



Building a Next Generation Carrier Ethernet transport Layer with PBB-TE

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IEEE GCC Conference November 2007

BUSINESS MADE SIMPLE



Networks today ...



TODAY

Layer 3 - IP

Layer 2.5 – MPLS

Layer 2 – Ethernet, ATM/FR

Layer 1.5 – GFP, LCAS, VCAT

Layer 1 – SDH

Layer 0 – Wavelength

Carrier request

The Nortel Network Vision

Business made simple



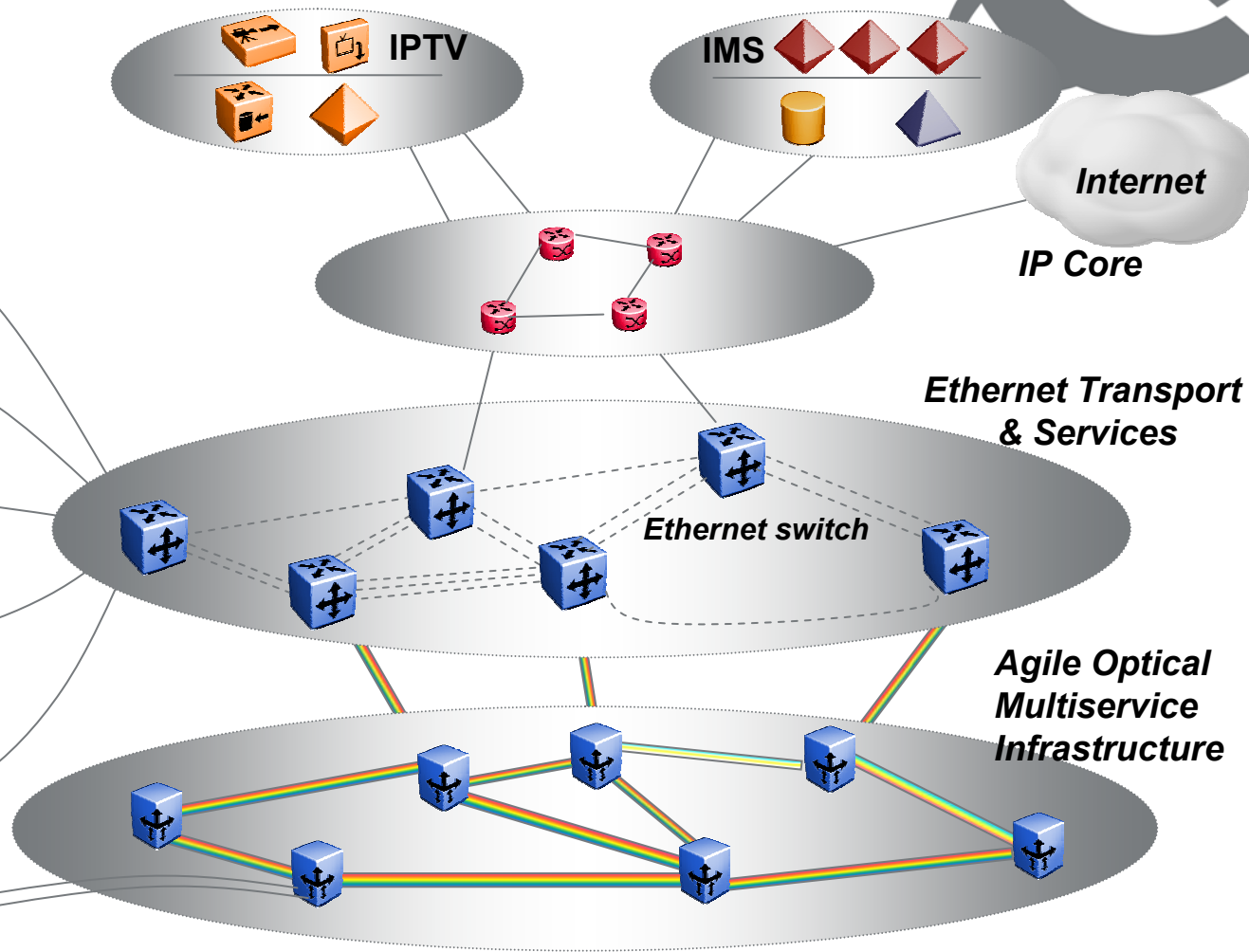
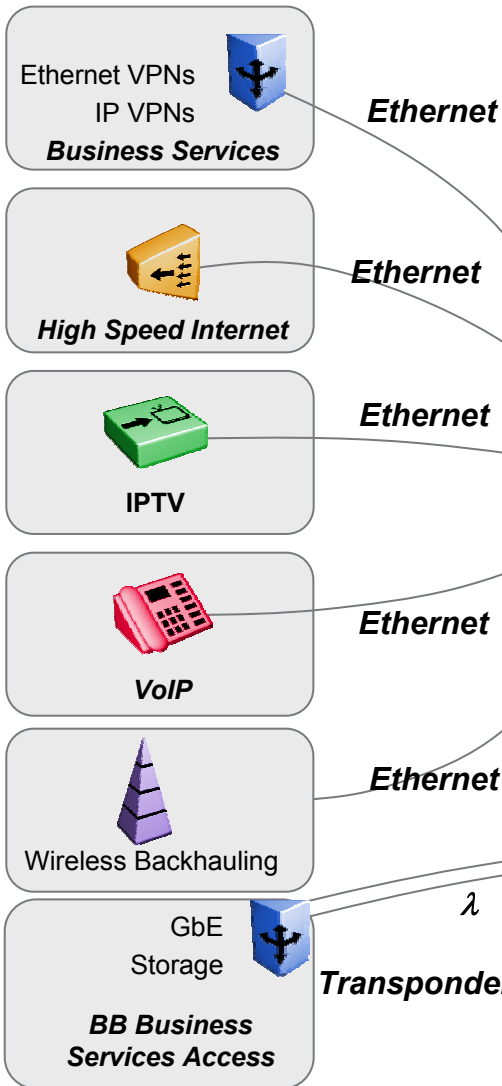
Layer 3 – IP/MPLS

