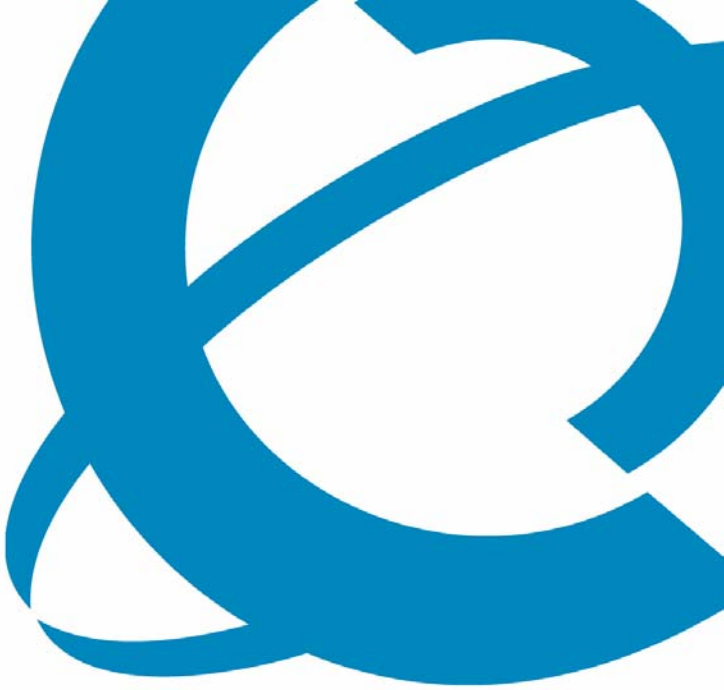


>THIS IS **THE WAY**

IEEE 802.1ah Update

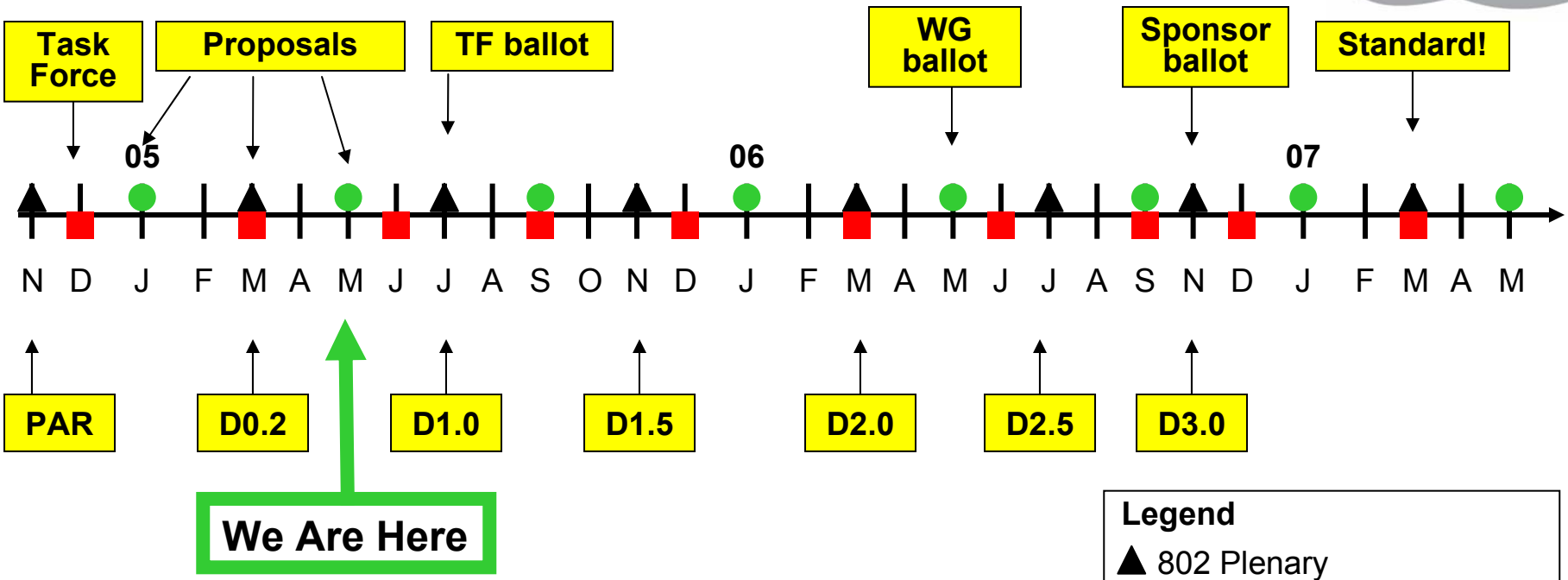
Paul Bottorff, Editor 802.1ah
May 9, 2005

>THIS IS NORTEL

Agenda

- > Introduction
- > Review
  - Terminology
  - Basic Operation
- > Frame Format Alternative
  - Formats from draft 1
  - Format identifier field proposal
  - Format mapping to I-Comp/B-Comp reference model
- > Reference Model Alternative
  - I-Comp/B-Comp reference model (Draft 1)
  - M-Comp reference model alternative
  - Revised I-Comp/B-Comp reference model

P802.1ah - Provider Backbone Bridges –
Targeted Timeline



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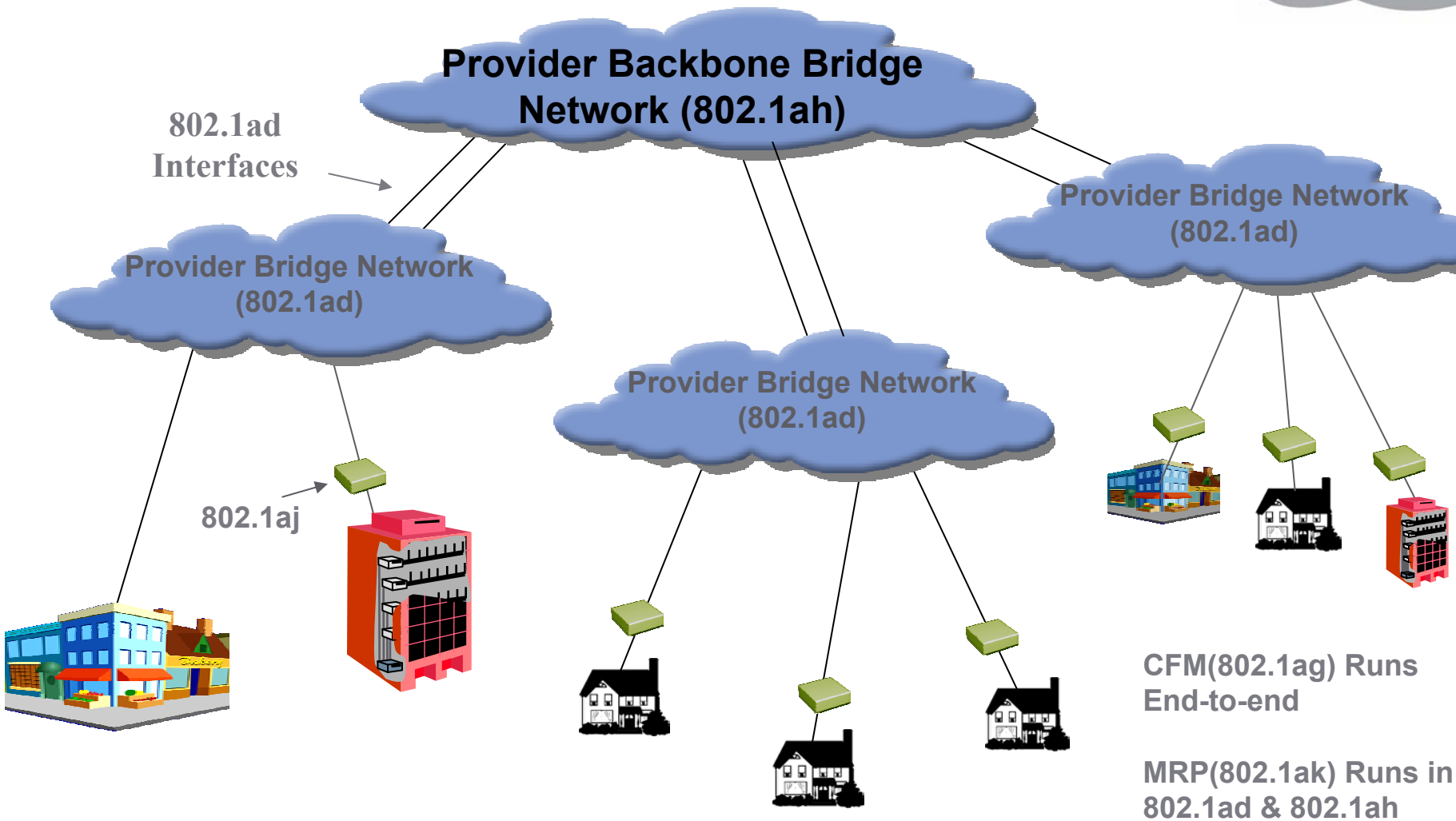
- Muneyoshi Suzuki, Assistant Editor, suzuki.muneyoshi@lab.ntt.co.jp

IEEE 802.1ah (Provider Backbone Bridge) Context



Draft 0.2 Content

> Draft 0.2 available at: http://www.ieee802.org/1/pages/802.1ah.html

> Much of P802.1ad is included within editor's notes

> Added clauses 23, 24, and 25
  - Clause 23: **Support of the MAC Service by Provider Backbone Bridged Networks**
  - Clause 24: **Principles of Provider Backbone Bridged network operation**
  - Clause 25: **Principles of Provider Backbone Bridge operation**

> **Clause 1 contains some suggestions for scope**

> **Clause 3/4 contains new Provider Backbone Bridge definitions and acronyms**

> **Clause 9 contains I-TAG VCI format**

Open items in Draft 0.2

> Clause 5: Conformance statement

> Clause 12: Management for PBB bridges

> Clause 23:

- Port based interface description
- I-Frame based interface description

> Clause 24:

- Interaction of Provider Backbone Edge Bridges with Provider Bridge spanning trees
- Operation of Provider Backbone Bridge spanning trees

> Clause 25:

- Details of I Component and B Component operation
- Operation of address correlation data base

> Informative annex on an integrated C-VLAN aware component

The Big Ticket Items for Draft 1.0

> No format identifier specified for I & B formats
  - Could use multiple .1ah Ethertypes or format field in I-TAG
  - Additional formats are necessary to indicate a “naked” OAM frame

> Current Dual Relay Model Issues
  - Externalized “naked” I-TAG interface (I-Format)
  - B-Comp is upside down
  - I-Comp to B-Comp relationship not 1-1
  - I Format not consistent with standard tag operations
  - Virtual MAC addressed by B-MAC is not clearified by draft 0.2

> Draft 1 has only an S-TAG user interface
  - Could also support an untagged transparent interface
  - Extensions also allow embedding a C-VLAN aware component
  - Also the “naked” I-TAG interface could be externalized

> Decoupling PBN and PBBN spanning tree is not described
  - Redundant PBB interface is not specified
  - Spanning tree handling for redundant PBB

> Extended multicast pruning techniques are not described for PBBNs

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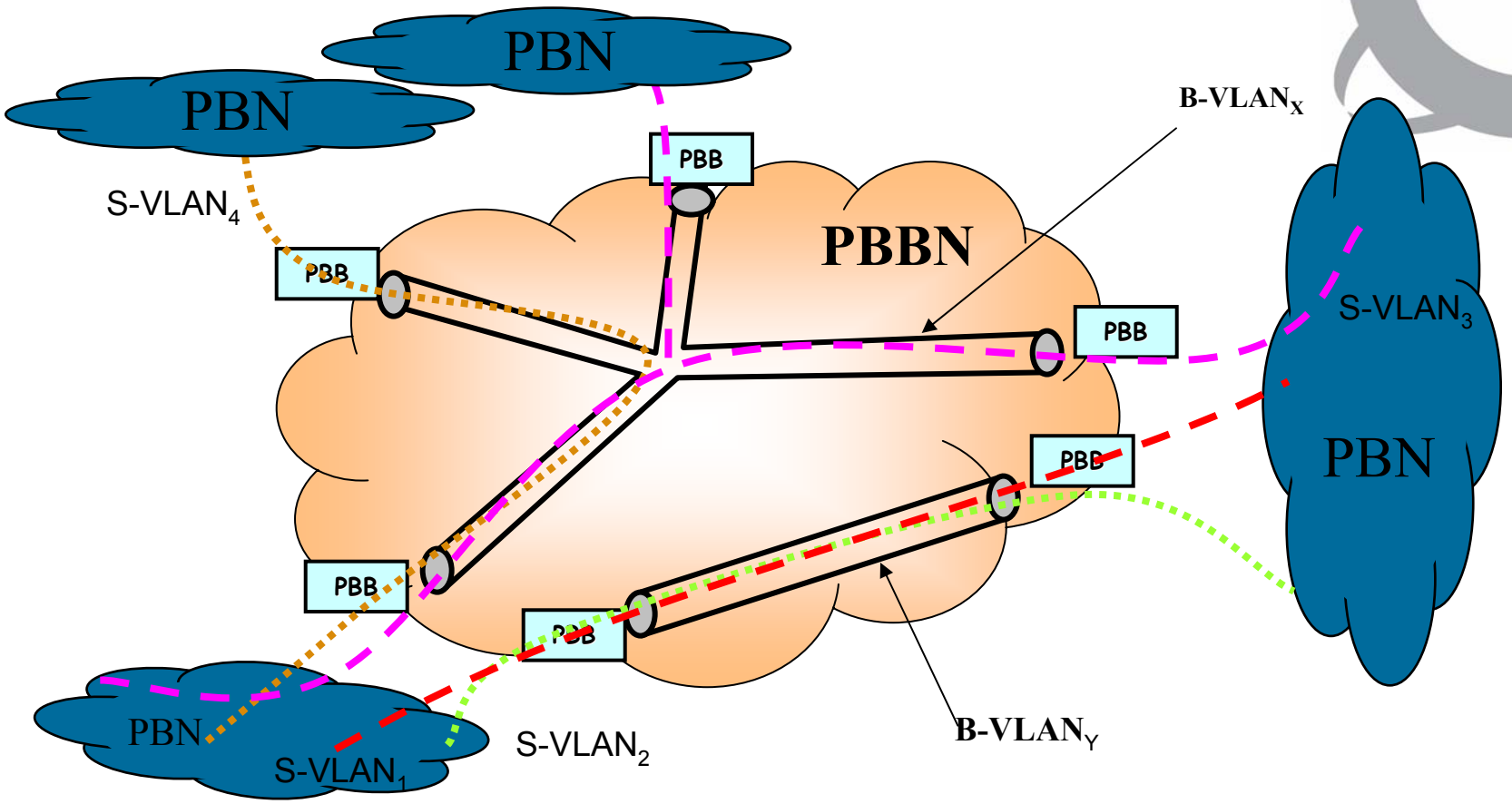
Agreed Terminology

