Cisco Catalyst 6500 Supervisor Engine 32 Programmable Intelligent Services Accelerator

Product Overview

The Cisco® Catalyst® 6500 Supervisor Engine 32 Programmable Intelligent Services Accelerator (PISA) delivers superior deep packet inspection, application awareness, security, availability, and manageability services for the networks of small and medium-sized business, enterprises, and service providers. This supervisor engine is ideal for securing campus access networks, converged services MAN/WAN applications and small/medium backbone functions.

The PISA on the Supervisor Engine 32 PISA provides hardware acceleration of services such as network-based application recognition (NBAR) and flexible packet matching (FPM) at multigigabit speeds, in addition to the management and control plane functions traditionally provided by the multilayer switch feature card (MSFC). The Supervisor Engine 32 PISA is offered with the Policy Feature Card 3B (PFC3B), to ensure feature and performance compatibility with the Cisco Catalyst 6500 Supervisor Engine 32. Two uplink options are available: 8-port Gigabit Ethernet Small Form-Factor Pluggable (SFP)-based uplinks (Figure 1) and 2-port 10 Gigabit Ethernet XENPAK-based uplinks (Figure 2). In addition to these modular uplinks, the Supervisor Engine 32 PISA also includes one port of 10/100/1000 RJ-45 for ease of network management. All ports on the Supervisor Engine 32 PISA can be active at the same time.

Figure 1. Supervisor Engine 32 PISA with 8-Port Gigabit Ethernet and PFC3B

Figure 2. Supervisor Engine 32 PISA with 2-Port 10 Gigabit Ethernet and PFC3B

The Supervisor Engine 32 PISA offers:

- **Deep Packet Inspection and Application Awareness:** Support for hardware acceleration of intelligent services like NBAR and FPM at multigigabit speeds and inspection 4096 bytes into the packet. NBAR is a classification engine that can recognize a wide variety of applications, including Web-based applications and client/server applications that dynamically assign TCP or User Datagram Protocol (UDP) port numbers. After the application is recognized, the network can invoke specific services for that particular application. NBAR works with quality-of-service (QoS) features to help ensure that the network bandwidth is best used to fulfill the company's objectives. These features include the ability to guarantee bandwidth to critical applications, limit bandwidth to other applications, drop selective packets to avoid congestion, and mark packets appropriately so that the network and the service provider's network can provide QoS from end to end. FPM provides the means to inspect packets for characteristics of an attack, and to take appropriate actions (log, drop). FPM provides a flexible Layer 2 through Layer 7 stateless classification mechanism. The user can specify classification criteria based on any protocol and any field of the traffic's protocol stack. Based on the classification result, actions such as drop or log can be taken on the classified traffic.
- **Programmable Architecture:** The Supervisor Engine 32 PISA is based on an adaptable, programmable architecture that adjusts to grow with the dynamic needs of the network. As new techniques for network intrusion or application compromise are created, the programmable nature of the Supervisor Engine 32 PISA ensures that the network administrator has the ability to quickly react to the changing environment. Additionally, the architecture integrates a high-performance hardware-based AES encryption engine to potentially next-generation Layer 2 through 7 services requiring multigigabit encryption services in the future.
- **Integrated security:** The Supervisor Engine 32 PISA helps mitigate damage from denial-of-service (DoS) attacks using Control Plane Policing, hardware-based MAC learning, and user-based rate limiting. It limits threats from the Dynamic Host Configuration Protocol (DHCP) server, default gateway, or end-user IP address spoofing using features such as DHCP snooping, Dynamic Address Resolution Protocol inspection (DAI), and Unicast Reverse Path Forwarding (uRPF). The supervisor engine allows close control over which users can access the network and what privileges they are granted through identity-based networking with IEEE 802.1x and port-based security. These integrated security features

are hardware-based so they can be enabled concurrently without compromising system performance as traffic levels increase. The intrusion detection services module, firewall services module, or the IPsec VPN SPA can be installed in the same chassis for maximum security.

