PBB-TE Segment Protection

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Problem Statement

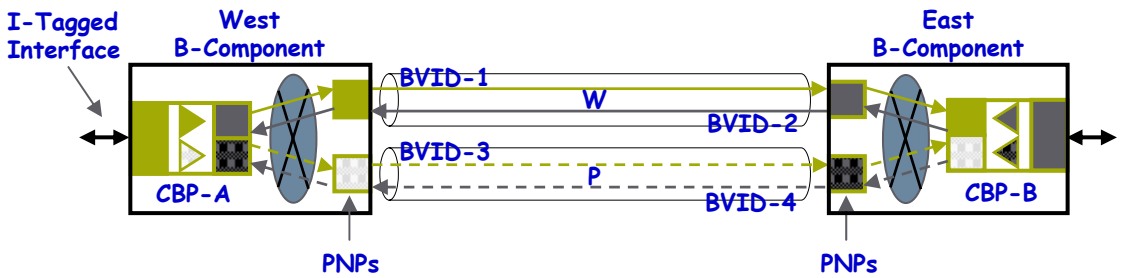
- **For any connection oriented end-to-end path protection scheme (aka trail protection), as the total media length and the amount of intermediate equipment increases so does the probability of simultaneous failures (i.e., within a 4hr MTTR window) along both the working and protection paths, eventually impacting the corresponding availability target (e.g., 99.999% or 5min/yr downtime)**
- **PBB-TE P802.1Qay 1:1 protection falls into the above category**
- **September (Seoul) presentation* provided requirements from two Service Providers in India for a PBB-TE local repair mechanism to mitigate the above problem**

MTTR = Mean Time To Repair

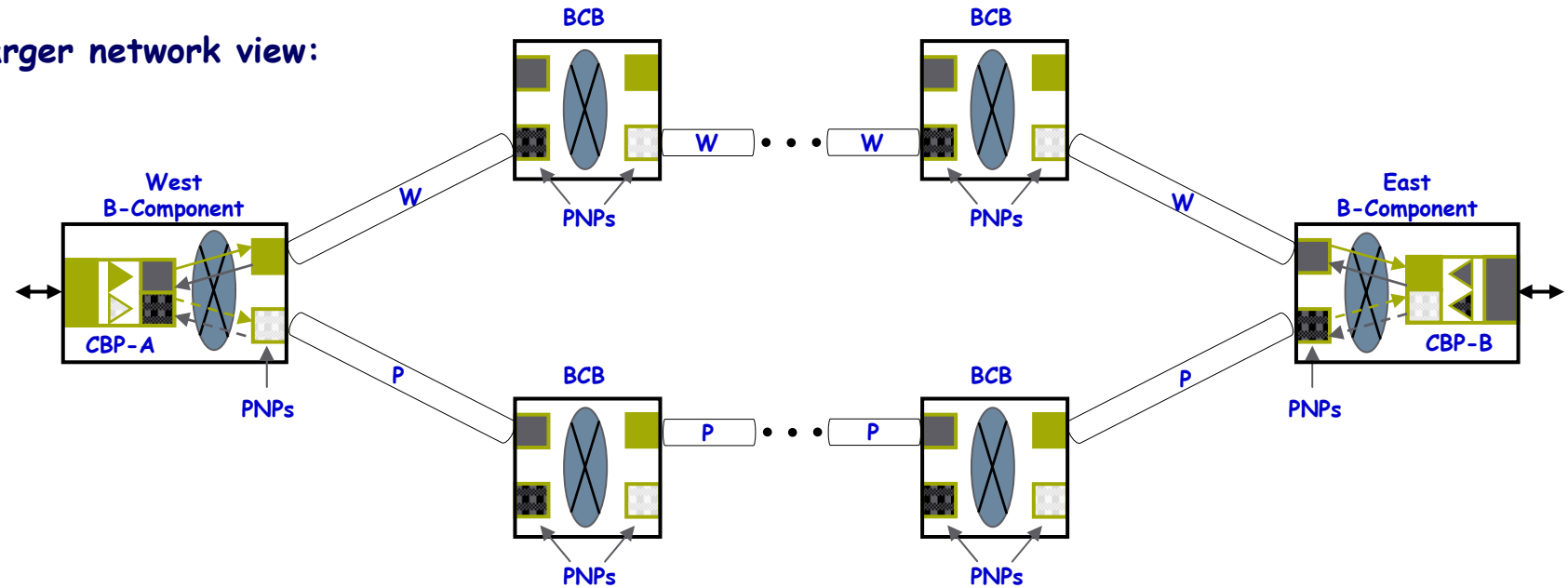
* new-Protection-Vinod-Case-for-Segment-Protection-0908-v1.pps

PBB-TE Protected Domain: Expanded View

P802.1Qay view:

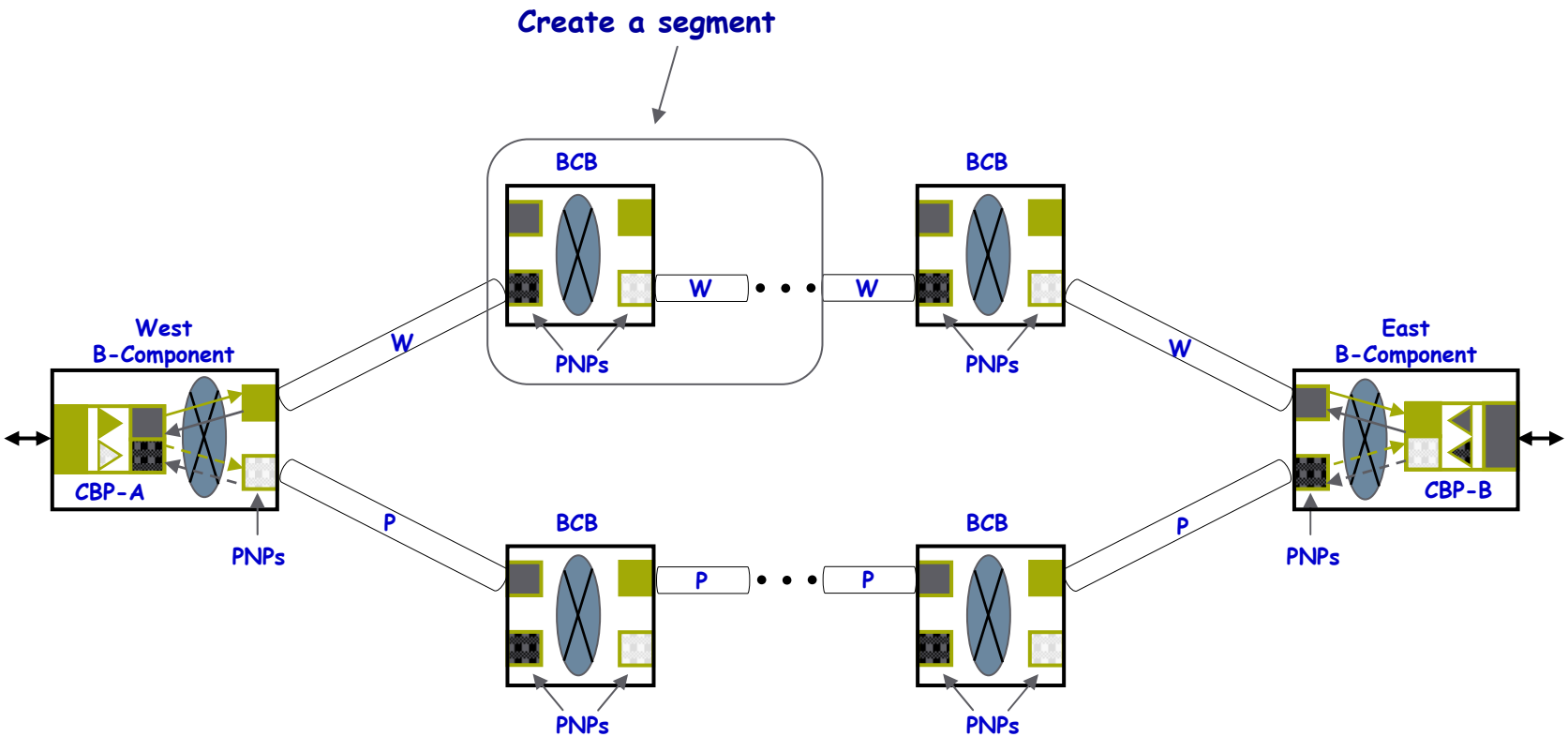


Larger network view:

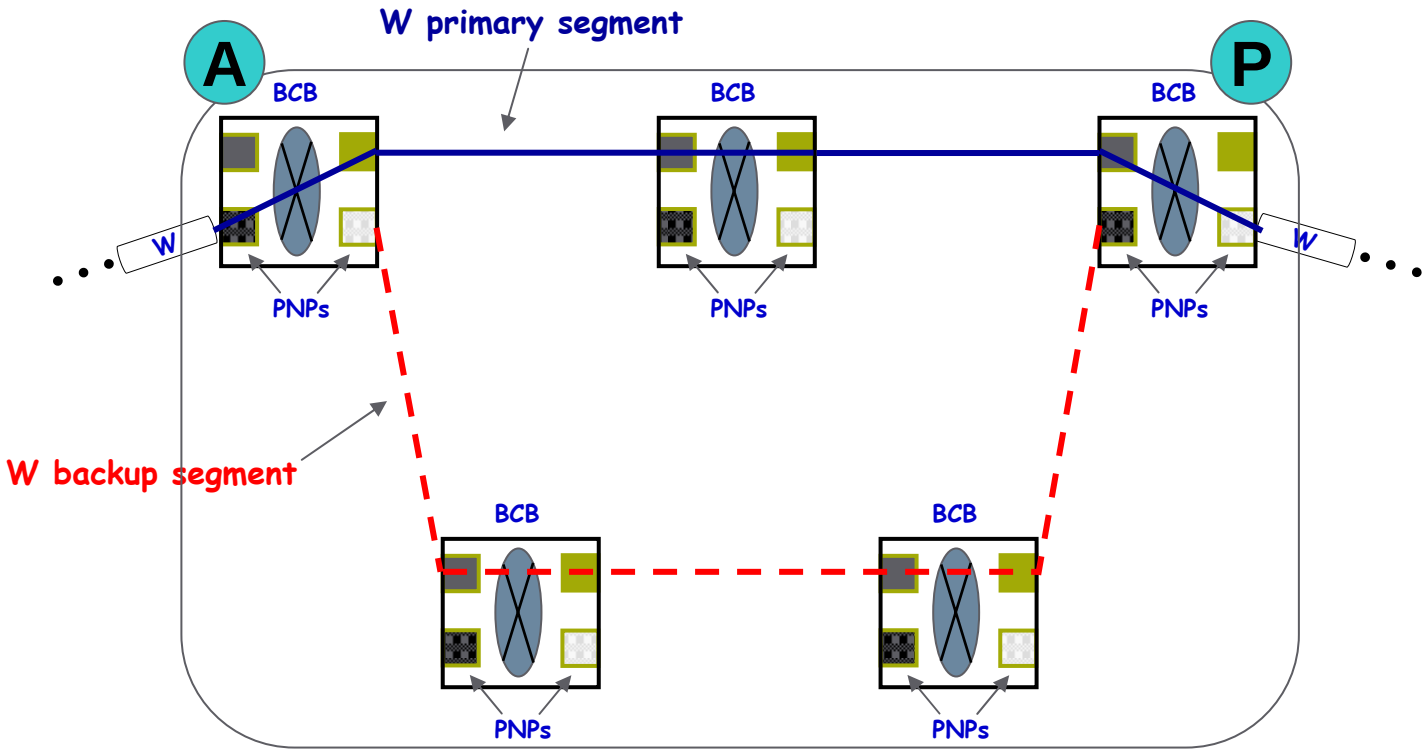


General Segmentation Approach

- **The general solution is to split up the end-to-end paths and provide some type of local repair on a segment in order to improve overall availability**



PBB-TE TESI Segment Definition



- **Primary segment (the protected entity) is the portion of a TESI between the PNPs on nodes A and P**
- **Backup segment is pre-established using the same TESI <B-DA, B-VID>**
- **Obviously this approach assumes that such an alternate route is available**

