Multi-Homed NNIs (802.1ah Class IV)

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NORTEL

Agenda

- Introduction for new project
- Requirements
- Solution elements
  - Topologies of interest
  - Protocols over the demarcation point
  - Protocols within PBNs
  - Protocols within PBBNs
- Recommendations

Class IV Protected Service Interface

- Removed from 802.1ah in draft 3.7 subclause 25.9.3
- Hides the attached network topologies and topology protocols
- Decouples topologies of the attached networks (does not tunnel them over PBBN)
- A class IV protected service interface protects:
  - against any single link failure and some multi-link failures
  - against any single node failure and some multi-node failures
  - against some segmentation failures and detection of others
  - the PBBN filtering table states against any link failure and some node failures
- Minimizes the state changes within the PBBN
  - Keep state changes local to failure rather than spreading over PBBN
  - Update only the state information related to affected services (don't disrupt unaffected services)
- Service types for class IV protected service interface
  - port based service interfaces
  - S-tagged service interfaces
  - I-tagged service interfaces
- Other objectives include
  - Provide rapid switch over within the core (sub 50 msec for link fail)
  - Provide selective I-Comp filtering database updates within core
- A class IV protection interface is in high demand for attaching both access networks to cores and between peer networks.

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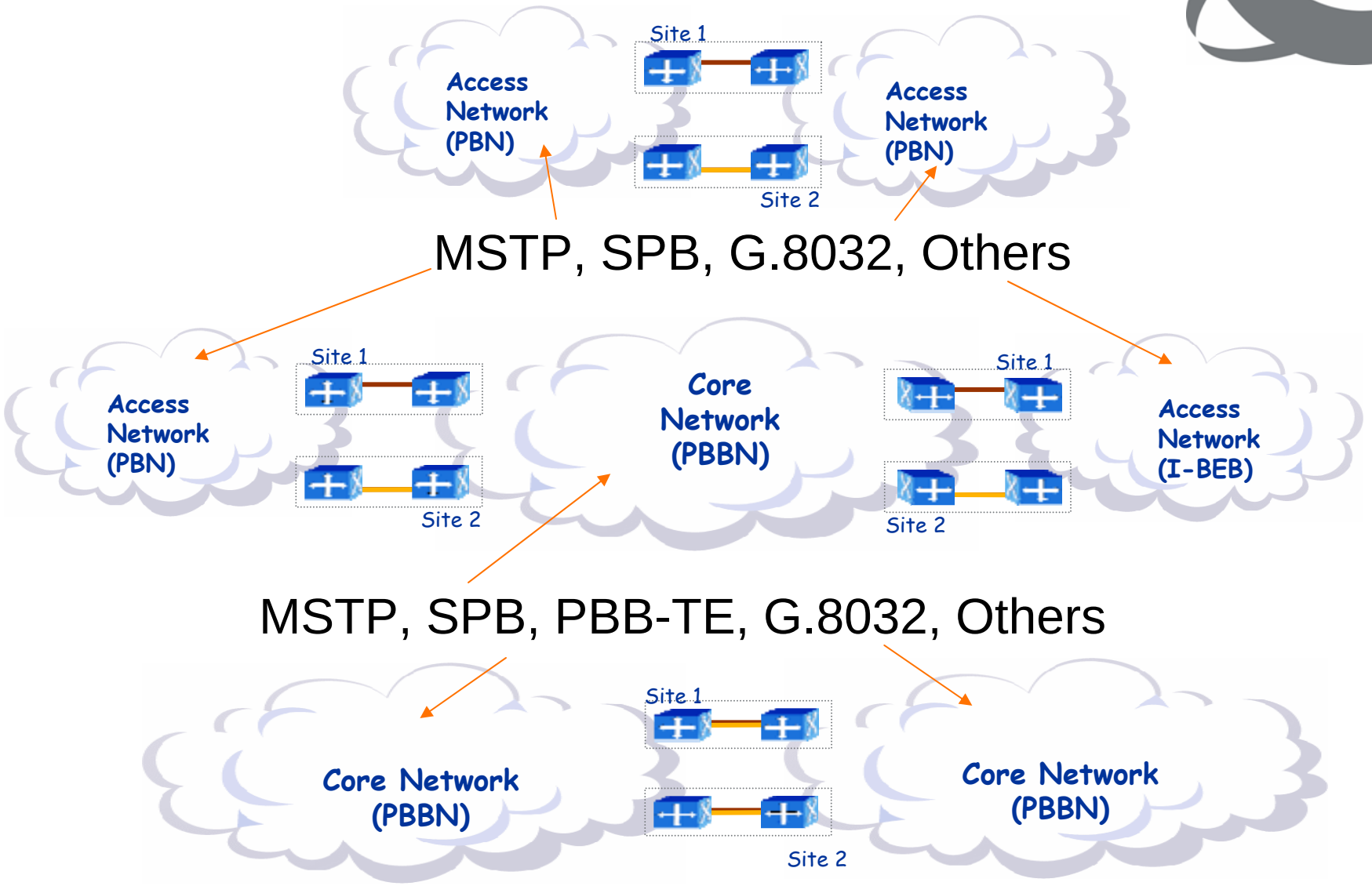
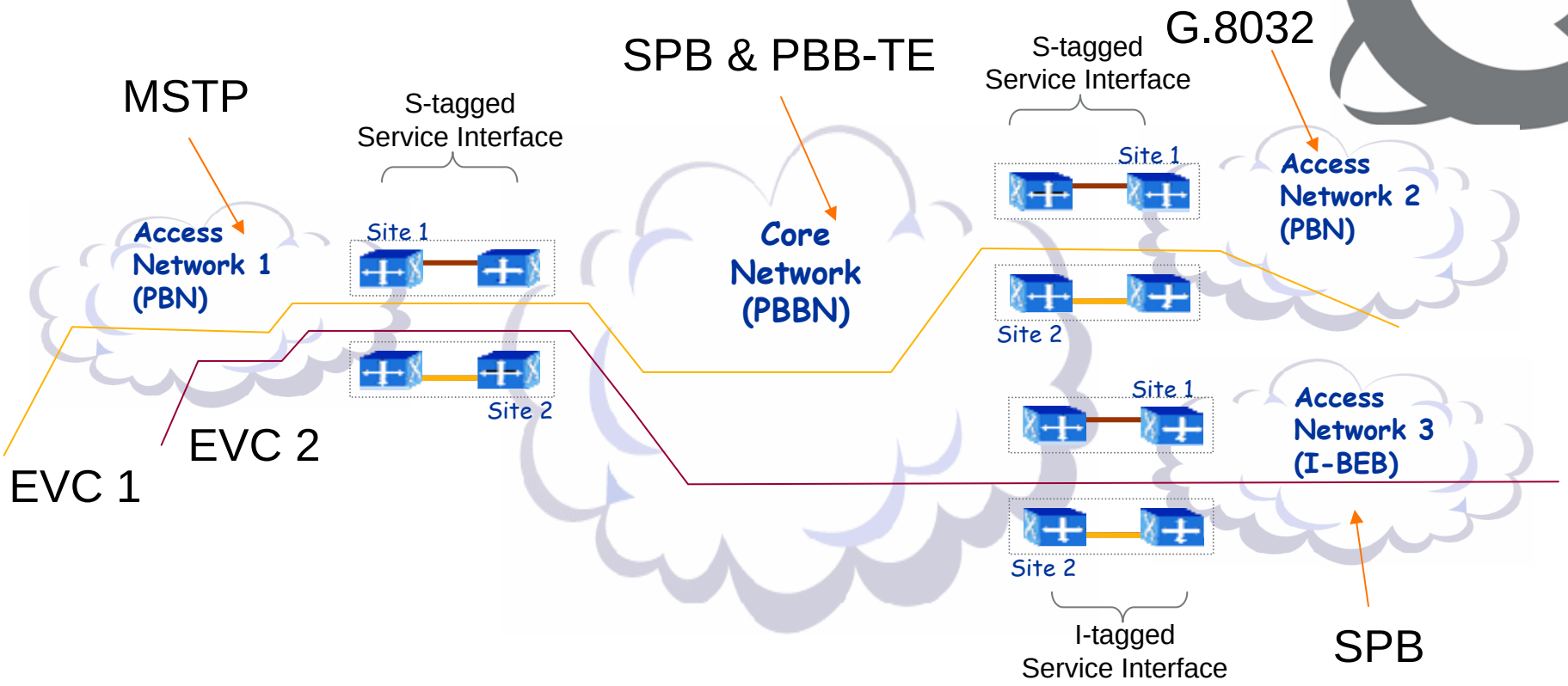
Must decouple and hide PBN/PBBN topologies and protocols



