



White Paper

The Value of Subscribing to Managed Metro Ethernet Services from Service Providers with Cisco QoS Certification

By extending Ethernet beyond your office or campus to the metropolitan-area network, you can gain greater reliability, performance, and flexibility than you can with other broadband access methods, usually at lower cost. And when you subscribe to Metro Ethernet services from a service provider that has earned the Cisco® Quality of Service (QoS) Certification, you know that you are dealing with a company serious about living up to its network-performance promises.

The Cisco Powered Network QoS Certification for Metro Ethernet indicates that a managed Metro Ethernet service meets QoS requirements for delay-sensitive traffic.

Executive Summary

This paper is written for technical staff members in enterprises that are considering deploying Metro Ethernet services.

The paper begins by describing how Ethernet has evolved from a technology exclusive to LANs to one equally at home in WANs – the “metropolitan area.” By extending Ethernet to the WAN, you can better control your communications; take advantage of converged voice, data, and video services; and save money, among numerous other benefits.

Next the paper highlights a number of important reasons why your IT department should consider out-tasking the management of its Metro Ethernet services. Cutting administrative overhead and reducing capital investment are two prime reasons, but many other compelling incentives exist as well.

The paper then explores why your company needs QoS levels for its Metro Ethernet services. In essence, these QoS levels let high-priority traffic – voice and video for instance – get through networks in sufficient time to deliver the desired quality of service. Next, the paper defines and describes how to calculate three performance parameters that can affect both your service-level agreement (SLA) and your Metro Ethernet QoS: frame delay, frame jitter, and packet loss.

The document then explains how Cisco Systems® has introduced a new Cisco Powered Network Metro Ethernet QoS Certification that can help you find a qualified service provider. In essence, this certification tells you two things: First, that the managed service provider delivers its services over a network built end to end with Cisco hardware and software. And second, that the voice and video traffic on this network meets high performance standards.

The final section of the document describes the technologies that certified service providers use to attain these performance standards.

Ethernet Evolves Into a Valuable WAN Technology

Approximately 85 percent of the world's LAN-connected PCs and workstations use Ethernet. Easy to understand, implement, manage, and maintain, this technology was devised as a straightforward, cost-effective network protocol for office computer networks, typically with a few hundred users at most.

Ethernet was not initially intended for public networks and their expansive user bases. But that restriction applies no longer. Today, *Metro Ethernet* is linking physically distant private-network sites by extending Ethernet past buildings and into the WAN. In fact, Metro Ethernet is a rapidly maturing networking technology that broadens Ethernet to the public networks run by telecommunications companies. Consequently, these service providers can capitalize on IP-aware Ethernet switches to offer you a suite of converged voice, data, and video services such as IP telephony, video streaming, imaging, and data storage.

Low costs, reliability, ease of expansion, and interoperability with traditional broadband access technologies well suit Ethernet to a dominant role in both LANs and WANs. By extending Ethernet to the metropolitan area, you can provide your remote offices with reliable access to applications and data on your headquarters LAN.

Benefits of Metro Ethernet

Reduces expenses and administration

- Spares you from having to categorize data, voice, and video applications into individual circuits, saving you time and money
- Provides a switched, high-bandwidth Layer 2 network capable of managing data, voice, and video all on the same infrastructure; this characteristic increases your bandwidth and eliminates expensive conversions to ATM and Frame Relay
- Enables you to cost-effectively connect numerous sites in the metropolitan area to each other and to the Internet

Integrates easily

- Connects easily to existing Ethernet LANs, reducing installation costs and time
- Coexists with other broadband access methods such as Frame Relay, ATM, and TDM, prolonging your investment in these technologies
- Offers a highly scalable alternative to traditional broadband access methods such as Frame Relay, ATM, and TDM

