The Evolution of Ethernet

How Ethernet solutions, such as NTT America's VLink, can help businesses reduce private networking costs while leveraging Ethernet technology.

Introduction

Despite recent economic woes, Ethernet continues to grow at a steady pace; during 2009, Ethernet services in North America grew at a double-digit rate. Vertical Systems Group projects Ethernet to grow to a $40 Billion industry by 2013, which is a 48% projected compound annual growth rate from 2008. The same cannot be said for legacy technologies, for which sales continue to decline as companies migrate to Ethernet technology as the primary means to connect their Wide Area Network (WAN).

So, why has this shift occurred? Why are companies migrating from legacy technologies to Ethernet, ultimately causing an explosion of growth? This paper will explore the many benefits associated with using Ethernet when extending a Local Area Network (LAN); some reasons are as mundane as simply reducing operating expenses and others are more complex, such as the ability to run the protocol of the customer's choice over the links. Ultimately, Ethernet has merit and has earned the title of being the preferred long haul data transport method.

From its humble beginnings in 1973, with speeds topping out at 3 Mbps, Ethernet has come a long way. Originally intended to create a private network in one location or LAN, Ethernet can now connect multiple locations around the world at speeds up to 10 Gbps, and soon 40 and 100 Gbps. As the use of video and voice applications increases almost exponentially, the need for more bandwidth is also growing at an almost insatiable rate. The constant need for an increase in bandwidth is the primary reason for the migration to Ethernet from other WAN technologies. This is because Ethernet bandwidth can usually be increased within hours rather than days or weeks like on other mediums.

Some WAN technologies, such as ATM, have attempted to design an end-to-end approach to the problem of increasing bandwidth needs. However, these solutions are technically complex and costly for the WAN communications carriers to offer on a large-scale basis; this translates into an expensive product that many potential customers are not able to use.

Successfully accomplishing what legacy technologies have not quite attained while including features such as, being cost effective, easy to configure and increase bandwidth, have contributed to Ethernet surpassing other data transport services such as ATM and Frame Relay to become the preferred long haul data transport method. However, the migration is due to several additional factors including: unprecedented scalability and flexibility, protocol neutrality, ease of use, reliability and general availability/ubiquity.

While Ethernet clearly has many benefits, it is difficult to lump Ethernet technology into one bucket, as there is much diversity amongst Ethernet services/providers. Most of the diversity is found in the service providers' network and how the data is transferred from one location to another; reasons for this diversity can be found within Ethernet's history.

Ethernet History in Brief

Ethernet was originally intended to create a network in a small area known as a Local Area Network (LAN); these networks are in areas that are relatively small and can be connected without a third party or service provider. They are typically deployed to support areas like a home, office, or small group of buildings. Until recently, IT departments had to use different technologies when connecting multiple high performance office LANs together across slower Wide Area Networks (WANs) such as Leased Lines, Frame Relay and ATM.

In general, Leased Lines and Frame Relay do not offer sufficient bandwidth to cope with a dynamic mix of real time interactive and file transfer bulk traffic that makes up the majority of what LAN users need on a daily basis. Desktop connectivity has evolved from 10 Mbps half duplex in the 1980s to 100 Mbps and even 10 Gbps full duplex today; these increases are primarily due to the escalated use of real-time video, voice and data networking applications. Service providers need to accommodate a solution equipped with the bandwidth to carry larger files efficiently and seamlessly. Gradually, and now more predominantly, Ethernet technology has evolved so it not only connects networks that are in a close radius but now can connect networks around the globe, making users thousands of miles apart feel as if they are in adjacent offices; these features make it easy for companies worldwide to look to Ethernet as the current and future standard for delivering WAN services.

While Ethernet is becoming the standard for WAN services, Ethernet services themselves are not standardized. In fact, there are several mechanisms a service provider can use to configure their Ethernet service, including Virtual Private LAN Service (VPLS), Ethernet Private Line (EPL) / Ethernet Virtual private Line (EVPL), Hybrid WAN VPLS/IP VPN, Multi-Protocol Label Switching (MPLS)/VPLS and the use of E-Access to Internet Protocol enabled Virtual Private Networks (IP VPNs).

