

UNDERSTANDING BUSINESS ETHERNET SERVICES

EMPOWER YOUR BUSINESS TO MEET 21ST CENTURY DEMANDS

INTRODUCTION

“The network is your business” has been a mantra for many years indicating how businesses rely more heavily on being networked between their facilities, data centers, suppliers, business partners and customers. Your network enables your business to:

- Improve productivity
- Provide business continuity
- Increase customer satisfaction
- Reduce costs

Selecting the optimal wide area networking service to meet your diverse needs has been challenging given the many choices. However, over the past several years, business Ethernet services have emerged as the optimal choice to best address many applications.

Since the initial business Ethernet services were launched in 2000, much has changed. Ethernet services have become more standardized, thanks to the work of the Metro Ethernet Forum. Ethernet services have also improved significantly from their switched Ethernet “best effort” origins. Today, business Ethernet services can provide service performance that rivals TDM private line services but with the improved flexibility, scalability and cost effectiveness of Ethernet.

Ethernet services today can provide service performance that rivals TDM private lines

Over the years, Ethernet technology was augmented from its LAN origins to meet WAN requirements in the areas of bandwidth, virtual connectivity and service performance. This paper describes these WAN-related augmentations.

One of the most appealing aspects of Ethernet services is that it uses the same fundamental Ethernet LAN technologies familiar to IT personnel. Businesses can leverage this to have a common pool of resources to manage both their LANs and WANs.

With Ethernet services, businesses now have a common pool of resources to manage their LANs and WANs

This paper provides an overview of the different types of Ethernet services, the service components that differentiate them, their business and technical benefits, and important things to consider when selecting an Ethernet service.

FUNDAMENTAL SERVICE COMPONENTS

All Ethernet services have three fundamental components required to order a service, namely:

- Ethernet Ports
- Ethernet Connectivity
- Ethernet Service Bandwidth

All Ethernet services provide these three components to deliver the basic Ethernet service functionality. For some applications, this may suffice. However, a growing number of applications require more service capabilities such as Classes of Service and Service Performance metrics.

As the market has matured, many of these more advanced service components, described in a subsequent section of this paper, have become standard Ethernet service capabilities.

Ethernet Ports

An Ethernet port, technically referred to as an Ethernet UNI (User-to-Network Interface), provides the service demarcation point of responsibility between you and the service provider. The UNI type will be selected based on the type of Ethernet port your attaching equipment uses, e.g., fiber optic or electrical connection and the speed of the port. Standard Ethernet speeds are listed in Figure 1.

Port Speed	Connection Type
10 Mbps	Mostly Electrical
100 Mbps	Electrical or optical
1 Gbps	Electrical or optical
10 Gbps	Mostly optical
100 Gbps ¹	Optical

Figure 1: Standard Ethernet Port Speeds

Some equipment supports multi-rate ports, e.g., 10/100Mbps or 10/100/1000Mbps electrical interfaces, which simplifies the migration to higher speeds as your bandwidth needs increase over time.

The significance of the Ethernet port speed you select will depend upon your initial bandwidth requirements and your anticipated incremental bandwidth needs for the duration of the service agreement. Note that there is generally little cost difference between an Ethernet port with a 10/100Mbps or a 10/100/1000Mbps electrical interface so using the latter on your attaching equipment prepares you for future bandwidth needs.

Ethernet Connectivity

Ethernet services are available that address two basic types of connectivity, namely, point-to-point (site-to-

site) or multipoint (any-to-any). The MEF has defined the Ethernet Virtual Connection (EVC) to logically represent these forms of Ethernet connectivity. The EVC was modeled after the Frame Relay PVC (Permanent Virtual Circuit) so those familiar with Frame WAN implementations will be somewhat familiar with the EVC terminology.

The type of Ethernet connectivity is closely related to the type of network topology you would like to create and its selection will depend upon a number of factors including:

- Type of applications to be supported
- Application performance requirements
- Number of locations to connect initially and anticipate to connect over time
- Traffic flow patterns

The most widely deployed Ethernet services use point-to-point connectivity. Multi-site connectivity can be achieved by using a hub and spoke or meshed topology of point-to-point EVCs or a multipoint EVC. It is important to understand the differences between each approach to ensure you select the one that best addresses your application requirements.

