Provider Backbone Transport

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Agenda


> PBT Overview & Value Proposition

> Services supported with PBT

> Connection management with Protection using OAM (802.1 ag)

> Managing & Control Planes

> What Would the IEEE Need To Do to Support PBT
What is Provider Backbone Transport (PBT)?

> PBB provides customer-carrier isolation (encapsulation), mpt, pt-mpt, and pt-pt services based on B-VLAN tunnels routed by MSTP, and defines a management domain.

> PBT is a feature added to a PBBN supporting engineered pt-pt trunks. These trunks are used in place of B-VLANs to carry pt-pt, pt-mpt, or mpt services.
  • Removes constraint of following MSTP topology for path engineering
  • Provides bandwidth management allowing traffic engineering over path
  • Any number of 802.1ah services may be carried over a PBT trunk.

> Both PBB and PBT use 802.1Q MAC address based relays.

> Leverage Emerging standards for:
  • Provider Isolation – PBB (802.1ah)
  • OAM & Protection(802.1ag & ITU-T Y.1731/G.8031)
  • PWE Carriage (IETF Dry Martini)
  • Management system or GMPLS for provisioning
  • PBT is currently on the living list at ITU-T SG15 PBT architecture description G.pbt
PBT Values

- **Traffic Engineering**
  - Control of routing
  - Admission control / policing

- **Connectivity monitoring (IEEE 802.1ag)**
  - Strong service management when coupled with Traffic Engineering & Service Assurance

- **Stronger resiliency and Protection (w/ ITU-T Y.1731 / G.8031)**
  - Eliminates Spanning Tree for tunnels

- **Easier management fit with auto-discovery (w/ IEEE 802.1AB)**
  - Fits with current transport operational model

- **Clear profit/business case for any given service**
  - Can map a service to its path & resources

- **Simply Scalable**

- **Reuses existing hardware and standards**
  - Maximizes the potential of today’s ethernet forwarding hardware
  - Many IVL switches require only software changes to support PBT!
    - 12-bit VLAN/Route Discriminator & 48 bit global address

Delivers a lowest cost, dependable, easy-to-manage infrastructure
PBT MAC Forwarding

> PBT frames are forwarded based on B-DA MAC + B-VID using 802.1Q bridge relays just like normal bridge frames.
> The B-DA determines the BEB destination as normal.
> The B-VID determines the route tree for this B-DA MAC.
  • No VLANs exist in the PBT domain.
  • This is the key conceptual difference. The B-VID does not determine a VLAN, instead B-VIDs select a path for a destination.
  • The conceptual change does not change the operation of a 802.1Q relay. It is just conceptual!
> Each B-VID is reused for path selection for each B-DA. The total number of B-VIDs required is the number of independent paths needed to each destination.
> Things which are different than a standard 802.1Q ports and relay.
  • PBT must have control of a PBT B-VID address space and the port state for this B-VID address space.
  • PBT ports must start up with learning off and forwarding on.
  • Unknown or broadcast frames received at any PBT port must be discarded, not flooded.
> The PBT relay scales just as the Ethernet relay. It is possible to have 70 trillion destinations each with as many as 4094 paths.
  • Each relay carries a filtering table only as large as the number of PBT trunks passing through its relay.
PBT Control and Management

> So we split the B-VIDs, turn off MAC learning, Broadcast Unknown, and STP
  • Use PBB hierarchy to separate customers from the Provider network, and add
    hierarchical dataplane OAM for instrumentation and protection.

> Place under a Comprehensive Management system
  • Use a base spanning tree to control switches using SNMP
  • Management build complete topology model using auto-discovery base on 802.1AC

> Management sets up connections, populating switch bridging tables:
  • The VLAN tag is no longer a network global : scaling issues are removed;
  • VLAN tags now used to set up per destination alternate paths
  • A range of VLANs can be used for bridging and another range for PBT

> Optional evolution to GMPLS signalling
Dataplane Example

Note that MACs and VIDs can overlap, it is the combination of both that is unique and allows diverse routing.
QoS and Resiliency

> Bandwidth can be reserved for the tunnel at each end point
  • The management system (or external control plane) does bandwidth allocation for the PBT trunk and each service over the trunk.
  • The bridges just forward frames they do not need any additions

