

Cisco Catalyst 4000 Enhances Control of Voice, Video, and Data Traffic for Converged Networks

Introducing the Cisco Catalyst® 4006 Supervisor Engine III and the Cisco Catalyst 4000 Family 48-Port 10/100/1000 Line Card

Overview

The Cisco Catalyst 4000 integrates nonblocking Layer 2/3/4 switching with enhanced control, enabling business agility for enterprise and metropolitan (metro) Ethernet customers deploying Internet-based applications. As a key component of Cisco AVVID (Architecture for Voice, Video and Integrated Data), the Cisco Catalyst 4000 extends control from the backbone to the network edge with intelligent network services, including advanced quality of service (QoS), scalable performance, comprehensive security, and simple manageability. The modular architecture, media flexibility, and expandability of the Cisco Catalyst 4000 enable a longer deployment life in converged networks, reducing the cost of ownership by minimizing recurring operational expenses, thus, improving return on investment (ROI).

Convergence

In today's highly competitive business environment, a converged network plays a critical part in helping an organization gain a competitive advantage through increased productivity, organizational flexibility, and reduced operational costs. Integration of voice, video, and data onto a single (IP-based) network requires a switching infrastructure that can differentiate each traffic type and handle it according to its unique requirements. The Supervisor Engine III for the Cisco Catalyst 4006 offers a switching infrastructure that can deliver this advanced functionality through sophisticated control features of Cisco IOS® Software.

Control

The Cisco Catalyst 4000 provides the network infrastructure for Cisco AVVID that is the foundation for all applications that will be integrated to solve business problems. Extending intelligent network services to this platform is imperative to ensure control of all traffic types. The Cisco Catalyst 4000 Supervisor Engine III delivers control with:

- QoS—Advanced Layer 2/3/4-based QoS and sophisticated traffic management with rate-limiting capabilities help organizations improve responsiveness with unimpeded access

Figure 1:
Cisco Catalyst 4003
and 4006



to critical information, by prioritizing time-sensitive and mission-critical traffic based upon business-defined policies. Network policies can be applied based on traffic types such as specific users, IP addresses, or actual applications.

- *Enhanced performance*—Wire-speed, hardware-based switching at 48 Mpps is enabled through Cisco Express Forwarding (CEF), providing efficient Layer 3/4 packet-processing capabilities and optimizing network performance in increasingly dynamic network environments.
- *Security*—As more users access the Internet and as companies expand their networks, control over security for internal networks becomes increasingly challenging. The Cisco Catalyst Supervisor Engine III performs hardware-based filtering based on access lists used to define security policies.
- *Manageability*—The Cisco Catalyst 4000 provides a single point of management for the configuration and control of all ports at Layer 2 and Layer 3/4, resulting in fewer network elements overall, simplified changes and a lower risk of configuration errors.

Scalable Architecture

As convergence lowers the overall cost of ownership of a network and simplifies administration and maintenance through the elimination of separate voice, video, and data infrastructures, it makes sense for companies to seek these qualities in the network infrastructure itself. The modular architecture of the Cisco Catalyst 4000 provides the scalability and flexibility to eliminate the need for multiplatform deployments, minimizing maintenance expenses. Now with enhanced control and performance with the Supervisor Engine III, the Cisco Catalyst 4000 is well positioned to provide business agility and a competitive advantage to all corporations implementing converged network infrastructures.

Cisco Catalyst 4000 System

The Cisco Catalyst 4000 Family, now with two chassis alternatives and three supervisor engines, provides a common architecture that scales to 240 ports of 10/100 or 100BASE-FX Fast Ethernet, or 240 ports of 10/100/1000BASE-T or 1000BASE-LX Gigabit Ethernet. The Cisco Catalyst 4006 enhances Cisco's commitment to affordable enterprise and branch scalability, providing a cost-effective, flexible network solution that scales to meet today's high-performance needs with investment protection.