Layer 2 – Ethernet – PBB/PBB-TE

Layer 0 – Wavelength

An application view

Converged Network Services





Nortel's Strategy

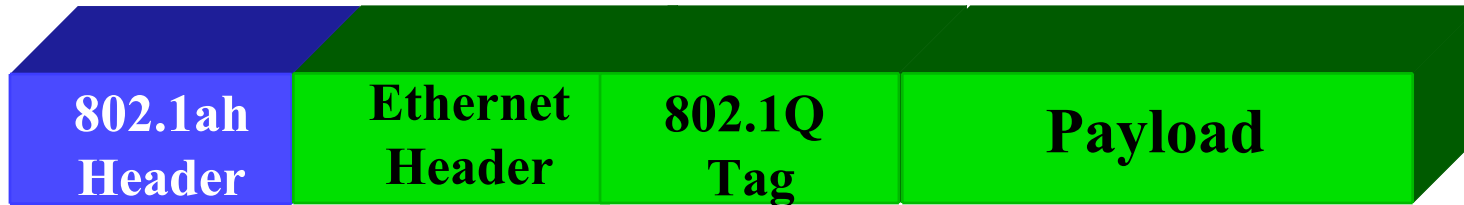
- Ethernet switches are the telecommunications infrastructure with the lowest cost point
- We can re-purpose these switches with new control software to meet carrier needs
- This can be done with minimal changes to Ethernet standards and those changes are in progress
- This can be done while preserving investment in service provisioning