Boosts business productivity

- Enables you to take advantage of productivity-enhancing IP applications that are difficult to implement on TDM or Frame Relay networks. These applications include:
 - Hosted IP Communications
 - Voice over IP (VoIP)
 - Streaming and broadcast video
 - Real-time applications such as collaborative development
 - Secure Layer 2 and Layer 3 VPNs
 - Business intranets and extranets
 - Network security
 - Storage area networking and hosting
 - Disaster recovery

Out-Tasking Metro Ethernet Service Management Can Save You Money and Improve Productivity

If you are considering designing, deploying, and managing a Metro Ethernet network, you have two choices: You can do it yourself in house, or you can contract a qualified managed service provider to do it for you. (A managed service provider delivers and manages network-based services, applications, and equipment to businesses or other service providers.) In many cases, the latter option will be your smartest decision for several reasons:

- **Increases control of your business:** You spare your IT staff from routine tasks such as daily monitoring, support, provisioning, transport, and router maintenance. Your staff is therefore free to focus on your core business and strategic initiatives such as network design and planning.
- **Reduces costs:** You can cut your capital investment and lower your operating costs. Your service provider can capitalize on its economies of scale to charge less than you would have to spend on operations, maintenance, service, equipment, and technology upgrades. Out-tasking also enables you to pay as you grow and avoid investing in upfront idle capacity to accommodate expected growth. In other words, you pay only for what you need today.
- **Makes recurring costs more predictable:** By shifting from a variable to a fixed-cost model, you will know your monthly costs in advance, and you will not have to scramble to find the budget to deal with unexpected network upgrades or outages.
- **Scales easily:** Because managed service providers offer bandwidth in small increments from 1 Mbps to 1 Gbps, you can more easily keep your network capacity in step with your traffic volume.
- **Lets you meet changing business needs:** As your business needs change, your service provider can increase or scale back bandwidth, add security services such as encryption, and adjust QoS to meet desired service levels for voice or other time-sensitive applications.
- **Simplifies network management:** Your service provider can make a change once and then apply it efficiently to all your locations.
- **Improves network availability and performance:** For most types of Metro Ethernet services, your service provider will provision, manage, and monitor your service online to ensure high availability and dependable performance.
- **Offers you expertise and support not available in house:** Service providers can fill critical resource gaps in areas such as network security, which typically requires special training and expertise.

Next, this paper describes the importance of establishing QoS levels for your Metro Ethernet service.


Metro Ethernet QoS Levels Let You Match Network Performance to Business Needs

Ethernet was originally restricted to enterprise LANs because it did not offer the performance that service providers and their customers demand. And although early adopters of Metro Ethernet put up with inconsistent performance in exchange for increased bandwidth or lower prices, without Ethernet service-level agreements (SLAs), many prospects will stay with their traditional Frame Relay, private line, or ATM services. *To attract more enterprises to managed Metro Ethernet, service providers need to offer Metro Ethernet SLAs.*

Fortunately, technological advances now let service providers do just that. In effect, these organizations commit to providing a certain level of network performance or QoS. Typically defined in SLAs, these QoS guarantees are intended to protect your critical applications and your business, ensuring that you get the service performance and reliability you need.

QoS-based networks allow delay-sensitive data packets for such services as voice and video to bypass congested routers, just as ambulances have the right of way at crowded intersections. In other words, critical traffic gets through. For example, QoS is crucial to making voice calls over IP data networks sound just as good as conversations on the public switched telephone network (PSTN).

How do QoS and Metro Ethernet help your company? First, you can protect your most important applications. They also enable service providers to offer different classes of service that correspond to a variety of committed information rates (CIRs). You select the levels that meet your needs and your budget.



For instance, your service provider could offer three classes of service – bronze, silver, and gold – each characterized by successively better performance. You might put basic, noncritical data on a bronze class of service, backup traffic on a silver class, and voice traffic on a gold class. Service providers can differentiate service classes by varying network-performance characteristics, three of which are described next.