- IEEE 802.1ad Terminology
  - C-TAG — Customer VLAN TAG
  - C-VLAN — Customer VLAN
  - C-VID — Customer VLAN ID
  - S-TAG — Service VLAN TAG
  - S-VLAN — Service VLAN
  - S-VID — Service VLAN ID
- Additional Provider Backbone Bridge Terminology
  - I-TAG — Extended Service TAG
  - I-SID — Extended Service ID
  - C-MAC — Customer MAC Address
  - B-MAC — Backbone MAC Address
  - B-VLAN — Backbone VLAN (tunnel)
  - B-TAG — Backbone TAG Field
  - B-VID — Backbone VLAN ID (tunnel)

More Terminology

- CBN — Customer Bridge Network
- CB — Customer Bridge
- PBN — Provider Bridge Network
- PB — Provider Bridge
- PBBN — Provider Backbone Bridge Network
- PBB — Provider Backbone Bridge

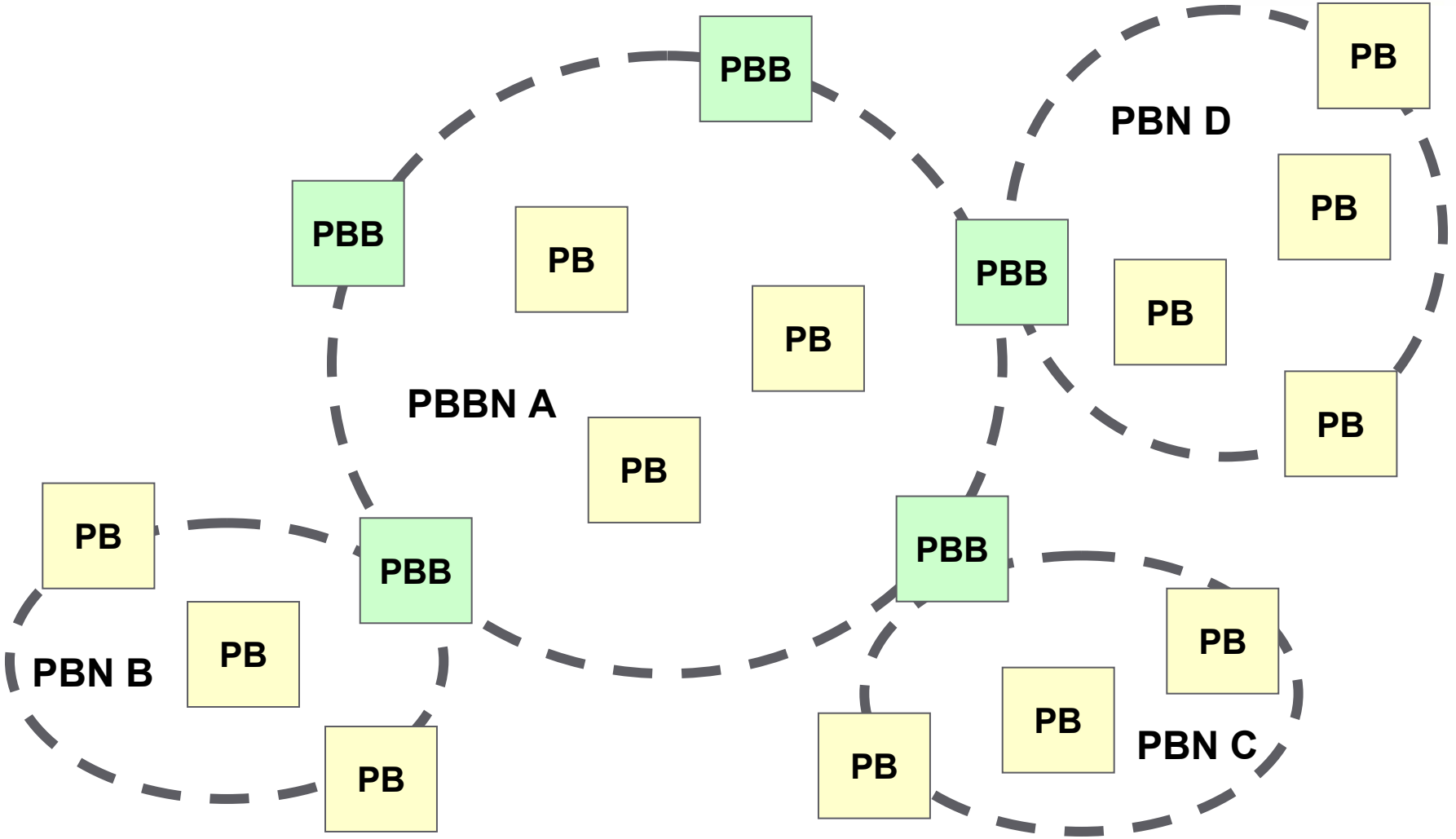
PBBN Provides Multi-Point tunnels between PBNs



- **PBB**: Provider Backbone Bridge Edge

- Each B-VLAN carries many S-VLANs
- S-VLANs may be carried on a subset of a B-VLAN (i.e. all P-P S-VLANs could be carried on a single MP B-VLAN providing connection to all end points.

Combined 802.1ad and 802.1ah Network



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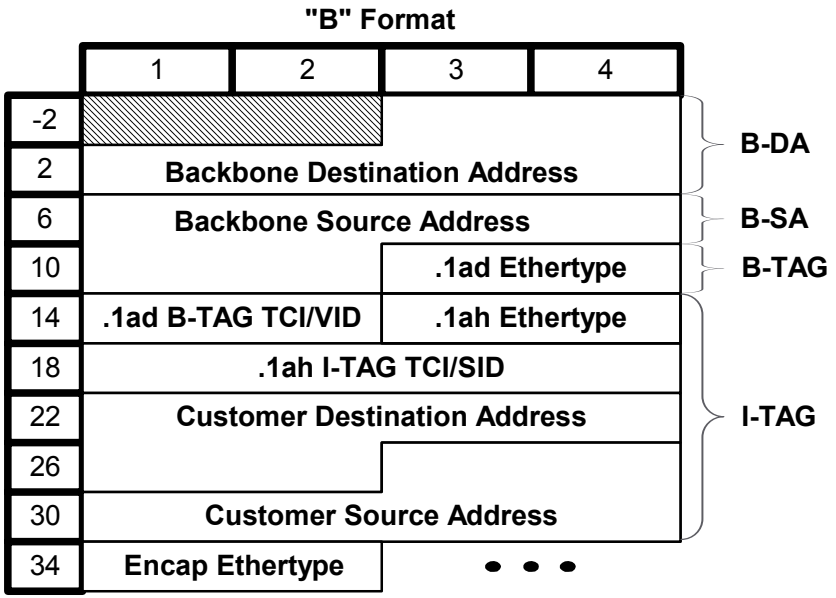
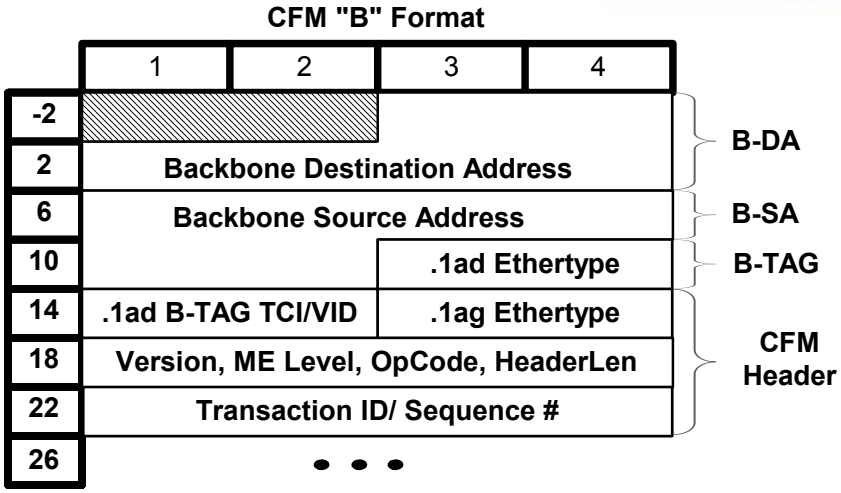
802.1ah Encapsulation Format

- 802.1ah Bridges encapsulate frames with a BBN header
- 802.1ah header contains
  a) Extended Service identifier (I-SID)
     - Identifies the Provider Bridge S-VLAN within the BBN
     - Is carried within an I-TAG which is 32 bits long and identified by an 802.1ah Ethertype
     - Requires at least 2^20 bits to identify 1M services
     - Proposals for 2^20, 2^24, and 2^28 bits
  b) Site Connectivity identifier (B-VID)
     - Identifies a B-VLAN (or tunnel) that is used to transport the BBN S-VLANs
     - Site connectivity (i.e., tunnel) can be point-to-point or multi-point in nature
     - B-VLAN is carried in a B-TAG with the 802.1ad Ethertype and S-TAG format
  c) Backbone POP Address (B-MAC)
     MAC Address for POPs within Site Connectivity
- 802.1ad Service VLAN IDs (S-VIDs) map to 802.1ah Extended Service IDs (I-SIDs)
  - PBN S-VIDs are local to the PBN
  - PBBN I-SIDs are local to the PBBN

Formats On PBBN Wires



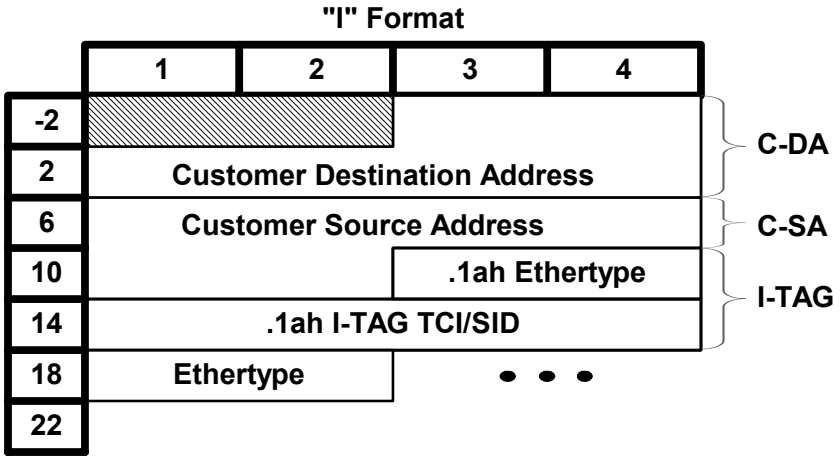


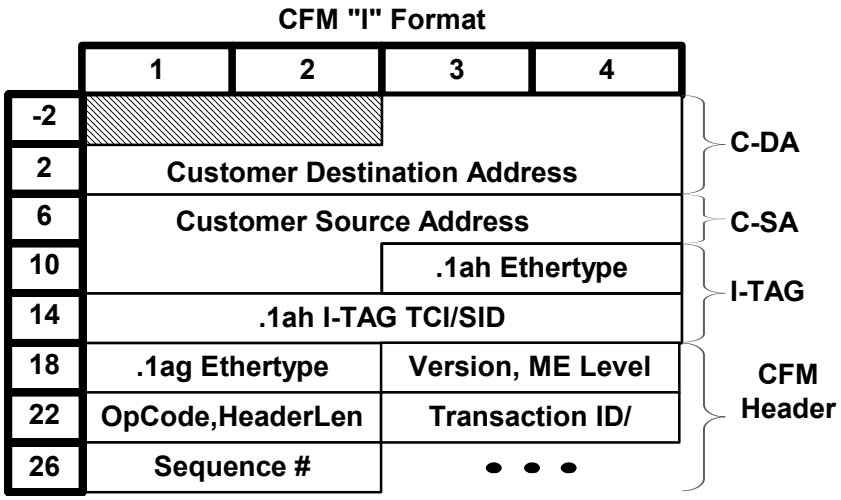
B-TAG is identical to S-TAG and optional in the frame

I-TAG is optional in frame

CFM format is for management of a B-VLAN

“Naked” I-TAG Formats on I-B Link

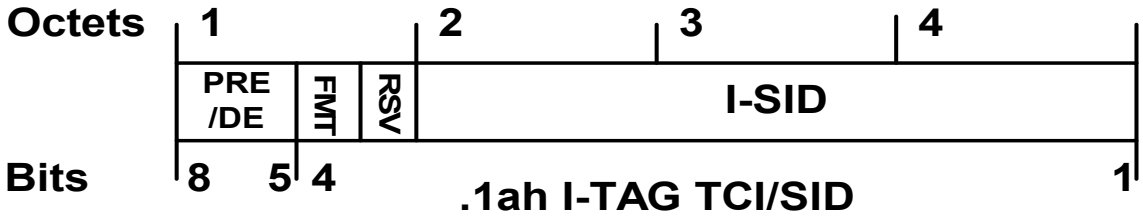




No B-TAG present in these frames

I-TAG may also be absent in these formats

Proposal for I-TAG Format Field



FMT: 0 - "I" Format No Encapsulated Frame
1 - Reserved
2 - "B" Format Encapsulated Frame w/o FCS
3 - "B" Format Encapsulated Frame w FCS

