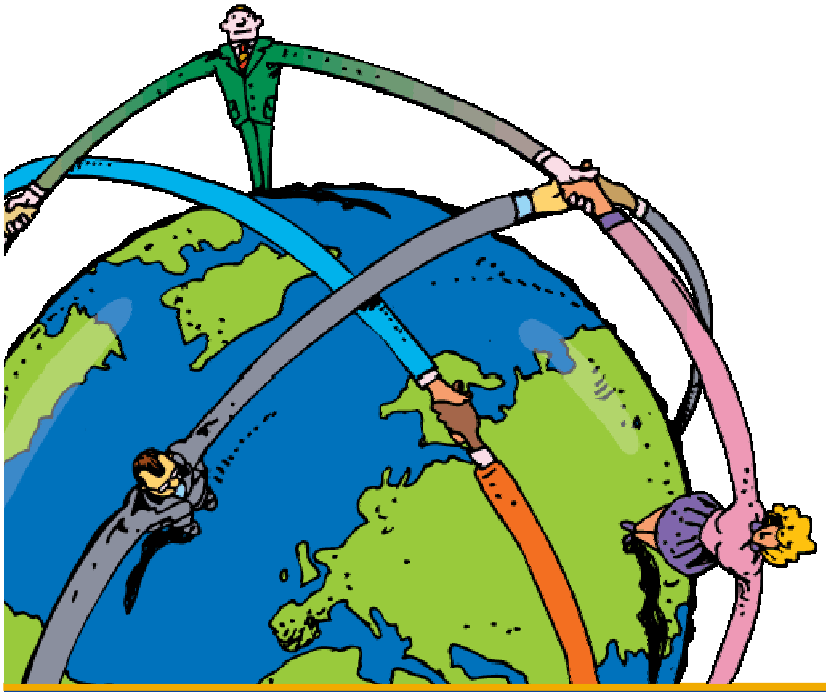


Next-Generation MPLS MVPN

Amit Kumar Dash
adash@juniper.net

- Multicast VPN drivers
- Next Generation MVPN Goals
- What is MVPN
- Control Plane And Data Plane Challenges in existing MVPN Implementations
- Next generation MVPN Solution
- Advantages of NG-MVPN
- Summary

2547 VPN Multicast Drivers

- **Growing number of 2547 VPN customers have IP multicast traffic**
  - Expected to grow to a large fraction of customers
- **Volume and Type of the multicast traffic**
  - Expected to grow to a significant share of the overall traffic(Increasing demand for Video-Conferencing, Telepresence, Media-Rich Financial Institutions, Content Distribution, Wholesale IPTV, Wholesale Content Distribution, Inter-Metro IPTV/Broadcast TV traffic)

Next-generation MVPN: Goals

- **Extend 2547 VPN service offering to include support for IP multicast for 2547 VPN customers**
- **Follow the same architecture/model as 2547 VPN unicast**
  - No need to have the Virtual Router model for multicast and the 2547 model for unicast
- **Re-use 2547 VPN unicast mechanisms, with extensions, as necessary**
  - No need to have PIM/GRE for multicast and BGP/MPLS for unicast
- **Retain as much as possible the flexibility and scalability of 2547 VPN unicast**

What is an MVPN?

- **MVPN is defined by two sets of sites, Sender Sites set and Receiver Sites set, with the following properties:**
  - Only hosts within the sender sites set can originate multicast data traffic; can have sources
  - Only hosts within the receiver sites set can receive multicast data traffic from any of the hosts in the sender sites set

