

Cisco Metro Ethernet Access Services

High bandwidth, flexible bandwidth increments, and low cost

Executive Summary

Demand for bandwidth in the metropolitan-area network (MAN or metro) is exploding, the result of data-intensive applications, new business models that rely on the Internet, and population growth.

Increasingly, service providers are meeting that demand with Metro Ethernet Access Services, which are based on Ethernet, IP, and optical technologies. Compared to fixed bandwidth facilities, Metro Ethernet Access Services provide more bandwidth, the ability to provision bandwidth in flexible increments, and better support for converged voice, video, and data services.

Cisco® Metro Ethernet Access solutions support three connectivity models:

- Transparent LAN Service (TLS), which creates a virtual LAN (VLAN) that spans multiple customer locations
- Dedicated Internet Access (DIA)
- Private-Line Service (PLS), a symmetrical, point-to-point connection between two customer locations

With one of these infrastructures in place, service providers can generate new revenue streams from value-added services such as VoIP over Ethernet, video streaming over Ethernet, and real-time gaming over Ethernet.

Service providers can choose from multiple Cisco solutions to deliver Metro Ethernet Access Services, selecting the one that best uses their existing infrastructure and supports

their business goals. The Cisco solutions include Ethernet Private-Line Service, Ethernet Wire Service, Ethernet Relay Service, Ethernet Multipoint Service, and Point-to-Point VLAN.

This document summarizes the market drivers for Metro Ethernet Access Services, describes the three services (Transparent LAN, Direct Internet Access, and Ethernet Private-Line Service), explains the Cisco solutions that enable service delivery, and lists service benefits for the service provider and its enterprise customers.

Market Drivers

Following are the major market drivers for growing demand for Metro Ethernet Access Services:

- *Surging bandwidth requirements*—Companies of all sizes are deploying more high-bandwidth applications, such as voice, video, networked storage, distance learning, medical imaging, videoconferencing, and CAD/CAM applications, as well as hosted applications, such as data backup, Oracle-lite, and SAP-lite. To deploy these applications, companies need a high-bandwidth, low-cost, reliable “last mile” service.
- *More MAN terminations in buildings*—The number of Ethernet building terminations has risen from nearly zero in 2000 to a projected 500,000 in 2006, according to Gartner.



- *Pressure to reduce expenditures and increase service revenues*—To remain profitable, service providers need to reduce capital expenditures and operating expenses and to introduce profitable, high-margin services. The cost of introducing Metro Ethernet Access Services is relatively low because the services can operate on the service providers' existing infrastructures and operating support systems (OSSs).

Service Descriptions

Cisco Metro Ethernet Access Solutions support three network connectivity models, as shown in Table 1.

Table 1 Three Network-Connectivity Models

Network Connectivity Model/Service	Description	What It Replaces
Transparent LAN Service	Interconnects separated LANs across a MAN	Frame Relay and TDM private lines
Dedicated Internet Access	Ethernet connection to ISP	Broadband and TDM-based access
Private-Line Service	Dedicated subscriber Ethernet WAN connection	TDM-based access

The three models are described in the following paragraphs. The next section, "Solution Descriptions," describes the Cisco product offerings that enable service delivery.

Transparent LAN Service

The Transparent LAN Service (TLS) provides Ethernet connectivity among geographically separated customer locations, creating a VLAN that spans those locations. Typically, enterprises deploy TLS within a metro area to interconnect multiple enterprise locations. However, TLS also can be extended to locations worldwide. Used this way, TLS converts wide-area connectivity into a VLAN so that the enterprise customer does not need to own and maintain customer premises equipment (CPE) with wide-area interfaces. Customers are freed from the burden of managing—or even knowing anything about—the WAN connection that links their separate LANs.

TLS is much less expensive and simpler to implement on Ethernet than on a Frame Relay or ATM network. The lower cost results primarily from lower equipment costs. Cost savings are a primary reason that TLS accounted for more than 63 percent of Metro Ethernet revenue in 2002 and will account for 60.3 percent in 2007, according to IDC.

Another advantage of implementing TLS on Ethernet is that service providers gain the flexibility to provision more bandwidth, and with varying quality-of-service (QoS) capabilities and service-level agreements (SLAs.)