RSV: Reserved flags must be set to 0

I-SID: 24 bits

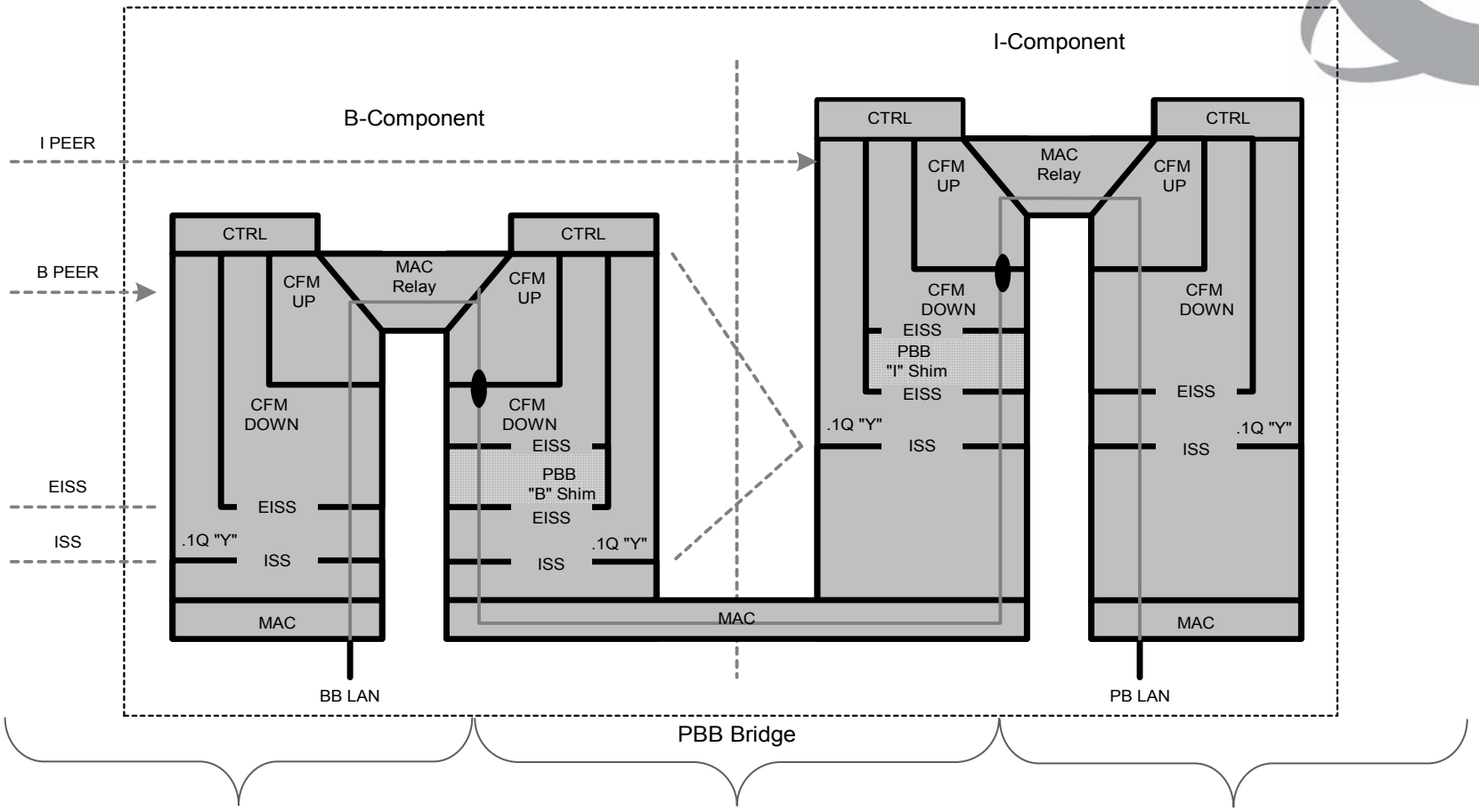
> High order bit of FMT determines “I” Format or “B” Format

> Low order bit of FMT determines FCS retention

> RSV bits are for future use

> Alternatively two Ethertypes would be required

Dual Relay PBB Model

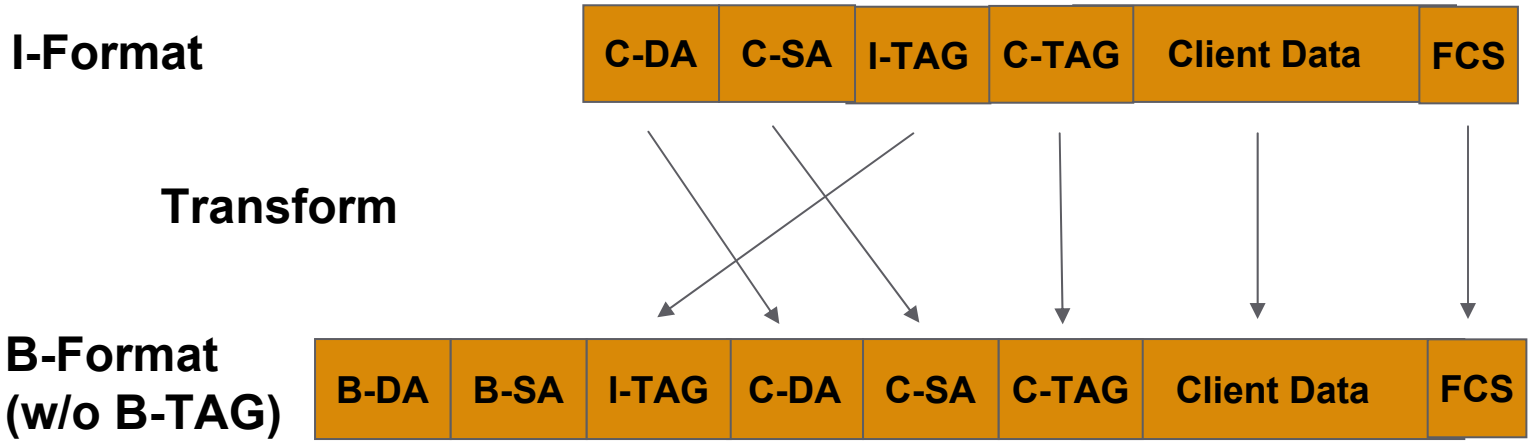


B-Formats
MAC Encap
802.1ah

I-Formats
“Naked I-TAG”
802.1ah

S-Formats
802.1ad

Alternative For Naked I-TAG Format?



> Pro for I-Format is minimum information between I&B Comp

> Con for I-Format is B-Shim transformation is upside down

> Pro for B-Format is B-Shim has a regular transformation

> Con for B-Format is I-B link either exposes backbone address or uses dummy addresses

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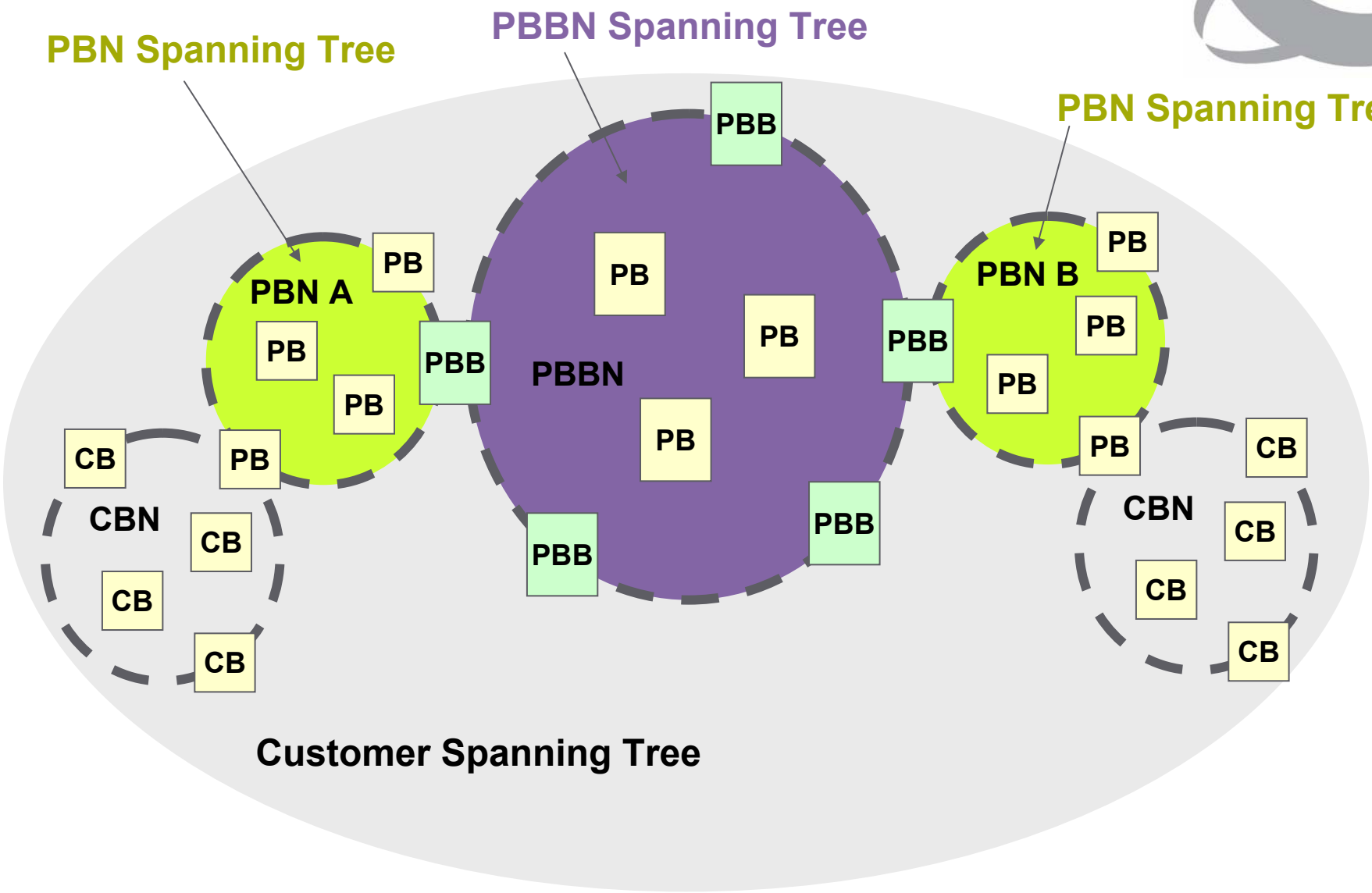
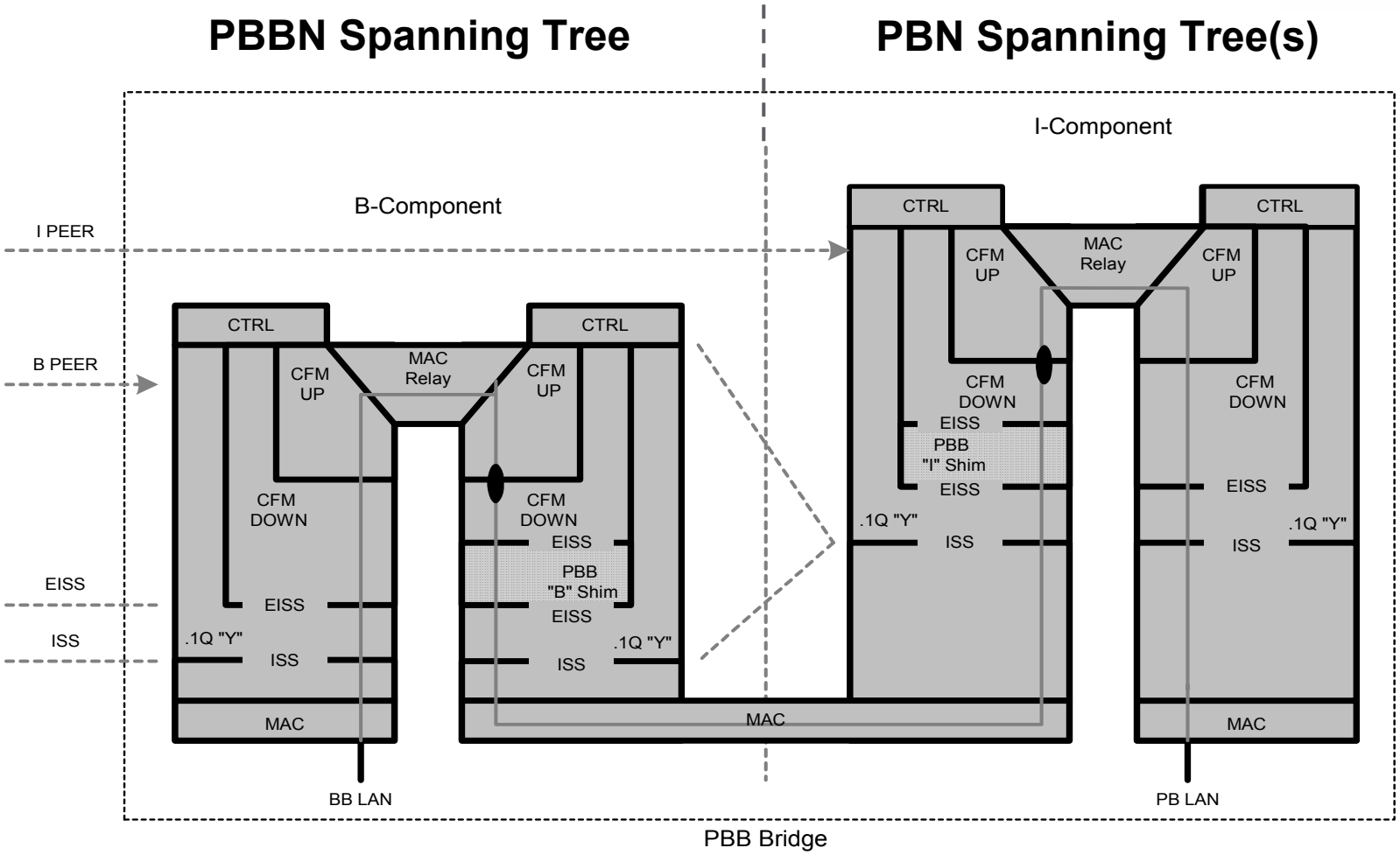
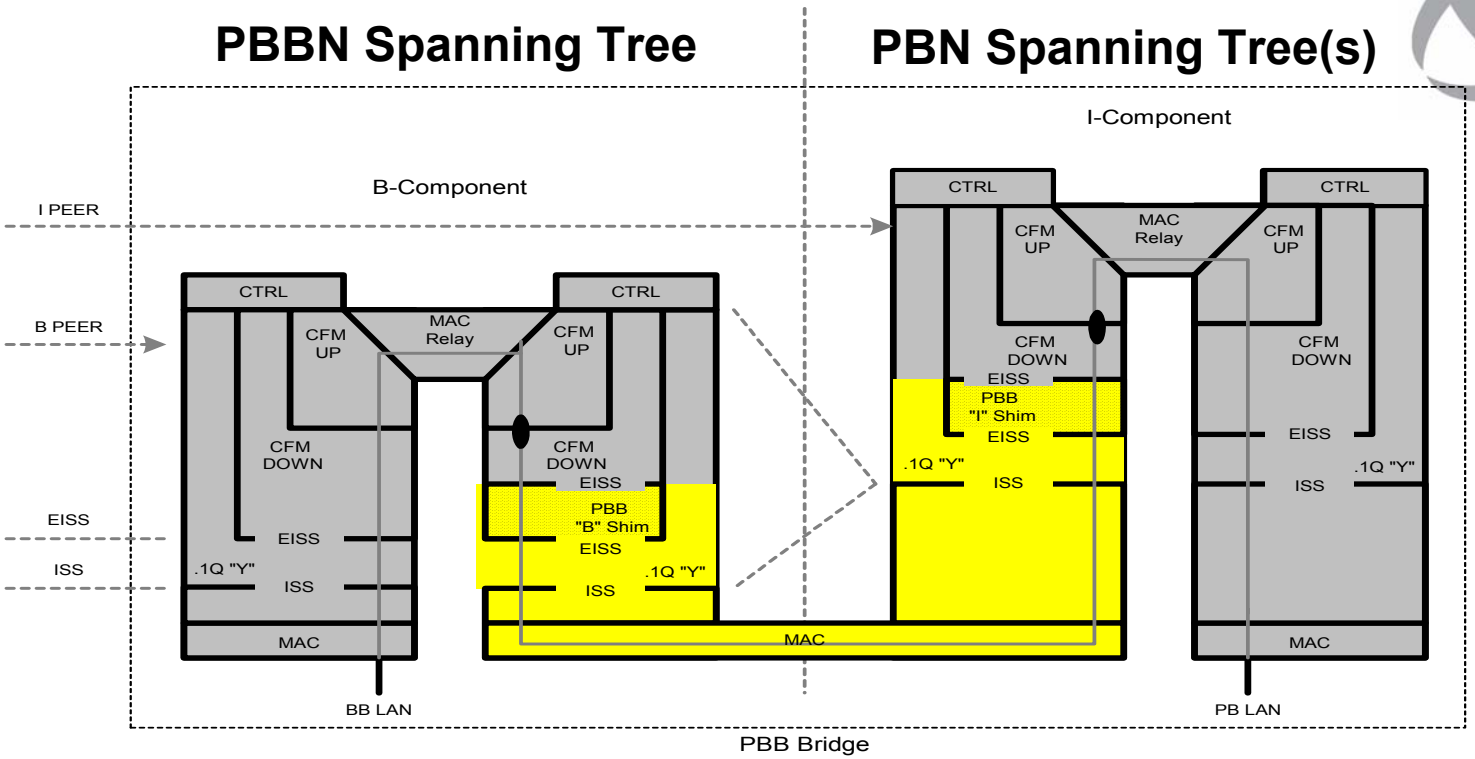