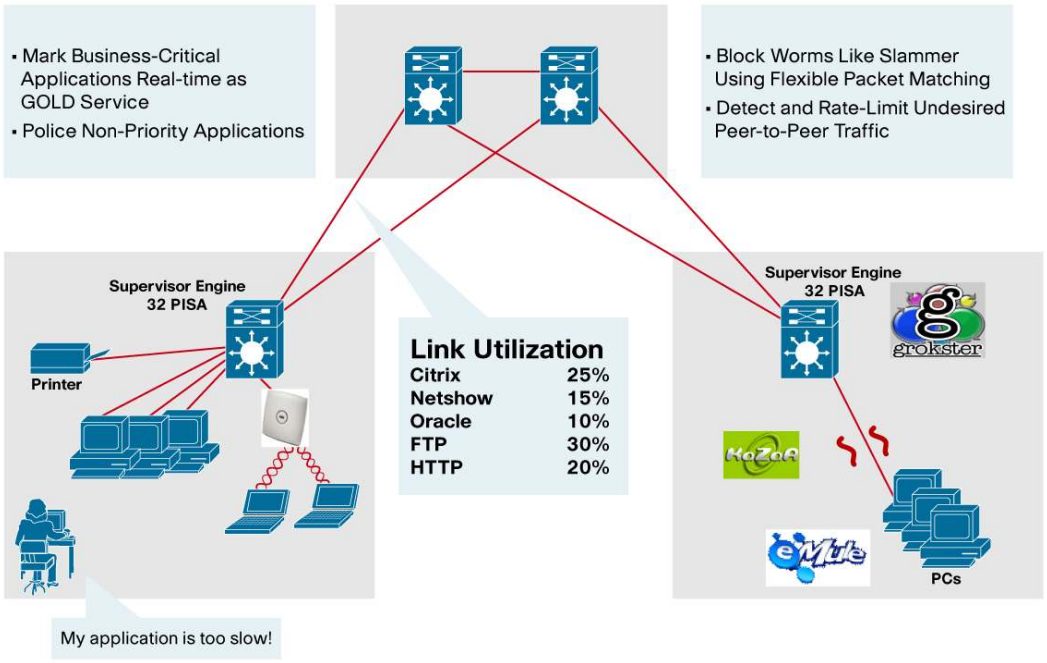
- **High availability:** The Supervisor Engine 32 PISA helps ensure business continuity through minimizing network downtime with its support of Layer 2 Stateful Switchover (SSO), Layer 3 Nonstop Forwarding (NSF), Gateway Load-Balancing Protocol (GLBP), multimodule Cisco EtherChannel®, and rapid convergence protocols such as IEEE 802.1s and 802.1w. It also supports proactive detection and prevention of network equipment failures using Generic Online Diagnostics (GOLD).
- **Enhanced manageability:** Enhancements include support for the Embedded Event Manager (EEM), a powerful ally for device and system management, enabling network administrators to harness the network intelligence intrinsic to Cisco IOS® Software and customize the behavior based on real network events as they happen; support for ACE counters for identifying the frequency that specific access-control-list (ACL) entries are hit; support for hardware-based NetFlow, providing a metering base for a key set of applications, including network traffic accounting, usage-based network billing, network planning, as well as denial of service monitoring capabilities; and support for Encapsulated Remote SPAN (ERSPAN), Digital Optical Monitoring, and Generic Online Diagnostic functions to simplify operational complexity. These enhanced capabilities enable network administrators to respond quickly to user access problems and simplify network management.
- **Slot efficiency:** Uplink density of eight Gigabit Ethernet SFP-based ports and increased bandwidth to two 10 Gigabit Ethernet XENPAK-based ports save slots for deployment of integrated service modules or higher-density chassis.
- **Investment protection:** The Supervisor Engine 32 PISA supports Cisco Catalyst 6500 Series classic modules and Cisco Express Forwarding 256-based (CEF256) modules and is backward-compatible with all Cisco Catalyst 6500 Series chassis, allowing deployment of new, advanced services on existing equipment. The Supervisor Engine 32 PISA also supports the Enhanced FlexWAN module and the shared port adapter (SPA) Interface Processors (SIPs) along with the associated SPAs. This prolongs the deployment lifetime of interface modules and provides greater return on investment.
- **Superior traffic management:** Uplinks are available with four transmit queues per port, with one strict priority queue for high-priority, low-latency traffic, and two receive queues per port. Each port supports Weighted Random Early Detection (WRED) for congestion avoidance within each queue, and Shaped Round Robin (SRR) as well as Deficit Weighted Round Robin (DWRR) for scheduling between queues to aid in traffic prioritization. Up to eight thresholds can be configured to manage differentiated levels of service.
- **Extensive management tools:** The Supervisor Engine 32 PISA supports the CiscoWorks network management platform; QoS Policy Manager (QPM); Network Analysis Module (NAM); Simple Network Management Protocol (SNMP) Versions 1, 2, and 3; Cisco Security Manager; and four Remote Monitoring (RMON) groups (statistics, history, alarms, and events).

Applications

Secure Enterprise LAN Access

The Supervisor Engine 32 PISA provides deep packet inspection, application awareness, high levels of security, availability, and manageability for enterprise LAN access deployments. Support for hardware-accelerated FPM and NBAR on the Supervisor Engine 32 PISA allows customers to move security and classification right to the edge of their networks, providing a comprehensive worm mitigation and application classification solution. Supervisor Engine 32 PISA is capable of accelerating services at 2Gbps for Internet mix (IMIX) traffic, which is optimal for standard campus access networks of typical enterprises using a pair of Gigabit Ethernet Small Form-Factor Pluggable (SFP) uplinks to each distribution layer switch. See Figure 3 for a deployment example.