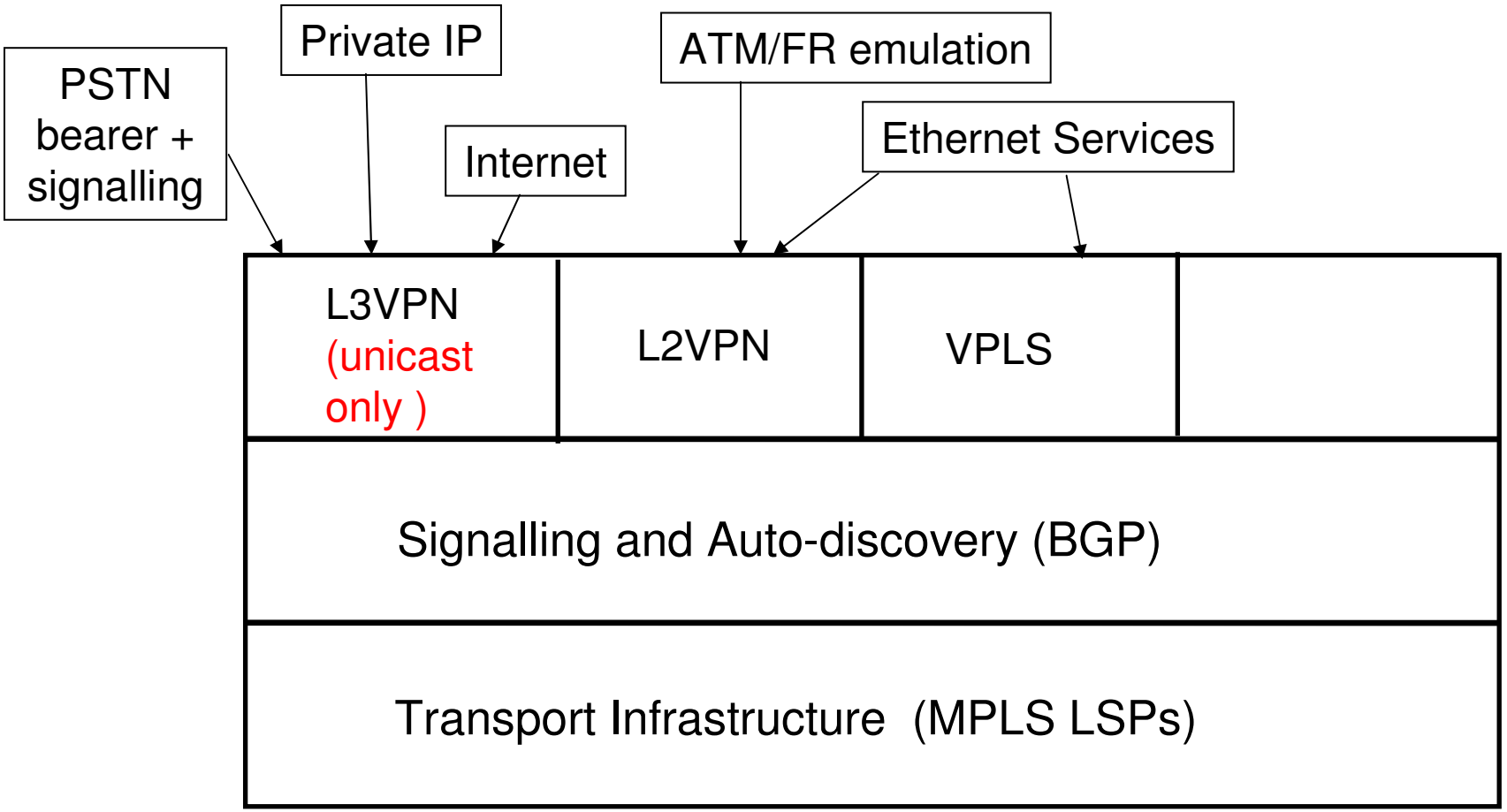
What is an MVPN… ?

- **A site could be both in the Sender Sites set and Receiver Sites set**
  - Hosts within a site could both originate and receive multicast traffic
  - Extreme case: Sender Sites set is the same as Receiver Sites set – Any to Any Scenario
- **A site may be in more than one MVPN**
  - MVPNs may overlap
- **Sites within a single MVPN may be either within the same, or in different organizations**
  - MVPN can be either Intranet or Extranet
- **MVPN can span multiple service providers**

What is an MVPN… ?