Because TLS is a low-cost service, the service provider can use it as a draw for bundled services, which increase margins and strengthen the customer relationship. Typical value-added services include Ethernet interface to the Internet, storage transport, and data-center connectivity.



Dedicated Internet Access

The Dedicated Internet Access (DIA) service provides high-speed access from the enterprise LAN to the ISP point of presence (POP).

By offering Ethernet-based DIA, service providers can successfully compete by price in a saturated market. After attracting customers with the initial offering, the service provider can add value-added services, which increase revenue and can reduce churn.

The service provider can choose from several business models for the DIA service. Some service providers maintain ownership of the CPE and provide it as part of a bundled solution with a monthly recurring charge. Others sell the CPE to the customer. Regardless, the service provider's primary value is to deliver, configure, provision, and test the device in conjunction with the DIA service.

Ethernet Private-Line Services

Traditionally, Private-Line Services (PLSs) have been dedicated, point-to-point, fixed-bandwidth, nonswitched links between two customer locations. They are typically used for TDM applications such as voice or data, and do not require the service provider to offer any added value such as Layer 3 (network) or Layer 2 addressing.

An Ethernet PLS is a point-to-point Ethernet connection between two subscriber locations. It is symmetrical, providing the same bandwidth performance for sending or receiving. Ethernet PLS is equivalent to a Frame Relay permanent virtual circuit (PVC) but with a greater range of bandwidth, the ability to provision bandwidth in increments, and more service options. In addition, it is less expensive and easier to manage than a Frame Relay PVC because the CPE costs are lower for subscribers, and subscribers do not need to purchase and manage a Frame Relay switch or a WAN router with a Frame Relay interface.

Ethernet PLS can be delivered in a variety of topologies, from business parks to downtown multitenant units (MTUs) to multidwelling units (MDUs) such as apartment complexes. To deliver services across this wide range of technologies, Cisco Metro Ethernet Access Services use multiple transport technologies, including SONET/SDH, WDM, Ethernet switching, and Dynamic Packet Transport (DPT).

Value-Added Services

After deploying the infrastructure for Metro Ethernet Access Services, service providers can generate new revenue streams by offering value-added services, including:

- VoIP over Ethernet, such as voice tie lines, IP PBX interconnection, and business voice services
- Video streaming over Ethernet services, such as video multicasting on demand, stock price streaming, and videoconferencing
- IP VPN Connectivity to Branch Offices
- Security Services such as Managed Firewall and Intrusion Detection Services
- Storage and Offsite Disaster Recovery Mirroring
- Data Center Connectivity and Managed Hosting

Service providers can offer Metro Ethernet Access Services as standalone offerings or in tiered bundles. For example, a bundle for midsized businesses might include the following:



- Metro Ethernet Internet access with voice, managed security, and VPN services
- “Always on” Internet access from 20–50 Mbps with 50 mailboxes and a Class C address block
- Site-to-site VPN with remote access VPN for teleworkers and mobile workers
- Managed IP telephony services

Cisco Solution Descriptions

Table 2 maps the three Metro Ethernet Access Services with the Cisco solutions that enable them. Note that service providers that want to offer the TLS and DIA services can choose from multiple Cisco solutions, selecting the one that takes most advantage of their existing infrastructure and most effectively supports their business goals.

Table 2 Cisco Solutions for Metro Ethernet Access Services

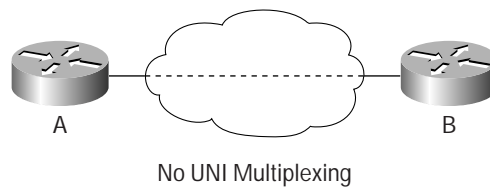
Service Offering	Layer 1		Layer 2		Layer 3–7
	Ethernet Private-Line Service	Ethernet Wire Service	Ethernet Relay Service	Ethernet Multipoint Service	Point-to-Point VLAN
Transparent LAN Service	x	x		x	
Dedicated Internet Access	x	x	x		x
Private-Line Service	x				

All Cisco Metro Ethernet Access solutions are delivered through an end-to-end OSS with a flexible control layer (IP or Multiprotocol Label Switching [MPLS]) through a smart transmission/physical layer (SONET/SDH, DPT, switched Ethernet) and finally over a fiber or lambda infrastructure.

