SPBB – emulated LAN segment (VPLS) interworking

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Some SPBB Interworking Scenarios

NNI Interworking with VPLS

- **PBBN with MSTP ⇦*B-tagged NNI*⇨ VPLS with LDP**

NNI Overlay with VPLS

- **PBBN with SPBB ⇦*B-tagged NNI*⇨ VPLS with LDP**

NNI Interworking with PBN/PBBN

- PBBN with SPBB ⇦*I-tagged NNI*⇨ PBBN with SPBB
- PBN with SPB ⇦ *S-tagged NNI*⇨ PBN with MSTP
- PBBN with SPBB ⇦*B-tagged NNI*⇨ PBBN with MSTP

UNI Interworking

- PBBN with MSTP ⇦*I-tagged UNI*⇨ VPLS with LDP
- PBBN with SPBB ⇦*S-tagged UNI*⇨ VPLS with LDP
- PBBN with SPBB ⇦ *S-tagged UNI*⇨ PBN with SPB
- PBBN with SPBB ⇦ *S-tagged UNI*⇨ PBN with MSTP

The first & second scenarios are considered here.

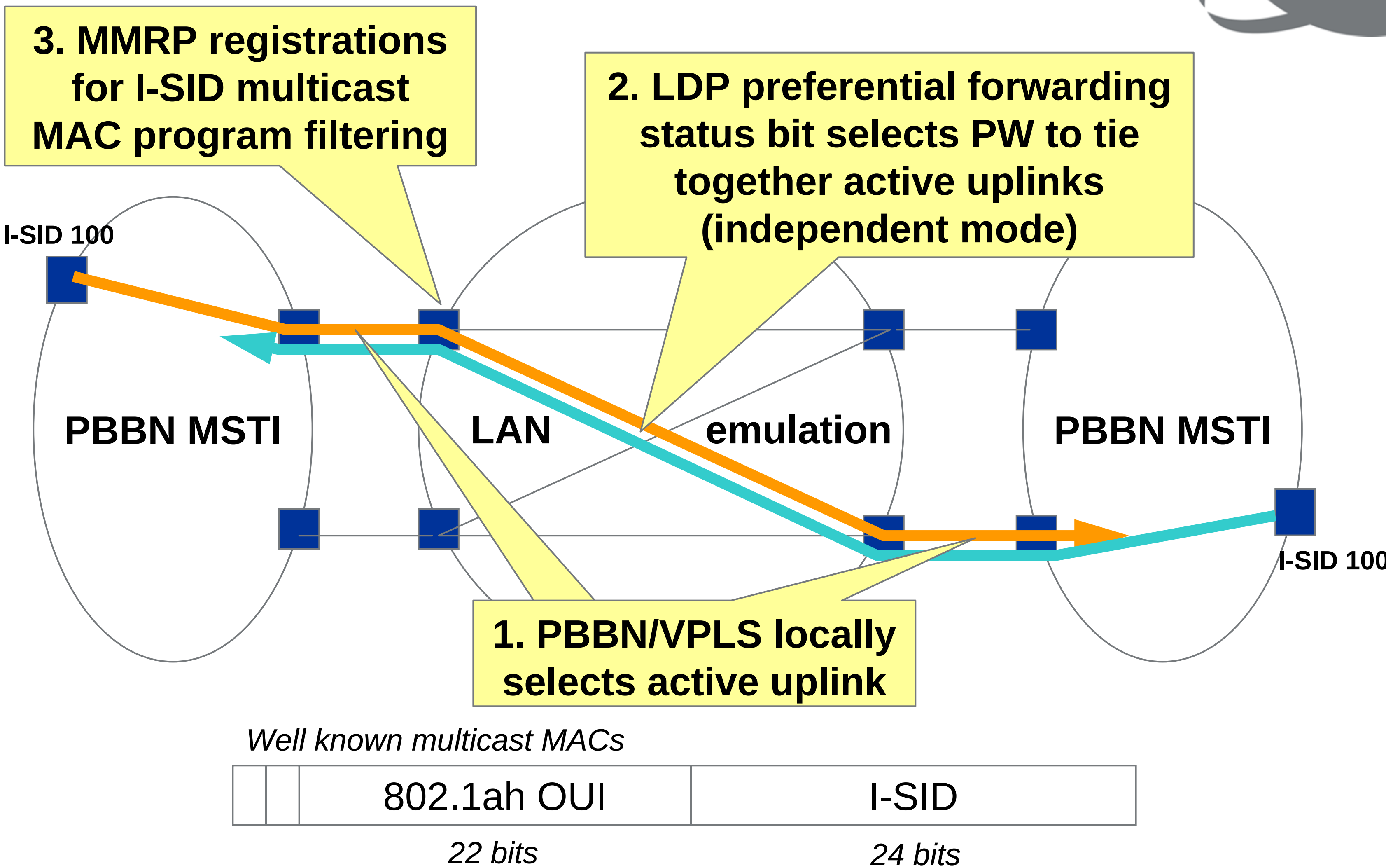
Problem Statement

- PBB is endorsed by IETF L2VPN WG as an “access network” for a VPLS core network offering virtualised LAN emulation
  - It improves scalability since VPLS has only visibility of B-MACs, C-MACs are learned only in the PBB nodes
- PBBN-VPLS interworking is different from PBN-VPLS….
  - It is a VPN of VPNs
  - Need for “per-service” multicast containment
  - Resilient and efficient interconnect
  - Large number of I-tagged services are aggregated onto any NNI
- Current arrangement is with MSTP control plane on PBBN or single subtending BEBs
  - Isolate and interconnect active topologies with VPLS
- The SPBB control plane will scale well enough (target is 1000 nodes in a single area) to permit **overlay** of LAN segments and emulated LANs