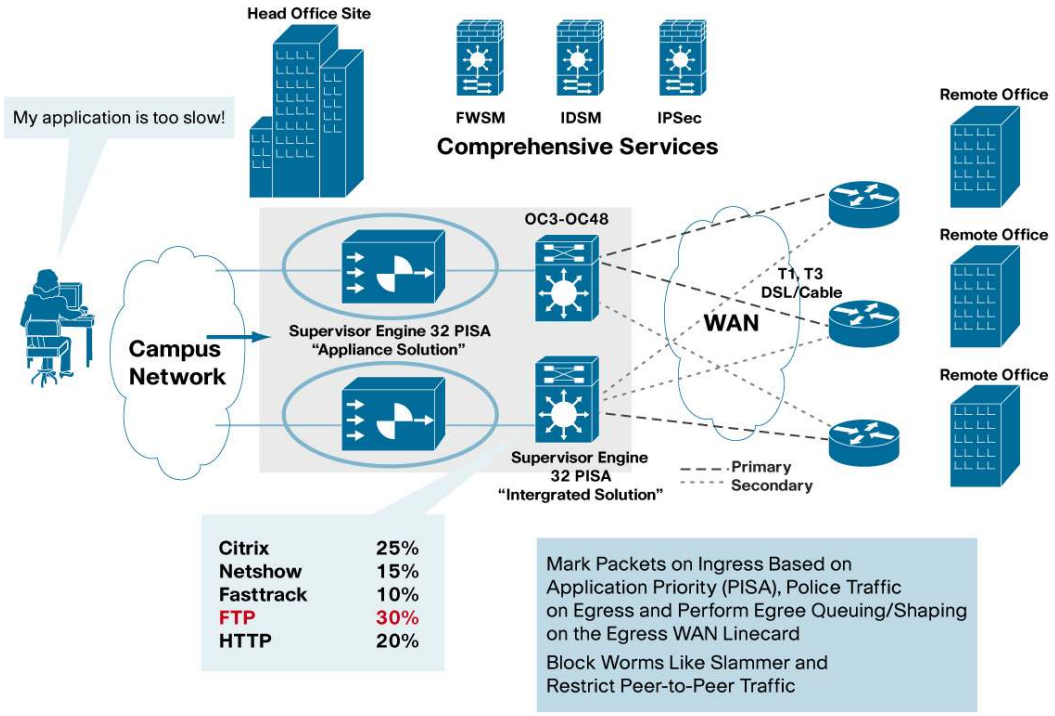
Figure 3. Supervisor Engine 32 PISA Deployment Example in LAN Access



Enterprise WAN Edge, Internet Gateway and Service Provider Services

The Supervisor Engine 32 PISA is purpose built for enterprise WAN edge, Internet gateway, and Metro Ethernet deployments. The PISA on the Supervisor Engine 32 PISA provides hardware acceleration of intelligent services like NBAR and FPM to provide application classification and worm and virus mitigation at multigigabit speeds. Support for these intelligent services, coupled with the support for 256k routes and interface support from T1 to OC48 with shaping, makes the Supervisor Engine 32 PISA an ideal platform for WAN aggregation and Internet gateway deployments. Additionally, equipped with PFC3B, the Supervisor Engine 32 PISA ensures feature and performance compatibility with the Cisco Catalyst 6500 Supervisor Engine 32. It offers advanced hardware-accelerated IP services such as Multiprotocol Label Switching (MPLS), IPv6, Network Address Translation (NAT), generic routing encapsulation (GRE) tunneling, ACLs, rate limiting, and advanced QoS to enable network administrators to build feature-rich networks. (See Figure 4) The uplinks of the Supervisor Engine 32 PISA can also support SRR for rate limiting traffic.

Figure 4. Supervisor Engine 32 PISA Deployment Example in WAN Aggregation and as a Service Appliance



Service Appliance

The Cisco Catalyst 6504-E, together with the Supervisor Engine 32 PISA and up to three service modules, forms an ideal service appliance. High availability can be incorporated in this appliance by making use of a dual Supervisor Engine 32 PISA configuration. Hardware-accelerated services on the PISA, along with service modules like the firewall services module and intrusion detection services (IDS) module, can be deployed together as a security appliance. These advanced services can then be distributed in the network over the integrated eight-port Gigabit Ethernet uplinks or two-port 10 Gigabit Ethernet uplinks from the Supervisor Engine 32 PISA.

Features and Benefits

Table 1 lists the features and benefits of the Supervisor Engine 32 PISA.

Table 1. Features and Benefits of Supervisor Engine 32 PISA

Features	Benefits
Secure Application Fluency and Deep Packet Inspection	
Network Based Application Recognition at Multigigabit Speeds	• Provides the ability to discover protocols and applications running on the network • Allows Intelligent traffic classification based on application type • Supports addition of new protocols and applications using packet description language modules (PDLMs) • Provides the ability to load new PDLM's without changing Cisco IOS Software releases and without rebooting the switch • Supports a wide variety of applications and protocols, including: - P2P: BitTorrent, eDonkey/eMule, FastTrack, Gnutella, KaZaA - Enterprise applications: PCAnywhere, Citrix ICA, Microsoft SQL Server - Streaming Media applications: Real Time Streaming Protocol (RTSP), CU SeeMe, Netshow, StreamWorks, VDOLive - Network Mail Services: Simple Mail Transfer Protocol(SMTP), point of presence (POP3), Internet Mail Access Protocol (IMAP), Lotus Notes, Microsoft Exchange - Internet: HTTP(Hypertext Transfer Protocol) , FTP (File Transfer Protocol), NNTP (Network News Transfer Protocol), IRC (Internet Relay Chat) • GUI based management using QoS Policy Manager (QPM)
Flexible Packet Matching at Multigigabit Speeds	• Provides next generation "Super ACL" pattern matching capability for granular and customized packet filtering • Provides the ability to match on arbitrary bits of a packet at arbitrary depth (offset) in the packet header and payload hence allowing detection of malicious patterns deep within the packet • Allows users to define customized classification criteria for stateless traffic using CLI or off-box via XML • Provides the ability to install new filters on switches without reload • Provides protection again notable worms/viruses such as Slammer and MyDoom and protects against malicious attacks such as Fragmented UDP, HTTP vulnerabilities, and TCP SYN floods. • Supports Flexible Configuration in the Cisco Security Manager to push configuration files to switches
L3 Routing	
• Open Shortest Path First (OSPF and OSPFv2) • Enhanced Interior Gateway Routing Protocol (EIGRP) • Intermediate System-to-Intermediate System (IS-IS) Protocol • Border Gateway Protocol Version 4 (BGPv4) • Bidirectional Forwarding Detection (BFD) for OSPF and IS-IS • Static Routing	High-performance IP routing protocols form the foundation for scalable Layer 3 services.
IPv6	
• Native IPv6 • RIPng, MP-BGP4, OSPFv3 • IPv6 over IPv4 Tunnels • Internet Control Message Protocol Version 6 (ICMPv6) • Configured, Automatic, GRE, 6to4, ISATAP Tunnels • IPv6 QoS • PIM-SM and PIM-SSM	Improves the scalability of IP deployments, allowing high-performing network evolution. Multicast protocols and QoS features optimize triple-play and video delivery over an end-to-end IP architecture.
L2 Switching	

