

Multipoint Layer 2 VPNs over Ethernet Access Networks

Introduction

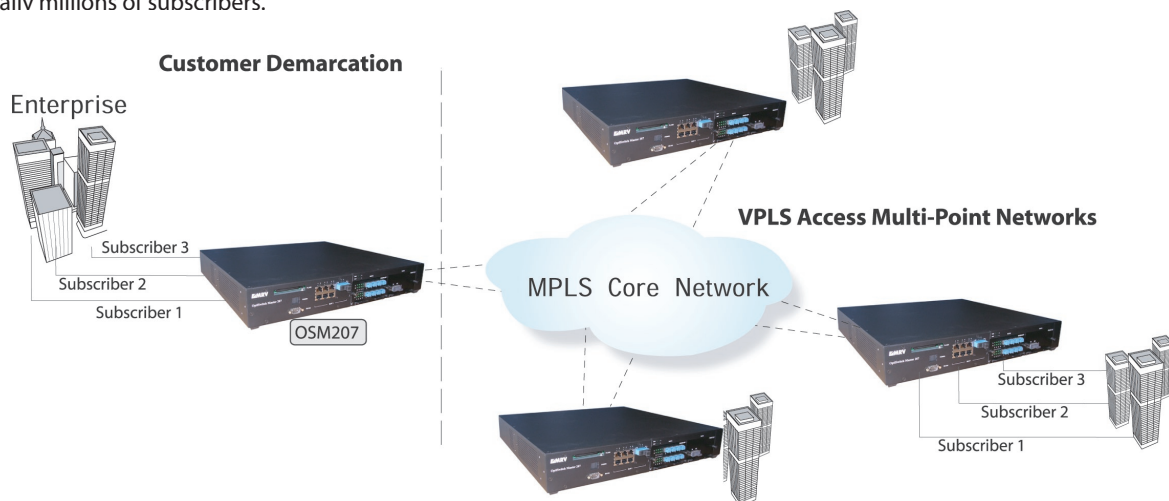
Today's economical climate reflects the trend in decentralization of enterprise Ethernet networks that are geographically separated yet require simple, flexible, and broadband glue to interconnect them. The customer expects to have a single scalable Ethernet pipe that will carry multiple services across multiple sites, at the desired service level, with maximum transparency of the provider network.

The typical example will be headquarters and remote offices that are dispersed over a geographical metro area and require a LAN-like communication with a broadband connection. Such a scenario will be preferable with a simple Ethernet connection to the provider network and transparency of communication protocols in order to satisfy customer needs and to avoid overhead in installations.

The objective of this guide is to explain this solution based on Virtual Private LAN Services technology and to identify its benefits in carrier networking environments.

What is VPLS?

Virtual Private LAN Service (VPLS) is a class of Layer 2 Ethernet VPN that allows connection of multiple Ethernet sites over Multiple Protocol Label Switching (MPLS) private or metro networks. Such implementation emulates a LAN that provides transparency and full learning and switching capabilities with carrier-class scalability and service delivery. VPLS embraces the same logical concept as the Virtual LAN (VLAN) technology in Local Area Networks, but with evolution of carriers' needs with scalability for literally millions of subscribers.



Industry Review

During the last 3 years, the telecommunications market faced a few changes that had a direct impact of economical changes worldwide.

Financial constraints of time-to-revenue reflected the race towards alternative technologies that have a low-risk for capital investment and greater adaptability to market needs. Driving market needs are customers that have well-developed notions of service and value-added applications transpiring from the Local Area Networks. In fact, it is these considerations that forced carriers to start new services and implement technologies even before they became standards. As a result, credibility of Ethernet-based services over carrier networks became reinforced. Ethernet networks were traditionally used as LANs, but networking vendors foreseeing market changes developed new technologies that could be used for Ethernet and that have carrier-class qualities.

The Virtual Private LAN Service (VPLS) technology is part of this significant revolution that will transform the telecom industry in a few years from now and will get the acceptance of customers and carriers.

Key Features of the Technology and Services

VPLS is defined as a carrier class technology with the following four fundamental key features:

1. Service transparency
2. QoS connection
3. Bandwidth scalability
4. Financial argument

VPLS utilizes all the above with the scalability and resiliency of IP/MPLS to carry transparent LAN services between metropolitan areas which standard Ethernet equipment cannot support. Its significant advantage is that at the connection between the provider edge and the customer devices, there is no IP protocol interaction.

