

Managed Access Cisco Cable-Ready Solution

Proven solution that enables cable operators to provide subscribers Internet access via a choice of service providers

Executive Summary

Cable operators stand to gain many operational and scalability benefits from deploying a Managed Access Cisco Cable-Ready Solution. With managed access, cable operators can introduce a host of new services that not only attract new customers, but also create new revenue opportunities. Cable operators can grant subscribers their choice of ISP based on established partnerships. Cable operators can give ISPs access to their hybrid fiber-coaxial (HFC) cable networks. ISPs can build value-added services on top of the HFC infrastructure. Subscribers can select services from multiple service providers on either a subscription or pay-per-use basis.

In an increasingly competitive marketplace, the level of service offering differentiates a service provider. As subscribers team up with their preferred ISP and choose services from multiple providers, loyalty increases. Incremental revenue opportunities develop a more stable and wider customer base for cable operators. Behind any cable modem, cable operators can configure and manage independent service levels across multiple customer premises equipment (CPE), even though subscribers receive services from different ISPs. Cable operators can capitalize on the rapidly growing home and small business networking market as PCs, Internet appliances, and IP telephones proliferate at subscriber locations.

Virtual private network (VPN) technology is the chief enabler. VPNs allow cable operators to extend their networks securely. Cable operators can partition their cable plants and create scalable VPNs with varying quality of service (QoS) requirements for multiple ISPs and their subscribers.

The Managed Access Cisco Cable-Ready Solution gives cable operators the choice of two implementations:

- Policy based routing (PBR) which uses standard routing protocols to route a packet based on the destination address.
- Multiprotocol Label Switching (MPLS) which uses an innovative technique for high-performance packet forwarding based on a label applied at the edge of an MPLS domain.

The Managed Access Cisco Cable-Ready Solution not only delivers the networking products essential for connecting multiple ISPs and their subscribers to a shared cable infrastructure, but also comes with network management applications that address all aspects of a cable provider's operations. Cisco Cable Internet Operations Support Systems (OSS) and cable network management products are available that support troubleshooting, service fulfillment, assurance, and billing. Components of the Managed Access Cisco Cable-Ready Solution can be mixed and matched. The Cisco uBR7200 Series Universal Broadband Router and Cisco uBR900 Series Cable Access Routers can be used to interface the cable IP network. VPN concentrators, access servers, firewalls and IP core routers round out architecture choices. Together, these components give cable operators the framework to offer value-added open access services. Cisco IOS[®] Software ties all Cisco products together, enabling end-to-end networking with consistent policies over a shared cable infrastructure.

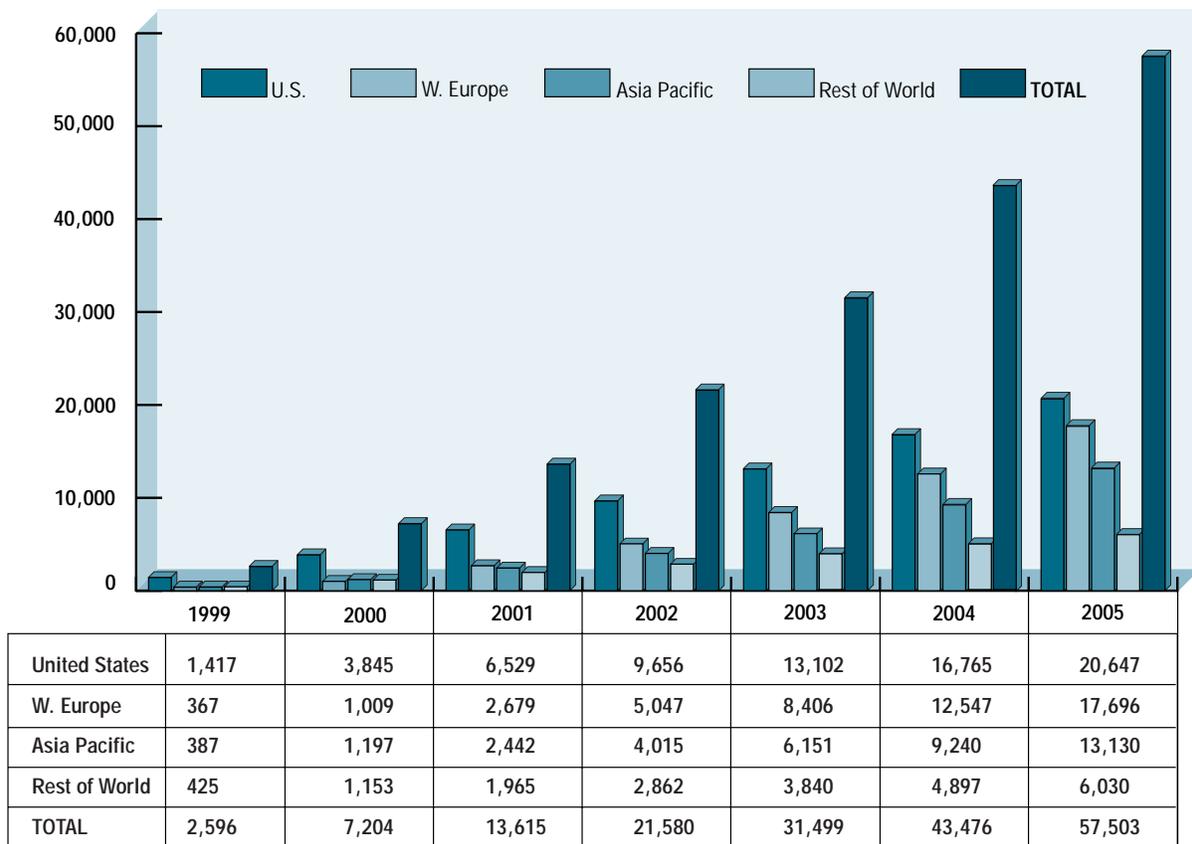
The Managed Access Cisco Cable-Ready Solution:

- Offers end-to-end services from CPE to the IP core.
- Automates service activation to shorten time-to-service and reduce truck rolls.
- Minimizes the complexity of managing IP address blocks.
- Responds to needs for service fulfillment, assurance, and billing.

Opportunities

The cable market has come a long way in a very short time. As recently as 1997, direct Internet access via cable was still in its infancy. A few years later with the help of Cisco’s DOCSIS-based CMTS/router—the Cisco uBR7246 Universal Broadband Router—the market welcomed more than three million cable broadband subscribers—a number that continues to grow. IDC research indicates there were more than seven million cable modem service users in 2000. IDC projects that with the current growth rate, the number of cable modem service subscribers will reach 57 million worldwide by 2005. This phenomenon translates to a 51.5 percent compounded annual growth rate (CAGR) between 1999 and 2005.

Figure 1
Worldwide Cable Modem Service Subscription Forecast

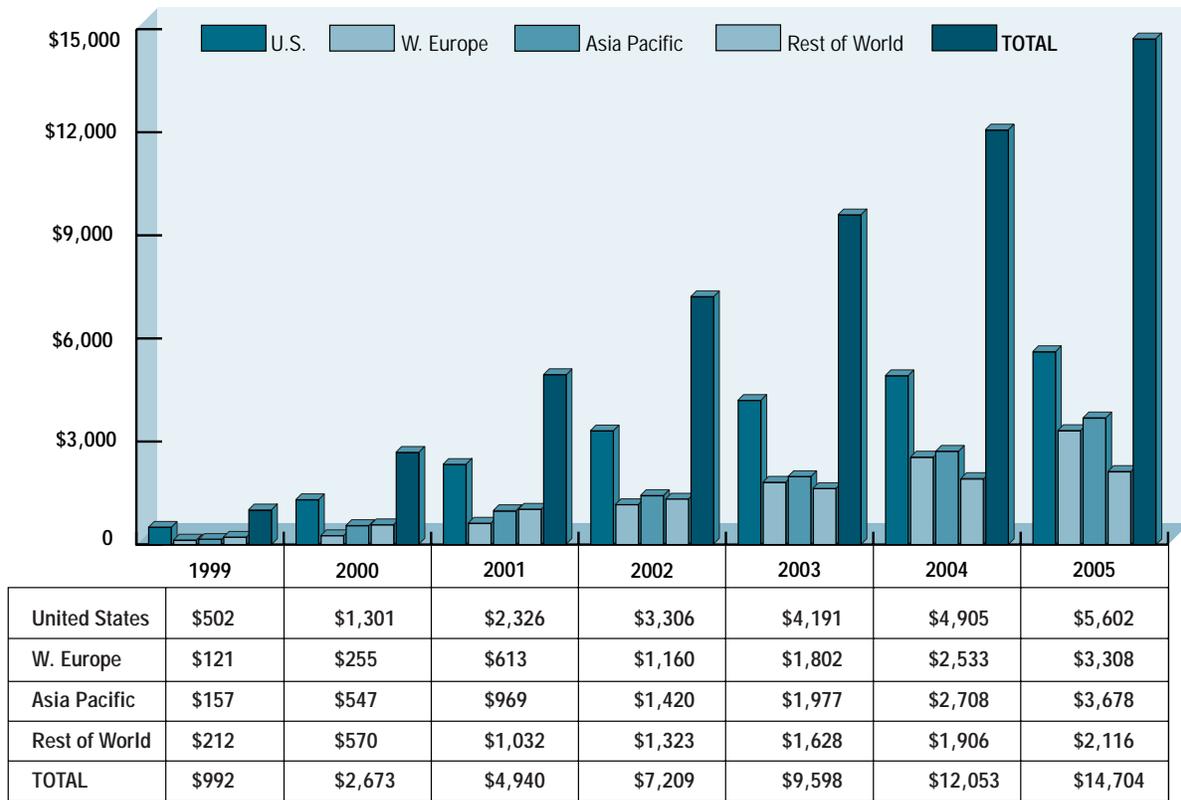


Source: IDC April 2001

With such large numbers of cable subscribers, the potential revenue is huge. Worldwide cable operator revenue generated by cable modem services will total nearly \$5 billion in 2001 and can potentially reach \$14.7 billion by 2005. This revenue opportunity will drive the introduction of new applications to market.

Figure 2

Worldwide Cable Modem Service Revenue Forecast



Source: IDC April 2001

To tap into the large high-speed data (HSD) market and projected revenues, ISPs are pushing to gain access to HFC cable infrastructures. Cable operators face newly imposed regulations to open their networks. AT&T recently began offering EarthLink as an ISP alternative to subscribers. AOL/Time Warner announced cable subscribers will no longer be required to purchase AOL or RoadRunner services in the future and will begin offering alternative ISPs. Cable operators in Canada and Brazil are required by law to open their network infrastructure to ISPs. Operators in other countries, such as Korea, are facing similar regulation from their own governments.

For cable operators, there is new revenue opportunity in wholesale services. Cable operators can capitalize on the potential advantage of opening up their cable infrastructures. Broadband services from other ISPs represent a powerful cross-selling opportunity for cable operators. ISP partnerships can deliver the kind of extended reach and scale no single cable company can achieve by itself. Cable operators can quickly and effectively deliver premium services, such as managed firewall, VPN services, email, and Web hosting, that command fees higher than basic high-speed Internet access.

Cable operators can potentially achieve more than a 50 percent return on capital as early as three years after deploying a Managed Access Cisco Cable-Ready Solution by:

- Leveraging their existing cable infrastructures and obtaining revenue from ISPs who focus on delivering services to end users.
- Billing ISPs based on the number of subscribers that access services via cable.