Key Benefits

The Cisco Catalyst 4000 Series provides advanced high-performance solutions for enterprise wiring closets, small backbones, Layer 3 distribution points, and integrated branch-office solutions. Key benefits include:

- *Performance*—Delivering advanced switching solutions that scale bandwidth as you add ports, the Cisco Catalyst 4000 Family solution is powered by leading-edge application-specific integrated circuit (ASIC) technology that offers wire-speed Layer 2 and Layer 3 10/100 or gigabit switching. Offering modular supervisor flexibility with complete line card compatibility, Layer 2 switching can scale up to 64 Gbps, 48 Mpps. Layer 3/4 switching is CEF based and can also scale up to 64 Gbps, 48 Mpps.
- *Port density*—The Cisco Catalyst 4000 Family of switches meet network element connectivity requirements of up to 240 copper or fiber Fast Ethernet or Gigabit Ethernet ports in a chassis. The Cisco Catalyst 4000 supports the industry's highest-density 10/100/1000 autosensing, autonegotiating Gigabit Ethernet from the network edge directly to desktop computers. The hot-swappable modular "plug-and-play" switching solution of the Cisco Catalyst 4000 Family reduces complexity and easily supports the changing desktop environments of today's networks.
- *Cisco IOS network services*—Cisco Catalyst 4000 Family switches provide mature enterprise Layer 2 and Layer 3 features capable of enhancing corporate networks. These features meet the advanced networking demands of medium- and large-enterprise businesses because their improvements have been based on years of customer feedback.
- *Consistent software architecture*—Because of the consistent Cisco Catalyst software and user interfaces, customers can take advantage of their knowledge base and continue to grow their infrastructures using a combination of Cisco Catalyst 2950, 3550, 4000, 5000, 6500, and 8500 Series members.
- *Investment protection*—The flexible, modular architecture provides cost-effective change management of dynamics desktop connections in the wiring-closet or branch-office backbone. The Cisco Catalyst 4006 backplane further provides network protection for the Supervisor Engine II installed base because it supports a 64-Gbps nonblocking capacity for chassis upgrades to Supervisor Engine III. Compatible sparing between Cisco Catalyst 4003 and 4006 chassis provides a large overlap with commonality of power supplies and switching line cards, lowering the overall deployment, migration, and support costs.

- *Functionally transparent line cards*—The Cisco Catalyst 4000 system can easily upgrade all system ports to higher-layer switching functionality by simply adding a new supervisor engine such as the Supervisor Engine III. Higher-layer functionality enhancements are possible on all system ports without replacing existing line cards and wiring, unlike conventional switching products where forklift upgrades are a typical operation during migration. This architecture advantage extends the useful deployment life of Cisco Catalyst 4000 Series line cards.
- *Cisco AVVID integration*—Inline power line cards, combined with the Cisco Access Gateway Module (AGM) integrating Cisco CallManager voice services, enable the Cisco Catalyst 4000 to support Cisco AVVID in the enterprise headquarters and branch office.
- *WAN integration*—The Cisco Catalyst 4000 Access Gateway Module provides integrated WAN routing to the Cisco Catalyst 4000 Family of switches to offer infrastructure consolidation and Cisco AVVID support for the branch office.
- *Gigabit to the desktop*—The Cisco Catalyst 4000 Family already provides a rich variety of 1000-Mbps desktop and server switching solutions. The scope of gigabit solutions of the Cisco Catalyst 4000 system is easily extended to the desktop, with the 48- and 24-port triple-speed autosensing and autonegotiating 10/100/1000BASE-T line cards and 12-port 1000BASE-T (plus 2-port GBIC) line card for the Cisco Catalyst 4000 Family Series. The triple-speed 48- and 24-port modules, with autosensing technology, provide wiring-closet investment protection by allowing Fast Ethernet desktops today to migrate to Gigabit Ethernet in the future without replacing the line cards.
- *Hardware-based multicasting*—Protocol Independent Multicast (PIM), dense and sparse mode, Internet Group Management Protocol (IGMP), and Cisco Group Management Protocol support standards-based and Cisco product-enhanced efficient multimedia networking without compromising performance.
- *Shared-memory architecture*—The low-latency, centralized, shared-memory switching-fabric architecture delivers leading-edge, wire-speed broadcast/multicast capabilities without the need of replicating packets. It also eliminates any possibility of head-of-line blocking.
- *Manageability*—Increased control and security are assured with the advanced manageability delivered on every Cisco Catalyst 4000 Family switching solution, with industry standards-based management built into every port. A common modular QoS CLI (MQC) simplifies the creation of policy traffic maps, and delivers a consistent interface across large and small Cisco Catalyst switches. Your network operations are enhanced with flexible, Web-based, graphic user interface (GUI)-based, and