When deciding which service provider to use for Ethernet services, one may want to consider the technology the service provider is using as it does impact the amount of control/management the user is able to leverage on their side. Some technologies require more configuration and are more automated while others are very easy to implement and are less automated. However, most of the configuration happens on the Service provider's side and minimally impacts the user if at all.

Benefits of Ethernet

As previously mentioned, Ethernet has many advantages that include cost efficiencies, unprecedented scalability and flexibility, protocol neutrality, ease of use, reliability and general availability/ubiquity. The following explores these benefits and explains why Ethernet truly has an advantage over legacy technologies.

Cost Efficiencies

Using Ethernet to connect LANs to Metro Area Networks (MANs) and WANs can help reduce capital expenses and operating expenses in several ways. First, Ethernet is a technology widely known by IT professionals, primarily because it has been used to connect LANs for several decades; thus, most IT professionals have experience setting up and using Ethernet. This translates to savings, as companies do not need to invest in training as they migrate to using Ethernet for their WAN.

Secondly, because Ethernet is already in almost all networking products, the Ethernet interface itself is inexpensive. MANs and LANs generally use shared equipment from an Internet Service Provider helping Ethernet services normally cost less than competing services.

Lastly, most Ethernet services allow users to add bandwidth incrementally, which enables customers to increase bandwidth as needed, making it easy to pay only for what they use, as opposed to private lines where the user must pay for a set bandwidth regardless of need. Ethernet services can provide multi-megabit to multi-Gigabit transport speeds for a fraction of the cost per bit as compared to what is currently paid for legacy services. While companies are searching for ways to decrease costs and increase efficiencies, Ethernet puts businesses in the position to decrease expenses while their network can be easily upgraded as bandwidth needs increase.

Unprecedented Scalability and Flexibility

Many Ethernet service providers allow customers to connect their business networks in ways that are either more complex or impossible with legacy services. For example, a single Ethernet service interface can connect multiple locations for their Internet VPNs, connect business partners or suppliers via Extranet VPNs and provide a high speed Internet connection to an Internet Service Provider. With managed Ethernet services, subscribers are also able to add or change bandwidth in minutes instead of days or weeks like with legacy technology services. Additionally, these changes, generally, do not require the subscriber to purchase new equipment or coordinate a visit with a service provider's technician.

Protocol Neutrality

As opposed to regular Internet traffic, carrier Ethernet that runs at Layer 2 does not have a standard Layer 3 protocol attached to it; this allows for users to run the protocol of their choice over their Ethernet connection (IPv4, IPv6, both, or another Layer 3 protocol). This flexibility allows for consistency throughout the customer's network. With Ethernet, users can use the same protocol in their LAN and WAN, creating a cohesive network from end to end.

Ease of Use

Due to the length of time Ethernet has been in existence and the fact that much of a WAN is managed by a 3rd party, it is relatively easy to set up. Of course the technology the Ethernet provider uses (i.e. MPLS, Martini, IP VPN) and at which layer the information runs (Layer 2 vs. Layer 3) will determine the actual amount of time it takes to set up and manage.

The speed with which a circuit can be activated also plays into ease and efficiency of Ethernet. As long as the carrier's fiber-connected Ethernet multiplexor is already in the customer's building (i.e. the building fiber is said to be 'lit'), then the service can be turned up in a matter of days, rather than the weeks or months which is required by legacy solutions. One of the primary features that contributes to Ethernet's ease is it allows for the same technology to be run throughout the whole network rather than transforming protocols when transferring traffic to different locations.

Reliability

Most of the WAN is managed by a 3rd party. As a benefit, the user adopts the ISP's backbone as part of their network thus the reliability associated with the providers network is adopted into the user's WAN. All top tier providers implement a Service Level Agreement that normally doesn't go below 99% guaranteed uptime, as such when the ISP's network is up so is the user's. In the same vein, if the network should go down, it is the ISP's responsibility to repair it, rather than the user's IT department.