Dual Relay PBB Model

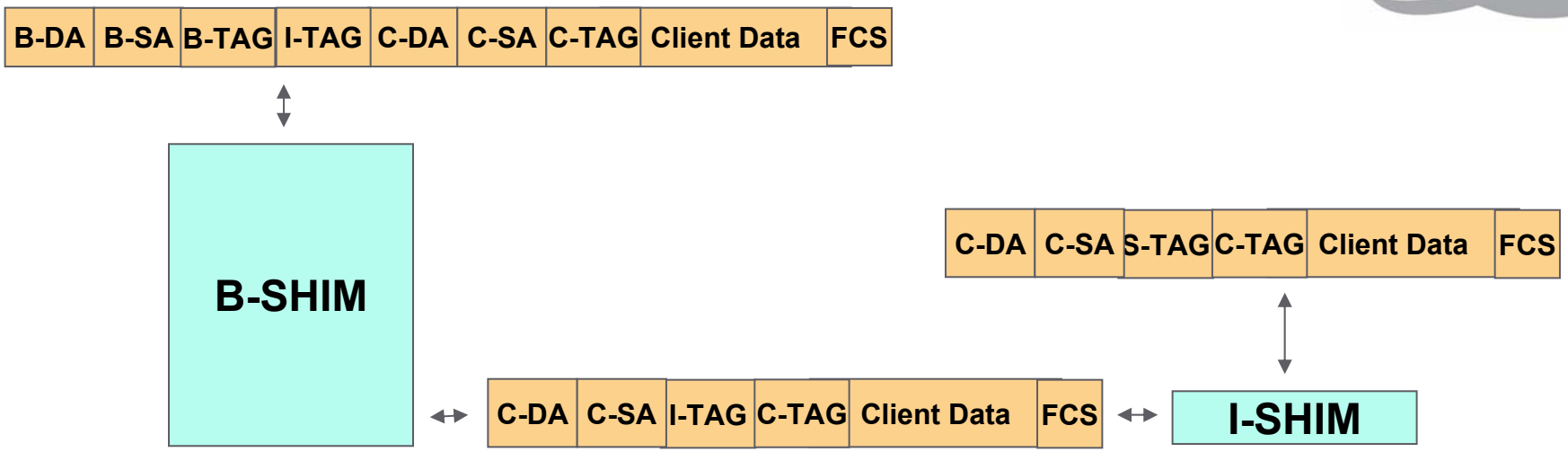


Shims May Split Functions Anywhere



- Entire yellow region may be considered a single shim with functions divided to either side of the interconnect
- Splits moving functions toward the I-Comp move knowledge of the backbone topology into the PBN region
- Current split moves most functions toward B-Comp maximizing information hiding

Current Reference Model: Alternative 1

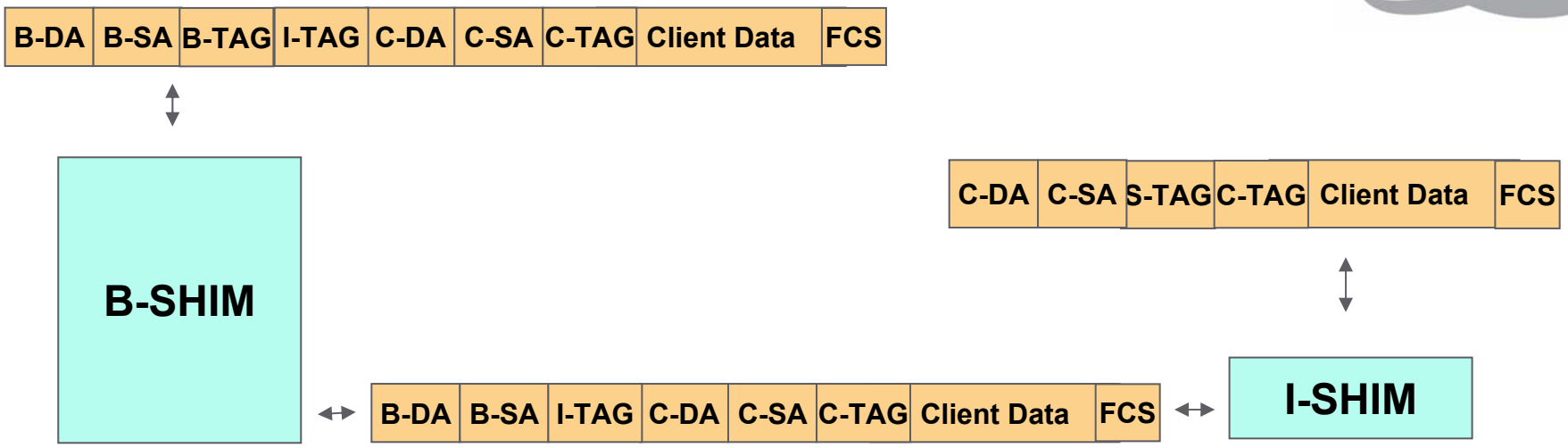


> I to B Shim format “naked I-TAG” in I-Format
  - Minimum frame information between I-Shim and B-Shim
  - B-Shim transform is irrigular since I-TAG is moved in frame
  - B-Shim upside down since frame grows moving upward

> I to B Shims are 1-1

> I-Shim function is very thin while B-Shim does most of work

Alternative 2

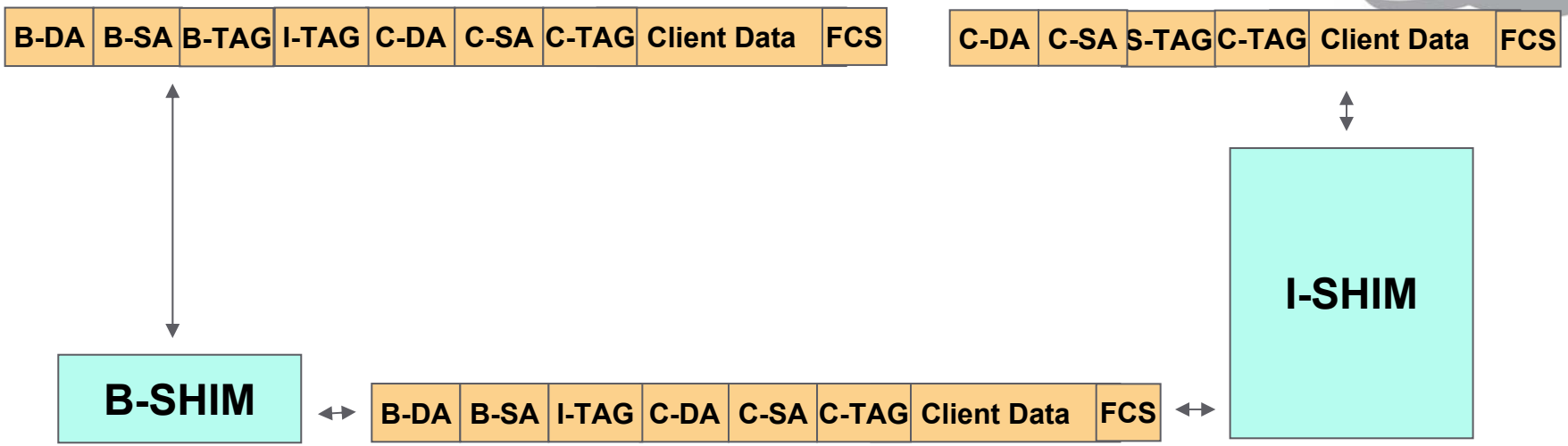


> I to B Shim format “naked I-TAG” in B-Format
  - B-DA is dummy field
  - B-Shim transform is regular
  - B-Shim right side up

> I to B Shims are 1-1

> I-Shim function is thin while B-Shim does most of work

Alternative 3

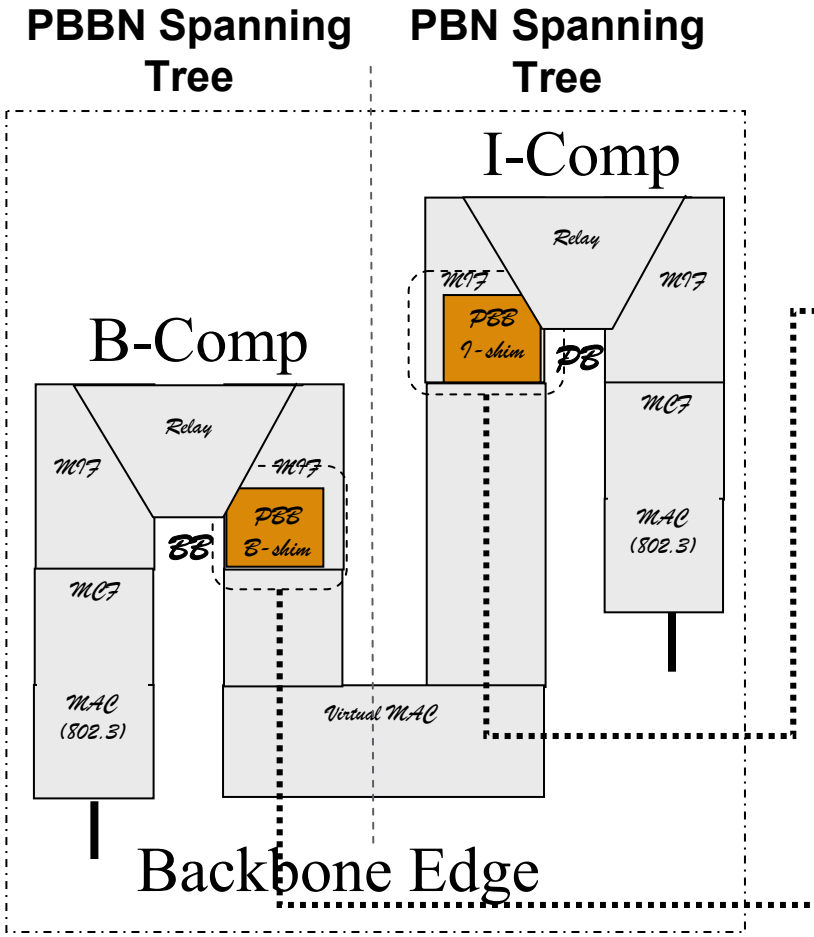


> I to B Shim format “naked I-TAG” in B-Format
  - B-DA functions handled by I-Shim
  - B-Shim transform is regular
  - B-Shim right side up

> I to B Shims are 1-1

> I-Shim function is thick while B-Shim only handles B-TAG

PBB I & B Shim Alternatives 1-3

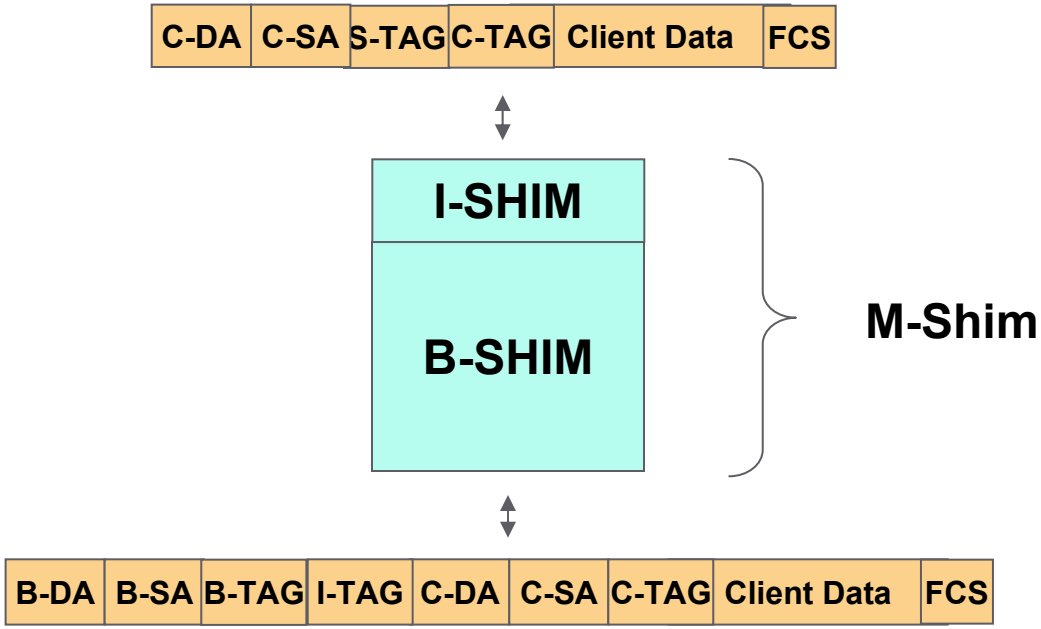


> I-Shim Operations
- Maps S-VID from 802.1ad into larger Extended Service VID (I-SID)
- Filters L2 control packets sourced by core relays or by provider bridge relays (divides spanning trees)

> I or B Operations
- Does encap/decap of 802.1ad frame
- Learns and Correlates Backbone POP and Customer MAC addresses

> B-Shim Operations
- Filters L2 control packets sourced by core relays or by provider bridge relays (divides spanning trees)

