

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

Introducing the new Cisco Catalyst® 4500 Series that integrates resiliency for advanced control of converged networks

Figure 1

New Cisco Catalyst 4500 Series (Cisco Catalyst 4503, Cisco Catalyst 4506, and Cisco Catalyst 4507R)



Figure 2

Cisco Catalyst 4000 Series (Catalyst 4003 and Catalyst 4006)



Overview

The Cisco Catalyst 4000 Family integrates nonblocking Layer2/3/4 switching with optimal control, enabling business resilience for enterprise and metropolitan (metro) Ethernet customers deploying Internet-based business applications. The Cisco Catalyst 4000 Family, including the Cisco Catalyst 4000 Series and the new Cisco Catalyst 4500 Series, is a key component of Cisco AVVID (Architecture for Voice, Video and Integrated Data). The Cisco Catalyst 4000 Family extends control to the network edge with intelligent network services, including sophisticated quality of service (QoS), predictable performance, advanced security, and comprehensive management. The Cisco Catalyst 4500 Series delivers advanced control with integrated resiliency. Integrated resiliency in both hardware and software minimizes network downtime, ensuring workforce productivity, profitability, and customer success.



The modular architecture, media flexibility, and expandability of the Cisco Catalyst 4000 Family 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 distinguish each traffic type and handle it according to its unique requirements. The Cisco Catalyst 4000 Family provides a switching infrastructure that, when combined with the Cisco IOS® Software, can deliver this advanced functionality and control.

Optimal Control

The Cisco Catalyst 4000 Family 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 with integrated resiliency leads to control of all traffic types with minimal downtime. The Cisco Catalyst 4000 Family delivers this control with:

- **Integrated resiliency**—Network downtime is minimized with redundant supervisor engine capability (Cisco Catalyst 4507R), software-based fault tolerance, and 1 + 1 power supply redundancy across the Cisco Catalyst 4500 Series. Integrated inline power in all Cisco Catalyst 4500 Series chassis simplifies network design and limits the number of points of failure in an IP telephony implementation.
- **Sophisticated QoS**—Integrated Layer 2/3/4-based QoS and traffic management capabilities classify and prioritize mission-critical and time-sensitive traffic based on 32,000 QoS policies. The system has the ability to shape and rate-limit bandwidth-intensive traffic with mechanisms such as input and output policers based on user, network, and application information.
- **Predictable performance**—The Cisco Catalyst 4000 Family offers up to 48-Mpps wire-speed forwarding rate in hardware for both Layer 2 and Layer 3/4 traffic. Switching performance is independent of the number of route entries or advanced Layer 3 services enabled.
- **Advanced security**—The Cisco Catalyst 4000 Family supports 32,000 wire-rate Layer 2/3/4 access lists, and includes other advanced security capabilities such as user authentication and client security.
- **Comprehensive management**—The Cisco Catalyst 4000 Family offers Web-based management for the configuration and control of all ports, which allows central managements of critical network characteristics such as availability and responsiveness.

Scalable Architecture

As convergence lowers overall cost of network ownership 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 Family provides the scalability and flexibility to eliminate the need for multiplatform deployments, minimizing maintenance expenses.



Now with integrated resiliency in the Cisco Catalyst 4500 Series, the Cisco Catalyst 4000 Family is well positioned to strengthen workforce productivity, profitability, and customer success to all corporations implementing converged network infrastructures.

Cisco Catalyst 4000 Series

The Cisco Catalyst 4000 Series, with two chassis alternatives (Cisco Catalyst 4003 and 4006) and four supervisor engine alternatives, 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 the Cisco 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.

Cisco Catalyst 4500 Series

A next-generation Cisco Catalyst 4000 Family platform, the Cisco Catalyst 4500 Series includes three new Cisco Catalyst chassis: Cisco Catalyst 4507R (seven slots), Cisco Catalyst 4506 (six slots) and Cisco Catalyst 4503 (three slots). Integrated resiliency enhancements offered in the Cisco Catalyst 4500 Series include 1 + 1 supervisor engine redundancy (Cisco Catalyst 4507R only), integrated inline power for IP telephony, software-based fault tolerance, and 1 + 1 power supply redundancy. Integrated resiliency in both hardware and software minimizes network downtime, ensuring workforce productivity, profitability, and customer success.