> Ethernet VLAN “p” bits for differentiated services
  • One tunnel can provide per packet CoS
  • Can also support per packet pre-emption for resiliency

> Backup Trunks can be pre-provisioned for redundancy
  • Defined in G.8031 (Ethernet PS coordination) - *ITU SG15/Q9*
  • Ethernet CFM provides fault notification in millisecond time frames
  • Synchronizes PS state at both ends of a path
  • PS type (1+1, 1:1, etc.)
  • Administrative state (what is working, manual switch etc.)
  • Administrative control (force switch, revertive/non-revertive etc.)
  • Primary utility for maintenance operations
PBT OAM Key Principles

> PBT can reuse all the Ethernet OAM initiatives in the IEEE and ITU
  • Fault detection and notification (IEEE 802.1ag)
    > CFM hierarchy (IEEE 802.1ag)
    • Service Monitoring and performance (ITU-T Y.1731)
    • Resiliency and Protection switching (ITU-T G.8031)
    • Link layer discovery (IEEE 802.1AB)

> Each PBT packet is self identifying
  • Where did it originated (SA MAC)
  • Where is it going (DA MAC)
  • Which maintenance level is it (CFM)
  • What action/functionality does this frame represent.

> No need to involve an unreliable control plane
  • MPLS OAM relies on control plane
    • Determinism? Scalability?
1. **Performance of Service**
   a) **Frame Loss Ratio (FLR)** parameter is the number of service frames marked green on a per \{VID, Pbits, CoS\} basis that are delivered by the Provider network versus the total sent.
   b) **Frame Delay (FD)** Measurement of round trip frame delay by utilizing the OAM frames as defined in ITU-T Y.1731
   c) **Frame Delay Variation (FDV-Jitter)** Measurement of delay using time stamps of consecutive OAM frames.

2. **Availability of Service**
   a) AoS is currently defined in Y.1731 as the amount of time that the PoS (i.e., FLR, FD, FDV for a given service) is satisfied versus the overall period of time in service.

3. **Utilization of Service**
   a) UoS is a proposed parameter derived from the OUTOCTETS count on a per \{VID, P bits, CoS\} basis. The counter is read periodically (e.g., every second) and binned to some intermediate value (e.g., 1 minute), when an average utilization metric can be calculated
   b) Usage: Tracks bandwidth usage over time, fault detection,

*Items in ORANGE are not available in MPLS OAM*
What Would IEEE Specify?

> Add to or amend 802.1ah

> Things which are required for PBT relay:
  • 1)Must provide a method for splitting B-VID address space between different topology protocols
  • 2)Must provide PBT states which force the port PBT port state to learning off and forwarding on
  • 3)Must provide a feature to disable broadcast and unknown forwarding

> Not required for PBT, but would be nice:
  • Provide 802.1ag features for CC, LB, and LT (derived from Y.1731)
    • All CFM frames delivered over PBT must be unicast B-DA
    • For responses frames must a PBT TLV with the reverse B-VID
  • Provide IEEE protection switching features (derived from G.8031)
Proposal For PBT Support

> Define a special MSTID called the PBTID (use 0xFFE) which identifies PBT rather than a MSTI.
  • An MSTIDs not in the MSTI list indicates some protocol other than MSTP that may run in parallel to MSTP (12.12.1 and 8.6.2)

> Allow the FID to MSTID Allocation Table (12.12.2) to allocate a FID to the PBTID. (i.e. FID=0xFFE to PBTID=0xFFE)

> Allow the MST Configuration Table (12.12.3) to allocate VIDs to the PBTID.
  • The PBTID code of 0xFFE in the MST Configuration Table means “this B-VID is not allocated to an MSTI and is available to PBT for use as a route selector“.

> All VIDs allocated to PBT have a port state at each bridge port who’s state is forced to forwarding=on and learning=off (change 8.4)

> For any frame who’s VID is allocated to PBT(in the PBT FID) and who’s B-DA has no static entry in the filtering database the frame will be discarded. (change to 8.10.8 table 8-5)

> Informative Annex explaining the use of PBT