Controller Based BGP Multicast Signaling

draft-zzhang-bess-bgp-multicast-controller-00

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Agenda

- BGP Signaled Multicast Review
  - draft-zzhang-bess-bgp-multicast
  - Presented in 98th IETF
- Controller-based BGP Multicast Signaling
  - draft-zzhang-bess-bgp-multicast-controller
- Summary

Multicast: complexity, fear/dislike, necessity/reality

- Many operators do not want to burden their infrastructure with multicast trees
  - They can live with ingress replication for multicast traffic
  - They do not like the following aspects of multicast trees
    - Per-tree state
    - PIM soft-state refresh overhead
    - PIM-ASM complexity due to shared-to-source tree switch
    - Yet another protocol to set up the trees

- Nonetheless, some operators have a lot of mission-critical multicast traffic, and still need the efficiency gains of having multicast trees in the infrastructure
  - at least until BIER arrives ᨓ

BGP Signaled Multicast: What & Why

- Use BGP to signal multicast
  - Use as a replacement for PIM
    - (s,g)/(*,g) unidirectional/bidirectional trees
      - Optionally with MPLS data plane
  - Use as a replacement for mLDP
    - Use mLDP FEC (<root, opaque_value>) to identify tree
- Why?
  - Remove PIM soft state and ASM complexities
    - PIM-Port only removed soft state and deployment has been limited
    - PIM-SSM removes ASM complexities but requires good source discovery methods
  - Consolidate to BGP signaling
    - Single, scalable protocol for unicast/multicast, labeled/unlabeled

How to signal tree/tunnel using BGP

- Use receiver-initiated “joins” - Leaf A-D routes in C-MCAST SAFI
  - Propagated over hop by hop EBGP/IBGP sessions or through RRs
- Each node determines upstream hop by using same RPF procedure as PIM/mLDP
- Leaf A-D routes serve the purpose of PIM Join or mLDP P2MP label mapping
  - NLRI encodes (s,g)/(*,g) or mLDP FEC
  - Route Target identifies Upstream node
  - Routes processed by upstream node and not propagated further
    - A new route with different NLRI is originated for the next node in the tree
  - Tunnel Encapsulation Attribute carries forwarding information
    - In case of labeled tree/tunnel, or
    - If downstream/upstream are not directly connected
  - For MP2MP labeled tunnels, S-PMSI/Leaf A-D routes serve the purpose of mLDP MP2MP-U/MP2MP-D label mappings
- For ASM, source specific trees are set up after source discovery via Source Active (SA) A-D routes, avoiding RP/shared-trees

Source Discovery for ASM

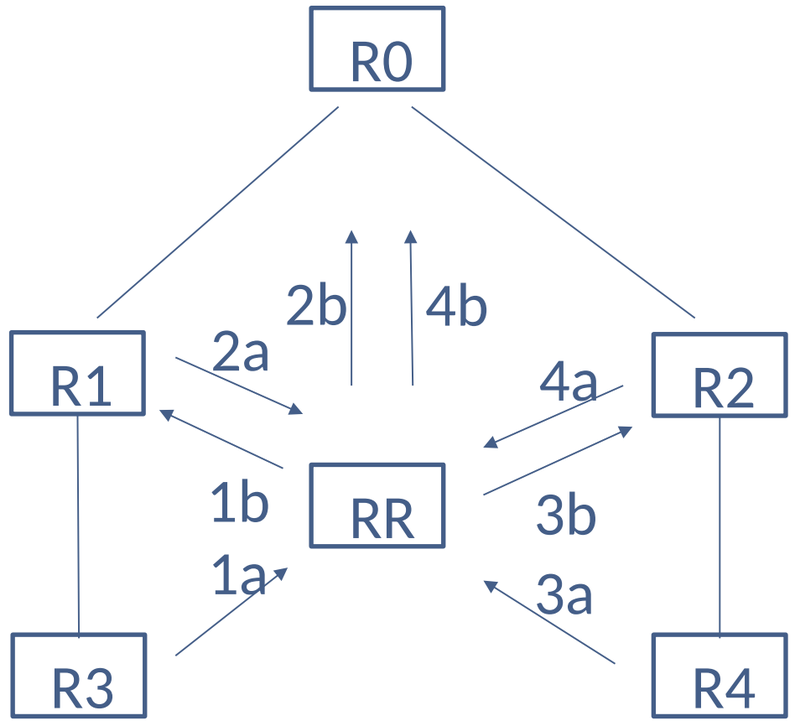
- First Hop Routers (FHRs) advertise SA routes
  - Upon receiving locally originated traffic
- Last Hop Routers (LHRs) receive SA routes and join source specific trees
- Similar to MSDP method, but:
  - Extended from among RPs to among FHRs and LHRs
  - With BGP advantages:
    - No periodical refreshing
    - No peer RPF checks for SA propagation
    - RRs and Route Target Constrain (RTC) can be used to avoid flooding SA routes
      - FHRs attach a RT that encodes the group address and advertise to RRs
      - LHRs advertise RT Membership NLRIs that encode the above mentioned RT for groups that they’re interested in
      - SAs are only advertised to interested LHRs due to the RTC mechanism

Incremental Transition

- For mLDP or PIM-SSM replacement, transition can independently happen at any node
  - If the upstream neighbor can support BGP multicast signaling, then use it
- For PIM-ASM replacement, first upgrade the RPs so that they can advertise SA routes. After that each node can independently transition
  - If an upgraded node receives (*,g) PIM join, and its upstream supports BGP multicast signaling, it behaves as if it were a LHR
    - Terminate (*,g) join
    - Send RT Membership NRLI corresponding to the group
    - Establish source trees after receiving corresponding SA routes.