Must support PBN - PBBN

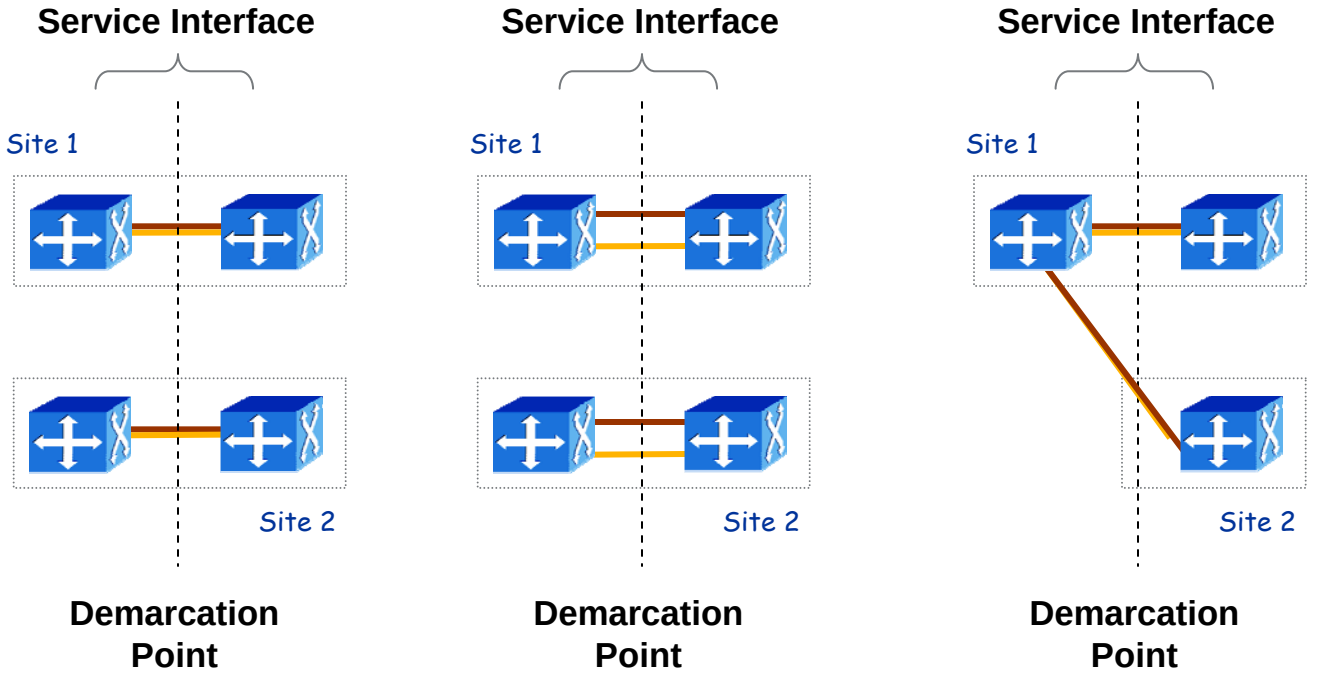
- Asymmetric Network Interfaces
  - PBN – PBBN: Demarcation point at S-tagged service interface
  - I-BEB – PBBN: Demarcation point at I-tagged service interface over split I-BEB / B-BEB
- Symmetric Network Interfaces
  - PBBN – PBBN: Demarcation point at I-tagged service interface over peer E-NNI between B-BEBs
- Connected types covered by project:
  - Asymmetric PBN – PBBN only (Required)
  - Asymmetric I-BEB – PBBN (Desired)
  - Symmetric PBBN – PBBN (Desired)
  - May be best to push PBBN – PBBN into a future project while keeping both asymmetric interfaces

Example Network (Asymmetric Cases)



- All four of these networks use a different topology protocol, however we must be able to protect EVCs which traverse all these network and use these different topology protocols in each segment.
- A topology independent protocol must be provided over demarcation points
- Due to backward compatibility requirements it should also be possible to option MSTP over the demarcation for the special case where:
  - The service interface is an S-tagged interface
  - The access network uses MSTP but does not support L2GP

Must provide redundant links and nodes



- Must allow dual links and desirable to provide N links
- Must allow dual nodes
- Desirable to allow dual nodes on only one side of the demarcation point
- Must recover from any single link or node failure
- Must fail consistently on any un-recoverable multi-link or node failure

Must provide state protection

- Within PBBN core we keep state tables in the I-Components which map C-MACs to B-MACs (and S-VIDs to I-SIDs)
- Re-direction of traffic within the PBBN and changing the use of source B-MACs requires updating state distant from the failure.
- The protected interface must protect the core state for any single link failure
- The protected interface should protect the core state whenever possible on node failure
- The protected interface should provide a method (protocol) for updating the remote state which:
  - Must updates only the state of the affected service
  - Minimizes the changes in the core of the PBBN

Must provide protection by link or EVC

- Link level protection – a protection switch moves all traffic from the primary link crossing the demarcation point to a secondary link crossing the demarcation point. With this type of protection one link of the dual attach is idle.
- MSTI level protection – a protection switch moves all traffic for a specific MSTI from the primary to a secondary link.
- EVC level protection (S-VID & I-SID) – a protection switch moves all traffic for a specific EVC from the primary to secondary link.
- Could also consider C-MAC wondering.

Must support CFM over interface

- A EVC level CFM MA must not be affected by protection switching at the interface
- All paths must be monitored by CFM at an interface level including the backup paths

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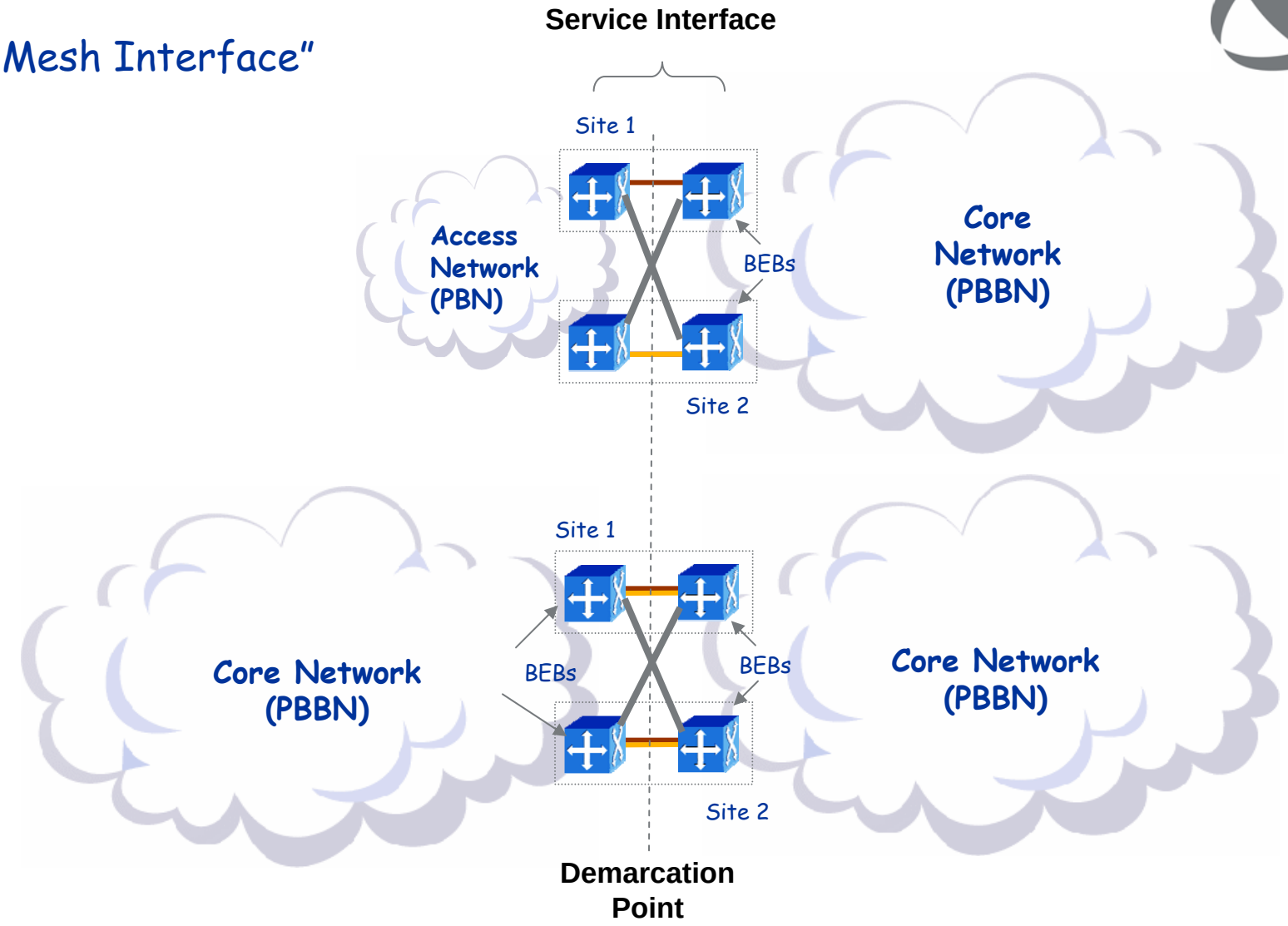
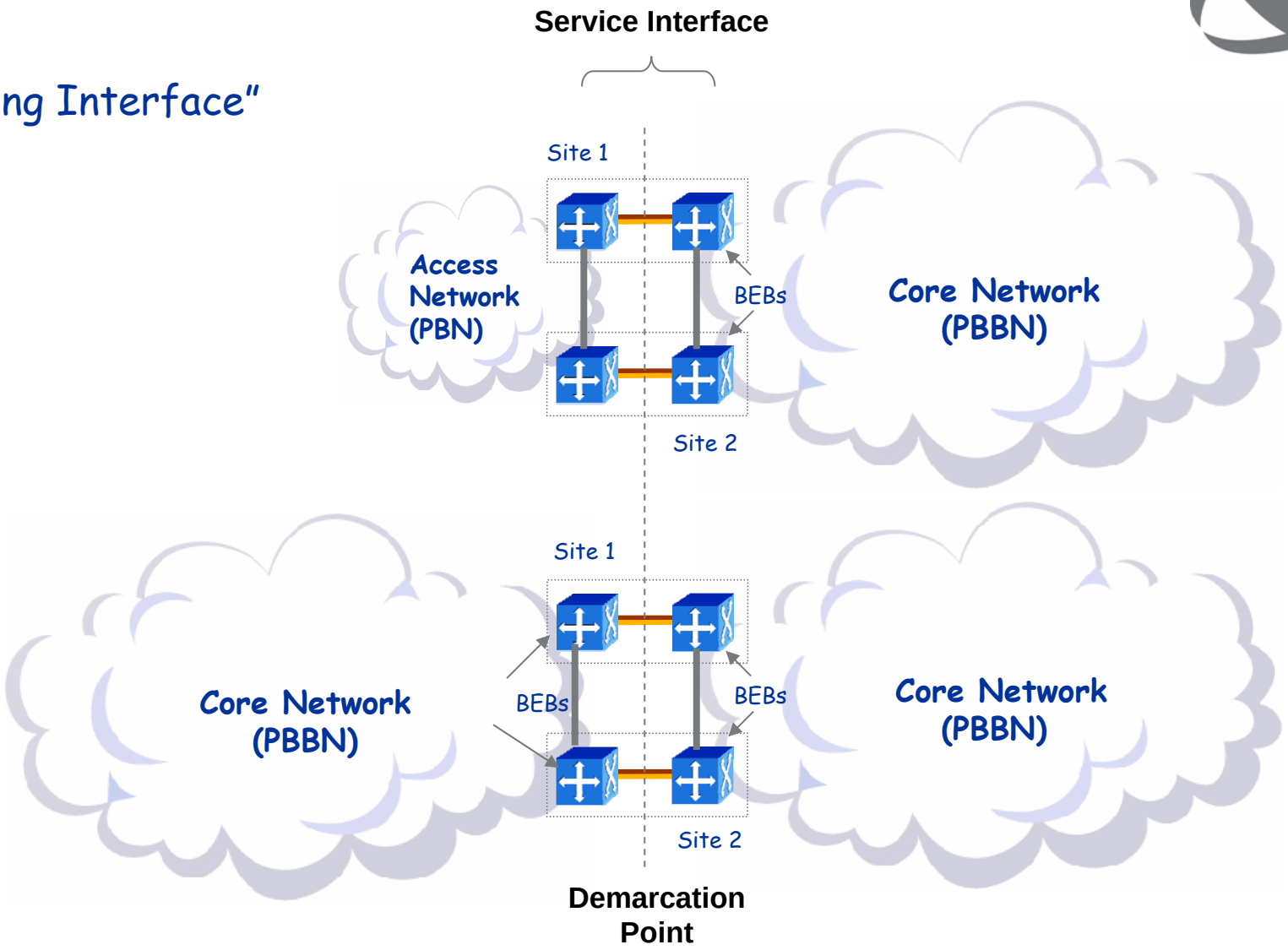
Class IV PBB Topologies