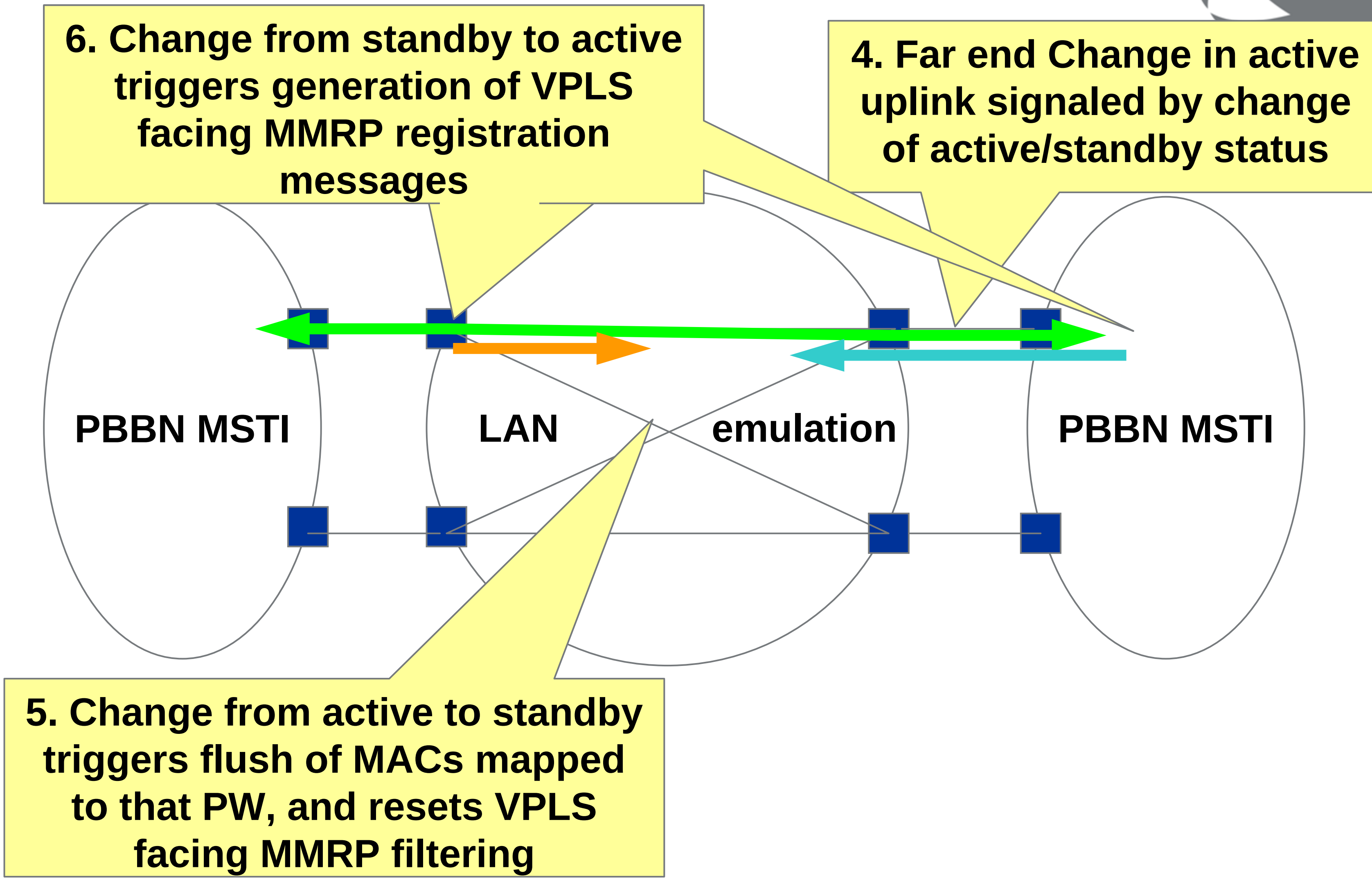
Scaling VPLS using PBBN with MSTP

- To maximize scalability
  1. Peer at the B-component (and not I-component)
     - Appropriate filtering of B-component multicast addresses is sufficient to isolate services
     - Elimination of the need for hosting I-components in VPLS PEs eliminates need for any PBB specific LDP signaling enhancements
  2. This requires a single emulated LAN for all services carried by the PBBN
     - Operational decoupling of service provisioning from infrastructure when VPLS used for PBBN transit
  3. Use multicast MAC filtering at ingress to the emulated LAN for multicast efficiency
     - Dynamic registration using 802.1ak MMRP is one option
  4. Eliminates requirement for LDP “MAC withdraw” messaging
     - Current practice for selective invalidation of MAC entries in VPLS PEs
- Resiliency capabilities in a scaled environment should include handling the severing of a subtending MSTI domain

Operational Model - VPLS⇔PBBN / MSTP



Operational Model - VPLS⬄PBBN / MSTP

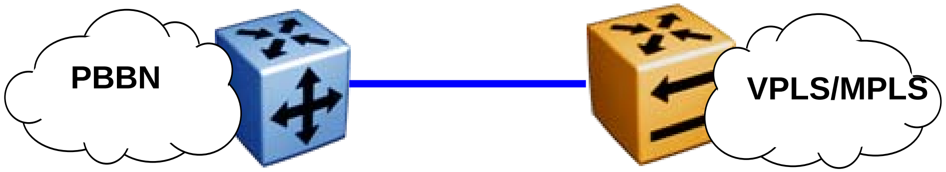


We can go further with a PBBN avec 802.1aq

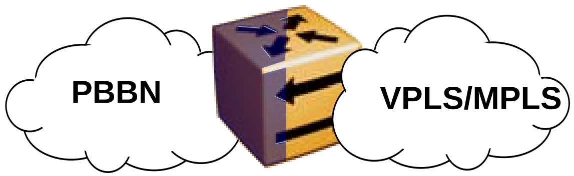
- We will keep
  1. Peering at the B-component layer
  2. A single pre-provisioned PW mesh for all services carried by the PBBN with SPBB
  3. Use of multicast MAC filtering at ingress to LAN emulation for multicast efficiency
     - But can also drive it directly from IS-IS in an integrated model
- And we can
  - Eliminate requirement for LDP participation in the active topology entirely
    - and so achieve O(N) messaging load for any change in the attachment configuration
      - no need to inform all VPLS service endpoints

