

Cisco 7600 Series Internet Router

A Multi-use Platform

for Service Provider Points of Presence



Introduction

The increase in demand for e-business applications requires service providers (SPs) to offer both increased bandwidth and enhanced network services. Enterprises are increasingly outsourcing the hosting of these applications, requiring SPs to offer Web, application, and remote storage hosting with guaranteed service-level agreements. Simultaneously, broadband residential services are being widely deployed using digital subscriber line (xDSL) and cable technology; traffic that was once constrained to high-speed LAN network is now routinely transported across metropolitan and wide-area networks (MANs/WANs). Not only must this increasing traffic be aggregated and transported over the MAN and WAN, but also it must meet the quality-of-service (QoS) and security requirements that business-critical applications demand without impacting performance. This white paper describes how the Cisco 7600 Series Internet Router meets these needs by providing the widest range of high-speed optical interfaces with flexible and cost-effective line-rate services.

High-Performance Platform

The Cisco 7600 Series router delivers optical WAN and MAN networking with a focus on line-rate delivery of high-touch IP services at the edge of service providers networks. Now, service providers can “service enable” their networks at optical speeds, enabling the SP to differentiate their service offerings for competitive advantage. The Cisco 7600 Series is an important component of Cisco's end-to-end IP+Optical offerings, which help service providers break through service and bandwidth barriers to increase revenue and profits

The Cisco 7600 provides a scalable, high-performance platform that meets the needs of a wide range of applications. Its underlying infrastructure, employing the Supervisor 2, Multilayer Switching Feature Card (MSFC2), Policy Feature Card (PFC2), and up to 256-Gbps crossbar switch fabric, bring new and enhanced capabilities to the Cisco family of products.

The Supervisor 2/MSFC2 supports memory configurations up to 512M bytes of DRAM, easily accommodating the entire Internet routing table. The platform is capable of switching up to 256 Gbps when configured with the crossbar switch fabric. This architecturally advanced fabric allows line-rate, nonblocking switching on all ports. Routing table maintenance is performed on the Supervisor 2/MSFC2. The Cisco 7600 with Cisco Express Forwarding (CEF)-based switching is capable of forwarding 30M pps, a level sufficient to switch a nine slot Cisco 7600 fully loaded with OC-48 modules at line rate with 64-byte packets.

This combination of large routing table capacity, high-speed switch fabric, CEF switching, and up to 30-Mpps forwarding capacity means that the Cisco 7600 is capable of operating in the most demanding SP environments.



High Reliability

The Cisco 7600 should be placed in critical locations in the network requiring a high-availability, high-resilience platform. It supports the necessary hardware redundancy features, including redundant processors, switch fabrics, power supplies, cooling, and clock circuitry, to satisfy these requirements.

In addition to basic hardware redundancy, the Cisco 7600 has logical redundancy features such as Hot Standby Router Protocol (HSRP), Layer 3 load balancing, and Cisco EtherChannel® technology to provide higher-level protection. QoS and security access control list (ACL) states are synchronized between the active and backup processor, whereas hitless software upgrades allow the Cisco 7600 to be upgraded while the router is active. Line cards are not rebooted in the case of processor failover.

Together, these high-availability features mean that the Cisco 7600 is ready today for deployment in mission-critical network locations.

Advanced Optical Services Modules

Raw forwarding performance alone, however, does not guarantee successful deployment of broadband network services. SP networks require security and QoS features that in themselves consume large amounts of processing power. Thus, the ability to enable and deliver complex services without impacting performance is critical in these networks.

The Cisco 7600 meets the line-rate service requirements by using Cisco Parallel Express Forwarding (PXF) technology. This is a programmable, pipelined, parallel network processor that performs complex network services in-line in the data path, eliminating any bottlenecks for CPU or other resources that can occur when complex network services require a centralized resource for execution. The programmable architecture also means that services can be more easily enhanced and extended going forward as compared to more traditional hardware or application-specific integrated circuit (ASIC)-based solutions.

Services such as line-rate hierarchical traffic shaping and link sharing, and destination-sensitive services are now possible on interfaces up to OC-48c and beyond with no performance degradation.

Packaging Options

The Cisco 7600 Series is available in a nine, six, or three-slot Network Equipment Building Systems (NEBS) Level 3 compliant chassis suitable for installation in central office environments. The Cisco 7600 can be either AC or DC powered. Power sizing options include 1000W, 1300W, and 2500W supplies. Redundant power supplies are supported.

Table 1 Cisco 7603, 7606, and 7609 Characteristics

	Cisco 7603	Cisco 7606	Cisco 7609
Height	7 inches (four RU)	12.25 inches (7 RU)	33.5 inches (20 RU)
Chassis/Rack	10	6	2
Slots	3 (horizontal)	6 (horizontal)	9 (vertical)
NEBs Compliance	Yes	Yes	Yes
Bandwidth	32 Gbps	160 Gbps	256 Gbps
Switching Performance	15 Mpps	30 Mpps	30 Mpps
Service Performance	6 Mpps per OSM	6 Mpps per OSM	6 Mpps per OSM



Service Provider POP Solutions

Service Providers require networking platforms that scale from sub-T1 to OC-48c and beyond. They also need to support a consistent set of line-rate features across this range. The ability to deploy a wide set of revenue generating services using a single standardized platform is an enormous benefit.