- Partnering with ISPs to offer value-added services such as hosting and voice over Internet Protocol (VoIP) that provide new revenue and deliver high profit margins.
- Using fee discounts to motivate ISPs to agree to long-term contracts.

Challenges

To improve profit margins, cable operators must reduce operational costs. Already, operators face the challenge of activating subscriber service as quickly as possible with a minimum of truck rolls. Open access adds to this challenge because cable operators must now manage IP address blocks from multiple ISPs. Automating the service provisioning process is a critical factor towards realizing expense reduction goals.

Open access creates additional challenges. Cable operators must partition the cable plant to prevent any one ISP from impacting the service of others. The network must be configured to support multiple ISPs and possibly tens of thousands of VPNs.

Traffic engineering is a concern. The cable IP network must support IP-based VPNs with different qualitative classes of service (CoS) and different quantitative quality of service (QoS).

Deploying advanced IP services requires a wide breadth of technologies, expertise, and products. Cable operators need to devise strategies that allow them to minimize diverse architectures, operating systems, and network management schemes. The cable network is no longer just from the headend to the subscriber. The new cable network extends back into the core and across diverse networks to ensure subscriber-to-subscriber connectivity and service integrity. The Cisco Managed Access Cisco Cable-Ready Solution simplifies all this.

Managed Access Cisco Cable-Ready Solution Description

Cisco cable products and solutions are built on expertise in IP internetworking, network design, and radio frequency (RF) technology. Our Managed Access Cisco Cable-Ready Solution seamlessly blends high-speed broadband cable access with the scalable, secure, and flexible technology we're known for in the IP core. The solution enables cable operators to conform to market requirements and leverage existing HFC infrastructures to offer high-margin services. Because Cisco solutions are tested and proven with components that are pre-integrated, cable operators can turn on services quickly.

The Managed Access Cisco Cable-Ready Solution is available in two implementations:

- Policy-based routing (PBR) uses standard routing protocols to route a packet based on the destination address. Generally, a cable operator selects PBR for its simplicity and shorter time to service.
- Multiple Protocol Label Switching (MPLS)—MPLS is a superior technology to implement managed access. In addition to providing scalability, MPLS meets many cable operator requirements for delivering managed access services, including traffic segregation, support for various access technologies, QoS, and service level agreements (SLAs). To deploy MPLS, however, the IP core must be MPLS-enabled for the cable operator to set up virtual tunnels between subscribers and ISPs.