command-line interface (CLI)-based management alternatives. Best of all, behind every Cisco Catalyst 4000 Family switch are award-winning Cisco service and support solutions.

- *Bandwidth protection for mission-critical applications*—Centralized enterprise-wide policy creation with CiscoAssure support and network-wide QoS for both Layer 2 class of service (CoS) and Layer 3 type of service (ToS) combine to guarantee application performance from the edge to the core. Even when using only Layer 2 switching, the Cisco Catalyst Supervisor Engine III benefits from looking at the Layer 3 (IP address) and Layer 4 (TCP/User Datagram Protocol [UDP] port number) header information for additional control without the all-too-common performance penalty of turning on advanced features.
- *Fiber to the desktop*—The Cisco Catalyst 4000 Family 24- and 48-port 100BASE-FX line cards offer the security and resiliency features of fiber-optic cable plants, making them ideal for networks with concerns for distance limitations, intrusion, or radio frequency interference. Enterprise customers or government agencies that process confidential information or offer e-commerce will appreciate the security benefits of these line cards.

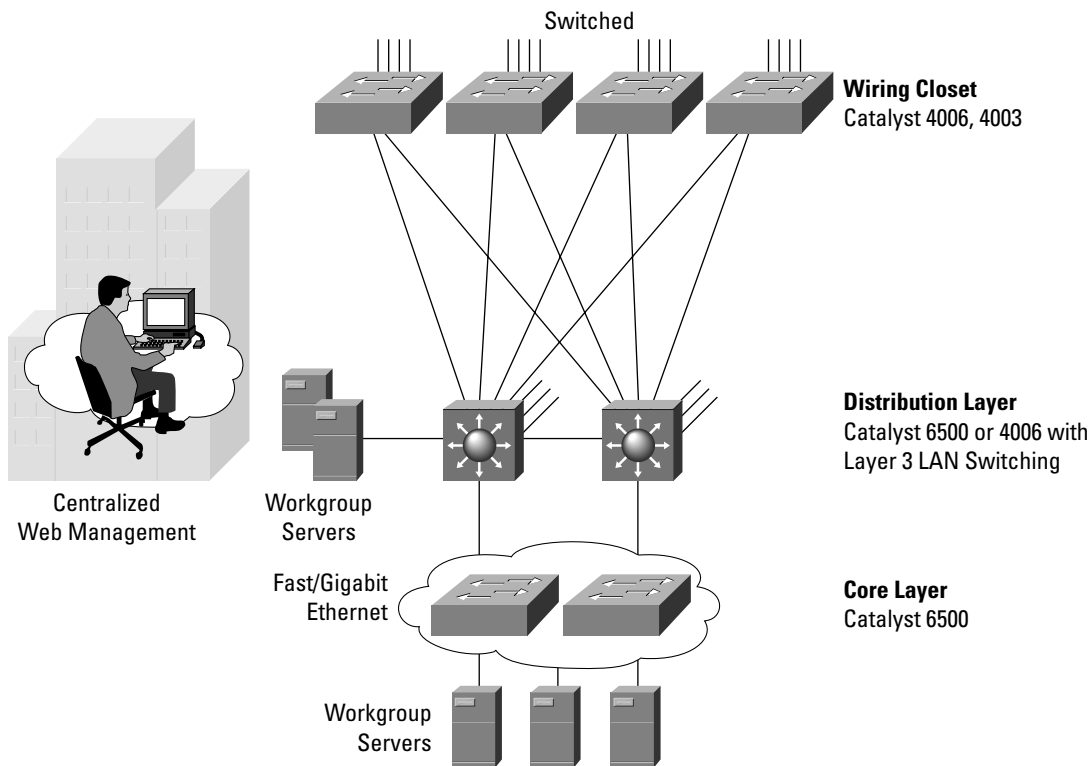
Applications

Multilayer Switched Enterprise Network with Ethernet Backbone

- Today's leading-edge network designs utilize a Layer 2 wiring closet (Cisco Catalyst 4000 Family); the distribution layer is a combination of Layer 2 and Layer 3 (Cisco Catalyst 4000 or 6000 Family) and the backbone is Layer 2 (refer to Figure 2). Supporting IP-only routing with the Supervisor Engine III, the Cisco Catalyst 4000 can be deployed in low-density distribution points in the enterprise network.
- The distribution layer Cisco Catalyst switches use the hardware-based, Cisco Express Forwarding routing engine, capable of scaling to 48 Mpps. This architecture enables multiple millions of packets-per-second throughput of Layer 3 switching, with no penalty for header prefix lengths.
- Virtual LAN (VLAN) trunking is used primarily as a traffic-engineering tool for the uplinks. Provisioning the correct amount of Layer 3 switching accommodates the 20 to 80 traffic flow patterns.

Figure 2:

Enterprise Network with Cisco Catalyst 4000 Family Switches



Key advantages of the Cisco Catalyst enterprise solution follow:

- VLAN trunking is used to maximize uplink utilization.
- ASIC-based Layer 3 performance equals Layer 2 performance.
- Mature Hot Standby Router Protocol (HSRP) is used for Layer 3 redundancy.
- UplinkFast is used in the wiring closets for Layer 2 redundancy.
- Traffic differentiation and service agreements benefit from rich multilayer QoS—including policing (ingress and egress), classification, shaping, sharing, marking, and advanced scheduling—implemented in hardware with advanced parallel pipeline processing.