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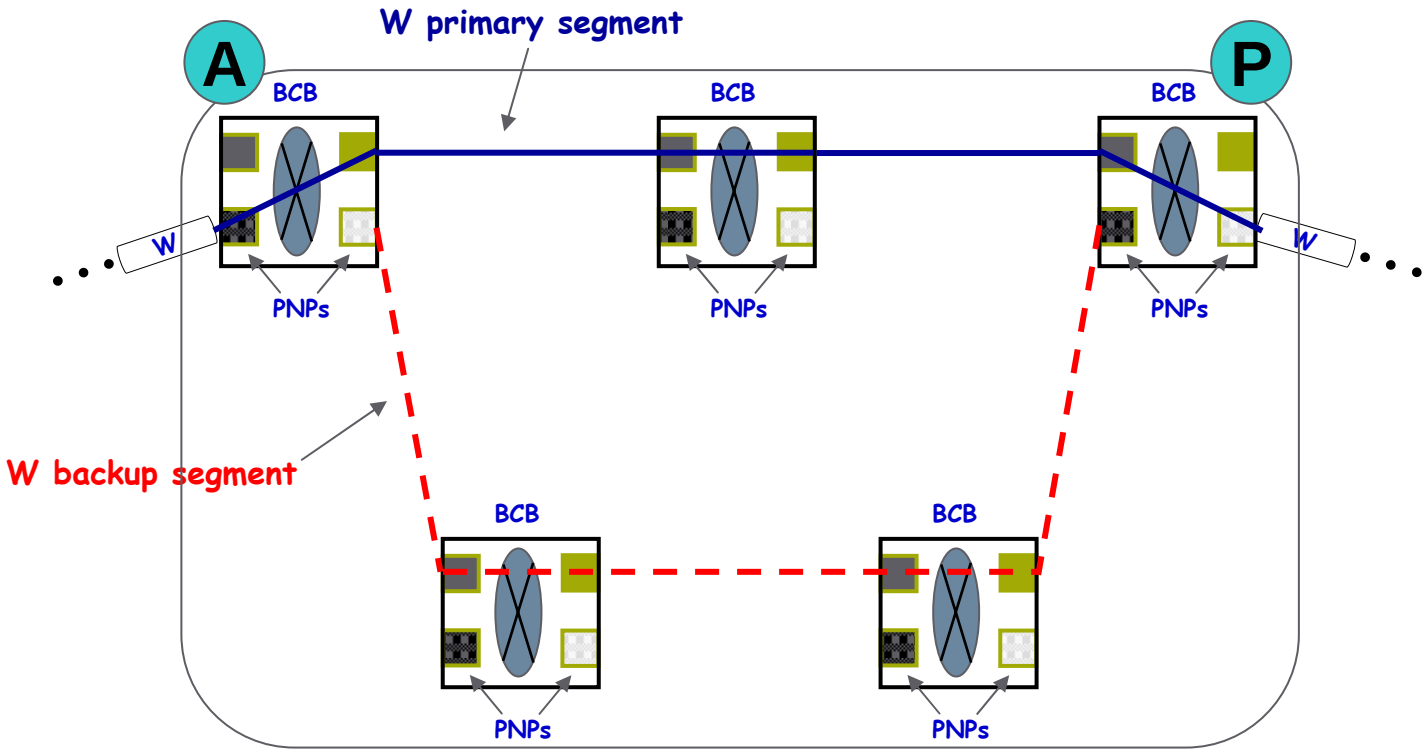
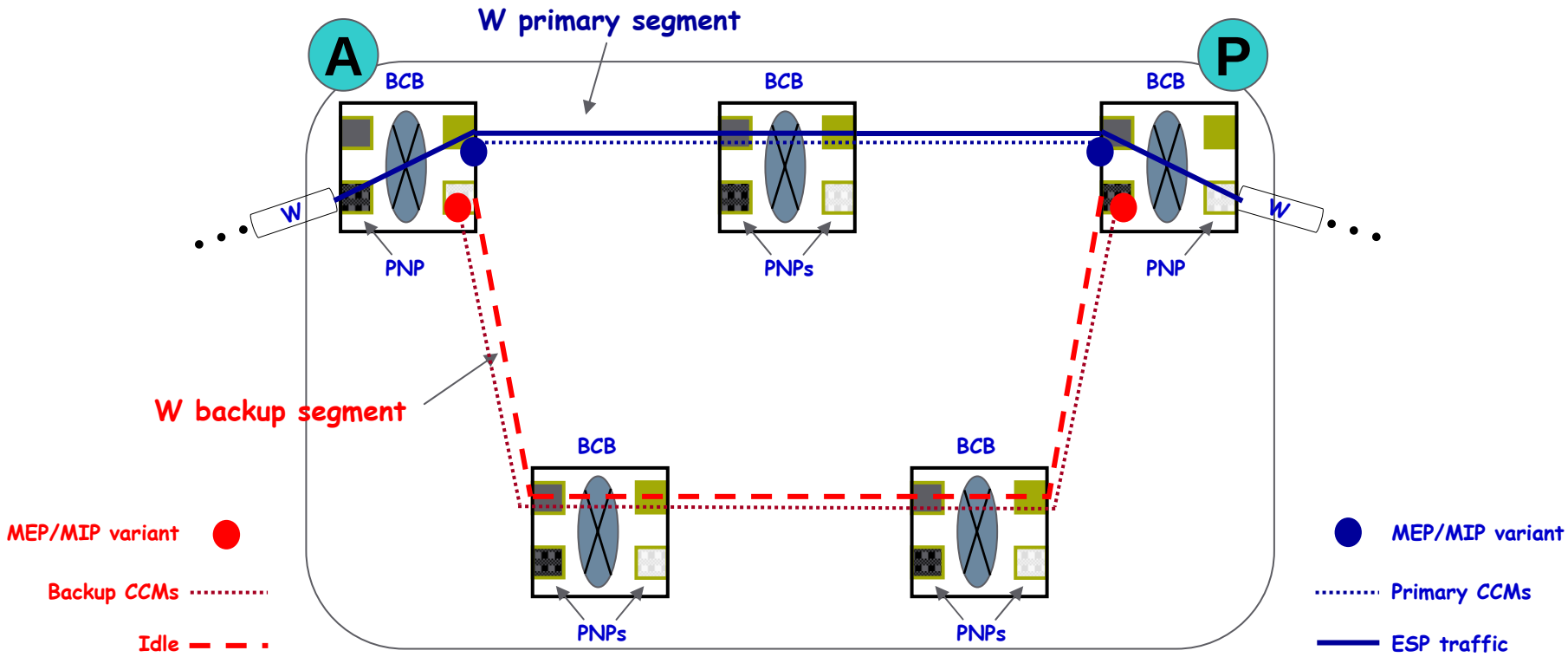
PBB-TE TESI Segment Creation



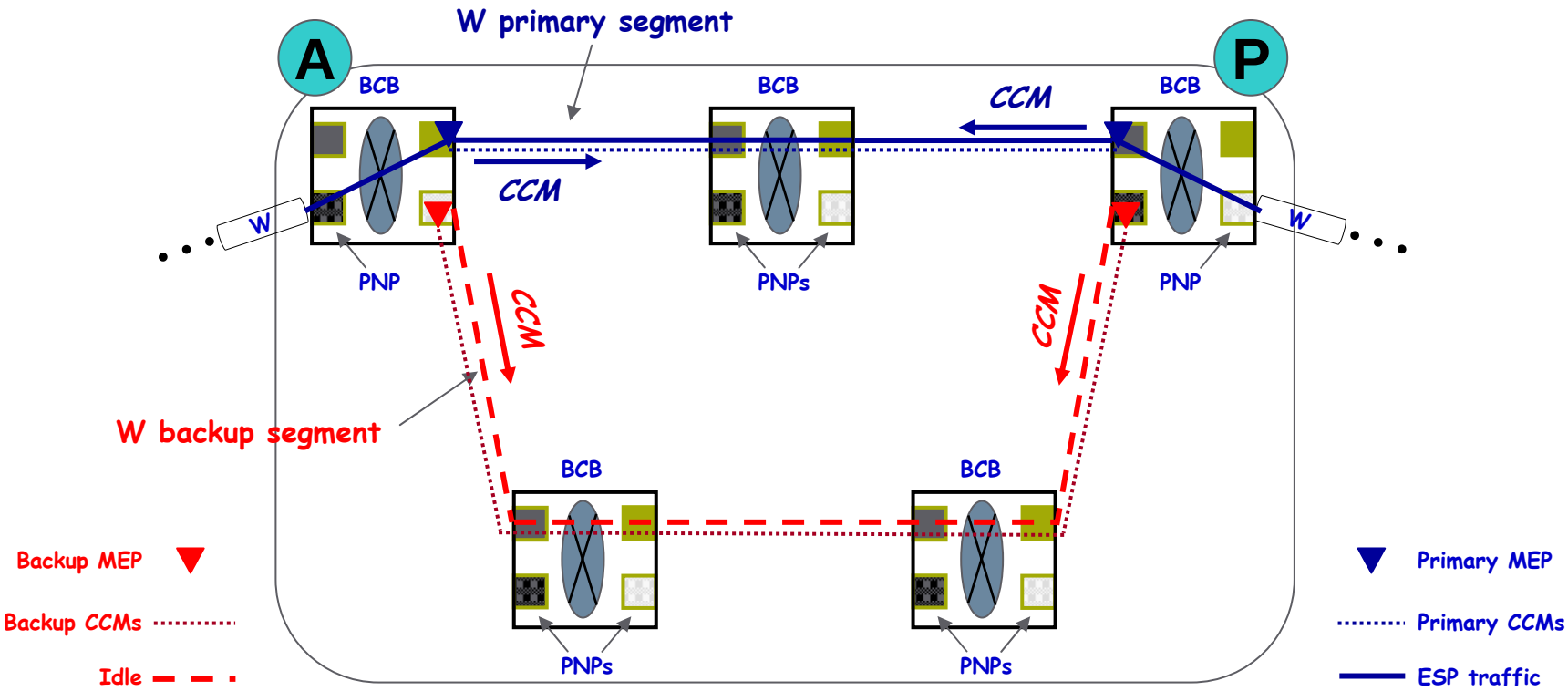
- **Both primary and backup segments have same TESI <B-DA, B-VID> FDB entries, the only requirement being that those segments never cross**
- **Need to provide associated segment MAs in order to detect a segment fault to trigger and coordinate bi-directional switching, but how?**

Segment Integrity Check Requirement



- **If avoiding "blind switching" is desired, the integrity of each ESP 3-tuple datapath (i.e., each direction of the TESI) must be verified with CCMs over both the primary and backup segments simultaneously**