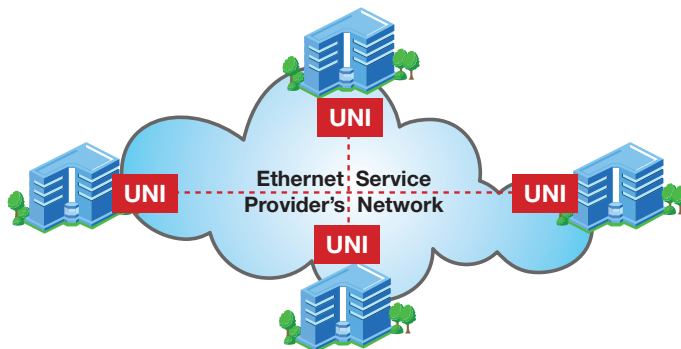


Figure 2: Multi-site Connectivity using Multipoint EVC

Figure 2 illustrates multi-site connectivity using a multipoint EVC. With this type of connectivity, the Ethernet Service Provider performs all the switching enabling every site to communicate with every other site. This WAN connectivity is very similar to LAN connectivity inside a building.

If you anticipate a large number of sites to be interconnected, multipoint connectivity enables additional sites to be more easily added to the WAN. Multipoint connectivity also allows for simple traffic

¹Standardized in June 2010.

prioritization and can effectively support IP telephony (VoIP) and data traffic over the same WAN. Finally, a multipoint EVC is better suited for applications requiring significant amounts of any-to-any site communication. However, if sites are geographically dispersed over large distances, a multipoint EVC may not be available nor be able to provide acceptable service performance for demanding applications to those long distance sites.

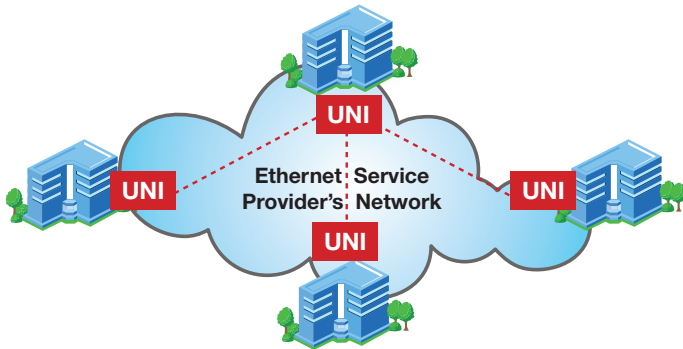


Figure 3: Multi-site Connectivity using Point-to-Point EVC

Figure 3 illustrates multi-site connectivity using multiple point-to-point EVCs in a hub and spoke arrangement. With this type of connectivity, the hub site router or Ethernet switch perform all the switching between the spoke sites. Therefore, for any spoke site to communicate with another spoke site, the traffic must first go over the EVC to the hub site and then get switched to the EVC of the other spoke site. This type of connectivity is very similar to a typical Frame Relay or Private Line WAN deployment.

Multiple point-to-point EVCs for multi-site connectivity is better suited for applications where most of the WAN traffic is between spoke sites and a hub site. The bandwidth and performance requirements between sites are simpler to engineer with this type of WAN architecture.

Ethernet Service Bandwidth

Ethernet service bandwidth defines the amount of traffic you can send to or receive from the network. The service bandwidth can be specified to be the bandwidth of an entire Ethernet port speed or the port speed could be subdivided into the amount of bandwidth needed for a given application. Service bandwidth could also be specified for each service or Class of Service (CoS).

Ethernet service bandwidth is specified using a Committed Information Rate (CIR). The CIR, specified, in Mbps, articulates the amount of service bandwidth that will be subject to the service performance objectives in the product specifications.

Service providers may offer an Excess Information Rate (EIR) or a CIR and EIR for a given service. An EIR-based service (service with no CIR, i.e., CIR=0) is a best effort service with no assurance that any traffic will get through the network. A service with a CIR and EIR will assure that traffic conformant to the CIR will meet the specifications. Traffic bandwidth that exceeds the CIR is considered excess traffic and is provided no bandwidth assurances. EIR traffic may get through the network if there is no congestion.

At a minimum you want your Ethernet service to have a CIR to assure service bandwidth

Having an EIR improves what is called “Goodput” which enables you to get more of your traffic through the network at times when the network is not congested. Compare an EIR to residential broadband service bandwidth where sometimes you receive better application performance, e.g., watching a streaming video uninterrupted, and when the network is congested and your video stutters as video packets are lost due to congestion and must be retransmitted.

Service bandwidth increments are often related to the port speed. While any bandwidth increment can be offered at any port speed, service providers typically provide bandwidth in the increments listed in Figure 4.

