

# Catalyst 8500 Series Multiservice Switch Router

## Introduction

The Catalyst 8500 series Multiservice Switch Routers integrate multiservice ATM switching with wire-speed multiprotocol routing and Layer 2 switching for Gigabit Ethernet into a single platform that also supports advanced Cisco IOS services for QoS and security. The Catalyst 8500 family delivers campus and metropolitan network solutions with scalable performance, lower cost of ownership, and the features needed by intranet-based applications to deliver increased business productivity.

Historically, enterprise network managers faced a choice of several different technologies when building or upgrading campus network backbones. Today, the choice is between Fast Ethernet/Gigabit Ethernet on one hand, which provides high performance, low cost, and familiarity (relative to Ethernet), and ATM on the other hand, with its high performance, advanced QoS capabilities, support for multiservice voice/data integration and metro/wide area extendability. The network designer must also think about the role of routing in the backbone, which is required for network scalability. The Catalyst 8500 family takes the risk out of this choice by supporting Fast Ethernet/Gigabit Ethernet, ATM, and wire-speed multiprotocol routing in a single platform. This combination enables network designers to combine multiple technologies in a single network, using each to its best advantage. It also greatly simplifies future migration from one technology to the other, should the needs of the network backbone change over time.

## Applications

Large-scale deployment of centralized server farms and the proliferation of intranet applications are continuing to drive the exponential growth of traffic volumes in enterprise networks. The

increased traffic volumes are coupled with fundamental shifts in traffic patterns that do not conform to traditional network design principles such as the 80/20 rule.

### Centralized Server Farms and Mission-Critical Applications

The implementation of centralized server farms is increasing the volume of client/server traffic that traverses the campus backbone. Mission-critical applications demand differentiated service levels from the network because they need protection from other types of traffic. Scalable control, high performance, and rich QoS mechanisms are therefore prerequisites to meeting these requirements in any enterprise network.

Because applications are inherently end-to-end, it is not sufficient for a single system in the network to support traffic prioritization at the application level. A common framework is required to represent the different service levels, and every network node needs to understand the framework in order to support differentiated services. In addition, network administrators also need tools to easily provision and manage these different service levels throughout the network.

Wire-speed performance, scalable control, and rich QoS capabilities of the Catalyst 8500 series allow network managers to smoothly integrate the Catalyst 8500 with the Catalyst 5500, the Cisco 7500/7200 series, the LightStream 1010 and IGX 8400 switch, as well as the MC 3810. Using a Cisco end-to-end solution, they can create a unique solution that truly meets the end-to-end QoS requirement for differentiated services in the enterprise. CiscoAssure Policy Networking orchestrates the provisioning and management of multiple service levels necessary to maintain consistent application-level QoS throughout the enterprise.

### Intranets

Intranets are the next wave in enterprise networking as they enable a wide spectrum of applications, which present a whole new value proposition in terms of streamlining fundamental business processes throughout the enterprise. The convergence of voice, video, and data is also being witnessed in the Internet and intranets with the emergence of voice over IP and ATM and through multimedia applications such as video multicasting and conferencing.

Intranet applications create traffic patterns that are dynamic and varied in their requirements from the network. The underlying network infrastructure, therefore, needs to provide scalable and advanced network services such as IP multicasting and IP and ATM QoS.

### Cisco's Value

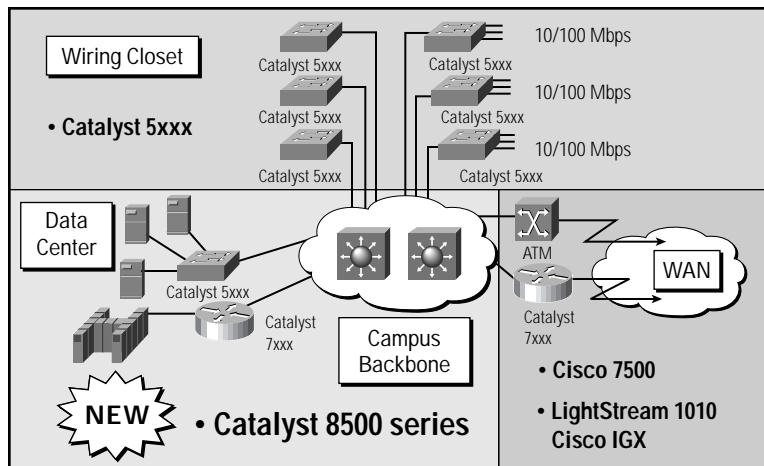
Cisco's experience in building some of the largest enterprise networks while also building the largest network of them all—the Internet—has been integrated into Cisco IOS software over many years. Cisco IOS software is the common framework integrated across all Cisco products; it provides the foundation for building a scalable and intelligent network infrastructure.

Cisco 7500/7200 series routers and the Cisco 12000 GSR series power over 85 percent of the Internet and provide the scalable infrastructure needed to support the Internet. Incorporating the capabilities of the Cisco 7500 and 12000 series, the Catalyst 8500 series is specialized for campus backbone applications.

The Catalyst 8500 integrates smoothly into any existing network; it is a powerful new addition to the Cisco end-to-end solution, consisting of industry-leading products such as:

- Catalyst 5000/5500 series, ideal for the wiring closet and LAN backbone aggregation
- Cisco 7500/7200 series routers for diverse LAN and WAN integration, multiprotocol routing, and System Network Architecture (SNA) integration
- Cisco LightStream 1010 and Cisco IGX 8400 wide-area switches for LAN/Metropolitan-area network (MAN)/WAN Asynchronous Transfer Mode (ATM) and Frame Relay switching

Figure 1 Catalyst 8500 Enables Scalable, High-Performance, and Intelligent Campus Backbones





## Catalyst 8500 Deployment Flexibility

The Catalyst 8500 series can be deployed as a Layer 3 switch providing nonblocking routing for IP, IPX, and IP multicast while also offering wire-speed Layer 2 switching for nonroutable protocols such as NetBIOS and DECnet local-area transport (LAT). This capability allows network managers to augment their multiprotocol backbones with the Catalyst 8500 without having to build parallel networks, as is often required with IP-only switches.

The Catalyst 8500 series can also be deployed as a multiservice ATM switch or as an integrated Layer 3 and multiservice ATM switch. This unique ability allows the deployment of hybrid networks implementing the best of both technologies while eliminating the need to choose one technology over another.

When deployed with the Switch Route Processor (SRP), C8510-SRP, the Catalyst 8510 is equipped as a Layer 3 switch only. When deployed with the Multiservice Switch Route Processor, C8515-MSRP, the Catalyst 8510 is equipped as a multiservice ATM switch. Future software enhancements and the addition of an ATM

router module will allow the deployment of multiservice ATM and Layer 3 interfaces in a single Catalyst 8510 chassis deployed with the C8515-MSRP.

Likewise, when deployed with Route Processors (RP) and Switch Processors (SP), C8541-RP and C8542-SP, the Catalyst 8540 is equipped as a Layer 3 switch only. When deployed with Multiservice Route Processors (MSP) and Multiservice Switch Processor (MSP), C8545-MRP and C8546-MSP respectively, the Catalyst 8540 is equipped as a multiservice ATM switch. Future software enhancements and the addition of an ATM router module will allow the deployment of Multiservice ATM and Layer 3 interfaces in a single Catalyst 8540 chassis deployed with the C8545-MRP and C8546-MSP.

Table 1 Processor Options and Line Cards Supported in the Catalyst 8500

<b>Catalyst 8510</b>	<b>Switch Route Processor (SRP)</b>	<b>Multiservice Switch Route Processor (MSRP)</b>
Fast Ethernet Line Cards	X	X
Gigabit Ethernet Line Cards	X	X
ATM/PoS Uplinks up to OC-12	X	X
ATM Switching Interface Line Cards from T1/E1 to OC-12		X
ATM Circuit Emulation Service (CES)		X
<b>Catalyst 8540</b>	<b>Switch Processor (SP) and Route Processor (RP)</b>	<b>Multiservice Switch Processor (MSP) and Multiservice Route Processor (MRP)</b>
High-Density Fast Ethernet Line Cards	X	X
High-Density Gigabit Ethernet Line Cards	X	X
ATM/PoS Uplinks up to OC-12	X	X
ATM Switching Interface Line Cards from T1/E1 to OC-48		X

ATM Circuit Emulation Service (CES)

(EIGRP) and Open Shortest Path First (OSPF), are stable, time-tested, and proven in the Internet and over 85 percent of

### Integrating the Catalyst 8500 into your Network

The Catalyst 8500 is optimized for campus backbone applications and complements the capabilities of the Catalyst 5500 multilayer switching platform and the Cisco 7500/7200 series routing platforms. The Catalyst 8500 switch routers enable IP, IPX, IP multicast, and bridging in hardware ASICs and thus can perform packet switching at wirespeeds over Fast Ethernet and Gigabit Ethernet interfaces and performs wire speed ATM switching up to high-density OC-12 and OC-48 switching. They complement but do not replace the Catalyst 5500 series or the Cisco 7500 series in the campus backbone. One member of the Catalyst 8500 family, the Catalyst 8510, can be integrated into the Catalyst 5500 to boost the capability of existing Catalyst 5500s.