Keep Ethernet simple, flexible and cost effective

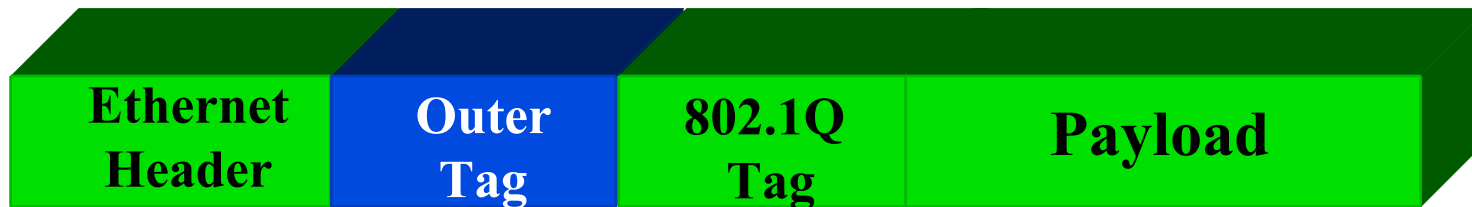


IEEE 802.1ah Encapsulation

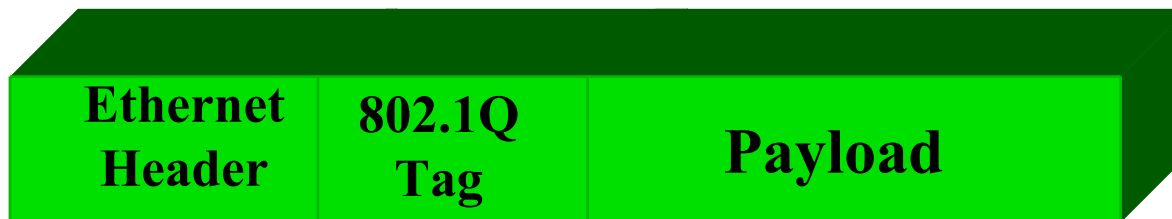
Provider Backbone Bridging



3. Customer frame is transparently tunneled from UNI to UNI



2. Service Provider Q tag identifies customer

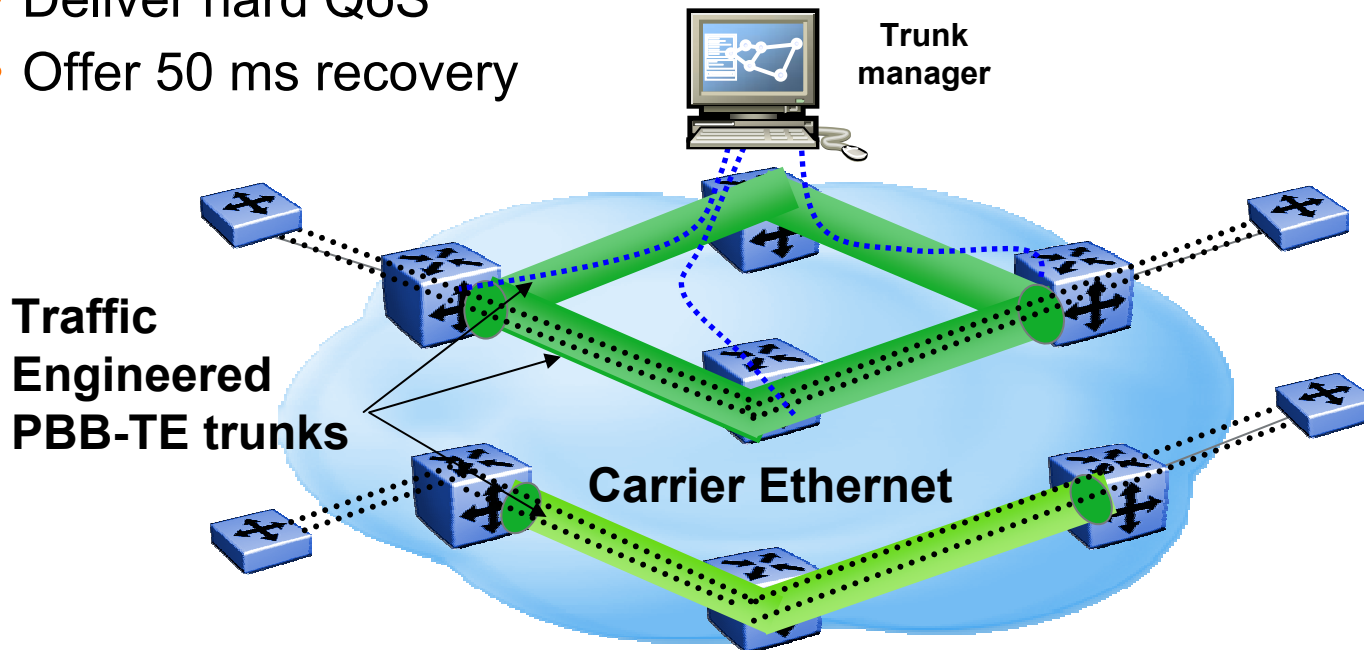


1. Q tag identifies VLAN

Provider Backbone Bridging - Traffic Engineering (IEEE 802.1Qay PBB-TE, aka PBT)



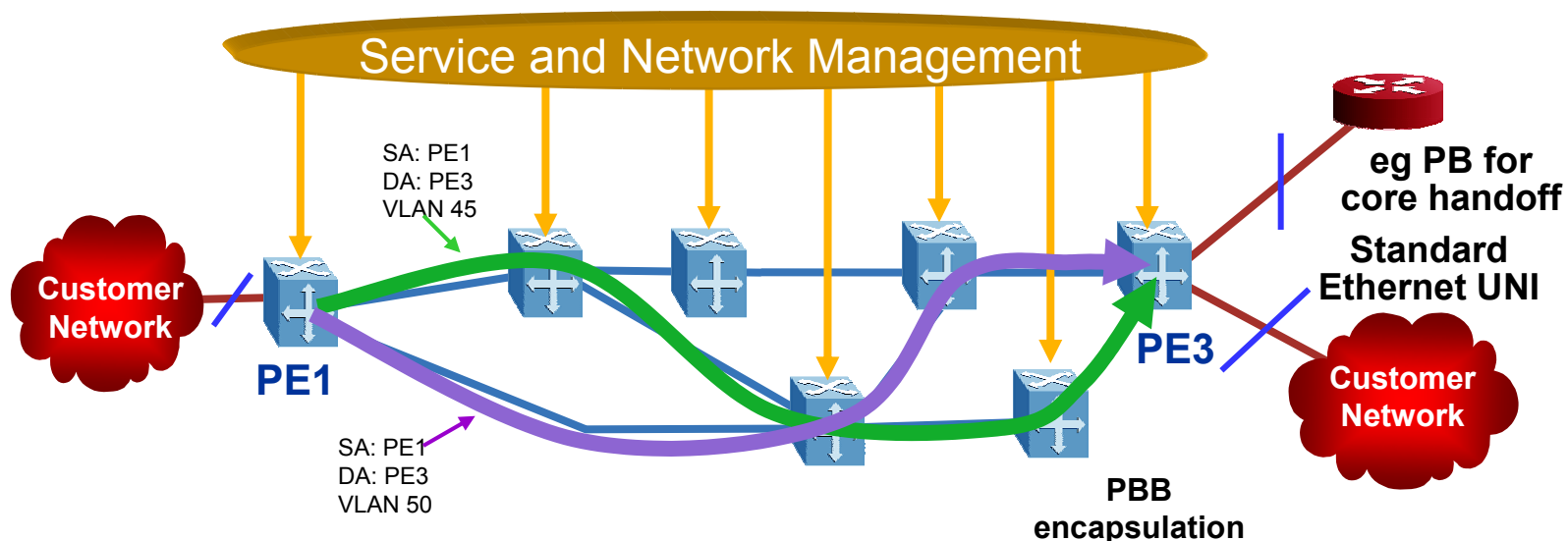
- A simple point-to-point Ethernet tunneling technology
 - Reserve bandwidth
 - Deliver hard QoS
 - Offer 50 ms recovery



Provides “SDH like” guaranteed performance & SLAs

PBB-TE Innovation Model

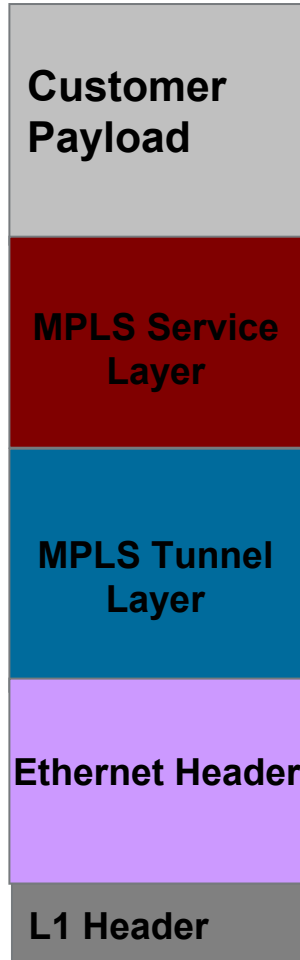
- Turn off MAC learning, Broadcast Unknown and STP
 - Use PBB hierarchy to separate customers from the carrier network
- Carrier-grade Management system sets up connections, populating switch bridging tables
- B-DA MAC + VLAN identifies uniquely the PBB-TE circuit
- Primary and secondary paths are monitored by IEEE 802.1ag CCMs (Connectivity Check Messages)