Port Speed	Service Bandwidth Increments
10 Mbps	1 Mbps
100 Mbps	10 Mbps
1Gbps	100 Mbps
10 Gbps	1 Gbps

Figure 4: Service Bandwidth increments by Port Speed

When multiple EVCs are delivered on a single Ethernet UNI, a CIR (and/or EIR) can be defined for each service. The MEF has defined a “bandwidth profile” which includes the CIR and EIR values. Figure 5 lists the different types of bandwidth profiles and use cases. As you can see, there are many options which create complexities.

Bandwidth Profile Type	Use Cases
Per UNI	<input type="checkbox"/> CIR \leq port speed <input type="checkbox"/> One service per port (UNI)
Per EVC	<input type="checkbox"/> Sum of CIRs \leq port speed <input type="checkbox"/> Multiple service EVCs per UNI
Per CoS per EVC	<input type="checkbox"/> Sum of CIRs \leq port speed <input type="checkbox"/> One or more EVCs per UNI <input type="checkbox"/> One or more CoS per EVC

Figure 5: Bandwidth profile types and their use cases

ADVANCED SERVICE COMPONENTS

Once the fundamental service components of ports, connectivity and service bandwidth are selected, there are additional, more advanced, service components to select to ensure that the service best meets the needs of your applications. Most Ethernet service providers currently provide some form of these advanced service components in their service portfolio.

Classes of Service

Classes of service (CoS) address the unique service performance requirements for different applications. For example, if you have a call center using VoIP, you may want to differentiate the VoIP traffic from the data traffic used to interact with customers. This could be accomplished by purchasing an Ethernet service with two classes of service. Your router or Ethernet switch that attaches to the Ethernet UNI would mark each Ethernet frame associated with the VoIP or data with a unique Ethernet priority code point (PCP) also known as an IEEE 802.1p marking. Your Ethernet service provider may have a predefined set of PCPs to indicate each CoS. Therefore, you need to configure your attaching equipment to properly mark the PCP of the Ethernet frames to match the PCP specified for each CoS purchased from the service provider.

Alternatively, you could purchase a separate EVC for each class of service. Using the above example, you would purchase an EVC with a CoS suitable for your VoIP traffic and an EVC with a CoS suitable for your data traffic. Each EVC, and hence CoS, is identified via a unique VLAN ID or set of VLAN IDs. The approach to select will depend upon the service cost and capabilities for each. Either approach can achieve the same result.

Service Performance Parameter	Example Service Performance Objectives
Frame/Packet Loss	< 0.01% over 30 days
Frame/Packet Delay/Latency	< 30 ms for < 350 miles
Frame/Packet Delay Variation/Jitter	< 8 ms for < 350 miles
Mean Time to Restore (MTTR)	4 hours
Service Availability	99.99% over 30 days

Figure 6: Ethernet Service Performance Metrics

Service Performance Metrics

The service performance metrics indicate how your service will perform and should be an important consideration when selecting an Ethernet service. Figure 6 provides a list of some commonly provided service performance parameters and an example of how they could be specified. Note that delay measurements are affected by the distance of the connection over which the EVC traverses.

Note that terminology varies between service providers. For example, the terms “packet” or “frame” can be used interchangeably. The term “jitter” is used interchangeably with “delay variation”. The term “latency” is interchangeable with “delay”.

Delay and Delay Variation can be measured as a one-way or round trip (two-way) measurement so it is important to understand the type you need and the type provided by the service.

The mean time to restore (MTTR) service provides the duration between the times a service outage is determined and when it is restored to the service level

objectives specified in the SLA. Service Availability indicates the amount of time a service meets the service level objectives over a specified measurement period.

The MEF 10.2 technical specification has standardized terms and describes algorithms to measure many of the service performance metrics.

STANDARDIZED ETHERNET SERVICES

The MEF has defined standardized Ethernet services that address the two basic types of connectivity, namely, point-to-point (site-to-site) or multipoint (any-to-any). When investigating the different service offerings, you need to consider the type of connectivity you require to address your current and future application requirements.

Each of these service types have two service definitions associated with them. One service definition is for port-based services similar to traditional TDM private lines where you order a single service per Ethernet port. The other is a VLAN-aware service where the service provider differentiates between certain Ethernet traffic based on how it is tagged – with or without a VLAN ID.

Port-Based Ethernet Services

Port-based services are the simplest form of Ethernet service requiring little co-ordination with the Ethernet service provider. This is because the service makes no differentiation of Ethernet traffic entering the UNI from the customer’s attaching equipment. Basically, it provides a “bits in”, “bits out” service for a specific amount of subscribed bandwidth. The MEF has defined Ethernet Private Line (EPL) and Ethernet Private LAN (EP-LAN) as the point-to-point and multipoint port-based services.