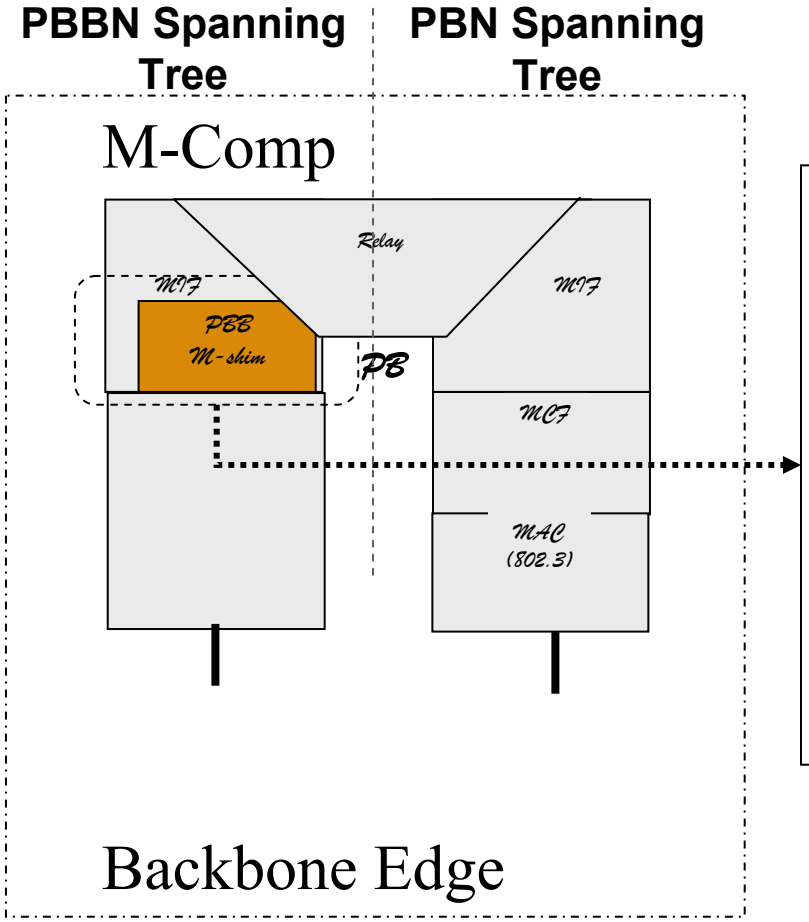
Alternative 4



> I and B Shim combined into an M-Shim
  - All functions contained in single shim
  - Model becomes a single relay model
  - Functions are right side up
  - Spanning tree splits in the middle of the relay

> No middle level interface exposed by architecture

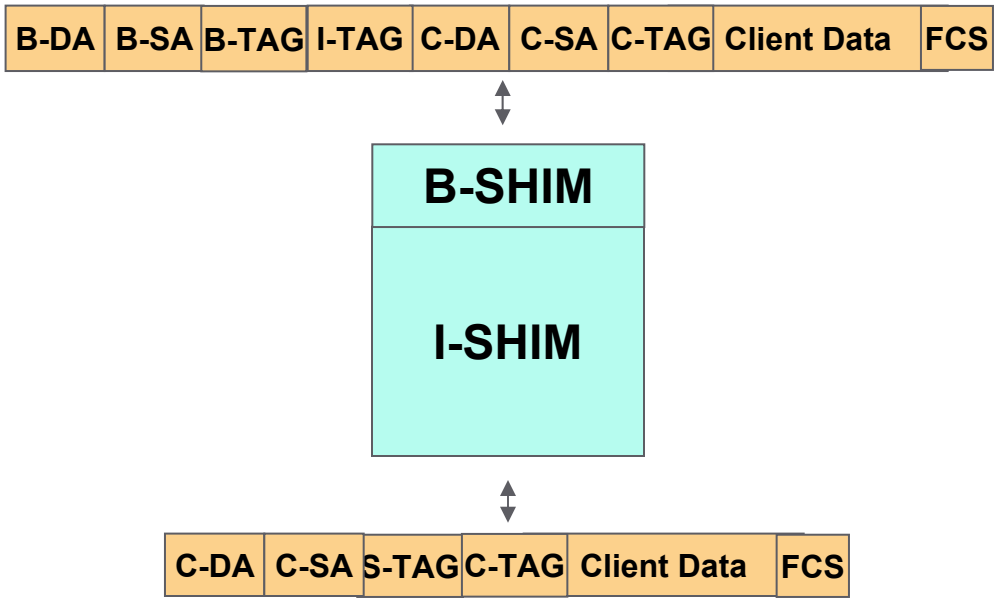
PBB I & B Shim Alternatives 4



> M-Shim Operations

- Maps S-VID from 802.1ad into larger Extended Service VID (I-SID)
- Filters L2 control packets sourced by core relays or by provider bridge relays (divides spanning trees)
- Does encap/decap of 802.1ad frame
- Learns and Correlates Backbone POP and Customer MAC addresses
- Filters L2 control packets sourced by core relays or by provider bridge relays (divides spanning trees)

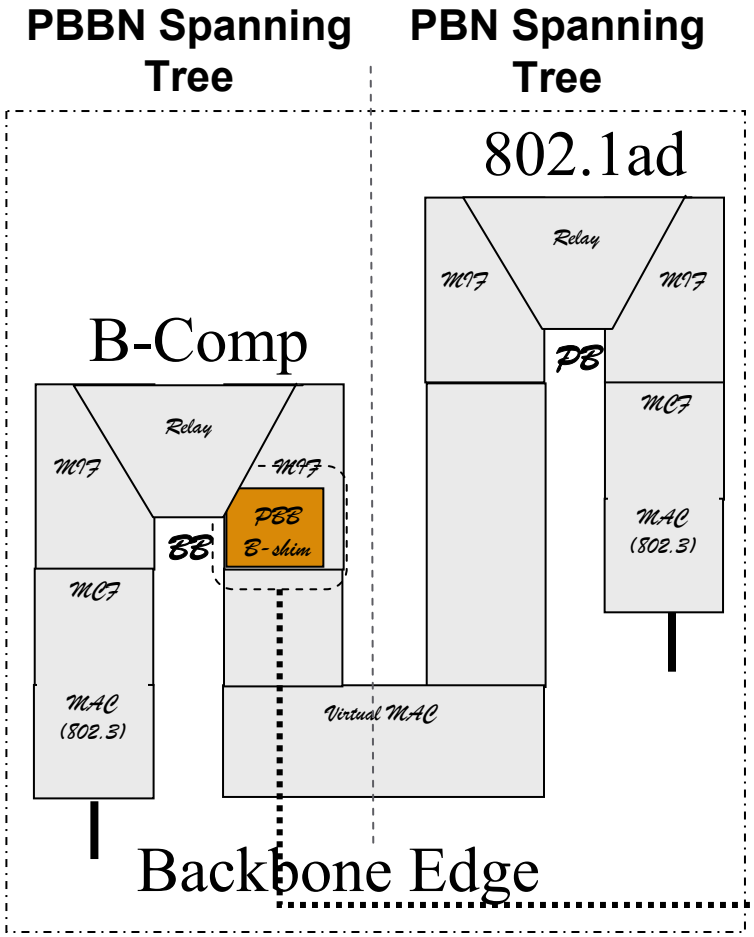
Alternative 5



> I and B Shim combined into an M-Shim
  - All functions contained in single shim
  - Model becomes a single relay model
  - Functions are right side up
  - Spanning tree splits on link

> No middle level interface exposed by architecture

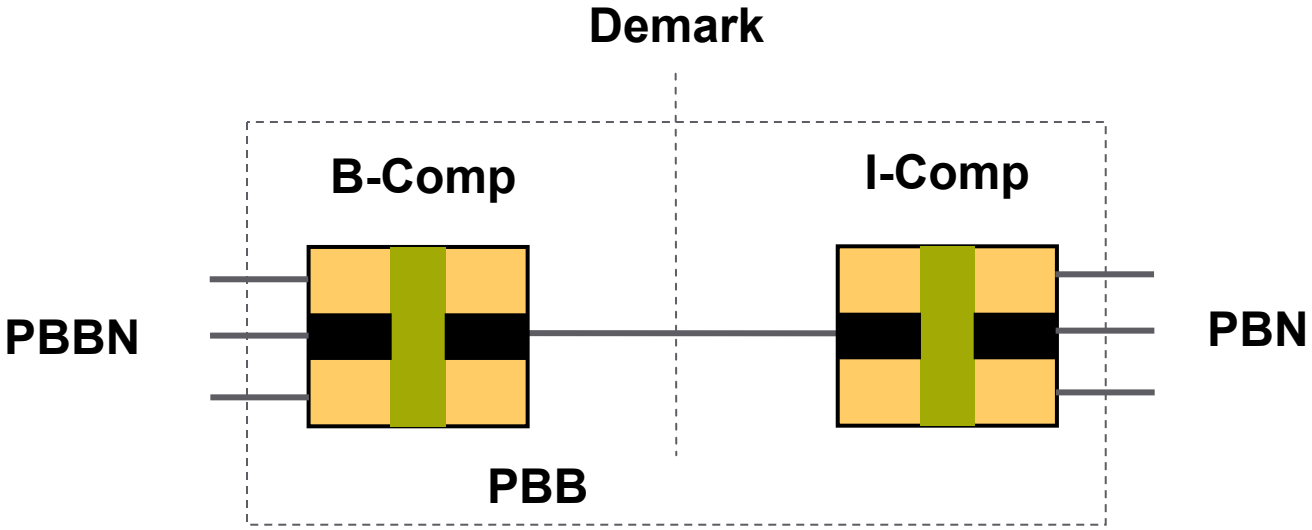
PBB I & B Shim Alternatives 5



> I & B -Shim Operations

- Maps S-VID from 802.1ad into larger Extended Service VID (I-SID)
- Filters L2 control packets sourced by core relays or by provider bridge relays (divides spanning trees)
- Does encap/decap of 802.1ad frame
- Learns and Correlates Backbone POP and Customer MAC addresses
- Filters L2 control packets sourced by core relays or by provider bridge relays (divides spanning trees)

Alternatives 1-3: PBN to PBBN Demark



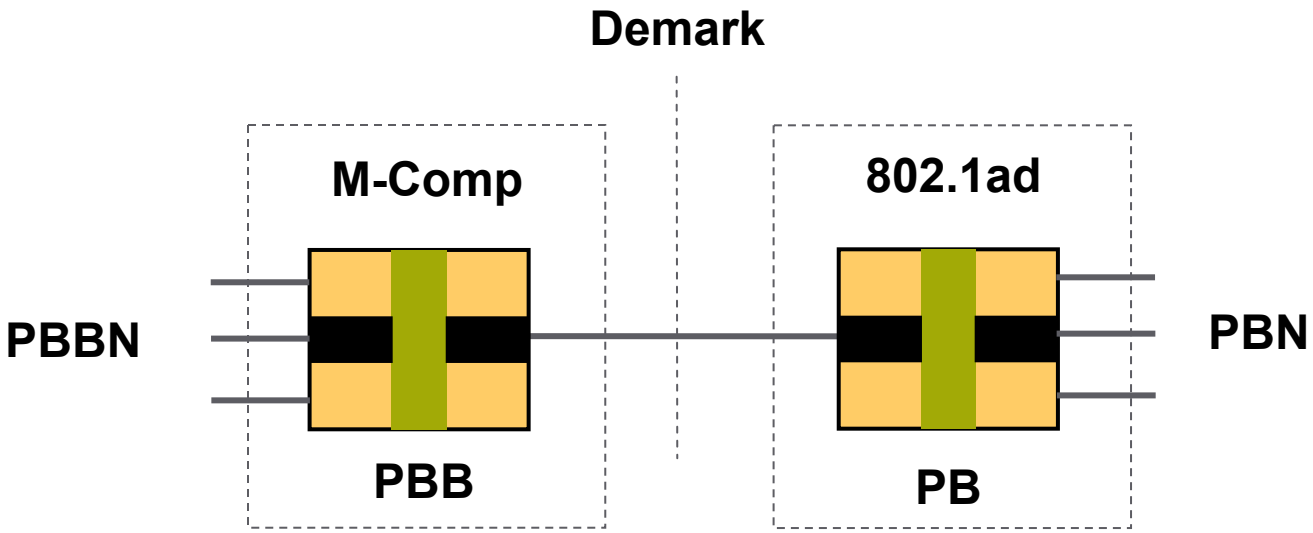
> I-Shim and B-Shim 1-1 connected

> Single I-B Shim pair forms interconnect of PBN and PBBN

> Spanning trees split between B-Comp to I-Comp

> Implementation may be a single box or two boxes

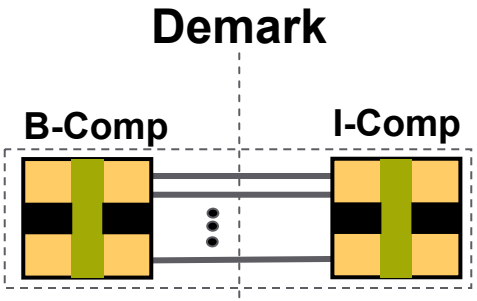
Alternatives 4: PBN to PBBN Demark

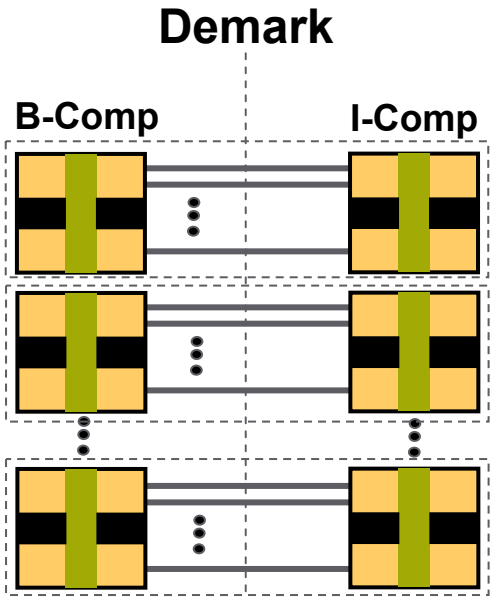


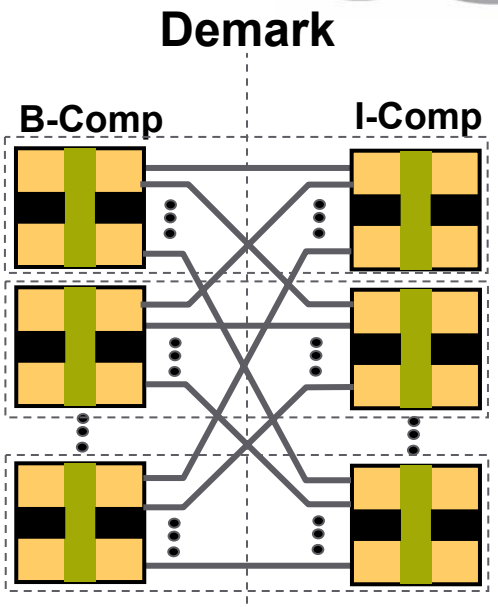
> Interconnect of PBN and PBBN is between a PBB and a PB

> Spanning trees split between in middle of M relay

Redundant Interconnects: Alternatives 1-3







> Class 1:

> Redundant Links and Non-redundant Switch

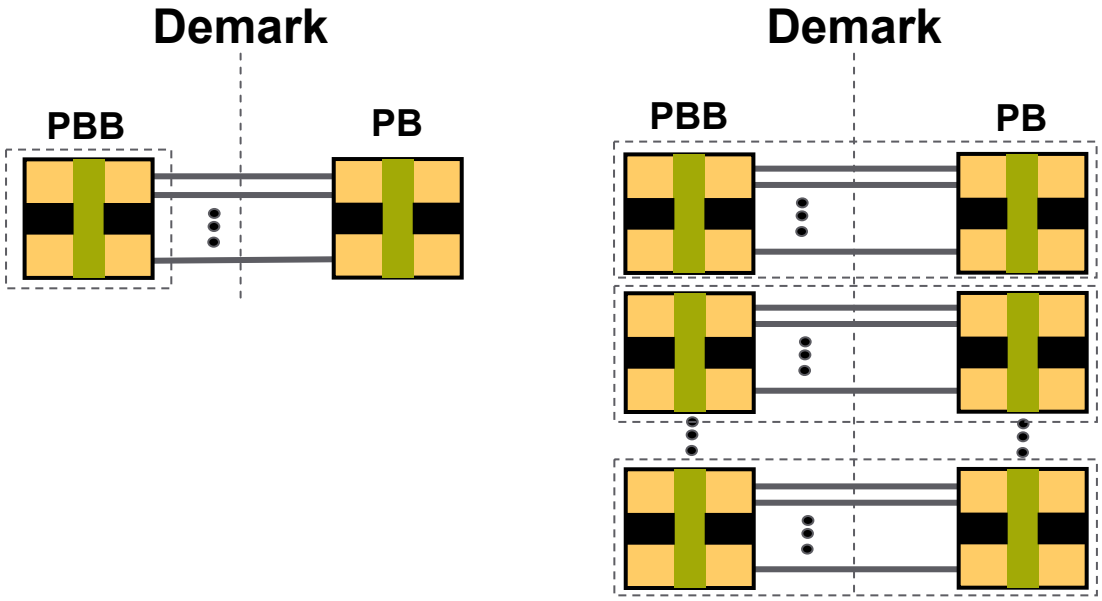
> Class 2:

> Redundant Links and Redundant Switches

> Class 3:

> Redundant Links and Mesh Connected Redundant Switches

Redundant Interconnects: Alternative 4



> Class 1:

> Redundant Links and Non-redundant Switch

> Class 2:

> Redundant Links and Redundant Switches

> Class 3:

> Probably outside model

Recommendations

> Any of the reference models can work

> The dual relays create internal frame format

> Alternative 2 dual relay will provide regular frame transformations and right-side up operation

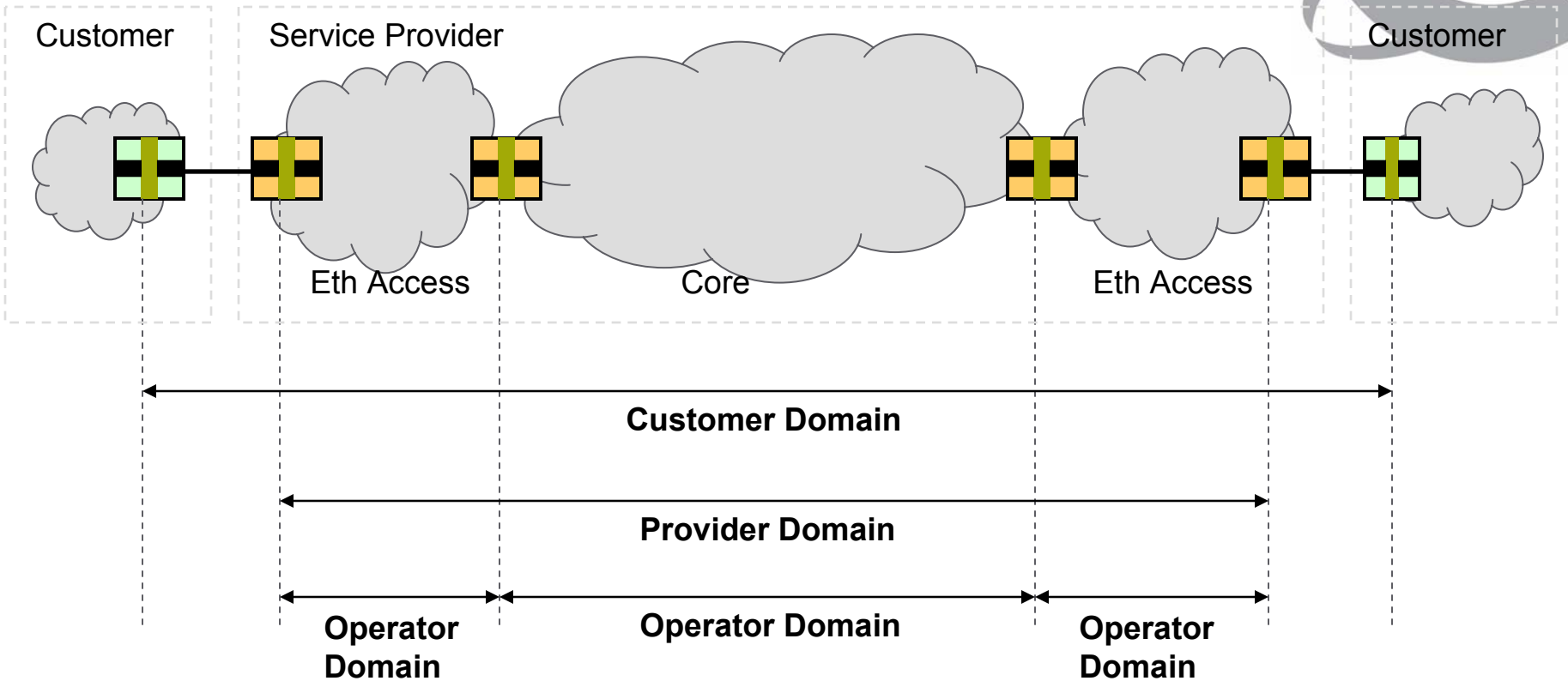
> Alternative 4 is probably the simplest

>THIS IS **THE WAY**

Backup Slides

>THIS IS NORTEL

Multiple Domain Management

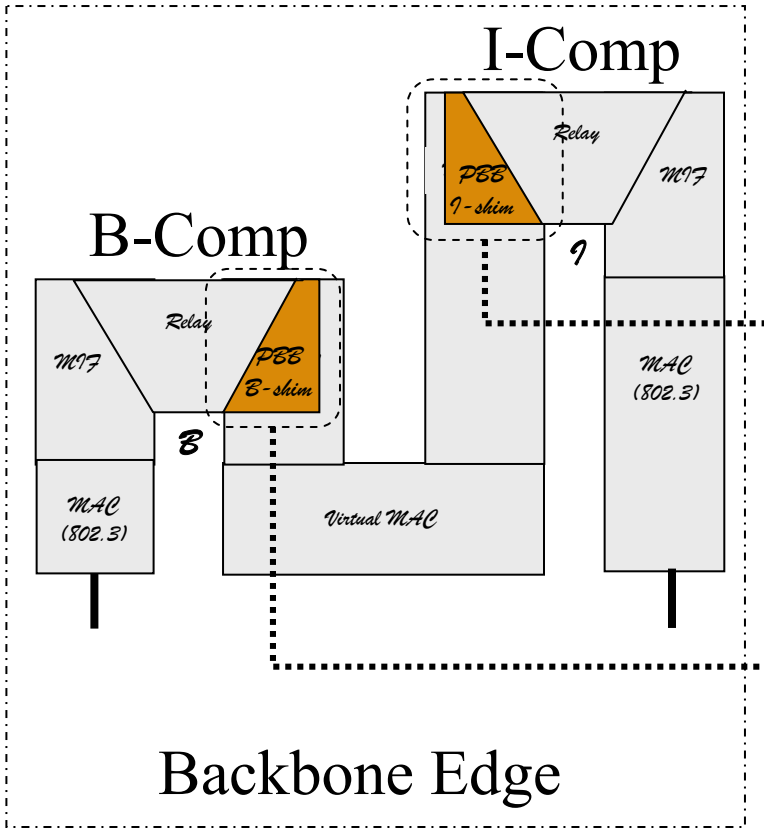


> Ongoing work at IEEE 802.1ag, ITU SG13 Y.17ethoam, MEF

> IEEE P802.1ag Service OAM flows at multiple levels.

> Ethernet Service OAM allows multiple autonomous networks.

PBB Shim Functions



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> B-Shim Operations
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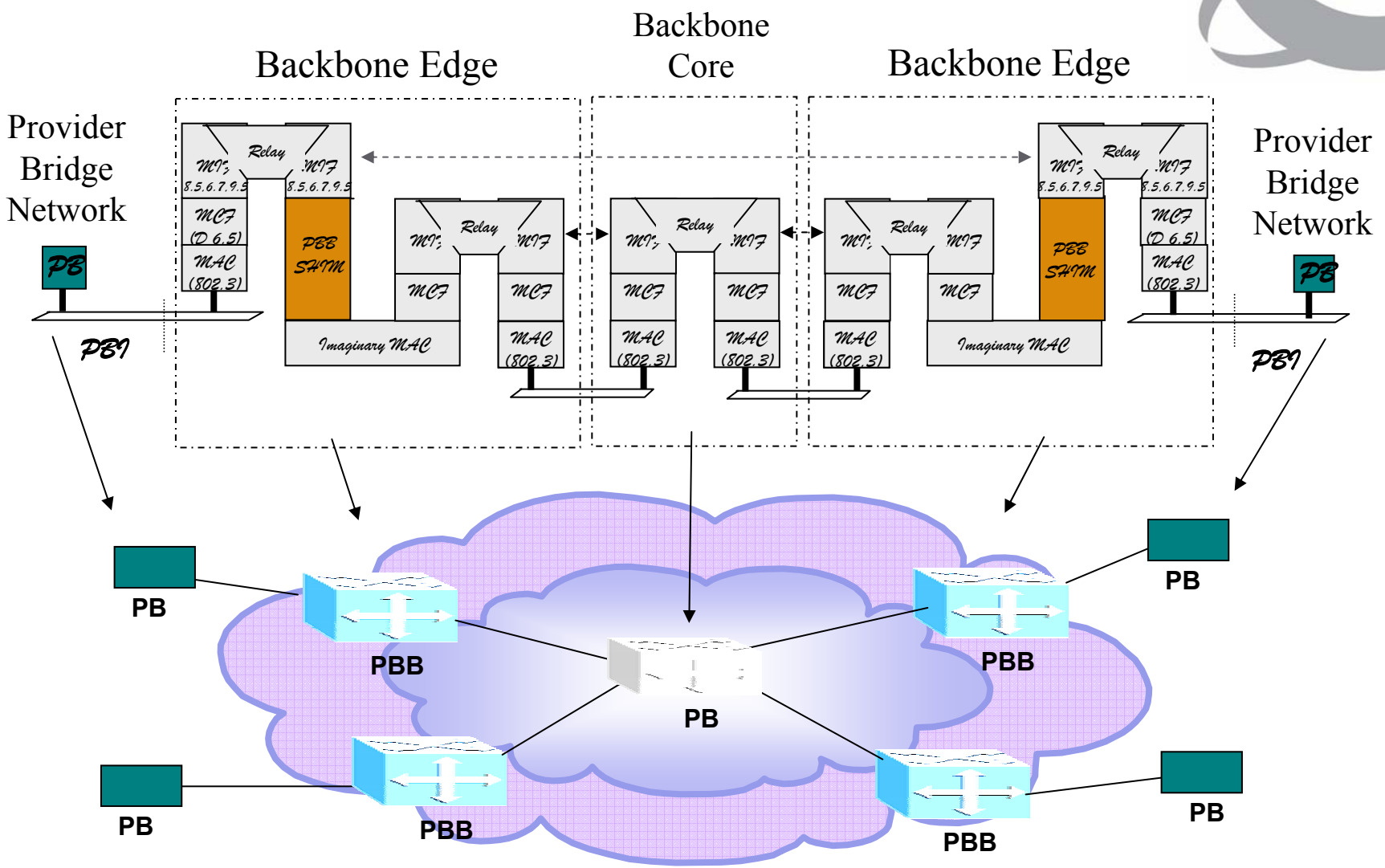
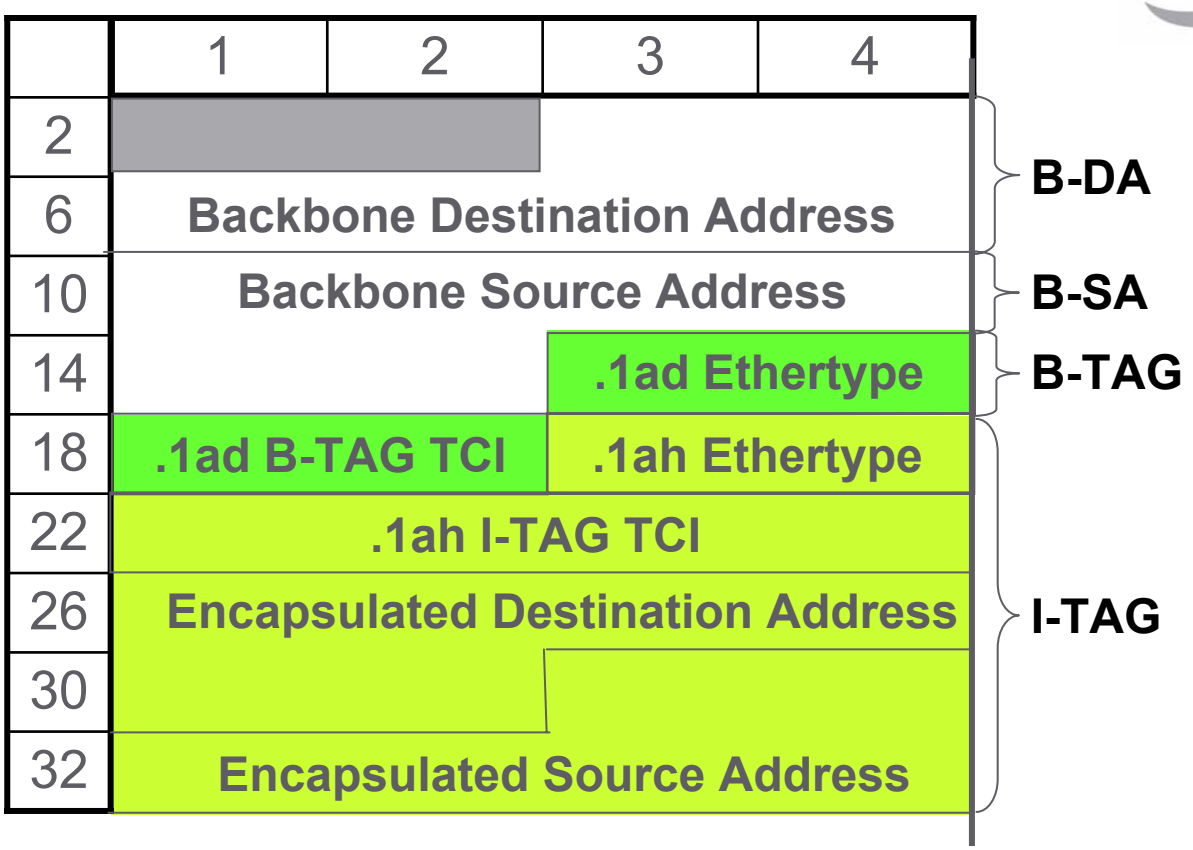
- Learns and Correlates Backbone POP and Customer MAC addresses
- Filters L2 control packets sourced by core relays or by provider bridge relays (divides spanning trees)