The Cisco Catalyst 4500 Series provides a common architecture, taking advantage of the Cisco Catalyst 4000 Series line cards scaling to 240 ports of 10/100 or 100BASE-FX Fast Ethernet, or 240 ports of 10/100/1000BASE-T or 1000BASE-LX Gigabit Ethernet. Offering compatibility with Cisco Catalyst 4000 Series line cards and supervisor engines, the Cisco Catalyst 4500 Series enables an extended window of deployment for the Cisco Catalyst 4000 Family in converged networks.

Cisco Catalyst 4000 Family Key Benefits

The Cisco Catalyst 4000 Family 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 each with complete line card compatibility, Layer 2 switching can scale up to 64 Gbps, 48 Mpps. Based on Cisco Express Forwarding, Layer 3/4 switching can also scale up to 64 Gbps, 48Mpps.
- **Port density**—The Cisco Catalyst 4000 Family is capable of meeting 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, easy-to-use switching solution of the Cisco Catalyst 4000 Family reduces complexity and easily supports the changing desktop environments of today's networks.
- **Supervisor engine redundancy**—The Cisco Catalyst 4507R can support 1 + 1 supervisor engine redundancy for integrated resiliency. Redundant supervisor engines ensure that network downtime is minimized. Minimal network downtime ensures business continuance and increased employee productivity.



- *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 they have been improved 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 interface upgrades for 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 or IV. Compatible sparing between Cisco Catalyst 4003, 4006, and 4500 chassis provides 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 or IV. Higher-layer functionality enhancements are possible on all system ports without replacing existing line cards and wiring, unlike conventional switching products where complete equipment upgrades are typical 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 access gateway module (AGM) that integrates 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 AGM provides integrated WAN routing to the Cisco Catalyst 4000 Family of switches to provide 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 the 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 two-port gigabit interface converter (GBIC) line card for the Cisco Catalyst 4000 Family. 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 multicast*—Protocol Independent Multicast (PIM), dense and sparse mode, Internet Group Multicast Protocol (IGMP), and Cisco Group Multicast Protocol (CGMP) 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 for replicating packets. It also eliminates any possibility of head-of-line blocking.
- *Manageability*—The Cisco Catalyst 4000 Family is supported by the Cisco Works product family, which provides innovative tools to centrally manage critical network characteristics such as availability, responsiveness, resilience, and security for the intelligent switching infrastructure. 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-, graphical user interface (GUI)-, and command-line interface (CLI)-based management alternatives. Best of all, behind every Cisco Catalyst 4000 Family switch are the award-winning Cisco Systems service and support solutions.

- **Bandwidth protection for mission-critical applications**—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 Supervisor Engines III and IV benefit 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-to-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. This makes 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.