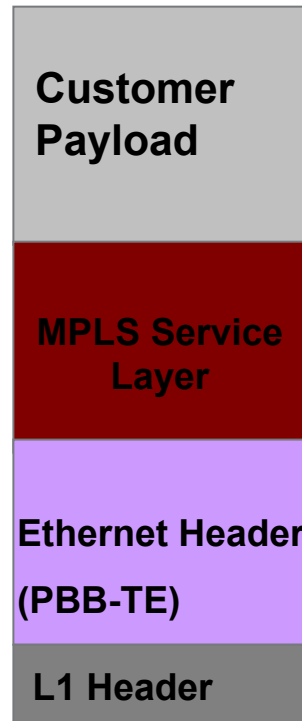
PBB-TE and MPLS Co-existence



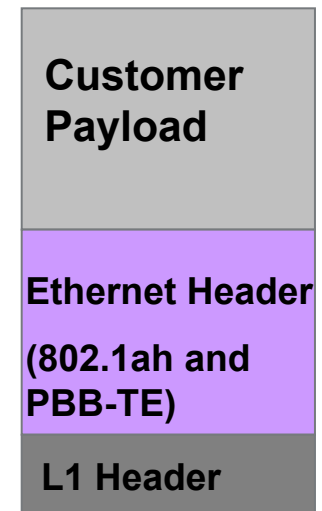
Core Only



✓ MPLS Services



✓ Ethernet Services





Ethernet OAM

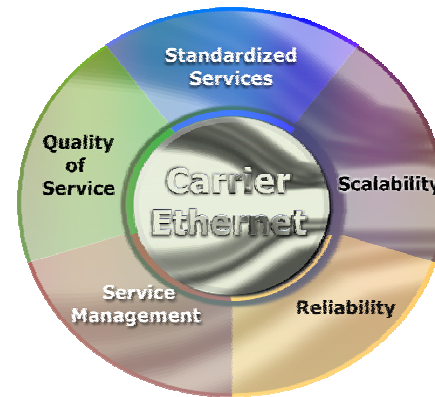
- **802.1ag gives:**
 - Rapid notification of end-to-end connectivity failure.
 - Where is broken link?
 - MTU/priority-related faults→ Faults found & fixed quicker & more easily.
- **Y.1731 measures:**
 - Frame delay, delay variation, frame loss
 - AIS→ Diagnostics/monitoring to support premium high-QoS services
- **Resiliency and Protection switching (ITU G.8031)**
 - Provides 50ms protection switching
- **802.1ab Autodiscovery**

**“SDH Like” simple operational paradigm -
Functionality is on the box, EMS/NMS not involved**

The End Result



- Scalability
 - PBB supports 16 million services
- Reliability
 - PBB-TE provisions backup trunks
 - Ethernet OAM detects fault condition
- Hard QoS
 - Pre-determined paths guarantee service performance
- Service management
 - Fault management – IEEE 802.1ag
 - Performance monitoring – ITU-T Y.1731
- TDM support
 - Native Ethernet connectivity provides low latency for real-time applications (voice, video etc)

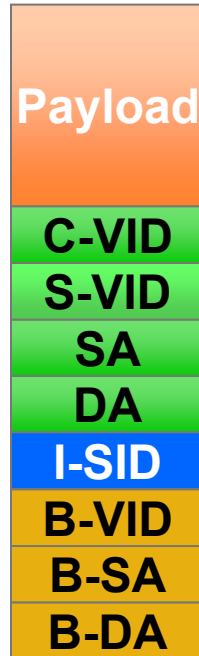


PBB, PBB-TE and OAM makes Ethernet carrier-grade

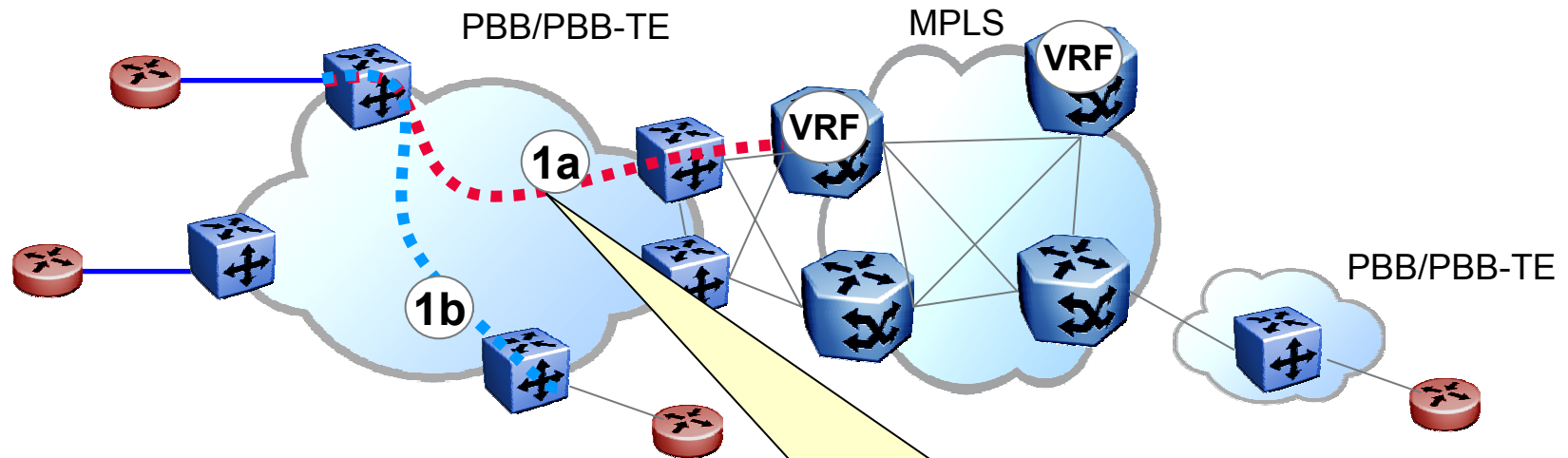


PBB-TE Benefits

- PBB-TE may be a new name but it's just Ethernet
- Reuses existing Ethernet header and hardware
 - Capital expenditure savings 42-65%
- Self identifying frame leads to easier fault management
- Comprehensive PMs allow simple to manage SLAs
- Carrier Ethernet re-uses existing transport skill set
- Fewer protocols require lab testing
- Total operational expenditure savings of up to 32%



