

# Cisco 7500 Series Router

## Increased Performance with Enhanced High-Availability and Networking Features



**High-density, highly available aggregation and intelligent network services at the edge for service providers and enterprises.**

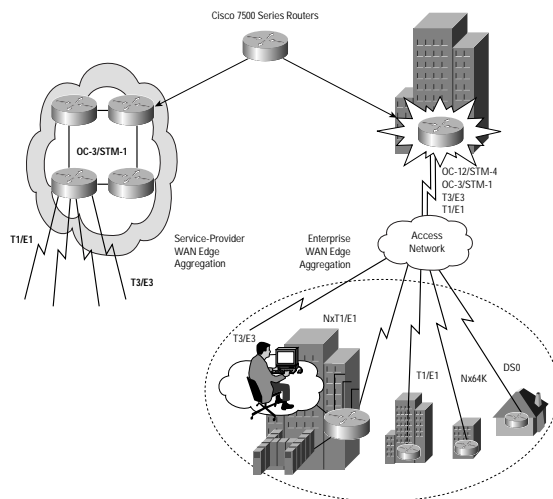
### Advantages

- Increase the performance to over two million packets per second
- Enhanced high availability (HA) features
- Feature-rich IP network services
- Market-proven performance, scalability, and reliability
- Investment protection for large installed base and advanced customer support
- Advanced, scalable distributed switching and service, architecture

### Solutions

- Content networking—Network-Based-Application-Recognition (NBAR) and quality-of-service (QoS) services, such as Distributed Weighted Random Early Detection [dWRED], Distributed Class-Based Weighted Fair Queuing [dCBWFQ]
- Multiservice—Real-Time Transport Protocol (RTP) header compression, Multilink PPP (MLPPP) with link fragmentation and interleaving (LFI), Frame Relay Forum (FRF) 11 and 12 support for optimal digital voice transmission
- DS0 to DS3 and STM-1 WAN aggregation
- IBM mainframe connectivity
- Broadband Aggregation

**Figure 1** 7500 Series Routers in Service-Provider and Enterprise Networks



## Summary

Network Computing Magazine recognized the Cisco 7500 Series Router as one of the top three on the list of “The Ten Most Important Products of the Decade” in 2000. Since its introduction, many thousands of units have been installed over the world in service-provider and enterprise networks deployed at both the network backbone and WAN edge. The Cisco 7500 Series Router has a broad customer base with market-proven performance, scalability, and reliability. To satisfy the ever-growing market demand for bandwidth and performance, Cisco Systems has increased the performance of its Cisco 7500 Series Router, and has substantially increased system availability and network features.

## Advanced Distributed Switching and Services Architecture

The distributed switching architecture (DSW) using Versatile Interface Processors (VIPs) is the key to the scalability of the Cisco 7500. Each VIP has its own processor and memory, which is capable of switching IP data packets and providing network services. This scenario allows the overall system performance of Cisco 7500 Series Router to scale up when they need to handle more high-speed network connections and more data packets.

