CAPPING CAPEX: THE CASE FOR ETHERNET AS METRO INFRASTRUCTURE

Business Case

Metro Ethernet business services case study for a service provider

Introduction

Ethernet services in the metro are taking off in popularity as enterprises increase their demand for higher bandwidth and more cost-effective connectivity than existing Wide Area Network (WAN) services provide. According to Infonetics Research, the Ethernet services market is expected to reach $25.4B worldwide by 2009.[1] Service providers want to leverage Ethernet not only to offer Ethernet-based services (E-Line, ELAN and E-Tree for example) but also as an infrastructure for value-added services and applications (such as IPTV, broadband access and VoIP).

Using Metro Ethernet equipment for this new service infrastructure is appealing to service providers because of its lower cost and simpler operational characteristics compared with alternative equipment. In this business case, we highlight the key findings from a recent Metro Ethernet business services case study. This study compares the CAPital EXpenditures (CAPEX) for several vendors' Metro Ethernet infrastructure solutions required to support business service traffic in a major metro area.

Overview

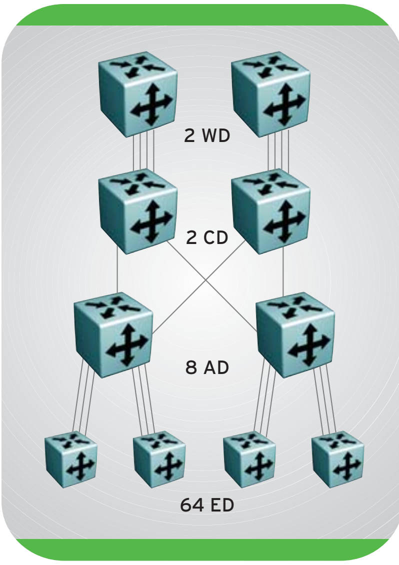
The analysis is based on an incumbent North American provider targeting a medium-sized city with Ethernet business services. These E-Line and E-LAN services are offered via 10/100/GigE physical interfaces and have combined peak traffic of 4 Gbps at each edge device.

The metro network architecture consists of 64 edge devices, two core devices and two WAN hand-off devices — all supporting IEEE 802.1ad Provider Bridges (PB or Q-in-Q).

Several challenges exist with the current Q-in-Q-based network, particularly with service scalability. Hence, the proposal is to add a layer of eight aggregation devices and replace the two existing core devices with two new devices that solve the network problems associated with the Q-in-Q implementation. At customer

[1] Ethernet and IP MPLS VPN Services, Infonetics Research, April 2007

Figure 1. Proposed network architecture



sites, CPE devices are used to provide cost-effective Ethernet access. The proposed metro network architecture is shown in Figure 1.

Technology options

Two solutions are under consideration.

- **MPLS solution** —IP/MPLS switches are used to provide E-Line services based on Pseudo Wire Emulation Edge to Edge (PWE3) or E-LAN services based on Virtual Private LAN Service (VPLS).
- **Metro Ethernet solution** — Ethernet Switches are used to provide E-LAN services using Provider Backbone Bridges (PBB) technology and E-Line technology using Provider Backbone Transport (PBT).

To perform the CAPEX comparison, the same performance criteria (such as interface speeds, power and switch fabric redundancy) are used for all vendors. List pricing is used throughout in order to provide a realistic, apples-to-apples CAPEX comparison.

The comparison results

MPLS-enabled switches are typically classified as multiservice routers and as such tend to have a more costly pricing structure. Due to the number of interface types, technologies and protocols that must be supported, multiservice routers generally require more processing and memory capabilities, which tends to drive costs higher.

Nortel's Metro Ethernet switching solution, based on PBB/PBT, delivers 45 percent to 62 percent CAPEX savings as compared to the other three vendors' MPLS-based solutions, as shown in Figure 2. (Note: Some vendors have two MPLS solutions: a and b.)

Business services case study walk-through

The business case is based on Nortel's Metro Ethernet Routing Switch 8600 with PBB/PBT in the metro aggregation and core device locations. At customer locations, the Metro Ethernet Services Unit 1800/1850 is used for edge access. This is compared to three competitors' MPLS-based metro Ethernet solutions.

