Scaling Seamless MPLS networks using “MPLS Namespaces”

https://datatracker.ietf.org/doc/html/draft-kaliraj-bess-bgp-sig-private-mpls-labels-03

IETF 111

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July 27, 2021

Agenda

- Problem statement, and scope
  - Scaling problem.
  - Convergence problem.

- Describe solution
  - MPLS namespaces, signaled by BGP.
  - A new inter-AS option. (option BC+)

- Discuss Advantages
  - Scaling advantages
  - Convergence advantages
  - Brownfield deployment advantages.

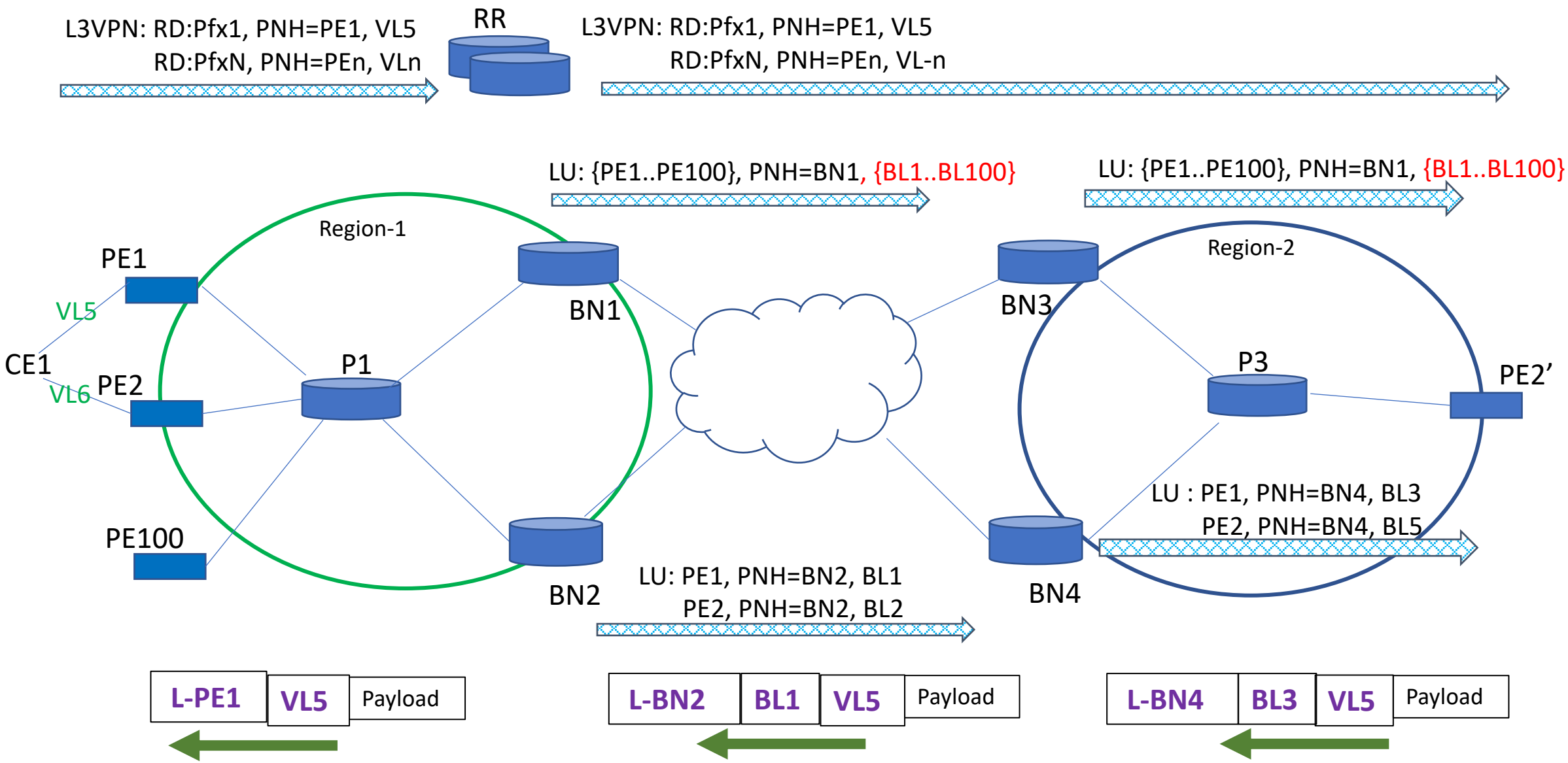
Problem statement, and scope

- Problem Scenario