All customer sites in a VPLS service appear to be on the same LAN, regardless of their geographical location. Each customer has its own private VPLS service that is completely separated logically from other customers across the whole shared carrier network. VPLS service allows an enterprise customer to be in full control of WAN routing policies by running the routing service transparently over a private or public IP/MPLS backbone. VPLS services are transparent to higher layer protocols, so that any type of traffic can be transported and tunneled seamlessly.

For example, customer networks are not restricted to carrying only IP traffic.

In fact, the following protocols can be found in a typical customer networks:

- Internet Protocol IPv4 with private IP address
- AppleTalk Protocol (Commonly used in graphical offices)
- Novell IPX protocol (NetWare operating system for LANs)
- IBM's SNA protocol (Commonly used in financial organizations)
- DECnet (legacy Digital systems in production terminal environments)
- Microsoft NetBEUI (commonly used for Microsoft SOHO internal shared LAN)

VPLS always offers Ethernet port hand-off (customer demarcation) between the carrier and the customer router or a simple LAN switch allowing higher bandwidth service at a lower cost of deployment.

Ethernet is the choice of next generation carrier networks and it will be embraced with the arguments that dictate financial and technological future.

Service Providers understand that behind the demarcation point of the carrier network, there are customers who want to be connected but who also want to be comfortable with the technology, price, and service.

A typical customer understands the Ethernet LAN technology and has a better understanding of the associated services rather any other alternative (legacy services) that offered traditionally by the carrier.

This demands simplicity in connecting geographically distributed sites, starting from small SOHO, that use only workgroup networks, up to high-end enterprises with complex financial and real-time applications. This simplicity is required to be manifested by pure transparency and the use of existing LAN infrastructure at the demarcation point in order to save the service provider the nightmare of work loads and equipment expenses such as expensive routers and IP-tunneling equipment (WAN gateways) that were previously required.

Quality of Service in a VPLS Network

QoS management is a fundamental requirement of any customer converged network that carries Voice, Video, and data over IP. VPLS networks use the tunneling technique and the QoS function offers a flexible framework in which we convey customer's traffic with corresponding Service Level Agreement (SLA) over a carrier network with the QoS policy set. Service providers can leverage Class-of-Service (CoS) technology to provide priority services and leverage rich QoS signaling protocols with bandwidth reservation technology providing connection-oriented paths for voice, video, and other mission-critical traffic services over their network.

VPLS can guarantee end-to-end QoS and preserve that capability as it scales.

This is a critical function that forces the Ethernet service to be adaptable and to offer lucrative applications.

Ethernet Bandwidth service - VPLS vs. Legacy SDH networks

Bandwidth profiles allow a service provider to bill on bandwidth usage and plan allocation of network resources. Bandwidth profiles enable a service provider to offer multiple service instances per variable, such as physical port, customer defined Virtual LAN Tag, or a VPLS service. Among the significant benefits of the VPLS access service are price and flexibility; allowing customers to order on-the-fly bandwidth increments for multiple sites instead of being constrained by the traditional E1 (2 Mbps), E3 (33 Mbps) and STM-1 (155Mbps) boundaries of legacy SDH services which are highly inflexible and limited to point-to-point interconnection. The other fact that should be considered is that legacy SDH networks require physical interface changes as bandwidth increases. This forces the subscriber to replace an interface or entire equipment set as bandwidth needs change and to "truck-roll" to the customer site with drastic time-consuming consequences.

In a new network design, bandwidth services can reach arbitrary speeds for an offered Ethernet physical port and with desired VPLS services for distributed sites.

Bandwidth services can be provisioned in real-time from 64 Kbps to 1 Gigabit with 1 Kbps granularity to allow multi-profile independent offerings for different customer needs and prices.

Carrier Motivations

Today, the motivations of CLEC and ILEC carriers are the same:

1. Cost-effective infrastructure.
2. Revenue growth with attractive new applications and prices.

In fact, the main difference between the two is whether the network exists and its size.

Deregulation and increased competition make it imperative that ILEC and CLEC respond quickly to customer demands for new services. After all, time-to-market can mean the difference between new found revenues and lost opportunities. The challenge is to deliver those new services as cost effectively as possible, while keeping a tight control on capital expenditures. VPLS reduces the high cost of ownership typically associated with multiple services replacing bandwidth non-scalable Frame Relay and ATM Layer 2 technologies.

Carriers can reduce training, maintenance, and administration costs by migrating to Ethernet VPLS that reflects a network design adaptable for service providers for transparent LAN services without facing IP complications that were typically dealt with by Internet Providers (ISPs).

CLECs and ILECs are typically transport carriers and this is exactly what their business customer expects; to have transparent pipes in a wide-area network.