#### Collapsed Backbone LAN Routing

Collapsed backbone routing is deployed in most enterprises as a means of centralizing routing capabilities into high-function routers. Cisco routers provide the industry's most versatile high-end routing platforms, and most enterprises have deployed them for handling the routing requirements in their networks.

Cisco routers provide high-performance and high-function routing capabilities by combining powerful packet switching hardware with intelligent network services built into Cisco IOS

enterprises worldwide. Cisco's high-end router series also provides advanced functions, such as multiprotocol routing, SNA integration, WAN aggregation, encryption, compression, and voice-over-IP capabilities in a single platform. Cisco continues to develop and build upon the high-end routers such as the Cisco 7500 series by adding innovations such as the advanced router system (ARS) to scale advanced services to perform at high speeds.

The Catalyst 8500 series complements the performance and services of the high-end router series by specifically enhancing protocols such as IP and IPX. These protocols are routed at speeds in excess of 20 million packets per second (pps) over Fast Ethernet and Gigabit Ethernet interfaces. Because the Catalyst 8500 is a Cisco IOS platform, it integrates smoothly into an existing Cisco router-based collapsed backbone routing environment. Specifically, it incorporates the same routing protocols and features that run on any enterprise-class Cisco router.

A campus LAN that requires high-density Fast Ethernet and Gigabit Ethernet routing for IP and IPX can seamlessly integrate a Catalyst 8500 with existing Cisco routers by leveraging protocols such as the Hot Standby Router Protocol (HSRP). The

Cisco 7500 and the Catalyst 8500 can then work in tandem to provide high-performance, high-function routing for the campus backbone.

Figure 2 Catalyst 8500 Integrates Smoothly into Existing Cisco 7xxx-Based Collapsed Backbone Router Networks

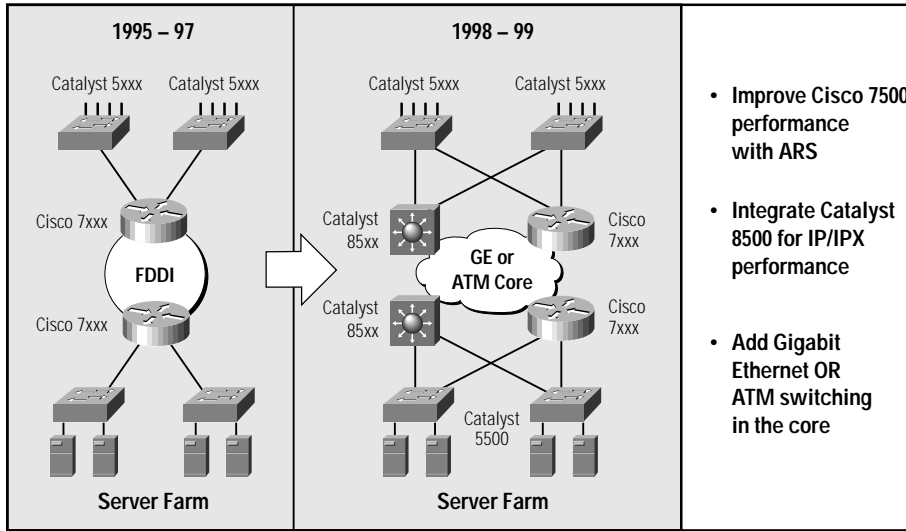
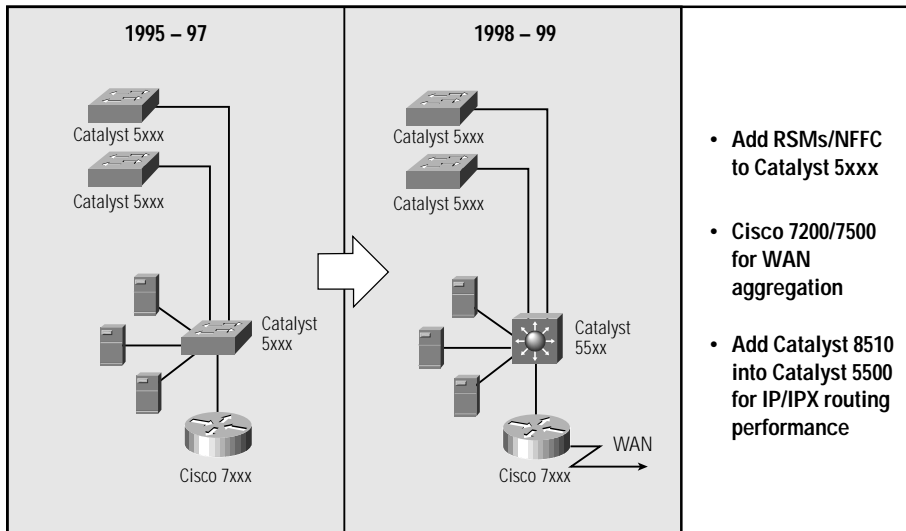


Figure 3 Catalyst 5500 Multilayer Switching Platform Provides Smooth Migration for Data Center and Campus Core Switching



### Data Center and LAN Backbone Switching

The Catalyst 5500 series is the industry's premier LAN switching solution. The Catalyst 5500 provides high-density LAN aggregation for Fast Ethernet and Gigabit Ethernet speeds, making it ideal for campus core switching and aggregating servers in data centers.

Cisco continues to evolve the Catalyst 5500 platform by integrating the route switch module (RSM) to bring the multiprotocol routing capabilities of a Cisco 7500 to the data center. In addition, IP packet switching performance can be

enhanced in excess of 1.5 million pps with the addition of a NetFlow feature card (NFFC) to an existing Catalyst 5500. This scenario makes the Catalyst 5500 the industry's highest-density multiprotocol LAN switch for Fast Ethernet and Gigabit Ethernet.

For networks that require both switching and routing capabilities in a single platform, the Catalyst 5500 provides unmatched value. To enhance the routing capabilities of the Catalyst 5500 even beyond 1.5 million pps, it is also possible to integrate the Catalyst 8510 Switch Route Processor (SRP) or

Multiservice Switch Route Processor (MSRP) and the line cards into the Catalyst 5500. This yields high-performance (up to 6 million pps) IP and IPX packet switching within the Catalyst 5500 platform.

**High Performance Campus ATM Backbones**

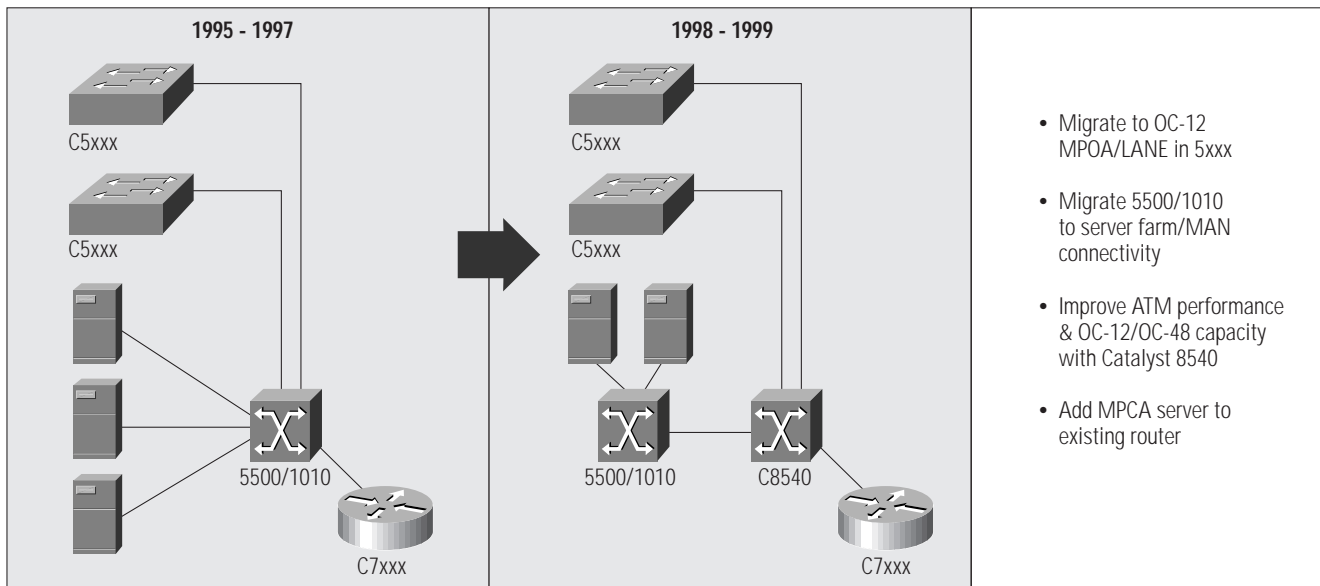
Administrators have deployed LAN Emulation (LANE)- based ATM campus backbones using the Catalyst 5000/5500 series switch with its OC-3 LANE modules at the edges (wiring closets) of the network and the LightStream 1010/Catalyst 5500-based ATM switching in the backbone. In order to scale these networks to the next generation, it is required to not only scale the capacity of the network but also the switching and routing services provided by the network.