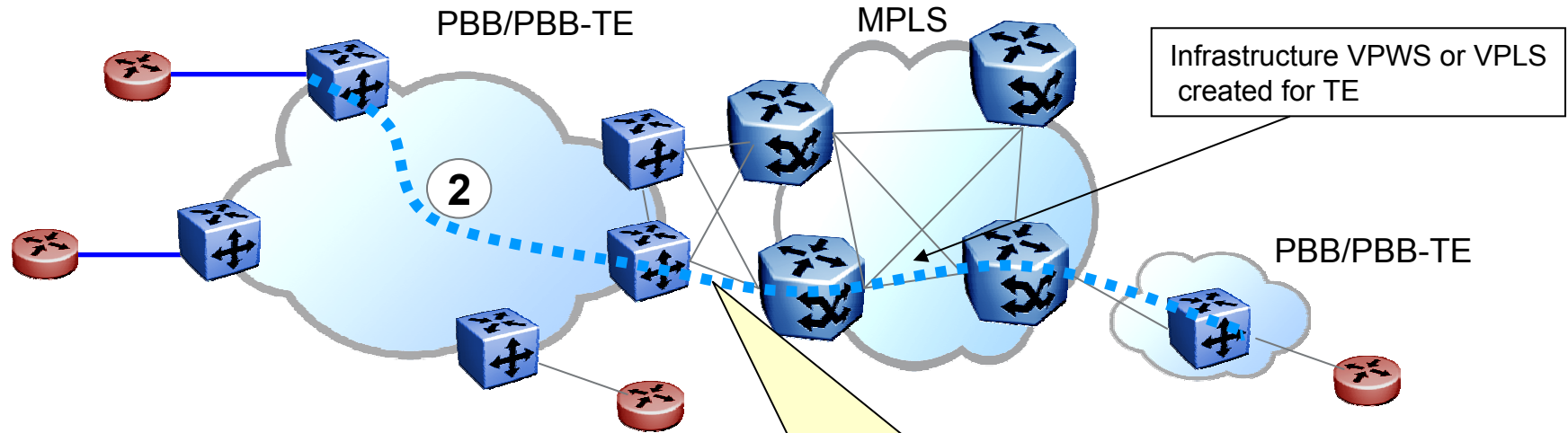
Business Services



1. Metro PBB-TE Service
 - a) backhaul to L3 VPN
 - b) Business ELINE service

- Point-to-point
- Guaranteed service
- Protection
- MEF accredited

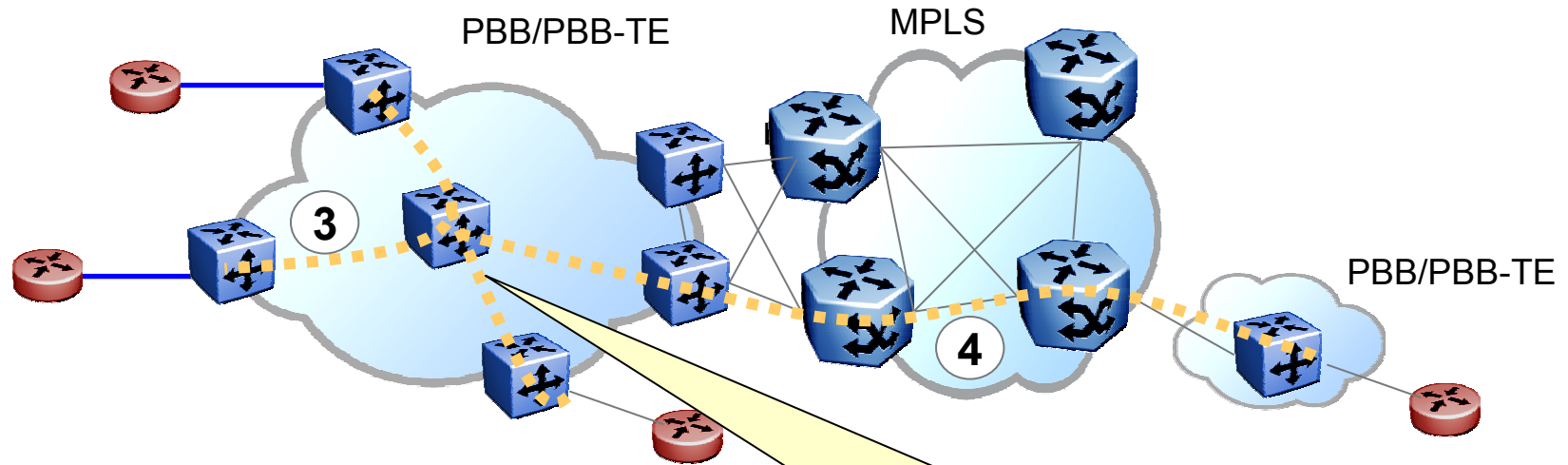
Business Services



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2. Inter-Metro PBB-TE service