"Mesh Interface"



Alternate Class IV Topology

"Ring Interface"

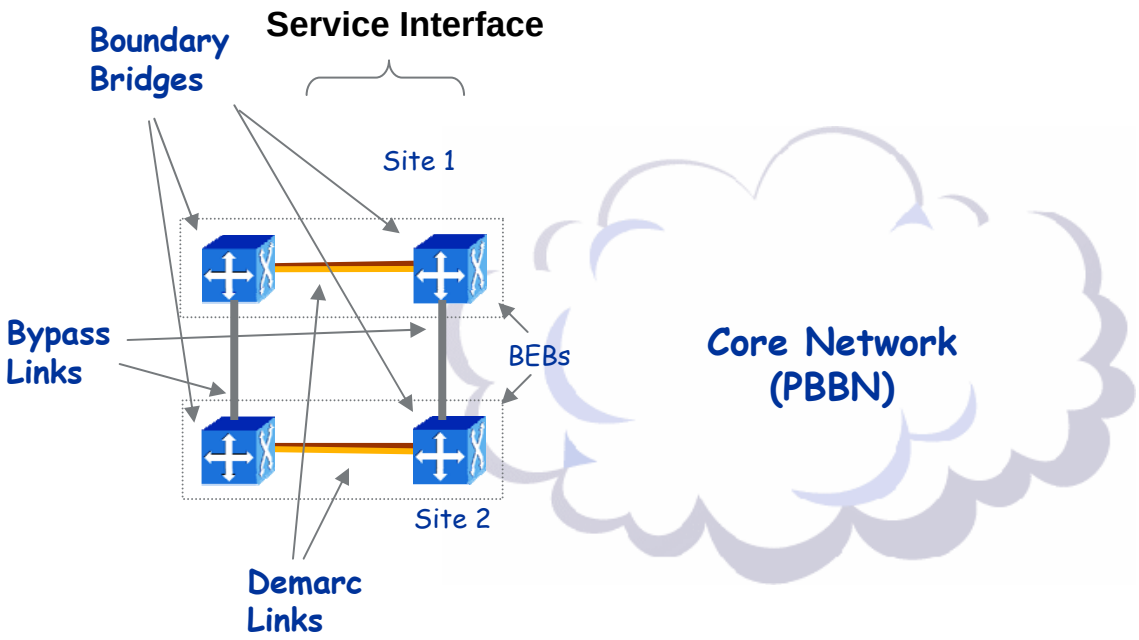


Ring vs. Mesh Protection Interface

- "Ring"
  - Minimizes the number of links crossing the demarcation point
  - Repair done uni-laterally
  - Traffic re-direction for core is controlled within core network
  - Supports only dual attach
  - Limits state changes in core and attached network for link failures
  - Limits state changes in core for bridge failure in attached network
  - Increases the number of hops when in failed state
- "Mesh"
  - Double the number of links crossing the demarcation point
  - Repair done bi-laterally
  - Traffic re-direction for core is controlled by attached network
  - Supports N attach
  - Limits state changes in core and attached network for link failures
  - Limits state changes in core for bridge failure in attached network
  - Does not increase the number of hops when in failed state

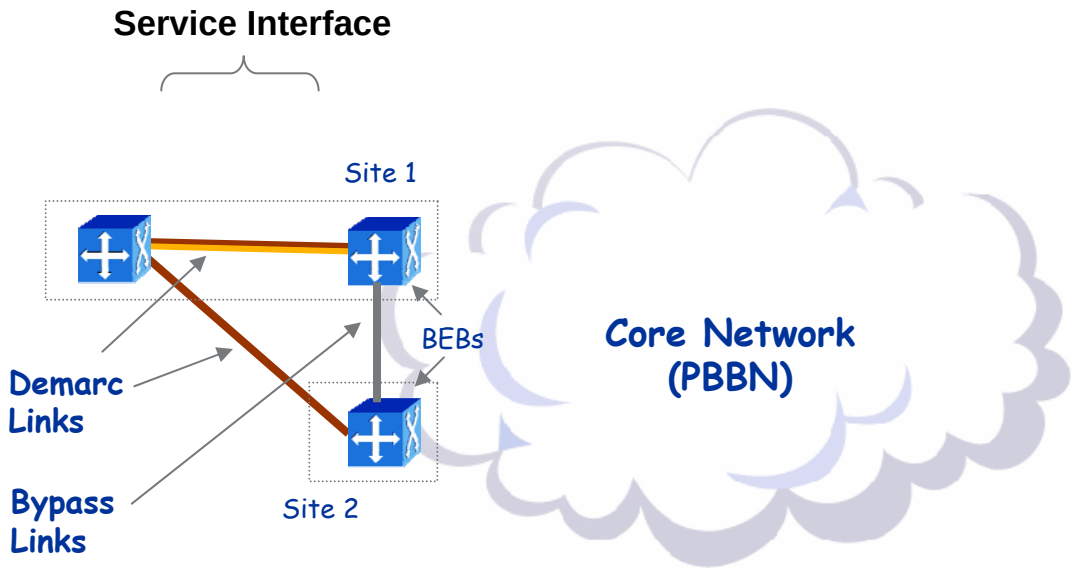
Ring interface is most attractive

“Ring” Interface Terminology



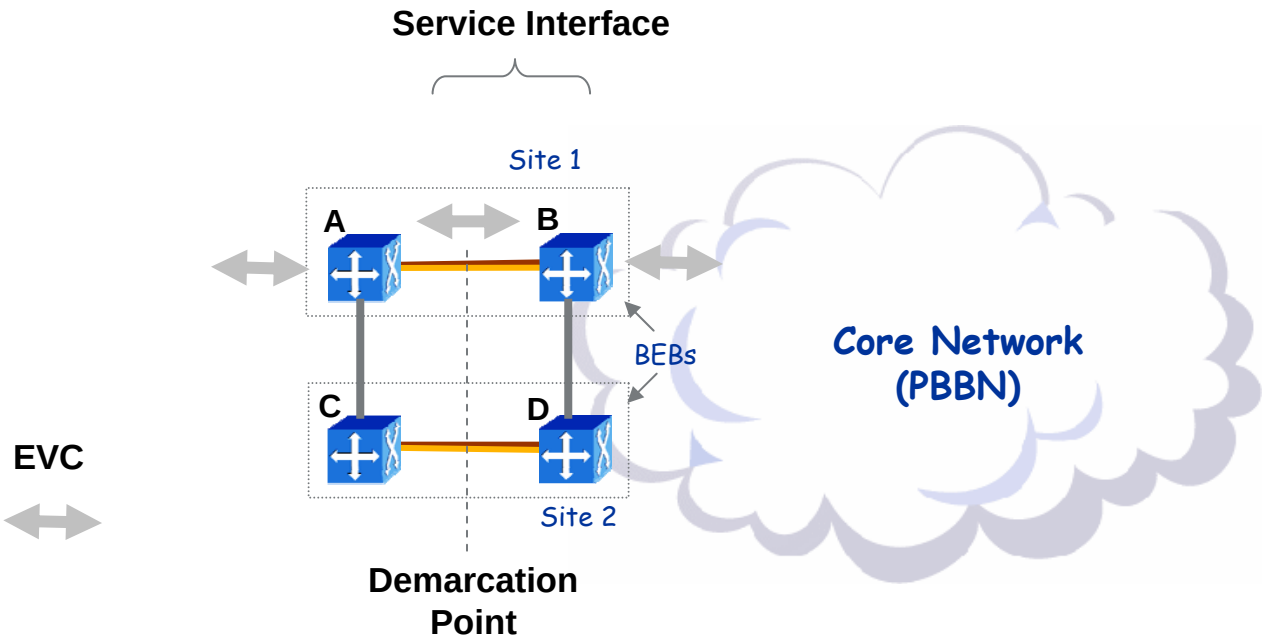
Terms: Demarc Links, Bypass Links, Boundary Bridges
Topology: A ring is formed from the Demarc and Bypass Links
Issues:
- Must be able to re-direct data bound for a failed link to an operative link
- Must be able to differentiate between failure of the bypass link vs. border bridge
- Must be able to detect and handle a segmentation fault
- Must be able to migrate remote I-Comp filtering database in the case where a boundary bridge fails
- May be able to migrate remote I-Comp filtering database in the case where a link fails