Ethernet Private-Line Service

Cisco Ethernet Private-Line (EPL) Service, shown in Figure 1, is a dedicated point-to-point connection from one customer-specified location to another, with guaranteed bandwidth and payload transparency end to end. The Cisco EPL Service is ideal for transparent LAN interconnection and data-center integration, for which wire-speed performance and VLAN transparency are important. While TDM and OC-x-based facilities have been the traditional means of providing EPL service, the Cisco EPL Service also supports lambda, Ethernet over SONET/SDH, and dedicated Ethernet platforms interconnected via fiber.

Figure 1
Ethernet Private-Line Service



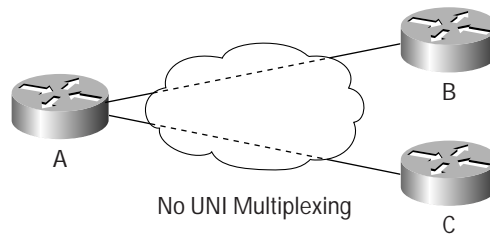


Ethernet Wire Service

Like the EPL Service, the Cisco Ethernet Wire Service (EWS), depicted in Figure 2, is a point-to-point connection between a pair of sites, sometimes called an Ethernet virtual circuit (EVC). Cisco EWS differs from Cisco EPL in that it is typically provided over a shared, switched infrastructure within the service provider network and can be shared between one or more other customers. The benefit of EWS to the customer is that it typically is offered with a wider choice of committed bandwidth levels—up to wire speed. To help ensure privacy, the service provider segregates each subscriber’s traffic by applying VLAN tags on each EVC.

EWS is considered a port-based service. All customer packets are transmitted to the destination port transparently and the customers’ VLAN tags are preserved from the customer equipment through the service provider network. This capability is called all-to-one bundling.

Figure 2
Ethernet Wire Service



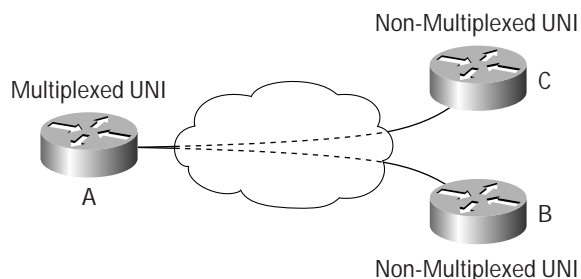
Ethernet Relay Service

Cisco Ethernet Relay Service (ERS), shown in Figure 3, enables multiple instances of service to be multiplexed onto a single customer User-Network Interface (UNI) so that the UNI can belong to multiple ERS. The resulting “multiplexed UNI” supports point-to-multipoint connections between two or more customer-specified sites, similar to Frame Relay service. ERS also provides Ethernet access to other Layer 2 services (Frame Relay and ATM) so that the service provider’s customers can begin using Ethernet services without replacing their existing legacy systems.

ERS is ideal for interconnecting routers in an enterprise network, and for connecting to ISPs and other service providers for DIA, VPN services, and other value-added services. Service providers can multiplex connections from many end customers onto a single Ethernet port at the POP, for efficiency and ease of management.

The connection identifier in ERS is a VLAN tag. Each customer VLAN tag is mapped to a specific Ethernet virtual connection.

Figure 3
Ethernet Relay Service

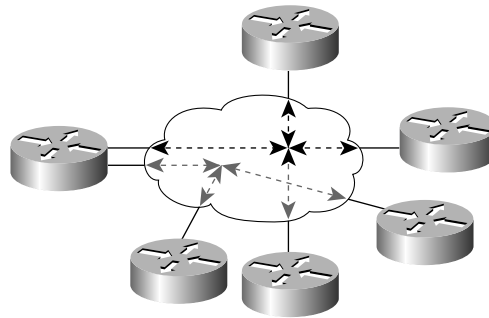




Ethernet Multipoint Service

A multipoint-to-multipoint version of EWS, Ethernet Multipoint Service (EMS), depicted in Figure 4, shares the same technical access requirements and characteristics. The service provider network acts as a virtual switch for the customer, providing the ability to connect multiple customer sites and allow for any-to-any communication. The enabling technology is virtual private LAN service (VPLS), implemented at the network-provider edge (N-PE).