Step 1. Ethernet Business Service description

The Metro Ethernet Forum (MEF) has defined two basic Ethernet service types: E-Line and E-LAN (with a third, E-Tree, in development). E-Line provides basic point-to-point connectivity, shown in Figure 3 and E-LAN provides any-to-any connectivity, shown in Figure 4. The provider currently offers both of these services in the metro. The service demarcation is provided by a CPE device — specifically, a bridge for E-LAN and a router for E-Line.

Key takeaways

All of the vendor equipment in this case study enables E-Line and E-LAN services and revenues. However, only Nortel's PBB/PBT eliminates the need for expensive MPLS-based metro aggregation and core switches, thus increasing service gross margins and driving profitability. Nortel's PBB/PBT puts the provider's Metro Ethernet infrastructure on the lowest cost curve, while providing a service-oriented solution that is extremely reliable, scalable and deterministic.

Figure 2. Metro Ethernet CAPEX analysis

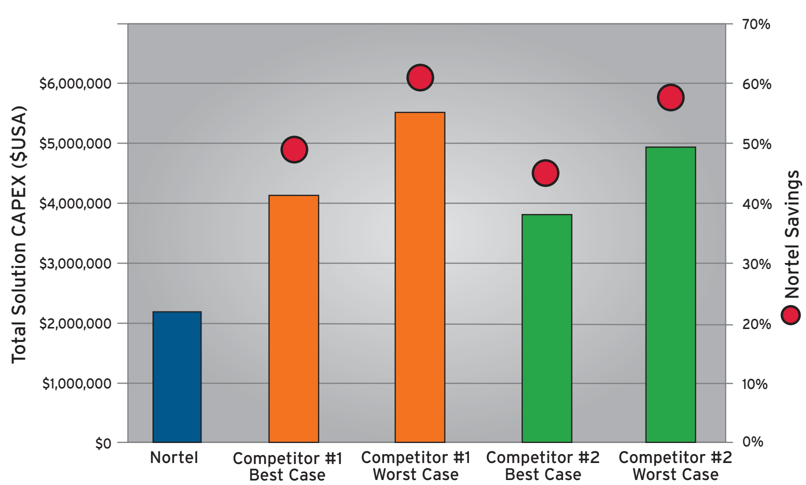


Figure 3. E-Line business service

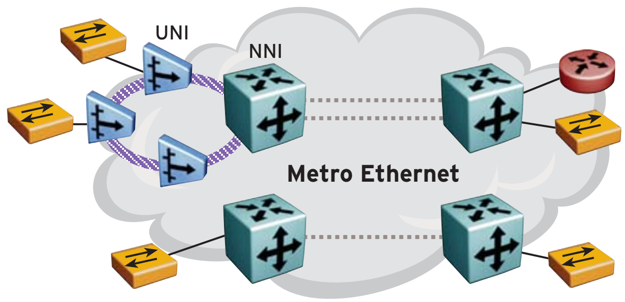
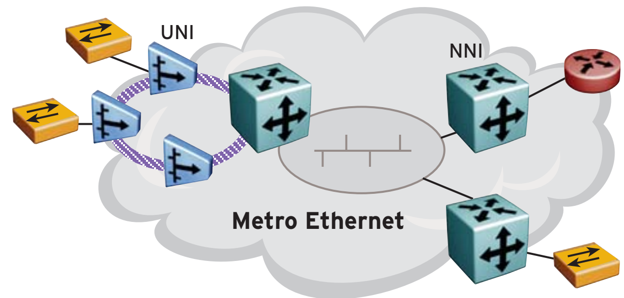


Figure 4. E-LAN business service



Step 2. Current network

The provider's existing network infrastructure for delivering the business services has a number of challenges that the new Metro Ethernet solution must address.

