Private MPLS Namespaces

Signaled using BGP VPNs

(ietf99)

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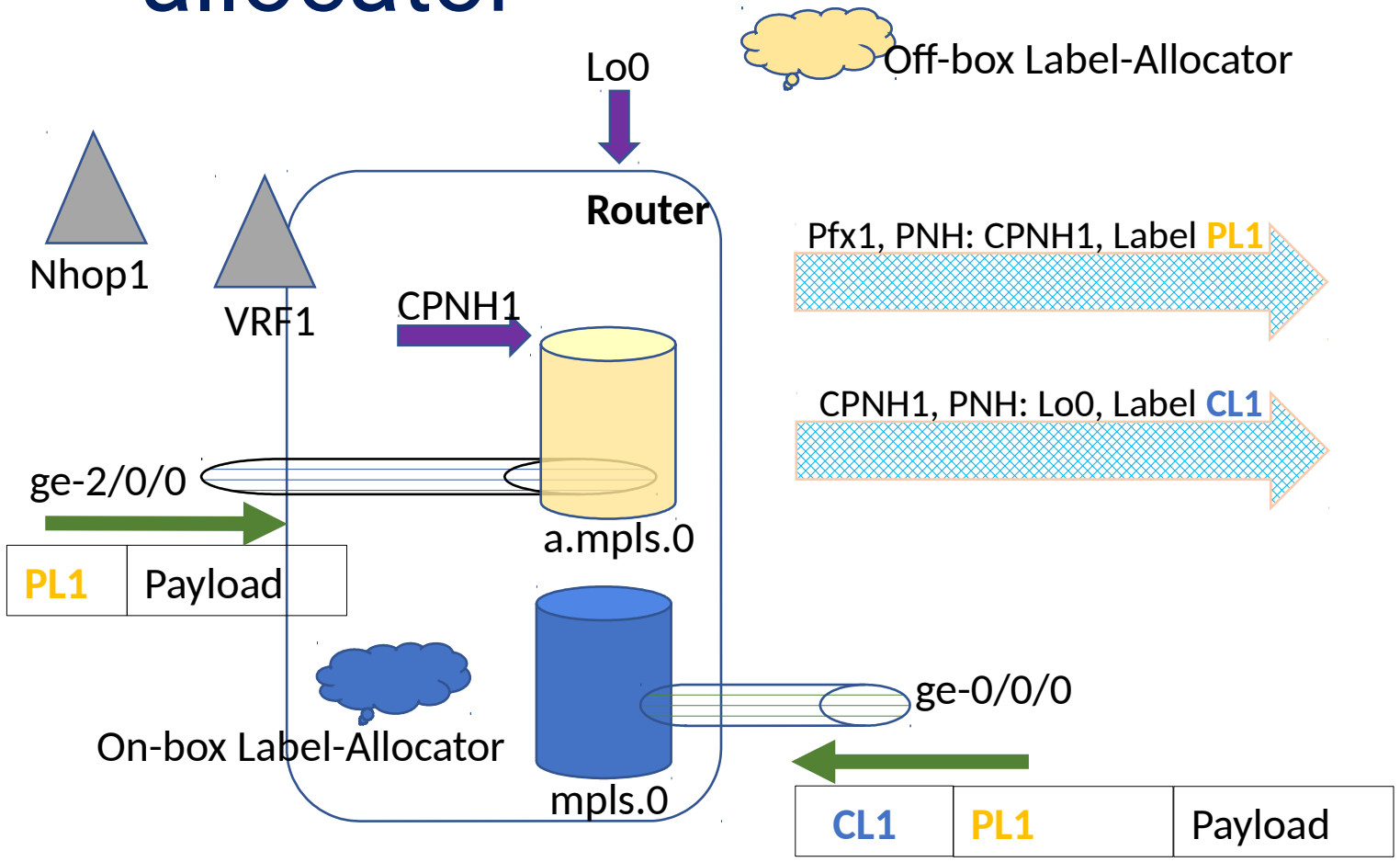
(https://www.ietf.org/id/draft-kaliraj-bess-bgp-sig-private-mpls-labels-00.txt)

Problem

- How to achieve “Predictable MPLS label allocation”
  - Install route with desired “label-value” and “forwarding-behavior” in a router’s MPLS forwarding-plane
  - API to mpls-router’s forwarding-plane, for use by external label-allocators (another router or a controller)
- Possible solutions:
  - Label range reservations
  - Label contexts, RFC 5331 (chosen here; why? slide15)

