's aCEF engine cannot handle.
- **aCEF-based forwarding requirements:** Requires a Cisco Catalyst Supervisor Engine 720 and a CEF720 class interface module equipped with an aCEF daughter card.

Ordering Information

Table 7 lists the ordering information for Supervisor Engine 720.

Table 8 Product Numbers for Ordering

Product Number	Description
WS- SUP720	Cisco Catalyst 6500 Series Supervisor Engine 720, Integrated Fabric, PFC3A, MSFC3
MEM-MSFC2-512MB	Cisco Catalyst 6500 MSFC2 Memory, 512 MB DRAM Option
MEM-MSFC2-512MB=	Cisco Catalyst 6500 MSFC2 Memory, 512 MB DRAM Spare
GLC-SX-MM=	Gigabit Ethernet SFP modular multimode fiber optics, LC connector SX transceiver
GLC-LH-SM=	Gigabit Ethernet SFP modular singlemode fiber optics, LC connector LX/LH transceiver

Dimensions

- (H x W x D): 1.6 x 15.3 x 16.3 in. (4.0 x 37.9 x 40.3 cm)

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%, noncondensing
- Regulatory compliance

Safety Certifications

- UL 1950
- EN 60950
- CSA-0C22.2 No. 950
- IEC 950

Electromagnetic Emissions Certifications

- FCC 15J Class A
- VCCI CE II
- CE mark
- EN 55022 Class B
- CISPR 22 Class B



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

Additional Cisco Catalyst 6500 Series Information

For additional information about the Cisco Catalyst 6500 Series, supervisor engines, interface modules, SFM, and services modules, visit: http://www.cisco.com/en/US/products/hw/switches/ps708/products_data_sheets_list.html



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