Ring Interface Special Case



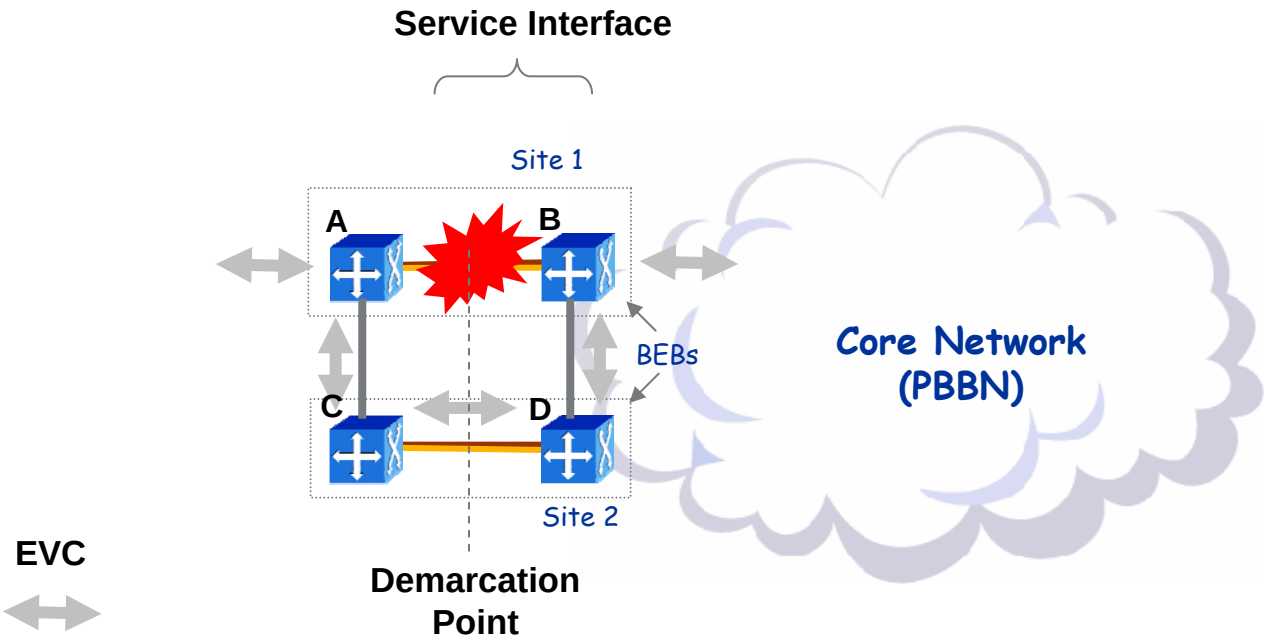
- The degenerate case where the access network has a single boundary bridge

Ring Interface Normal Operation



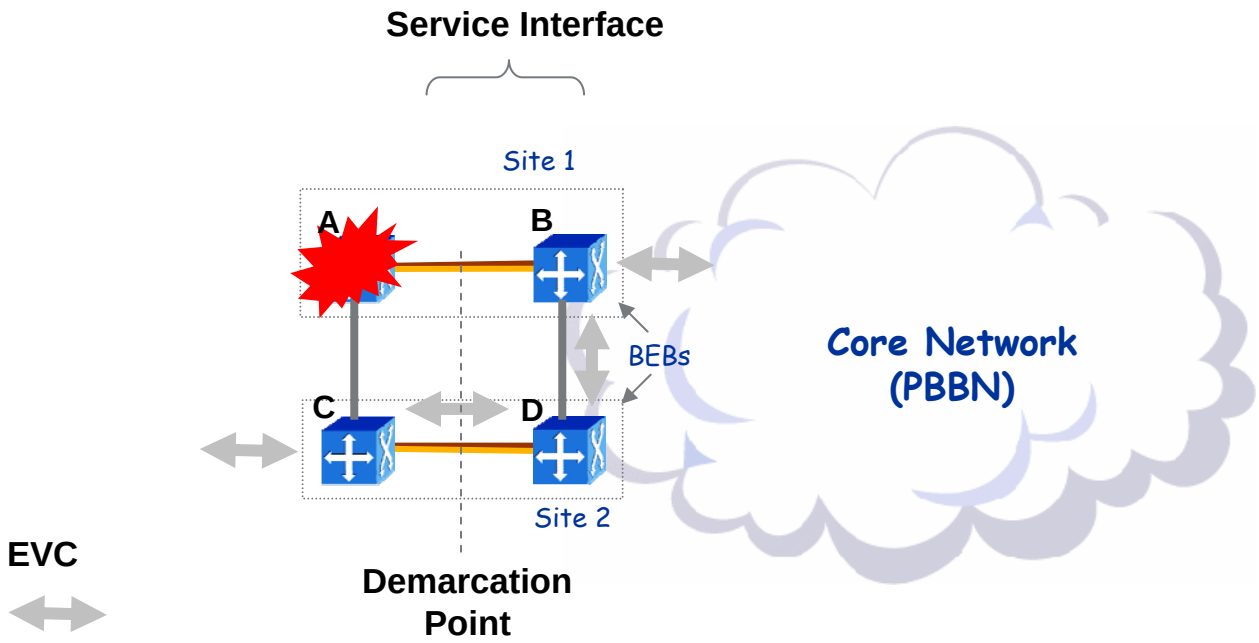
- An EVC entering at bridge A passes over the primary demarc link to bridge B
- At bridge B the BEB encapsulates frames with source B-MAC B

Primary Demarcation Link Failure



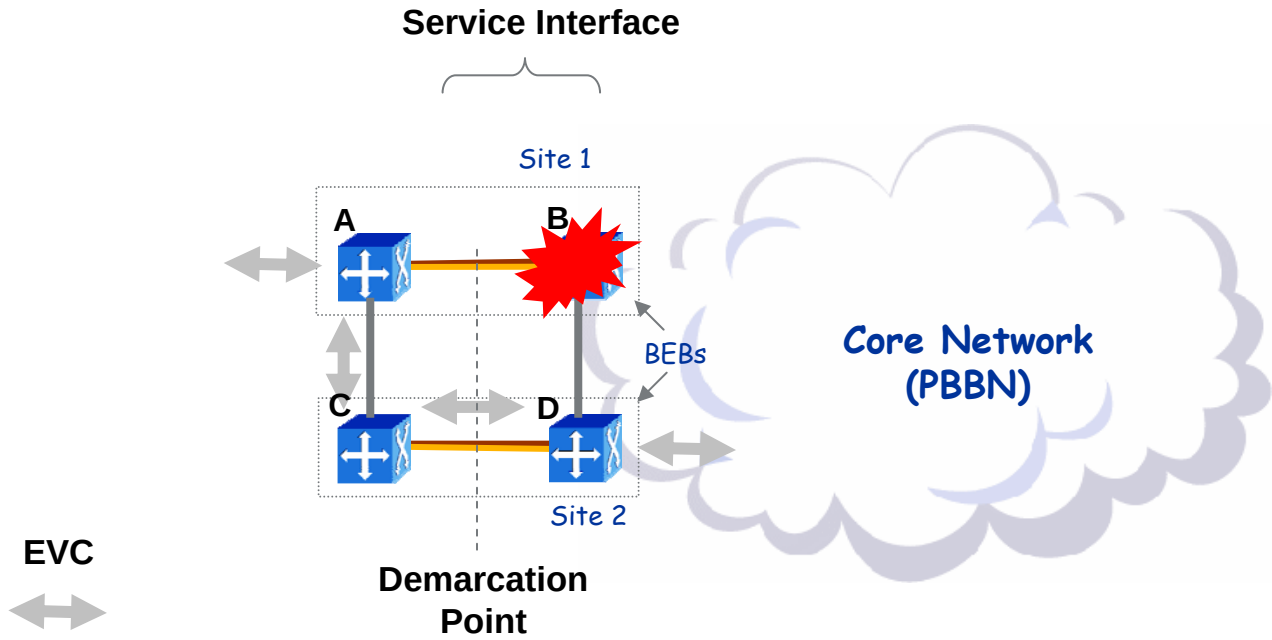
- If the primary demarc link fails the EVC bypasses the failure by routing through A-C-D-B
- Data enters the PBBN from bridge B encapsulated with source B-MAC B
- No state changes are required in BEBs at the edge of the PBBN