• IEEE 802.1Q • 802.1Q Tunneling • Layer 2 Protocol Tunneling (L2PT) • VLAN Translation	802.1Q and L2PT are the service enablers to offer Layer 2 VPNs. By encapsulating subscribers' data frames in a service provider 802.1Q tag and by tunneling subscribers' PDU, 802.1Q tunneling offers Transparent LAN Services (TLS) to scale the number of Metro Ethernet subscribers beyond the 4096 VLAN boundary. VLAN Translation increases the flexibility of single tagged 802.1Q service by decoupling subscribers' and service providers' VLAN IDs.
• IEEE 802.1D • IEEE 802.1w	Protocols such as IEEE 802.1D, IEEE 802.1w, and IEEE 802.1s help ensure business continuity by minimizing the network convergence time for time-sensitive applications.
• IEEE 802.1s • Flexlink • Port Aggregation Protocol (PAgP) • IEEE 802.3ad (LACP) • Unidirectional Link Detection	Flexlink provides fast failover over point-to-point connections, without the overhead of control protocols. PAgP and IEEE 802.3ad increase bandwidth availability and provide fast link failover within the Cisco EtherChannel bundle. Unidirectional Link Detection (UDLD) increases the network reliability by quickly detecting unidirectional links or misplaced fiber connectors.
• Cisco Discovery Protocol • VLAN Trunk Protocol (VTP)	Cisco Discovery Protocol and VTP ease the network and service configuration by detecting peer capability and by propagating the VLAN's information within the service provider network.
DDoS and Spoofing Protection, Intrusion Detection	
• DHCP snooping • Dynamic ARP inspection (DAI) • CPU rate limiting • Control Plane Policing • Hardware enabled NetFlow • User-based rate limiting • Unicast Reverse Path Forwarding (uRPF) • Hardware-based MAC learning • Cisco Catalyst 6500 IDS and Firewall modules • Broadcast and multicast suppression • Port Security on Access, 802.1Q Trunks, and 802.1Q Tunneling ports	Provides local containment of security threats and protects networks against security vulnerabilities, including malicious and inadvertent intrusion.
Trust, Identity, and Data Confidentiality	
• Identity-based networking services with IEEE 802.1x • Network Admission Control • IPsec support through IPsec SPA and SSC-400	Allows close control over which users can access the network and what privileges they are granted. Identifies posture (or compliance) of the device to help ensure the device can be safely admitted to the network without undue hazard. Provides confidentiality and integrity for data, voice, and management traffic.
High Availability	
• Hot-Swapping of Standby Supervisor Engines • Layer 2 rapid convergence protocol suite • Hardware redundancy with subsecond stateful failover (SSO) and Non Stop Forwarding (NSF) • Generic Online Diagnostics • Hot Standby Router Protocol (HSRP) • Virtual Router Redundancy Protocol (VRRP) • Gateway Load Balancing Protocol (GLBP) • Fault management: - Fault detection and troubleshooting - System health check - Enhanced memory protection - Proactive detection and prevention of network Equipment failures using GOLD	Helps ensure business continuity through minimizing network downtime for mission-critical applications.
Integrated and Operations Management	
Switched Port Analyzer (SPAN), Remote SPAN (RSPAN), Encapsulated Remote SPAN (ERSPAN)	Enables remote troubleshooting from anywhere, reducing troubleshooting time and tool costs.
CiscoWorks, Resource Management Essential (RME), QoS Policy Manager (QPM), Cisco Security Manager	GUI-based tools provide QoS and security management.
Network Analysis Module	Provides embedded data collection and analysis capabilities with a remotely accessible, Web-based management console.
ACE counters	Identifies frequency that specific ACL entries are hit for ease of management.