In addition to selling VPLS to business customers, some cable operators (MSOs) use VPLS for the dual purpose of offering broadcast video services and expanding into other business services.

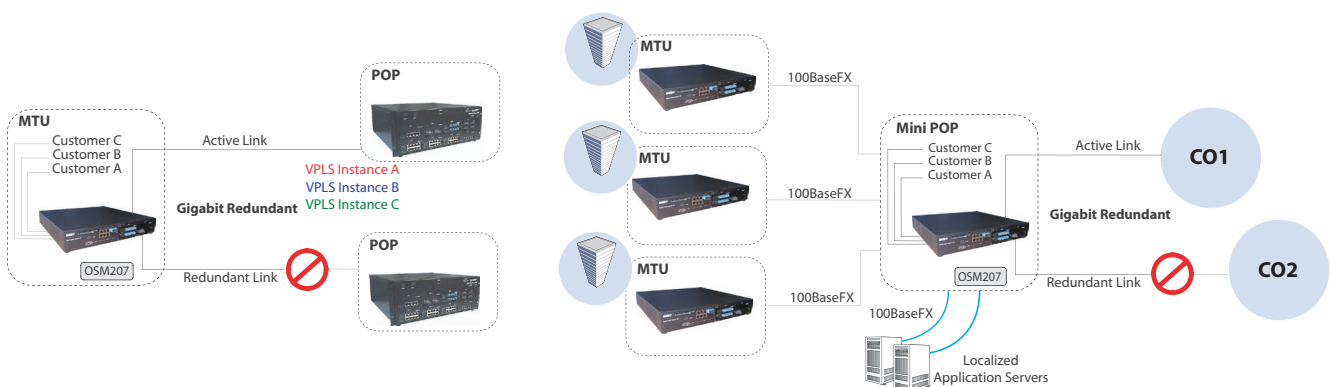
MRV's Solution

MRV's Virtual Private LAN Services (VPLS) solution, based on the OptiSwitch Master® carrier-class product line, provides the accurate solution for connectivity between geographically separated customer sites across IP/MPLS Ethernet packet-switched networks, minimizing network maintenance and operating costs. It enables service providers to migrate to next-generation networks with fast revenue-generating VPN services enabling them to operate as if they were interconnected on a private LAN. In addition, the OSM's VPLS, along with MRV's comprehensive range of Ethernet first-mile/last-mile solutions, is a natural choice since it offers the service provider an efficient way to implement sophisticated QoS triple play services (Voice, Video, and Data) into connected businesses.

OSM VPLS Benefits

MRV's OptiSwitch Master® platform is based on programmable modular hardware architecture capable of adapting to today's as well as future services and standards.

The modular platform can be any of a diverse range of chassis, from the small MTU model to higher capacity aggregation for the carrier's Central Office (CO) or Point-of-Presence (POP).



The OSM family incorporates VPLS functionality with a unique auto-discovery service.

The unique auto-discovery capability of VPLS, enabled at the provider edge and signaling its service capabilities, offers easy-to-use VPN membership allocation.

With auto-discovery, each VPLS Provider Edge (PE) discovers which other PEs are part of the same VPLS domain and discovers PEs when they are added or removed from the network. The auto-discovery VPLS service allows for a smooth and simple provisioning tool to connect customer sites with the following additional advantages:

- Easy to use (provision) and saves on time & money
- Fewer points of failure since no human interface is involved
- Enables mass deployment

VPLS Benefits Summary

- Transparent, protocol independent, multipoint solution with shared bandwidth pool for remote locations that belong to a specific customer VPLS domain.
- Ethernet LAN/WAN interfaces that offer reduction in total cost of ownership
- Eliminates L2 protocol conversion between LAN and WAN
- No training required on WAN technologies as in the case of Frame Relay and ATM
- Customers maintain complete control over their own switching and routing between branches, offering easier configuration and debugging in case of problems
- Removes the IP "issues", namely, Trust, security, and outsourcing.
- Bandwidth provisioning on-the-fly with 1 Kbps granularity from the wide range 64 Kbps to 1 Gbps for each subscriber independently per VPLS service offered to Enterprise.
- OSM's VPLS auto-discovery and service provisioning simplifies addition of new sites; without requiring re-configuration at existing sites.

Conclusion

Service providers are closer than ever in achieving the goal of service convergence on their MPLS networks. VPLS is the ultimate next generation access technology to enable smooth hand-off between the customer LAN and the provider MPLS WAN core. The VPLS concept enables providers to reach tremendously high savings on cost in equipment and operation, and to shed light on new value-added services in access networks with profit assuring solutions.