Table 1 summarizes the strengths and weaknesses of each approach. Both implementations are discussed further in the sections that follow.

Table 1

Managed Access Approach Comparison

Managed Access Implementation	Strengths	Weaknesses
PBR	<ul style="list-style-type: none">• Based on standard routing technology• Faster rollout	<ul style="list-style-type: none">• PC-assigned commercial customer address by cable operator provisioning system• Requires configuration and routing expertise to ensure that both the cable operator and ISP route packets properly in both directions• Somewhat difficult to scale due to complexities of management
MPLS	<ul style="list-style-type: none">• Provides virtual routing table (one for each ISP)• Full QoS and traffic engineering available; new QoS/CoS revenue opportunity• Fast reroute for protection, resiliency, and reliability• Guaranteed bandwidth for hard QoS guarantees• SLAs; new revenue opportunity	<ul style="list-style-type: none">• Requires MPLS on the entire backbone

Policy-Based Routing (PBR)

PBR uses standard routing protocols to determine how to route a packet. Standard routing is done based on the destination address of a packet. With PBR, the routing decision is based on the source address of the packet. Depending on the cable operator's objective, PBR can occur as the packet enters the network (ingress router, which is the CMTS), at an aggregation router, or as the packet leaves the network (egress router). If the goal is to keep some traffic segregated from other traffic within the cable operator's network, PBR must be done on every router along the packet's path.

Alternatively, PBR can be done at the ingress CMTS, with the packets then forwarded into a tunnel connected to the destination. If the goal is to allow all traffic to reach each other within a cable operator's network, then PBR can be done at the egress to the network. Figure 3 and Figure 4 describe the network architecture for Cisco PBR Managed Access Cable Packaged Solution implementation.

Figure 3
PBR Logical Network Description

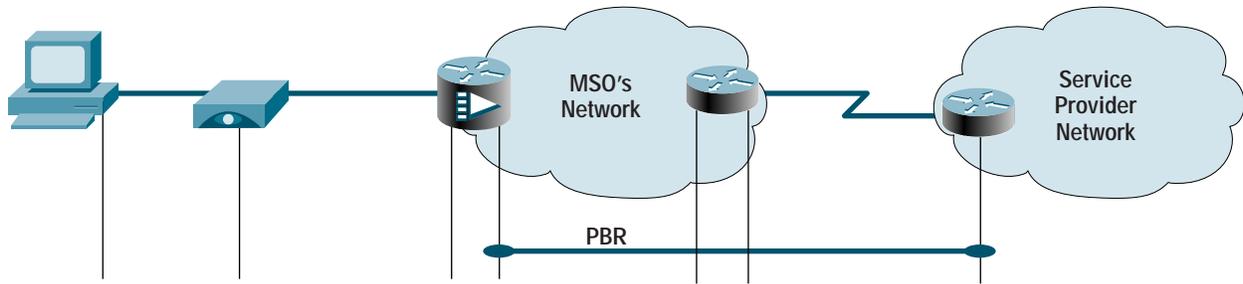
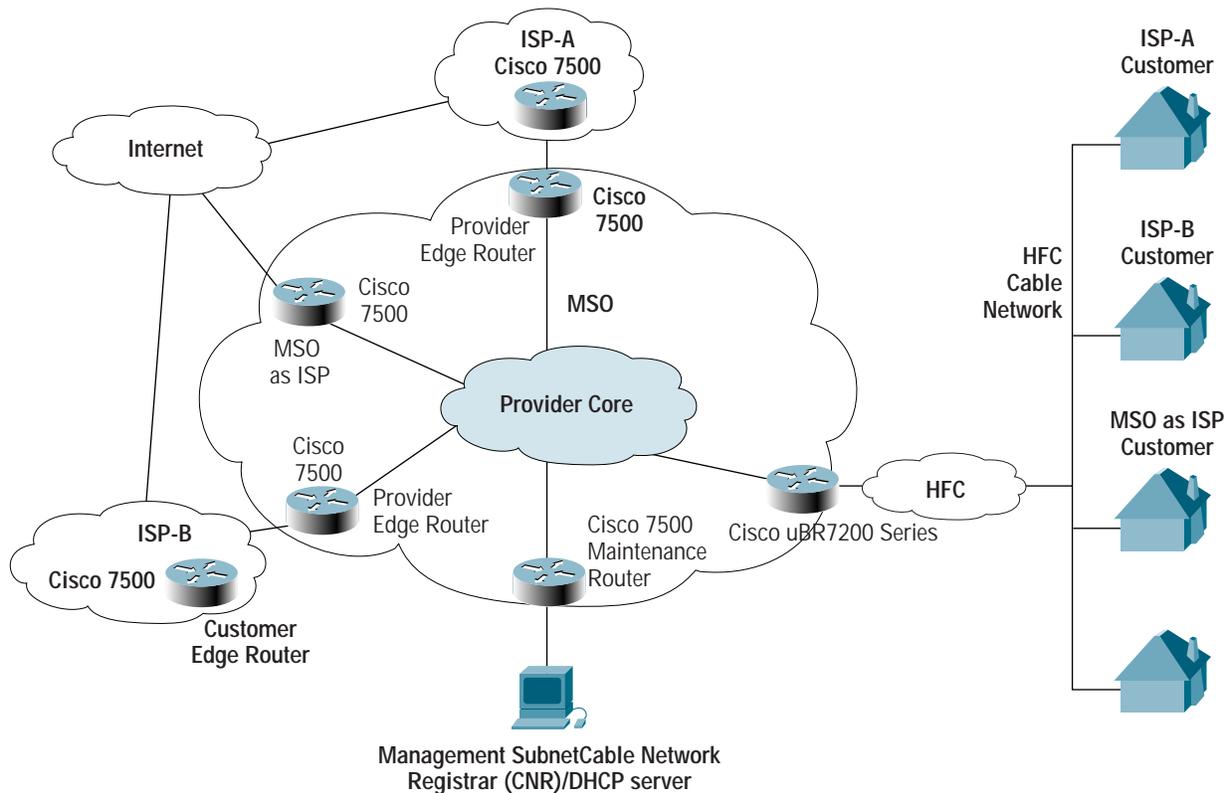