WAN Edge Aggregation

The Cisco 7600 configured with FlexWAN modules provides a high-density WAN aggregation solution. Supported FlexWAN Port Adapter options range from Channelized T1/E1 to OC-3c, including High-Speed Serial Interface (HSSI), DS3/E3/OC-3c ATM, and OC-3c Packet over SONET (POS). These are complemented by high-speed, native OC-3c, OC-12c, and OC-48c interfaces with onboard quad Gigabit Ethernet interfaces. These Gigabit Ethernet interfaces can be used as uplinks without PXF services. The platform also has a Gigabit Ethernet service-enabled line card for providing PXF services across Gigabit Ethernet. This range of interface speeds means the Cisco 7600 can be used in a wide variety of WAN edge aggregation designs. The high-speed uplink options allow the choice of implementing non-blocking uplinks or oversubscription in a single platform.

In addition to physical port capacity, the T1/E1 and T3/E3 interfaces are also available as channelized services, further enhancing the capacity for aggregating T1/E1 and DS0s.

Beyond basic connectivity, the Cisco 7600 can also provide differentiating services at the WAN aggregation layer. Traffic engineering, traffic shaping, QoS, security, and accounting/billing can all take place at the WAN edge without impacting performance.

Intra-POP Aggregation

Intra-POP aggregation applications are typified by the need for a large number of high-speed uplinks and connect at very high speeds to other point-of-presence (POP) switches and the backbone. Today's POP is typically a complex network composed of multiple edge routers connected by Ethernet switches with optical uplinks to a routed core. The high-speed switching capability of the Cisco 7600 coupled with a complete set of interfaces makes the Cisco 7600 ideally suited to intra-POP aggregation applications.

Because a wide range of low-speed and channelized interfaces are available, customer services can be terminated directly in the Cisco 7600. High-speed optical interfaces can be used for direct connection to the optical core. Intra-POP connections can be made with Gigabit Ethernet, channelized Gigabit Ethernet, and in the future, 10 Gigabit Ethernet connections. The availability of cost-effective Gigabit Ethernet interfaces in the Cisco 7600 reduces the need for a separate Layer 2 intra-POP switching layer. The availability of high-speed, long-reach optical interfaces also makes it practical to deploy geographically distributed POPs.

By collapsing edge router aggregation, core uplinks, and intra-POP switching into a single platform, service providers can significantly simplify their intra-POP designs—resulting in operational savings by reducing space, power, and support costs.

Optical Core Connectivity

The backbone core is at the next level of hierarchy in SP networks. This backbone core connection may be made either to a core router or directly to the optical core. In either case, high-speed interfaces and a choice of interface type are critical.

The Cisco 7600 is ideally suited to connect either to a core backbone router, such as the Cisco 12000 Gigabit Switch Router (GSR), or directly to an optical core (for example, long-haul dense wave-division multiplexing (DWDM) or wavelength router). A wide range of optical interfaces allows complete flexibility. Interfaces for core trunking are available in Gigabit Ethernet, POS (OC-48c/STM-16, and OC-12c/STM-4), and ATM (OC-12c/STM-4).



The ability to directly connect at very high speeds to either a routed backbone or an all-optical core gives SPs simple connectivity to the optical transport infrastructure. The flexibility in deployment scenarios with the Cisco 7600 in addition to high-touch services, low-speed aggregation, and content aggregation is unique in the industry, minimizing the need for extra hardware platforms in the network.

Content Aggregation

With the explosion of content hosting applications (for example, Web hosting, e-business applications, application service providers, remote storage hosting, and so on), service providers have a significant opportunity to generate new revenue. These hosting and content aggregation services are provided by building data centers with a discrete mix of Ethernet switching, routing, load balancers, and Web caches. Consolidating these functions in a single platform such as the Cisco 7600 platform can provide enhanced services at a lower cost.

Delivering intelligent IP service in the Cisco 7600 is made possible by the high-speed multilayer switching capability combined with integrated Layer 4 server load balancing (SLB). SLB has a 15-Mpps forwarding rate and can support up to 1 million simultaneous connections. Transparent Hypertext Transfer Protocol (HTTP) redirection is supported with the Web Cache Control Protocol (WCCPv2) protocol. Line-rate IP packet filtering with standard and extended ACLs is supported with a packet forwarding performance of 30M pps. High-density Ethernet and Gigabit Ethernet modules make very high server densities possible, while high-touch features like destination-sensitive billing and traffic shaping allow the SP to provision incremental services and bill customers accordingly.

These features enable the Cisco 7600 to consolidate functionality into a single platform for content delivery without sacrificing performance, resulting in lower operating costs for content SPs.