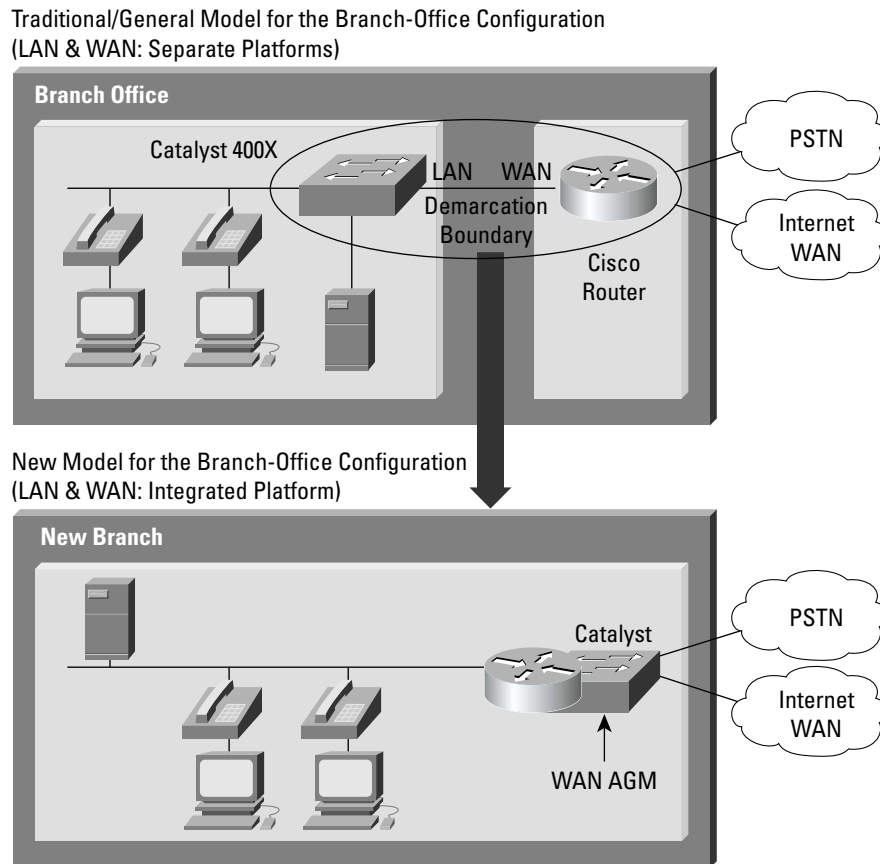
Branch-Office Applications

The Cisco Catalyst 4000 Family provides an ideal branch-office solution capable of meeting the needs of both small and large operations. The Cisco Catalyst 4006 Supervisor Engine III adds IP routing Layer 3 switching capabilities and gigabit wire-speed performance that allow for deployment as a branch-office backbone. Cisco IOS Software provides stable interconnection between other switches and WAN routers. This design is illustrated in the “Traditional/General Model” in Figure 3 below, with a separate LAN switch and WAN router working together as a branch-office solution.

Cisco now offers a branch-office design alternative with the introduction of the Cisco Catalyst 4000 Access Gateway Module. The Cisco Catalyst 4000 Access Gateway Module is a line card-based WAN router that combines Cisco IOS routing with the Cisco Catalyst 4000 Family of switches to provide infrastructure consolidation and Cisco AVVID support for the branch office. Combining the LAN and WAN infrastructure enables businesses to reduce network complexity, improve network deployment times, and prepare for voice, video, and data convergence (“New Model for Branch-Office Configuration” in Figure 3).

Figure 3:

Cisco Catalyst 4000 Family Branch-Office Solution



Cisco Catalyst 4000 Family Features and Benefits

Table 1 Cisco Catalyst 4000 Family Features, Functions, and Benefits

Feature	Function/Description	Benefit
Chassis		
Modular Three- and Six-Slot Chassis	<ul style="list-style-type: none"> Supports Cisco Catalyst Supervisor Engine and two or five additional interface modules 	<ul style="list-style-type: none"> Common architecture that can be standardized for campus-wide intranet needs