Figure 4
Ethernet Multipoint Service



Ethernet Relay Multipoint Service

The Ethernet Relay Multipoint Service (ERMS) is a hybrid of EMS and ERS. It offers the any-to-any connectivity characteristics of EMS, as well as the service multiplexing of ERS. This combination enables a single UNI to support a customer's intranet connection as well as one or more additional EVCs for connection to outside networks, ISPs, or content providers.

Table 3 summarizes the characteristics of Cisco Metro Ethernet Access solutions.

Table 3 Characteristics of Cisco Metro Ethernet Access Solutions

Service	EVC Type	CLE	Characteristics
EPL	P-to-P	Router/bridge	VLAN transparency, bundling
EWS	P-to-P	Router/bridge	VLAN transparency, bundling, Layer 2 Tunneling Protocol
ERS	P-to-P	Router	Service Multiplexing
EMS	MP-to-MP	Router/bridge	VLAN transparency, bundling, Layer 2 Tunneling Protocol
ERMS	MP-to-MP	Router	Service multiplexing, VLAN transparency, bundling, Layer 2 Tunneling Protocol

Network Management Systems

Cisco Network Management Systems (NMSs) provide the following capabilities:

- Configuration management, including service provisioning
- Fault management, including event flows, alarm surveillance, and service assurance



- Performance management

Cisco management solutions scale to allow easy migration from small to larger networks. They integrate with the existing OSS and provide reliability and redundancy. They also facilitate rapid development and deployment of value-added services essential to ongoing revenue streams.

Service Provider and Enterprise Benefits

Service Provider Benefits

Manageability

The Cisco Broadband Access Center for Ethernet to the home, building, or campus (ETTx) helps service providers manage the “triple play” of voice, video, and data services. It allows fully automated service subscription and activation—with no human intervention by the service provider—while maintaining complete control over subscribers and providing traceability and security.

Using the Cisco Broadband Access Center for ETTx, service providers can rapidly provision bandwidth in 1-MB increments from 10 MB to 10 GB. A scalable services interface supports all speeds on the same physical port, and most Layer 2/3 devices offer 10/100-Mbps and Gigabit Ethernet ports. This compares to private-line, Frame Relay, and ATM networks, where bandwidth must be provisioned in fixed increments, from T1 to T3 to OC-3. A new interface is needed to upgrade to a higher speed, and migration from Frame Relay to ATM is required for speeds above DS3.

Provisioning incremental bandwidth commonly takes 30 to 90 days for private line, Frame Relay, and ATM. In comparison, service providers can turn up bandwidth on Metro Ethernet within hours or days. This type of responsiveness is a competitive differentiator.

Quality of Service

A critical attribute of successful access service offerings is the ability to offer tiered service levels. That is, the service provider can charge different rates based on specified QoS metrics for availability, latency, jitter, packet loss, and restoration. The QoS attributes a subscriber needs depend on the specific application.

A Cisco Metro Ethernet Access solution enables QoS in two ways. First, it is capable of handling multiple diverse services—such as voice, video, and data—that require different class-of-service (CoS) metrics. Second, by employing packet marking, policing, and traffic shaping techniques, the solution can assign the appropriate CoS and priority to traffic associated with each subscriber service, thereby helping to ensure that the service conforms to the promised QoS metrics. As a result, service providers can offer varying levels of revenue-generating services on the same physical interface, thus increasing profitability.

Security

Cisco Metro Ethernet Access solutions provide the following security options:

- Security management
- VLAN support (802.1q)
- Multiple VLAN support for EtherVPN, providing multiple LAN interconnect service



- VPLS, which helps ensure that different customers' traffic carried on the same circuit remains protected

The Cisco NMS portfolio provides complete coverage of fault, configuration, accounting, performance, and security (FCAPS) management. The administrator can manage individual devices as well as networkwide applications that support SLA management, service provisioning, service assurance, user-based accounting, and more.

Service-Level Agreements

Service providers can win business by offering SLAs relating to the service metrics shown in Table 4.

Table 4 SLAs

Metric	Industry Target
Availability	99.99%
Latency	1–2 ms within metro network
Jitter	Less than 30 ms
Packet loss	.01–.0005%, depending on class of service
Restoration	Varies based on protection scheme

Sprint International uses Metro Ethernet to deliver carrier-grade SLAs with sub-50-millisecond network-restoration guarantees.