Cisco has scaled the capacity of the links interconnecting the edge to the backbone by developing a new wire speed OC-12 uplink module while developing the Catalyst 8500 series to provide high-density aggregation of these OC-12 uplinks. The OC-12 uplinks can function as MPOA Clients (MPCs) in addition to being normal LAN Emulation Clients (LECs) thus providing

the ability to scale the switching and routing services in the network. The Cisco 7500/7200 series will provide MPOA Server (MPS) capability which facilitates the establishment of high-speed cut-through paths for IP forwarding. The Cisco 7500/7200 series also deliver the default forwarding capabilities for multiprotocol inter-VLAN traffic.

This combination delivers the industry’s most comprehensive ATM campus solution while integrating Cisco IOS features such as PNNI routing for fast converging ATM cores, SSRP for resilient LANE services, and so on.

Figure 4 Evolution of ATM Backbones



**Benefits**

One of the key benefits of the Catalyst 8500 series is its high-performance routing and switching capabilities. The Catalyst 8510 is rated at 6 million pps and the Catalyst 8540 is

rated at 24 million pps for IP, IPX, IP multicast, and bridging. Both platforms offer non blocking ATM switching capabilities ranging from T-1 to OC-12 while the 8540 also provides for non

blocking OC-48 ATM switching. These performance numbers are combined with the features of Cisco IOS software to yield unmatched features/performance value for the campus backbone.

#### **Smooth Integration**

The Catalyst 8500 allows smooth integration into existing networks by incorporating:

- Cisco IOS-based routing protocols (IGRP, EIGRP, OSPF, BGPv4, Hierarchical PNNI) that are proven, time tested, reliable, and fast converging in the backbone
- Protocols such as HSRP and SSRP that allow for smooth fail-over and redundancy at the network layer
- Cisco IOS-based router management and configuration tools such as Cisco Resource Manager (CRM)

#### **Investment Protection**

- *Deployment options in the Catalyst 5500*—The Catalyst 8510 technology is integrated into the Catalyst 5500 chassis. Specifically, the Catalyst 8510 SRP or MSRP and the line cards can be deployed in the bottom five slots of the Catalyst 5500. This deployment option provides investment protection for customers who have already deployed the Catalyst 5500 in their networks while also complementing the capabilities of the Catalyst 5500 as a superior campus LAN aggregation switch.
- *Common line cards with the LightStream 1010*—The Catalyst 8500 series can use existing LightStream 1010-based line cards which provide not only investment protection for these line cards but also a complete set of line card functionality ranging from Circuit Emulation Service (CES) modules to OC-12 ATM switching modules. This continues Cisco's rich history in providing unsurpassed investment protection and smooth migration options for customers looking for ever-increasing performance from their campus networks.
- *Programmable ASICs*—The line card ASICs on the Catalyst 8500 series are flexible and future proof. Each line card ASIC can be upgraded by performing a simple microcode change that can be a part of the Cisco IOS software upgrade.
- *Common sparing*—The Catalyst 8510 shares the same power supplies and fan trays as the Catalyst 5000 and the Cisco LightStream 1010. This scenario provides common sparing for equipment across product lines in the enterprise.

#### **High Network Scalability and Availability**

Cisco Express Forwarding (CEF) was invented to solve scalability issues that occur in the Internet. As enterprise intranets begin to integrate with the Internet, it is imperative that technologies such as CEF are implemented in enterprise class products. CEF scales existing Cisco 7500 routers and the Cisco

12000 GSR routers by isolating the control plane (routing) and data plane (switching). The Catalyst 8500 series incorporates the CEF switching paradigm to yield proven "Internet-class" scalability and robustness.

The Catalyst 8540 delivers a wide range of services in a highly-available architecture. The route module is separated from the switching module and each function is then made redundant through the support of additional modules in the chassis. In addition, the Catalyst 8540 supports redundant AC/DC power supplies, power connections, and network clocking functions. While the Catalyst 8540 is in operation, the Cisco IOS software on the standby route module can be loaded with a different image and a switch to the standby module can be made under administrative control. This allows for the smooth migration of the network to support additional features as they become available with new releases of Cisco IOS software.

Preservation of permanent and switch virtual connections (PVCs and SVCs) is the primary goal of the high-availability ATM switching options. To that end, in the presence of redundant components, following any malfunction the Catalyst 8540 would become fully operational in under 60 seconds and in some cases—considerably less. Separation of the control from the forwarding ensures that the permanent circuits would not be taken down or suffer any cell loss when the primary Multiservice Route Processor module malfunctions. If the switch module malfunctions and a standby module is configured in the system, all the permanent circuits would continue operating with minimal loss. If a switch loses the primary reference clock source the on-board clock module would provide accurate holdover, and if the switch module malfunctions the redundant clock module would provide lossless holdover. All of the above, coupled with power supply redundancy ensures complete availability for mission-critical delivery of voice and data.

#### **Protects Mission-Critical Applications with Rich QoS Capabilities**

The ever-increasing traffic loads and dynamic traffic patterns in the enterprise network require network managers to protect mission-critical applications from other types of traffic.

The Catalyst 8500 series incorporates rich QoS capabilities such as Weighted Round Robin (WRR), Rate and Strict Priority queue scheduling and Per-Flow Queuing (PFQ). These capabilities, when combined with CiscoAssure Policy Networking, deliver the ability to protect mission-critical traffic by allowing network administrators to easily provision, manage, and control traffic flows in the network without sacrificing performance.

### Enables Multimedia Networking with Scalable IP Multicasting

A new class of multimedia applications is rapidly being implemented from the Internet to the intranet. These applications utilize IP multicasting, which provides a scalable method of enabling large-scale voice and video networking. Multimedia applications are delay sensitive while also requiring high performance. The latest innovation from Cisco in the field of scalable IP multicast routing is Protocol Independent Multicast (PIM). Cisco is driving its standardization in the Internet Engineering Task Force (IETF) while PIM is also being rolled out on Cisco routers in the Internet by all major Internet service providers (ISPs). PIM enables large-scale deployment of

multicast applications spanning both the Internet and corporate intranets, a scenario that was previously unachievable with Distance Vector Multicast Routing Protocol (DVMRP).

The Catalyst 8500 series, by virtue of running the Cisco IOS software, incorporates PIM and provides a scalable solution for both sparse and dense mode IP multicasting. The sparse mode is used for videoconferencing-type applications with a small number of participants. The dense mode is used for video broadcasting applications, and can be used for delivering corporate training, customer presentations, and so on.

The delay-sensitive nature of multimedia applications places stringent requirements on network response times. The Catalyst 8500 series alongside the complete Cisco end-to-end solution provides the necessary delay prioritization to deliver the QoS required to enable these applications.

### Enables Network Intelligence with Cisco IOS Software

The Catalyst 8500 series enables intelligent network services using Cisco IOS software. Specific services that can be enabled include:

- **Mobility**—Features such as Dynamic Host Configuration Protocol (DHCP) relay, BOOTP relay, and local-area mobility allow network administrators to enable user mobility throughout a campus network. This setup eases the adds, moves, and changes process and provides network managers a lower total cost of ownership.
- **Security**—TACACS+ and Remote Access Dial-In User Service (RADIUS) enable network administrators to secure the Catalyst 8500 series switches; these tools can be managed in a common fashion with other Cisco routers and switches.

### Eases Manageability

The Catalyst 8500 incorporates the Cisco IOS software and, therefore, it can be easily managed and configured by CiscoWorks and CRM. Its Cisco IOS command-line interface (CLI) allows it to be configured and debugged in a common manner across all Cisco IOS products. Its sophisticated debugging capabilities allow network administrators to effectively troubleshoot any problems that occur in the network.