Embedded Event Manager	Harnesses the network intelligence intrinsic to Cisco IOS Software and customizes the behavior based on real network events as they happen.
SNMPv3, SSH Protocol Version 2, Secure Copy Protocol (SCP)	Provides secure management.
Efficient Multicast Delivery	
• Hardware-based multicast forwarding • Bidirectional Protocol Independent Multicast (PIM) • Internet Group Management Protocol (IGMP) Querier • Router-port Group Management Protocol (RGMP) • Multiprotocol Border Gateway Protocol (MBGP) • Multicast Virtual Private Networks (MVPN) • PIM SM, PIM SSM, and PIM snooping • IGMP Versions 1, 2, and 3	Enables efficient video broadcasting, e-learning, and information sharing.
Slot Efficiency and Backward Compatibility	
Eight Gigabit Ethernet SFP-based ports or two10-Gigabit Ethernet XENPAK-based ports	Increases uplink density and saves slots to deploy integrated service modules or higher-density chassis. In addition to the uplinks, each supervisor provides a copper 10/100/1000 uplink.
Support for all Cisco Catalyst 6500 classic and Cisco Express Forwarding 256-based modules and relevant services modules; support for all Cisco Catalyst 6500 Series chassis	Allows deployment of new advanced services on existing equipment, prolonging the deployment lifetime of interface modules and providing greater return on investment.
Advanced Quality of Service (QoS)	
• Packet classification, marking, and congestion avoidance based on Layer 2-4 header information • User-based rate limiting enforces any of 64 policy rates, maintaining service-level agreements on a per-user basis independent of traffic type or IP address • QoS scheduling rules with thresholds can be configured in the switch for multiple receive and transmit queues	Superior traffic management enables efficient handling of converged networks that carry a mix of mission-critical, time-sensitive, and bandwidth-intensive multimedia applications.
• Priority Queue • Shaped Round Robin (SRR) • Deficit Weighted Round Robin (DWRR) • Weighted Random Early Detection (WRED) • Egress Policing	Intelligent queuing mechanism helps ensure that the highest-priority data is serviced ahead of other traffic. Congestion avoidance and scheduling algorithms help regulate traffic and prevent network congestion. SRR enhances the scheduling algorithm by shaping the traffic that egresses each queue.
MPLS	
• Ethernet over MPLS (EoMPLS) • EoMPLS VC Type 4 and VC Type 5 • MPLS VPNs (RFC4364/RFC2547bis) • MPLS Traffic Engineering (MPLS TE) • MPLS Fast Reroute (MPLS FRR)	Enhanced MPLS service flexibility allowing Layer 2 and Layer 3 services integration on the same platform.
Advanced Layer 2-4 Services	
• Hardware-enabled GRE tunnels for IP traffic • NAT—Translates addresses for inbound and outbound traffic in hardware, allowing clean separation between internal and external networks	Advanced Layer 2-4 forwarding enables service providers and enterprises to build feature-rich networks.

Note: Not all Supervisor Engine 32 PISA features are enabled in the first software release. Refer to the release notes for up-to-date software version information for support of different features at http://www.cisco.com/univercd/cc/td/doc/product/lan/cat6000/relnotes/index.htm.

NBAR Protocol Support

NBAR on Supervisor Engine 32 PISA is capable of classifying the following types of protocols:

- Non-UDP and non-TCP IP protocols
- TCP and UDP protocols that use statically assigned port numbers
- TCP and UDP protocols that dynamically assign port numbers and therefore require stateful inspection.
- Peer to Peer Protocols
- VoIP Protocols

Table 2. Non-UDP and Non-TCP Protocols

Protocol	Type	Protocol Number	Description
EGP	IP	8	Exterior Gateway Protocol
EIGRP	IP	88	Enhanced Interior Gateway Routing Protocol
GRE	IP	47	Generic Routing Encapsulation
ICMP	IP	1	Internet Control Message Protocol
IPINIP	IP	4	IP in IP
IPSec	IP	50, 51	IP Encapsulating Security Payload/Authentication Header

Table 3. TCP and UDP Static Port Protocols

Protocol	Type	Well-Known Port Number	Description
BGP	TCP/UDP	179	Border Gateway Protocol
CU-SeeMe	TCP/UDP	7648, 7649	Desktop videoconferencing
CU-SeeMe	UDP	24032	Desktop video conferencing
DHCP/BOOTP	UDP	67, 68	Dynamic Host Configuration Protocol/ Bootstrap Protocol
DNS	TCP/UDP	53	Domain Name System
Finger	TCP	79	Finger user information protocol
Gopher	TCP/UDP	70	Internet Gopher Protocol
HTTP	TCP	80[2]	Hypertext Transfer Protocol
HTTPS	TCP	443	Secured HTTP
IMAP	TCP/UDP	143, 220	Internet Message Access Protocol
IRC	TCP/UDP	194	Internet Relay Chat
Kerberos	TCP/UDP	88, 749	Kerberos Network Authentication Service
L2TP	UDP	1701	L2F/L2TP tunnel
LDAP	TCP/UDP	389	Lightweight Directory Access Protocol
MS-PPTP	TCP	1723	Microsoft Point-to-Point Tunneling Protocol for VPN
MS-SQLServer	TCP	1433	Microsoft SQL Server Desktop Videoconferencing
NetBIOS	TCP	137, 139	NetBIOS over IP (MS Windows)
NetBIOS	UDP	137, 138	NetBIOS over IP (MS Windows)
NFS	TCP/UDP	2049	Network File System
NNTP	TCP/UDP	119	Network News Transfer Protocol
Notes	TCP/UDP	1352	Lotus Notes
Novadigm	TCP/UDP	3460-3465	Novadigm Enterprise Desktop Manager (EDM)
NTP	TCP/UDP	123	Network Time Protocol
PCAnywhere	TCP	5631, 65301	Symantec PCAnywhere