Attached Network Primary Boundary Bridge Failure



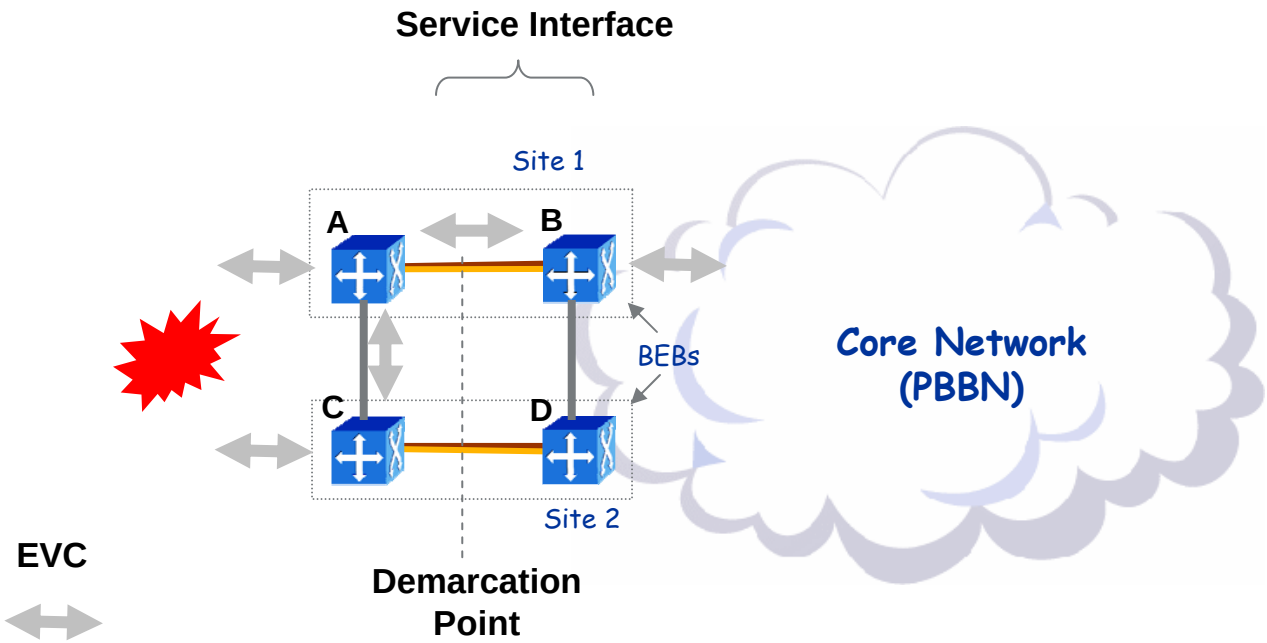
- If the attached network boundary bridge A fails then the attached network must re-route the EVC to boundary bridge C
- Boundary bridge C delivers frames to D and D uses the bypass link to deliver frames to B. Frames are encapsulated at B with source B-MAC B
- The state in the attached network must change to re-route the EVC to C
- No state changes are required in BEBs at the far edge of the PBBN

Core Primary Boundary Bridge Failure



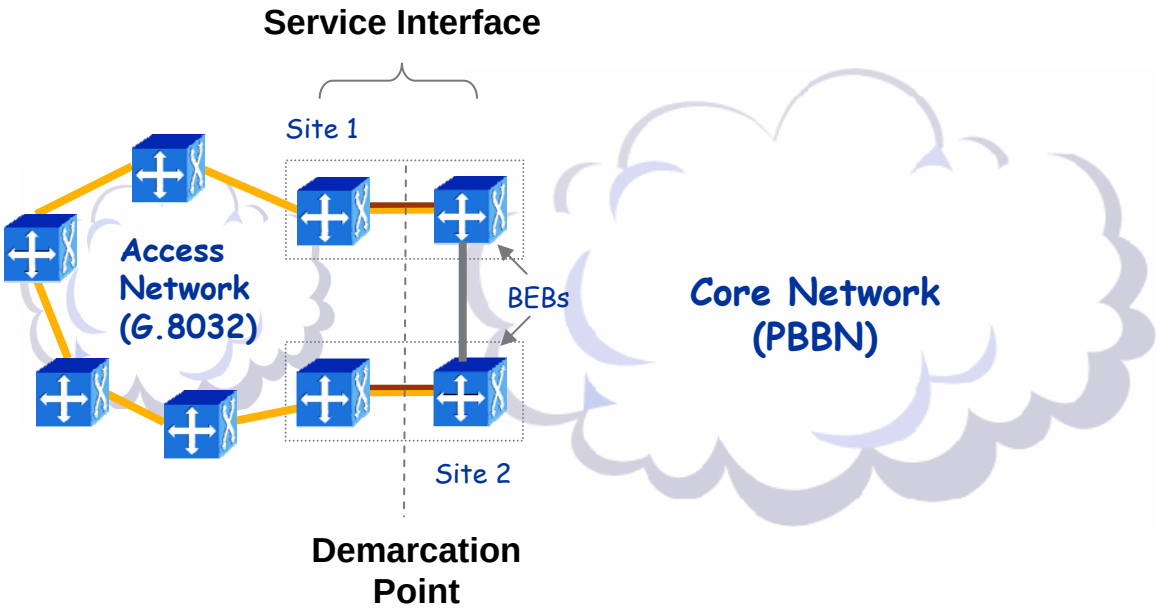
- If the core network boundary bridge B fails then the core network must re-route the EVC to boundary bridge D
- Boundary bridge A delivers frames to C and C uses the secondary demarc link to deliver frames to D.
  - Frames are encapsulated at D with source B-MAC D
  - Or frames are transferred with source B-MAC
- No state changes are required in the attached network
- The core network must change the state of the BEBs at the far edge of the PBBN by updating the filtering database of the I-Comp

Attached Network Segmentation Failure



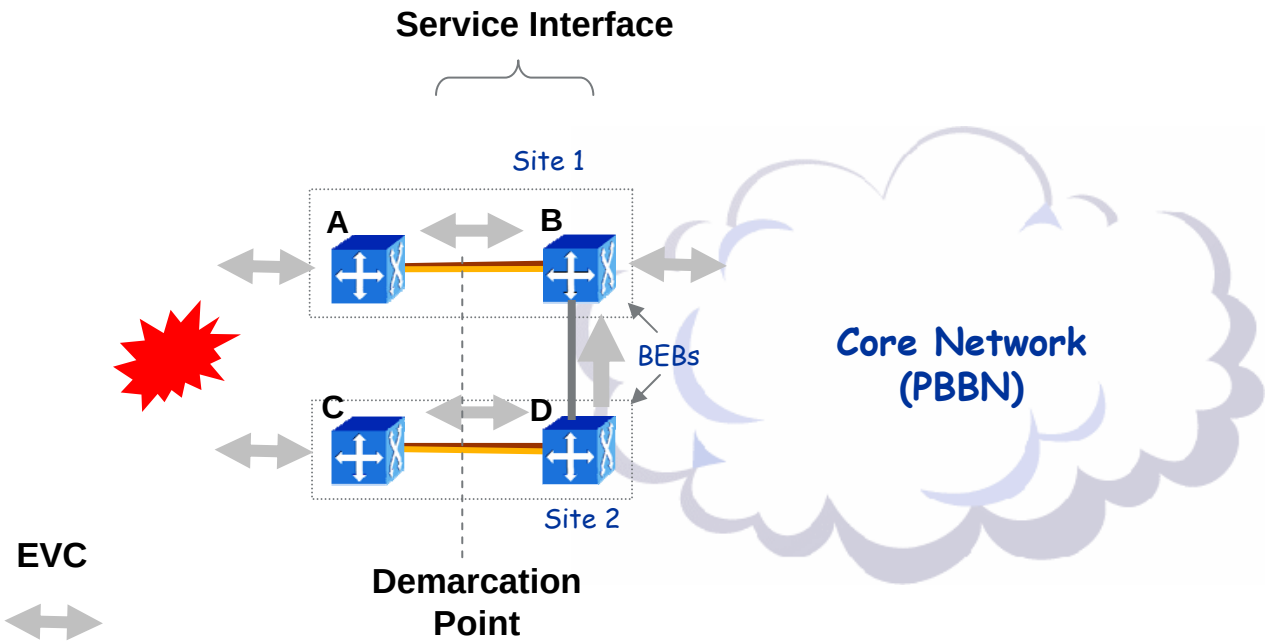
- The attached network has an internal segmentation fault which splits the EVC to A and C
- The EVC is delivered to over bypass link C to A to B
- No state change is required at the far edge of the PBBN

Special Case Topology – Access Chain



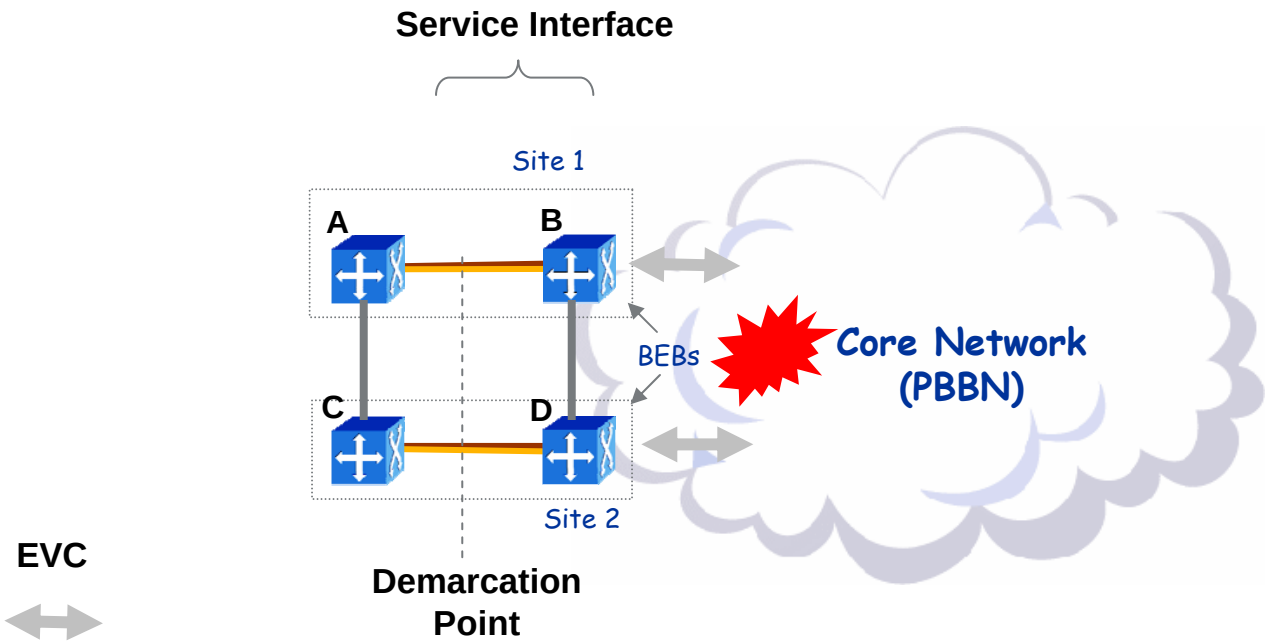
- For an open chain the attached network bypass link is not provided
- In this case a single failure will produce a segmentation fault