Fault-Tolerant, Load-Sharing Power Supplies	<ul style="list-style-type: none"> Supports one, two, or three power supplies 	<ul style="list-style-type: none"> Increases reliability using multiple power supplies in a fault-tolerant configuration
Hot-Swappable Power Supplies and Switching Modules	<ul style="list-style-type: none"> Enables hot insertion and extraction for changes and maintenance any time without bringing down your system 	<ul style="list-style-type: none"> Increases reliability by reducing downtime
Flexible Switching Modules—Standards Based, Autosensing, and Autonegotiating	<ul style="list-style-type: none"> Offers wide variety of interface choices: 10/100-Mbps Ethernet and 10/100/1000 or 1000-Mbps Gigabit Ethernet 	<ul style="list-style-type: none"> Accommodates IP campus LAN bandwidth growth, providing easy migration while future-proofing the network
24-Gbps Capacity Backplane (Cisco Catalyst 4003)	<ul style="list-style-type: none"> Forwards more than 18 million 64-byte Ethernet packets per second 	<ul style="list-style-type: none"> Designed to meet the throughput demands of a fully populated system with all interfaces operating at wire speed
64-Gbps Capacity Backplane (Cisco Catalyst 4006)	<ul style="list-style-type: none"> Provides enough capacity to forward wire rate, nonblocking 48 million packets per second 	<ul style="list-style-type: none"> Designed to meet the worst-case throughput demands of a fully populated system with all interfaces operating at wire speed (<i>note:</i> nonblocking fabric requires Supervisor Engine III)