There are two Implementation Models

- The "Arms length" model
  - VPLS PE has no knowledge of PBBNs
  - VPLS VSI FDB is populated by traditional flooding, learning & registration



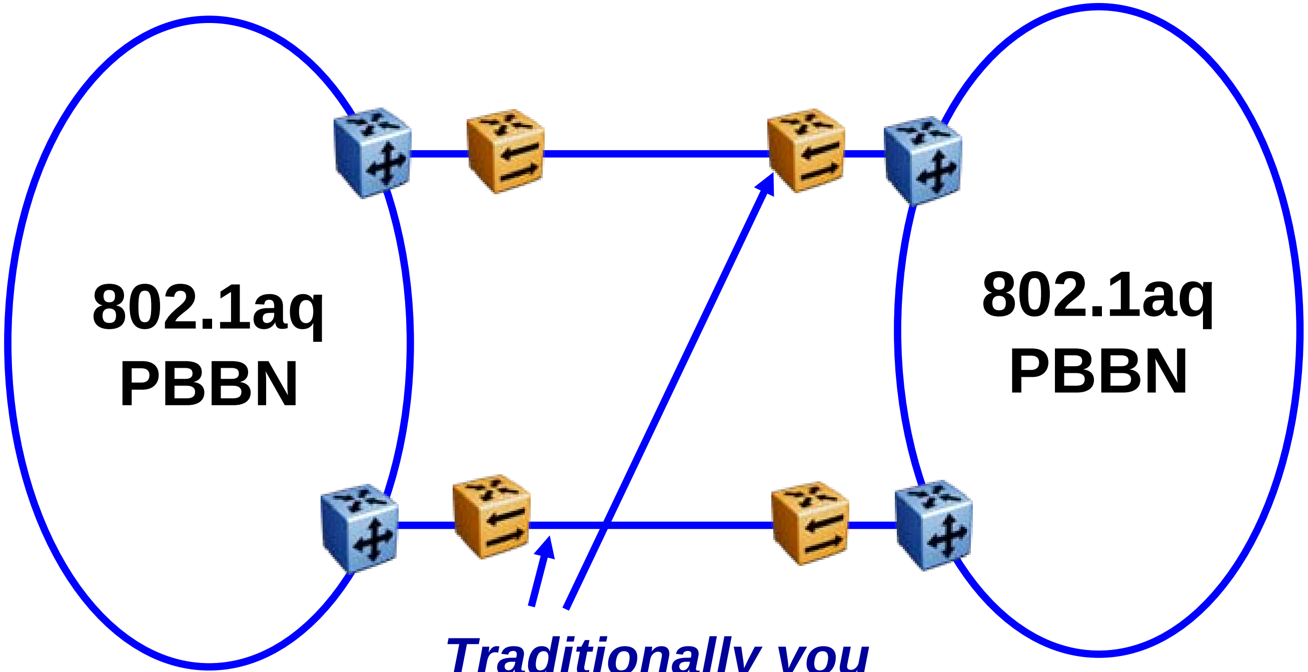
- The "Integrated" model
  - VPLS PE is also a PBB/SPBB BCB
  - VPLS VSI FDB is populated by the SPBB control plane



The "arms length" model represents inter-working between standards, and so is the model considered

A key property of SPBB NNIs

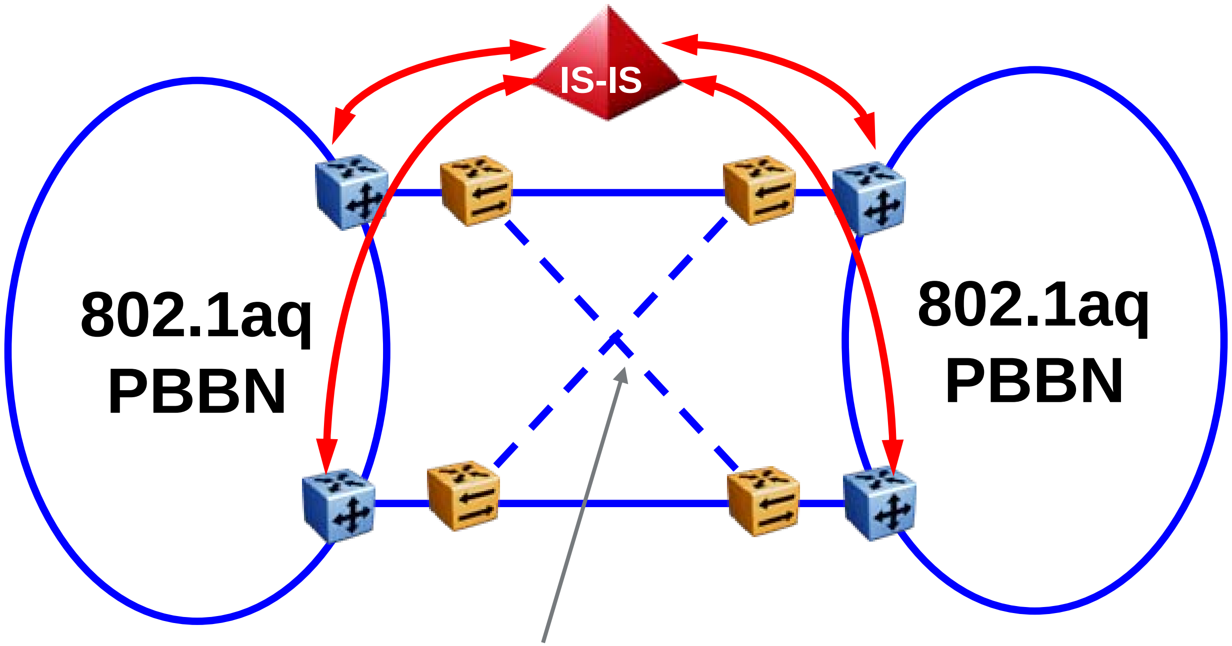
- SPBB can fully utilize a physical mesh