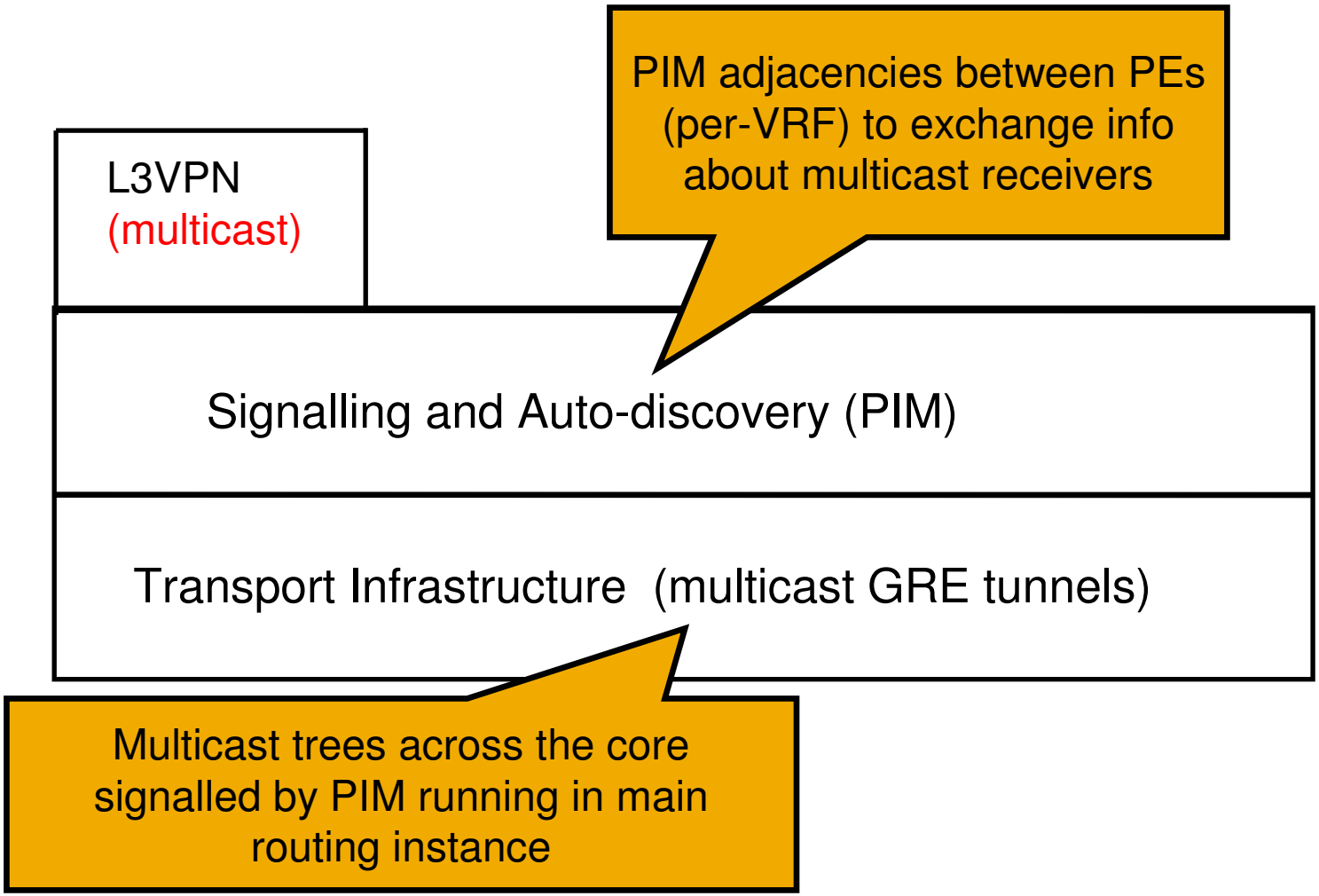
- **MVPN is defined by a set of administrative policies**
  - Policies determine both Sender Sites and Receiver Sites
  - Policies are established by MVPN customers
  - Policies are implemented by MVPN Service Providers
    - Using the existing BGP/MPLS VPN mechanisms with extensions eg. Route Targets

Model for multi-service network



L3VPN multicast does not conform to this model !!