MPLS context-table, enables “off-box” lbl-allocator



a.mpls.0
PL1 -> VRF1
PL2 -> Nhop1

mpls.0
L1 -> VRF1
L2 -> Nhop1
CL1 -> a.mpls.0 (context-lbl)

Private MPLS namespace (mpls-plane)

- Router creates MPLS name-space (context-table) for an Application, and propagates in the network using BGP.
- App's handle to the name-space:
  - "context-label" or "private-interface" : for forwarding-control
  - "context-route-target" : for routing-control.
- The network thus provides a 'private MPLS-plane' abstraction to Apps, over a shared MPLS-network.
- A 'mpls-plane' is identified by a "Context-PNH". Service routes bind to this PNH, instead of PE-lo0, to use a mpls-plane.

Protocol extensions

- New RFC-4364 style AFI-SAFIs to exchange Private-Labels

  (https://www.ietf.org/id/draft-kaliraj-bess-bgp-sig-private-mpls-labels-00.txt)

- A new BGP “Multi-Nexthop” attribute to carry Forwarding-nexthop information for the Private-Labels

  (https://www.ietf.org/id/draft-kaliraj-idr-multinexthop-attribute-00.txt)

  - Ability to carry multiple nexthops in one bgp-route
  - Each nexthop-leg expressed with “FwdSemantic” of (Forward, Push, Pop, Swap) with qualifiers such as preference, load-balance-factor etc.
  - Facilitates the API to express forwarding-behavior for upstream-allocated labels.

Details, Route-Types

- Route-Type-1 “Context-PNH advertisement”

  Prefix: RD:CPNH-Address

  Attributes:

    - MultiNexthopAttr:

      Push(CL1), ForwardTo(Lo0)

    - Route-Target identifying the mpls-plane

- Lo0 resolves over some transport tunnel (LDP, RSVP, GRE, …)

Details, Route-Types …

- Route-Type-2 “Private Label advertisement”

  Prefix: RD:Label

  Attributes:

  - MultiNexthopAttr:

    e.g. - ForwardTo(RD:CPNH-addr)

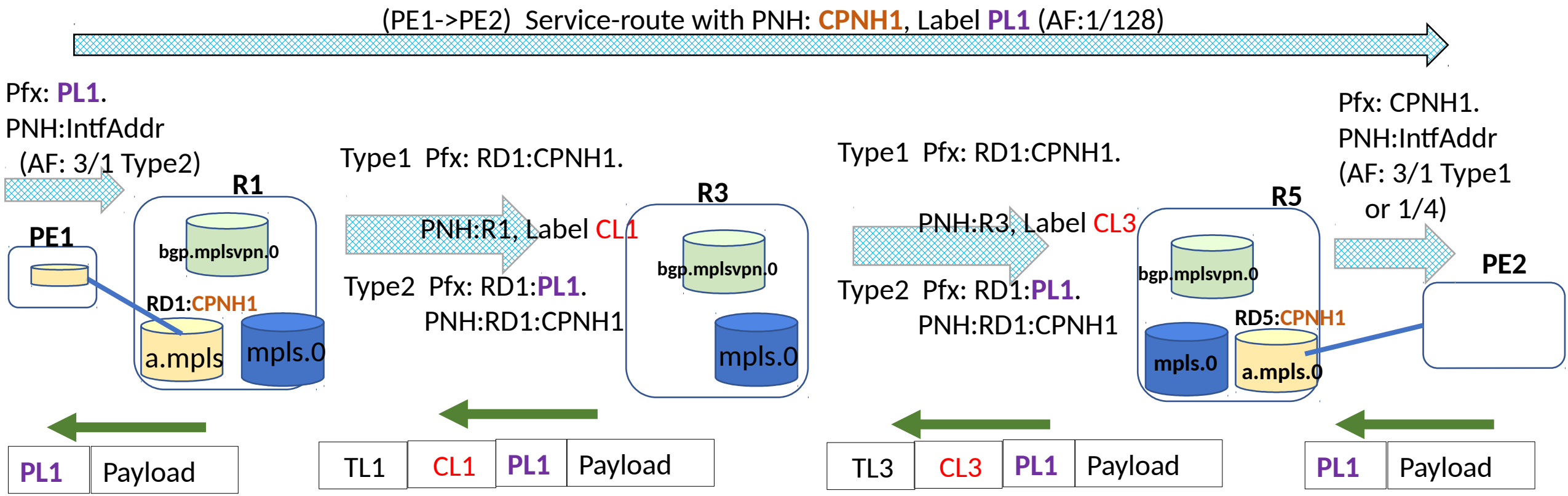
    - Pop-n-Lookup(VRF-RD)