Segment Integrity Check I

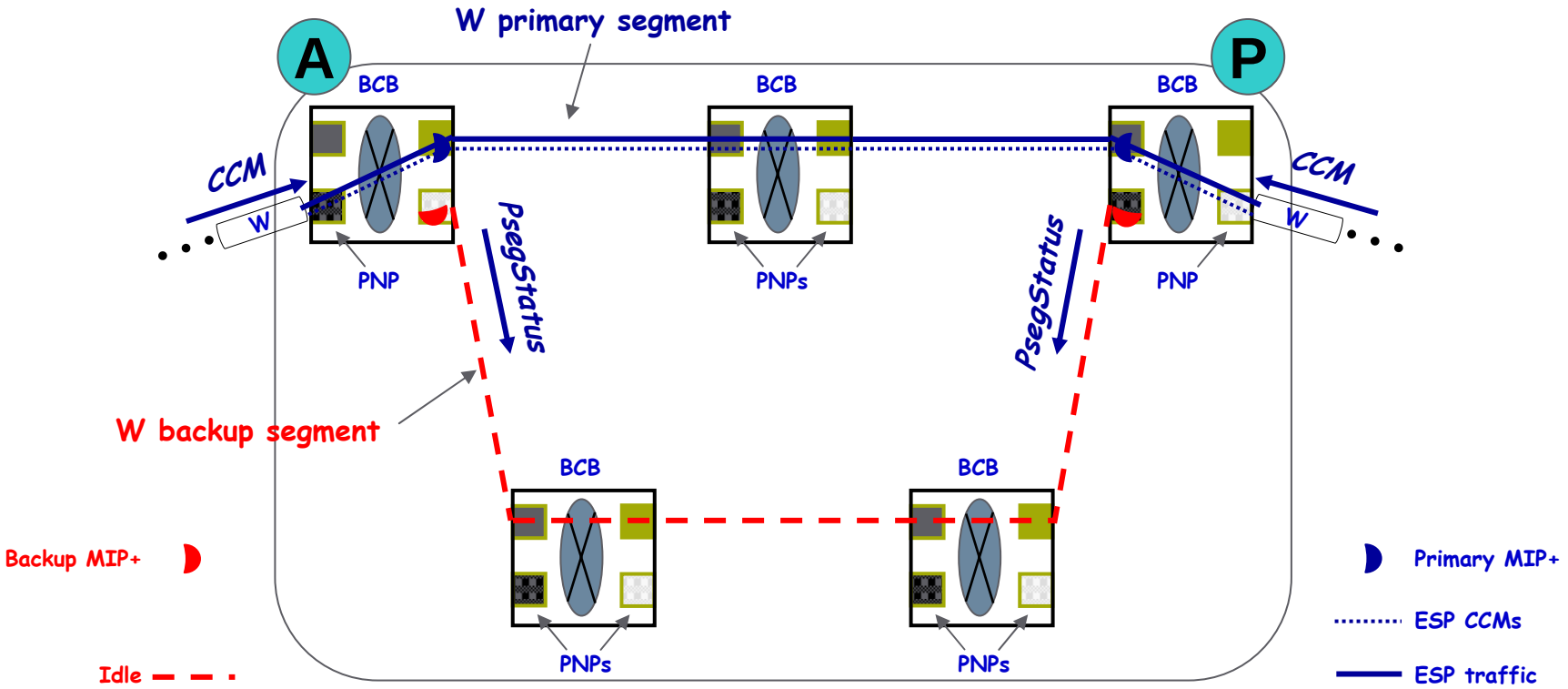


- **Introducing a new MA between nodes A and P on the primary segment would not verify the ESP 3-tuple datapath → different addressing**

  <P, A, ESP-VID> ≠ <ESP-DA, ESP-SA, ESP-VID>

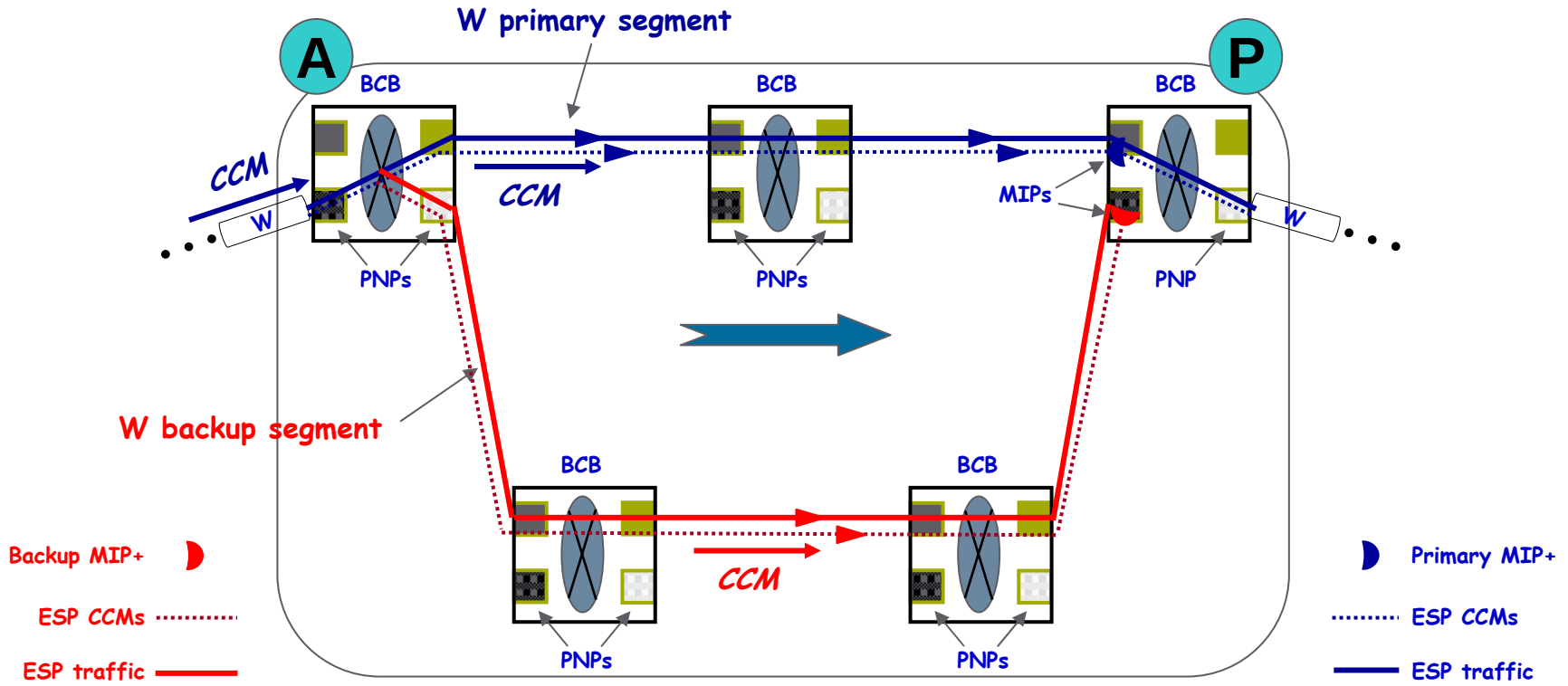
- **Similar issue for the backup segment**

Segment Integrity Check II



- **Snooping the existing ESP CCMs via MIPs at nodes A and P would require: significantly enhanced MIPs, status exchange (e.g., via backup segment), correlation of views → OAM processing load (CCMs & journaling), perhaps slower fault detect time due to synchronizing views**
- **No ESP CCMs on the backup segment → still risk of "blind switching"**

Segment Integrity Check III



- **Introducing a 1+1 bridge (ESP frame copy) would forward ESP data/CCMs via both primary and backup segments allowing MIPs at tail-end node P to monitor segments → not natural for a bridge to send an identical frame out two ports, need enhanced MIP functionality, operational risk**

Segment Integrity Check Summary

- **A single approach to monitoring a segment MA is either insufficient or impractical**
- **Perhaps a combination of approaches could provide the required integrity coverage**
- **Need to explore such alternatives…**

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1:1 Segment Protection Switching (SPS)