High Availability

Service providers that deploy Cisco Metro Ethernet Access solutions can select from a variety of approaches to high availability:

- *Cisco Redundant Route Processor Plus (RPR+)* provides Cisco IOS® Software configuration synchronization between route processors, no line card reset during switchover, and Layer 3 peer reset.
- *Nonstop forwarding (NSF)* provides continuous forwarding of packets based on Forwarding Information Base (FIB) in-line cards with route processing failure, Point-to-Point Protocol (PPP), and stateful switchover (SSO) capabilities.
- *Physical redundancy* applies to components such as route processors, the switch fabric, power supplies, cooling. Online insertion and removal (OIR) of components enables service providers to fix or replace failed components without taking devices offline.
- *Logical redundancy* is available for SONET APS/MSP, DPT-IPS, HSRP/VRRP, and MPLS FRR.



Profitable Business Model

Cisco Metro Ethernet Services are designed to quickly become profitable because of the following:

- *Multiple revenue streams from a single interface*—To deploy data services on legacy SONET/SDH platforms (as opposed to the Cisco ONS 15454 Multiservice Provisioning Platform), service providers need to provision a separate circuit for each individual customer, which raises costs and increases provisioning times. With Metro Ethernet Access Services, in contrast, the service provider can serve multiple customers on the same circuit, without truck rolls. Security features such as VPLS help ensure that different customers' traffic carried on the same circuit remains protected.
- *Price differentiation*—Service providers can offer superior service over Ethernet, at less expense than over T1 or E1. Therefore, service providers can choose to offer the service at the same price, for greater profitability, or to reduce prices to differentiate the service for competitive advantage. Cisco customer Cogent, for example, provides 60 times more bandwidth for 40 percent of the cost of a competitor's T1 offering.
- *Taking full advantage of existing infrastructure*—Cisco Metro Ethernet Access solutions use the service provider's investment in existing infrastructure with Layer 2 internetworking of Frame Relay and ATM to Ethernet, as well as internetworking via a routed Layer 3 solution. This enhances the value of Frame Relay, ATM, and Ethernet services.
- *Reduced operating costs*—Unlike data services deployed on the traditional SONET/SDH platform, Ethernet integrates optical transport and data switching in a single platform for service delivery. Table 5 shows the resulting savings.¹

Table 5 Factors Contributing to Reduced Operating Costs

Cost factor	Percent Savings	Source of Savings
Service provisioning	50%	Metro Ethernet eliminates the separate provisioning processes performed on Layer 1, Layer 2, and Layer 3 devices when data services are delivered over Layer 2 ATM and Layer 1 legacy SONET/SDH
Maintenance, monitoring, and field support (central NOC support, metro access field support, metro core field support)	52%	Consolidation of network elements reduces staffing needs
Environmental: Floor space, power, cooling, battery, generator backup cost	43%	Fewer network equipment layers reduce need for space and POP cost

Subscriber Benefits

Transparent LAN Service Subscriber Benefits

The primary subscriber benefits of TLS include:

- Interconnection of the LAN and WAN
- Faster service turn-up in comparison to ATM and Frame Relay networks

1. Source: Network Strategy Partners and Metro Ethernet Forum, 2002



- Minimized equipment requirements
- Protection from technology obsolescence because subscribers do not have to reinvest in WAN CPE
- Minimized management requirements: service providers generally assume full management and maintenance responsibility
- Wider range of connectivity speeds
- Ease of network growth
- Increased network flexibility because connections between network locations are made in software
- Simplified interoffice communications and the ability to create a virtual corporation from several functionally dedicated virtual private LANs

Dedicated Internet Access Subscriber Benefits

DIA subscriber benefits are:

- High-speed, networkwide Internet access, providing the ability to share network resources (printers, fax machines, and servers) and limit the proliferation of individual dial-access accounts
- Integrated Internet access solution with a single point of contact for service needs
- Easy Internet access: bundled service solution lifts the technology burden from in-house staff
- Cost-effectiveness
- Increased productivity from higher-speed Internet access
- Service reliability and performance
- Optional perimeter security to prevent unauthorized access to confidential LAN resources
- Flexibility to establish a security policy that distinguishes between internal, partner, and external access rights
- Reduced WAN costs through support for VPN applications
- Option for integrating firewall functions with existing access solution, eliminating the cost and learning curve associated with a new platform