Figure 5 The Cisco IP Multicast Solution Truly Enables End-to-End Voice and Video Networking

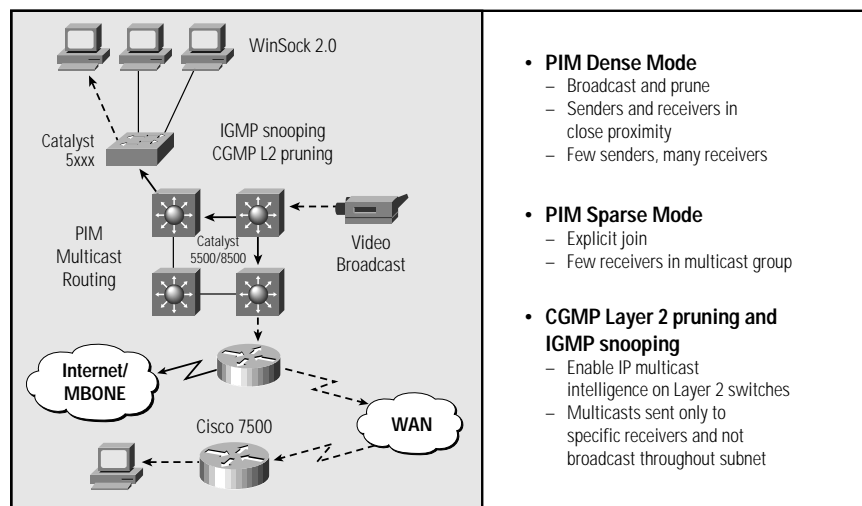
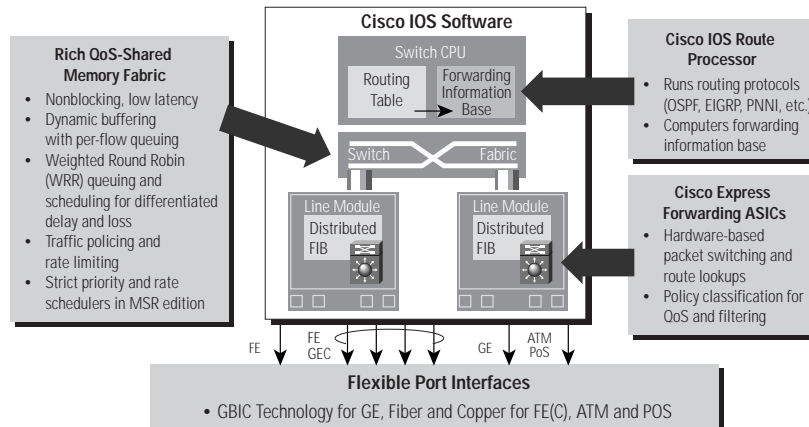


Figure 6 Catalyst 8500 Switch Architecture



### Catalyst 8500—Scalable System Architecture

The Catalyst 8500 is built from the ground up as a Cisco IOS platform. It specifically enables Cisco IOS functions such as IP, IPX, IP multicast, bridging, ATM switching and CiscoAssure policy-enabled QoS in hardware ASICs.

The Catalyst 8500 switch router architecture is based on the following key elements:

- Wire-speed, flexible ASICs on the line cards that make the packet forwarding and policy-based flow classification decisions
- Nonblocking, low-latency, and rich QoS switching fabric for advanced traffic management
- MIPS architecture-based CPU running Cisco IOS software for ensuring a stable network topology and fast convergence around failures
- Flexible port interface modules that provide access to a wide variety of media, including Ethernet, Fast Ethernet, Gigabit Ethernet, and ATM and Packet over SONET (POS) in the future

#### Powerful CPU and ASICs for Scalable Control and Forwarding

Integral to the Catalyst 8500 is the MIPS architecture-based CPU. This CPU runs the Cisco IOS and routing protocols such as EIGRP, OSPF, and PNNI, while also computing the Forwarding

Information Base (FIB). A highly optimized routing table lookup algorithm, the FIB is a key technology innovation under the CEF architecture. The FIB data structure is downloaded to the ASICs on the line cards that make the packet-by-packet forwarding (Layer 3 and Layer 2) decisions. The powerful CPU combined with CEF's separation of the data plane and the control plane enables the network to converge quickly in the event of topology changes, and minimizes the risk of packet loss. Additionally, the CPU also handles system maintenance tasks such as running the Cisco IOS CLI, environmental monitoring, retrieving packet statistics, and so on.

In addition to making the forwarding decisions, the CEF ASICs are also responsible for making policy-based flow classifications for QoS and filtering. Flows are identified based on IP precedence and type of service (ToS), providing a common way to represent priorities on a network. Future enhancements will include flow identification based on source IP address, destination IP address, and TCP/User Datagram Protocol (UDP) port combinations as well as Resource Reservation Protocol (RSVP) signaling requests. The ASIC architecture is flexible and future proof. Each line card ASIC can be upgraded by performing a simple microcode change that can be a part of the Cisco IOS software image.

**Rich QoS Switching Fabric and Policy-Enabled Networking**

The Catalyst 8500 series incorporates a centralized shared-memory switching fabric that is nonblocking and low latency. The rich QoS capabilities of the switching fabric provide customers very granular traffic management capabilities. Rich QoS mechanisms such as WRR queue scheduling and PFQ allow prioritization of mission-critical and delay-sensitive traffic. Per-queue drop thresholds provide differentiated loss priorities for prioritizing applications during periods of congestion. Customers also have the ability to provision, control, and manage bandwidth in the network by enabling features such as traffic policing and traffic shaping that are unique to the Catalyst 8500 architecture. The fast packet memory associated with the switching fabric is allocated in a dynamic fashion on a per-queue (flow) basis. Dynamic memory allocation policies, configurable queue scheduling weights, and user-defined queue thresholds all provide flexible support for managing traffic and minimizing the probability of packet loss.

The rich QoS capabilities of the Catalyst 8500 series are very useful in allocating bandwidth to server farms and fulfilling bandwidth and delay reservation requests generated by servers using RSVP. However, this complexity needs to be easily manageable for large-scale networks. CiscoAssure Policy Networking provides customers with a simple way to define policies using a graphical user interface that specifies the relative prioritization of users and applications on the network. Using CiscoAssure policy servers and the Catalyst 8500, customers can protect mission-critical traffic and enable delay-sensitive applications.

Figure 7 Rich QoS Switching Fabric with PFQ and WRR, Rate and Strict Priority Queue Scheduling

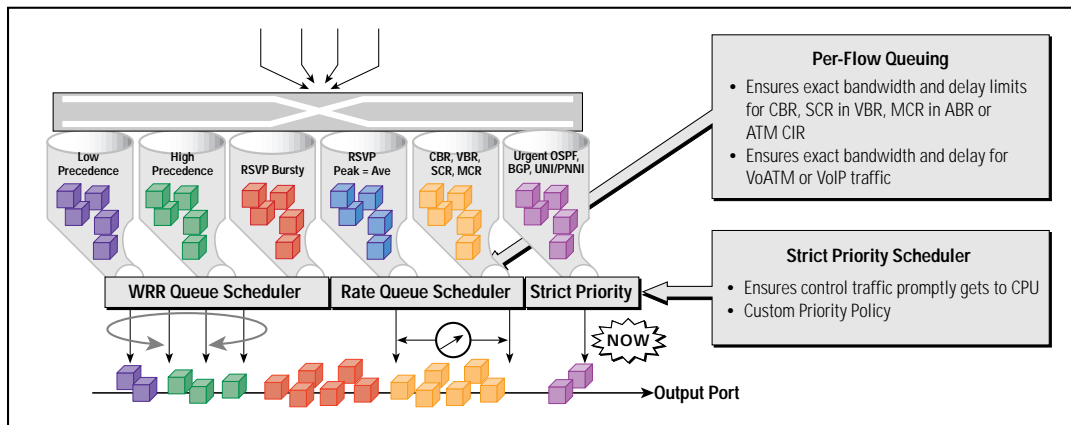
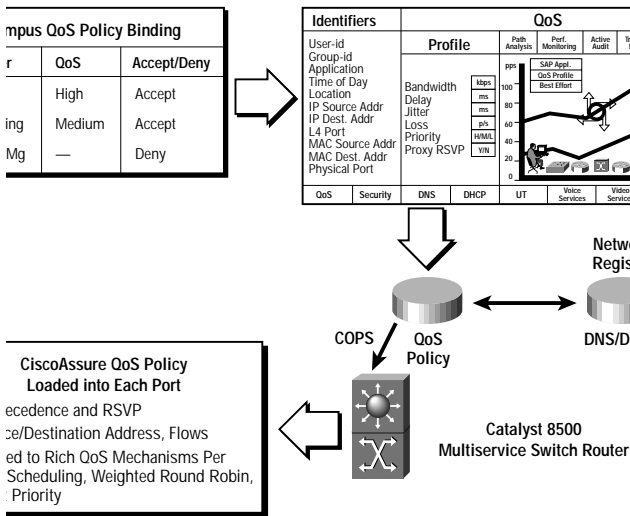


Figure 8 CiscoAssure Policy Networking and Catalyst 8500 Provide Simple

Management of QoS Policies



Flexible Layer 3 Switching Line Card Architecture

Each line card can be configured for either 16,000 or 64,000 address entries per port. Each address entry could be one of the following types: Layer 2 Media Access Control (MAC) address, an IP address, an IP network number, an IPX network number, or an IPX station address. The 16,000 address entries option is suitable for most enterprises, and the 64,000 address entries option is suitable for large enterprises and ISPs.