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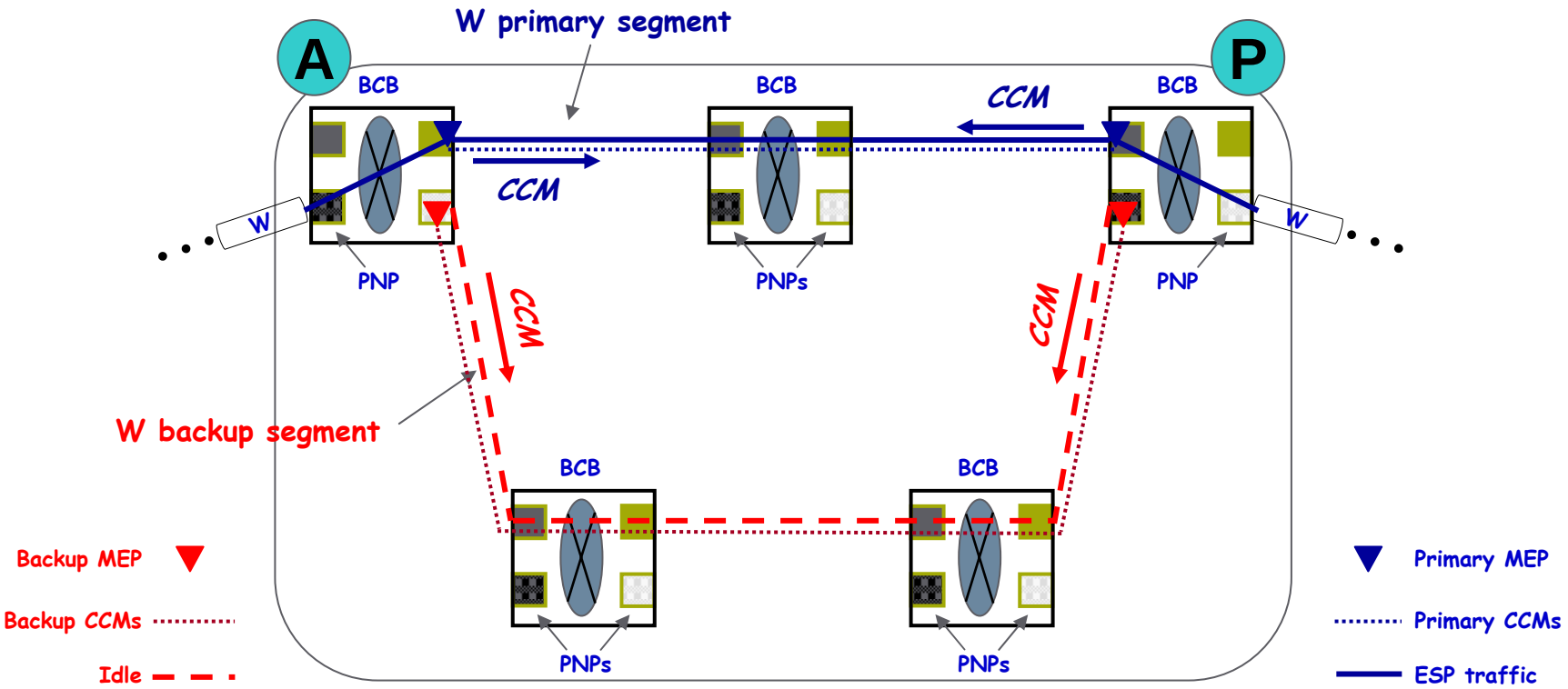
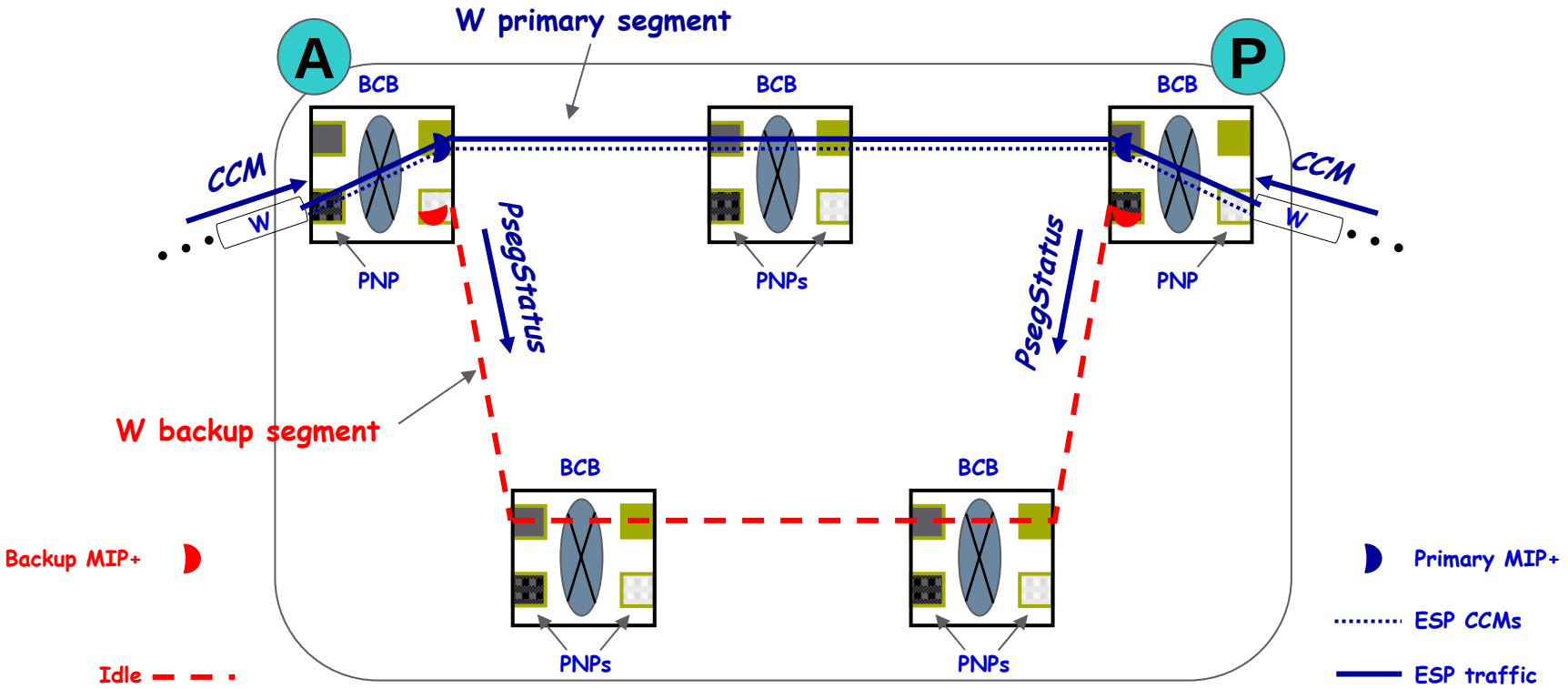
- **Recall the goal of segment protection is to improve the overall availability of a PBB-TE protected domain, because there is an unacceptably high probability of simultaneous faults on working and protection TESIs**
- **Those faults can be divided into two categories:**
  - **“infrastructure faults” – the failure of links between bridges, or a catastrophic bridge failure affecting all its traffic**
  - **“datapath faults” – a fault within a bridge affecting one or more services, such as an FDB corruption (either due to an equipment fault or a configuration error)**
- **The combination of the segment integrity checks I and II provides coverage for:**
  - **infrastructure faults on either the primary or backup segment**
  - **datapath faults on the active segment**