VLAN-Aware Ethernet Services

With VLAN-aware services, you can support multiple EVCs on the same Ethernet port. Each service is identified based on how the Ethernet frames are tagged. This saves you the cost of purchasing additional ports from the service provider as well as for your attaching equipment. It also enables you to add additional EVCs in the future as long as there is sufficient bandwidth available on the Ethernet UNI.

While VLAN-aware services require you to inform the service provider which VLAN IDs (or untagged Ethernet frames) you want associated with a particular service, this is a one-time co-ordination for each Ethernet UNI at each service location. The MEF has defined Ethernet Virtual Private Line (EVPL) and Ethernet Virtual Private LAN (EVP-LAN) as the point-to-point and multipoint VLAN-aware services.

MEF Service Types

The MEF has defined E-Line and E-LAN service types as the generic category to describe all point-to-point and multipoint services, respectively. Refer to Figure 7.

MEF Service Type	Port-based Service	VLAN-aware Service
E-Line (point-to-point)	Ethernet Private Line	Ethernet Virtual Private Line
E-LAN (multipoint)	Ethernet Private LAN	Ethernet Virtual Private LAN

Figure 7: MEF Ethernet Service Definitions

E-Line service types are best used for point-to-point connectivity for applications such as data center interconnect and site-to-site VPNs, or site-to-cloud applications such as cloud computing, SaaS, or connectivity to an MPLS backbone network. E-LAN service types are best used for multi-site connectivity where you have many locations in a metropolitan area that require a high degree of inter-site connectivity. Adding additional sites over time is simpler with E-LAN service types since adding a new site does not require every site’s bandwidth to be upgraded.

MEF Certified Ethernet Services



The MEF has a certification program which tests Ethernet services for compliance to MEF technical specifications. The certification assures buyers that the Ethernet services are MEF-compliant and capable of delivering well defined levels of service quality. The certification also provides IT departments with the information to make informed decisions when comparing Ethernet service offerings.

MEF 9 Certification tests for compliance to MEF 1, 5 and 6 technical specifications defining Ethernet service attributes at the Ethernet UNI. Note that MEF 1 and 5 have been subsumed into the MEF 10.2 technical specification.

MEF 14 Certification tests for compliance to Bandwidth Profile Rate Enforcement and Traffic Management in the MEF 5 (now MEF 10.2) technical specification.

MEF 18 Certification tests for compliance to transportation (circuit emulation) of TDM circuits over Ethernet networks as defined in the MEF 8 technical specification.

SUMMARY

Business Ethernet services are one of the fastest growing WAN communications services because of their flexibility, scalability and cost effectiveness to address a wide variety of current and emerging applications.

When selecting an Ethernet service, you should carefully consider the following:

- ✓ Does the service support Ethernet port speeds from 10Mbps to 10Gbps?
- ✓ Does the service offer a CIR?
- ✓ Does the service support multiple EVCs on the same Ethernet port (UNI)?
- ✓ Does the service provider offer both E-Line and E-LAN service types?
- ✓ Does the service support at least 3 Classes of Service?
- ✓ Does the service specify service level objectives for latency, jitter and loss?
- ✓ Is the service MEF Certified Compliant?

With Ethernet, you can simplify your network operations by using a common technology for both your LAN and WAN connectivity. Finally, by leveraging Ethernet services, you will empower your business to meet the 21st century demands for new applications yet to be created.

REFERENCES AND RESOURCES

- Metro Ethernet Services – A Technical Overview, Ralph Santituro/Metro Ethernet Forum
- MEF 6.1: Ethernet Services Definitions Technical Specification, Metro Ethernet Forum
- MEF 10.2: Ethernet Services Attributes Technical Specification, Metro Ethernet Forum
- Bandwidth Profiles for Ethernet Services, Ralph Santituro/Metro Ethernet Forum

ABOUT COMCAST BUSINESS ETHERNET

Comcast offers a complete range of MEF certified business Ethernet services including Ethernet Private Line, Ethernet Virtual Private Line, Ethernet Network Service (MEF E-LAN compliant) and Ethernet Dedicated Internet. Each service is offered with a 10Mbps, 100Mbps, 1Gbps, or 10Gbps Ethernet port in customer-selectable bandwidth increments ranging from 1Mbps to 10Gbps. For more information or to request a consultation about Comcast's Business Ethernet Services, please visit www.business.comcast.com/ethernet.