PCAnywhere	UDP	22, 5632	Symantec PCAnywhere
POP3	TCP/UDP	110	Post Office Protocol
Printer	TCP/UDP	515	Printer
RIP	UDP	520	Routing Information Protocol
RSVP	UDP	1698, 1699	Resource Reservation Protocol
SFTP	TCP	990	Secure FTP
SHTTP	TCP	443	Secure HTTP
SIMAP	TCP/UDP	585, 993	Secure IMAP
SIRC	TCP/UDP	994	Secure IRC
SLDAP	TCP/UDP	636	Secure LDAP
SMTP	TCP	25	Simple Mail Transfer Protocol
SNMP	TCP/UDP	161, 162	Simple Network Management Protocol
SNNTP	TCP/UDP	563	Secure NNTP
SOCKS	TCP	1080	Firewall security protocol
SPOP3	TCP/UDP	995	Secure POP3
SSH	TCP	22	Secured Shell
STELNET	TCP	992	Secure Telnet
Syslog	UDP	514	System Logging Utility
Telnet	TCP	23	Telnet Protocol
X Windows	TCP	6000-6003	X11, X Windows

Table 4. TCP and UDP Stateful Protocols

Protocol	Type	Description
Citrix ICA	TCP/UDP	Citrix ICA traffic by application name
FTP	TCP	File Transfer Protocol
Exchange	TCP	MS-RPC for Exchange
HTTP	TCP	HTTP with URL, MIME, or host classification
Netshow	TCP/UDP	Microsoft Netshow
R-commands	TCP	rsh, rlogin, rexec
RTP	TCP/UDP	Real-Time Transport Protocol Payload Classification
RTSP	TCP/UDP	Real-Time Streaming Protocol
SAP-PGM	TCP/UDP	SAP Program traffic
SAP-MSG	TCP/UDP	SAP Message traffic
SAP-APP	TCP/UDP	SAP Application traffic
SQL*NET	TCP/UDP	SQL*NET for Oracle
StreamWorks	UDP	Xing Technology Stream Works audio and video
SunRPC	TCP/UDP	Sun Remote Procedure Call
TFTP	UDP	Trivial File Transfer Protocol
VDOLive	TCP/UDP	VDOLive Streaming Video

Table 5. Peer-to-Peer Protocols

Peer-to-Peer Protocol	Type	Description
BitTorrent	TCP	File-sharing application
Gnutella	TCP	File-sharing application
Kazaa2	TCP	File-sharing application
eDonkey	TCP	File-sharing application
Fasttrack	TCP	File-sharing application
WinMX	TCP	File-sharing application
Direct Connect	TCP	File-sharing application

Table 6. VoIP Protocols

VoIP Protocol	Type	Description
RTCP	TCP/UDP	Real-Time Control Protocol
SCCP	TCP	Skinny Call Control Protocol
SIP	TCP/UDP	Session Initiation Protocol
MGCP	TCP/UDP	Media Gateway Control Protocol
H.323	TCP/UDP	An ITU-T standard for digital videoconferencing over TCP/IP networks

Supervisor Engine 32 PISA Architecture

The Supervisor Engine 32 PISA provides the intelligent services of the Supervisor Engine 32 and at the same time provides hardware acceleration of services like NBAR and FPM. Additionally, it provides performance and price points suitable for the LAN access, WAN edge, and Metro Ethernet access (Table 7).

Table 7. Cisco Catalyst 6500 Series Supervisor Engine Comparison

Feature	Supervisor Engine 720	Supervisor Engine 32	Supervisor Engine 32 PISA
Uplinks	Two Gigabit Ethernet ports: one gigabit interface converter (GBIC) based and one configurable to GBIC based or 10/100/1000 RJ-45 based	• Eight Gigabit Ethernet ports, SFP based + one 10/100/1000 RJ-45 port OR • Two 10 Gigabit Ethernet ports, XENPAK based + one 10/100/1000 RJ-45 port	• Eight Gigabit Ethernet ports, SFP based + one 10/100/1000 RJ-45 port OR • Two 10 Gigabit Ethernet ports, XENPAK based + one 10/100/1000 RJ-45 port
Uplink Queue Structure	• Tx 1p2q2t • Rx 1p1q4t • 512 KB buffer per port	• Tx 1p3q8t • Rx 2q8t • 9.5 MB buffer per Gigabit Ethernet port • 100 MB buffer per 10 Gigabit Ethernet port	• Tx 1p3q8t • Rx 2q8t • 9.5 MB buffer per Gigabit Ethernet port • 100 MB buffer per 10 Gigabit Ethernet port
Uplink Port Scheduler	WRR	DWRR or SRR	DWRR or SRR
Self-Power Cycling	No, power cycle line cards only	Yes, power cycle remotely through console port	Yes, power cycle remotely through console port
Backplane	720 Gbps integrated switch fabric module (SFM)	32 Gbps shared bus	32 Gbps shared bus
Performance	Up to 400 Mpps for Cisco Express Forwarding interface modules	Up to 15 Mpps IPv4 services	Up to 15 Mpps IPv4 services
Deep Packet Inspection Performance (NBAR, FPM)	N/A	N/A	2Gbps