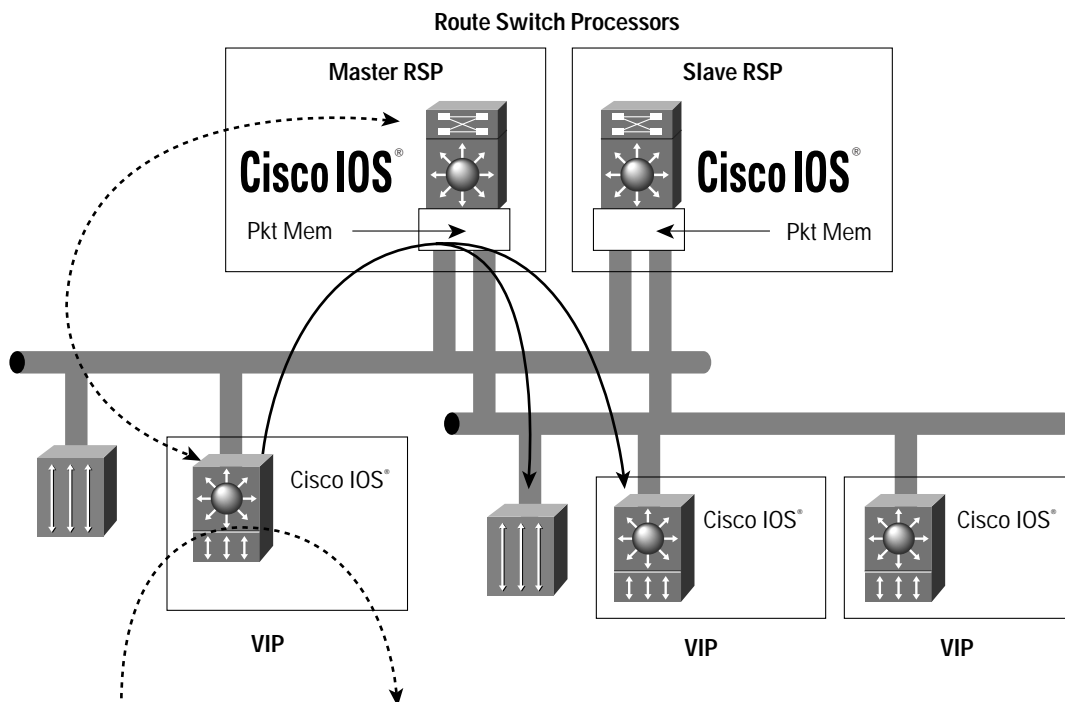
The Route Switch Processor (RSP) is still the master of the system. It runs routing protocols with other routers in the network to gather route information, which is then downloaded to the VIPs through distributed Cisco Express Forwarding (dCEF) so that each VIP can switch IP packets on its own.

In addition to performing packet switching, the VIPs can also provide a set of distributed IP network services, such as access control list (ACL), QoS, and traffic accounting (NetFlow). With the VIPs offloading these IP switching and service functions from the RSP, the RSP can devote all its CPU cycles to handle other essential tasks.

Since its launch, the Cisco 7500 Series Router has seen huge improvements in performance and its ability to scale. Alongside a widened number of interfaces (port adapters) for both LAN and WAN connectivity, the high-end RSP16 and VIP6-80 modules push the performance of the platform to a new high.



**Figure 2** Distributed Switching and Services Architecture



### Increased RSP Performance

The RSP16 dramatically increases the switching and processing performance of the Cisco 7500 Series Router. The RSP16 will support up to 1- GB of program memory which will allow customers to significantly increase their route tables. The RSP16 increases switching performance by more than 25 percent and 65 percent compared to RSP8 and RSP4+, respectively.

The RSP16 is available as an upgrade from existing RSP8, RSP4+, RSP4, or RSP2 based systems. It serves as an ideal option for enterprise and service-provider networks that require additional performance and processing power to support service-enabled edge and core applications.

The RSP16 combines all the routing and high-speed switching functions for the Cisco 7500 Series Router. Key functions include:

- Creates and maintains the routing tables
- Processes interior gateway protocols such as Intermediate System-to-Intermediate System (IS-IS), Interior Gateway Routing Protocol (IGRP), Open Shortest Path First (OSPF), and Enhanced IGRP (EIGRP) to determine the network topology
- Processes exterior gateway protocols such as Border Gateway Protocol (BGP)
- Handles general maintenance functions such as diagnostics, network management, console support, and VIP monitoring

Table 1 illustrates the comparison between RSP models.

**Table 1** RSP Models

Product	Optimal Switching (pps)	Packet Memory (SRAM)	Program Memory (DRAM)	Boot Flash	Flash Disk Support	PCMCIA Flash Card
RSP16	TBD	8 MB	128 MB (default) <b>256 MB</b> <b>512 MB</b> <b>1 GB (post FCS)</b>	16 MB	48 MB (default) <b>128 MB</b>	N/A

**Table 1** RSP Models

Product	Optimal Switching (pps)	Packet Memory (SRAM)	Program Memory (DRAM)	Boot Flash	Flash Disk Support	PCMCIA Flash Card
RSP8	470+k	8 MB	64 MB (default) <b>128 MB</b> <b>256 MB</b>	16 MB	48 MB (default) <b>128 MB</b>	16 MB (default) <b>20 MB</b> <b>32 MB</b>
RSP4+	345k	2 MB	64 MB (default) <b>128 MB</b> <b>256 MB</b>	8 MB	No	16 MB (default) <b>20 MB</b> <b>32 MB</b>

### Increased Performance of VIP

The VIP6-80 Services Accelerator for the Cisco 7500 Series Router enables high-performance switching and scalable LAN/WAN intelligent network services to meet the needs of high-performance applications. The VIP6-80 provides up to a 40 percent improvement over the VIP4 and a more than 100 percent improvement over the VIP2-50 when distributed features and quality-of-service (QoS) are enabled on an interface.