  - Seamless MPLS network (option-C inter-AS) may have huge number of nodes. Each node lo0 could be a Protocol Nexthop (PNH) in BGP routes.
  - MPLS labeled-routes and nexthops resources consumed on BNs is proportional to total number of nodes in the network
  - MPLS nexthops consumed on ingress-SNs is proportional to number of PNHs received, and ECMP across them.

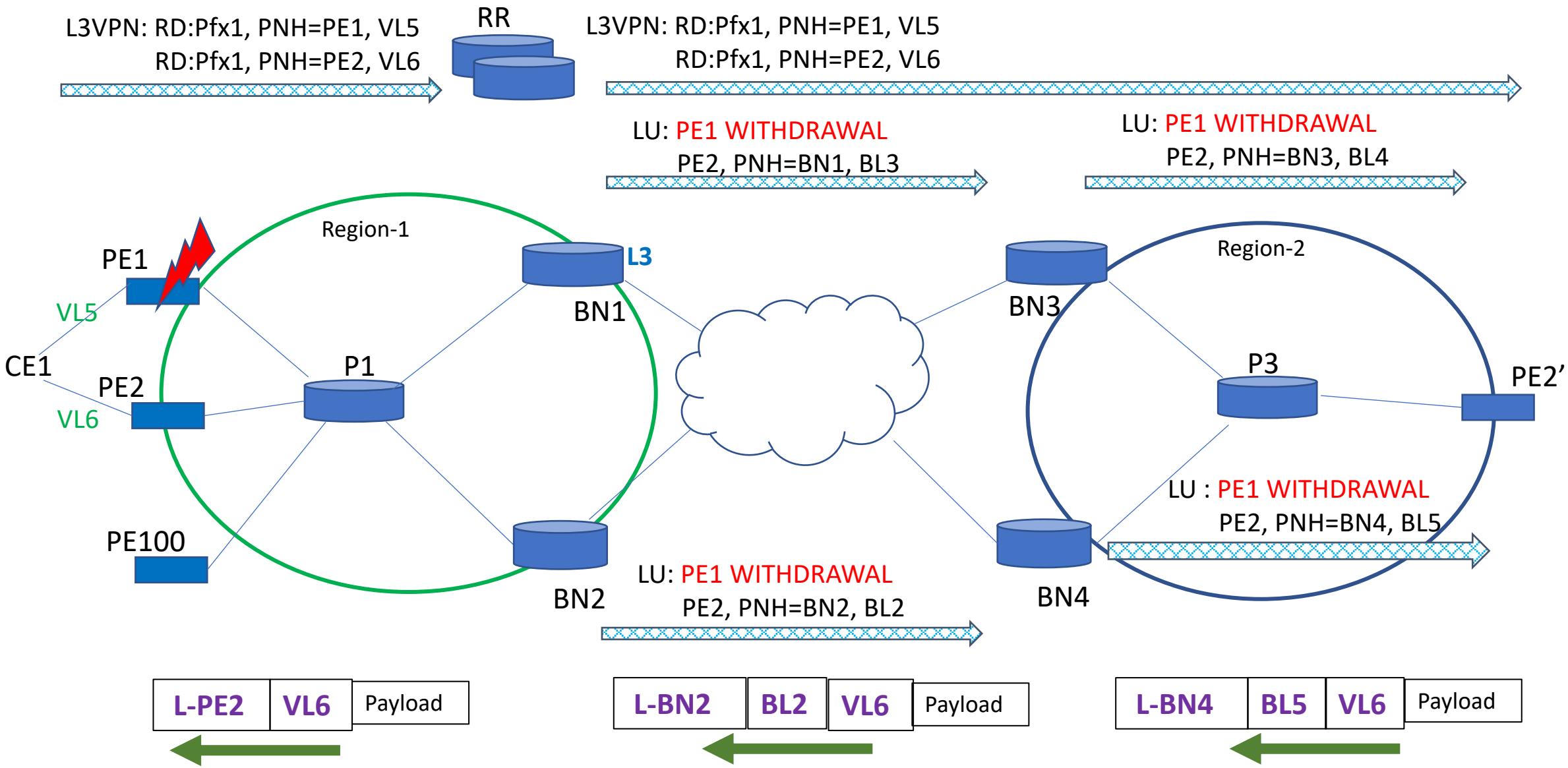
- Goal
  - Reduce the number of PNHs visible to the BNs in the network.
  - Improve scaling properties of BNs and SNs in the network by doing so.
  - Improve convergence properties of the network, by detecting and repairing traffic much closer to failure.