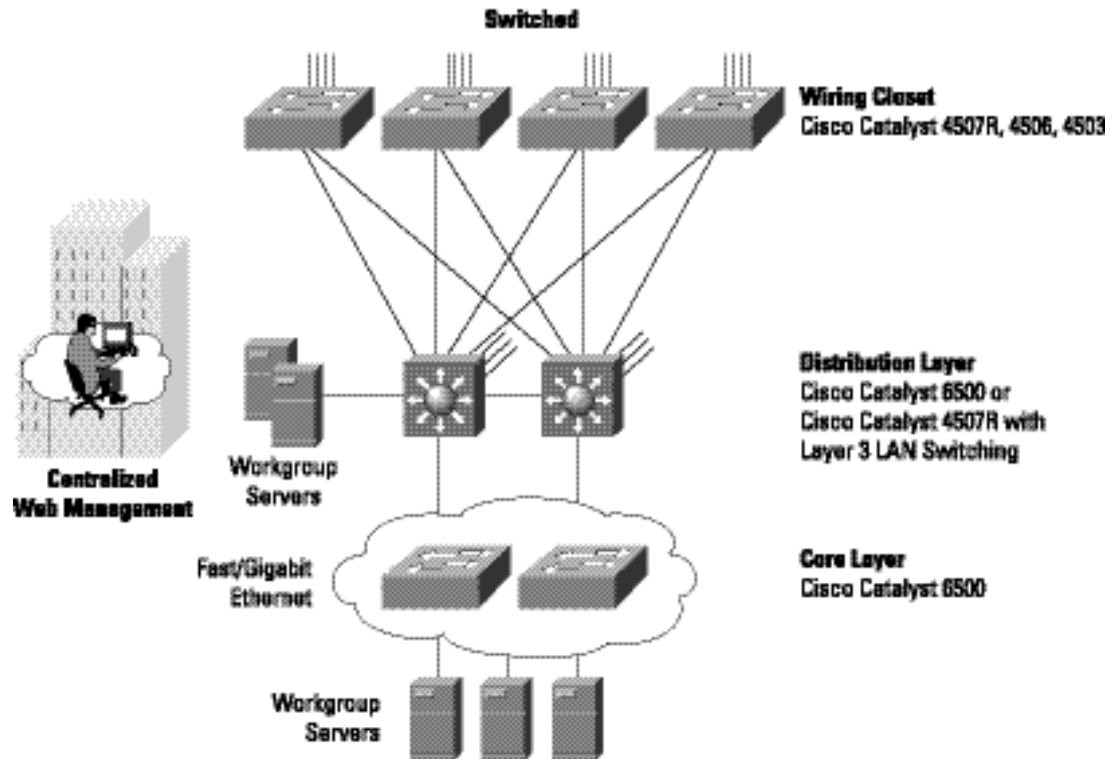
Applications

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 Series) and the backbone is Layer 2 (refer to Figure 3). The Cisco Catalyst 4000 supports IP-only routing with the Supervisor Engines III and IV, and 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 enables multiple millions of packets-per-second throughput of Layer 3 switching, with no penalty for header prefix lengths (Supervisor Engines III and IV).
- 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 3
Enterprise Network with Cisco Catalyst 4000 Family Switches



Key Cisco Catalyst enterprise solution advantages:

- VLAN trunking maximizes uplink utilization.
- ASIC-based Layer 3 performance equals Layer 2 performance.
- Mature Hot Standby Router Protocol (HSRP) provides Layer 3 redundancy.
- UplinkFast, IEEE 802.3s, and IEEE 802.3w are in the wiring closets provide Layer 2 resilience.
- 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 (Supervisor Engines III and IV).

