Multicast Source Routing over IPv6 (MSR6) Traffic Engineering

draft-geng-msr6-traffic-engineering

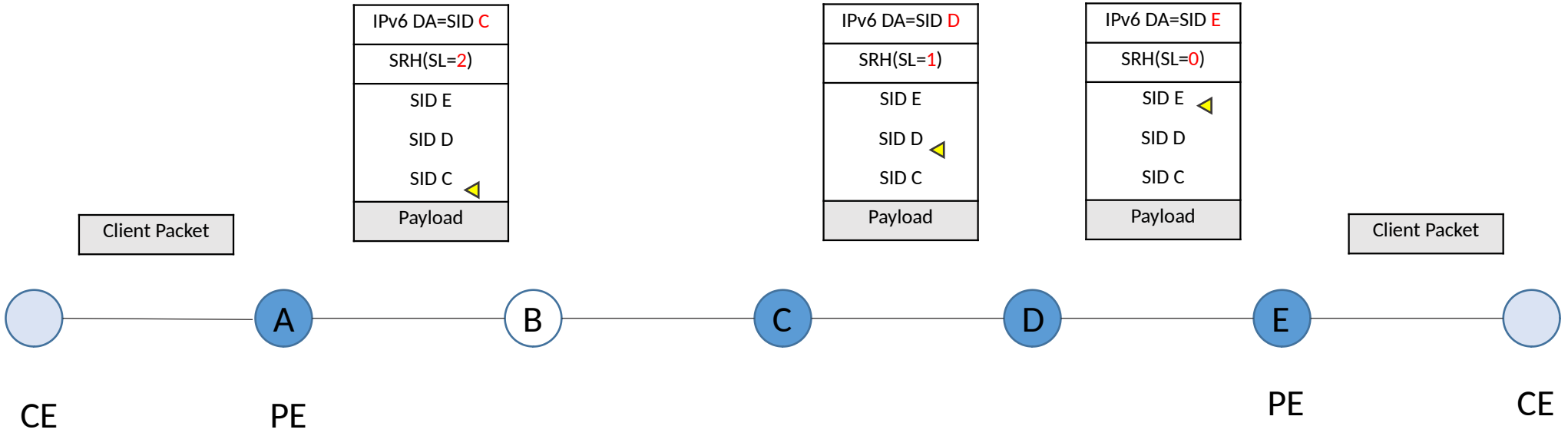
draft-geng-msr6-rlb-segment

Problem Statement

- SRv6 provides solution for unicast service to indicate P2P path through segment list in SRH for TE secnario
  - No flow status is maintained in the intermediate nodes
- There are several SR P2MP solutions under discussion for multicast TE
  - **draft-ietf-pim-sr-p2mp-policy**: A SR P2MP tree is constructed by stitching a set of replication segments together through SR P2MP policy in each replication node
  - **draft-chen-pim-srv6-p2mp-path**: A segment list for P2MP path is provided to the ingress and there are 2 arguments for each SID (N-branches and N-SIDs) to indicate the next level of sub-tree after replication
- This document provides an optional solution of P2MP path indication for multicast TE

Existing Solution: SRv6 for Unicast

- Firstly, let's briefly review what has been done in SRv6…
  - **Ingress node:** Encapsulate the packet with IPv6 header and SRH. The segment list in SRH shows the indicated path
  - **Endpoint:** Update the Segment Left by (Segment Left-1) and the IPv6 DA is replaced by the next active SID pointed by Segment Left, which steers the packet to the next indicated node/adjacency in the TE path (Based on the behavior defined for the function of End/End.X in RFC8986)
  - **Egress Node:** Segment Left==0 and de capsulate the packet



Solution 1: Structural Segment List for Multicast Tree

- **Basic Idea**

  Define a new Function type, End.RL(Replication through segment list), for explicitly specifying the nodes which the multicast tree passes through; and define two parameters in the SID: Replication Number and Pointer, which are used to indicate the replication-forwarding relationship between upstream and downstream nodes.