- Following two slides describe with example topology, the scale problem and convergence problem.

Problem: Scaling on all BNs is a Function(num PEs) times num-ECMP.



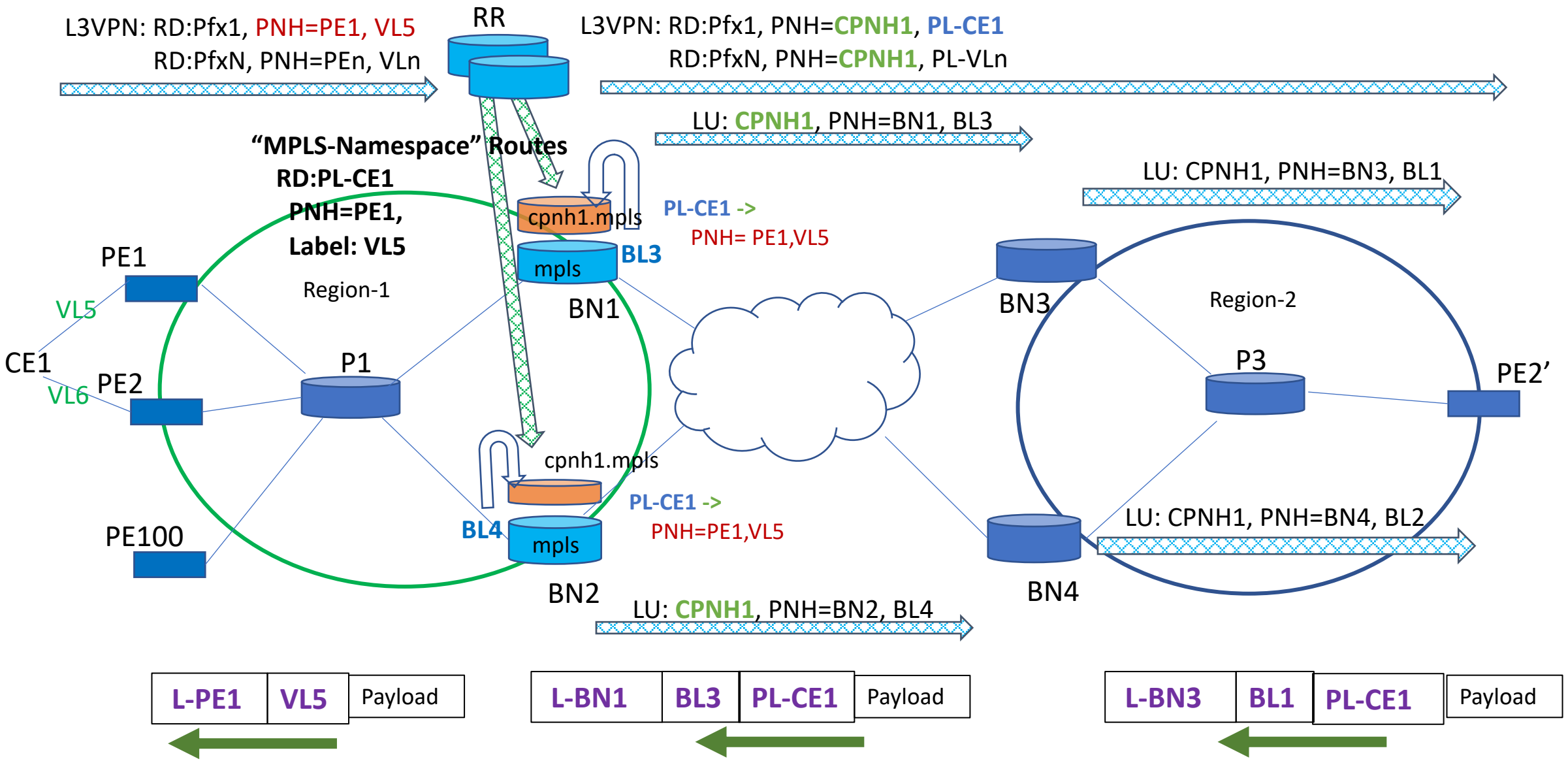
Problem: PE1 failure needs to propagate until PE2’ for PIC convergence.



