Bridge Port Extension using PBB-TE

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Comparison between E-TAG and PBB-TE Port Extenders

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1) Since E-Paths are uni-directional it is not possible to have CN on E-Paths.
Extended Bridge built from BEBs

- The EVB Controlling Bridge is composed of a BEB with a B-component and a T-component per VIP coupled to the primary C-VLAN aware component (or S-VLAN aware component)
  - Each Cascade Port is just an exterior facing PNP of the BEB
  - The VIP’s of the CB-BEB are modified to form the B-DA and B-SA based on information passed from the C-Component
- A Port Extender is a BEB composed of a primary B-component and a T-component per EP
  - The VIPs of the Port Extender BEBs use standard T-Components
  - An optional 2-Port C-Comp on each leaf Extended Port is used for C-TAG manipulations
The Port Extender components of the Controlling Bridge along with the external Port Extenders make a complete PBBN which can support PBB-TE forwarding.
What is the same as PBB/PBB-TE?

• Just an application of PBB-TE with a limited topology and component organization, therefore the Controlling Bridge and Port Extender can be PBB/PBB-TE, with Extended Bridge feature additions.
  - Each leaf EP is connected to a CB-BEB VIP with a point-to-point TESI
  - Each UP is connected to a CB-BEB VIP with a point-to-point TESI
  - Each “replication group” or EP set is connected from a CB-BEB VIP with a point-to-multipoint ESP

• The Controlling Bridge’s primary component is modified as in 802.1Qbh

• The Port Extenders forward along configured TESIs
  - Each EP is attached to single VIP and PIP on a T-Comp
  - The PIP associated with an EP is identified by a unique B-MAC, which may be constructed using the E-PID
What is different from PBB/PBB-TE?

- The forwarding state for the CB-BEB and Port Extenders is configured using the Port Extender Control and Status Protocol.
- The C-VLAN component relay issues one request primitive for each frame to be forwarded via the PE:
  - The connection_identifier parameter carries a port map indicating the ports associated with EPs to which the frame should be forwarded.
  - If the related indication primitive was received from the PE, the request primitive is sent on the port from which the indication was received.
  - If the related indication was not received from the PE, the request is sent on one of the ports indicated in the connection_identifier.
- The CB-BEB PIPs assign B-MAC addresses selecting the ESP for each primitive according to modified rules for Port Extension:
  - For “remote replication groups” the PIP selects a B-DA (E-PID) identifying a point-to-multipoint TESI (as currently in Qbh).
  - If the PIP’s corresponding EP is not in the connection_identifier port map, the frame is marked for echo cancellation.
- Echo cancellation is performed at the PIP associated with an EP, whenever the B-SA is equal to the corresponding root EP’s CB-BEB echo cancellation B-MAC:
  - Subclause paragraph 6.10.1f) is extended to provide a parameter for the B-SA which is cancelled. This parameter is set to the associated root EP.
802.1Qbh/BR Leverage

• Port Extender Control and Status Protocol from 802.1BR with perhaps some modest changes in the E-PID field definitions

• The managed object extensions for the Controlling Bridge MIB

• The PE LLDP extension TLVs for the Controlling Bridge and Port Extender
PBB Encoding Transform from E-TAG

- The Ingress PE Port is identified by the B-SA rather than an Ingress_E-PID, while the PE Destination (group or unicast) is identified by the B-DA rather than an E-PID.
- The E-PCP and E-DEI are carried in I-PCP, I-DEI.
- The I-SID is not used for a PE application.
No new relays, components, ports, or tags
Yellow indicates subclauses requiring feature additions, other subclauses are unmodified
Port Extender Baggy Pants Diagram

- Unmodified components form the PE relay
- One “real” filtering database at the B-Comp
- The optional 2-Port C-component allows C-tagging/untagging
- The control plane is replaced with the PE CSP
Extended Bridge component peering

- VIPs in T-Components terminate Backbone Service Instance over Port Extender network
- C-Components in Controlling Bridge and Port Extender terminate port extensions
• All the VIPs of a connected PE “tree” are members of the same Backbone Service Instance (BSI) and therefore use the same I-SID value.
• In the example above we have two PE “trees” and each with a different I-SID value indicated by the _yellow_ and _pink_ marks.
• Note that a VIP for BSI termination exists above the Uplink Port LLC layer.
Extended Bridge TESIs
Traffic Engineered Service Instances

- Tan lines in the diagram show the attachments of point-to-point TESIs
  - One pt-pt TESI couples a Root EP’s VIP to the Uplink Port’s LLC on each Port Extender
- Purple lines indicate the attachments of pt-mpt TESIs within the Port Extender “trees”
  - Though a single pt-mpt TESI attaching a Root EP’s VIP to all Leaf EPs VIPs of the PE “tree” is shown, additional pt-mpt TESIs attaching to limited groups of Leaf EPs are possible
Port Extension B-VIDs

Path Selection

• Without redundant links the Port Extender can use a single default B-VID

• By using multiple B-VIDs to engineer alternate ESPs it would be possible to support extended features
  – The B-VID can be used to enhance the Port Extenders with protection support
  – The B-VID can be used to enhance the Port Extenders with multi-pathing support
Frame forwarding from Leaf EP