A key VIP feature is its ability to receive and execute on route information provided by the RSP. Based on this route data, a VIP can make its own Layer 3 switching decisions, providing a scalable, distributed switching architecture.

Each VIP runs, in effect, a subset of the Cisco IOS<sup>®</sup> Software. This powerful feature enables the VIP to execute complex and processor-intensive IP services, scaling the application and performance of these features while offloading the main route processor. Distributed services deliver enhanced, network-layer IP services such as distributed QoS and security services.

Port adapters (PAs) provide the media-specific interfaces for the VIP6-80 Services Accelerator, enabling the VIP6-80 configuration to be optimized in terms of price, performance, and density. Up to two PAs can be configured on each VIP. More than 60 media-specific LAN and WAN PAs are supported, including Fast Ethernet, T1/E1, High-Speed Serial Interface (HSSI), T3/E3, T3/E3 ATM, multi-channel T1/E1, multichannel T3/E3, STM-1, OC-3 ATM, OC-3 Packet over SONET (POS), OC-12 DPT and OC-12 ATM.

### Enhanced High-Availability (HA) Features

As the result of rapid growth of Internet connectivity and mission-critical Internet-based applications and services, service-provider and enterprise customers are demanding greater reliability, availability, and higher recovering speed from network outages.

To satisfy customers' demand for the network HA feature, Cisco Systems has initiated a series of programs to boost the strength of the Cisco 7500 Series Router in these areas.

#### General HA Features

##### High System Availability

Redundancy is the primary way to achieve high system availability (HSA), even when using components that can fail, making the recovery from unexpected failure and planned upgrade much faster. Cisco supports redundancy of various components through the HSA feature.

The RSP supports the HSA feature, which allows two RSPs to be used simultaneously with the HSA feature enabled and configured. With the HSA feature, one RSP operates as the active processor and the other RSP operates as the standby processor, which takes over if the active RSP fails. In addition, the Cisco 7500 supports redundancy of power supplies.



### Hot Standby Router Protocol

The Cisco 7500 Series Router supports Hot Standby Router Protocol (HSRP), which enables a set of routers to work together to present the appearance of a single virtual router or default gateway to the hosts on a LAN. Whenever the active router malfunctions, the virtual router will direct the packets to the standby router, which is configured to the same virtual router. HSRP provides redundancy between workstation and router at the session layer and thereby facilitates end-to-end redundancy, which is useful in environments where critical applications are running and fault-tolerant networks have been designed.

### Cisco 7500 Specific HA Features

#### Cisco 7500 Single Line Card Reload

The Single Line Card Reload (SLCR) feature isolates a fault in one VIP from the rest of the system. It allows the system to reload only the line card that has failed, without affecting the work of the other line cards. This feature dramatically reduces total outage time and impact.

#### Cisco 7500 Route Processor Redundancy

The Route Processor Redundancy (RPR) feature reduces unplanned downtime. It allows the standby RSP to be loaded with the same Cisco IOS Software image as the active RSP upon system booting. Thus when a fatal error occurs on the active RSP, the system switches over to the standby RSP without waiting for the reloading. This feature reduces the RSP switchover time by 50 percent.

#### Cisco 7500 Route Processor Redundancy+

The RPR+ feature is an enhancement to the RPR feature. RPR+ further accelerates RSP switchover (down to only 30-40 seconds) compared to RPR. Also, it keeps the line cards from being reset and reloaded when an RSP switchover occurs.

#### Cisco 7500 Fast Software Upgrade

The Fast Software Upgrade (FSU) feature reduces planned downtime; this feature is based on the same mechanism as RPR. It allows users to configure the system to switch over to a standby RSP, which is preloaded with a different image from that running on the active RSP.

#### Cisco 7500 Stateful Switchover

This feature, which is based on RPR+, allows the active RSP to pass the necessary state information of key routing and interface protocols to the standby RSP upon switchover, thereby reducing the time for the standby RSP to learn and converge routes. This feature is planned to be available in 12.0(22)S.