Traditionally you would have needed to block one of these links to avoid looping

Another key property of SPBB NNIs

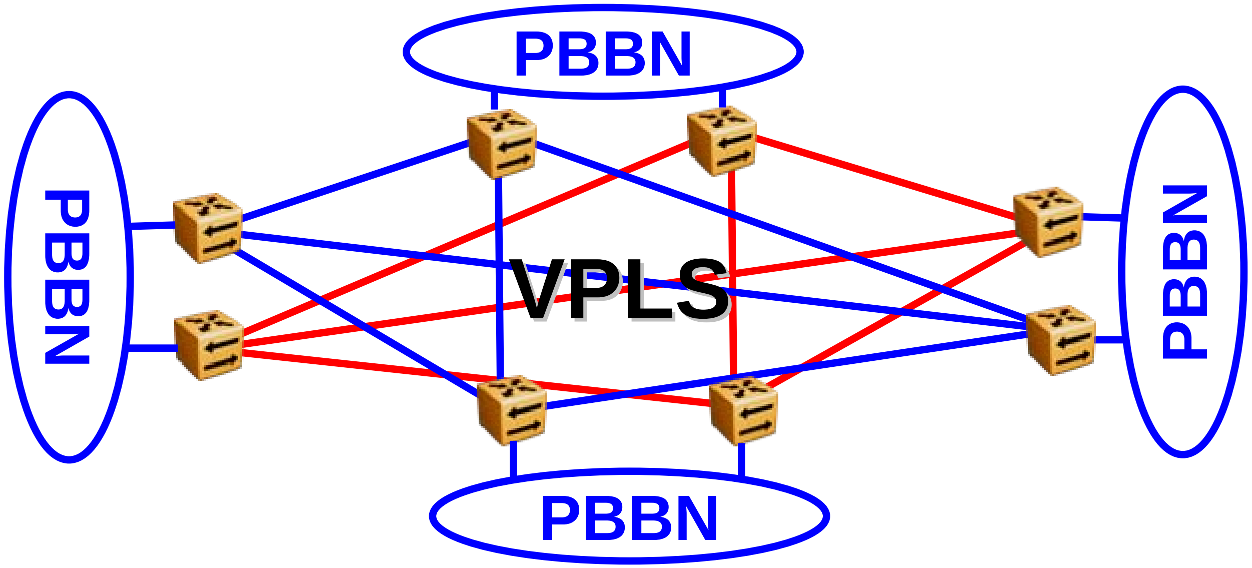
- SPBB can coordinate the PBBN side of VPLS points of attachment, IS-IS simply overlays LAN emulation
  - SPBB loop avoidance works across LAN emulation



Full mesh of LDP adjacencies to coordinate VPLS end points and elect a single PW is not required

Extending this to interconnect multiple PBBNs

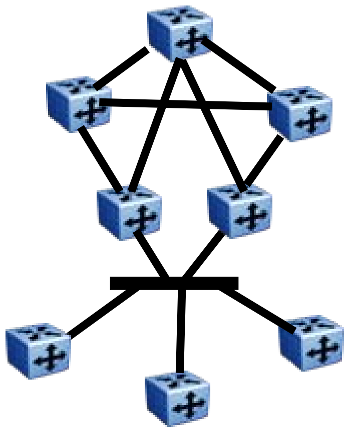
- Provision two parallel meshes = two parallel LAN segments
  - Each singly homed on each PBBN
    - each ¼ of the PWs of the MSTP solution
  - Invariant PW meshes eliminate need for LDP “MAC withdraw” or “preferred forwarding” handshaking
    - PWs are not an “active” component



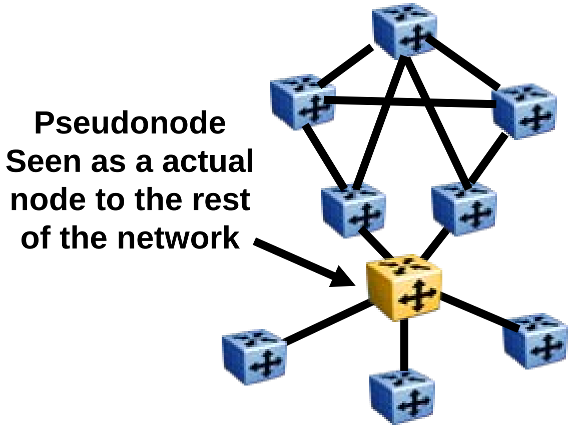
Routing - VPLS as transit LAN segment

- LAN segments have existed “forever” and are already accommodated by link-state control plane architectures :
  - There are already data-plane models for use in SPF calculations;
  - The control plane architecture collapses the number of adjacencies from O(**N²**) to O(**N**);