Feature	Function/Description	Benefit
(Supervisor Engine III) Integrated Cisco IOS Layer 3 Switching	<ul style="list-style-type: none"> Offers ASIC-based IP routing at gigabit speeds 	<ul style="list-style-type: none"> Layer 3 subnet control of network traffic Mature and proven routed protocols
Multilayer QoS	<ul style="list-style-type: none"> Offers enterprise policy solution with CiscoAssure end-to-end, seamless integration 	<ul style="list-style-type: none"> Centralized control of prioritization, or deprioritization, of network-wide traffic Easily creates and manages policies to protect mission-critical applications
Ingress and Egress Policing (Supervisor Engine III)	<ul style="list-style-type: none"> Identifies illegal packets at entrance and after QoS reclassification at exit on a port basis 	<ul style="list-style-type: none"> Granular traffic control with sophisticated, fast, traffic differentiation per VLAN, port, user, or application
WAN Integration	<ul style="list-style-type: none"> Provides integration of LAN and WAN interfaces on the same platform 	<ul style="list-style-type: none"> Simplifies network design Lower cost of ownership
Cisco AVVID Integration	<ul style="list-style-type: none"> Integrates voice, video, and data into one campus infrastructure 	<ul style="list-style-type: none"> Lower cost of ownership, improved productivity, investment protection, scalability, and performance
Integrated Inline Power	<ul style="list-style-type: none"> Provides centralized power to Cisco IP phones from Ethernet switch ports 	<ul style="list-style-type: none"> Single wire to the desktop; no cubicle uninterruptible power supply (UPS)
Dynamic Inter-Switch Link (ISL) Protocol	<ul style="list-style-type: none"> Dynamically configures trunk ports between Cisco Catalyst switches 	<ul style="list-style-type: none"> Minimizes VLAN trunk configuration, maximizes plug-and-play capabilities
Load Balancing via Spanning-Tree Priority on Parallel ISL Trunks	<ul style="list-style-type: none"> Assigns spanning-tree priority on a per-VLAN basis 	<ul style="list-style-type: none"> Increased throughput and redundancy between Cisco Catalyst 4000 switches
IGMP Multicasting	<ul style="list-style-type: none"> Offers hardware-based multicasting replication 	<ul style="list-style-type: none"> Standards-based multicasting; multicast throughput equals unicast throughput
Centralized Shared-Memory Architecture	<ul style="list-style-type: none"> Delivers up to 48-Mpps low-latency, low-cost switching for wiring-closet and branch-office backbone applications Offers full local and remote management 	<ul style="list-style-type: none"> Provides a completely manageable switching system solution that delivers high performance with the capacity to handle high port density with no head-of-line blocking
IP Architecture	<ul style="list-style-type: none"> IP frame switching backplane accommodates Ethernet, Fast Ethernet, and Gigabit Ethernet 	<ul style="list-style-type: none"> Delivers a single-system platform solution for all current desktop switching needs, with modular flexibility for future technology protection from LAN to WAN
Multilayer Switching	<ul style="list-style-type: none"> Supports Layer 2 (Media Access Control [MAC]), Layer 3 (IP address), and Layer 4 (TCP/UDP port) switching 	<ul style="list-style-type: none"> Provides desktop switching and integrated routing functionality (Supervisor Engine III) in the wiring closet or small enterprise backbone solution
Multiple Queues on Every Port Interface	<ul style="list-style-type: none"> Offers multiple queue classification and scheduling of network traffic on a packet-by-packet basis 	<ul style="list-style-type: none"> Differentiates network traffic to improve traffic control and latency Enables sophisticated QoS for superior data, voice, and video traffic
Cisco Discovery Protocol	<ul style="list-style-type: none"> Provides automated switch and router neighbor discovery 	<ul style="list-style-type: none"> Simplifies configuration management and enables a higher level of Cisco IOS network services
Standards Compliance	<ul style="list-style-type: none"> Supports industry-standard architecture 	<ul style="list-style-type: none"> Multivendor interoperability
Support for 4096 VLANs	<ul style="list-style-type: none"> Ensures high number of switched VLANs are available for enterprise networks Enables users to select interfaces on multiple switches, network wide, to create logical LANs 	<ul style="list-style-type: none"> Eases network administration by enabling users to be logically grouped together, regardless of physical interface location, for performance and security considerations Provides VLAN capability without forcing users to invest in new backbone technology
Switched VLAN Trunks	<ul style="list-style-type: none"> Supports multiple VLANs between switches across any Fast Ethernet using the 802.1Q protocol (or ISL with Supervisor Engine III) 	<ul style="list-style-type: none"> Enterprise-wide VLANs
VLAN Trunk Protocol (VTP)	<ul style="list-style-type: none"> Distributes VLAN configuration information 	<ul style="list-style-type: none"> Seamlessly integrates Fast Ethernet VLANs