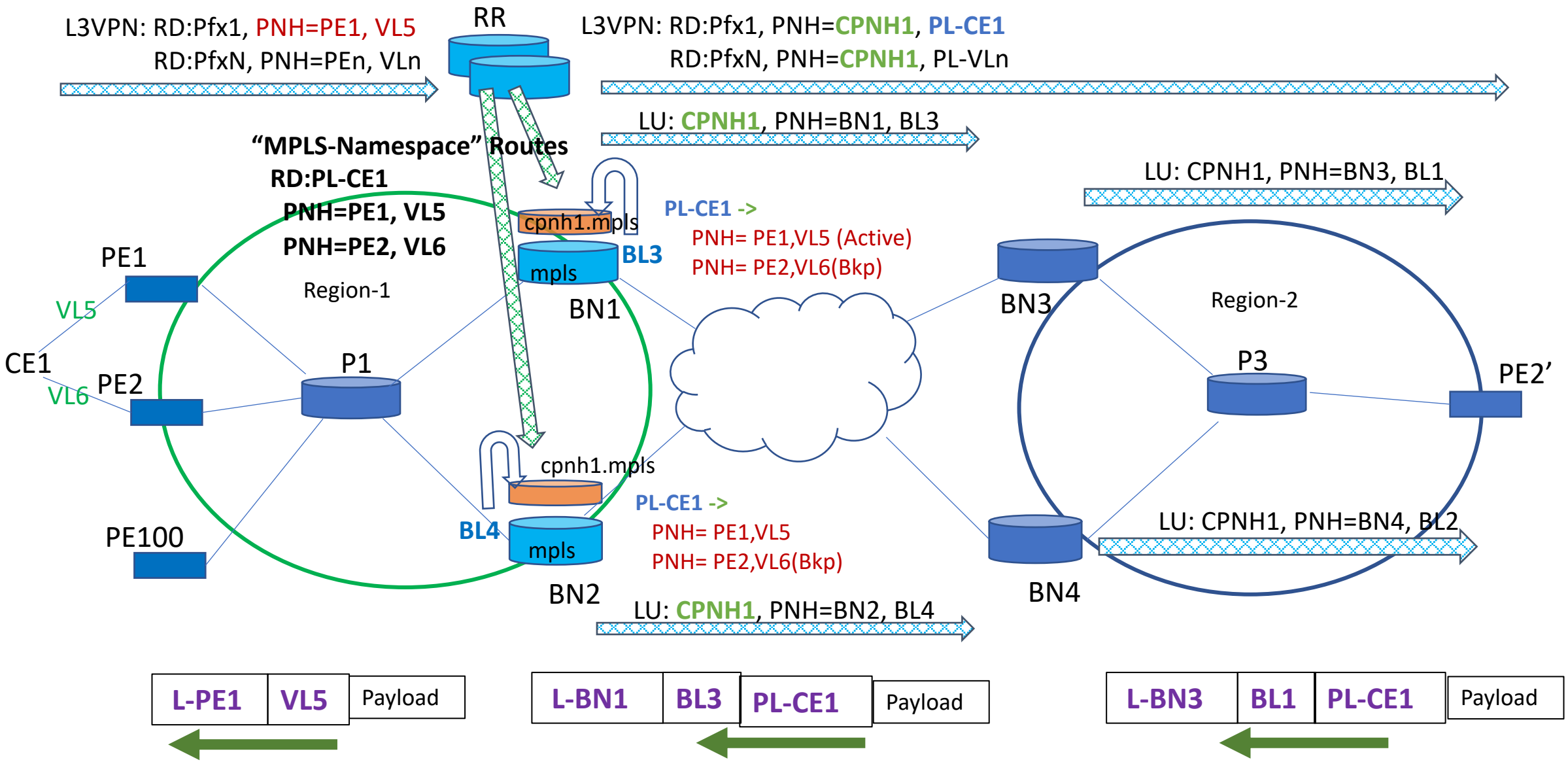
Solution – MPLS-namespaces signaled by BGP