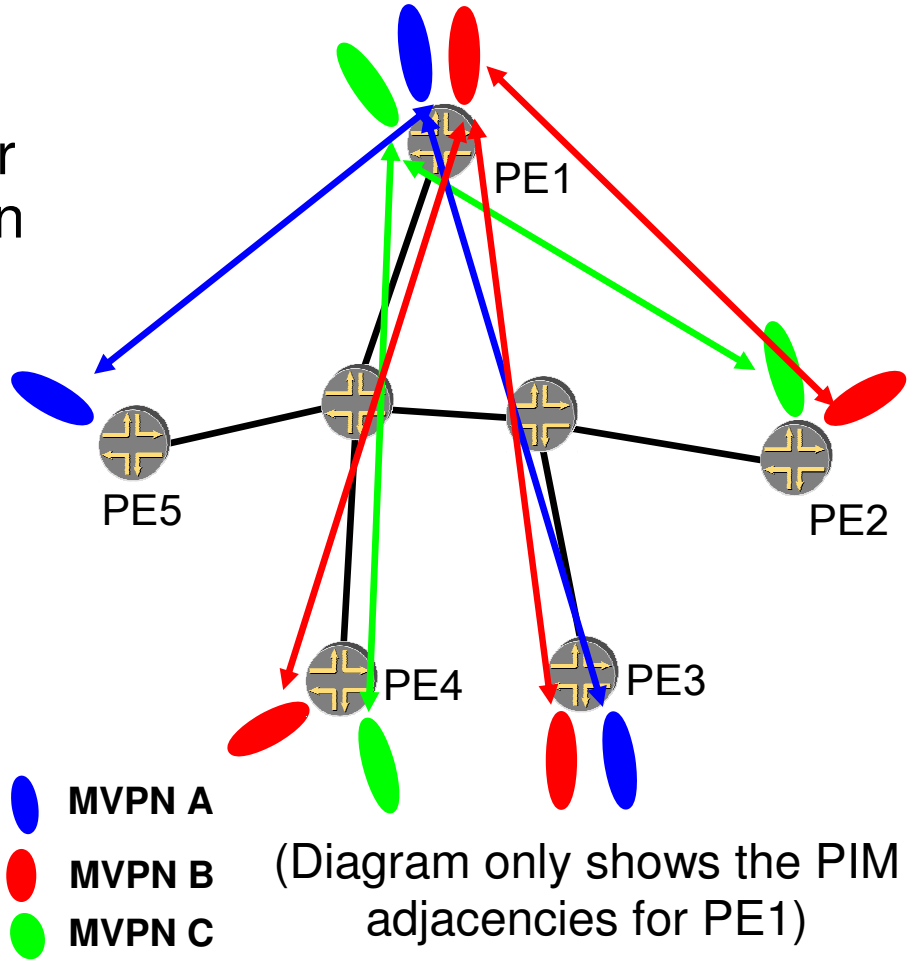
Prior scheme for MVPN (draft-Rosen)



PIM adjacency problem

Control plane overhead:

- Each PE has to maintain PIM adjacencies with all other PEs for which it has at least one MVPN in common ***per MVPN***
  - If *M* PEs have *N* MVPNs in common, then each such PE has to maintain *M*N* PIM adjacencies with the other PEs
  - Due to the virtual router model
- Further compounded by complete period update property of PIM
  - Every 60 secs



(Diagram only shows the PIM adjacencies for PE1)

Control Plane Problems

- **Control plane limitations:**
  - Inter-AS operations options (b) or (c) require PEs in different ASes to have (direct) PIM routing peering
    - As long as these PEs have at least one MVPN in common
    - Due to the virtual router model