The line cards are available in Fast and Gigabit Ethernet, with ATM and Packet over SONET uplinks to be released in the future. Gigabit Ethernet line cards will use the Gigabit Interface Controller (GBIC) interface for flexible per-port configuration of the interface types. GBICs are available in the short wavelength multimode fiber, long wavelength multimode fiber, and single-mode fiber interface types. Fast Ethernet interfaces are available in the 10/100 unshielded twisted-pair (UTP) and multimode fiber media types.

The Catalyst 8500 switch family consists of the Catalyst 8510 and 8540, 5- and 13-slot modular chassis-based implementations of the Catalyst 8500 technology.

Catalyst 8510 System Components

The Catalyst 8510 is a modular five-slot chassis switch with dual, redundant, load-sharing power supplies. One of the slots (center slot) is dedicated to the SRP or MSRP and the remaining four slots are available for line cards. A detailed description of the system components follows:

- Five-slot chassis with passive backplane and fan tray
- Dual redundant, load-sharing power supplies with AC or DC (-48V) options
- SRP/MSRP running Cisco IOS software with a choice of software; SRP/MSRP consists of the nonblocking, low-latency, 10-Gbps shared-memory switching fabric, dynamic packet memory, and a MIPS R4600 CPU running the Cisco IOS software
- Up to four line cards for the Catalyst 8510; Tables 2 and 3 give the full set of line card options

Figure 9 Catalyst 8510 System Overview

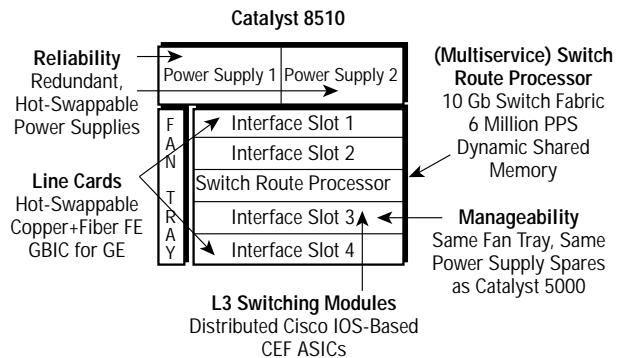


Table 2 Catalyst 8510 Layer 3 Line Cards

Line Card	Media Options	Maximum Switch Density
<b>8-Port Fast Ethernet</b>	<ul style="list-style-type: none"> <li>• 10/100 UTP with RJ-45 connectors</li> <li>• 100 BaseFX MMF with SC connectors</li> </ul>	32 ports
<b>1-Port Gigabit Ethernet</b>	<ul style="list-style-type: none"> <li>• GBIC connectors                             <ul style="list-style-type: none"> <li>– Short wavelength (250m)</li> <li>– Long wavelength (500m)</li> <li>– Single mode (3 km)</li> </ul> </li> </ul>	4 ports
<b>Modular ATM and Packet over SONET Uplinks</b>	<ul style="list-style-type: none"> <li>• OC-3c, OC-12c</li> </ul>	Details to be announced later

**Catalyst 8540 System Components**

The Catalyst 8540 is a modular 13-slot chassis switch with dual redundant, load-sharing power supplies, redundant route processor and redundant switch processor options. The primary Route Processor (RP)/Multiservice Route Processor (MRP) is installed in slot 4 and an optional redundant RP/MRP can be installed in slot 8. Similarly, the primary Switch Processors (SP)/Multiservice Switch Processors (MSP) are installed in slots 5 and 6 while a redundant SP/MSP can be installed in slot 7. The remaining slots 0-3 and 9-12 are available for installing line cards. The following gives further details on the system components of the Catalyst 8540:

- 13-slot chassis with hot-swappable fan tray and passive backplane
- MIPS R5000-based RP/MRP running Cisco IOS software with the option for a redundant RP/MRP
- 40-gigabit centralized SP/MSP, with options for a redundant SP/MSP
- Up to 8 line cards; Tables 3, 4, and 5 summarize the list of line cards available for the Catalyst 8540

Figure 10 Catalyst 8540 System Overview

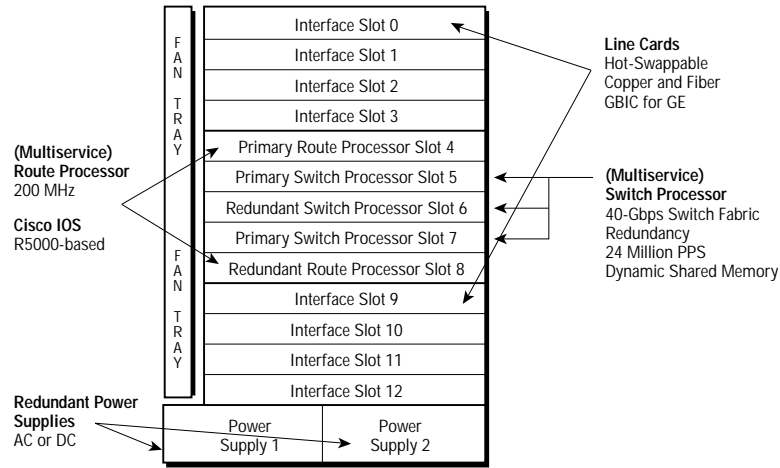


Table 3 Catalyst 8510 Multiservice Line Cards When MSRP is Installed in Addition to L3 Line Cards Above (Note: These are the same PAM Modules as those Available for the LightStream 1010)

Interface Type	Rate	Media Options	Max Range/Notes	Ports/PAM	Max Per Catalyst 8510	Max Per Catalyst 8540
25 ATM	25 Mbps	UTP-3	50-100m	12	96	N/A
OC-3c	155 Mbps	MMF/SMF	2 km and 15 km	4	32	64
		3 x MMF + 1 x SMF	2 km and 30 km	3+1	32	64
		UTP-5	100m	4	32	64
		SMF LR	40 km	4	32	64
OC-12c	622 Mbps	MMF/SMF	500m and 1 km	1	8	16

Table 3 Catalyst 8510 Multiservice Line Cards When MSRP is Installed in Addition to L3 Line Cards Above (Note: These are the same PAM Modules as those Available for the LightStream 1010)

Interface Type	Rate	Media Options	Max Range/Notes	Ports/PAM	Max Per Catalyst 8510	Max Per Catalyst 8540
OC-12c	622 Mbps	SMF LR	40 km	1	8	16
DS3 ATM	45 Mbps	Coaxial		4	32	64
E3 ATM	34 Mbps	Coaxial		4	32	64
T1/E1 ATM	1.5 Mbps	TP—RJ-48 and coaxial for E1		4	32	64
T1/E1 CES	1.5 Mbps	TP—RJ-48 and coaxial for E1	(Un)structured	4	32	64

Table 4 Catalyst 8540 Layer 3 Line Cards

Line Card	Media Options	Maximum Switch Density
16-Port Fast Ethernet	<ul style="list-style-type: none"> <li>• 10/100 UTP with RJ-45 connectors</li> <li>• 100 BaseFX MMF with mini-MT connectors</li> </ul>	128 ports
2-Port Gigabit Ethernet	<ul style="list-style-type: none"> <li>• GBIC connectors                             <ul style="list-style-type: none"> <li>– Short wavelength (250m)</li> <li>– Long wavelength (500m)</li> <li>– Single mode (3 km)</li> </ul> </li> </ul>	16 ports
Modular ATM and Packet over SONET Uplinks	<ul style="list-style-type: none"> <li>• OC-3c, OC-12c</li> </ul>	Details to be announced

Table 5 Catalyst 8540 Multiservice Line Cards in Addition to Layer 3 Line Cards Above (Note: The LightStream 1010 PAMs in Table 3 can be used in the Catalyst 8540 also.)