#### Cisco 7500 Non-Stop Forwarding

Also based on RPR+, Non-Stop Forwarding allows routers with redundant RSPs to continue forwarding data to the standby RSP during a switchover. This feature uses the Forwarding Information Base (FIB) that was current at the time of the switchover. Once the routing protocols have converged, the FIB table is updated and stale route entries are deleted. This feature eliminates downtime during the switchover. Planned availability of this feature is in 12.0(22)S.

### Select Hardware and Software Services

Cisco is continuously creating new interface processors and Cisco IOS Software features to satisfy the industry demand for scalability, flexibility, port density, multiservices, security, and cost savings.

#### Dual-Port Fast Ethernet Port Adapters (PA-2FE-TX and PA-2FE-FX)

The PA-2FE is a dual-port, single-wide port adapter for the Cisco 7500 Series Router. The PA-2FE provides Fast Ethernet LAN connectivity for 100BaseTX (copper) and 100BaseFX (fiber) interfaces in full- or half-duplex operation. The PA-2FE supports 10- or 100-Mbps configurations and auto-negotiation, which enables auto-selection of the appropriate network speed and duplex mode.

Providing the highest packet throughput available from Cisco 7500 Fast Ethernet interfaces, the PA-2FE is the preferred choice for Fast Ethernet connectivity for the Cisco 7500 Series Router. The PA-2FE is ideal for campus/enterprise backbones, data centers, high-performance routing between multiple Ethernet virtual LANs (VLANs), and other deployments requiring line-rate Fast Ethernet connectivity.

#### **T1 and E1 Enhanced Digital Voice Port Adapters (PA-VXC-2TE1+ and PA-VXB-2TE1+)**

These port adapters provide high-capacity, large-scale voice termination to private branch exchanges (PBXs), and the Public Switched Telephone Network (PSTN) for central-site and large-branch packet voice applications. These enhanced port adapters come with increased digital-signal-processor (DSP) memory for support of future additional voice and voice-band features.

Both enhanced digital voice port adapters are highly integrated solutions that offer a leap forward in voice-channel density and application flexibility. These single-width port adapters incorporate two universal ports that can be configured for either T1 or E1 connection with high-performance DSPs that support up to either 48 or 120 channels of compressed voice. Integrated channel service unit/data service unit (CSU/DSU), echo cancellation, and digital signal level 0 (DS0) drop-and-insert functionality eliminate the need for external line-termination devices and multiplexers, simplifying network design and management.

Rather than deploying separate voice and data networks, enterprises and service providers can merge these into a common multiservice infrastructure. Deploying a multiservice network with data, voice, and video provides tremendous cost savings by eliminating redundant network infrastructure, reducing voice toll charges, and reducing network operations overhead.

#### **Enhanced Gigabit Ethernet Interface Processor**

The Enhanced Gigabit Ethernet Interface Processor (GEIP+) is a single-port VIP4-based interface processor for the Cisco 7500 Series Router. The GEIP+ provides high-speed LAN connectivity, broadening the deployment options for the Cisco 7500 Series Router to provide high-capacity Gigabit Ethernet connections for environments with dense WAN or diverse LAN aggregation requirements.

The GEIP+ integrates a VIP technology-based intelligent processor with a media-specific network interface. This provides a complete, single-slot solution for Gigabit Ethernet connectivity in the Cisco 7500 Series Router, providing high-performance solutions for Gigabit uplinks from the enterprise edge and data center, as well as in service-provider points of presence (POPs).

#### **OC-12c/STM-4 Enhanced ATM Port Adapters (PA-A3-OC12SM and PA-A3-OC12MM)**

Cisco provides the dual-wide, single-port OC-12c/STM-4 ATM port adapter for the Cisco 7500 with VIP4-80 and VIP6-80 only. This port adapter allows higher-speed support for WAN aggregation, Intra-POP, and metro applications. This allows ATM-based enterprise WAN and service providers to take advantage of the higher bandwidth and QoS available with ATM services. High-speed ATM access provides cost-effective, value-added, high-speed managed router services to both enterprise and service-provider customers.

The OC-12c/STM-4 ATM port adapter is available in two hardware versions: an OC-12c/STM-4 multimode (500 m) and an OC-12c/STM-4 single-mode intermediate reach (15 km). The OC-12c/STM-4 ATM port adapter will support per-virtual circuit (VC) and per-virtual path (VP) traffic shaping, and will support all ATM traffic classes, except available bit rate (ABR). Basic Multiprotocol Label Switching (MPLS), MPLS class of service (CoS), MPLS traffic engineering, and MPLS virtual private network (VPN) are supported.