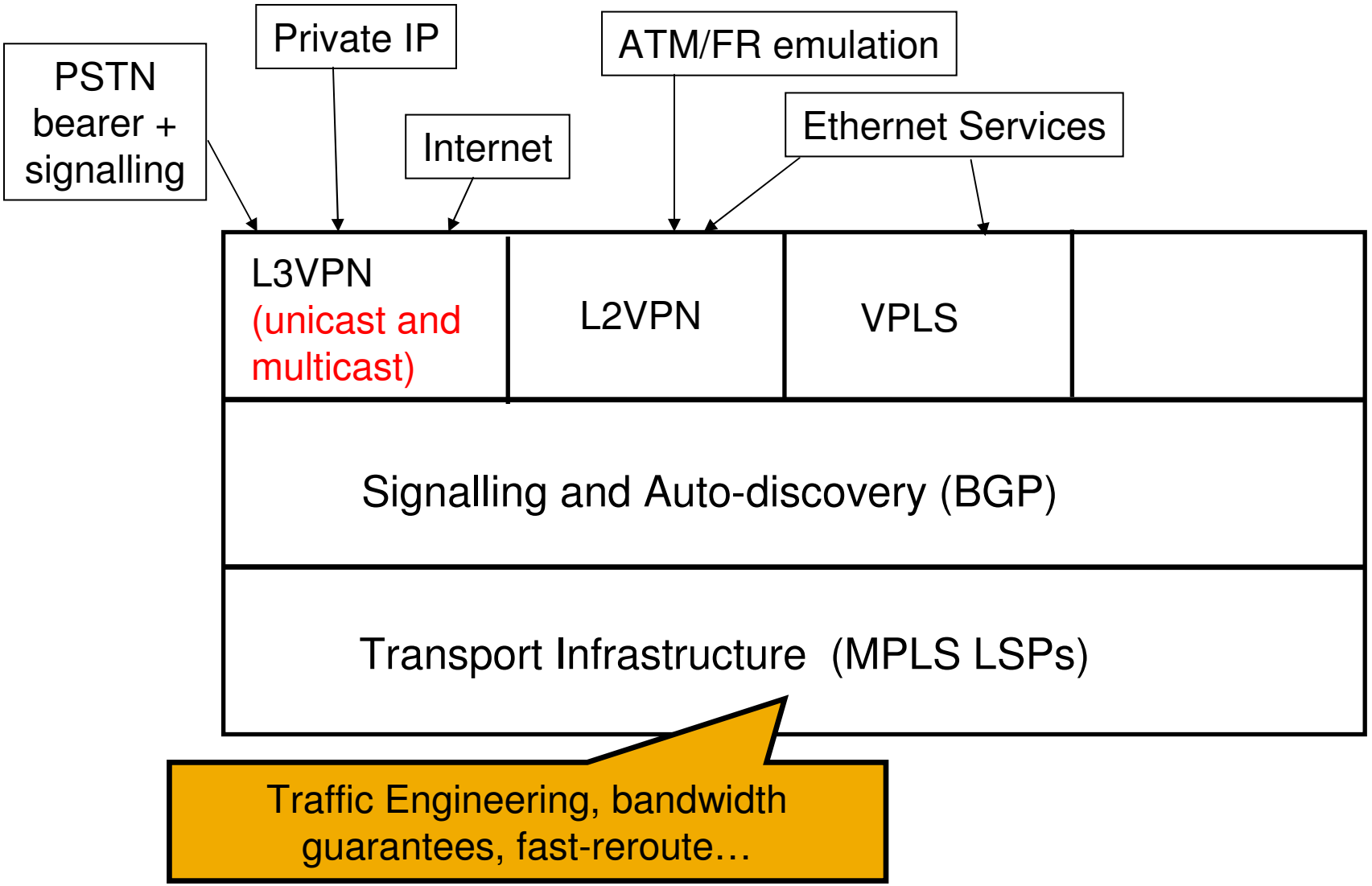
Data plane limitations with draft-Rosen

- **Data plane overhead:**
  - No ability to aggregate multiple MVPNs into a single inter-PE tunnel
- **Data plane limitations:**
  - No MPLS support
  - Forces all providers to use the same tunneling technology - GRE

Next Generation (NGEN) MVPN Solution

- **Started with Draft-raggarwa-l3vpn-mvpn-vpls-mcast-00.txt**
- **MVPN solution is now a L3VPN WG draft**
  - Draft-ietf-l3vpn-2547bis-mcast-01.txt
- **BGP details are in**
  - Draft-raggarwa-l3vpn-2547-mcast-bgp