Cisco Express Forwarding	Hardware-based	Hardware-based	Hardware-based and PISA assisted for features like NBAR and FPM
Distributed Cisco Express Forwarding	Yes, with a DFC3 present	No	No
***SP NVRAM**	2 MB (SP)	2 MB (SP)	2 MB (SP)
***SP Dynamic RAM (DRAM)**	512 MB default, upgradeable to 1 GB on Supervisor Engine 720-3B; 1 GB default on Supervisor Engine 720-3BXL	512 MB default, upgradeable to 1 GB	512 MB default, upgradeable to 1 GB
***SP Onboard Flash (BootFlash)**	64 MB upgradeable to 512 MB, 1GB	256 MB, through internal compact flash (referred to as sup-bootdisk in command-line interface), upgradeable to 512 MB, 1 GB	512 MB, through internal compact flash (referred to as sup-bootdisk in command-line interface), upgradeable to 1 GB
****RP Dynamic RAM (DRAM)**	512 MB default, upgradeable to 1 GB on Supervisor Engine 720-3B; 1 GB default on Supervisor Engine 720-3BXL	512 MB default, upgradeable to 1 GB	1GB default
****RP Onboard Flash (BootFlash)**	64MB default	64MB default	256MB default
Chassis Supported	All Cisco Catalyst 6500 Series chassis with fan tray 2 or E-Series fan tray and 2500W power supplies or above	All Cisco Catalyst 6500 Series chassis with fan tray 2 or E-Series fan tray and 2500W power supplies or above	All Cisco Catalyst 6500 Series chassis with fan tray 2 or E-Series fan tray and 2500W power supplies or above
Minimum Software Support	• Cisco Catalyst 6500 Series: • CatOS 8.1(1) • Cisco IOS Software 12.2(14)SX	• Cisco Catalyst 6500 Series: • CatOS 8.4(1) • Cisco IOS Software 12.2(18)SXF	• Cisco Catalyst 6500 Series: • Cisco IOS Software 12.2(18)ZY
Slot Requirements	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	Slots 1 and 2 in a 3-slot and 4 slot chassis, slots 5 and 6 in a 6- or 9-slot chassis, and slots 7 and 8 in a 13-slot chassis	Slots 1 and 2 in a 3-slot and 4 slot chassis, slots 5 and 6 in a 6- or 9-slot chassis, and slots 7 and 8 in a 13-slot chassis
Hardware-Based Forwarding Engine	PFC3A, PFC3B, or PFC3BXL onboard	PFC3B onboard	PFC3B onboard
MSFC Daughter Card Version	MSFC3	MSFC2A; Advanced routing protocol support with layer 3 license	PISA, which integrates MSFC2A functions of Supervisor Engine 32 board

*Switch Processor, **Route Processor.

The Supervisor Engine 32 PISA with PFC3B and PISA daughter cards provide the following functions:

- **PFC3B:** Performs hardware-based Layer 2-4 packet forwarding as well as packet classification, traffic management, and policy enforcement.
- **PISA:** Performs Layer 3 control-plane functions, including address resolution and routing protocols; In addition performs hardware acceleration of deep packet inspection services such as NBAR and FPM.

Ordering Information

Table 8 provides part numbers for the Supervisor Engine 32 PISA.

Table 8. Supervisor Engine 32 PISA Part Numbers

Product Number	Description
Supervisor Engine 32 PISA	
WS-S32-GE-PISA	Catalyst 6500 Supervisor 32 with PISA and 8 GE uplinks
WS-S32-10GE-PISA	Cat 6500 Supervisor 32 with PISA and 2 ports 10GbE
Memory Options for Supervisor Engine 32 PISA	
MEM-xCEF720-512M	Default switch processor (SP) DRAM on the Supervisor Engine 32 PISA baseboard
MEM-MSFC3-1GB	Default route processor (RP) DRAM on PISA (Programmable Intelligent Services Accelerator)
MEM-C6K-CPTFL512M	Default switch processor (SP) bootflash on the Supervisor Engine 32 PISA baseboard
MEM-C6K-CPTFL256M	Default route processor (RP) bootflash on PISA (Programmable Intelligent Services Accelerator)
MEM-C6K-CPTFL256M	Optional external 256-MB compact flash memory
MEM-C6K-CPTFL512M	Optional external 512-MB compact flash memory
Software Options for Supervisor Engine 32 PISA	
S3P3IBL-12218ZY	Cisco CAT6000 SUP 32 PISA IP BASE LAN ONLY Includes support for • RIP, Static Routing, EIGRP Stub • Network Based Application Recognition (NBAR) • Flexible Packet Matching (FPM)
S3P3IBK9L-12218ZY	Cisco CAT6000 SUP 32 PISA IP BASE SSH LAN ONLY Includes support for • RIP, Static Routing, EIGRP Stub • Network Based Application Recognition (NBAR) • Flexible Packet Matching (FPM)
S3P3IS-12218ZY	Cisco CAT6000 SUP32 PISA IP SERVICES Same functionality as the IP BASE image PLUS • IPv4 routing and services
S3P3ISK9-12218ZY	Cisco CAT6000 SUP32 PISA IP SERVICES SSH Same functionality as the IP BASE image PLUS • IPv4 routing and services
S3P3AIK9-12218ZY	Cisco CAT6000 SUP32 PISA ADVANCED IP SERVICES SSH Same functionality as the IP SERVICES image PLUS • Advanced MPLS feature set • Layer3 IPv6 Services • Advanced FPM Manageability

Standards and Management

Table 9 describes Supervisor Engine 32 PISA standards and management.