Figure 4
PBR Implementation for Cisco's Managed Access Solution



Multiple Protocol Label Switching (MPLS)

Initially developed as part of Cisco TAG switching development, MPLS is an innovative technique for high-performance packet forwarding. Essentially, MPLS is the IP version of ATM with similar data labeling and handling capability. There are many uses for MPLS technology, both within a service provider environment and within an enterprise network. With the introduction of MPLS-enabled VPNs, network designers are able to better scale their networks than with methods available in the past.

Using MPLS-VPN, service providers deliver IP services using Layer 3 QoS and a label-based forwarding paradigm that ensures privacy. Labels indicate route and service attributes. Cable operators who own the HFC cable plant build VPNs for ISPs to move traffic over the cable TCP/IP network. ISPs then use the HFC network to supply service to their customers.

MPLS VPN constrains the distribution of a VPN's routes only to the routers that belong to a specific network. Thus, each ISP's VPN is insulated from other ISPs sharing the cable infrastructure. An MPLS VPN assigns a unique VPN routing/forwarding (VRF) instance to each VPN. A VRF instance consists of an IP routing table, a derived forwarding table, a set of interfaces that use the forwarding table, and a set of rules that determine the contents of the forwarding table. MPLS VPNs use Border Gateway Protocol (BGP) and IP address resolution to ensure security.

The MPLS network has a unique VPN called the management VPN that exclusively manages the cable operator's devices. The management VPN connects the Cisco uBR7200 Series Universal Broadband Router to a provider edge router that attaches the VPN label based on the interface or subinterface on which they were received. This router typically interfaces to a customer router in an ISP or enterprise network. The management VPN also contains the servers and other devices to which all other VPNs require access. All additional VPNs are used for unique service provider networks, and route subscriber traffic securely across the cable operator's network.

In an MPLS network, there are three basic types of devices: the customer edge (CE) device, a provider edge (PE) device, and the provider (P) device. The MPLS VPN connects an interface on one PE device to an interface on one or more distant PE devices. Traffic entering one VPN interface will be sent to one (or more) distant interfaces. Traffic entering one VPN interface will be sent to one or more remote interfaces.

The MPLS VPN solution operates as an "overlay" on top of the typical cable operator's network and requires minimal changes to the physical network. In the implementation of this application, the cable modem's Station Identification (SID) is tied to the MPLS VPN's sub-interface. Because DOCSIS 1.0 which defines technical specifications for equipment at both the subscriber location and the cable operator's headend allocates a single SID to each cable modem, all devices behind that cable modem will be a part of the same VPN. With DOCSIS 1.1 support of multiple SIDs per cable modem, this application will be able to support multiple VPNs per cable modem. Figures 5 and 6 illustrate the logical and network architecture of the Cisco MPLS Managed Access Cisco Cable-Ready Solution implementation.