Segment Infrastructure Integrity Check



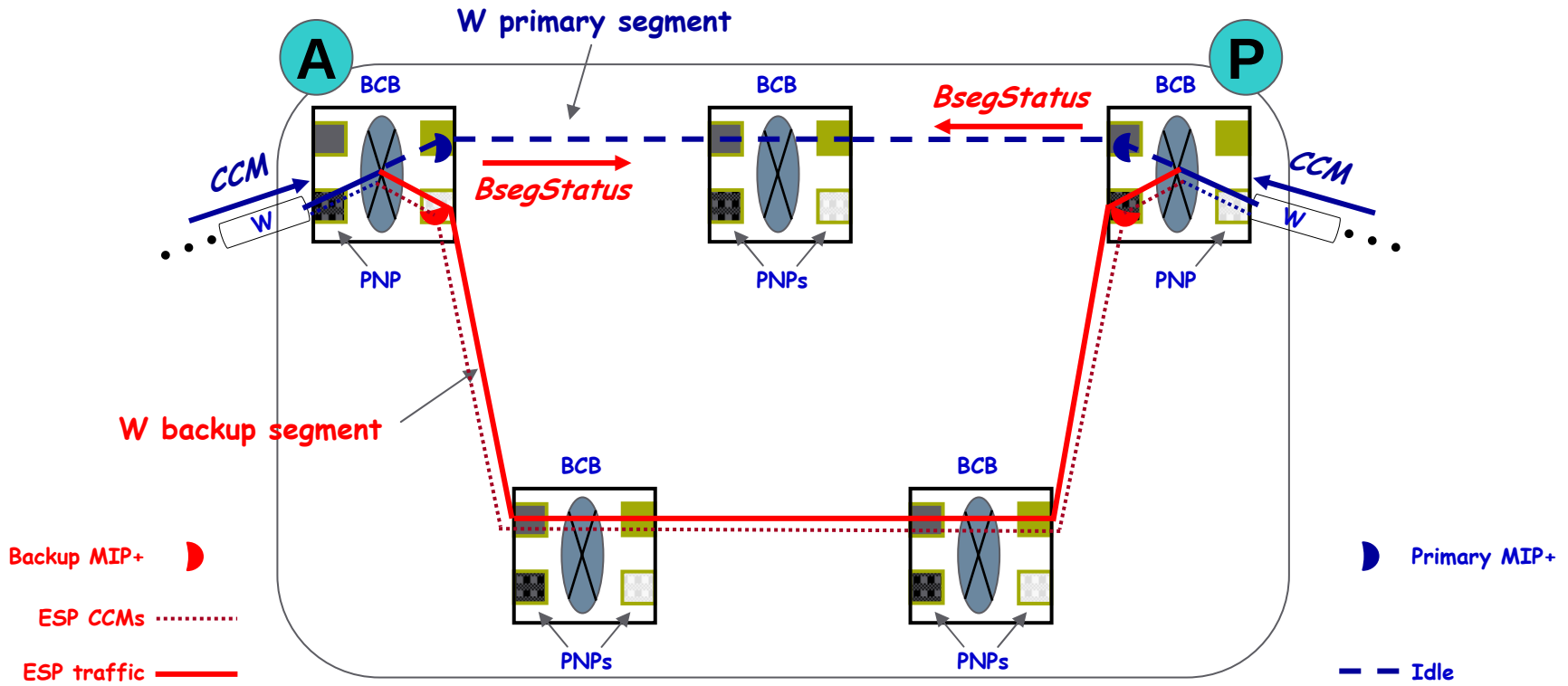
- Introduce a MA between nodes A and P on the primary segment and a MA on the backup segment
- CCM addresses are the MACs of the associated PNPs
- A segment infrastructure fault would trigger protection for all client TESIs

Segment Datapath Integrity Check - Primary



- Snoop existing ESP CCMs via MIPs on primary segment at nodes A and P
- Exchange primary segment status via backup segment and correlate views
- A segment datapath fault triggers protection only for the affected TESI
- Since there are no ESP CCMs on the backup segment to snoop, it would be a “blind switch”

Segment Datapath Integrity Check - Backup



- Snoop existing ESP CCMs via MIPs on backup segment at nodes A and P
- Exchange backup segment status via primary segment and correlate views
- Since there are no ESP CCMs on the primary segment to snoop, the reversion switch would be a “blind switch”

1:1 Segment Protection Switching Summary

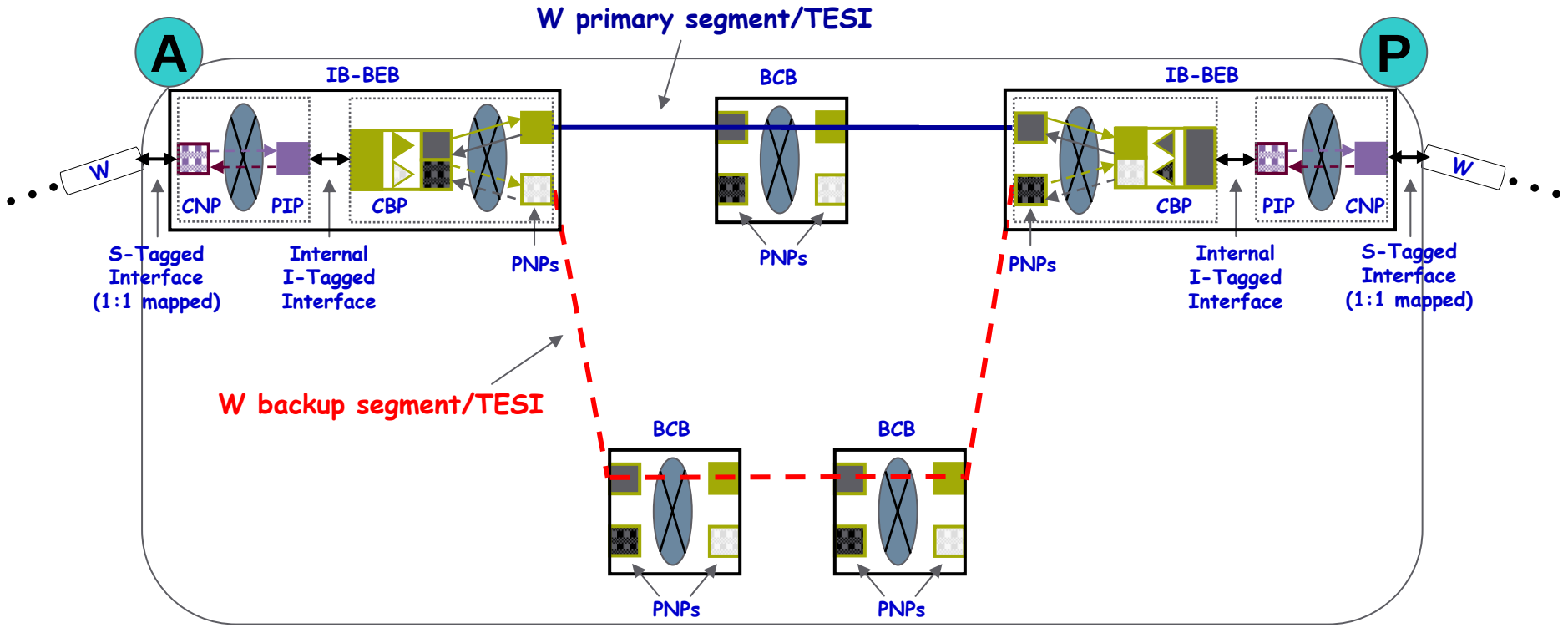
- **The combination of the segment integrity checks I and II will provide coverage for:**
  - **infrastructure faults on either the primary or backup segment**
  - **datapath faults on the active segment (in addition to the fault coverage provided by the e2e PBB-TE protection)**
- **The only integrity coverage missing is that of the inactive segment datapath, the consequences being:**
  - **for a fault initiated switch to the inactive segment (with a latent datapath fault), the e2e PBB-TE protection mechanism would eventually execute following its hold-off timeout and if resources are available**
  - **for a manual switch to the inactive segment (with a latent datapath fault), there would be a brief traffic loss until that fault triggered a reversion switch**
- **So there is a corner case integrity exposure**