Table 9. Supervisor Engine 32 PISA Standards and Management

Description	Specification
Standards and Protocols	• IEEE 802.3 • IEEE 802.3u • IEEE 802.3z • IEEE 802.1t • IEEE 802.1u • IEEE 802.3x • IEEE 802.3ab • IEEE 802.1Q • IEEE 802.1p • IEEE 802.1D • IEEE 802.1w • IEEE 802.1s • IEEE 802.1x • IEEE 802.3ad • IEEE 802.3x • RIPv2 • EIGRP • OSPF • IS-IS • BGPv4 • Policy Based Routing (PBR) • HSRP (RFC2281) • Virtual Router Redundancy Protocol (VRRP) • Bidirectional Forwarding Detection (BFD) for OSPF and IS-IS • Internet Group Management Protocol (IGMP) v1, v2, v3 • IGMP Proxy reporting for IGMPv2 and MLDv1 • PIM • PIM-SM, PIM-SSM, Bidirectional PIM • WCCPv2 • MPLS VPN (RFC2547) • Ethernet over MPLS (EoMPLS Martini draft)
Management	• Simple Network Management Protocol Version 1, 2, and 3 (SNMPv1, v2, v3) • Telnet Interface • VTP • CDP • IGMP Snooping • DHCP Snooping • Remote Switch Port Analyzer (RSPAN), Encapsulated Remote SPAN (ERSPAN) • Embedded Remote Monitoring (RMON) software agent • Domain Name System (DNS) • Trivial File Transfer Protocol (TFTP) • Network Timing Protocol (NTP) • Multifunctional LEDs per port

MIBs	• BRIDGE-MIB (RFC1493) • BGP4-MIB (RFC1657) • CISCO-ACCESS-ENVMON-MIB • CISCO-BGP-POLICY-ACCOUNTING-MIB • CISCO-BGP4-MIB • CISCO-CDP-MIB • CISCO-CLASS-BASED-QOS-MIB • CISCO-CONFIG-COPY-MIB • CISCO-CONFIG-MAN-MIB • CISCO-ENTITY-ALARM-MIB • CISCO-ENTITY-EXT-MIB • CISCO-ENTITY-VENDORTYPE-OID-MIB • CISCO-FLEX-LINKS-MIB • CISCO-FTP-CLIENT-MIB • CISCO-HSRP-EXT-MIB • CISCO-HSRP-MIB • CISCO-IETF-IP-FORWARD-MIB • CISCO-IETF-IP-MIB • CISCO-IF-EXTENSION-MIB • CISCO-IMAGE-MIB • CISCO-IP-STAT-MIB • CISCO-IPMROUTE-MIB • CISCO-L2-CONTROL-MIB • CISCO-L2-TUNNEL-CONFIG-MIB • CISCO-MAC-NOTIFICATION-MIB • CISCO-MEMORY-POOL-MIB • CISCO-NBAR-PROTOCOL-DISCOVERY-MIB • CISCO-NDE-MIB • CISCO-OSPF-MIB • CISCO-OSPF-TRAP-MIB • CISCO-PAE-MIB • CISCO-PAGP-MIB • CISCO-PIM-MIB • CISCO-PING-MIB • CISCO-PRIVATE-VLAN-MIB • CISCO-PROCESS-MIB • CISCO-PRODUCTS-MIB • CISCO-QUEUE-MIB • CISCO-RMON-CONFIG-MIB • CISCO-RTTMON-MIB • CISCO-STP-EXTENSIONS-MIB • CISCO-SVI-AUTOSTATE-MIB • CISCO-SWITCH-ENGINE-MIB • CISCO-SYSLOG-MIB • CISCO-TCP-MIB • CISCO-UDLDP-MIB

Safety and Compliance

Table 10 describes Supervisor Engine 32 PISA safety and compliance.

Table 10. Supervisor Engine 32 PISA Safety and Compliance

Description	Specification
Electromagnetic Emission Compliance (EMC)	• FCC Part 15 (CFR 47) Class A • VCCI Class A • EN55022 Class A • CISPR 22 Class A • CE marking • AS/NZS 3548 Class A • ETS300 386 • EN55024 • EN61000-6-1 • EN50082-1
Physical Specifications	• Occupies one slot in a Cisco Catalyst 6500 Series • Dimensions (H x W x D): 1.6 x 15.3 x 16.3 in. (4.0 x 37.9 x 40.3 cm)
Safety	• UL 60950 • CSA-C22.2 No. 60950 • EN 60950 • IEC 60950 • AS/NZS 60950/TS001
ETSI	• ETS 300 019 Storage Class 1.1 • ETS 300 019 Transportation Class 2.3 • ETS 300 019 Stationary Use Class 3.1
Operating Environment	• 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: Sea level to 6500 ft (1981 m)

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