Line Card	Media Options	Max Per Catalyst 8540
16-Port OC-3c Line Card	MMF with Mini-MT connectors	128 ports
4-Port OC-12c Line Card	SMF-IR and MMF with SC connectors	32 ports
1-Port OC-48 Line Card	SMF with SC connectors	8 ports

### Catalyst 8500—Features at a Glance

- High-performance IP, IPX, IP multicast, and Layer 2 switching with wire-speed integrated routing and bridging (IRB); performance rated at 6 and 24 million pps for the Catalyst 8510 and the Catalyst 8540, respectively
- Cisco IOS routing protocols, including:
  - OSPF, IGRP, EIGRP, Routing Information Protocol (RIP), RIP-2
  - Border Gateway Protocol (BGP) can be supported via a software upgrade
  - RIP, EIGRP for IPX
  - NetWare Link Services Protocol (NLSP) will be supported via a future software upgrade
  - PIM—sparse mode, dense mode, and DVMRP interoperability for IP multicast
- Rich QoS:
  - Per-Flow Queuing (IP precedence and TOS-based flows)
  - Differentiated delay and loss priorities using WRR scheduling and per-flow queue thresholds
  - IP source/IP destination-based flows and TCP/UDP port-based flows, RSVP-based flows (future)
  - Traffic classification, shaping, and policing (future)
- Cisco IOS security, including:
  - TACACS+, RADIUS, Kerberos encrypted passwords, Lock and Key features
  - Message Digest 5 (MD5) route authentication
- Reliability features such as:
  - HSRP for router redundancy
  - Layer 3 load balancing across multiple network paths and Fast and Gigabit EtherChannel<sup>®</sup> technology for multilink load sharing
  - High system availability (Catalyst 8540), redundant switching fabric, CPUs, and power supplies
- Mobility features such as DHCP relay, BOOTP relay, and local-area mobility
- Virtual LAN encapsulations such as Inter-Switch Link (ISL) and 802.1Q (via future software upgrade)
- Network management capabilities, including:



- Cisco IOS CLI, remote Telnet access, and extensive online debugging capabilities
- Cisco Discovery Protocol (CDP) for reliable topology discovery for network management purposes
- Widely implemented MIBs and statistics collection on a per-port basis
- CiscoWorks for Switched Internetworks (CWSI), CRM, and Netsys Service-Level Management Suite (NSLM) modeling tools

Table 6 Catalyst 8500 ATM Traffic Classes

Traffic Classes Available Today	Typical Use
<b>Constant Bit Rate (CBR)</b>	Typically used for telephony or legacy, site-to-site videoconferencing applications, ATM circuit emulation service
<b>Real-Time Variable Bit Rate (RT-VBR)</b>	Designed for delay- and jitter-sensitive applications, such as many-to-many desktop videoconferencing applications
<b>Non-Real-Time Variable Bit Rate (NRT-VBR)</b>	Designed for delay- and jitter-tolerant, but bandwidth-hungry applications, such as one-to-many video broadcasts
<b>Available Bit Rate (ABR) + Minimum Cell Rate (MCR)</b>	Best effort with congestion feedback notification plus an optionally defined minimum bandwidth, typically used in the WAN
<b>Unspecified Bit Rate (UBR) + MCR</b>	Cisco-unique traffic class for best-effort traffic with a specified minimum bandwidth, typically used in the LAN for strategic resources or applications or in the WAN for an ATM committed information rate (CIR)-like service
<b>Unspecified Bit Rate (UBR)</b>	Most legacy data applications using fair best-effort service

Table 7 Catalyst 8500 Features and Benefits Summary

Feature	Comment/Description	Benefit
<b>High Performance, High Scalability</b>		
Wire-Speed, Low-Latency Switching for IP, IPX, IP Multicast, and Layer 2 Bridging	<ul style="list-style-type: none"> <li>Catalyst 8510—6 million pps, 10G nonblocking switching fabric</li> <li>Catalyst 8540—24 million pps, 40G nonblocking switching fabric</li> </ul>	<ul style="list-style-type: none"> <li>Nonblocking performance means that the total switching capacity of each Catalyst 8500 series platform is greater than what is needed to switch the total traffic load across all the respective interfaces simultaneously, even if all the traffic is to be routed.</li> </ul>
Cisco Express Forwarding (CEF)	<ul style="list-style-type: none"> <li>Same switching paradigm used to scale Cisco 7500 and GSR 12000 series routers by isolating control plane (routing) and data plane (switching)</li> </ul>	<ul style="list-style-type: none"> <li>CEF, designed originally to solve Internet scalability issues, provides needed scalability to emerging enterprise intranets and applications.</li> </ul>
Hardware-Based Routing Tables on Each Port	<ul style="list-style-type: none"> <li>Cisco's highly optimized lookup algorithm, the FIB, is downloaded to the ASICs on each line card</li> </ul>	<ul style="list-style-type: none"> <li>This optimized algorithm, together with the CEF architecture, ensures that the route processor is free to keep the network topology consistent and to converge quickly in the event of topology changes or link failures.</li> </ul>
SRP/MSRP in the Catalyst 8510 Is R4600 RISC-Based RP/MRP in the Catalyst 8540 Is R5000 RISC-Based	<ul style="list-style-type: none"> <li>100-MHz clock speed</li> <li>200-MHz clock speed</li> </ul>	<ul style="list-style-type: none"> <li>High performance meets requirements for quick convergence of routing protocols upon topology changes or link failures and for running resource and policy admission control, and so on.</li> </ul>
<b>Cisco IOS Routing Support</b>		
Cisco IOS IP Routing Support	<ul style="list-style-type: none"> <li>OSPF</li> <li>EIGRP</li> <li>IGRP</li> <li>RIP</li> <li>RIP-2</li> <li>CIDR support</li> <li>VLSM</li> <li>IP multicast: PIM—sparse and dense mode and DVMRP interoperability support</li> </ul>	<ul style="list-style-type: none"> <li>Consistent LAN and WAN implementation</li> <li>Fast convergence around failures with OSPF and EIGRP</li> <li>Stable, time-tested, and proven industry-standard routing protocol feature set</li> </ul>

Table 7 Catalyst 8500 Features and Benefits Summary (Continued)

Feature	Comment/Description	Benefit
Cisco IOS IP Routing Support	<ul style="list-style-type: none"> <li>• RIP</li> <li>• EIGRP</li> <li>• NLSP (future)</li> </ul>	<ul style="list-style-type: none"> <li>• Fast convergence around failures with EIGRP</li> <li>• Stable, time-tested and proven industry-standard routing protocol feature set</li> </ul>
Integrated Routing and Bridging (IRB)	<ul style="list-style-type: none"> <li>• Both routing and bridging on ports or sets of ports</li> </ul>	<ul style="list-style-type: none"> <li>• Supports nonroutable protocols and facilitates some address transition plans.</li> </ul>
HSRP	<ul style="list-style-type: none"> <li>• Cisco value add protocol for router redundancy</li> </ul>	<ul style="list-style-type: none"> <li>• Network redundancy and loadsharing with smooth integration into existing Cisco networks; failover transparent to end users.</li> </ul>
<b>Rich QoS</b>		
Nonblocking, Shared-Memory Switching Fabric with Low Latency and Rich Mechanisms for Queuing and Scheduling	<ul style="list-style-type: none"> <li>• Dynamic allocation of shared memory maximizes performance and flexibility with a high degree of effective buffer utilization</li> </ul>	<ul style="list-style-type: none"> <li>• Supports all IP QoS and IEEE 802.1Q traffic classes and allows for reservations on demand while minimizing packet loss.</li> </ul>
Integrated into CiscoAssure Policy Networking Architecture	<ul style="list-style-type: none"> <li>• Integral part of end-to-end QoS architecture</li> </ul>	<ul style="list-style-type: none"> <li>• Provides simple means to define policies that prioritize users or applications in the network.</li> </ul>
Per-Flow Queuing	<ul style="list-style-type: none"> <li>• Granular traffic queuing capability</li> </ul>	<ul style="list-style-type: none"> <li>• Differentiate and protect mission-critical applications from other traffic.</li> </ul>
Weighted Round Robin (WRR)	<ul style="list-style-type: none"> <li>• Differentiated queue scheduling discipline</li> </ul>	<ul style="list-style-type: none"> <li>• Fair, differentiated delay probability for traffic classes, including multiple IP Precedence levels, ToS, or RSVP service classes.</li> </ul>
Per-Queue Drop Thresholds	<ul style="list-style-type: none"> <li>• Supports early discarding of packets when user-defined buffer threshold(s) are exceeded</li> </ul>	<ul style="list-style-type: none"> <li>• Multiple thresholds offer differentiated loss probability for multiple IP Precedence level or ToS service classes.</li> </ul>
Traffic Policing and Rate Limiting	<ul style="list-style-type: none"> <li>• Token bucket algorithm for frame switching (future)</li> </ul>	<ul style="list-style-type: none"> <li>• Ensures that traffic reservations are guaranteed by protecting against misbehaving or noncompliant traffic.</li> </ul>
Resource and Policy Admission Control	<ul style="list-style-type: none"> <li>• RSVP reservations and other emerging reservation routing protocols require sophisticated resource and policy admission control algorithms</li> </ul>	<ul style="list-style-type: none"> <li>• Ensures that guarantees made to existing flows or policies set by CiscoAssure can be honored when setting up new reservations.</li> </ul>
<b>Cisco IOS Intelligent Network Services</b>		
Mobility	<ul style="list-style-type: none"> <li>• DHCP</li> <li>• BOOTP relay</li> <li>• Local-area mobility</li> </ul>	<ul style="list-style-type: none"> <li>• Offers numerous options to support dynamic IP addressing in environments with frequently moving desktops, as well as transition to DHCP deployment strategies</li> </ul>
Routing Security	<ul style="list-style-type: none"> <li>• MD5 route authentication</li> </ul>	<ul style="list-style-type: none"> <li>• Prevents unauthorized routers from interrupting trusted router operations</li> </ul>
VLANs	<ul style="list-style-type: none"> <li>• Cisco ISL</li> <li>• 802.1Q via a future software upgrade</li> </ul>	<ul style="list-style-type: none"> <li>• Allows multiple subnets to be overlaid logically between the backbone and wiring closets</li> <li>• Allows smooth integration with installed Catalyst LAN switches</li> </ul>
Load Sharing Across Redundant Links	<ul style="list-style-type: none"> <li>• Support for Fast EtherChannel and Gigabit EtherChannel</li> <li>• Support for parallel links using unique Layer 3 load-balancing algorithm</li> </ul>	<ul style="list-style-type: none"> <li>• Increases effective link bandwidth and network uptime</li> </ul>
<b>Manageability Mechanisms</b>		

