BGP Classful Transport Planes

https://tools.ietf.org/html/draft-kaliraj-idr-bgp-classful-transport-planes-07

IETF 110

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Agenda

- Recap BGP CT; problem, solution, advantages, presented at IETF-108.
- Share changes to the draft – since last presentation.
- Share learnings from implementation, qualification.
- Introduce related drafts.
- Next steps.

BGP-CT: Problem

- A domain has intra-AS tunnels with varying TE characteristics (gold, silver, bronze).

- There could be multiple tunnels to the same destination. And different tunneling protocols creating those tunnels.

- These tunnels may need to be extended inter-domain, while preserving their TE characteristics end-to-end.

- Different Service routes want to resolve (put traffic) over intra/inter-domain tunnels of a certain TE characteristic, with an option to fallback on tunnels belonging to a different TE characteristic, including best-effort tunnels.

- How to extend BGP to signal these pieces of information, and get the job done.

- Solution agnostic of transport (RSVP, SRTE, Flex, IP-tunnels, etc..) and service layer (L3VPN, IPv6, Flowspec, Static, L2VPN, EVPN, etc..). i.e. works with any of these protocols in service and transport-layer.

BGP-CT: Solution constructs.

- Transport Class: collects tunnels with same TE characteristics (gold, silver, etc). Identifier: 32-bit Color.

- BGP-CT is a new BGP transport layer address-family (SAFI: 76, "Classful Transport") that follows RFC-4364 procedures.

- Ingress routes collected in a TC are advertised in BGP-CT family, to other BGP speakers.
  - With "Route Distinguisher:TunnelEndpoint" as the NLRI.
  - And "Transport Class Route Target" that identifies the TC it belongs to.

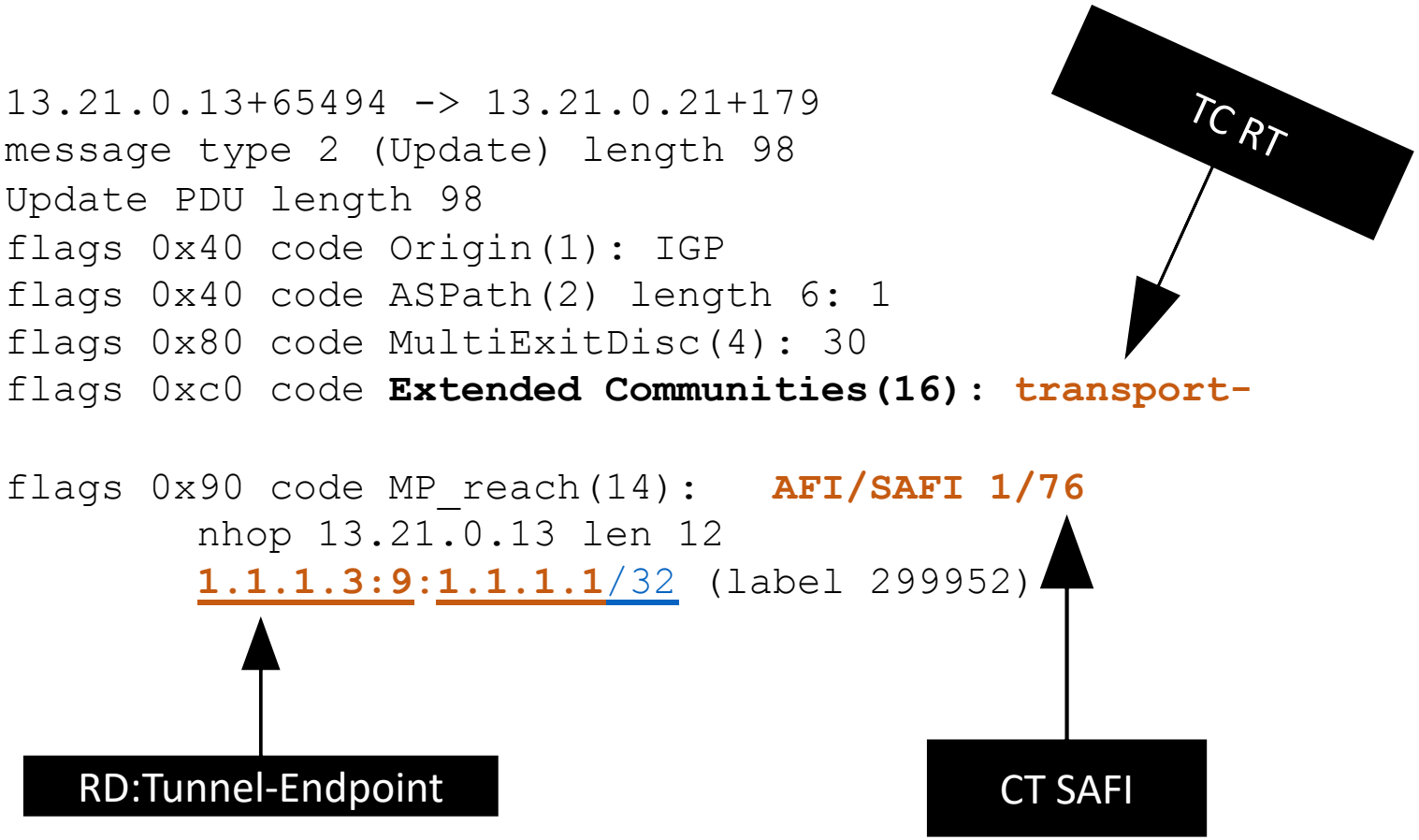
- BGP-CT extends the tunnel across inter-domain boundaries, while preserving the same Transport class end-to-end.
  - Resolve BGP NH using tunnels belonging to the same Transport class.
  - Follow RFC-4364 option-C style procedures, to create swap-routes on domain boundaries.
  - Works in conjunction with option-A, option-B scenarios as-well.