With next-gen MVPN scheme

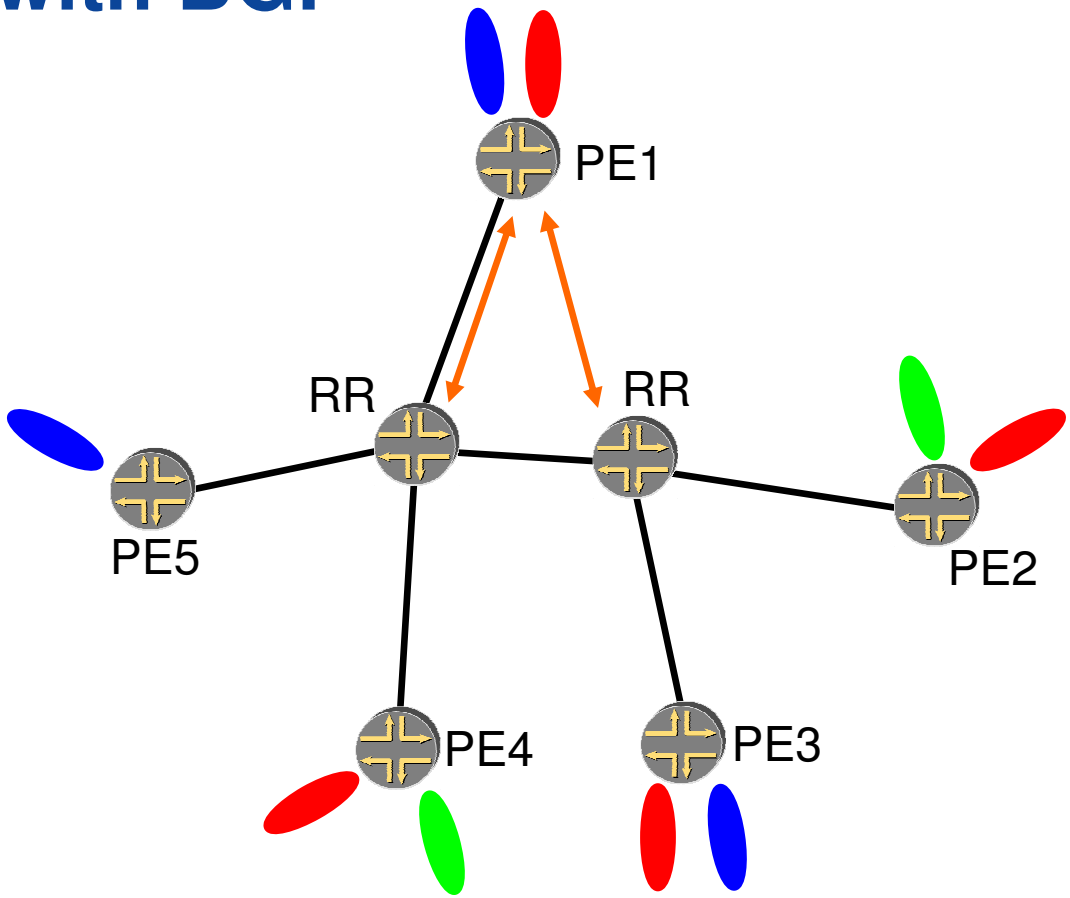


Replacing PIM with BGP

Using BGP for the PE-PE signalling:

Each PE only needs a couple of BGP sessions with a pair of route-reflectors

Same as L3VPN unicast scheme, using same BGP sessions that are already there



NGEN MVPN Control Plane

- **BGP: 2547 VPN PE-PE signaling mechanism**
- **Retains all commonly known advantages:**
- **Uniform control plane**
  - Leverage of capabilities:
    - Constrained distribution
    - Security
    - Summarization
    - Inter-AS, etc.