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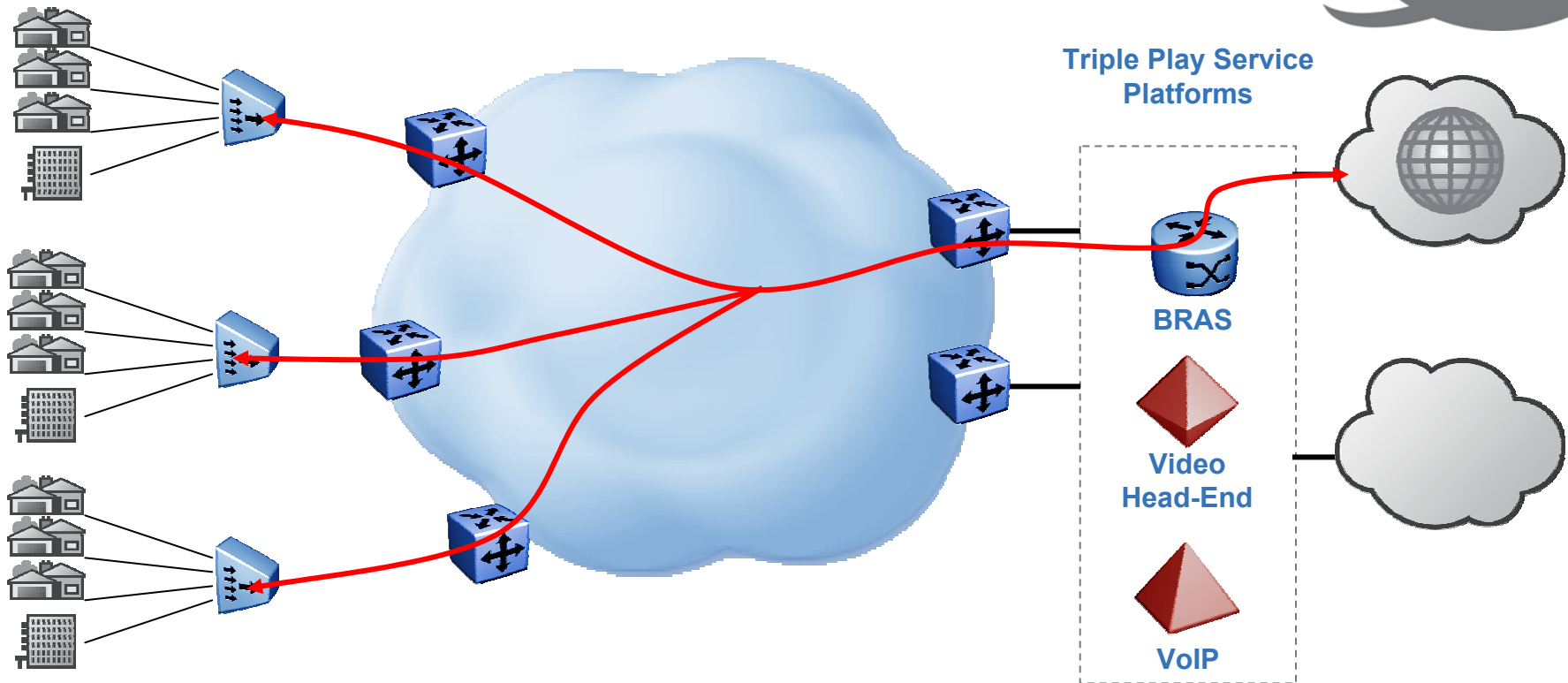
Business Services



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2. Inter-Metro PBB-TE service
3. Metro & Inter-Metro PBB Service

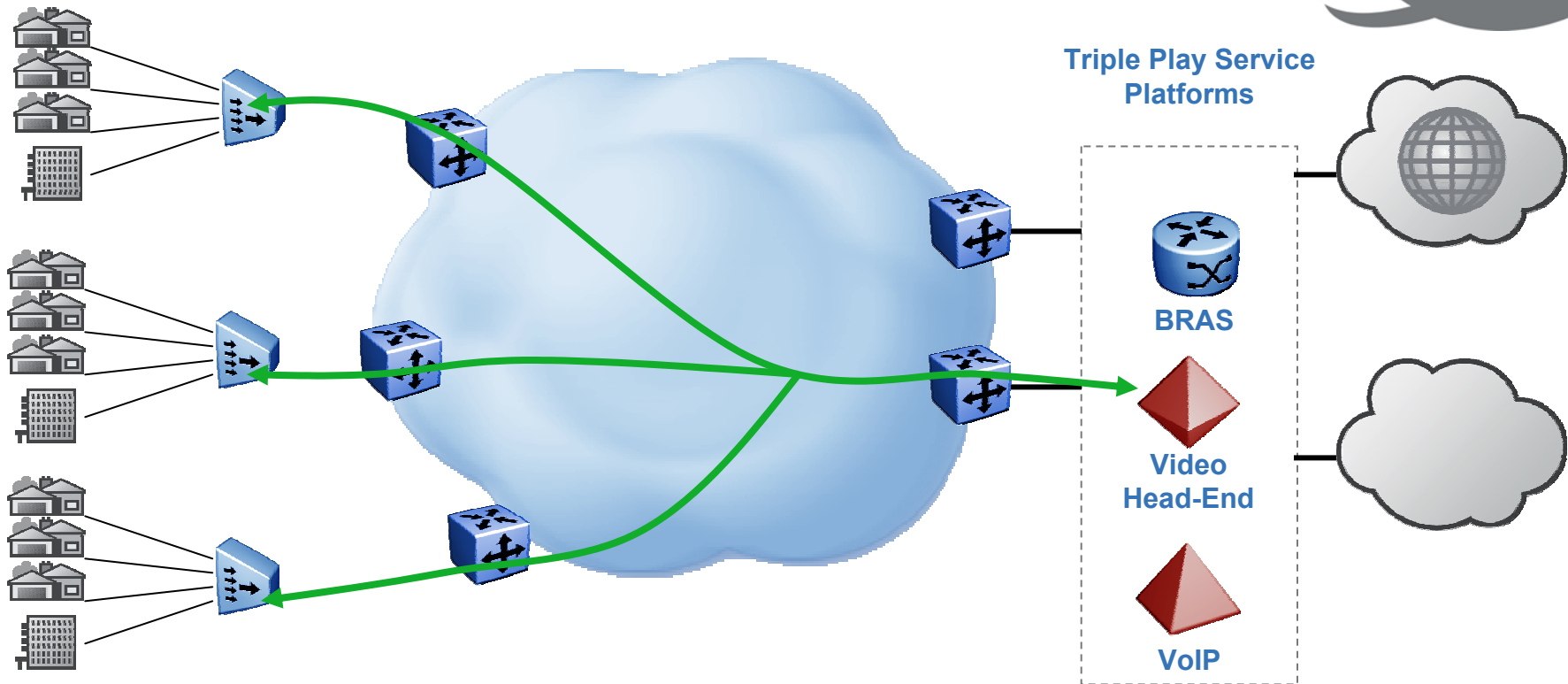
- Hub and Spoke or Any-to-Any
- Simple, easy to provision
- MEF accredited