    - Pop-n-Fwd(10.1.0.2)

  - Route-Target identifying the mpls-plane

- RD:CPNH-addr resolves over the Type-1 route in previous slide

Put it together

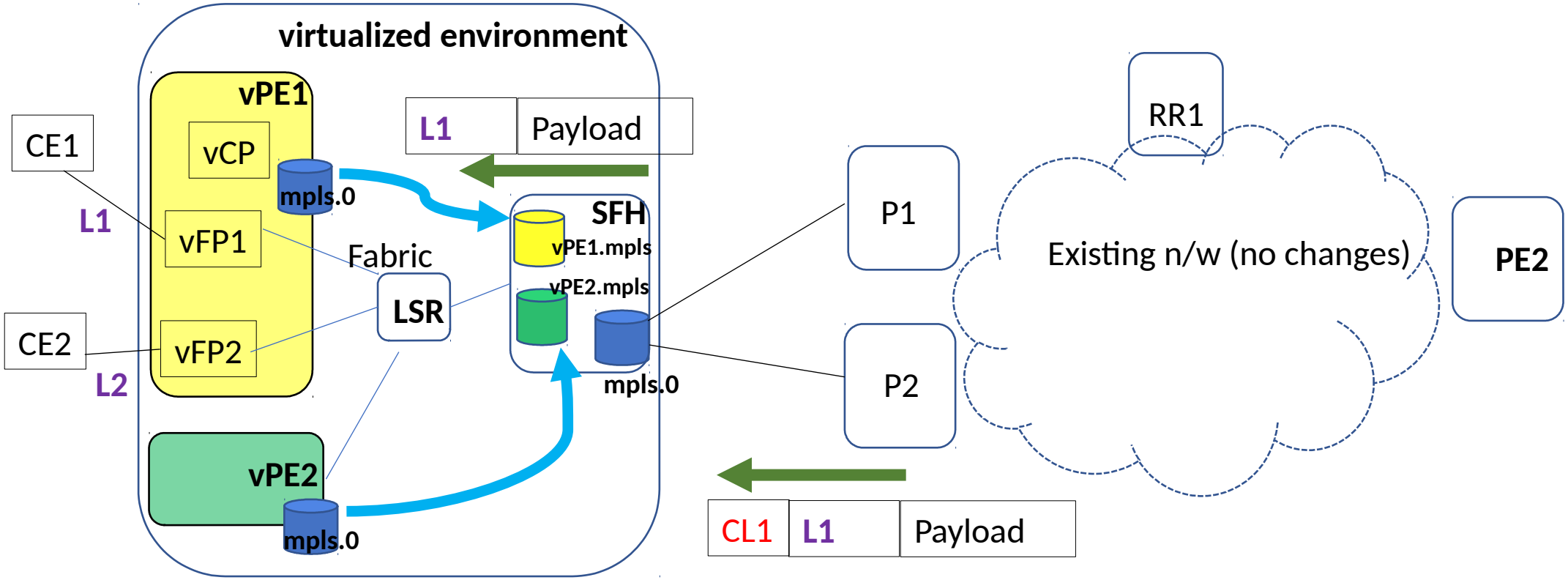


R3: mpls.0
CL3 -> Swap(CL1), ForwardTo(R1)
R3:bgp.mplsvpn.0
RD1:PL1 -> ForwardTo(RD1:CPNH1)
RD1:CPNH1 -> Push(CL1), ForwardTo(R1)
R3: inet.3:
R1 -> Push(TL1), ge-x/y/z

R5: a.mpls.0
PL1 -> ForwardTo(RD1:CPNH1)
R5:bgp.mplsvpn.0
RD1:PL1 -> ForwardTo(RD1:CPNH1)
RD1:CPNH1 -> Push(CL3), ForwardTo(R3)
R5: inet.3:
R3 -> Push(TL3), ge-x/y/z