- As number of PNHs grows in the network, some abstraction is needed across regions.
- “MPLS namespaces” can abstract PE lo0s (PNHs) in a region from rest of the regions. Thus providing this abstraction. All PEs in a region are represented by a “Context PNH” as the nexthop in BGP updates.
- “BGP MPLS namespaces” is a new BGP family (RFC4364 style) to populate upstream allocated labels in MPLS Context tables.
- This family needs to be negotiated only between Service-RR and BNs in the same region. It will mirror “Private labels” to the BNs’ context-table.
- Other regions will have route, nexthop state for “one” Context-PNH, instead of “N” PE-lo0 PNHs. Thus saving forwarding resources on all BNs and ingress-SNs
- We will see how forwarding to the N PEs works, while being abstracted by this one Context-PNH.
- PE advertised service-labels will be re-written with mpls-namespace private labels, and advertised with the context-PNH. Similar to L3VPN option-B. But without having service-routes at the BN.
- So in essence, this is a new inter-as option. Which has the benefits of option-B, option-C, and some more.
- Let us see how it works.

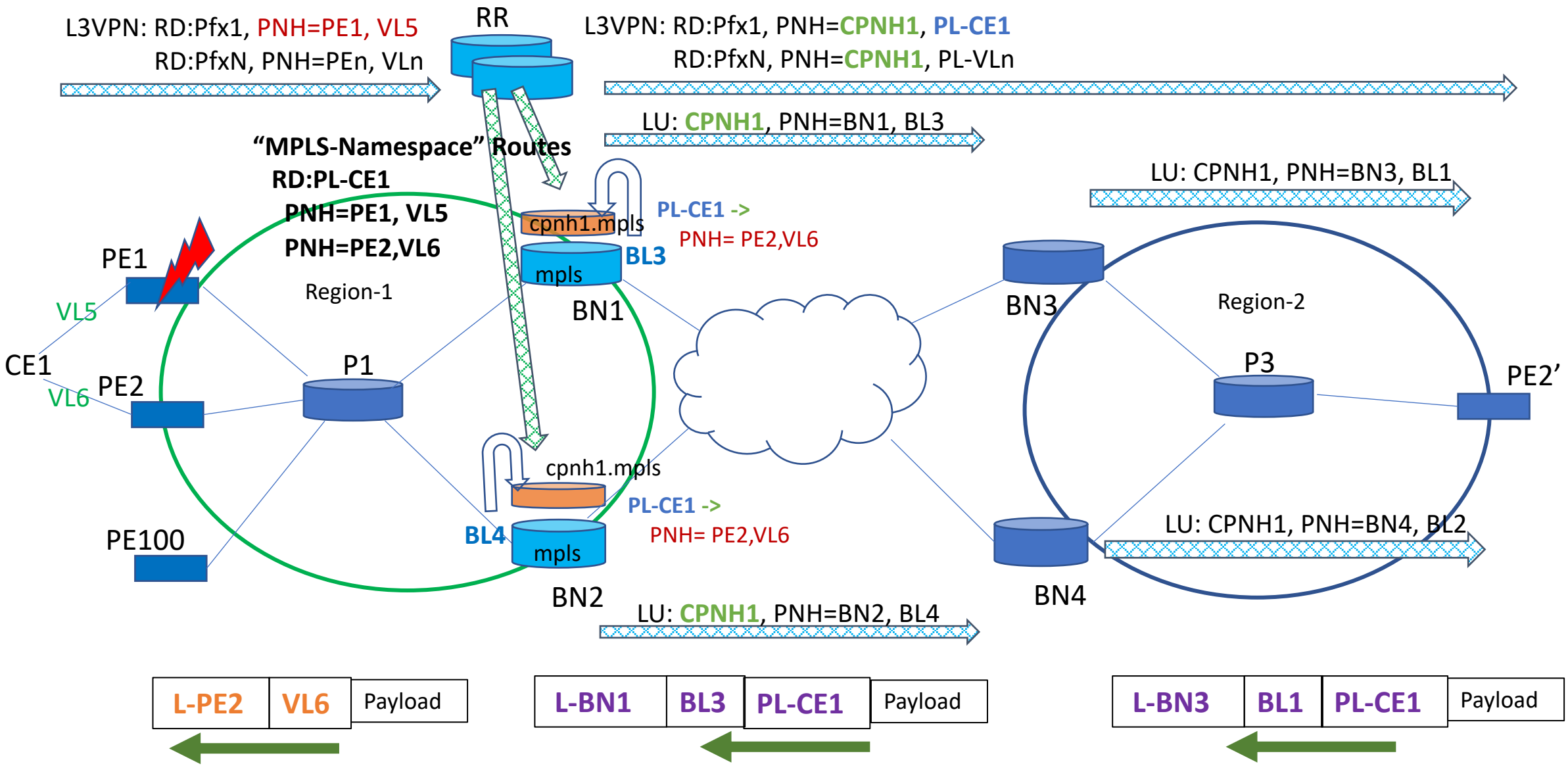
Solution: Scaling on all BNs becomes Function(num-Regions)