PBB Peer Model

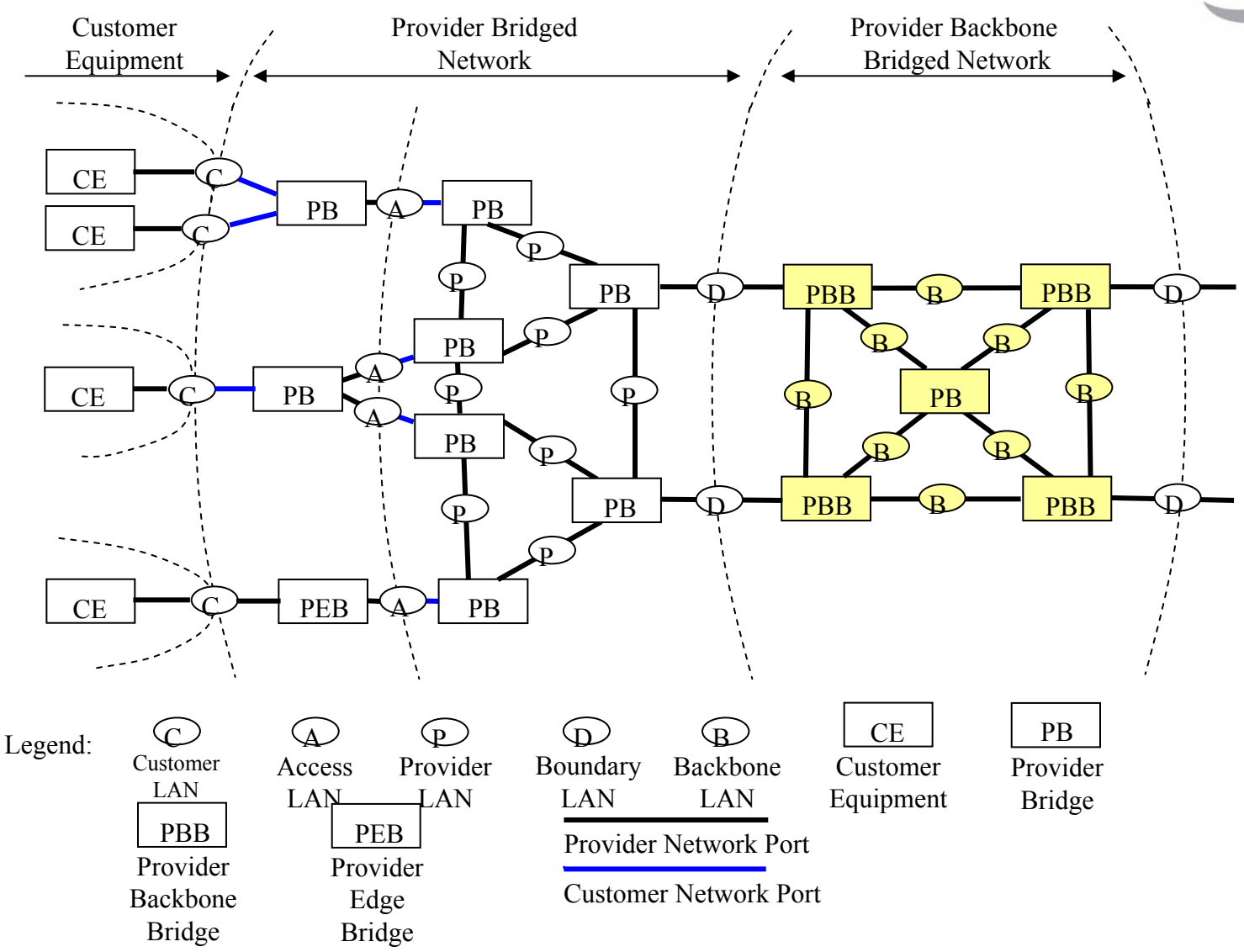


Encapsulation Frame Header

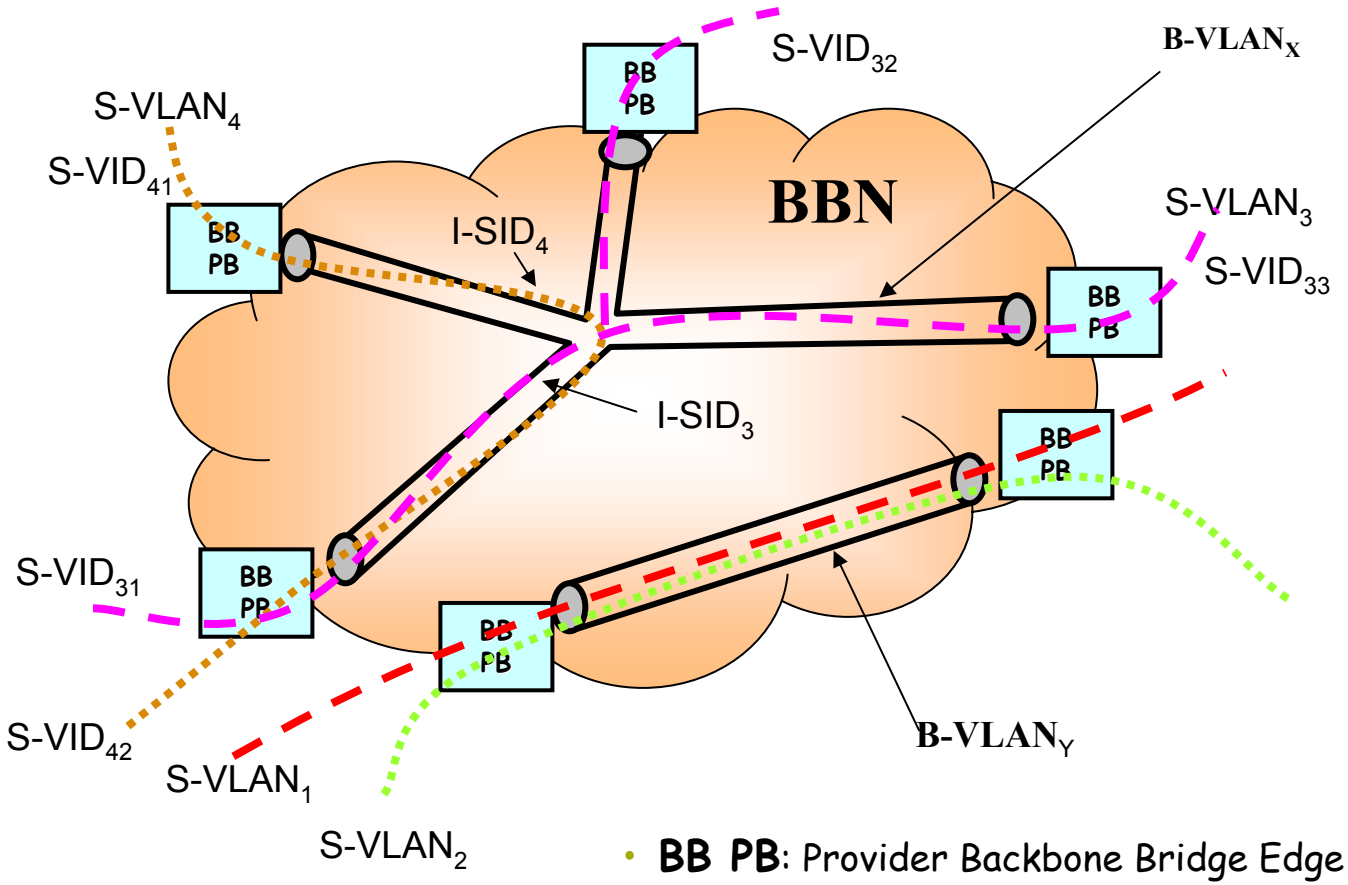


- The B-TAG is identical to S-TAG and optional in the frame

Provider Network Example



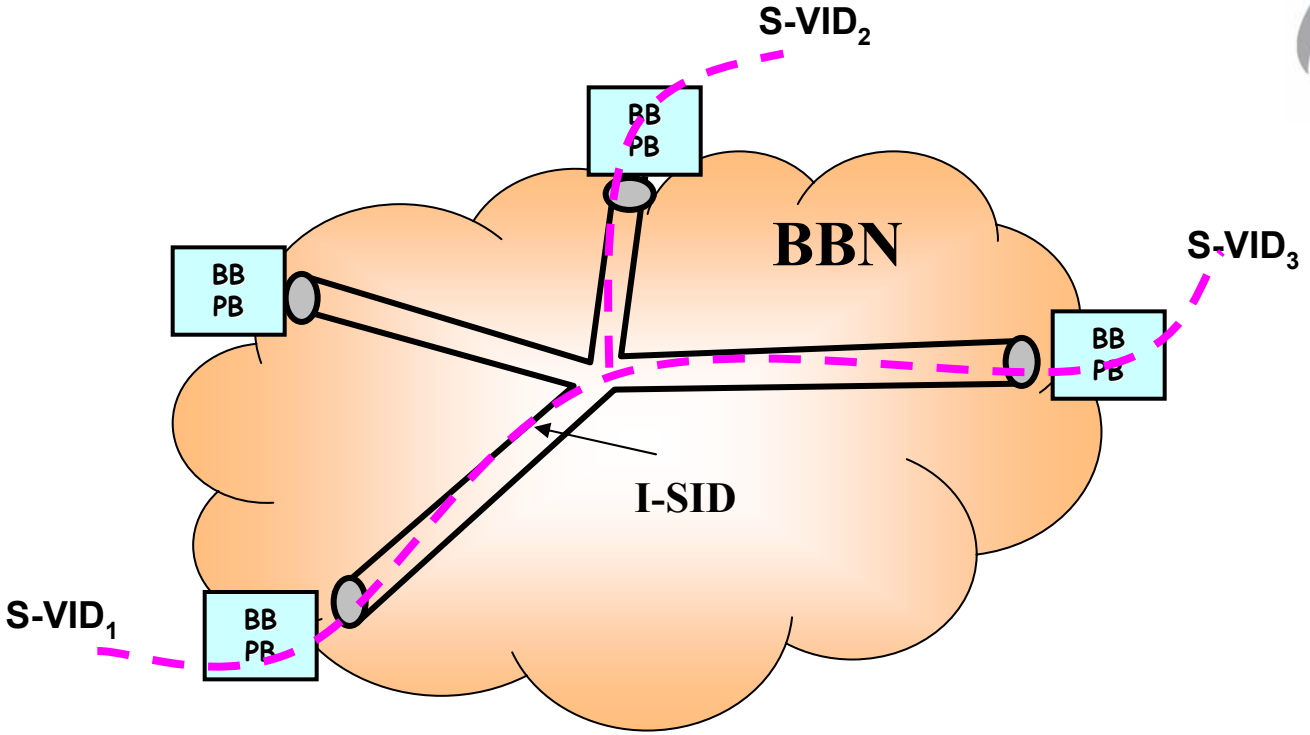
Extended Service VLAN IDs In Backbone



- **BB PB**: Provider Backbone Bridge Edge

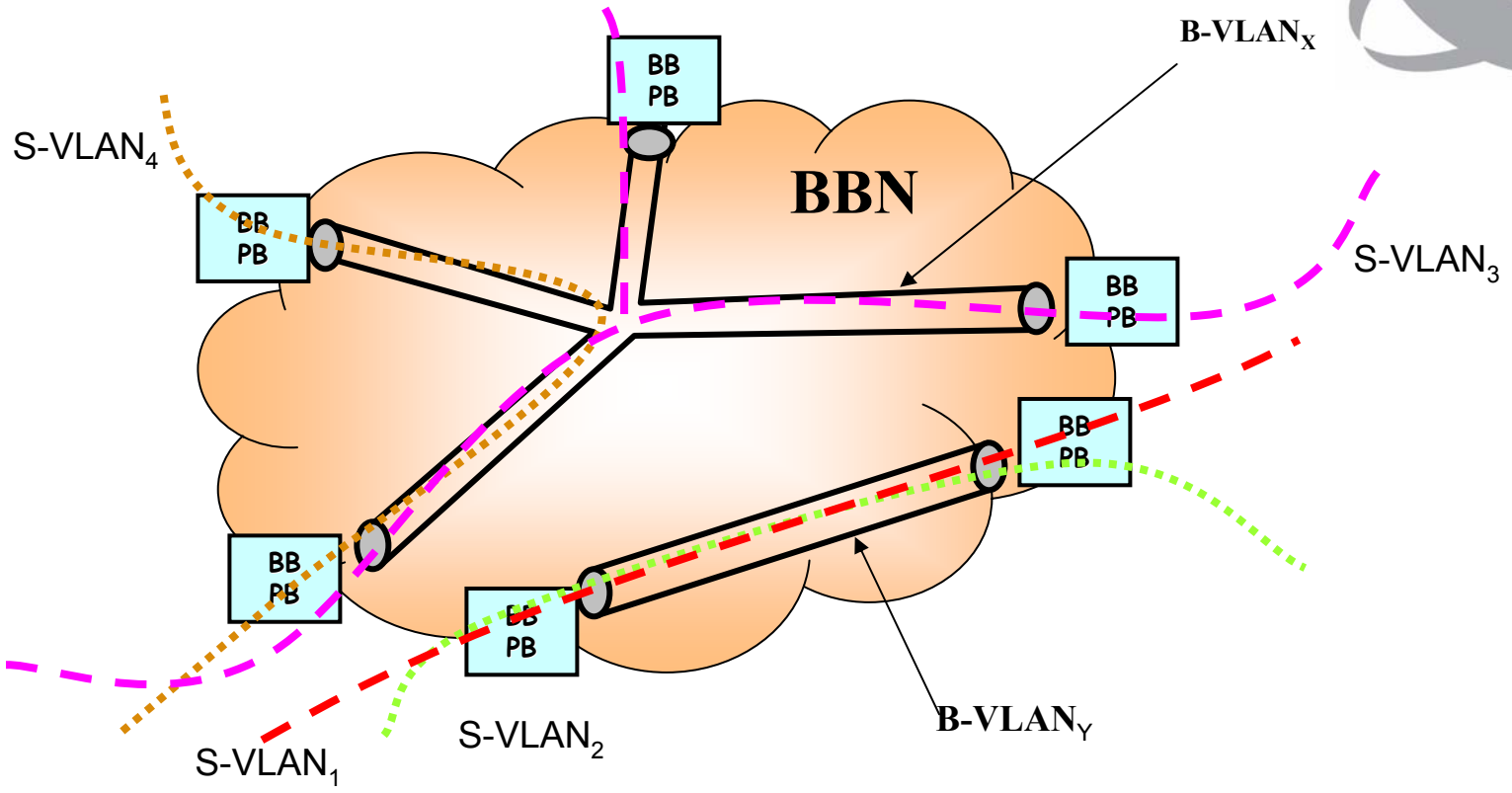
- An I-SID uniquely identifies a S-VLAN within the Backbone
- The MAP Shim translates between S-VID and I-SID
- The I-SID to(from) S-VID mapping is provisioned when a new service instance is created