Table 7 Catalyst 8500 Features and Benefits Summary (Continued)

Feature	Comment/Description	Benefit
Uninterrupted Software Upgrades	<ul style="list-style-type: none"> <li>The Catalyst 8540 can be deployed with two route processor modules where the secondary module can be loaded with a new software image and become the primary without any need to reboot or without any loss of traffic or connectivity</li> <li>Catalyst 8510 supports seamless software upgrades on its SRP</li> </ul>	<ul style="list-style-type: none"> <li>Eases maintenance and reduces mean time to repair (MTTR)</li> </ul>
Telnet, TFTP, and BOOTP	<ul style="list-style-type: none"> <li>Standard mechanisms for software downloads and configuration input/output</li> </ul>	<ul style="list-style-type: none"> <li>Facilitates easy and flexible configuration</li> </ul>
Flash Memory for Software Download	<ul style="list-style-type: none"> <li>Allows storage of multiple images and configuration files</li> <li>Remotely downloads new software revisions without hardware changes</li> </ul>	<ul style="list-style-type: none"> <li>Reduces cost of administering software upgrades by providing centralized network management and local storage capability.</li> </ul>
Cisco Discovery Protocol (CDP)	<ul style="list-style-type: none"> <li>Autodiscovers Cisco devices in a network</li> </ul>	<ul style="list-style-type: none"> <li>Reliable topology discovery for network management system.</li> </ul>
IP Ping, Trace Route	<ul style="list-style-type: none"> <li>Standard IP management mechanisms</li> </ul>	<ul style="list-style-type: none"> <li>Allows network administrator to verify path integrity at any intermediate point</li> <li>Facilitates network troubleshooting</li> </ul>
RMON MIB	<ul style="list-style-type: none"> <li>Four groups (many of the traditional RMON data sets such as alarms, events, statistics, and history)</li> </ul>	<ul style="list-style-type: none"> <li>Ease of management and proactive troubleshooting</li> </ul>
RMON Traps	<ul style="list-style-type: none"> <li>Can be applied to any MIB variable</li> </ul>	<ul style="list-style-type: none"> <li>Allows customized monitoring of switch operation</li> </ul>
Text-Based CLI	<ul style="list-style-type: none"> <li>Uses Cisco router CLI parser, accessible through local terminal or Telnet</li> </ul>	<ul style="list-style-type: none"> <li>Uses familiar Cisco CLI for online help, scripts and extensive debugging capabilities</li> <li>Facilitates smooth integration into Cisco router network</li> </ul>
Local Management Ports on SRP/MSRP in Catalyst 8510 and on the RP/SRP Module in Catalyst 8540	<ul style="list-style-type: none"> <li>Ethernet port</li> <li>Dual EIA/TIA-232 serial ports</li> </ul>	<ul style="list-style-type: none"> <li>Out-of-band management using parallel 10 MB Ethernet network</li> <li>Allows support for local terminal and modem for remote management</li> </ul>
Access Protection Mechanisms	<ul style="list-style-type: none"> <li>Multiple password levels and TACACS+, RADIUS, or AAA for device management access</li> </ul>	<ul style="list-style-type: none"> <li>Precludes unauthorized access to the Catalyst 8500, preventing "hacking" of configuration</li> </ul>
<b>Chassis</b>		
Modular, 5- and 13-Slot Chassis	<ul style="list-style-type: none"> <li>Supports required switch and route module(s) and up to four or eight line cards</li> </ul>	<ul style="list-style-type: none"> <li>Allows users to flexibly add or mix and match number and type of line modules, as needed</li> </ul>
Catalyst 8510 Uses the Same Chassis Footprint as Catalyst 5000 and LightStream 1010	<ul style="list-style-type: none"> <li>Common power supplies and fan tray</li> </ul>	<ul style="list-style-type: none"> <li>Allows for leveraging investments in spares</li> </ul>
Fits Standard 19-Inch Rack	<ul style="list-style-type: none"> <li>Works with existing wiring closet racks</li> <li>Mounts at front or rear of chassis</li> <li>Rack-mounting hardware and cable guides included</li> </ul>	<ul style="list-style-type: none"> <li>Ensures ease of installation in wiring closet and network center</li> </ul>
Dual, Fault-Tolerant Power Supplies	<ul style="list-style-type: none"> <li>Can configure one or two power supplies, where the second provides redundancy</li> <li>Both AC and DC (-48V) options available</li> </ul>	<ul style="list-style-type: none"> <li>Offers option of increased reliability for fault-tolerant configurations</li> </ul>
Dual Power Cords	<ul style="list-style-type: none"> <li>One to each power supply</li> </ul>	<ul style="list-style-type: none"> <li>Can be powered by independent power sources or distribution systems for greater reliability</li> </ul>
Field-Replaceable Fan Tray	<ul style="list-style-type: none"> <li>Supports multiple redundant fans</li> </ul>	<ul style="list-style-type: none"> <li>Eases maintenance and reduces MTTR</li> </ul>
Field-Replaceable SRP/MSRP Module in the Catalyst 8510 and Field-Replaceable SP/MSP and RP/MRP Modules in the Catalyst 8540	<ul style="list-style-type: none"> <li>The Catalyst 5500 does not need to be powered down to replace the SRP/MSRP</li> </ul>	<ul style="list-style-type: none"> <li>Eases maintenance and reduces MTTR</li> </ul>

Table 8 Catalyst 8500 ATM Switching-Specific Features and Benefits

Feature	Comment/Description	Benefit
<b>Multiservice Switch and Route Processor</b>		
Shared-Memory Fabric	<ul style="list-style-type: none"> <li>Switch memory shared across all ports</li> </ul>	Allows for high degree of effective buffering, multiplying physical buffer space
Low Switch Latency	<ul style="list-style-type: none"> <li>Latencies of 18 to 25 microseconds typical</li> </ul>	Supports delay- and jitter-sensitive traffic
Flash Memory	<ul style="list-style-type: none"> <li>Supported in internal SIMMs and PC Card</li> </ul>	Allows for upgrades to support larger code sizes
<b>Standards-Based Port Interfaces</b>		
Standards Compliance	<ul style="list-style-type: none"> <li>Per ATM Forum UNI specifications and all referenced PHY specifications therein</li> </ul>	Multivendor interoperability
Network Clocking (Stratum 4 Standard) Stratum 3 via Optional Daughter Available for Catalyst 8540 MSR	<ul style="list-style-type: none"> <li>Supports loop timing, slave mode to timing master port, or local clocking</li> </ul>	Allows for all modes of operation, depending upon type of interface or application; loop timing for wide-area ports and clock distribution from master port for synchronous interfaces to support AAL1 or ATM CES
Automatic Interface Recognition	<ul style="list-style-type: none"> <li>Uses the ILMI protocol to identify any new interfaces as UNI or NNI, public or private</li> </ul>	Precludes need for manual configuration
Interface LEDs	<ul style="list-style-type: none"> <li>Two LEDs (RX and TX) per port</li> </ul>	Visual indication of port operation and status
<b>Connection Management</b>		
VC and VP Switching, VP Multiplexing	<ul style="list-style-type: none"> <li>Supports up to 256 VPCs</li> <li>8 bits VPI, 14 bits VCI</li> </ul>	Supports all modes of switch and end-system operation and allows for large numbers of connections across high-speed ports
Logical Point-to-Multipoint VCs	<ul style="list-style-type: none"> <li>Multiple leafs per output port for each point-to-multipoint, when the port has multiple VPs</li> </ul>	Required at the CPE demark when leafs from a point-to-multipoint connection are destined for multiple sites tunneled through different VPs across the public network
VC Merge (frame mode)	<ul style="list-style-type: none"> <li>Preserves AAL5 cell sequencing when merging input from two or more connections onto one output connection</li> </ul>	Supports multipoint-to-point connections network-wide, providing much greater VC utilization, and thus greater scalability in wide-area networks that support packet- or frame-based traffic, such as Tag Switching networks
<b>ATM Signaling and Routing</b>		
UNI 3.0, 3.1, and 4.0 Signaling (ITU-T Q.2931, Q.2971)	<ul style="list-style-type: none"> <li>Fully standards compliant; supports signaling version interworking</li> </ul>	Allows end systems of any UNI version level to signal for SVCs