Physical Network



Link State Topology View



Filtering

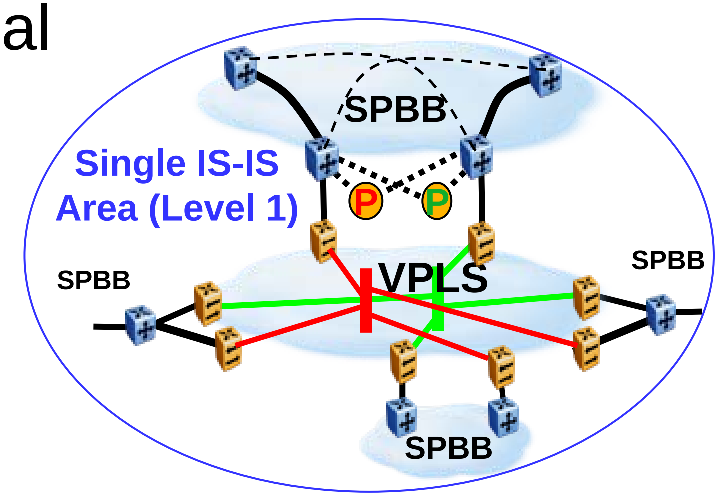
- We can surround a LAN segment (VPLS) with filtering to teach it what the SPBB control plane wants :
  - it will naturally reconcile with the SPBB SPF computations
  - guaranteed symmetric congruence of go and return paths means that what SPBB wants to teach, the (emulated) LAN segment will learn….

- FDB requires an additional filtering option to avoid creation of duplicate frames when VPLS is "learning"
  - Port of arrival filtering for a DA as defined in 802.1ap is either permit <u>one</u> port or permit <u>all</u> ports
  - 802.1aq requires ability to define a valid port map for receipt of a DA
    - "<u>some</u>" ports … those on a valid shortest path to a DA in SPBB

Multicast - implementation

When overlaying a LAN segment, SPBB has a complete topology view :

- SPBB builds (S, G) trees to support shortest path routing;
- A LAN segment only requires (*, G) trees,
- but MMRP can be used to signal and build SPBB (S, G) trees :
  - they install full bi-directional state, but this is not harmful,
  - since only one SPBB source ever transmits on each tree.



Summary

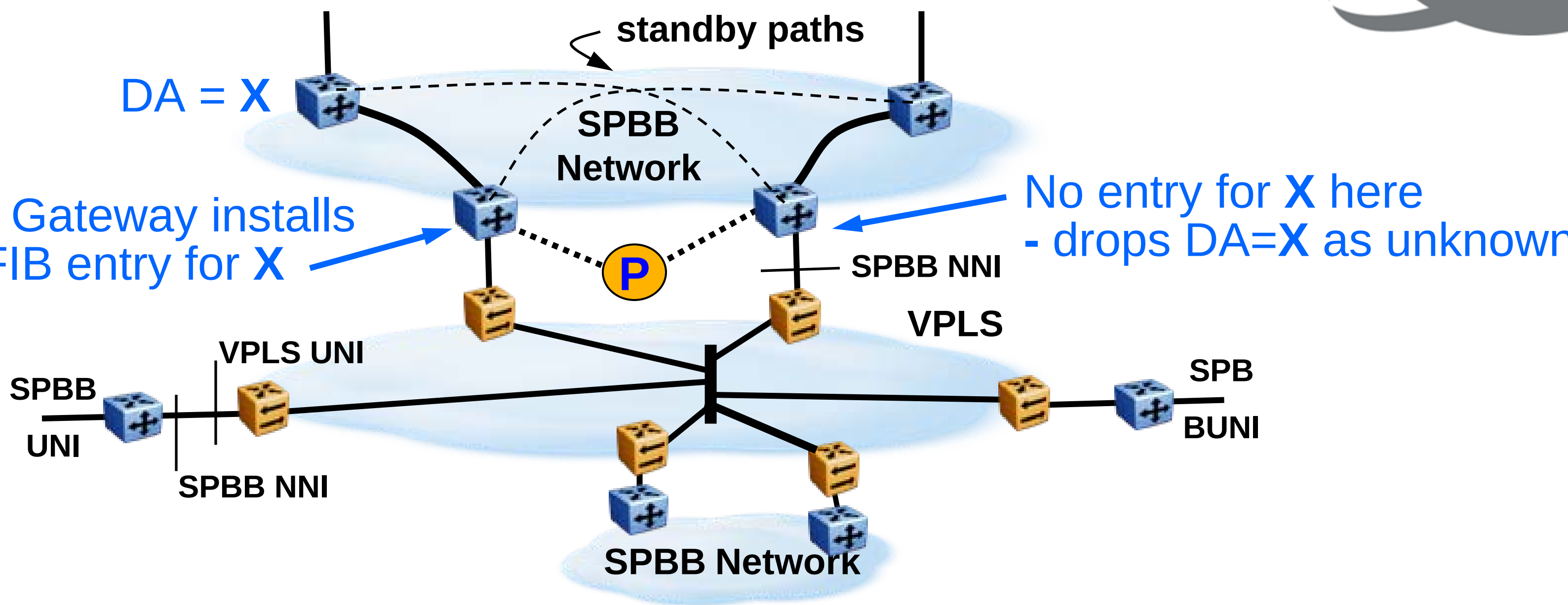
- PBBN-VPLS interworking already embraced by industry due to scalability enhancements
  - Move to single PW mesh for PBBN interconnect
  - MMRP awareness
  - Reduced core MAC table consumption

- SPBB-VPLS interworking offers further simplification in the form of significantly reduced messaging load on any VPLS core
  - No need for “MAC withdraw” or “preferred forwarding” LDP message exchange as part of fault recovery

- PBBN-emulated LAN segment interworking requires
  1. Per PW multicast filtering
     - IETF already considering MMRP “awareness” for PBB-VPLS
  2. Addition port of arrival filtering options for the DA in BCBs
     - “PortList” syntax for FDB MIB object

