802.1aq Shortest Path Bridging Recap and Status

By

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History

- 802.1aq SPB started in 2005
- 4 Draft Revisions (0.1, 0.3, 0.4, 1.0)
- Version 1.0 (Worked Clause 6, 7, 8)
- Currently working Clauses 13, 27, 28 (merging 28&29)
- Draft 1.1 currently with the editors
- Clause 13, Clause 28 (former 29)
PAR

• Original Scope was VLAN Bridges
  – Shortest Path within a region
  – Interwork with RSTP, MSTP bridges
  – Scope
    • This standard specifies shortest path bridging of unicast and multicast frames, including protocols to calculate multiple active topologies that can share learnt station location information, and support of a VLAN by multiple, per topology, VLAN identifiers (VIDs).
  – Compatibility
    • This amendment will not change the conformance of IEEE Std 802.1Q to Std 802. Overview and Architecture, or its relationship to that specification.
Applicability

IEEE 802.1aq

Shortest Path Bridging (SPB)
- Small VLAN Networks
  - 2-100 bridges
  - Plug and play
  - Efficient
  - Low delay
  - Backwards Compatible
  - E-Line, E-Tree, E-LAN Services

Shortest Path Backbone Bridging (SPBB)
- Large PBB Networks
  - 2-1000 backbone bridges
  - Carrier Grade
  - Fast convergence
  - Efficient use of resources
  - B-VLAN Partitioned Forwarding Compatible
  - Provider E-Line, E-Tree, E-LAN Services
IEEE 802.1aq

Currently Three Variants

Per VID Trees
RFPC/VID
PBB Only

Most Scalable VID and FDB
PBB Only

Original PAR
802.1Q capable

CST, RPF VID

SPB SPVIDs
(Learning Optional No Learning)

SPBB SPVIDs

PBB No Learning

Base VID

SPBB Single VID

Original PAR
802.1Q capable

Most Scalable VID and FDB
PBB Only

Currently Three Variants
Link State and Spanning Tree

- Link State brings advantages by capitalizing on technology change.
  - Larger Cheaper Memory
  - Faster Processors
  - Higher Capacity Links
  - Result is Shortest path routing with speed and scale.
  - Link State comes at a cost of more hardware but offers more decoupled distributed forwarding state (a fact we need to account for when doing loop prevention.)
SPB

- Only supports IS-IS Link state protocol (instead of MSTP)
- SPB (Shortest Path Bridging) (802.1Q compliant)
  - must use VID, don’t own the C-MAC
  - Solution Attributes
    - Uses VID Trees, one source per (edge) bridge, distributed in IS-IS
    - Defines a SPT (Shortest Path Tree) Region, def by “Base VID”
    - SVL learning of unicast forwarding required
    - Supports an IST in region
  - Solution Requirements
    - May Interwork at edges with RSTP, MSTP
    - The region may default to a single instance MSTP (associated with the “Base VID”) if the VID allocation fails or detects errors
SPBB

- SPBB (Shortest Path Backbone Bridging)
  - IS-IS Control
  - May use VID Trees or a Single VID for an SPT Region
  - Does not use learning of B-MACs
    - Provider addresses will all be known allows for more efficient flooding (no B-MAC broadcast storms), ingress check, Reduction in forwarding space Shared Forwarding, Efficient Multicast and faster convergence Link State.
  - Works Ships in the Night with RSTP, MSTP in the B-MAC space.
    - Partitioned B-VID Space
    - No interworking with RSTP, MSTP
### SPB - SPBBB progress

Lots of alignment

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>VLAN Topology</td>
<td>Support shortest path Trees</td>
</tr>
<tr>
<td>VLAN Partitioning</td>
<td>Aligned</td>
</tr>
<tr>
<td>Link state topology</td>
<td>Use IS-IS</td>
</tr>
<tr>
<td>Mesh Networking</td>
<td>Support shortest path trees</td>
</tr>
<tr>
<td>Forwarding: backwards compatibility</td>
<td>Use a VID+DMAC context</td>
</tr>
<tr>
<td>Control plane objects</td>
<td>Similar requirements</td>
</tr>
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<td>SPT computation</td>
<td>Similar requirements</td>
</tr>
<tr>
<td>Multicast Groups</td>
<td>SPB – MRP SPBB uses IS-IS</td>
</tr>
<tr>
<td>Multicast and Unicast Congruency</td>
<td>Aligned</td>
</tr>
<tr>
<td>Forward &amp; Reverse Path Congruency</td>
<td>Aligned</td>
</tr>
</tbody>
</table>
## SPBB progress
### Lots of alignment