- Service routes want to resolve using a Resolution scheme asper user intent *(e.g.. use tunnels of a certain Transport class, with an option to fallback on Best-effort or another Transport class)*.

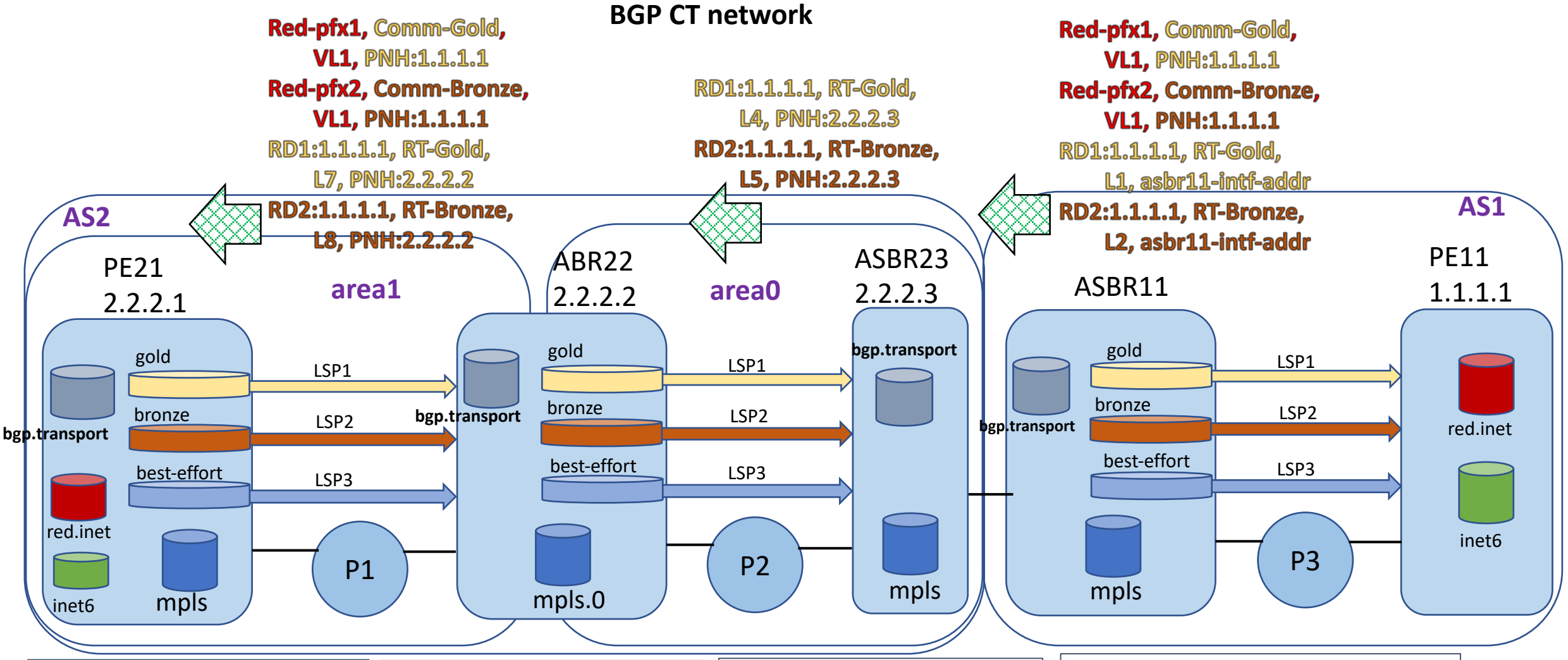
- Desired Resolution scheme is signaled via "Mapping community" on BGP route. E.g:
  - Color:0:<n> on the service-route. Resolves over Color "n" tunnels, with fallback on 'best-effort' tunnels.
  - Transport-Target on BGP-CT route. Resolves strictly over Color "n" tunnels.