- **Solution**

1. MSR6 Segment List.

   Contains the SIDs corresponding to the indicated nodes in the multicast tree

2. MSR6 End.RL Segment format.

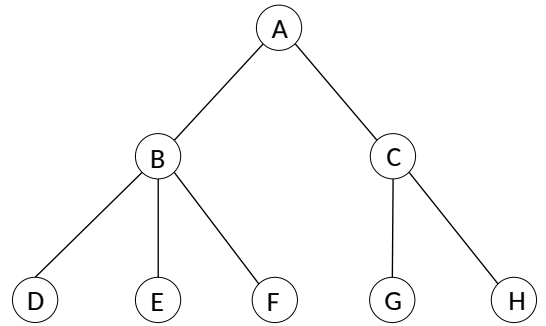
   Locator: used to route to the replication node, e.g., IPv6 address prefix

   Function: Indicates that the segment performs the End.RL function.

   Replication Number: Indicates how many packets to replicate in this nodes

   Pointer: Indicates the Segment left value of the first child node;

3. End.RL Behavior:
   - Replicate packets based on “replication number”
   - update Segment Left and IPv6 DA based on “pointer”
   - forward the replicated packets to the downstream nodes



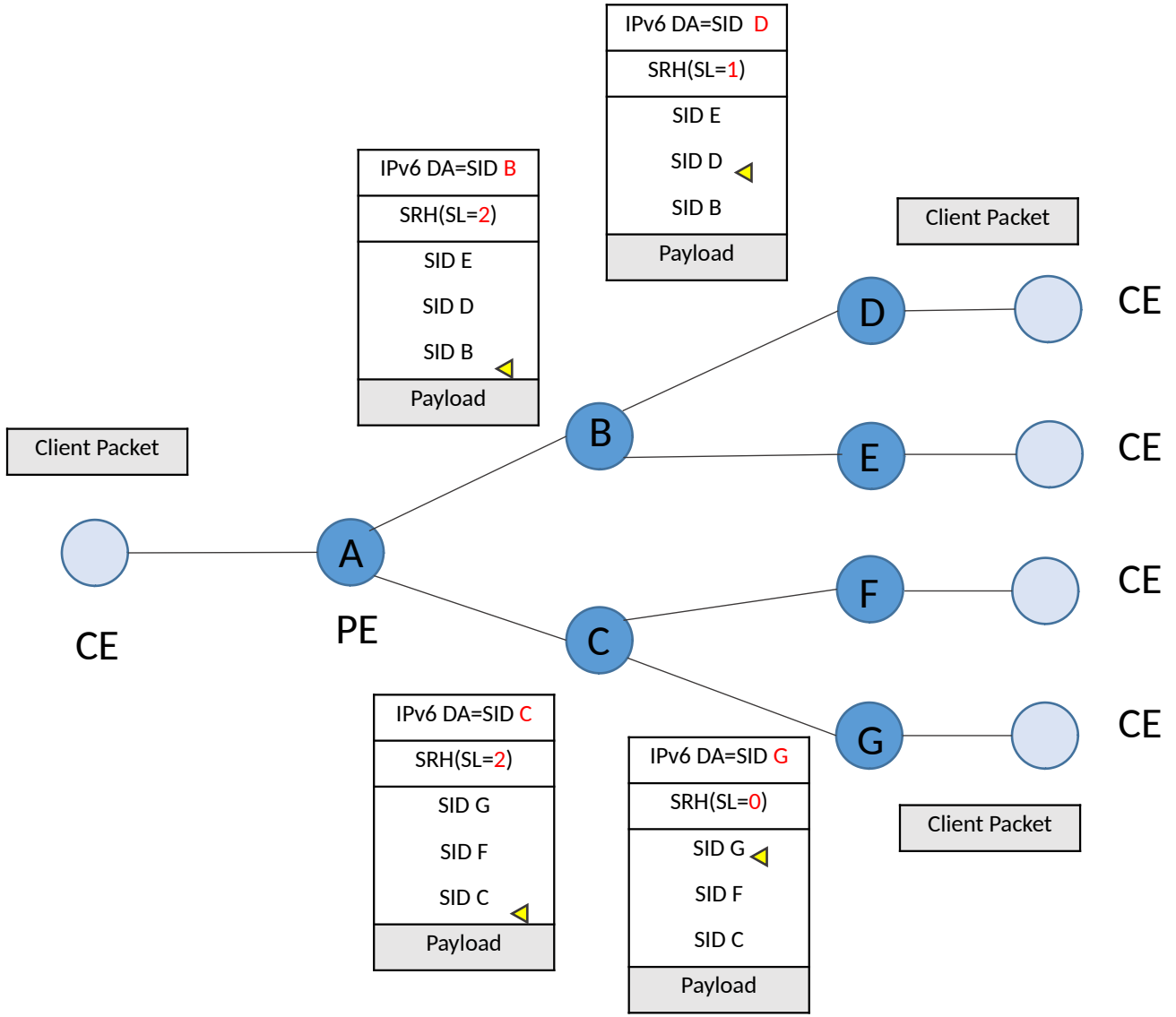
An Indicate Multicast Tree

Locator	Function	Replication Number	Pointer	SL
A	End.RL	2	1	0
B	End.RL	3	3	1
C	End.RL	2	6	2
D	End.RL	0	0	3
E	End.RL	0	0	4
F	End.RL	0	0	5
G	End.RL	0	0	6
H	End.RL	0	0	7

Segment List in MRH

Example 1

- **Ingress node:** Encapsulate the packet with IPv6 header and MRH. The segment list in MRH shows the indicated multicast tree
- **Endpoint:** Replicate the packet based on the “replication number” and update the IPv6 DA with the SID which is indicated by “pointer”