Attached Network Segmentation Failure -special case where we have an attached chain



- The attached network has an internal segmentation fault which splits the EVC to A and C
- The EVC is delivered to over both the primary and secondary demarc links
- Boundary bridge D uses the bypass link to direct the EVC traffic from C to B
- No state change is required at the far edge of the PBBN

Core Network Segmentation Failure



- The attached network has an internal segmentation fault which splits the EVC to B and D
- The EVC is blocked
- This is a failure case
- Detect the segmentation fault in the core and bring the interface down

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Protocols Over Demarcation Point

- Protocols over S-tagged demarcation point for PBN-PBBN
  - Interface operation protocol – monitors all 4 nodes and links
    - Uses PHY level CFM for link monitoring
    - Must be sufficient for link or node level protection
  - MVRP as access protocol (per EVC)
    - Need a way to accept – reject MVRP request
  - Optionally MSTP as access protocol (per MSTI)
- Protocols over demarcation point for I-BEB – PBBN and PBBN-PBBN
  - Interface operation protocol – monitors all 4 nodes and links
    - Uses PHY level CFM for link monitoring
    - Must be sufficient for link of node level protection
  - New MRP protocol for I-SIDs MIRP?
    - May have scaling issues
    - Need ability to send change for either side of interface
    - Need ability to accept or reject a request

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Protocols in PBN

- L2GP was defined in 802.1ah and provides decoupling of topology for MSTP
- Need similar protocol for SPB
- Need a liaison to ITU-T for similar protocol on G.8032
- Need provisions for interface operation protocol

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Protocols in PBBN

- Need interface operations protocol
- Need protocol used to update B-MACs over PBBN per service and per link

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Recommendations

- Issue new PAR for a class IV PBN – PBBN and I-BEB – PBBN redundant interface
- Don’t require a solution to the peer E-NNI
- Limit the solutions to the “ring” interface
- Specify the interface operations protocol
- Specify the B-MAC update protocol for 802.1ah
- Not certain the B-MAC update and MIRP protocol are different. If they are then specify the MIRP protocol.

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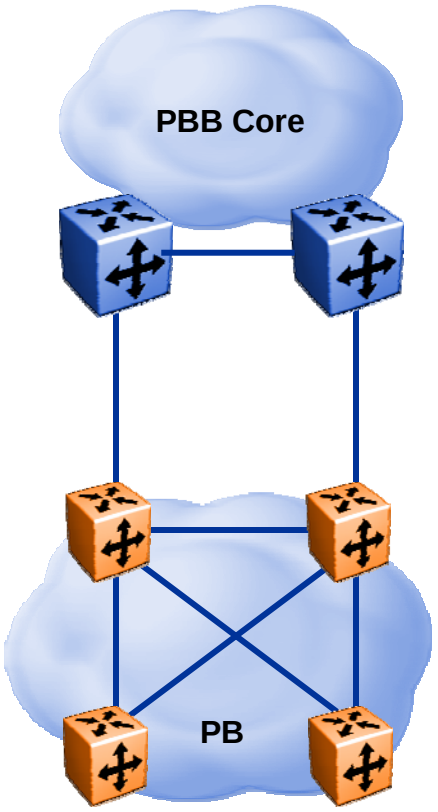
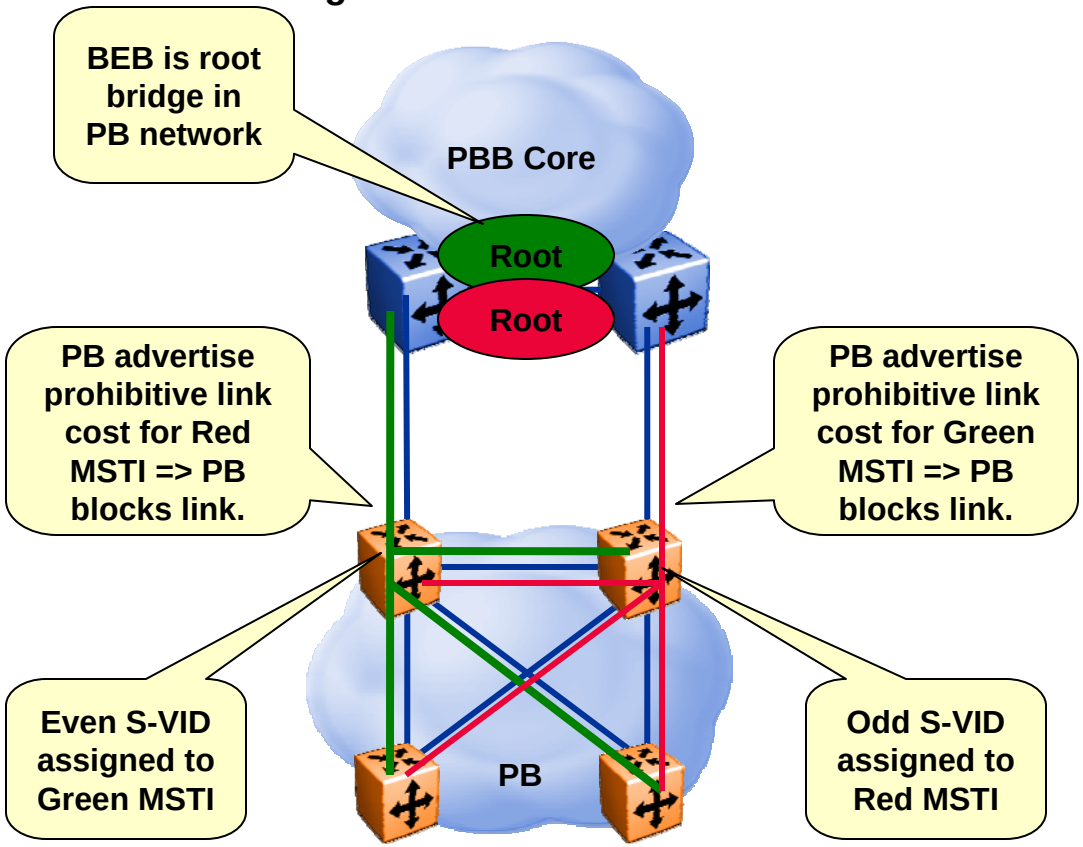
Backup Slides