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<tr>
<th>Attribute</th>
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<tbody>
<tr>
<td>VLAN Partitioning</td>
<td>Use a logical B-VLAN</td>
</tr>
<tr>
<td>No Learning</td>
<td>Use IS-IS to populate FDB</td>
</tr>
<tr>
<td>Forwarding: backwards compatibility</td>
<td>Use a VID+DMAC context</td>
</tr>
<tr>
<td>SPT computation</td>
<td>Similar requirements</td>
</tr>
<tr>
<td>Number of Trees for Unicast Forwarding</td>
<td>Use one tree per source BEB</td>
</tr>
<tr>
<td>Number of Trees for Multicast Forwarding</td>
<td>Use one per (S,G)</td>
</tr>
<tr>
<td>Multicast Trees</td>
<td>Use pruning of the broadcast source tree</td>
</tr>
<tr>
<td>Multicast Groups</td>
<td>Use Groups to represent multiple I-SIDs</td>
</tr>
<tr>
<td>Single path per VID to a destination</td>
<td>Aligned No per hop ECMP</td>
</tr>
</tbody>
</table>
Problems to Solve
Where are we now?

- Topology Distribution
  - IS-IS
- Loop Prevention
  - TAP or SPBB Multicast Loop Prevention
- Loop Mitigation
  - Optional Forwarding change Ingress Check
- SPVID allocation
  - Leverage link State
- SPBB
  - Multicast Source Tree identification
    - SPVID or B-VID&Source DA
    - MRP and Link State
- Path Computation
  - Convergence
- Provisioning
  - Tree types (Shared Trees or Tree per source, etc)
  - MIBs
  - Mis-provisioning
- CFM
  - SPB CFM
  - SPBB CFM

Only IS-IS
Documenting options
Documenting options
Need to Discuss
Need to Discuss
Need to Discuss
TBD
TBD
Loop Prevention/Loop Mitigation

• Prevention (SPB & SPBB Multicast & SPB Unicast)
  – Control plane handshakes
  – Some Blocking
  – Use this for Multicast TAP & IS-IS digests + Handshake
• Mitigation (SPBB Unicast)
  – TTL
    • Needs hardware change and Frame change
    • Kills all unicast loops after some number of hops
    • Currently out of Scope
  – Ingress Check
    • Needs hardware change (smaller than TTL)
    • Stops most unicast loops
    • Latest Thinking (source based (SA or VID))
## Loop Prevention and Loop Mitigation Current View

<table>
<thead>
<tr>
<th></th>
<th>SPB Multicast</th>
<th>SPBB Multicast</th>
<th>SPBB Unicast</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Loop Prevention</strong></td>
<td>Must</td>
<td>Must</td>
<td>None or Optional</td>
</tr>
<tr>
<td><strong>Loop Mitigation</strong></td>
<td>Optional Data Plane Ingress check</td>
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</tr>
</tbody>
</table>
No SPBB Unicast Mitigation Implications

• SPBB Unicast forwarding can:
  – Work with no loops
  – Temporally Break with no loops
  – Temporally Break with a loop
    • This is the case of interest what happens?
      – Loops of 3 or more nodes
      – These loops are transient and short lived
      – Could use Unicast prevention wait for handshake
Switching Context of Source Tree
Backwards Compatible

SPVID = Source Tree and VLAN In VID Tree Context

VID Trees

SPVID = Source Tree and VLAN In VID Tree Context

Single VID
Resolve DA to unique destination

Efficient Multicast B-DA based on Multicast Interest (I-SID)

(B-VID + B-DA) = Source Tree and Destination in Source VID Tree Context

VID + DA = Topology and Destination in VID Context
Control Plane Scope

SPB and SPBB Different Operating Spaces
VLAN Usage and Topology

- **Topoogy Extent** (ability to utilize multiple paths)
- **VID Usage**
  - Single VID
  - SPVID
  - MSTP
  - RSTP

- **Single topology**
- **Mesh topologies**

- **4096**
- **2**
- **1**

(ability to utilize multiple paths)