Private-Line Service Subscriber Benefits

PLS subscriber benefits include:

- Easy integration with existing infrastructure
- Ease of management because subscriber can manage its own bandwidth
- Private, dedicated connection that addresses security requirements
- Protocol-independence, providing support for multiple applications and speeds
- Shortened provisioning intervals for new installations, upgrades, and moves
- High availability and performance supported by stringent SLAs
- Attractive cost basis and pricing flexibility

Why Cisco

As the leader in networking solutions, Cisco Systems® offers a complete end-to-end solution that enables service providers to deploy Metro Ethernet Access Services profitably. Cisco offers service providers the following advantages:

- *Market leadership in enterprise converged networking*—More enterprises have built their IP infrastructures with Cisco than with any other vendor. Therefore, service providers that work with Cisco can quickly connect with the customers, gaining the benefit of accelerated demand for services that increase overall network utilization, reduce cost per user, and generate a faster ROI.
- *Standards leadership*—For more than a decade, Cisco has been a major force in the development of innovative Ethernet, Layer 2, and IP MPLS features. And Cisco continues to lead support for Metro Ethernet standardization in the IEEE, ITU, IETF, and Metro Ethernet Forum, as well as in the MPLS and Frame Relay Alliance and the ATM Forum.
- *Technology leadership*—Cisco offers unsurpassed deployment experience, with more than 100 MPLS customers, 1000 optical customers, and countless IP customers. Cisco will invest \$10 billion during the next five years to continue to bring innovation to the service provider market.
- *Support services*—Cisco support services are designed to help services providers transition to a multiservice packet network. The services address device-, network-, and application-level challenges. Service providers that select Cisco Metro Ethernet solutions gain access to the industry's largest pool of networking experts, who work with the service provider in the planning, design, and implementation stages of a project, as well as with ongoing operational-support and network-optimization services.
- *Proven solution*—Cisco has validated the functionality and performance of its Metro Ethernet Access Services with multiple service provider partners—not just in the lab.

To learn more about Cisco Metro Ethernet Access Solutions and other Metro Ethernet Solutions, visit: www.cisco.com/go/metroethernet



Corporate Headquarters

Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 526-4100

European Headquarters

Cisco Systems International BV
Haarlerbergpark
Haarlerbergweg 13-19
1101 CH Amsterdam
The Netherlands
www-europe.cisco.com
Tel: 31 0 20 357 1000
Fax: 31 0 20 357 1100

Americas Headquarters

Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
www.cisco.com
Tel: 408 526-7660
Fax: 408 527-0883

Asia Pacific Headquarters

Cisco Systems, Inc.
168 Robinson Road
#28-01 Capital Tower
Singapore 068912
www.cisco.com
Tel: +65 6317 7777
Fax: +65 6317 7799

Cisco Systems has more than 200 offices in the following countries and regions. Addresses, phone numbers, and fax numbers are listed on the Cisco Web site at www.cisco.com/go/offices

Argentina • Australia • Austria • Belgium • Brazil • Bulgaria • Canada • Chile • China PRC • Colombia • Costa Rica • Croatia • Cyprus • Czech Republic • Denmark • Dubai, UAE • Finland • France • Germany • Greece • Hong Kong SAR • Hungary • India • Indonesia • Ireland • Israel • Italy • Japan • Korea • Luxembourg • Malaysia • Mexico • The Netherlands • New Zealand • Norway • Peru • Philippines • Poland • Portugal • Puerto Rico • Romania • Russia • Saudi Arabia • Scotland • Singapore • Slovakia • Slovenia • South Africa • Spain • Sweden • Switzerland • Taiwan • Thailand • Turkey • Ukraine • United Kingdom • United States • Venezuela • Vietnam • Zimbabwe

All contents are Copyright © 1992–2004 Cisco Systems, Inc. All rights reserved. Cisco, Cisco IOS, Cisco Systems, and the Cisco Systems logo are registered trademarks of Cisco Systems, Inc. and/or its affiliates in the United States and certain other countries.

All other trademarks mentioned in this document or Website are the property of their respective owners. The use of the word partner does not imply a partnership relationship between Cisco and any other company. (0403R) DM/LW6350 05/04