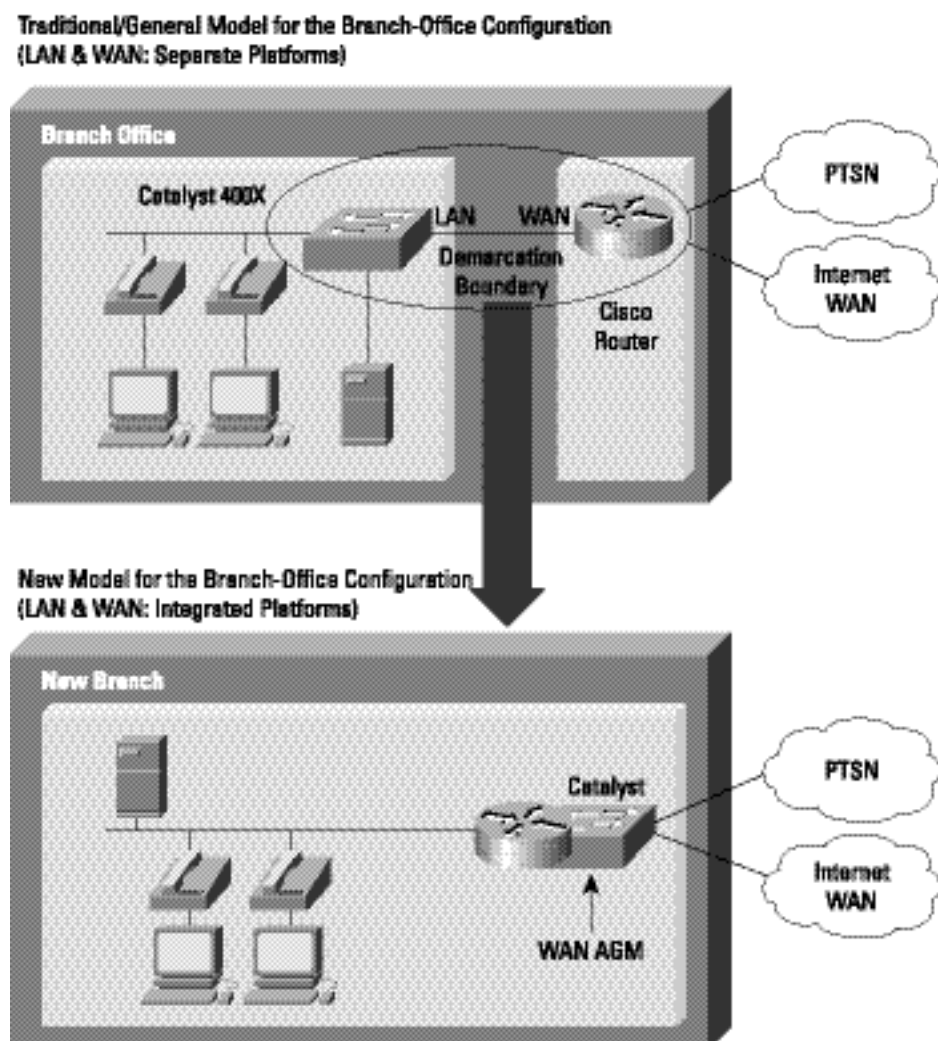
Branch-Office Applications

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 4000 Family Supervisor Engines III and IV add 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 is illustrated in the "Traditional/General Model" in Figure 4 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 AGM. The Cisco Catalyst 4000 AGM 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. (Refer to “New Model for Branch Office Configuration” in Figure 4.)

Figure 4
Cisco Catalyst 4000 Family Branch-Office Solution





Cisco Catalyst 4000 Family Features and Benefits

Table 1 Cisco Catalyst 4000/4500 Series Features, Functions, and Benefits

Feature	Function/Description	Benefit
Chassis		
Modular three- and six-slot Cisco Catalyst 4000 Series chassis	Supports supervisor engine and two or five additional interface modules	Common architecture that can be standardized for campus-wide intranet needs
Modular three-, six-, and seven-slot Cisco Catalyst 4500 Series chassis	Supports supervisor engine (up to two on the Cisco Catalyst 4507R), power supplies with integrated inline power, and two or five additional interface modules	Common architecture with advanced integrated resiliency that can be standardized for campus-wide intranet needs
Redundant supervisor engines (Cisco Catalyst 4507R only)	Dual supervisor engines with sub-minute failover	Minimizes network downtime that ensures business continuance and increased productivity
Fault-tolerant, load-sharing power supplies	Supports one, two, or three power supplies	Increases reliability using multiple power supplies in a fault-tolerant configuration
Hot-swappable power supplies and switching modules	Enables hot insertion and extraction for changes and maintenance any time without bringing down your system	Increases reliability by reducing downtime
Flexible switching modules—standards-based, autosensing, and autonegotiating	Offers wide variety of interface choices: 10/100-Mbps Ethernet and 10/100/1000- or 1000-Mbps Gigabit Ethernet	Accommodates IP campus LAN bandwidth growth, providing easy migration while future-proofing the network
24-Gbps capacity backplane (Cisco Catalyst 4003) 28-Gbps capacity backplane (Cisco Catalyst 4503)	Forwards more than 18+ million 64-byte Ethernet packets per second	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, 4506, and 4507R)	Enough capacity to forward wire-rate, nonblocking 48 million packets per second	Designed to meet the worst-case throughput demands of a fully populated system with all interfaces operating at wire speed (note—nonblocking fabric requires Supervisor Engine III or IV)
(Supervisor III and IV) Integrated Cisco IOS Layer 3 switching	ASIC-based IP routing at gigabit speeds	Layer 3 subnet control of network traffic; mature and proven routed protocols
Multilayer QoS	QoS for both Layer 2 CoS and Layer 3 ToS, traffic shaping, sharing, and policing	Centralized control of prioritization of network-wide traffic; easily creates and manages policies to protect mission-critical applications
Ingress and egress policing (Supervisor Engines III and IV)	Identify illegal packets at entrance and after QoS reclassification at exit on a port basis	Granular traffic control with sophisticated, fast, traffic differentiation per VLAN, port, user, or application