- **Q-in-Q:** Service scalability due to VLAN exhaust
- **Bridging for E-LAN:** MAC table explosion
- **Spanning Tree Protocol resiliency:** Unsatisfactory convergence time and bandwidth inefficiencies
- **Traffic engineering:** No bandwidth reservation capability for SLA assurance
- **Performance monitoring:** No service-based capabilities, only port and node counters

Step 3. New network solutions

The MPLS technology option, typically provided through competitors' multiservice routers, addresses several of the current network challenges, such as:

- Service scalability with Virtual Switch Instances (VSIs)
- MAC table explosion with MPLS encapsulation
- Resiliency with MPLS Fast Re-Route (FRR)
- Traffic engineering with Resource Reservation Protocol - Traffic Extension (RSVP-TE)

Performance monitoring is not solved. Additionally, costly new challenges are introduced, such as:

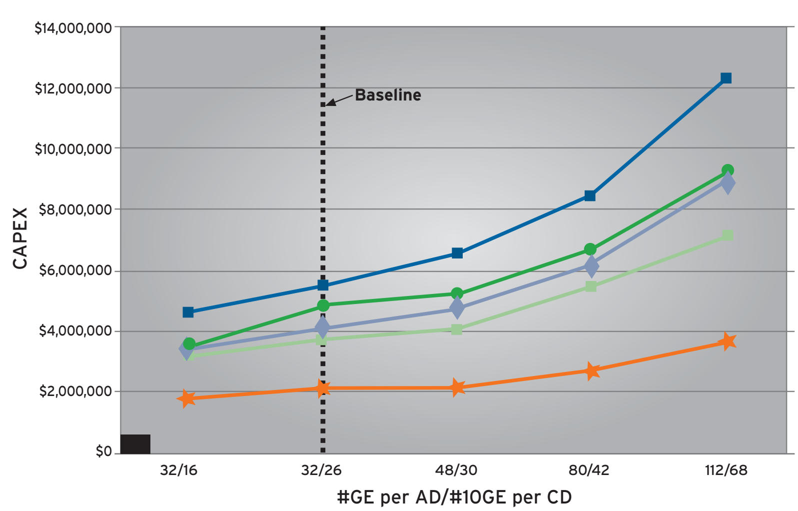
- Control plane complexity
- CAPEX costs
- OPerational EXpenditure (OPEX)
- MPLS learning curve in the metro

With MPLS, a variety of protocols (for traffic engineering and resiliency) must be supported, and must be ubiquitous throughout the metro network, adding to the control plane burden. This also means the providers' network operators must learn and understand these protocols, adding to the operations burden.

The Nortel PBB/PBT-based Metro Ethernet solution solves all the current network challenges, such as:

- Service scalability with PBB
- MAC table explosion with PBB
- Resiliency with Ethernet Linear Protection (ITU-T G.8031) for E-Line and Split Multi-Link Trunking for E-LAN
- Traffic engineering with PBT (IEEE 802.1Qay)
- Performance monitoring is provided by OAM functions and mechanisms for Ethernet-based networks (ITU-T Y.1731) and fault monitoring through Connectivity Fault Management (IEEE 802.1ag)

Figure 5. CAPEX sensitivity analysis



Step 4. Financial comparisons

The Nortel PBB/PBT-based Metro Ethernet solution delivers CAPEX savings of up to 62 percent or approximately $3.5M per metro for this case study. Sensitivity analysis on the service demand (varying the number of GigE and 10GigE ports) resulted in equally favorable results for the Nortel solution, as illustrated in Figure 5. As the bandwidth in the metro increases over time, so do the savings generated by Nortel's solution, versus the competitors' solutions.

Technology insight

Provider Bridges, also called Stacked VLANs or Q-in-Q and standardized as IEEE 802.1ad, will enable a service provider to offer the equivalent of separate LAN segments to a number of users over the provider's bridged network. Provider Backbone Bridges (PBB), also called Mac-in-Mac and currently being standardized as IEEE 802.1ah, is a new standard that brings massive service scalability to Ethernet, by solving the VLAN exhaust/coordination and MAC explosion issues, enabling IPTV and business service deployments to large customer bases. Provider Backbone Transport (PBT) is a new technology that Nortel has developed that transforms traditionally connectionless Ethernet, typically restricted to small-scale, local networks, into a more reliable, scalable and deterministic technology with connection management characteristics, making it ideal for IPTV and business services. PBT is currently being standardized as IEEE 802.1Qay Provider Backbone Bridges-Traffic Engineering (PBB-TE).

Conclusion

For a provider offering Metro Ethernet business services, Nortel's Metro Ethernet Routing Switch 8600 with PBB/PBT and Metro Ethernet Services Unit 1800/1850 provides a robust Metro Ethernet infrastructure complete with service scalability, resiliency, traffic engineering and performance monitoring. These technology characteristics continue to drive ongoing operational savings.

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