Single I-SID per S-VLAN



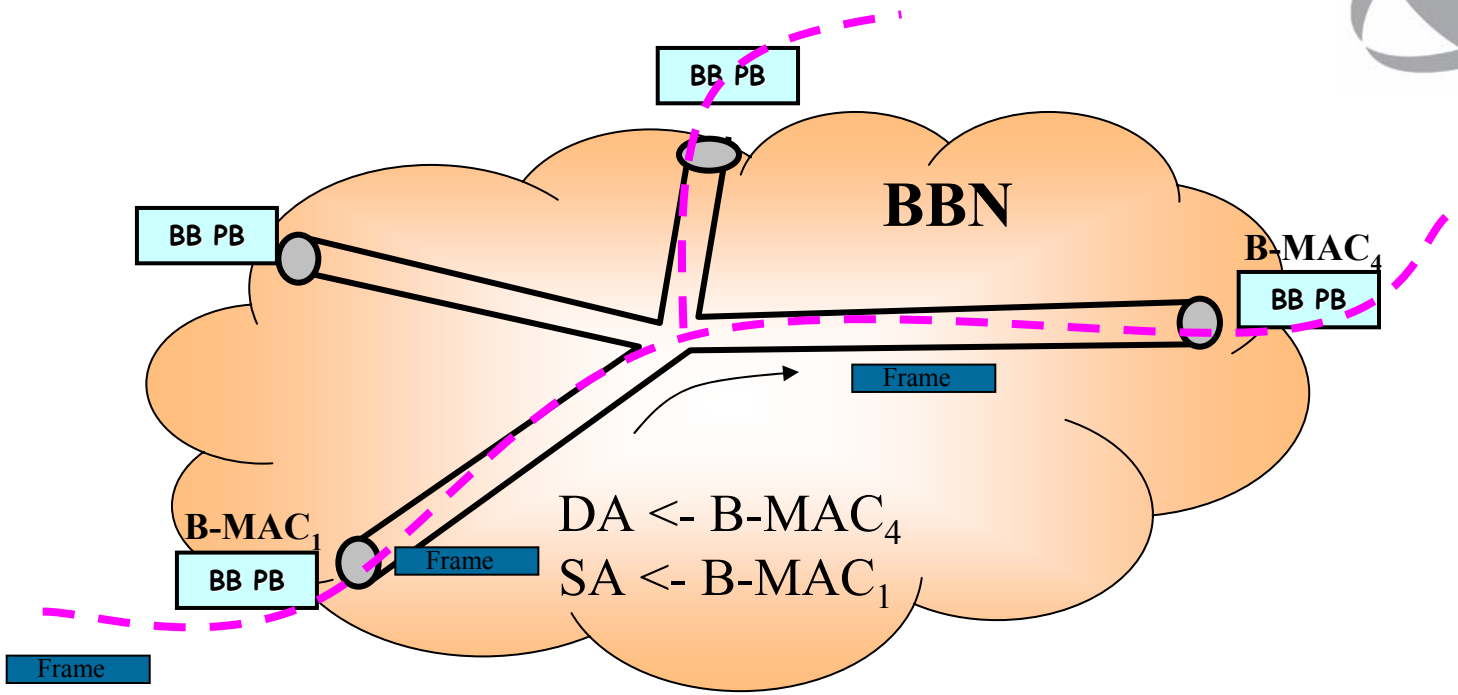
- Regardless of the I-SID address size the map tables only have 4096 entries since only one I-SID exists per S-VLAN and only 4096 S-VLANs exist per Provider Bridge.
- A different S-VID in each PBN maps to the I-SID

Site Connectivity B-VLAN ID



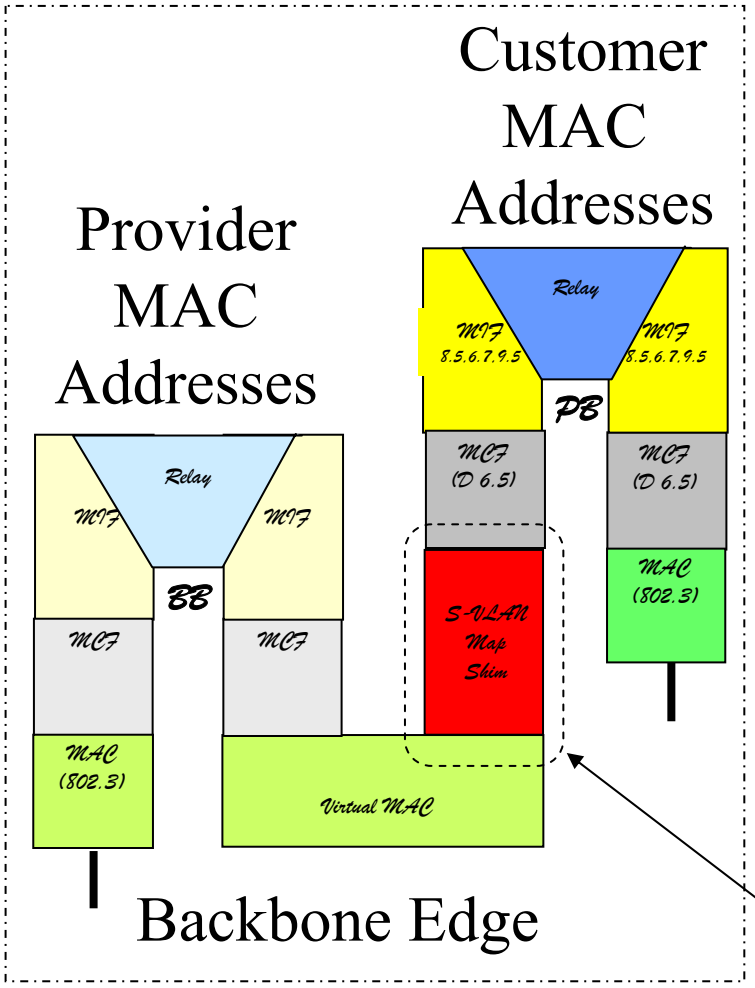
- B-VLANs are addressed like regular VLANs with a 12 bit B-VID
- B-VID and I-SID need to be separate ID spaces to allow many S-VLANs to be carried in a single B-VLAN

Backbone POP MAC Address



- B-MAC Addresses identify the Edge Provider Backbone Bridges (BB PB)
- B-MAC Addresses are learned by other Edge Backbone Edge Bridges
- The backbone edge MAC address determines which edge on the B-VLAN will receive the frame.
- Frames may be flooded by sending with broadcast or multicasts DA B-MACs to the B-VLAN.
- Map shims filter based on the I-SID removing any misaddressed frames

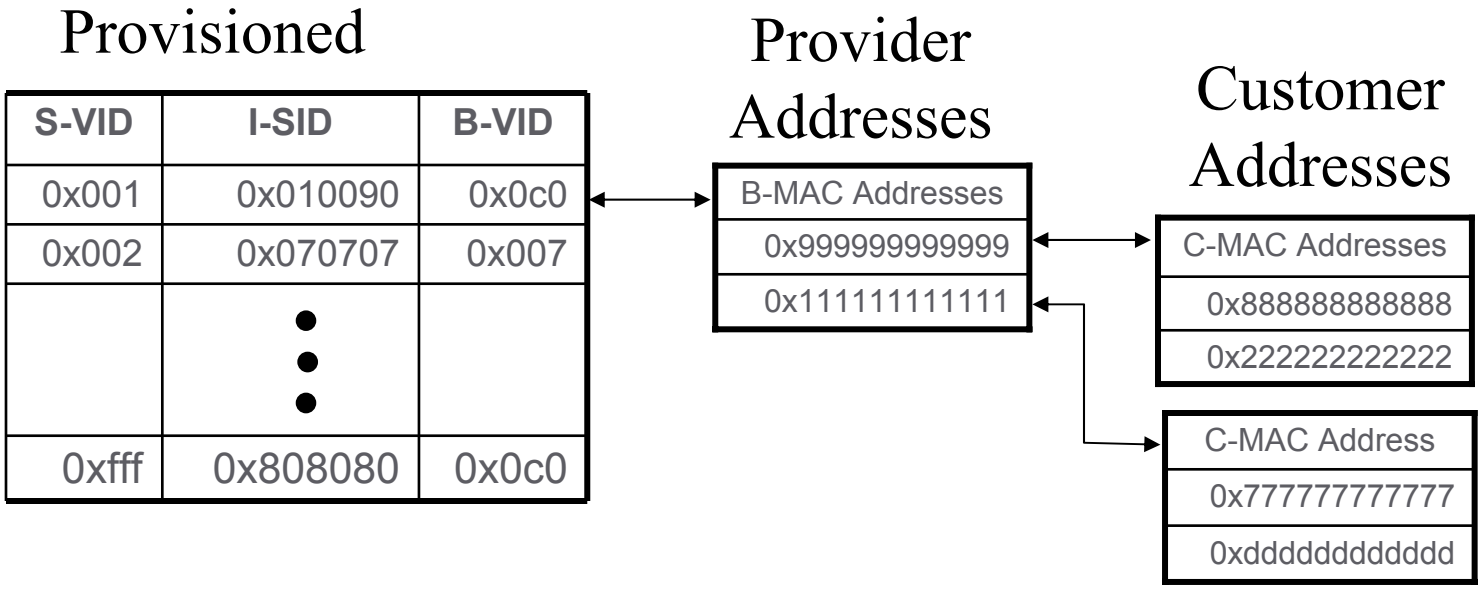
Customer/Provider Addresses



- PB Relay Learns Customer Address Per S-VLAN
- BB Relay Learns Provider Addresses Per B-VLAN
- MAP Shims Learns Correlated Customer and Provider MAC Addresses per S-VLAN

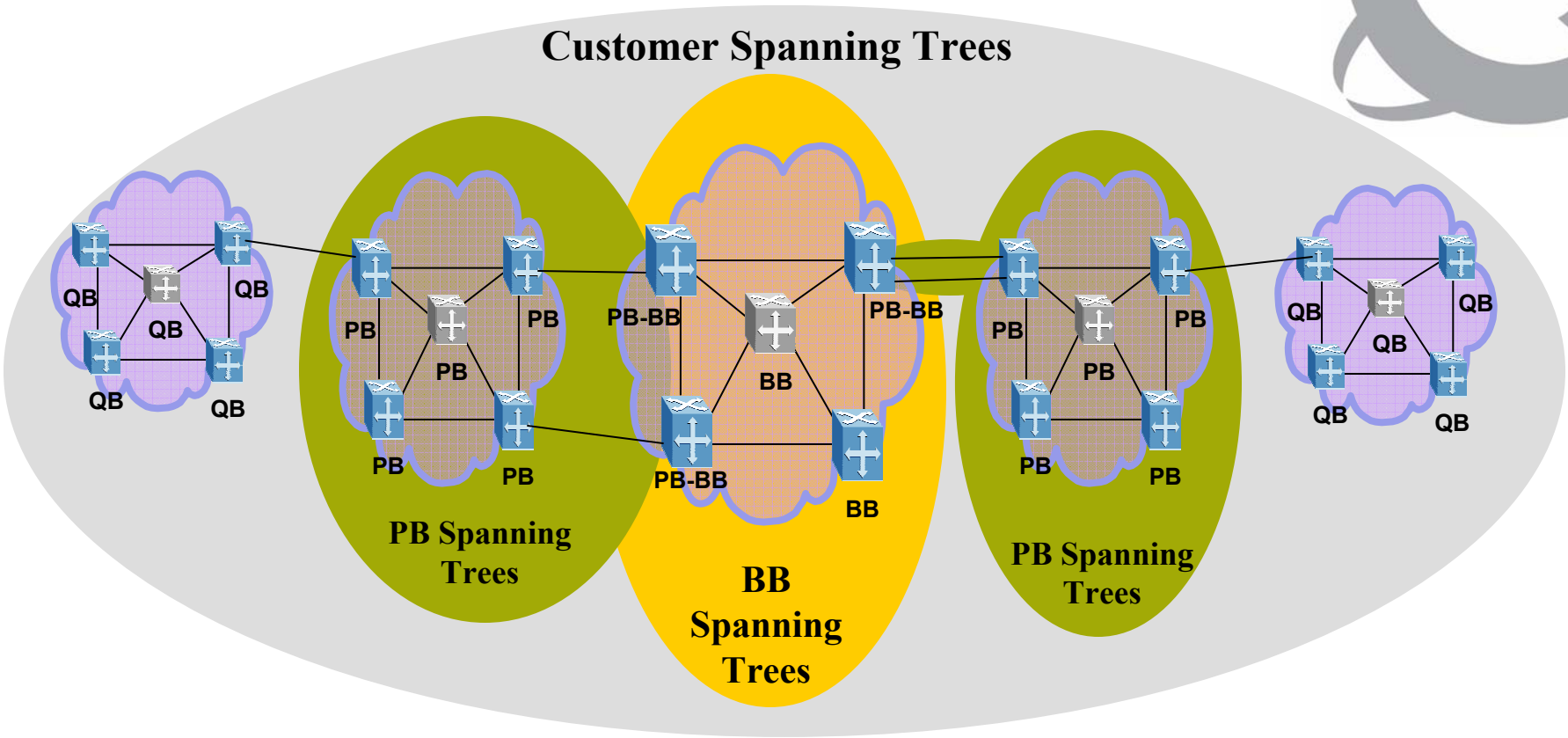
Customer/Provider MAC Address Correlation

MAP Shim Correlation Table



- In the beginning the MAP Shim is provisioned with the correlation between the S-VID, I-SID, and B-VID
- During operation the MAP Shim learns both B-MAC addresses and C-MAC addresses
- The MAP Shim keeps track of which C-MAC addresses are behind which B-MAC
- The correlation data is used to encapsulate frames from the PBNs

Customer, PB, BB Spanning Trees



- Customer spanning trees may extend over Provider Network
- PB Network and BB Network spanning trees must be decoupled to scale the provider network
- Provider Backbone Bridge may conform to the requirements for an Interconnect Medium