1:1 Segment Server Protection

1:1 Segment Server Protection

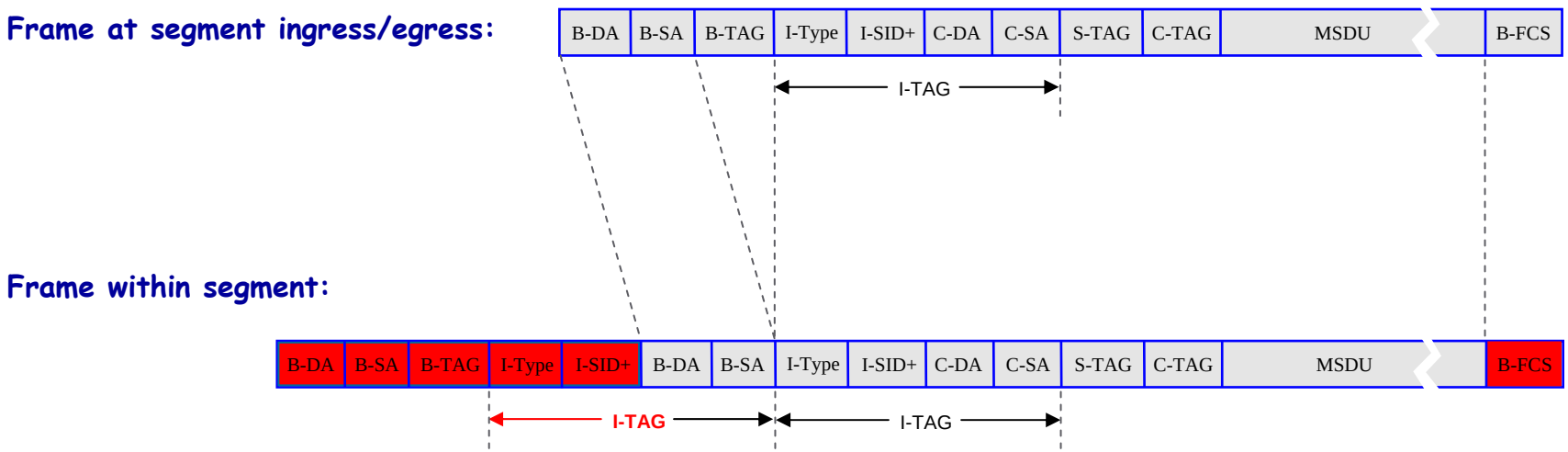
- **Rather than attempt to provide a protection mechanism at the same layer, consider a hierarchal approach**
- **Fully encapsulate all e2e PBB-TE traffic along either the working or protection entity into a new PBB-TE protected domain for the extent of the segment**
- **Provides full integrity coverage**
- **Avoids defining a new protection mechanism**

PBB-TE 1:1 Segment Server Protection



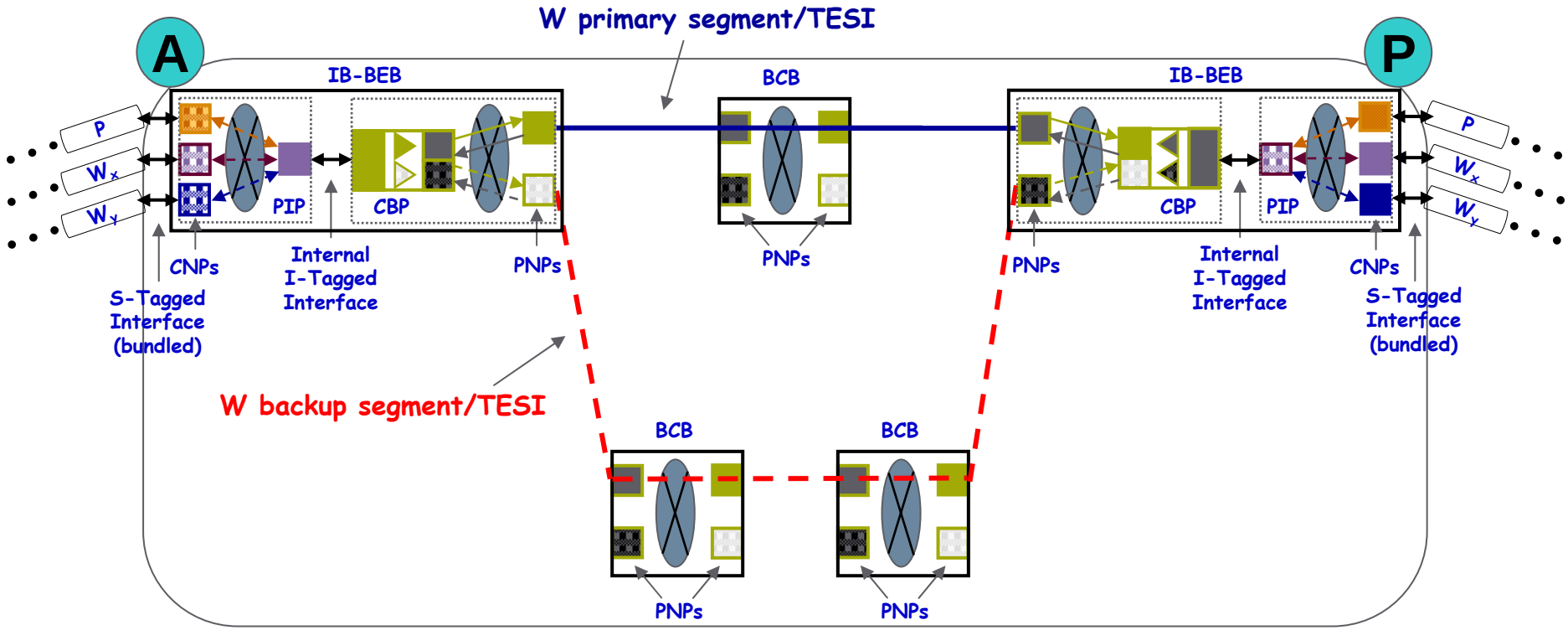
- Upgrade the BCBs at the edges of the segment to IB-BEBs and provide a PBB hierarchal (802.1ah 26.6.1) S-tagged interface (802.1ah 25.4)
- Each segment is now a new (server layer) TESI in a regular PBB-TE 1:1 TESI PG, with the corresponding TESI CCM integrity coverage

1:1 Segment Server Protection (cont'd)