NGEN MVPNs

- **MVPN membership is very similar to L3VPN membership**
  - Matching on RT extended communities
- **MVPN Membership is discovered automatically**
  - Using Auto-Discovery (AD) BGP routes
  - Different types of routes at different stages of discovery discovery
- **MVPN Data Plane Auto-Discovery**
  - Same AD routes discover and bind services to PMSI tunnels
  - Do not setup the tunnel; rather initiate the setup

BGP MVPN Functionality
Intra-AS

- **MVPN Auto-Discovery/Inclusive Binding**
  - Auto-discovery of MVPN members; RTs
  - Binding one or more MVPNs to a P-tunnel
- **C-multicast routing information exchange among PEs**
  - Mechanisms to exchange C-Control traffic through the SP network is independent from the mechanisms to exchange C-Data traffic
- **Selective binding and switching from Inclusive P-Tunnel to Selective P-Tunnel**
  - One or more specific C-multicast streams, from one or more MVPNs, to a P-Tunnel

Mapping of MVPNs to multicast trees

- **Draft discusses various ways of mapping MVPN traffic to multicast trees and type of multicast trees across the provider network**
- **Trade-off between bandwidth efficiency and number of trees required**
  - Inclusive tree
    - Each tree serves one MVPN only. All the multicast traffic in that MVPN arriving at an ingress PE is mapped to that same tree to get from the ingress PE to all the other PEs in the same MVPN
    - Analogous to default-MDT in draft-Rosen
  - Aggregate inclusive tree
    - All the multicast groups in more than one MVPN use the same shared tree. The tree goes from the ingress PE to all the other PEs that serve at least one of those MVPNs

Mapping of MVPNs to multicast trees (cont'd)

- Selective tree
  - Each tree serves particular selected multicast group(s) from a given MVPN
  - Similar to data-MDT in draft-Rosen
- Aggregate selective tree
  - Each tree serves particular selected multicast groups from more than one given MVPN

Types of multicast tree

- **Draft discusses different types of multicast tree that could be used**
  - PIM-SM
  - PIM-SSM
  - PIM Bidir
  - P2MP LSP (RSVP-signalled)
  - P2MP LSP (LDP-signalled)

BGP control plane functions

1) Discovery of which PEs are members of each MVPN and communication between PEs of which tree type will be used and (if necessary) which particular tree. Referred to as “Auto discovery routes”
2) Exchange of vpn-ipv4 unicast routes between PEs (multicast sources and RPs in the customer domain would be among those routes)
3) Discovery of location of multicast receivers for each multicast group in each MVPN

NGEN MVPN: Key Advantages (1)