Figure 5
MPLS Logical Network Description

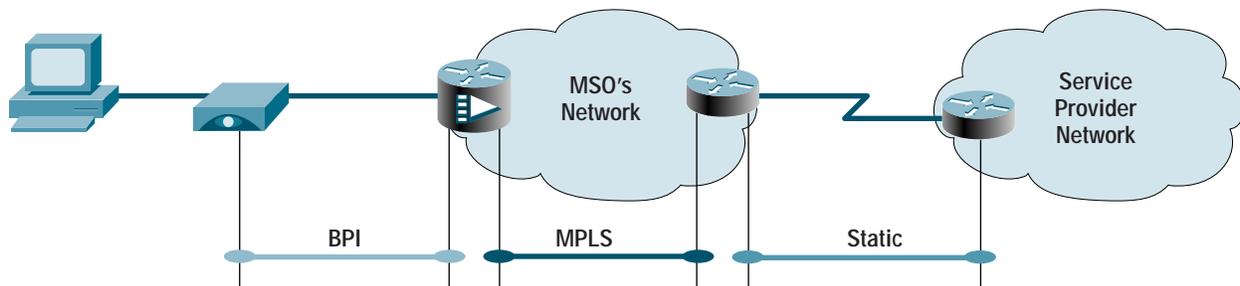
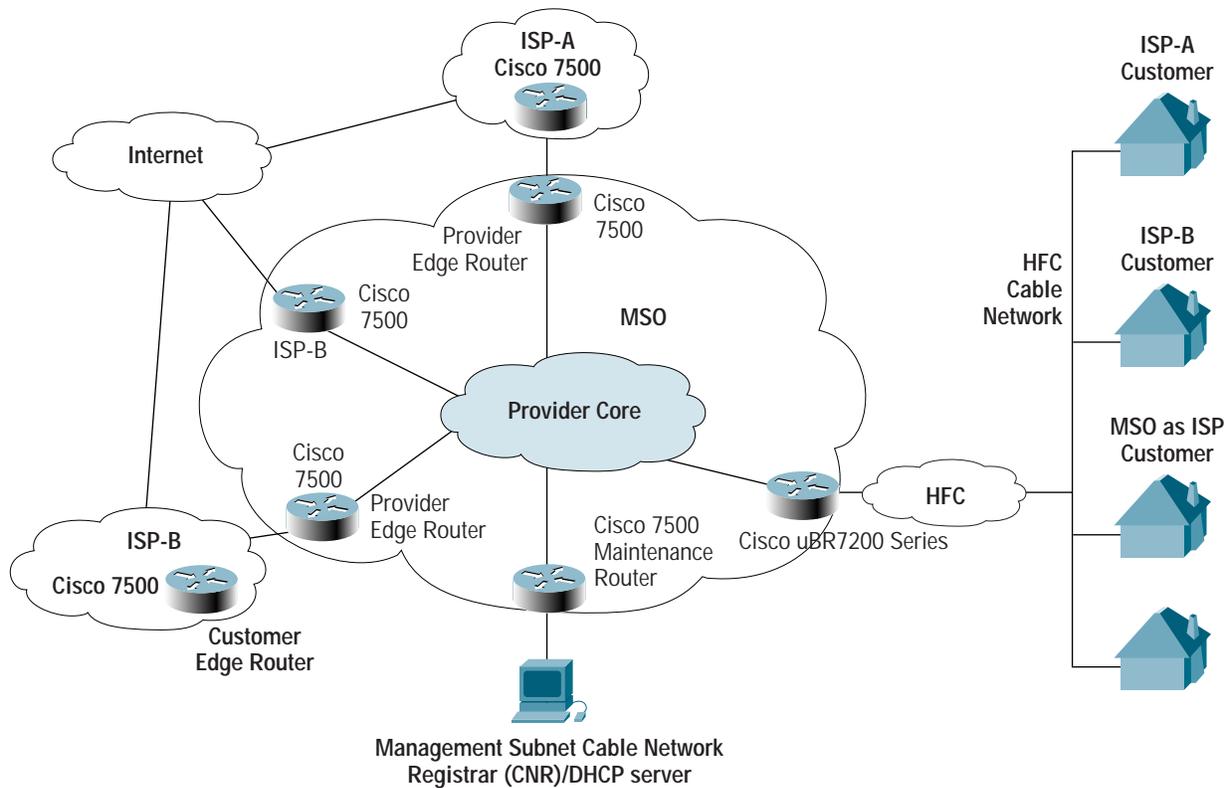


Figure 6
 MPLS Implementation for Cisco's Managed Access Solution



Why the Managed Access Cisco Cable-Ready Solution?