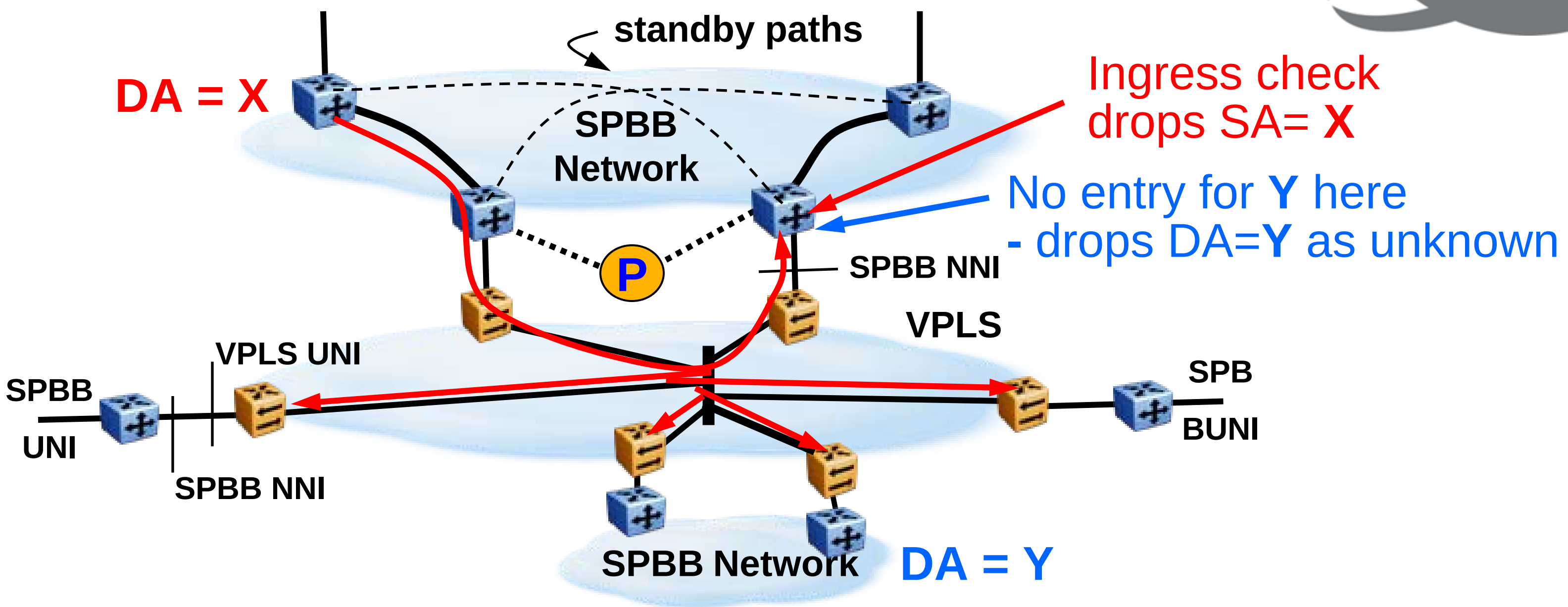
Backup

Connection of SPBB nodes over VPLS *(1)*



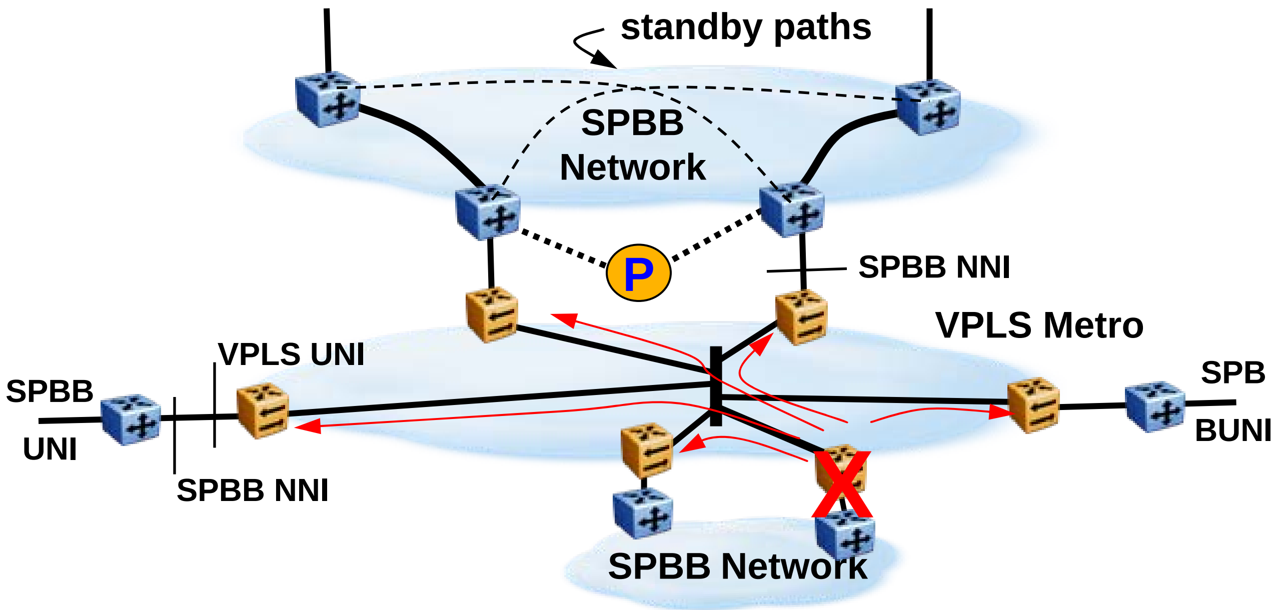
- Set up ELAN services over VPLS (as many as needed, only 1 shown)
- SPBB SPF computation only installs forwarding state in the SPBB Gateway on the shortest path **to** any **B-MAC DA** reachable through it
  - the other Gateway blocks that DA, by "discard on unknown", preventing more than one copy of a unicast packet entering the SPBB network.
  - SPBB returns traffic by the shortest path only, "teaching" VPLS the route