- **Egress Node:** Pointer==0 and de capsulate the packet



Solution 2: Structural Segment List with Local Bitstring

- **Basic Idea**

1. Define a new Function type, End.RLB.X(Replication through Local Bitstring), for adding a Local Bitstring to the SID to specify the output port sending; The meaning of the bitstring is local to the the node which advertises the SID

- **Solution**

1. MSR6 Segment List

   Contains the SIDs corresponding to the indicated nodes in the multicast tree except for the leaf nodes

2. MSR6 End.RLB.X Segment format

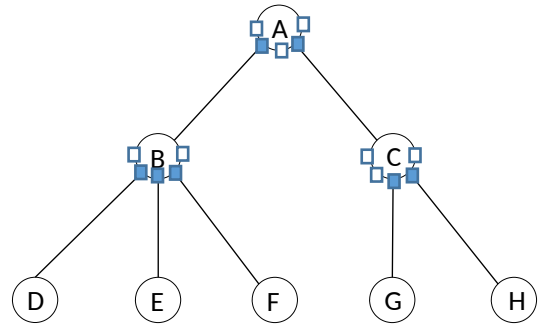
   Locator: used to route to the replication node, e.g., IPv6 address prefix

   Function: Indicates that the segment performs the End.RL function.

   Pointer: Indicates the Segment left value of the first child node;

   Local Bitstring: Each bit represents a local outgoing port, and a bit position represents the outgoing port from which the packet is to be forwarded

3. End.RLB.X Behavior:
   - Replicate packets based on “bitstring”
   - update Segment Left and IPv6 DA based on “pointer”
   - forward the replicated packets to the downstream nodes