Feature	Function/Description	Benefit
Comprehensive Switched Network Management		
Embedded RMON	<ul style="list-style-type: none"> • Provides four RMON groups on all ports: <ul style="list-style-type: none"> – Statistics – History – Alarms – Events 	<ul style="list-style-type: none"> • Delivers efficient and effective workgroup troubleshooting tools • Furnishes analysis tools to help managers tune network performance • Helps identify heavy network users as candidates to move to dedicated ports or higher-speed ports • Proactively monitors the switched internetworking • Industry-based standards
Enhanced Switch Port Analyzer (SPAN)	<ul style="list-style-type: none"> • Allows for monitoring a single port or multiple (VLAN) ports via a single monitor port 	<ul style="list-style-type: none"> • Managers can use existing network analyzers to troubleshoot switched internetworking • Preserves the network visibility that might otherwise be lost by switches that do not support SPAN • Delivers an analysis path into company's VLAN architecture
Remote SPAN	<ul style="list-style-type: none"> • Allows monitoring of multiple switches across the network from a single switch 	<ul style="list-style-type: none"> • Reduces number of analyzers necessary to monitor networks
Full Simple Network Management Protocol (SNMP) Management (gets and sets for Ethernet Management Information Base [MIB], MIB II, VTP, and system extensions)	<ul style="list-style-type: none"> • Enables management of Cisco Catalyst 4000 from any SNMP-based management station 	<ul style="list-style-type: none"> • Eases management from installed network management platforms • Extends VLAN configuration to SNMP management software
Password-Protected Administration Interface	<ul style="list-style-type: none"> • Requires password for local or remote access via Telnet 	<ul style="list-style-type: none"> • Provides protection from unauthorized configuration changes
Local (in-band) Management	<ul style="list-style-type: none"> • Supervisor engine has an EIA/TIA-232 interface for modem or console terminal connection 	<ul style="list-style-type: none"> • Manages Cisco Catalyst 4000 from a directly attached, low-cost terminal or PC
Remote (out-of-band) Management through SNMP Sets or Telnet (client) Connection	<ul style="list-style-type: none"> • Offers accessibility through any switched interface 	<ul style="list-style-type: none"> • Manages Cisco Catalyst 4000 switches from anywhere in the network
Onboard Flash Memory for Trivial File Transfer Protocol (TFTP) Download/Upload of Operating Software	<ul style="list-style-type: none"> • Remotely downloads new revisions of operating system without hardware changes 	<ul style="list-style-type: none"> • Reduces cost of administering software upgrades by providing centralized network management capability
Removable Compact Flash (Supervisor Engine III)	<ul style="list-style-type: none"> • Allows for storage of Cisco IOS images and configuration settings 	<ul style="list-style-type: none"> • Supports centralized corporate administration with easy distribution across the enterprise of configuration and software standards
Switch Management Applications		
CiscoWorks2000	<ul style="list-style-type: none"> • Offers resource and network management suite 	<ul style="list-style-type: none"> • Leading-edge enterprise network control and management
CiscoView Application	<ul style="list-style-type: none"> • Provides intuitive GUI that supports chassis physical view, configuration, performance monitoring, and minor troubleshooting 	<ul style="list-style-type: none"> • Simplifies switched internetworking management • Integrated management solution provides user with one tool for determining status of system

CISCO SYSTEMS



Corporate Headquarters

Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA

www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 526-4100

European Headquarters

Cisco Systems Europe
11, Rue Camille Desmoulins
92782 Issy-les-Moulineaux
Cedex 9
France

www-europe.cisco.com
Tel: 33 1 58 04 60 00
Fax: 33 1 58 04 61 00

Americas Headquarters

Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA

www.cisco.com
Tel: 408 526-7660
Fax: 408 527-0883

Asia Pacific Headquarters

Cisco Systems, Inc.
Capital Tower
168 Robinson Road
#22-01 to #29-01
Singapore 068912

www.cisco.com
Tel: 65 317 7777
Fax: 65 317 7799

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