General Availability and Ubiquity

Ethernet is now supported by more than 60 service providers and 100 equipment manufacturers, making Ethernet available in thousands of cities around the world. Because ISPs now provide Carrier Ethernet, it is available everywhere general Internet is available, meaning a company can create a WAN locally, nationally and globally.

Future of Ethernet

The benefits of Ethernet are not only causing a massive migration and adaption from legacy technologies but they are also positioning Ethernet to evolve and continue to be the preferred high bandwidth data transfer method. As the market continues to crave and consume more and more bandwidth, Ethernet technology is staying one step ahead, now developing networks and hardware capable of delivering speeds of first 40 Gbps then quickly there after 100 Gbps. This will allow Ethernet to become an even more dominant technology medium in the market place.

There may also be a trend toward network neutral data centers, which traditionally are used for ISPs to peer or exchange Internet traffic, starting to offer a collocation where ISPs can share Ethernet traffic. Since Ethernet traffic generally stays on one provider's network, the user is restricted by the provider's reach; the primary benefit of these Ethernet "exchange" points is to allowfor providers with a smaller reach to partner with other Ethernet providers and transfer Ethernet traffic between each other's network, essentially increasing a provider's reach while keeping costs low.

Lastly, there is a trend toward multi-point services. When ISPs initially launched MAN and WAN Ethernet services it was restricted to point-to-point configurations between two locations; if a customer had several locations to connect, the customer had to maintain several point-to-point links rather than having a hub and spoke or fully meshed configuration managed as one service. Now, ISPs are offering fully meshed multi-location offerings and will continue to develop these offerings so they are even easier to configure, deploy and manage.

NTT America's Ethernet Solution

VLink is a Layer 2 VPN Ethernet product intended to satisfy the need for ultra high speed, high bandwidth data transfer of voice, video and data which are able to travel all on the same link. VLink can be configured in several ways to connect two or more location points: VLink Direct (point-to-point), VLink Plus (hub and spoke) and VLink Mesh (fully meshed). Currently, bandwidth commitment rates for VLink range from 100 Mbps to 10 Gbps. Traffic runs separately from general Internet traffic and has prioritized buffering, thus both network performance and security are improved.

As with all Ethernet-based solutions, installation and configuration are easier and faster than traditional, legacy WAN solutions, because nothing beyond a simple Ethernet interface is required from a customer's access switch or router. A customer can choose the most optimal configuration and can choose to run IP transit on the same port, which reduces port costs and local loop costs. A Gigabit or 10 Gigabit Ethernet physical interface is generally recommended and required for those customers who have usage needs above 100 Mbps. NTT America will multiplex traffic to/from the customers various end location over one physical Ethernet interface using VLAN tagging where VLAN IDs are mutually agreed to with the customer. Customers have the flexibility to use different speed interfaces at their various locations, and have the luxury of routing whichever Layer 3 protocol over the network they choose.

VLink uses a Martini style configuration, which complies with RFC 4448, and is considered an IP VPN service with Ethernet edge-to-edge (PWE3) emulation. VLink runs simply using one physical port at each location and requires only 2 command codes on the customer's router to provision.

NTT America invites you to discover how VLink's capabilities can help your business respond quickly and cost-effectively using a secure and scalable, Ethernet-based WAN connectivity solution.

Resources:

Heavy Reading: Ethernet Services Continue to Soar in Downturn (Jan. 5, 2010)
http://www.tmcnet.com/usubmit/2010/01/04/4556920.htm

Carrier Ethernet for Business
http://metroethernetforum.org/PPT_Documents/CE4Business.ppt#540,1,Slide 1

Ethernet Timeline
http://timeline.ethernethistory.com/

Ethernet
http://en.wikipedia.org/wiki/Ethernet

Ethernet Services Lead to Telco Recovery
http://www.bworldonline.com/main/content.php?id=4091

Metro Ethernet Services – A Technical Overview
http://metroethernetforum.org/PDF_Documents/metro-ethernet-services.pdf

Martini Draft
http://en.wikipedia.org/wiki/Martini_draft

The Future of Ethernet
http://www.netevents.tv/video/the-future-of-ethernet