Multicast Segment Routing over IPv6 (MSR6)

Native Stateless IPv6 Multicast is Necessary

MSR6 focuses on use cases with the following characteristics:

- **Large-scale** network with **numerous multicast streams**
- **Host-initiated** or overlay Multicast Transport
- **IPsec** to guarantee security when multicast transmitting through Internet

MSR6 use case includes:

- Multicast for Telecom Network: **5G Transport Network**
- Multicast for IDC Network: **Large Scale Data Center**
- Multicast for Enterprise Network: **Surveillance Camera**
- A holistic multicast solution with add-on features: **SD-WAN**

MSR6 could also be apply for traditional multicast scenarios

Multicast for 5G

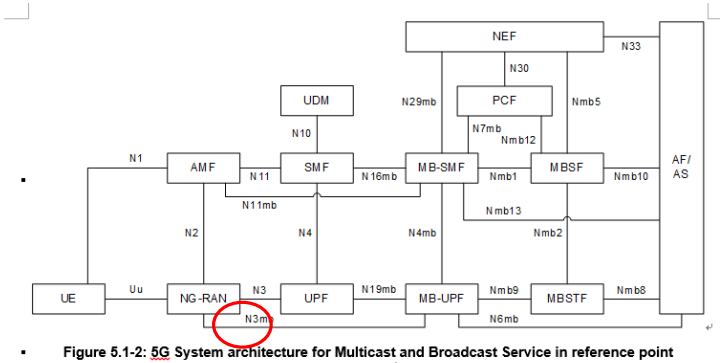
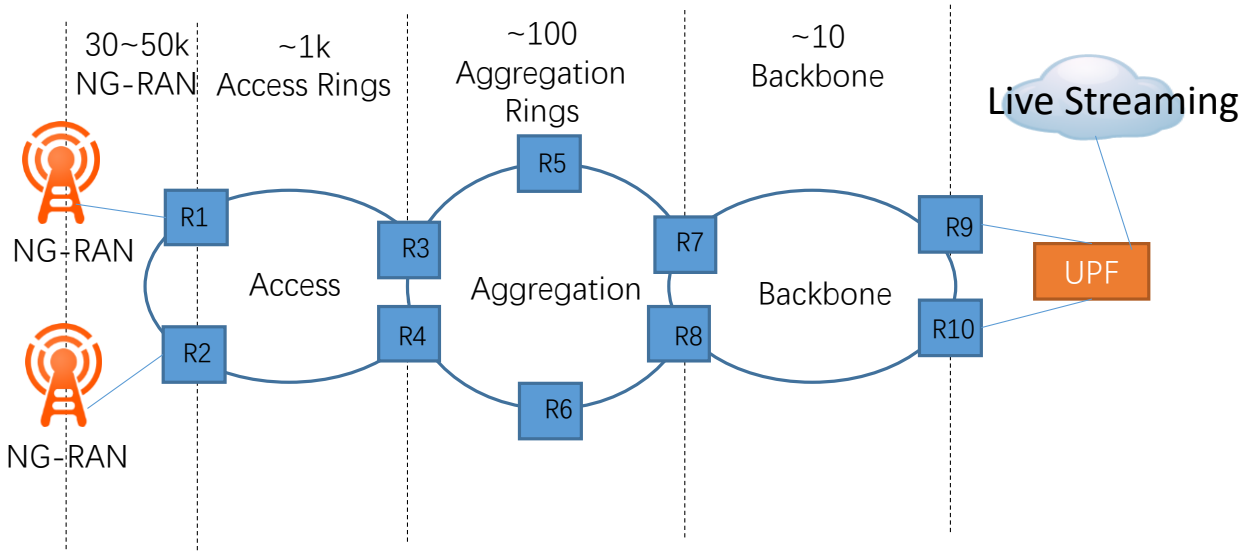


Figure 5.1-2: 5G System architecture for Multicast and Broadcast Service in reference point representation.