The Managed Access Cisco Cable-Ready Solution covers CPE devices, headends, and core IP routers. All aspects of network management including provisioning devices, managing IP address blocks, establishing VPNs, and monitoring network fault and performance are addressed.

Cisco IP experience and expertise is unparalleled. Cisco equipment forms the foundation of today's Internet backbone. Cisco understands the demands of advanced IP services and the unique requirements of today's market. Cisco invented MPLS. It has more MPLS deployments than anyone else in the world. Cisco is also the leader in DOCSIS technology. Cisco was the first to introduce a DOCSIS 1.0 and DOCSIS 1.1-qualified CMTS layer 3 router. Cisco continues to lead the market and drive innovation.

The Cisco advantage is:

Investment Protection

Cisco Managed Access is based on a DOCSIS and EuroDOCSIS-compliant architecture that supports two-way data over HFC. This architecture allows cable operators to use existing cable infrastructures to connect ISPs to their subscribers. Subscribers can use their existing Internet access to receive content and applications from their ISP of choice. Their investment is protected because they can make choices without any service interruption.

New Revenue Potential

Cisco Managed Access gives cable operators flexibility in delivering value-based services to subscribers. These services not only meet customer needs and enrich the operator's service portfolio, but also present the cable operator with new revenue opportunities that improve return to shareholders.

Scalability

Cisco Internet leadership is asserted with its scalable networking technologies. Similarly, Cisco cable switching platforms share this capability. Cisco Managed Access can scale as the cable provider's business grows. This effectively alleviates cable operator challenges to reduce costs associated with capital investment and operations.

Flexible Billing Options

The cable operator, with the Managed Access Cisco Cable-Ready Solution, can offer different billing categories to subscribers. Subscribers can be charged on a fixed-rate or usage basis. The solution can also enable cable operators to implement differentiated billing based on the traffic content. For example, a subscriber can be charged for an Internet connection based on a per-connection, duration or volume (e.g. streaming content) basis.

Simple Provisioning

Cisco Managed Access virtually eliminates the complexity associated with cable modem configuration by automating many steps to configure a user and modem. As a result, the cable operator reduces much of the cost of activating services and avoids multiple truck rolls. This enables the user to enjoy services when they subscribe to them and allows cable operators to quickly realize revenue.

Advanced IP Address Management

As IP addresses become scarce, cable operators require a comprehensive solution for managing IP address blocks. This involves assigning IP addresses, recycling relinquished addresses, and maintaining relationships between subscribers and their assigned addresses.

The Cisco Address and Name Registrar (ANR) ease the cable operator's challenge in IP address management. Cisco ANR eliminates many manual administrative tasks for IP address management. With this product, the cable operator can define policies to automate the distribution of IP addresses.

Key Components of the Managed Access Cisco Cable-Ready Solution

The Managed Access Cisco Cable-Ready Solution is comprised of carrier-class equipment. Components have been pre-integrated and tested, enabling cable operators to mix-and-match components and quickly deploy services.

Cisco uBR7200 Series Universal Broadband Router

Designed for cable deployments with large numbers of subscriber modems, telephones, set-top boxes, and other IP-enabled devices, the Cisco uBR7200 Series Universal Broadband Router offers flexible and cost-effective expansion of DOCSIS infrastructures. The Cisco uBR7200 Series supports a broad set of residential and commercial multi-service offerings, including IP telephony, multicast, streaming media, and VPN applications.

The Cisco uBR7200 Series is DOCSIS-qualified. The Cisco uBR7246VXR, a member of the Cisco uBR7200 Series, is the industry's only DOCSIS 1.1 qualified Layer 3 CMTS. The chassis are fully RF hardened to ensure noise-free transmission. All major components are hot swappable to guarantee maximum reliability.

The Cisco uBR7200 Series offers a complete line of DOCSIS-qualified line cards. A range of network interfaces are available, including the newest line of Cisco Dynamic Packet Transport (DPT) port adapters, which provide direct, high-speed optical connectivity combined with add-drop multiplexer capability.

The Cisco uBR7200 Series delivers high-performance core network routing capability at the edge, supporting BGP version 4 (BGP4), Internal Border Gateway Protocol (IBGP), Multicast, Open Shortest Path First (OSPF), and many other routing and switching protocols. Like all other Cisco routers, the Cisco uBR7200 Series runs Cisco IOS Software—the industry's most feature-rich and stable software platform.

Cisco uBR900 Series Cable Access Router

The Cisco uBR900 Series Cable Access Router is the ideal solution for cable service providers deploying feature-rich broadband access to telecommuter, small office, and branch office customers. A fully integrated Cisco IOS Software Router and DOCSIS 1.1 standards-based cable modem, the Cisco uBR900 Series provides business-class functionality. The product offers hardware-accelerated IP Security (IPSec) functionality, allowing service providers to increase revenues and support commercial and residential customers.