BGP CT: pcap sneak peak

```
Nov 10 22:00:51.708561 BGP SEND 13.21.0.13+65494 -> 13.21.0.21+179
Nov 10 22:00:51.708563 BGP SEND message type 2 (Update) length 98
Nov 10 22:00:51.708572 BGP SEND Update PDU length 98
Nov 10 22:00:51.708574 BGP SEND flags 0x40 code Origin(1): IGP
Nov 10 22:00:51.708580 BGP SEND flags 0x40 code ASPath(2) length 6: 1
Nov 10 22:00:51.708581 BGP SEND flags 0x80 code MultiExitDisc(4): 30
Nov 10 22:00:51.708596 BGP SEND flags 0xc0 code Extended Communities(16): transport-
target:0:100
Nov 10 22:00:51.708605 BGP SEND flags 0x90 code MP_reach(14):   AFI/SAFI 1/76
Nov 10 22:00:51.708611 BGP SEND         nhop 13.21.0.13 len 12
Nov 10 22:00:51.708631 BGP SEND         1.1.1.3:9:1.1.1.1/32 (label 299952)
```



BGP CT network



PE21: red.inet fib
- Pfx1 -> Push VL1, L7, LSP1
- Pfx2 -> Push VL1, L8, LSP2

PE21:inet6
- Pfx3 -> Push 2, L7, LSP1

ABR22: mpls fib
- L7 -> Swap L4, Push LSP1
- L8 -> Swap L5, Push LSP2
- L9 -> Swap L6, Push LSP3

ASBR23: mpls fib
- L4 -> Swap L1, asbr11-Intf
- L5 -> Swap L2, asbr11-Intf
- L6 -> Swap L3, asbr11-Intf

ASBR11: mpls fib
- L1 -> Pop, Push LSP1 Labels
- L2 -> Pop, Push LSP2 Labels
- L3 -> Pop, Push LSP3 Labels

BGP-CT: advantages of reusing 4364 encoding

- Using RFC-4364 style “Route Distinguisher” allows advertising multiple tunnels to the same destination
  - Avoids using multiple loopbacks on Egress-PE,
  - Avoids path-hiding when transiting RR/ASBRs,
  - Allows unambiguously identifying the originating PE, for debugging.
  - Supports TunnelEndpoint being an Anycast-address participating in multiple domains.
  - Allows path-selection after stripping RD, when necessary. Helpful for faster convergence.

  Basically, RD is an identifier of convenience. Use it when needed, Strip it when not needed. Preserved end-to-end.

- Using RFC-4364 style “Route Target” to propagate Transport-Class allows:
  - Forming Venn diagrams of color domains as desired.
  - Core network having more fine-grained colors than Access networks.
  - Other creative use-cases possible in future, e.g. Hub and Spoke Color domains..?
- Treating “Color” as an attribute (adjective), rather than part of NLRI (noun)
  - Helps in cases where domains have different numbering of color values. Attribute rewrites is easier than rewriting NLRI.

- ODN using Route Target Constrain procedures.
  - Service-routes can have a clean API with Transport-layer, to request for only the BGP-CT routes required by service-routes.

- Re-uses the time tested, well deployed, RFC-4364 machinery. That cuts down implementation, testing time. Improves reliability of the solution, and time to deploy. Preserves ROI.
- Mantra of 21st century technologies is “reduce, re-use, recycle”. From Software perspective: “re-use, reduce, extend”.