Usecase1: optimal traffic-fwd in virtualized environment

- “service-label mirroring” to Service-Forwarding-Helper
- SFH optimally forwards mpls-traffic from core to correct vFP

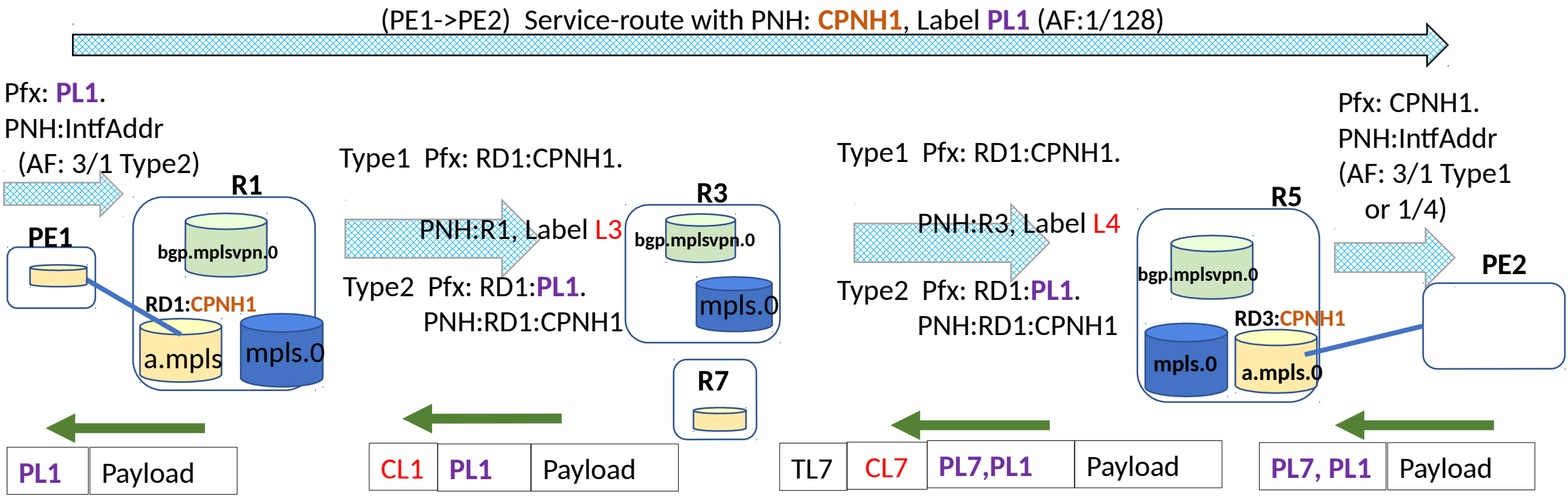


Backup slides.

Summary, nomenclature

- Context-PNH : IP-address identifying a private-mpls-plane. (Network-wide Unique like a Lo0)
- Context-Label: Locally-significant label pointing to label-context. App sends mpls-traffic with context-label to get to the right context-table.
- Private-interface: ge-x/y/z interface at router owned by application. App doesn’t use context-label if it is connected via private-interface
- Context-Route-Target: Route-target identifying the mpls-plane

Bkp-slide: Show traffic detour via R7



R7: mpls.0
CL7 -> Pop, Lookup(a.mpls)

R7: a.mpls
PL7 -> Pop-and-Lookup
PL1 -> ForwardTo(RD1:CPNH1)