Spanning Tree Trigger Operation

Physical View

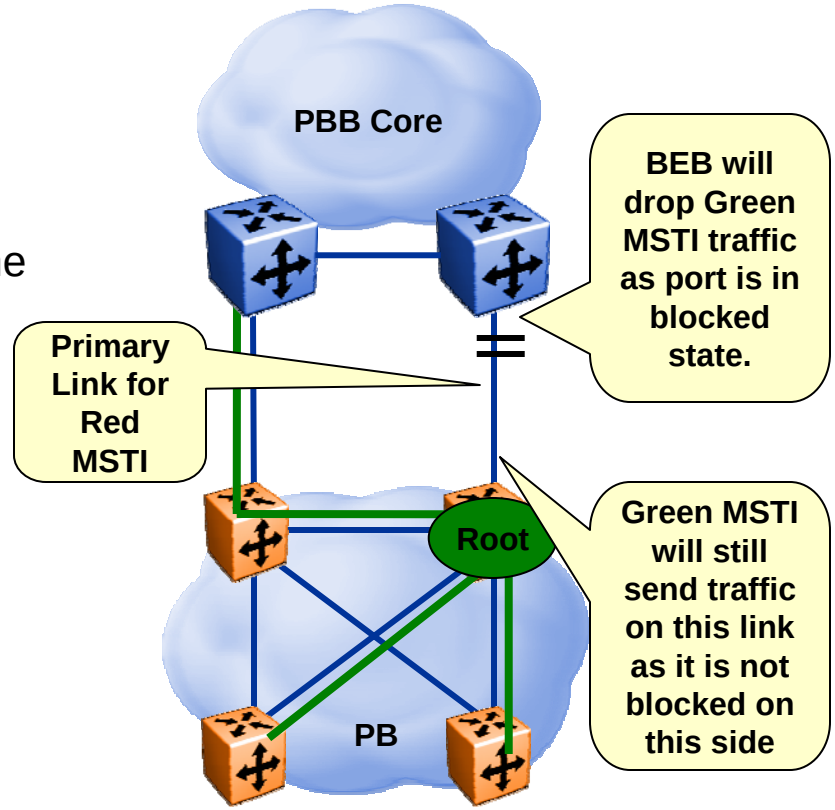


Logical View



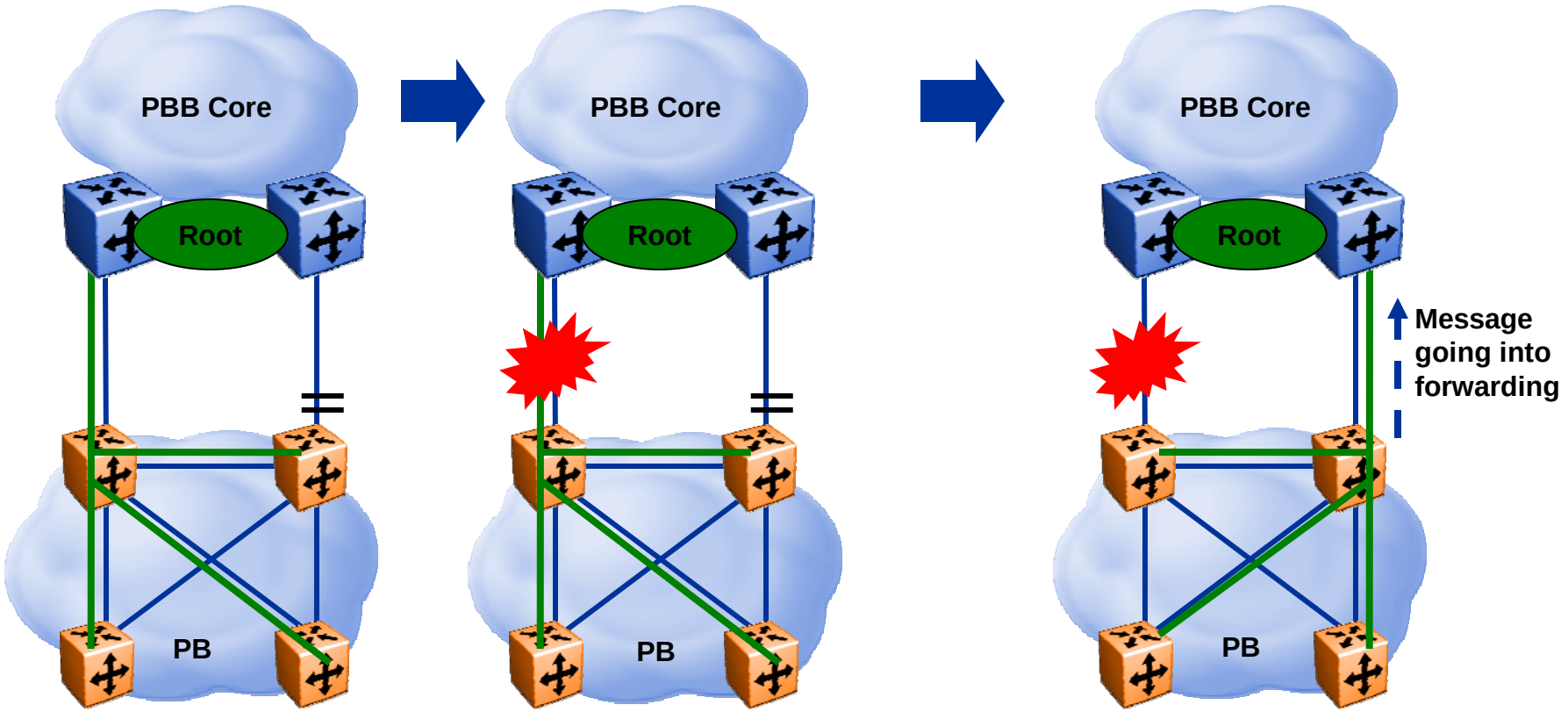
Who is the Root?

- If root was on PB node, then PB network may not block port to secondary BEB for that MSTI which causes inefficient usage of PB to PBB node link bandwidth.
- In example on the right, Red MSTI for which the link is not blocked on both sides would see reduced throughput.
- Since BEB pair is setup to only have one BEB handle traffic for a particular S-VID at a time, BEBs can ensure it will not use the secondary link when primary is active.

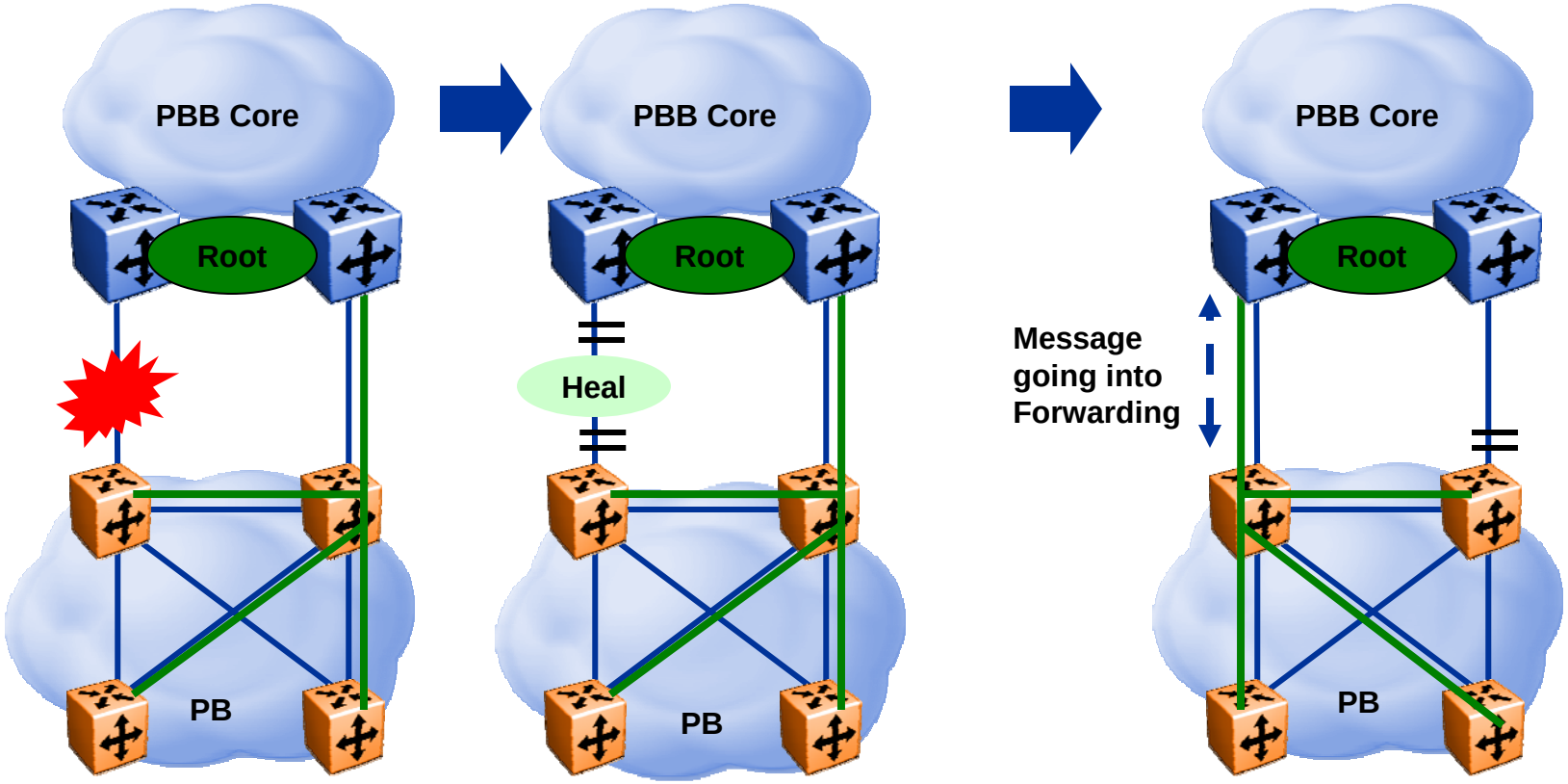


Conclusion: BEB pair should be the Root of MSTI. BEB Pair and PB Pair has to be in the same Region. BEB Pair will be CIST root.