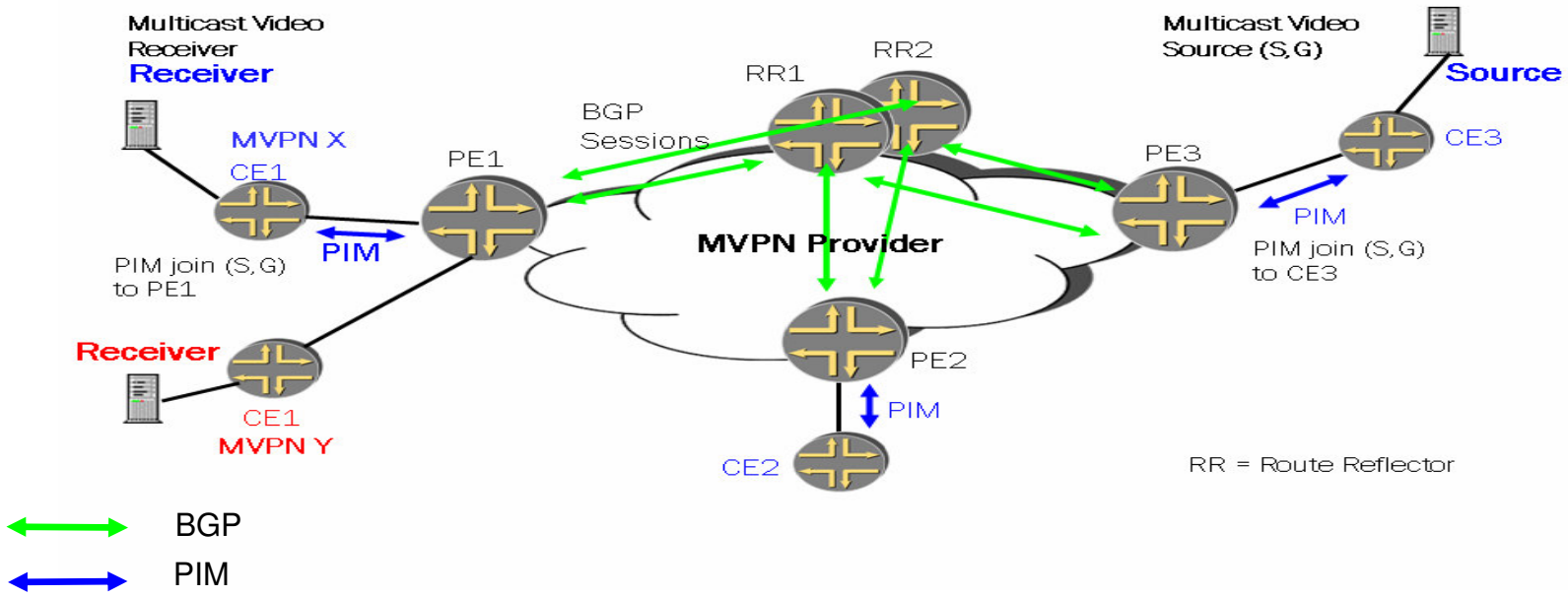
- **Multiple Transport options**
  - Different MVPNs can use different tunneling technologies (P2MP MPLS or PIM-SM GRE)
- **Scalable and Extensible Signaling**
  - BGP, same model as unicast Layer 3 VPN and supports autodiscovery of routes
  - Each PE uses existing IBGP sessions, which may only require sessions with the route reflectors.
- **Reducing data plane overhead**
  - It is possible to aggregate multiple (S,G) of a given MVPN into a single selective tunnel

NGEN MVPN: Key Advantages (2)

- **Proven and flexible Inter-AS Operational model**
  - Seamlessly works with all three options (A, B and C as defined in RFC 4364) available for inter-AS unicast
  - Segmented inter-AS trees that allows each AS to independently run a different tunneling technology
- **Lifting P-Tunnel Mesh Requirement**
  - Allows providers to support MVPN customers who want to restrict multicast sources to a subset of its sites
    - Provides the SP with the flexibility to build pricing models for a MVPN service based on number of sources/receiver sites in a MVPN
- **Seamless support for Extranet and Hub and Spoke Topologies similar to Unicast VPN**

NGEN MVPN Application Example: Video transport across the core

- **MVPN scheme is a good solution if provider wants P2MP in the core, and PIM islands at the edge of the network, with traffic sent into P2MP LSP determined by PIM joins from the edge**
  - Good integration between the core domain and edge domain (e.g. PIM join from edge triggers multicast flow from ingress PE into the core)
  - Built-in redundancy mechanisms, if source multi-homed to two PE routers
  - Receivers can be attached to two PE routers for resilience too



P2MP MPLS Transport –

- **Mature implementation of P2MP with ongoing enhancements**
  - P2MP CSPF
  - P2MP Link Protection
  - P2MP Transit Graceful Restart
  - P2MP Integration with IP multicast on egress LSRs
  - P2MP TE ingress PE redundancy
- **Common technology for enabling multiple applications**
  - IP Multicast
  - L2 Multicast
  - Multicast VPNs (MVPNs)
  - Efficient VPLS Multicast

Why P2MP?

- **Efficient traffic replication in the network**
- **Optimize MPLS data plane for high volume multicast**
  - key for large scale video deployments
- **Leverages the existing control plane model**
  - RSVP-TE based which has resource reservations, FRR and flexible path compution support
- **Application agnostic**

Summary

- **Next-gen MVPN brings many architectural improvements over the draft-Rosen scheme**
  - Control plane and data plane consistent with L3VPN unicast model
- **Applicable both as explicit service to end-customers and as an internal infrastructure tool for service providers**


Juniper your Net™