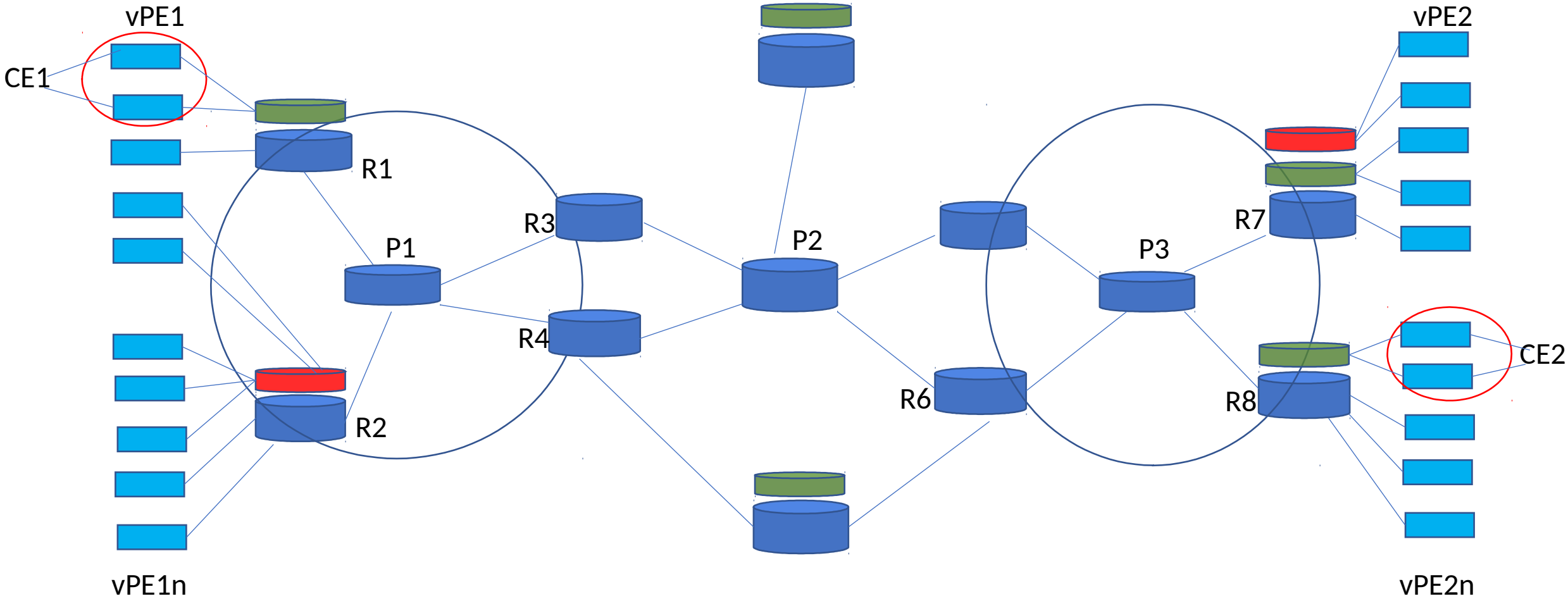
R5: a.mpls.0
PL7 -> ForwardTo(RD7:CPNH1)

R5: bgp.mplsvpn.0
RD7:CPNH1 -> Push(CL7), ForwardTo(R7)

Usecase 2: Static-bindings for Control-plane routes

- Take as example L3VPN network. Use “Context-PNH” as the PNH for service-routes, and “Private-Labels” as the service-label.
- State on end vPEs get reduced, they don’t need all PE lo0 state
- POP of service can be taken into M/W by just tweaking Private-Label-route Local-preference.
- Single-homing, multihoming of service works
- Features like PIC-edge/Egress-Protection/EPE can be provided at private-mpls layer, and be actually service agnostic.
- Inet family can be equated with L3VPN, by using Multi-nexthop attribute to advertise a “push label” for inet-uni family routes as-well.

Seamless MPLS – private mpls-planes



Comparison (why you should be interested)

(Focus of this talk ⬇)

Comparison	Label range reservation	Label contexts (private namespace)
Scaling	Shrinks per application usable namespace	Gives each application a full mpls label namespace
Coordination with existing users of MPLS global-namespace	Tightly coupled, range reservation and coordination required	Flexible. No overlap with global/other MPLS namespace users.
Security	nope	Yes. Fwd-context based spoof-check
Platform dependency (label-context forwarding support RFC5331)	Not required	Lbl-ctx Forwarding support required, only on Private-LERs
Label-stack overhead	No overhead	One extra label (Context-label)
Applicability	Limited (e.g. cannot be used for label-mirroring applications)	More flexible. As it gives full control to external allocator on label-value.

Pointers to new drafts:

- https://www.ietf.org/id/draft-kaliraj-bess-bgp-sig-private-mpls-labels-00.txt
- https://www.ietf.org/id/draft-kaliraj-idr-multinexthop-attribute-00.txt

References to existing specs:

- [RFC-4364] BGP/MPLS IP Virtual Private Networks (VPNs)
- [RFC-5331] MPLS Upstream Label Assignment and Context-Specific Label Space