Residential Services - Internet Access



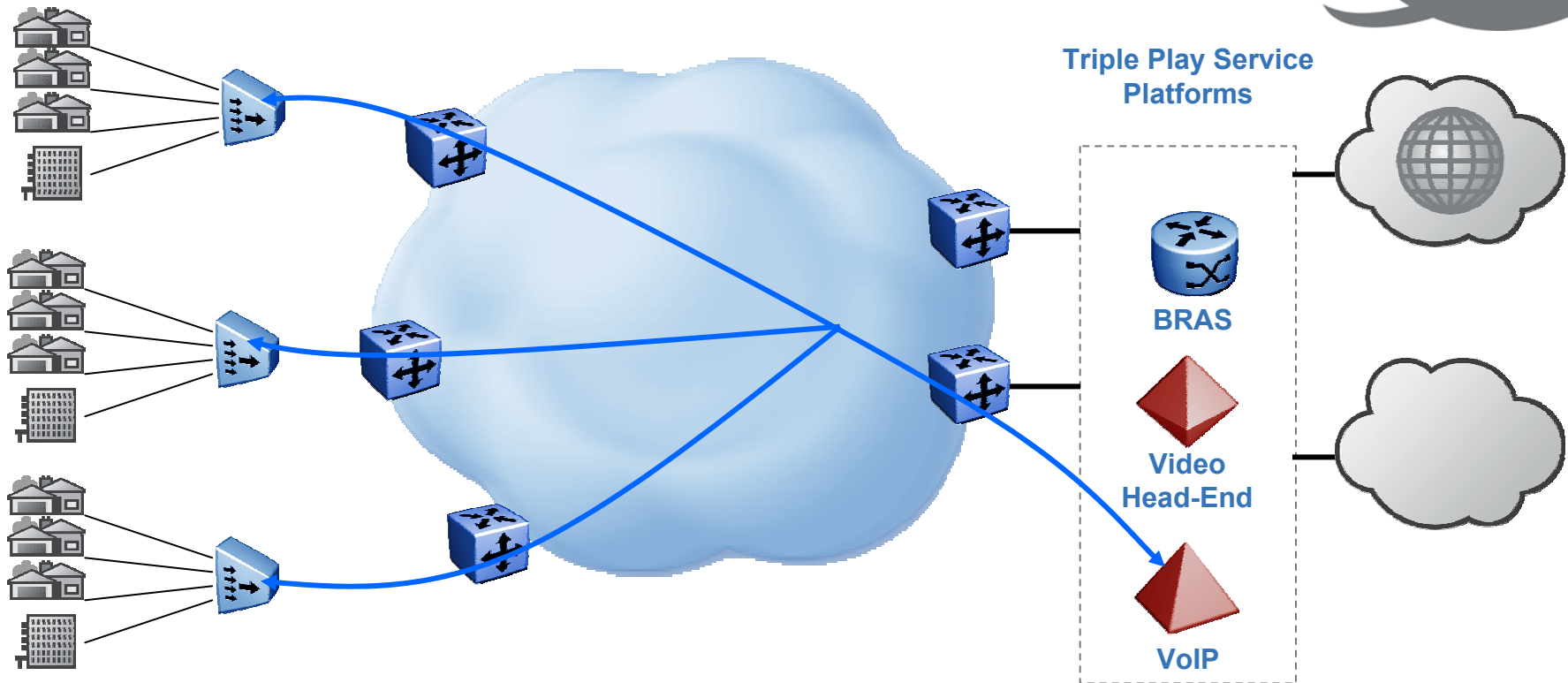
- E-TREE between access device and BRAS
- BRAS aggregates and manages individual services
- E-LINE can provide dedicated access
- Ethernet offers cost-effective transport

Residential Services - Broadcast Video



- E-TREE between access device and video head end
- Layer 2 multicast efficiently delivers broadcast video
- IGMP snooping selectively delivers content
- VLANs support video on the same interface as internet access