Applications Areas

The Consolidated POP

There are three main functional areas within a POP architecture—access aggregation, core backbone (including Internet peering), and local server farms. Top-tier service providers typically deploy at their primary POPs a segregated architecture, where each functional area is implemented with a separate set of networking equipment. There are a set of routers for access aggregation, a set of routers as core backbone, and a set of routers and switches for the local server farm. Such a POP architecture is appropriate for large POPs with lots of access and backbone connections and plans for significant growth.

For smaller POPs where scalability requirements are not as intensive, a segregated POP architecture may not be the most efficient and cost-effective, because the amount of connections to be supported may not justify a dedicated set of networking equipment for each of the three main functional areas. Instead, one can consolidate the three functional areas into a single set of networking equipment, with each piece of equipment involved in supporting multiple functions, to optimize equipment utilization and cost-effectiveness. Such an architecture is referred to as a Consolidated POP.

A well-designed consolidated POP architecture can support a wide range of connectivity requirements. It can scale and grow from a simple single-box solution to a multi-box structure, with flexibility to support a wide range of interface media and speed, and maintain at all times the same basic architecture for consistent network operations and modular growth. The key to achieving such a powerful solution is the proper choice of products. The Cisco 7600 is a unique product with capabilities and features that are ideally suited for building efficient, scalable, and high-performance consolidated POP solutions.

Metro Services Aggregation

Metro aggregation refers to the aggregation of access connections in a metropolitan area network (MAN). Metro networks, as the name implies, are found in metropolitan areas characterized by a high concentration of business and commercial facilities in a relatively small geographical area. A high concentration of customers prompts economies of scale, enabling service providers to offer high-bandwidth network services at relatively low costs. The recent advent of optical transport



technologies has fueled the growth of metro network services, as the increased span of optical fiber (up to tens of miles) eliminates the need for optical repeaters, and makes it possible to provision dark fiber in quantity to support network services within metro areas.

Traditional metro network services have been based primarily on SONET and ATM technologies to offer high-bandwidth connectivity. Service providers build SONET and ATM networks to interconnect customers' locations within metro areas, and to provide Internet access and long-haul connectivity to other metro areas. Customers will access such services via SONET and ATM access links from their premises to service providers' points of presence (POPs), and the customer edge equipment has to support WAN interfaces such as SONET and ATM. Customer edge equipment can be owned by the customer or by the service provider.

An emerging alternative to the traditional SONET/ATM-based metro networks is the use of Gigabit Ethernet (GE) as the access link between customers' premises and service providers' POPs. Service providers are beginning to offer GE-based services over fibers within metro areas from customers' premises to service providers' POPs. The advantages are a simpler technology, higher bandwidth, and less-expensive edge equipment—a GE interface instead of a SONET or ATM interface. Customers can use these GE services to access the Internet or to connect to their other locations either within the same metro area or over long distance using the service provider's long-haul backbone. With the right equipment such as the Cisco 7600, a network can support various service features. For example, service providers can offer “fractional GE” services through traffic shaping on the GE interfaces, when there is not enough customer traffic to justify a full GE.

Investment Protection

Service providers must consider investment protection when qualifying new platforms for deployment. The Cisco 7600 provides excellent investment protection by taking advantage of past investments and protecting against unknown future requirements.

The Cisco 7600 provides an evolutionary upgrade path to IP+Optical networks for SPs that currently provision edge aggregation and services with the award-winning Cisco 7500 Series Router. The Cisco 7600 Series Router supports Cisco 7xxx series WAN port adapters with the FlexWAN module and any combination of traditional Catalyst 6000 family LAN interfaces from 10Mbps Ethernet to 1 Gbps. This provides seamless integration with, and migration from existing DS0 to OC3/STM-1 7200/7500 WAN deployments.

The Cisco 7600 takes advantage of many key existing components and technologies. As a Cisco IOS[®] software-based platform, the Cisco 7600 requires minimal training on the part of network operators. Consistent features and command-line interface (CLI) compatibility with a wide range of existing Cisco products result in faster deployments.

Looking forward, the Cisco 7600 provides a base platform with an extensible architecture that can support interface speeds up to 10 Gb and beyond. Cisco PXF technology providing line-rate services is flexible, allowing end users to develop and expand the range of services supported. Large memory size and CEF allow the platform to support the entire Internet routing table. High-speed optical interfaces with line-rate services allow the platform to meet the ever-expanding requirements.

The forward-looking features mean the Cisco 7600 can play a key role in networks for the foreseeable future, while the backward compatibility allows for quick, cost-effective deployments, common sparing, and reduced operating costs.

Summary

Today's service providers need to be able to scale customer services and bandwidth while offering intelligent, line rate network services in order to be competitive in their market space. The new Cisco 7600 provides the tools required to create agile networks by offering cost-effective delivery of high-touch services, scalability, flexibility, and performance needed to deploy intelligent network services. The deployment of the Cisco 7600 in service provider networks can enhance operating margins for the service provider.



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