#### **Dynamic Packet Transport (SRP) OC-12c/STM-4 Port Adapters (PA-SRP-OC12)**

The PA-SRP-OC12 Dynamic Packet Transport (DPT) port adapter is a dual-width OC-12c/STM-4 port adapter that provides a shared IP over Optical capability on the Cisco 7500 Series Router. The DPT port adapter provides two SC duplex ports. Each SC duplex port allows connection to an adjacent device in a DPT ring. The DPT port adapter is designed to be deployed in SONET OC-12c/STM-4 DPT rings. DPT rings can also be connected to SONET add drop multiplexers (ADMs), thus allowing for the creation of small or very large DPT rings. DPT is media-independent, capable of operation over dark fiber, SONET/SDH gear and WDM infrastructure.



DPT rings are dual, counter-rotating fiber rings. Both fibers are used concurrently to transport both data and control traffic, providing 2 x OC-12c/STM-4 of available bandwidth.

The Spatial Reuse Protocol (SRP) is the physical layer independent Media Access Control (MAC) layer that enables DPT functionality in ring configurations. The SRP MAC provides the base functionality for addressing, packet stripping, managing bandwidth using the SRP fairness algorithm, and controlling message propagation on the ring.

#### **Multichannel STM-1 Port Adapter (PA-MC-STM1)**

The multichannel STM-1 port adapter enables service providers to use a single fiber-optic circuit to provision 63 E1s, which normally require 63 separate copper pairs. Service providers can “turn up” new E1s quickly and simply through Cisco IOS Software. For service providers with customers that require smaller circuits, the multichannel STM-1 can support as many as 256 channel groups and can provision circuits down to DS0—providing even more flexibility and density.

#### **High Density ISDN Aggregation (PA-MC-8TE1+)**

The Cisco PA-MC-8TE1+ is a single-wide port adapter designed to provide a full eight port PRI multichannel solution for the Cisco 7500 Series Router. The interfaces can be channelized, fractional or ISDN-PRI, or unframed (E1) with up to 256 independent HDLC channels definable for T1 and E1 applications. For network administrators who require the higher performance provided by a PRI ISDN connection, the new Cisco 8TE1+ provides one of the greatest densities currently offered in the industry at eight PRI ports per card

#### **Multiport T1/E1 ATM Port Adapters with Inverse Multiplexing over ATM**

Inverse multiplexing over ATM (IMA) port adapters for the Cisco 7500 Series Router offer a cost-effective solution to increase bandwidth and extend multiservice capabilities to regional offices and large branches with ATM. By aggregating T1 or E1 communications links using standards-based IMA, service providers and enterprise customers can now take advantage of greater bandwidth flexibility as well as the advanced quality-of-service (QoS) features available with an ATM WAN infrastructure.

IMA is an ATM Forum specification that provides a cost-effective and scalable alternative to T3/E3 services by offering service providers and enterprise customers the ability to leverage widely available T1 services over ATM, and interoperate with other vendors' standards-based equipment. Multiport T1/E1 IMA can provide organizations with highly desired fractional T3/E3 bandwidth connectivity so critical in situations where DS3 or OC-3 fiber communications links are either cost prohibitive or unavailable.

#### **Firewall**

The Cisco 7500 Series Router supports the Cisco IOS Firewall Feature Set. It integrates robust firewall functionality and intrusion detection for every perimeter of the network, enriching existing Cisco IOS Software security capabilities such as authentication, encryption, and fail-over. It adds greater depth and flexibility to the standard feature set, including stateful, application-based filtering via Context-Based Access Control (CBAC), dynamic per-user authentication and authorization, defense against network attacks, Java blocking, and configurable, real-time alerts.

Cisco 7500 Series Routers are used in a variety of customer environments. In many cases, at perimeters of the network, vulnerabilities exist because of connectivity with less-trusted sites. In these deployments, access lists can be used on the router as a method to limit or control access, or as appropriate, a standalone firewall can be used to protect the network. The sophisticated security capabilities allow these devices to be used as firewalls throughout the network, with the added advantages of interface density and flexibility, excellent performance, and full, multiprotocol routing.

#### **Additional Information**

For additional information regarding the performance and features of the Cisco 7500 Series Router, please refer to: <http://www.cisco.com/warp/customer/cc/pd/rt/7500/>



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