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WAN integration	Integration of LAN and WAN interfaces on the same platform	Simplifies network design; lower cost of ownership
Cisco AVVID integration	Integrating voice, video, and data into one campus infrastructure	Lower cost of ownership; improved productivity; investment protection; scalability and performance
Integrated inline power	Provides centralized power to Cisco IP phones from Ethernet switch ports	Single wire to the desktop; no cubicle UPS
Dynamic Inter-Switch Link (ISL) Protocol and 802.1Q	Dynamically configures trunk ports between Cisco Catalyst switches	Minimizes VLAN trunk configuration, maximizes plug-in-and-play capabilities
Load balancing via spanning-tree priority on parallel ISL trunks	Assigns spanning-tree priority on a per-VLAN basis	Increased throughput and redundancy between Cisco Catalyst 4000 Family switches
IGMP	Hardware-based multicasting replication	Standards-based multicasting; multicast throughput equals unicast throughput
Centralized shared-memory architecture	Delivers up to 48-Mpps, low-latency, low-cost switching for wiring-closet and branch-office backbone applications; full local and remote management	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	IP Frame switching backplane accommodates Ethernet, Fast Ethernet, and Gigabit Ethernet	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	Supports Layer 2 (Media Access Control [MAC]), Layer 3 (IP address), and Layer 4 (TCP/UDP port) switching	Provides desktop switching and integrated routing functionality (Supervisor Engines III and IV) in the wiring closet, or small enterprise backbone solution
Multiple queues on every port interface	Multiple queue classification and scheduling of network traffic on a packet-by-packet basis	Differentiates network traffic to improve traffic control and latency; enables sophisticated QoS for superior data, voice, and video traffic
Cisco Discovery Protocol	Automated switch and router neighbor discovery	Simplifies configuration management and enables a higher level of Cisco IOS network services
Standards compliance	Industry-standard architecture support	Multivendor interoperability



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VLANs supported: 4096	Ensures high number of switched VLANs available for enterprise networks; enables users to select interfaces on multiple switches, network wide, to create logical LANs	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	Supports multiple VLANs between switches across any Fast Ethernet VLAN using the 802.1Q protocol (or ISL with Supervisor Engine III)	Enterprise-wide VLANs
VLAN Trunk Protocol (VTP)	Distributes VLAN configuration information	Seamlessly integrates Fast Ethernet VLANs
Comprehensive switched network management		
Embedded Remote Monitoring (RMON)	Provides four RMON groups on all ports: <ul style="list-style-type: none"> • Statistics • History • Alarms • Events 	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 centralized management using the Cisco Works family of solution Industry standards based
Enhanced Switch Port Analyzer (SPAN)	Allows for monitoring a single port or multiple (VLAN) ports via a single monitor port	Enables managers to 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	Allows monitoring multiple switches across the network from a single switch	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)	Enables Cisco Catalyst 4000 to be managed from any SNMP-based management station	Eases management from installed network management platforms Extends VLAN configuration to SNMP management software
Password-protected administration interface	Requires password for local or remote access via Telnet	Provides protection from unauthorized configuration changes



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Local (in-band) management	Supervisor engine has an EIA/TIA-232 interface for modem or console terminal connection	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	Accessible through any switched interface	Manages Cisco Catalyst 4000 switches from anywhere in the network
Management console	CLI	Provides easy-to-use ASCII text interface that requires no special applications Takes advantage of support staff's Cisco Catalyst knowledge
Onboard Flash memory for Trivial File Transfer Protocol (TFTP) download/upload of operating software	Remotely downloads new revisions of operating system without hardware changes	Reduces cost of administering software upgrades by providing centralized network management capability
Removable compact Flash (Supervisor Engines III and IV)	Allows Cisco IOS images and configuration setting storage	Supports centralized corporate administration with easy distribution across the enterprise of configuration and software standards
Onboard hardware diagnostics and LEDs	Status LED on each module shows successful completion, minor, and major failure of power-up diagnostics; link good LEDs show status of any interface; switch load LEDs show backplane utilization	Confirms module operation and enables easy visual inspection Improves access to switched network utilization Continues mature and proven Cisco Catalyst switch interfaces pioneered in earlier Cisco products
Switch management applications		
CiscoWorks Family of products	Comprehensive set of functionality aimed at monitoring, troubleshooting, and configuring the intelligent switching infrastructure	Offers superior, efficient management of the Catalyst 4000 family assuring increased security and control
CiscoView application	Provides intuitive GUI that supports chassis physical view, configuration, performance monitoring, and minor troubleshooting	Simplifies switched internetworking management; integrated management solution provides user with one tool for determining status of system

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