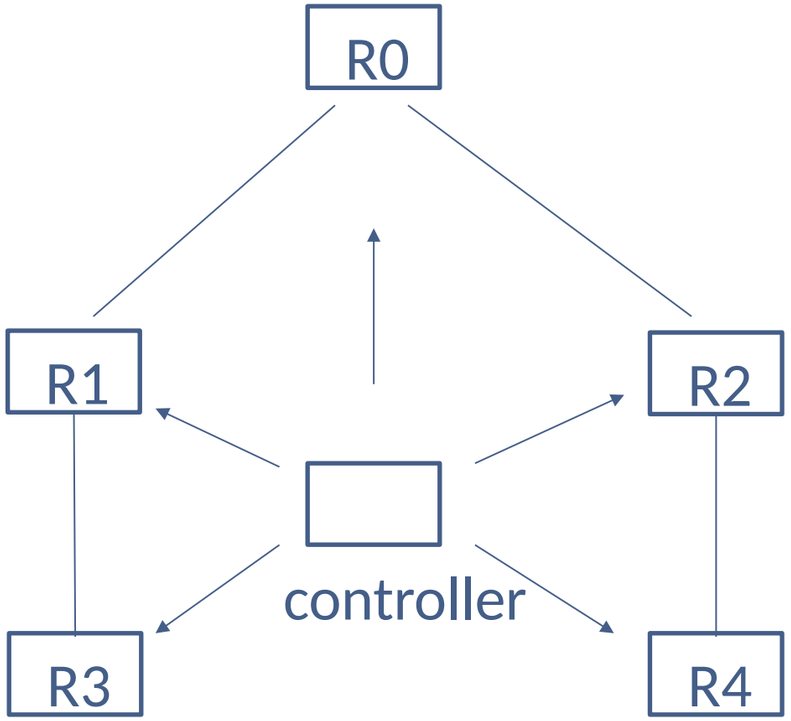
BGP hop-by-hop signaled multicast

- Each router independently determines its upstream and send Leaf A-D routes to it
  - Much like PIM/mLDP
- The routes may be reflected by a RR



Controller Based Signaling

- Instead of hop-by-hop signaling initiated from LHRs, an intelligent controller can figure out the entire tree/tunnel and signal to all routers on the tree/tunnel
  - Same Leaf A-D routes as in hop-by-hop case
  - The controller does not have to peer with each router directly – could be via other RRs
- Each router simply sets up forwarding state accordingly
  - No need for PIM/mLDP-like procedures to figure out upstream
  - No need to send message upstream and receive message from downstream



Differences from hop-by-hop case

- A single Leaf A-D route from the controller can signal multiple downstream routers to the same upstream
  - A new Composite Tunnel in Tunnel Encap Attribute (TEA) means traffic is to be sent out of all component tunnels represented by its sub-TLVs
  - Forwarding info used to receive traffic from its upstream is also signaled via the same Leaf A-D route
- Labels could be allocated from:
  1. A controller's own local label space
  2. A common SRGB
  3. Each router's SRLB
- With the first two label allocation options, per-tree/direction label could be used
  - Per-tree labels could be use for unidirectional trees
  - Per-<tree, direction> labels could be used for bidirectional trees
  - Neighbor-based RPF is needed in data plane to use per-tree/direction labels
    - <neighbor-identifying label, per-tree/direction label> stack for #2
- In the first option, a controller-identifying label is needed
  - <controller-identifying label, neighbor-identifying label, per-tree/direction label>
  - <controller-identifying label, tree-identifying label>

Consistency

- Multiple controllers could be used
  - Each could calculate and signal independently
  - As long as all the routers on a tree/tunnel choose routes from the same controller it’s fine
    - In labeled case, even if they choose differently, there is no traffic looping
    - In unlabeled case, routers must choose based on controllers’ address to ensure consistency and prevent loops
- Topology change in bidirectional case
  - Since upstream/downstream update their state (per signaling from the controller) independently, transient loops may happen
    - In the unlabeled case, order of updates must be ensured - out of scope
    - In the labeled case, per-tree label cannot be used
      - Per-<tree,direction> label may be fine
  - Not an issue for unidirectional case

Summary

- BGP-signaled multicast could replace PIM/mLDP signaling:
  - Removes PIM refreshes & PIM-ASM complexity
  - Consolidates to BGP signaling
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- BGP-controller-signaled multicast is well suited for SR networks
  - Tree calculation delegated to omniscient/omnipotent controllers
    - Based on many factors/constraints/algorithms
  - Router operation is simplified
    - Simple forwarding state programming based on BGP messages
    - Per-tree/direction labels may ease monitoring & troubleshooting
      - May not be supported due to software/hardware capabilities
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