- Before frame transmission the PIP of the T-component is programmed using PE CSP with:
  - It’s SA as a leaf EP address constructed from the E-PID
  - It’s Default Backbone Destination parameter set to a root EP address constructed from the E-PID
  - The enableConnectionIdentifier parameter is set to FALSE
  - The I-SID parameter is set to default value

1. A frame is transmitted from the ES attached to an Extended Port with DA/SA/C-TAG
2. The frame is received at a leaf PE of a T-component within the Port Extender who delivers it over the VIP-ISS to the PIP. The PIP builds a frame with B-DA = root EP and B-SA = leaf EP sending it to the CBP of the B-Comp who forwards it along the TESI
3. The frame is de-encapsulated at the PIP of the T-component within the CB-BEB and delivered over the internal LAN to an internal port of the C-VLAN aware component
Frame forwarding from the root EP Individual B-DAs

Before frame transmission the PIP of the CB-BEB T-component is programmed with:
- It’s SA as a root EP address constructed from the E-PID
- It’s Default Backbone Destination parameter set to a leaf EP address constructed from the E-PID
- The I-SID parameter is set to identify the PE “Tree”

1. A frame is sent from a C-Comp Port to a root EP of the CB-BEB with DA/SA/C-TAG
2. The frame is received at a root EP of the T-component within the CB-BEB and delivered over the VIP-ISS to the PIP. The PIP builds a frame with B-DA = leaf EP and B-SA = root EP sending it to the CBP of the B-Comp who forwards it along the TESI
3. The frame is de-encapsulated at the PIP of a T-component of an EP and delivered to a LAN
Frame forwarding from the root EP
Group B-DAs no Echo Cancellation

Before frame transmission the PIP of the CB-BEB T-component is programmed:
- Is programmed as in the Individual address case
- The T-component supports passing a connection_identifier containing a destination port map
- The PIP is modified to use the connection_identifier to select a B-DA using the destination port map

1 A frame is sent from a C-Comp Port to a root EP of the CB-BEB with DA/SA/C-TAG
   - The frame was sent from outside the “replication group” and so the connection_identifier contains a destination port map
     which includes the CB-BEB PIP used to forward the frame (only a single request is sent to the “replication group”).

2 The frame is received at a root EP of the T-component within the CB-BEB and delivered to the
   PIP. The PIP builds a frame and sends it to the CBP of the B-Comp who forwards it along a TESI
   - B-DA is selected based on the connection_identifier destination port map
   - B-SA = root EP B-MAC without Echo Cancellation (since the source is outside the replication group)

3 The frame is replicated over the TESI and de-encapsulated at the PIPs of the T-components, delivered to the leaf EPs and then the attached LANs
Frame forwarding from the root EP Group B-DAs with Echo Cancellation

The PIP of the CB-BEB T-component is programmed:
- Is programmed as in the Individual address case
- The T-component supports passing a connection_identifier containing a destination port map
- The PIP is modified to use the connection_identifier to select a B-DA using the destination port map
- The PIP is modified to use the connection_identifier to select the B-SA using both the destination port map and source port
- The PIP of all Leaf EPs are modified to filter out frames matching a B-SA filter parameter (6.10f)
  - Each root EP has two B-MACs one echo cancelled and one not. The B-SA filter parameter of the each leaf EP PIP is set to the echo cancelled B-MAC of it's root EP

A frame is sent from a C-Comp Port to a root EP of the CB-BEB with DA/SA/C-TAG
- The frame was sent from within the “replication group” and so the connection_identifier contains a destination port map which excludes the CB-BEB PIP used to forward the frame (only a single request is sent to the “replication group”).

The frame is received at a root EP of the T-component within the CB-BEB and delivered to the PIP. The PIP builds a frame and sends it to the CBP of the B-Comp who forwards it along a TESI
- B-DA is selected based on the connection_identifier destination port map
- B-SA = root EP B-MAC with Echo Cancellation of the source port from the connection_identifier (should be this root EP port)

The frame is de-encapsulated at the PIPs of the T-components of the PEs and delivered to the LANs which are not echo cancelled.
What needs to be specified

• Move clause 8, 7.12-7.14 (PE CSP) of 802.1BR into a new 802.1Qbh clause 45 using 7.12-7.14 as part of the protocol introduction.

• Port Extender can be defined by a new conformance subclause specifying a Port Extender as a specific type of BEB and including the PE CSP

• The Controlling Bridge can be defined using the current conformance statement from 802.1Qbh replacing the PE requirements with the requirements defining a CB-BEB
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**Constructed B-MACs**

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<td></td>
<td>OUI + I</td>
<td>OUI + G</td>
</tr>
<tr>
<td>Root</td>
<td>Res(8 b)</td>
<td>Res(10 bits)</td>
</tr>
<tr>
<td>Con</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-PID</td>
<td></td>
<td>E-PID</td>
</tr>
<tr>
<td>(14 bits)</td>
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<th>1</th>
<th>4</th>
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- Globally assigned B-MACs also could be used by simply increasing the E-PID size to a full TESI address.
- Constructed individual B-MACs use the Root indicator to differentiate between the CB-PIPs and the PE-PIPs.
- Constructed addresses use the Can indicator to differentiate frames which can be echo cancelled and those which can not.
- Constructed group B-MACs could use the Backbone Service Instance Group Address OUI.
- Since the Controlling Bridge is co-ordinating the selection of E-PIDs the assignments would be locally unique.
- Since the B-MACs don’t extend beyond a single PE mesh they would never interact with a general purpose system.