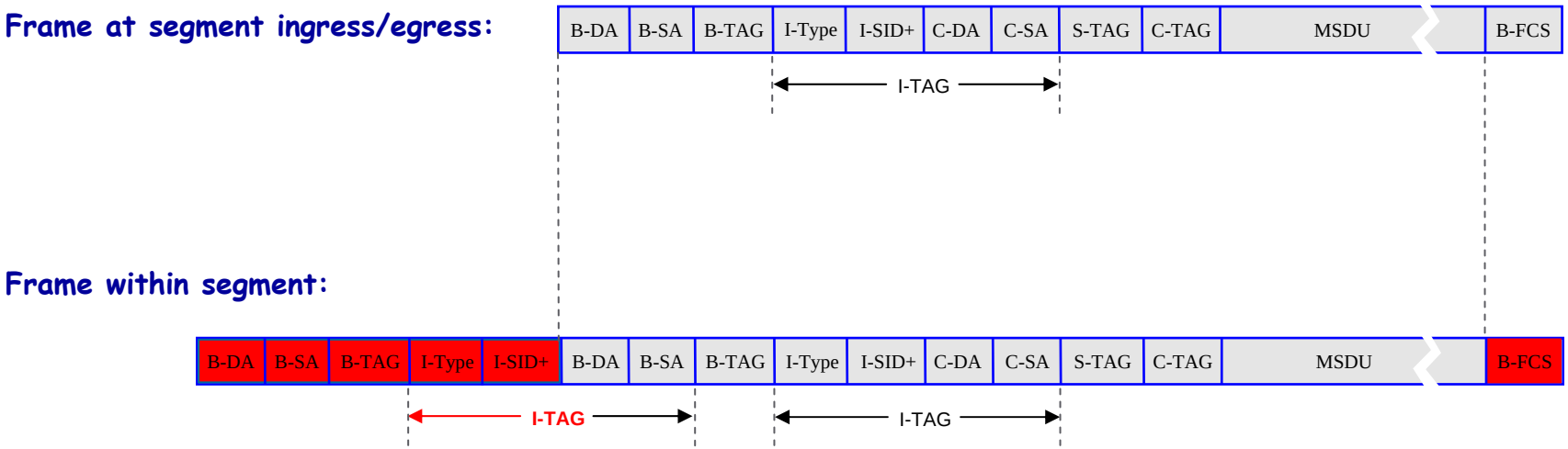
- **Segment B-MACs are the server IB-BEBs (nodes A and P) CBPs' MACs**
- **Segment B-VID corresponds to either primary or backup segment**
- **Segment I-SID could be copied from client ESP I-SID**
- **Note the original ESP B-TAG is removed and reinserted according to the one-to-one S-tagged interface definition**
- **A fresh FCS would be calculated and appended over the segment**

PBB-TE 1:1 Segment Group Protection



- **Alternatively, the IB-BEBs could provide a bundled S-tagged interface (802.1ah 25.4) for multiple client PBB-TE TESIs**

1:1 Segment Group Protection (cont'd)



- **Segment B-MACs are the server IB-BEBs (nodes A and P) CBPs' MACs**
- **Segment B-VID corresponds to either primary or backup segment**
- **Segment I-SID would be specific to that protected domain**
- **Note the original ESP B-TAG is retained according to the bundled S-tagged interface definition**
- **A fresh FCS would be calculated and appended over the segment**

1:1 Segment Server Protection Summary

- **No segment integrity coverage issue since the server layer provides necessary CCMs over both primary and backup segments (i.e., the server P802.1Qay working and protection entities)**
- **Protection within the segment is exactly as defined by P802.1Qay**
- **The segment group protection alternative provides a scalable solution for multiple client TESIs over a common segment**
- **No new work for 802.1**
- **The price tag is the additional PBB encap**

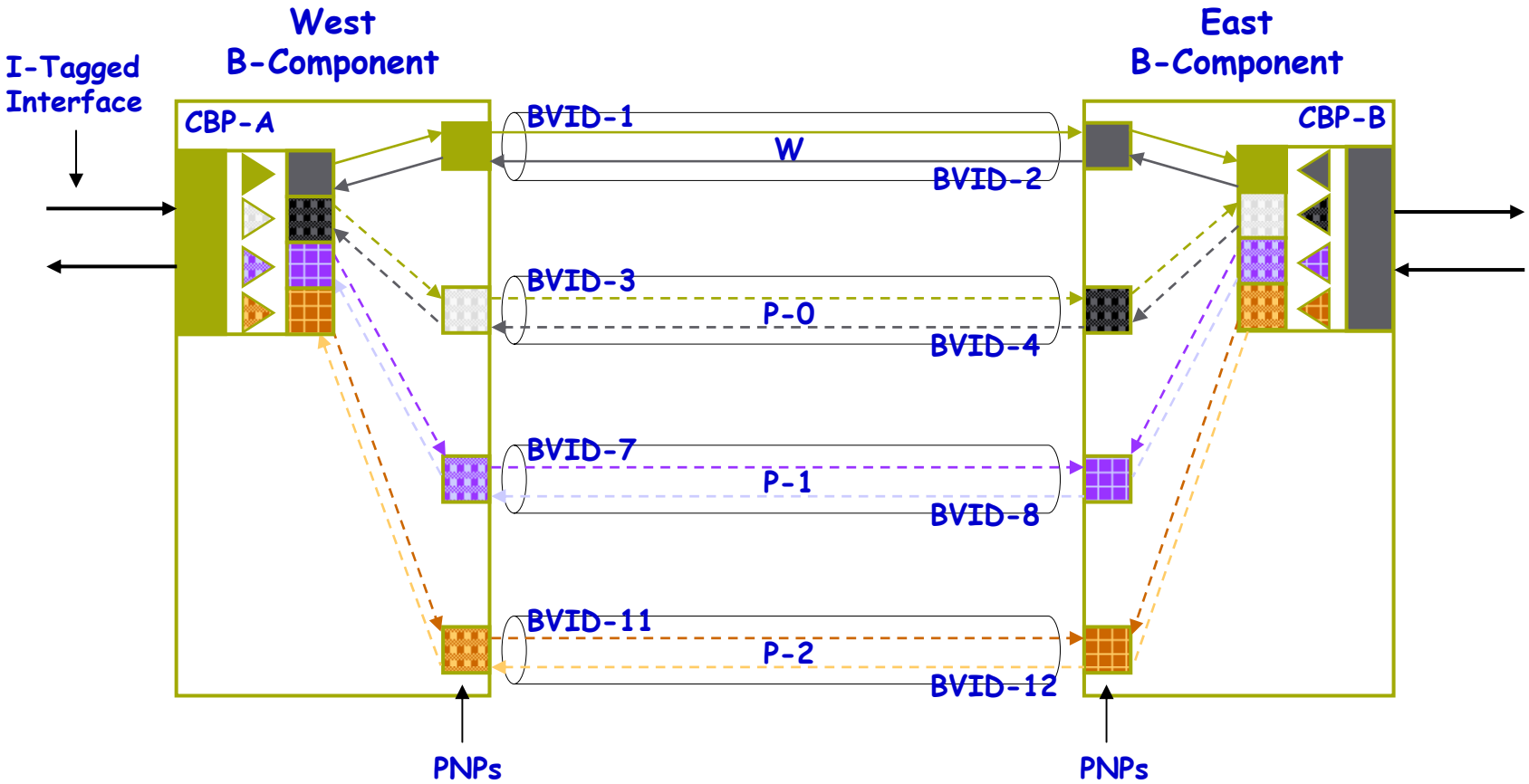
Note that the P802.1Qay PAR scope statement "This project will not take account of multi-domain networks" is referring to peered networks, not hierarchal networks such as discussed here

M:1 PBB-TE Protection

M:1 PBB-TE Protection

- **Rather than attempt to provide a protection mechanism at the same layer, or by a server layer protection mechanism, consider enhancing the P802.1Qay PBB-TE 1:1 TESI protection to M:1**
- **This addresses the problem of simultaneous working and protection entity faults by providing additional protection entities**
- **Note that in this context it is not a segment protection solution since it operates e2e**

Example 3:1 PBB-TE Protection Group



Transmit CBP traffic is sent over a given TESI by altering the B-VID accordingly
Received CBP traffic is the merge of traffic from all TESIs

M:1 PBB-TE Protection Summary

- **Provides high availability by switching to whichever protection entity is available, by automatically escalating through a pre-established prioritized sequence**
- **Since it is e2e protection, there is no maintenance domain independence as is possible with the prior two approaches**

Conclusions

- **1:1 Segment Protection**
  - **requires addition of segment MEPs for infrastructure protection (low overhead)**
  - **requires addition of enhanced MIP functionality, status exchange and correlation for datapath protection (higher overhead)**
  - **has a corner case integrity exposure**
- **P802.1Qay PBB-TE 1:1 Segment Server Protection**
  - **full integrity coverage, scalable**
  - **no new work for 802.1**
  - **requires additional PBB encap**
- **M:1 PBB-TE Protection**
  - **requires extensions to P802.1Qay 1:1 protection**
  - **does not provide maintenance domain independence**