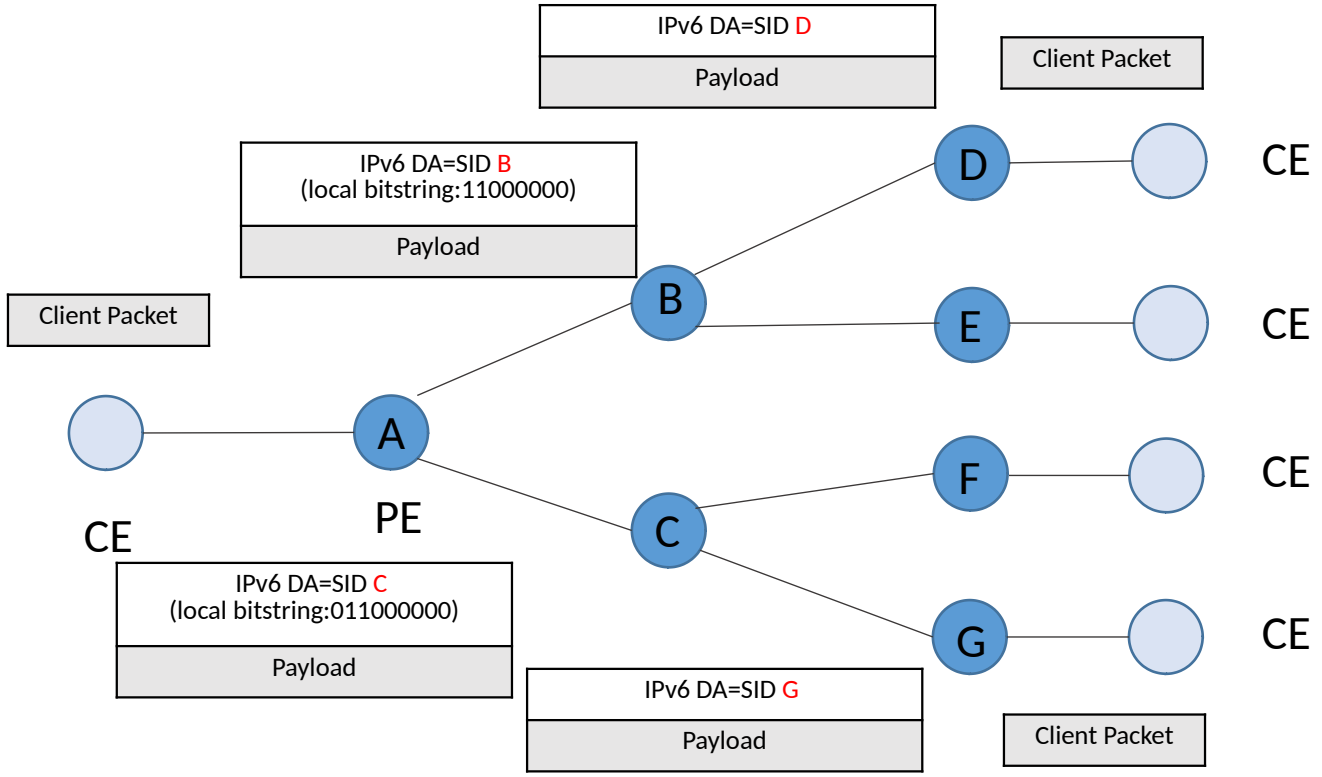
An Indicate Multicast Tree

Locator	Function	Pointer	Local Bitstring	SL
A	End.RLB.X	1	0011000	0
B	End.RLB.X	0	1110000	1
C	End.RLB.X	0	1100000	2

Segment List in MRH

Example 2

- **Ingress node:** Encapsulate the packet with IPv6 header and MRH. The segment list in MRH shows the indicated multicast tree
- **Endpoint:** Replicate the packet based on the “local bitstring” and update the IPv6 DA with the SID which is indicated by “pointer”
- **Egress Node:** Pointer==0 and de capsulate the packet



Some Additional Thoughts …

- A new type of IPv6 Routing Header for multicast(MRH) is proposed and contributions are needed to make the header reasonable and be able to compatible with various encoding forms, which may request cooperation with 6MAN people
- draft-chen-pim-srv6-p2mp-path vs. draft-geng-msr6-rlb-segment:
  - Different methods of encoding a multicast tree: recursive sub-tree vs. layered replication behavior
  - The former pops the irrelevant segments after replication and only remains the elevant rsub-tree
  - The latter keeps all the segments similar as SRv6 and the Segment Left is used to locate the active SID
- For the local bitstring method , the locator could be omitted considering that local bitstring is able to indicate the next hop IPv6 Prefix besides the output port
  - The detailed solution of this could be found in draft-geng-msr6-rlb-segment
- The local bitstring method could also be used together with the method introduced by draft-chen-pim-srv6-p2mp-path
- The segment could be compressed if it is requested

Next Step

- Hope more people will be interested in this work and there are a lot of things that could be done
- Comments and Feedback are welcome

Thanks