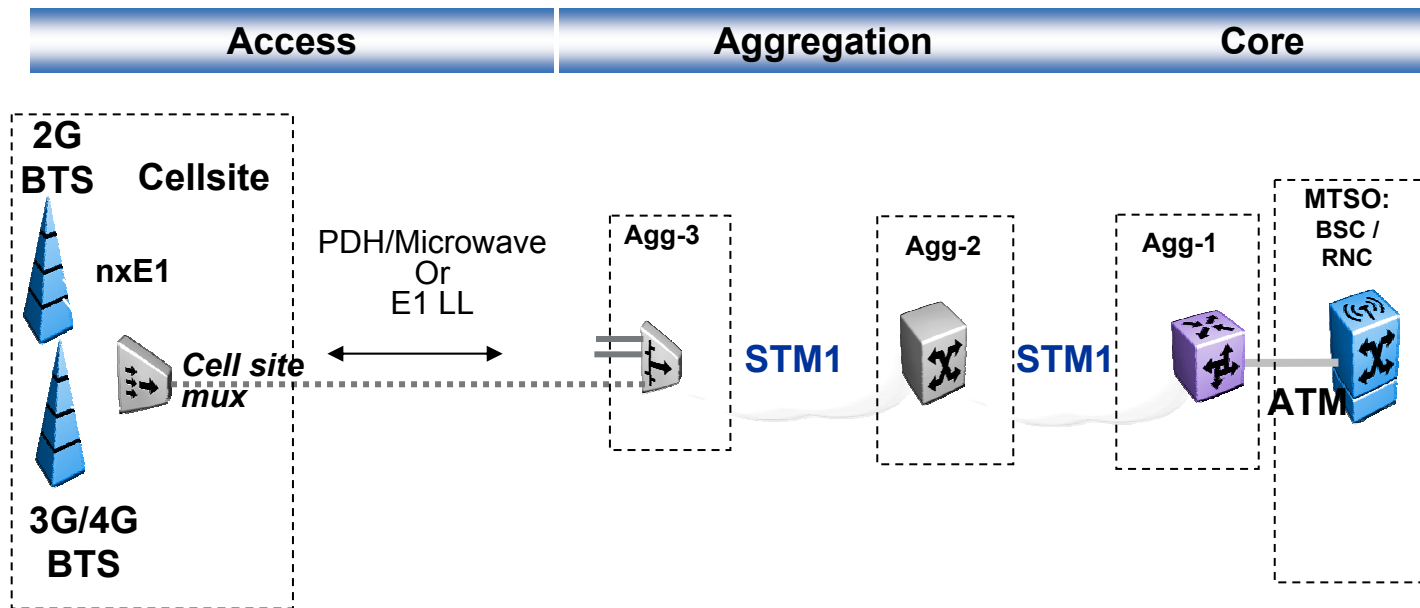
Residential Services - VoIP



- E-TREE between Access Device and Call Server
- Ethernet transport supports low jitter and latency for voice traffic

Mobile Backhaul

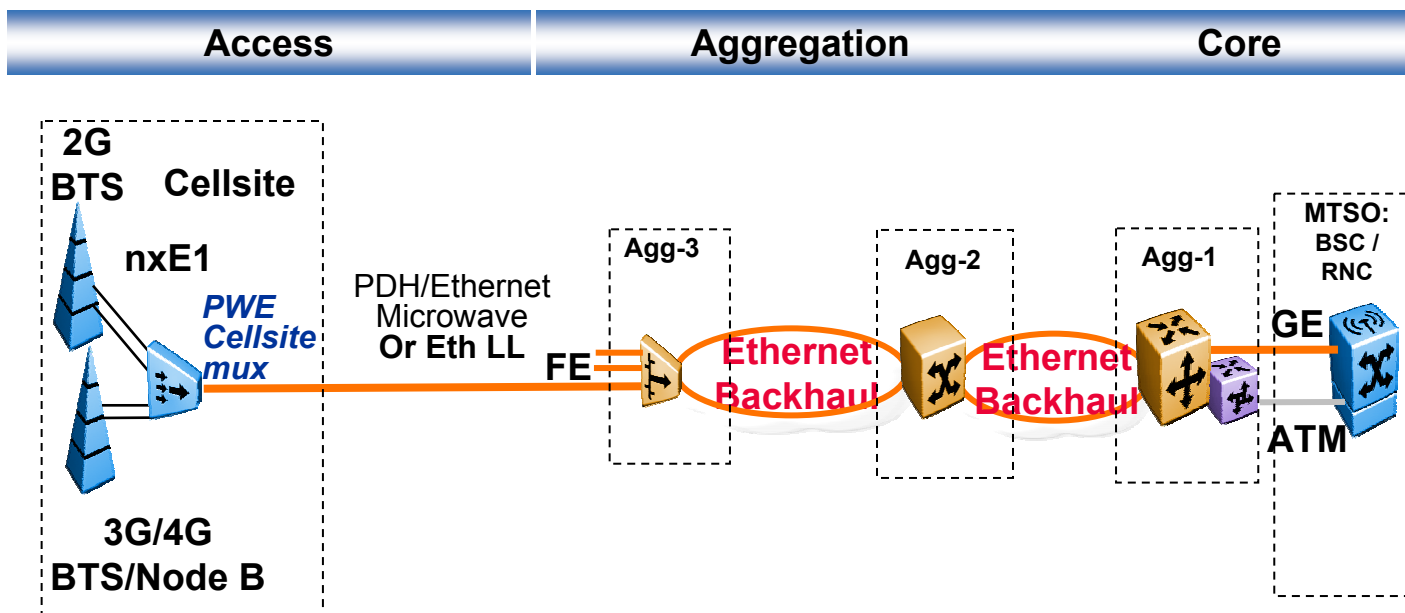
Present mode of operation



- Backhaul is TDM & ATM over E1/STM-1
- Today wireless providers tend to own the aggregation equipment
- Fixed carriers provide the leased line interconnect

Mobile Backhaul

Ethernet Access and Backhaul



- Carrier Ethernet for more efficient lower cost model
- PWE supports legacy 2G/3G services
- Ethernet provides common infrastructure for voice and data
- 4G Ready



Synchronization for Ethernet

Two Industry trends

- Layer 2 Timestamp-based (Data Layer)
 - Layer 1 agnostic - works over microwave, DSL, PON
 - Performance dependent on packet network impairments (jitter, loss, etc.)
 - PBB-TE provides guaranteed bandwidth and deterministic performance in conjunction with end-to-end timing protocol (IEEE1588)
- Layer 1 Synchronous Ethernet (Physical Layer)
 - Synchronize the bit stream of Ethernet physical layer
 - SDH/SONET performance equivalent
 - Concept exists & standardized in ITU G.8261

Both techniques will co-exist



Standards Summary



- IEEE 802.1AB Discovery
 - Published April 2005
- IEEE 802.1ad Provider Bridges
 - Published December 2005
- IEEE 802.1ag Connectivity Fault Management
 - Sponsors ballot passed
- IEEE 802.1ah Provider Backbone Bridges
 - Working group ballot passed
- IEEE 802.1Qay PBB –Traffic Engineering
 - PAR approved

PBB-TE is based on existing standards

Carrier Ethernet Ecosystem Partners





Summary

- PBB, PBB-TE and OAM are the building blocks of a Carrier Ethernet transport model that....
 - Keeps Ethernet simple and cost effective
 - Delivers a full set of applications
 - Has strong industry support through the Carrier Ethernet ecosystem
 - Has publicly announced customers, BT, Shanghai Telecom, Frontier, Dakota Carrier Network
 - Making good progress in relevant standards bodies