The Cisco uBR900 Series consists of:

- *Cisco uBR905*—Integrates a four-port 10BaseT Ethernet hub with firewall and IPsec VPN technologies in one box.
- *Cisco uBR925*—Like the Cisco uBR905, this model integrates a four-port 10BaseT Ethernet hub with firewall and IPsec VPN technologies in a single design. The product also supports voice, modem, and fax calls over the cable IP network. It further offers a USB port that serves as a separate routed interface.

Cisco Core IP Routers

Cable operators can deploy superior Cisco core IP routers such as the Catalyst® 7500 or the Cisco 12000 Internet Router series. These routers not only offer high density and high performance line cards, but also support a wide variety of interfaces. These routers deliver carrier-class scalability that can accommodate heavy traffic. Furthermore, these routers run the robust and proven deployment-tested Cisco IOS Software. Just like other Cisco products, the core IP routers can be managed with a rich suite of Cisco network management applications.

Cisco Subscriber Registration Center

The Cisco Subscriber Registration Center (SRC) Device Provisioning Registrar (DPR) 2.0 makes it easier than ever for service providers to deploy high-speed data and VoIP services. Cisco SRC DPR builds intelligence on top of the Cisco Network Registrar® protocol servers to allow service providers to automate the subscriber- provisioning process.

Performance, scalability, and reliability were the design requirements behind this second-generation Cisco SRC product. In addition, Cisco SRC DPR includes a Java-based provisioning application programming interface (API), ensuring quick and seamless integration with customers' existing and next-generation operations support systems (OSSs).

Cisco SRC DPR is the first lightweight version of Cisco SRC designed for streamlined provisioning of subscribers supporting both self-provisioning and pre-provisioning workflows. Building on Cisco Network Registrar to customize and automate the provisioning of cable modems, Cisco SRC DPR provides genuinely intelligent device management. This can greatly reduce or even eliminate costly truck-rolls—and set the stage for a retail-driven market for customer-configured broadband services. Cisco SRC DPR can scale to support the burgeoning number of subscribers who require support from even the largest of cable operators and service providers. There is no need to modify Cisco SRC as new services are introduced.

Cisco Network Registrar

The Cisco Network Registrar product provides comprehensive Domain Name System (DNS) and Dynamic Host Configuration Protocol (DHCP) administrative functionality to help customers automate and streamline IP networking services, including business-critical tasks such as client configuration and provisioning.

Large enterprises and Internet service providers use the Cisco Network Registrar product to efficiently administer DNS and DHCP services on large IP networks from Cisco. The product incorporates carrier-class performance and advanced provisioning features to help businesses reduce network operating costs while increasing their return on investment through faster, more reliable service deliveries.

Cisco Network Registrar automates common tasks such as IP address assignment and maintenance to simplify and streamline administration. Features such as the Lightweight Directory Access Protocol (LDAP) directory interface facilitate integration of DNS and DHCP services with other network management applications. Performance-optimized functions provide fast setup and task execution, and an availability-tuned architecture ensures reliable, consistent client services delivery.

Cisco Address and Name Registrar

Cisco Address and Name Registrar (ANR) provides an IP address management solution to ease the inherent complexities of IP address distribution, configuration, and monitoring. Cisco ANR release 2.0 specifically meets the requirements of cable providers by delivering an automated system to reduce administrative processes, easing the management of scarce IP addresses.

Cisco ANR 2.0 simplifies IP address management by using customized policies to drive intelligent IP subnet allocation and reclamation decisions. By taking advantage of the awareness of IP allocation, usage, and network configuration, Cisco ANR turns complex IP utilization data into meaningful management information. The result is efficient IP usage and distribution.

Why Cisco?

Cisco is the leading provider of innovative solutions that enable delivery of new communications services over a digital cable IP network. With a cable solution from Cisco Systems, you can introduce a host of new services that will not only attract new customers, but also create new revenue opportunities. Cisco offers solutions compliant with DOCSIS, EuroDOCSIS, and emerging standards. Only Cisco delivers standards-based, end-to-end solutions that give cable operators demonstrable return on their investment *today*. The Managed Access Cisco Cable-Ready Solution is not just a promise for the future, but is available now.

In addition to supporting Internet access, Cisco Cable-Ready Solutions provide the infrastructure to easily enable additional leading-edge services such as cable IP telephony. The solutions can dramatically improve your opportunities and position your business for higher service levels, revenue growth, and market leadership for years to come. Cisco brings powerful, flexible, end-to-end IP solutions and a proven track record in the cable industry to support your business growth and success.

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