Maintaining the Benefits of TDM-Based Branch Access Services

Vanguard's Multi-Protocol Access Gateways Adds Value to T1/E1 Services

TDM-based infrastructure for access services have for a long time formed the bulk of offerings from service providers. Both fractional and full T1 services in North America and corresponding E1 services outside North America have been hugely popular. In fact, both private line services and frame relay services have been successfully offered by global service providers over TDM-based infrastructure for a long time.

The push by newer IP/MPLS based services to replace this TDM-based infrastructure has however not dampened the desire by businesses to keep procuring T1/E1 based services. While the continuing interest in TDM-based services might appear surprising, it is not really so. The TDM-based services provide very specific benefits to businesses with stringent and specific needs.

Figure 1: U.S. Business Land Access Lines by Service Type 2003 – 2008. Source: *Vertical Systems Group*

Such benefits include:
- The ability to carry both voice and data simultaneously.
- Robust uptime guarantees of the order of 99.99% under most SLAs.
- Suitability for business environments that have a relatively large number of uses resulting in a lower cost per user.
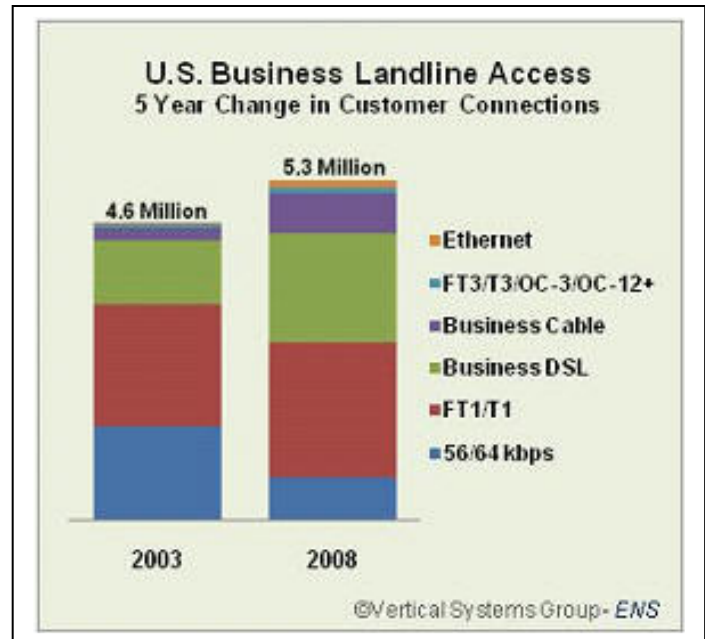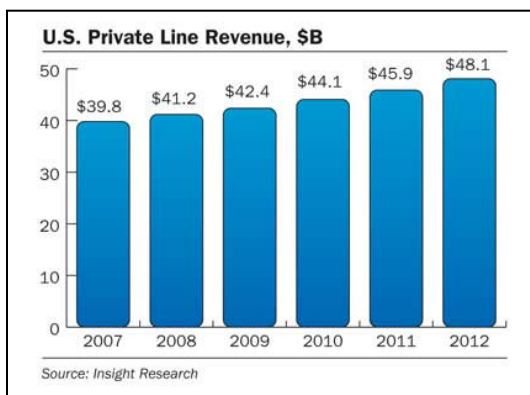

Figure 2: U.S. Private Line Revenue 2007 - 2012. *Source: Insight Research*

A survey done by Vertical Systems Group, as illustrated in Figure 1, shows that the largest percentage of the 5.3 access lines installed in the United States in 2008 were FT1/T1 lines. Another survey done by Insight Research as shown in Figure 2 project moderate growth of private line revenue for service provider's right up to 2012! This projection by Insight Research reveals revenue numbers that are by no means small.

When one considers that newer access technologies like cable, DSL, and Ethernet compete directly with TDM-based access for the vast majority of enterprise business access, this observation provided additional insight and also raised some interesting challenges for Vanguard Networks.

It becomes apparent from the statistics shown that:

- The robust benefits of TDM-based services would continue to ensure their attractiveness to businesses.
- Competing land access technologies would complement rather than compete with TDM-based services.
- Enterprise businesses that had already implemented and amortized T1/E1 based services would be reluctant to undertake capital-intensive forklift upgrades to transition to newer access technologies without clear perceived benefits.
- Enterprise businesses would push hard to derive additional value from their TDM-based services before.

Vanguard Networks took on the challenge of adding additional value to the TDM-based services already offered by its complete range of access products. Some of these capabilities are briefly presented below.

Multi-Link PPP over Frame Relay (MLPoFR) Carried Over Multiple T1 Links

Multilink PPP (MLP) over Frame Relay enables delay-sensitive real-time packets and non-real-time packets to share the same link by fragmenting large data packets into a sequence of smaller data packets (fragments). The fragments are then interleaved with the real-time packets. On the receiving side of the link, the fragments are reassembled and the packet