Defining Three Metro Ethernet QoS Variables

For Ethernet services to replace older Frame Relay and private line data services, Ethernet SLAs must incorporate the following QoS performance parameters. SLAs must also include penalties and provisions to rebate customers if service providers fail to meet performance standards.

- Frame delay

Frame delay is the maximum delay measured for a percentage of successfully delivered CIR-conformant service frames over a time interval. The delay has three sources, the sum of which generates the overall frame delay: (1) The user-to-network-interface (UNI) at one network-access point, (2) the Metro Ethernet network itself, and (3) the UNI device at the second network-access point.

- Frame jitter

Also referred to as delay variation, frame delay greatly affects the performance of real-time applications such as IP telephony or IP video. To function as intended, these applications require a low and bounded frame jitter.

You can derive frame jitter statistics from the frame delay measurement. To calculate frame jitter, find the service frame with the lowest service frame delay in the population of frame delay samples used to derive the frame delay. Subtract this service frame delay from the maximum frame delay for the entire population (that is, from the frame delay value). The resulting figure is the frame jitter. Note that frame jitter applies only to CIR-conformant service frames.

- Packet loss

Packet loss refers to the percentage of CIR-conformant service frames that fails to be delivered between UNIs during a measurement interval.

To calculate packet loss, take the number of service frames delivered to the destination UNI and divide it by the total number of service frames sent to the destination UNI. Subtract the resulting percentage from one and then multiply by 100 to get the frame loss.

A real-time application such as voice over IP may be able to accommodate a packet loss of one percent without compromising quality. Bump that percentage up to three percent, however, and voice quality will be unacceptable. Packet loss has less effect on transmission control protocol (TCP)-based applications such as Web browsing because the TCP protocol retransmits lost packets. Nonetheless, the higher the packet loss, the lower your Metro Ethernet QoS will be.

QoS is extremely important to your managed Metro Ethernet SLA. But how do you know that your service provider can live up to its QoS commitments? One way is to ensure they have a Cisco QoS Certification, which is discussed next.

The Cisco QoS Certification for Metro Ethernet Means Reliable Network Performance

A service-level agreement is only as good as the organization behind it. You may be compensated if your service provider fails to live up to its Metro Ethernet SLA, but you would rather avoid invoking penalties in the first place. You can lessen the likelihood of performance problems by dealing with a service provider whose Metro Ethernet service has been certified to meet the high QoS standards and best practices set by Cisco Systems.

Cisco offers a variety of Metro Ethernet service solutions, each of which enables providers to support QoS service classes to meet your needs. By applying effective QoS mechanisms, service providers can develop SLAs to align their services closely with your applications.

Technical Requirements for Cisco QoS-Certified Networks

Metro Ethernet services with the Cisco QoS Certification must meet the following requirements:

- Maximum 150 milliseconds (ms) one-way delay for voice and video packets
- Maximum one-way packet jitter of 30 ms for voice and video traffic
- Maximum voice and video packet loss of one percent

Table 1 summarizes these requirements.

Table 1. Cisco Metro Ethernet QoS Certification Standards

QoS Metric for Voice and Video Packets	Standard
One-way, end-to-end delay	<150 ms
Variation or jitter	<30 ms
Packet loss	<1%

Service providers that use Cisco equipment exclusively and meet these performance standards are eligible to receive the Cisco QoS Certification. When you work with a Cisco QoS Certified service provider, you know you are working with an organization that treats its service commitments seriously.

Comprehensive Certification Process Helps Ensure High Standards

Cisco follows an objective process for awarding the Cisco Powered Network QoS Certification. A third-party consultant assesses the service provider and verifies whether the company follows Cisco specifications and best practices for delivering SLAs pertaining to delay, jitter, and packet loss. The third-party assessor reviews important aspects of the service provider's operations and answers these questions:

- Does the service provider track and monitor the end-to-end network?
- Can the service provider secure its own network traffic and manage priority traffic across other networks?
- What are the minimum thresholds for network latency and availability?
- How is performance measured?
- Do procedures exist for load balancing, mirroring, caching, integrity, performance design reviews, security, backup, and recovery?
- Can the service provider's data center support enterprise requirements for physical and network security, capacity, availability, operations, and backbone connectivity?
- How quickly will the service provider respond to changing networking requirements as your business grows or changes?