Connection of SPBB nodes over VPLS *(2)*



- SPBB SPF computation only installs forwarding state in the SPBB Gateway on the shortest path **to** any **B-MAC DA** reachable through it
  - VPLS can flood a B-MAC as unknown
  - but SPBB does know where to find it
- With VPLS (*, G) multicast, and even under multi-homing, the ingress check prevents VPLS re-circulating frames into SPBB

Implications of single VPLS service



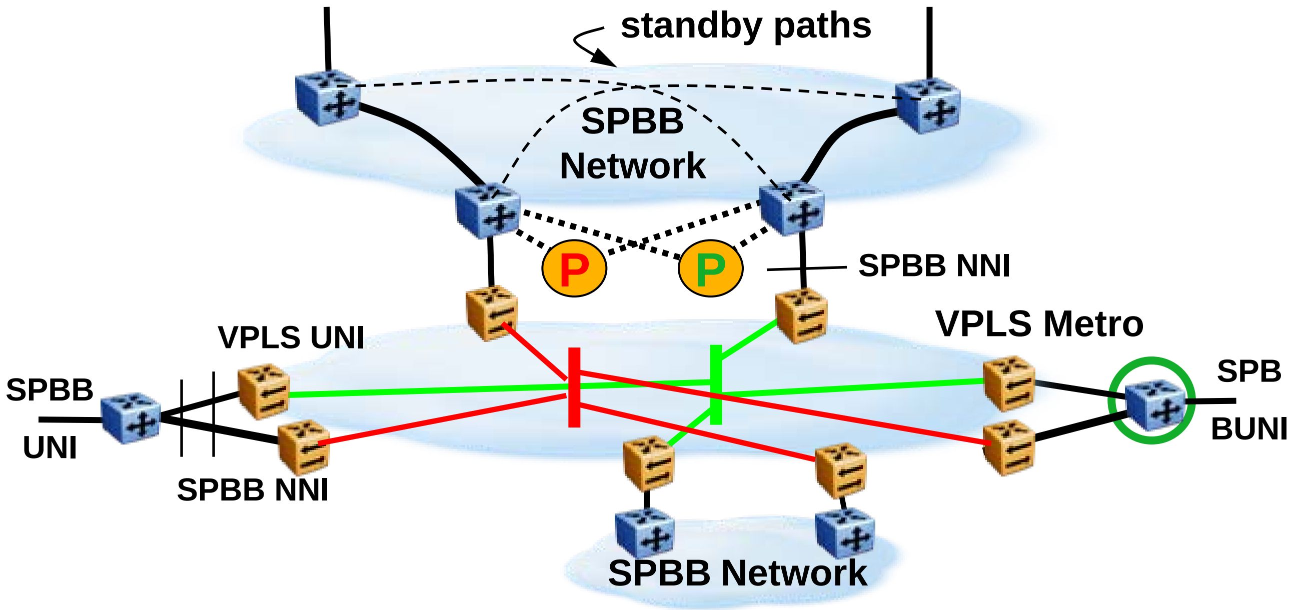
SPBB will work with one VPLS service dual-homed on SPBB “regions”

- ***but*** a failure requires both SPBB **and** VPLS to react

The network is not really re-converged after failure until both :

1. SPBB has converged
2. VPLS has done all the required MAC withdraw messages to reset learning

Dual service as the convergence solution



Single homing onto each of dual parallel VPLS service instances eliminates requirement for VPLS to re-converge for restoration :

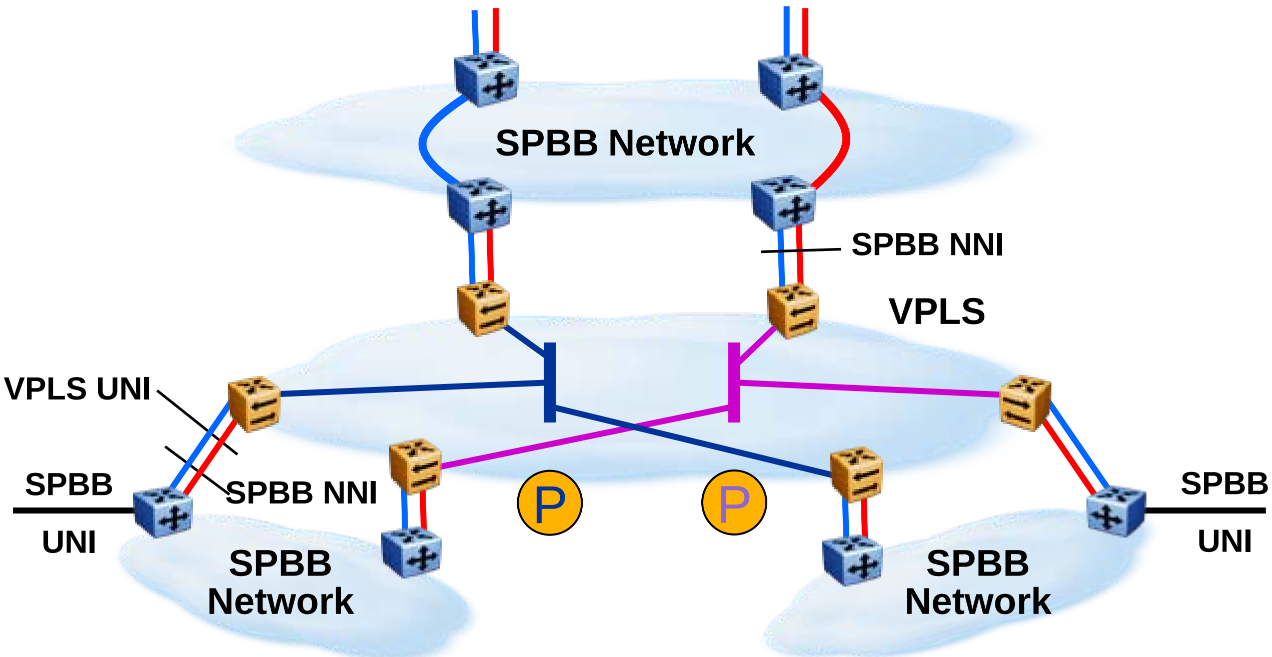
- SPBB can use parallel connectivity without looping