Figure 3: Multi-Link PPP over Frame Relay Using Vanguard Networks 3480 And 6840

reconstructed. This feature enhances VoIP Quality of Service (QoS) by preventing delay, delay variation (jitter), and packet loss for voice traffic on low speed FR-to-FR and Frame Relay-to-ATM inter-working networks. Figure 3 shows MLPoFR connectivity between Vanguard Network products across a Frame Relay network.
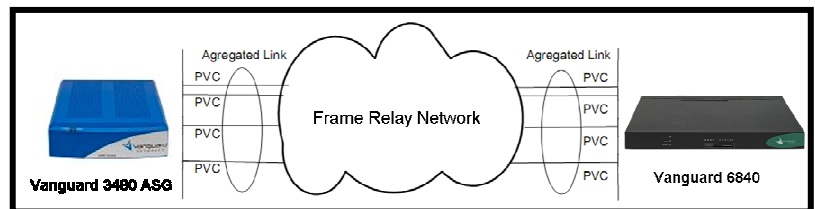
Multi-link PPP offers the following benefits:
- Total bandwidth available to MLP session may be increased by aggregating interfaces and VCs.
- Multilink PPP load-balancing sends packets across individual links while ensuring proper packet ordering.
- A multiple link bundle appears as one logical link, requiring only one network address to be configured.
- Enabling packet fragmentation can increase the efficiency of the multilink connection.
- Offers significant link manageability by detecting failed links and removing them from the bundle.
- Links can be added to or removed from the bundle in accordance with the current bandwidth requirements.
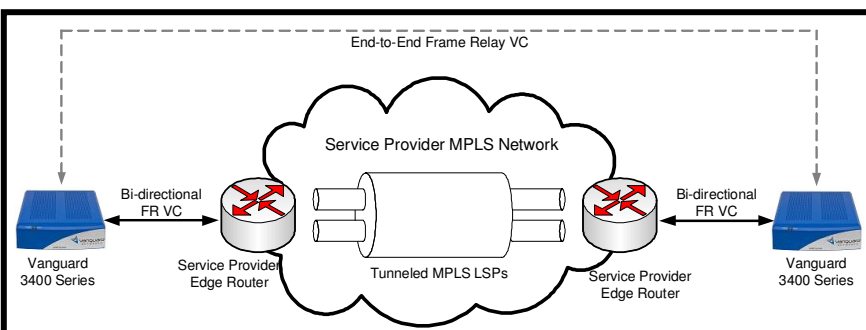
Frame Relay Transport over MPLS

Figure 4: Transporting FR over MPLS Core Networks utilizes all the benefits of MPLS

Many service providers around the world have transitioned their core transport infrastructure to IP/MPLS. As a result, enterprise organizations are eager to derive the benefits experience the cost savings by signing up for MPLS based services by service providers.

At the same time, enterprise organizations with shrinking budgets are reluctant to completely uproot their TDM-based frame

relay service in favor of broadband or Ethernet based access services. Many enterprises have come to rely on the robust benefits of their TDM-based services as mentioned before. Service providers on the other hand, in a bid to maintain the substantial revenue streams from existing TDM based services, have expanded their MPLS based services to deliver Frame Relay to MPLS-based inter-working, wherein Frame Relay VCs are transparently connected over the service provider's MPLS core. Figure 4 illustrates this service model.

Both the service provider and the enterprise customer derive numerous benefits from this service model. To keep the service delivery consistent with the original Frame Relay service, the MPLS core provides traffic engineering with dynamic bandwidth allocation, high levels of performance, QoS, reliability, and sophisticated management of services delivered by the service provider, without increasing the overall cost of ownership to the enterprise. The enterprise is shielded from the complexities of operation of the MPLS network while benefiting from the same high levels of service they obtained with their Frame Relay services. These MPLS-based services are essentially "managed" services, with key Tier 1 service providers providing the ability for various access infrastructure types to connect over their MPLS core.

Vanguard Networks entire range of access products are deployed in numerous managed network environments, either over native Frame Relay networks or over hybrid FR/MPLS networks with TDM-based T1/E1 and fractional T1/E1 being among the most popular access transport mechanisms.

TDM Interfaces Used In Multi-Port WAN Configuration

All Vanguard's access platforms including the 3400 Series and the 6800 Series platforms support T1/E1 based WAN interfaces, along with routable Ethernet WAN interfaces. This gives the enterprise running critical branch office access applications the ability to subscribe to a diverse array of WAN-based services to meet the needs of specific applications. A common

Figure 5: WAN Access with Combination of T1/E1 and Ethernet Links

application scenario is shown in Figure 5 where the T1 interface is used to transport packet voice, and one Ethernet WAN port is used for Internet access and backup services.
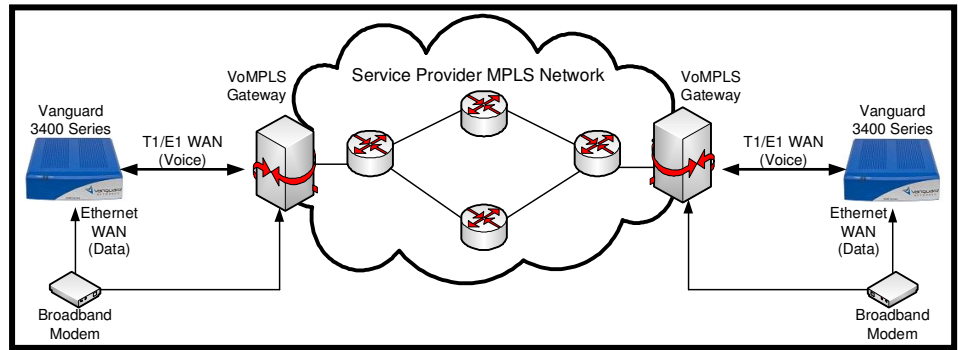
The benefits obtained from this configuration include:
- Segregation of high priority voice (T1) from lower priority internet/backup data traffic (Ethernet data).
- Ability to apply specific QoS traffic priorities to individual traffic types.
- Ethernet WAN acts as an alternate WAN link in case of failure/disruption of the T1 WAN connection.