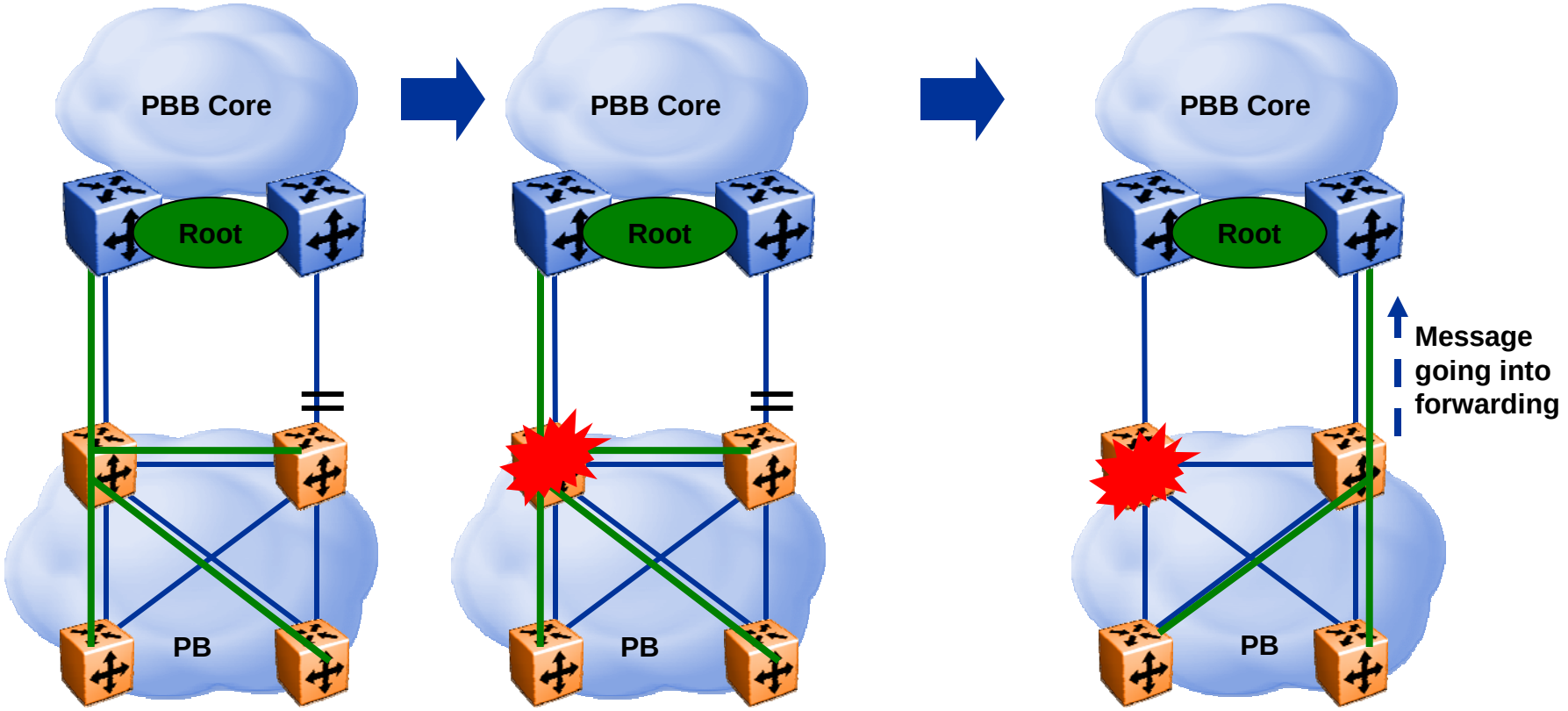
Failover Scenarios: Link cut



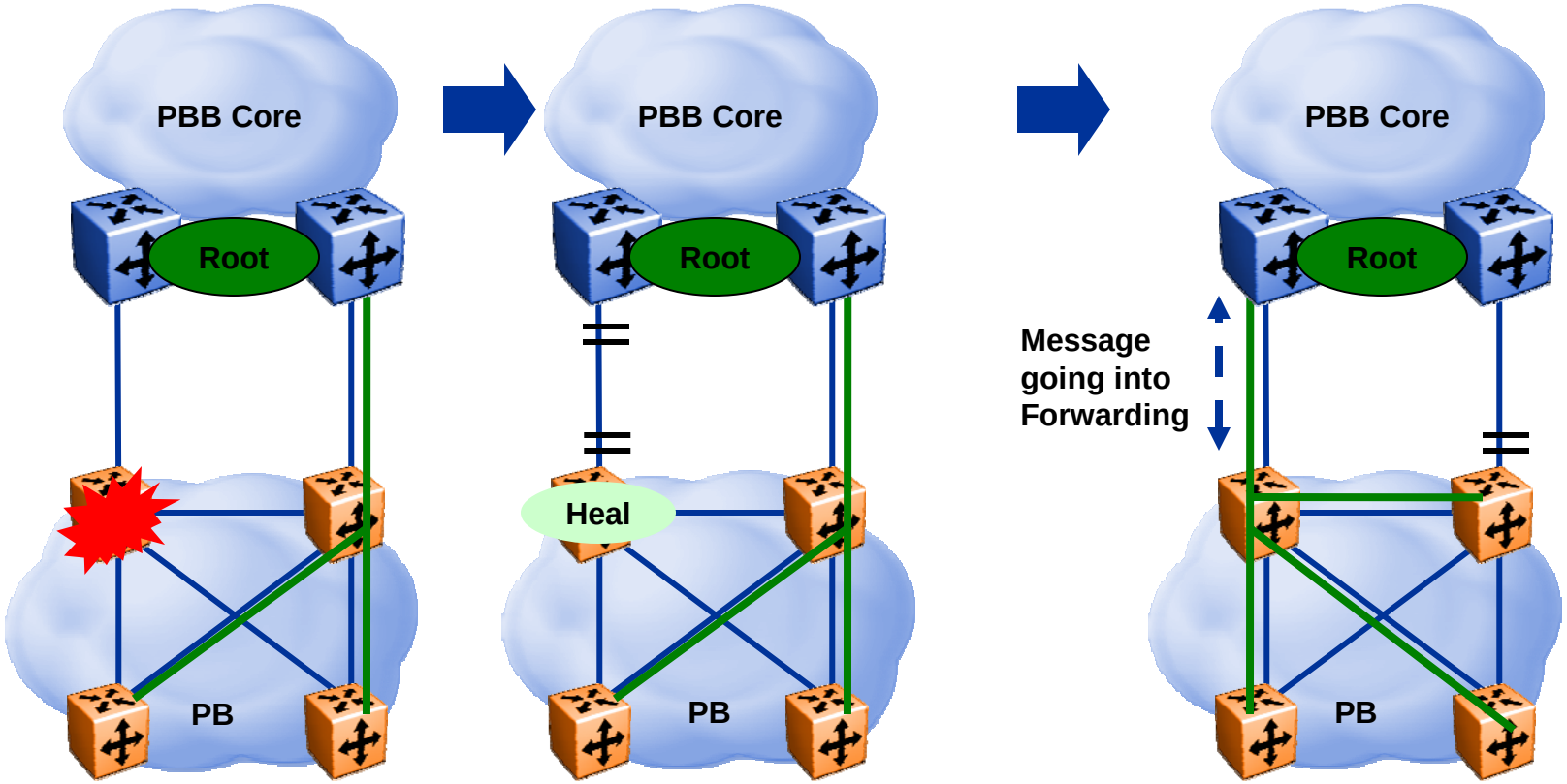
Failover Scenarios: Link Recovery



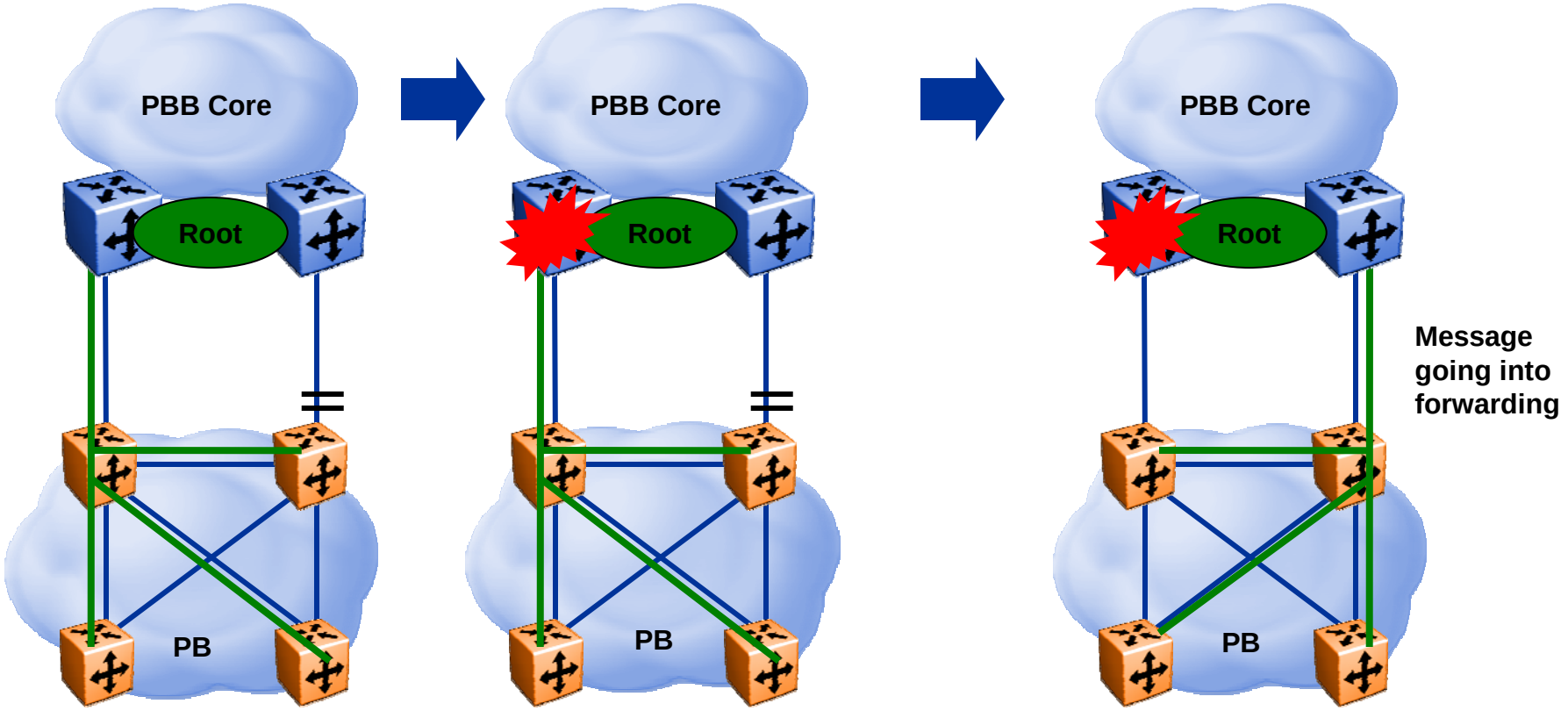
Failover Scenarios: PB Node Failure



Failover Scenarios: PB Node Recovery



Failover Scenarios: PBB Node Failure



Failover Scenarios: PBB Node Recovery