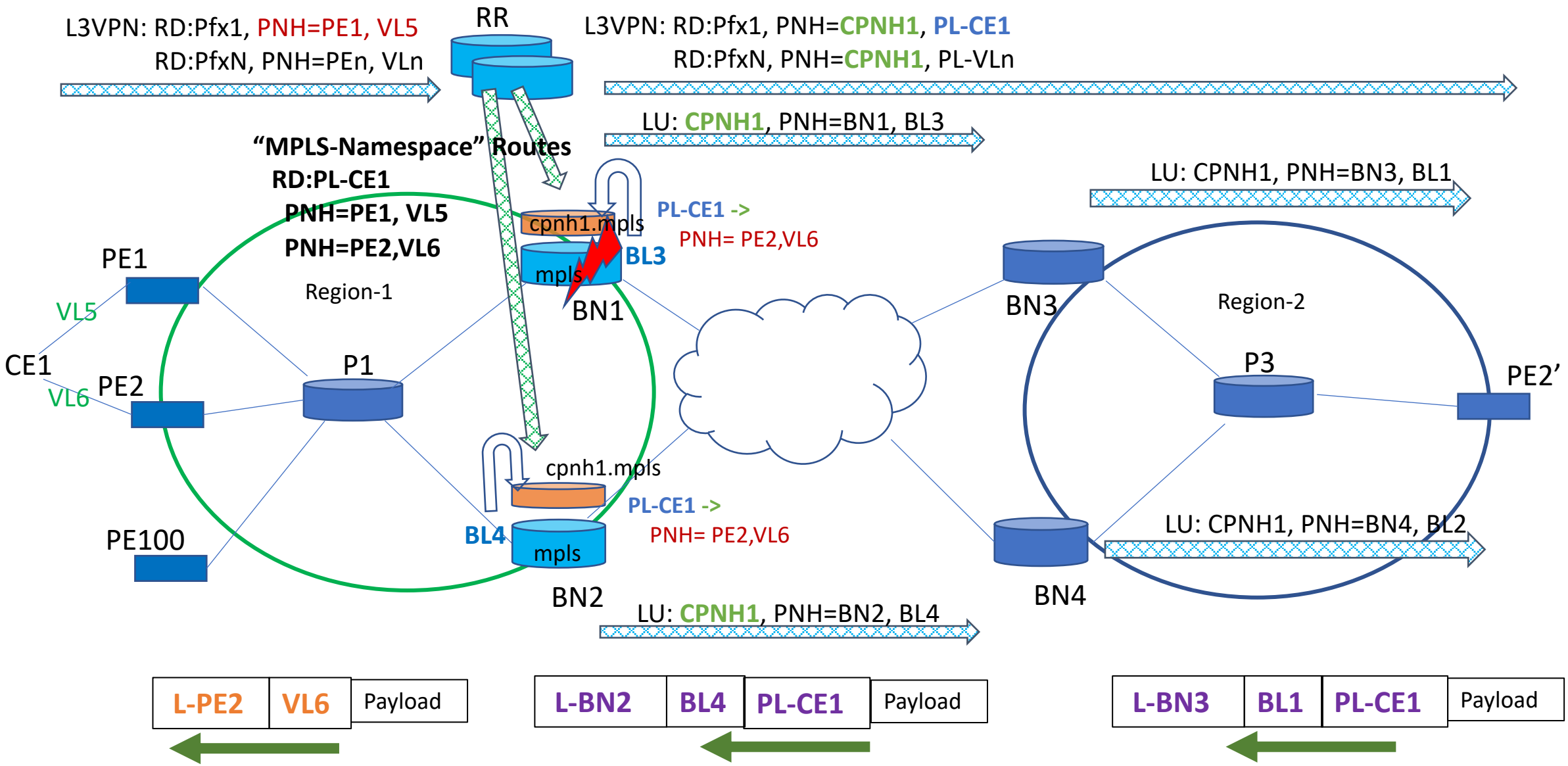
Solution: PE1 failure is absorbed by BNs for BGP PIC.



Solution: PE1 failure is absorbed by BN1,2 for BGP PIC.



Solution: BN1 failure is absorbed by BN3,4 for BGP PIC.



Advantages

- Scaling needs on BNs and SNs get reduced, they don’t need all PE lo0 routes. Just one CPNH per region.
- Less turbulence in the network during failures and M/W. Churn absorbed within region.
- The MPLS-namespace routes absorb the shocks when the topology shakes, sans affecting service routes.
- PIC/EP like convergence features provided at MPLS-namespace layer, is actually **BGP Service family agnostic**. Can provide sub-second traffic restoration against BN failure, and PE-failure also.
- **Works with legacy PEs also**. Only upgrade required is on RR, BNs. Localized feature between RR-BN provides network wide scale and convergence.
- Described procedure works for BGP-LU networks as-well as BGP-CT networks. The LU/CT route will advertise the CPNH address with Context-Label.

References

- https://datatracker.ietf.org/doc/html/draft-kaliraj-bess-bgp-sig-private-mpls-labels-03
- [RFC-4364] BGP/MPLS IP Virtual Private Networks (VPNs)
- [RFC-5331] MPLS Upstream Label Assignment and Context-Specific Label Space

Thank you.