This ongoing, rigorous assessment objectively validates the service provider's qualifications and the performance you can expect from its managed Metro Ethernet services. Services that display the logo in Figure 1 have passed the Cisco assessment. You can be confident that these services employ the best practices to deliver real-time voice and other critical applications over Metro Ethernet networks.

Figure 1

Cisco Powered Network Certification Logo



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Get the Right Service from the Right Provider

Choosing the right service provider when out-tasking a Metro Ethernet network can be critical. Since 1997, businesses have relied on the Cisco Powered Network designation to find providers that both deliver services over a network built end to end with Cisco technology and meet Cisco standards for network and service quality. Today, the Cisco Powered Network designation is even more important because providers that offer Metro Ethernet services must pass an objective assessment. This assessment certifies that the service meets Cisco best practices and standards for QoS for the metrics in Table 1.

In the final section, the document describes the technologies that these certified service providers use to meet the Cisco QoS network-performance metrics.

Network Capabilities Needed To Deliver High-Quality Metro Ethernet Services

To limit delay, jitter, and packet loss and to meet Cisco Metro Ethernet QoS standards, service providers employ a variety of technologies related to capacity, classification, prioritization, and link optimization.

Capacity

Capacity refers to the actual throughput, as opposed to bandwidth, across each link. Metro Ethernet services require sufficient throughput at each link to avoid delay when your traffic peaks.

Classification

To minimize delay and packet loss, the network must classify its traffic, especially voice and video, according to its performance requirements. Classifications typically include high priority, low latency, and best effort, and the classifications are made by service providers at the enterprise edge.

With a classification system in place, when the network is congested, critical traffic will advance to the front of the queue, unimpeded by noncritical traffic. Note that many networks use Layer 2 link-layer technologies, such as Frame Relay and Ethernet, in addition to Layer 3 technologies. To provide end-to-end IP QoS in these situations, Layer 2 and Layer 3 QoS classifications must match.

Prioritization

Prioritization ensures that delay-sensitive voice and video payload and signaling packets are forwarded promptly. When outbound traffic is congested, higher-priority voice and video packets are forwarded before data packets, even if the data packets had arrived first.

Link Optimization

Link optimization techniques include link fragmentation and interleaving (LFI) and traffic shaping:

- *LFI* – On access links under 768 kbps between the enterprise edge and service provider edge, large data packets can create unacceptable delays. To prevent these delays, service providers can fragment data packets at the enterprise edge.
- *Traffic shaping* – Although LFI helps ensure QoS when the network carries large packets, traffic shaping works to meet QoS standards when total traffic from all remote sites exceeds a central site's bandwidth capacity. In effect, traffic shaping accommodates mismatches between access speeds and aggregated bandwidth.

Taking the Next Step

To confidently deliver real-time voice and video applications end to end, you need a QoS-enabled network service. But it takes expertise and investment to develop and monitor such a network. For these reasons, out-tasking QoS management to a service provider can dramatically reduce your risk and save you money as well.

Fortunately, finding a managed Metro Ethernet service to meet your requirements is now easier than ever. All you need to do is check that your service provider candidate has both a Cisco Powered Network Metro Ethernet designation and the Cisco QoS Certification. Choosing a service provider with these qualifications will go a long way toward producing the network reliability and service performance that your business relies on.

To locate a managed Metro Ethernet service that has earned Cisco Powered Network QoS Certification, visit: <http://www.cisco.com/cpn>.

To learn more about managed services, visit: <http://www.cisco.com/go/managedservices>.

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