Table 8 Catalyst 8500 ATM Switching-Specific Features and Benefits

Feature	Comment/Description	Benefit
Integrated Local Management Interface (ILMI) 4.0	<ul style="list-style-type: none"> <li>Across UNI and PNNI or IISP</li> </ul>	Facilitates network-wide autoconfiguration; for example, through address registration and UNI/PNNI version negotiation; includes address scope indication and PVC parameter discovery, detects change of attachment points when there are moves across the UNI, and facilitates IISP link autoconfiguration and topology discovery
Full, ATM Forum-Compliant PNNI Support	<ul style="list-style-type: none"> <li>Default PNNI image license supports single level of hierarchy, where multiple peer groups can be interconnected by IISP or by other switches that support full PNNI hierarchy; extra PNNI image license will support multiple levels of routing hierarchy</li> </ul>	Support for ATM Forum specification for scalable, QoS-based ATM routing and switch-to-switch SVC interoperability
IISP Support	<ul style="list-style-type: none"> <li>Included in all software images/licenses</li> </ul>	Allows backward compatibility with switches not yet implementing ATM Forum-compliant PNNI
VP Tunneling	<ul style="list-style-type: none"> <li>Maps signaling channels and user connections into logical VP tunnels</li> </ul>	Allows signaling as well as user connections to be tunneled across public networks that do not support SVCs
Soft PVCs/PVPs	<ul style="list-style-type: none"> <li>Automates setup of PVCs or PVPs across network using signaling protocols</li> </ul>	Eases setup of PVCs or PVPs and allows for automatic rerouting of soft PVCs or PVPs
Soft PVC/PVP Continuous Route Optimization	<ul style="list-style-type: none"> <li>Used to reroute or redistribute soft PVC/PVP connections when better routes are available after failed links have healed</li> </ul>	Optimizes network utilization of soft PVC/PVP connections; how aggressive or nonaggressive the rerouting or redistribution proceeds is configurable to avoid oscillation connection rerouting found in other implementations
PNNI Closed User Groups (CUGs)	<ul style="list-style-type: none"> <li>Provides ability to construct ATM-layer virtual private networks (VPNs)</li> </ul>	Supports multiple user networks spread out over the same infrastructure, when they must be securely separated, across both UNI and PNNI
ATM Access Lists	<ul style="list-style-type: none"> <li>Allows firewalls based on ATM address fields within ATM signaling and ILMI registration</li> </ul>	Control over access to a network across particular links or between hosts, for example; also intrusion protection is provided via ILMI firewalls; all these can be set to vary on a time-of-day basis
Configurable "well-known" VCs for signaling, ILMI, or PNNI	<ul style="list-style-type: none"> <li>Allows for the custom configuration of nondefault well-known VCs</li> </ul>	Useful for service providers who offer SVC service and need multiple/numerous signaling channels
Anycast Support	<ul style="list-style-type: none"> <li>Optional feature of UNI Signaling 4.0</li> </ul>	Anycasting is based on new ATM services that use group addresses, where the group address may be shared among multiple end systems; the group address may represent a particular service, such as a configuration or name server
Peak and Minimum Cell Rate (PCR/MCR) Negotiation	<ul style="list-style-type: none"> <li>Optional feature of UNI Signaling 4.0</li> </ul>	Provides quicker connection setup when the original request for PCR or MCR cannot be met because of the lack of resources or policy constraints
E.164 <-> ATM NSAP Address Translation	<ul style="list-style-type: none"> <li>Many public ATM networks and ATM-attached PBX devices use E.164 addressing</li> </ul>	Allows private networks to be attached to public ATM networks at the CPE demark
Plug-and-Play Operation	<ul style="list-style-type: none"> <li>Uses preconfigured Cisco ATM address prefixes</li> </ul>	Precludes need for users to obtain ATM addresses for private networks and permits rapid setup
Redundant PNNI Links	<ul style="list-style-type: none"> <li>Support for parallel links using load-balancing or best-fit algorithms</li> </ul>	Enhances link and network utilization and increases system uptime
Microsoft Corporation Proprietary Funnel Join (or Flow Merge) Protocol	<ul style="list-style-type: none"> <li>Used to support Microsoft's NetShow Theater application for high-quality video broadcast; merging is only over the UNI</li> </ul>	Improves scalability of this video-on-demand system
<b>Rich ATM Traffic Management Mechanisms</b>		
Multiple Priorities for Queuing and Scheduling	<ul style="list-style-type: none"> <li>Supports all ATM Forum traffic classes and AAL types</li> </ul>	Supports all traffic types and allows for QoS on demand

Table 8 Catalyst 8500 ATM Switching-Specific Features and Benefits

Table 8 Catalyst 8500 ATM Switching-Specific Features and Benefits

Feature	Comment/Description	Feature	Comment/Description
Multiple Queue Scheduling Disciplines for Frames and Cells	• Strict Priority	ABR Congestion Control	Custom, guaranteed ATM traffic classes
	• Specified Rate		Guarantees peak rate for CBR (rate limiting), minimum cell rate for ABR or UBR, and sustainable cell rate for VBR
	• Weighted Round Robin (WRR)	Traffic Statistics	Fair, differentiated delay probability for UBR or NRT-VBR traffic classes, and for best effort with multiple IP precedence levels or RSVP service classes in Tag Switching networks
		LAN Emulation Services	Supports EFCI and Catalyst 8510 support for RR and Explicit R
Intelligent Early Packet Discard	• Supports early packet drop when user-defined buffer threshold(s) are exceeded	When user-defined buffer	Supports LUN thresholds used for weighted early packet drop
		Complete Network Reduction	Supports LUN thresholds used for weighted early packet drop
Intelligent Tail (Partial) Packet Discard	• Drops remaining cells of an ATM frame when any cells are dropped after failing traffic policing or other event that causes cell loss	ATM Forum CES v2.0	Improves goodput by not needlessly forwarding cells over ATM
		ATM Forum CES v2.0	Improves goodput by not needlessly forwarding cells over ATM
Cell Tagging and Selective Cell Drop	• Sets cell loss priority bit in cells that exceed buffer thresholds or fail traffic policing	ATM Forum CES v2.0	Optimizes network utilization while minimizing unnecessary cell loss
	• Preferentially drops cells with CLP bit set	CLP bit set	Prioritizes dropping of non-conformant cells
Traffic Policing (usage parameter control) per ITU-T I.371 and ATM Forum UNI Specifications	• Uses dual leaky bucket algorithm	Cisco Tag Switching (emerging IETF Multiprotocol Label Switching)	Allows enforcement of traffic contracts for all ATM Forum-defined traffic types
Traffic Pacing/Shaping	• Allows cells to be paced out specific connections and shaped VP tunnels at rates equal to or below the line rate	ATM-Specific Services and Mechanisms	Allows for rate-limited traffic on public network connections; 128 total VP tunnels can be shaped per switch, each VP with up to 128 VCs each
Resource and Policy Connection Admission Control	• Used in admitting and routing	ATM connections, P4 and P5 OAM Cell Flows	Ensures that guarantees made to existing connections or policies set by the administrator are honored when setting up new connections



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Table 8 Catalyst 8500 ATM Switching-Specific Features and Benefits

Feature	Comment/Description	Benefit
OAM Ping	<ul style="list-style-type: none"> <li>Value-added function includes IP or ATM address within OAM cell to direct pings to other Cat8500 and LS1010 switches</li> </ul>	Allows network administrator to verify link or connection integrity at any intermediate point; facilitates network troubleshooting
Numerous ATM MIBs	All standard MIBs and prestandard extensions, including, but not limited to, AToM MIB (RFC 1695) and its supplemental SVC MIB, ILMI MIB, PNNI v1.0 MIB, ATM signaling diagnostic MIB, ATM RMON and ATM Accounting MIBs (see following entries)	Allows full configuration and monitoring through Cisco's ATM management applications
ATM RMON MIB	ATM Forum has just finished the specification for ATM RMON; this ATM RMON MIB can be enabled on a per-interface basis	Extends traditional RMON data sets such as flow statistics, host, and traffic matrix to ATM switches/networks; an administrator can discover top talkers, for example
ATM Accounting MIB	Data collection is available for SVCs and switched virtual paths (SVPs); soft permanent virtual circuits (SPVCs) with value-added support for PVCs and permanent virtual paths (PVPs); because of the potentially large quantity of data collected, the ATM accounting MIB generates a compressed file of collected accounting information for retrieval via TFTP.	Allows network administrators to collect accounting data on ATM bandwidth/resource usage per connection within the ATM network; this feature is extremely useful for service providers, and a standard RFC for this architecture and MIB is nearing publication from the Internet Engineering Task Force (IETF) with the leadership of Cisco Systems
Per-Port and Per-Connection Snooping Capabilities	Allows connections in either direction of a selected port to be mirrored across to a specified snooping port for analysis by an external ATM analyzer	Facilitates nondisruptive analysis and troubleshooting of traffic flows; includes future remote support of connection steering mechanisms
In-Band ATM Management Access Support	Supports LANE and IP over ATM client on switch processor module	Allows for remote, in-band management across ATM ports