Any failure requires only SPBB convergence for complete recovery :

- MACs will simply move from one service to the other
- VPLS does not need to “unlearn” anything

Single points of SPBB attachment need to be dual-homed

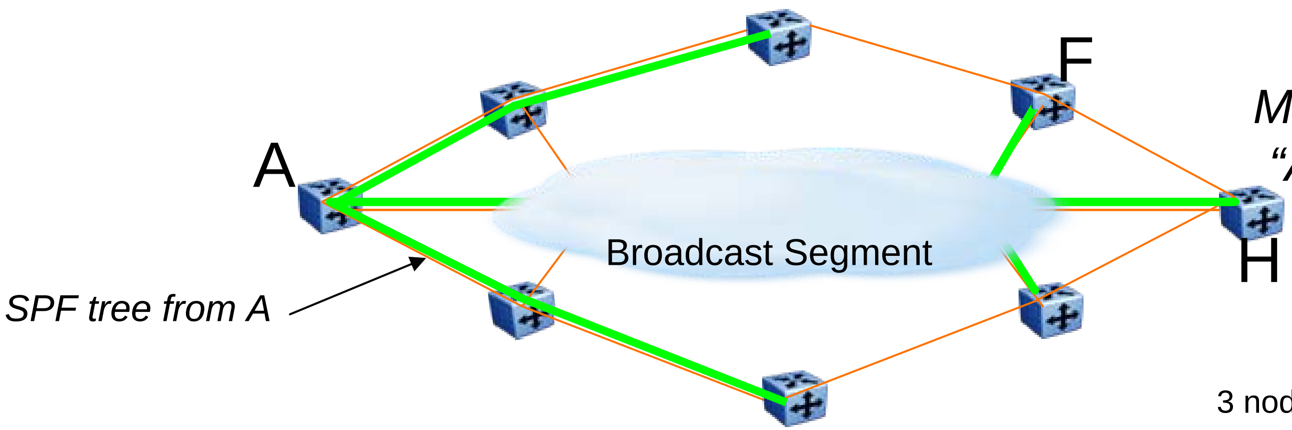
Dual service as the load-sharing solution



We can extend SPBB dual B-VID load balancing over VPLS

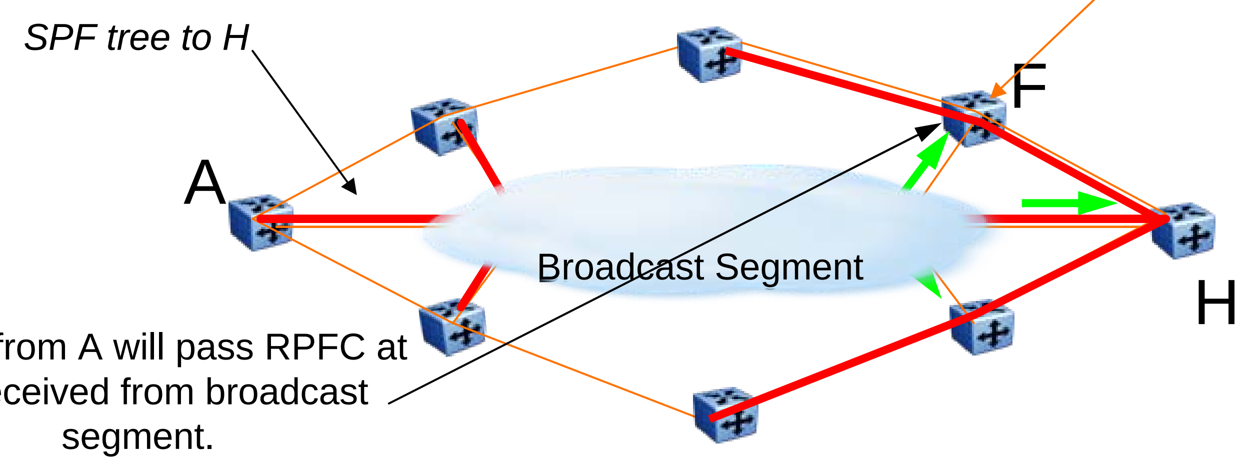
- set up as many ELAN services as needed to support the traffic
  - each service supports **both** SPBB B-VIDs (blue & red above)
- SPBB SPF computation only installs forwarding state in the SPBB Gateway on an ECMT VID for any **B-MAC DA** reachable through it.

Problem With Broadcast Segments (e.g. VPLS)



Multicast packets from "A" are fine, only one path to "H"

3 nodes connected to the shared segment are on H's tree and will accept from "A"



Without additional filtering multiple copies of any packet from A that is flooded will appear at H

Packet from A will pass RPFC at F if received from broadcast segment.
F is also on shortest path to H
So FDB contains both SA and DA

Broadcast Segment Solution

- Slightly enhanced filtering for boxes with a “unary” FDB
- In QBRIDGE-MIB of 802.1ap there is *ieee8021QBridgeStaticUnicastReceivePort* entry in the *ieee8021QBridgeStaticUnicastTable*,
  - Current “PortNumberorZero” syntax only allows us to specify a either promiscuous reception or reception restricted to a single port for the DA MAC referred to by the table entry…
  - We need the ability to specify *some* ports, in addition to *none, one or all….*

- A corresponding “PortList” syntax is needed
  - Same as for the objects
    - ieee8021QBridgeStaticUnicastStaticEgressPorts &
    - ieee8021QBridgeStaticUnicastForbiddenEgressPorts