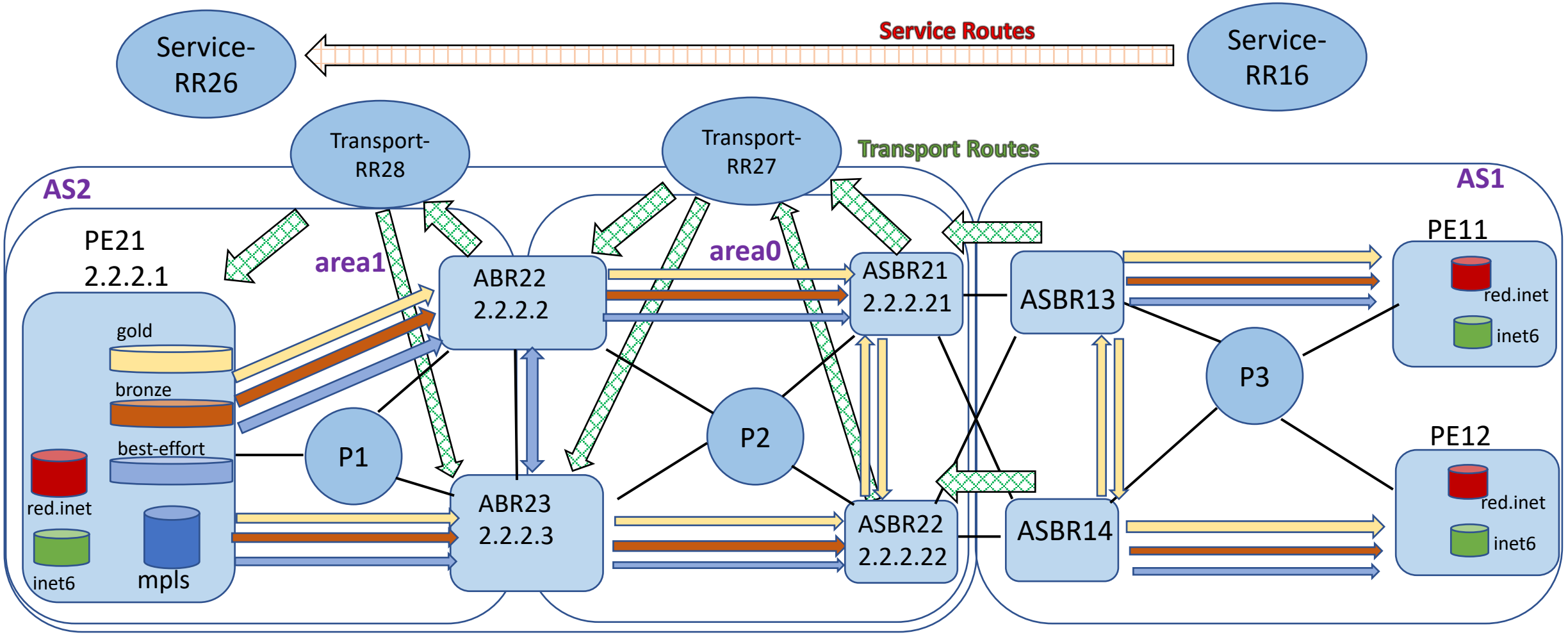
Updates since IETF-108

- Added illustration with example topology, MPLS OAM section.
- Documented how CT helps with Redundant ABRs scenario. Where RR is configured with nexthop-self. We will discuss this one in next two slide.
- Added Scaling considerations section.
  - Recommend RFC-8212 as default behavior for BGP-CT family.
  - Route-Target Filter usage for BGP-CT to provide ODN.
  - MPLS namespaces. A new concept can be applied to both LU or CT networks to deal with scaling.
- Added ‘Applicability to Network-Slicing’ section: Transport Class is the “Topology Slice” part of Transport slice (Transport slice = Topology slice + Resources)
- Welcome co-authors: VZ, Cox, Alibaba, Google.
- Status of Implementation: Code shipping on Junos 21.1R1

Redundant ABRs (RRs with NHS) in a BGP network

- Such topologies have possibility of forwarding loop forming between BGP-LU ABRs, because of RFC-4456 (it's focus is pure-RR functionality), which don't tie-break on Cluster-List before Router-ID.
- IGP-metrics need to be carefully chosen to avoid ABR choosing each other as best-path instead of ASBR.
- In some implementations LDP sets flat IGP-metric of 1 (perhaps for this reason). But when using L-ISIS or ISIS-Flex, IGP-metric makes a difference.
- Implementations may provide a way to put Cluster-List step before Router-ID step in path-selection, at "Forwarding RR-nodes doing nexthop-self".
- BGP-CT provides an easier deployment alternative: don't provision ABR to ABR colored-tunnels. This avoids possibility of any loops, without having to playing with IGP-metric or BGP path-selection.

Avoiding possible forwarding loop between redundant ABRs



ABR23: best-effort transport rib PE11: PNH=ABR22 PE11: PNH=ASBR21 PE11: PNH=ASBR22	ABR22: b-e transport rib PE11: PNH=ABR23 PE11: PNH=ASBR21 PE11: PNH=ASBR22	ABR23: gold transport rib PE11: PNH=ASBR22 PE11: PNH=ASBR21 PE11: PNH=ABR22 (Hidden)	ABR22: gold transport rib PE11: PNH=ASBR21 PE11: PNH=ASBR22 PE11: PNH=ABR23 (Hidden)

Related drafts

- PCEP RSVP Color
  draft-rajagopalan-pcep-rsvp-color-00

- Seamless SR – use cases.

https://datatracker.ietf.org/doc/draft-hegde-spring-mpls-seamless-sr/

- SRv6 and MPLS interop.

https://datatracker.ietf.org/doc/draft-bonica-spring-srv6-end-dtm/

- MPLS namespaces: signaled via BGP

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

- Generic RTC

https://datatracker.ietf.org/doc/draft-zzhang-idr-bgp-rt-constrains-extension/

Thank you.