Multicast in 5G Transport Network

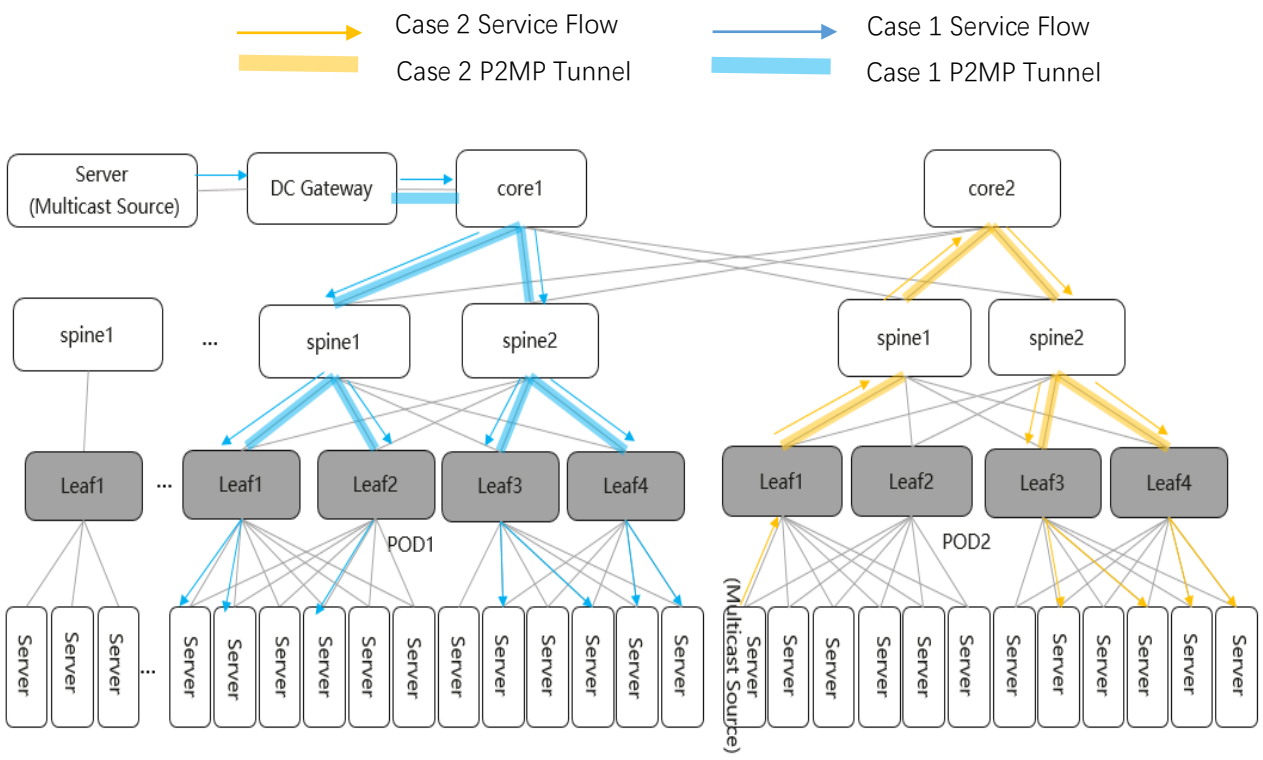
5G Transport Network is a large scale network with multiple potential multicast services

- TS 23.247 defineds Architectural enhancements for 5G multicast-broadcast services;
- IPv6 based 5G Transport Network :
  - 30k NG-RAN;
  - Potential solution for live video streaming transport, such as Tiktok

MSR6 provides packet encoding multicast tree decoupled with network scale and the number of multicast services

- Avoid per-flow status for soft-state protocol or too many protocol messages
- Prefer selective over inclusive mode multicast
- Avoid excessive packet encapsulation overhead and multicast forwarding table entries

Multicast for DCN



Multicast in DCN

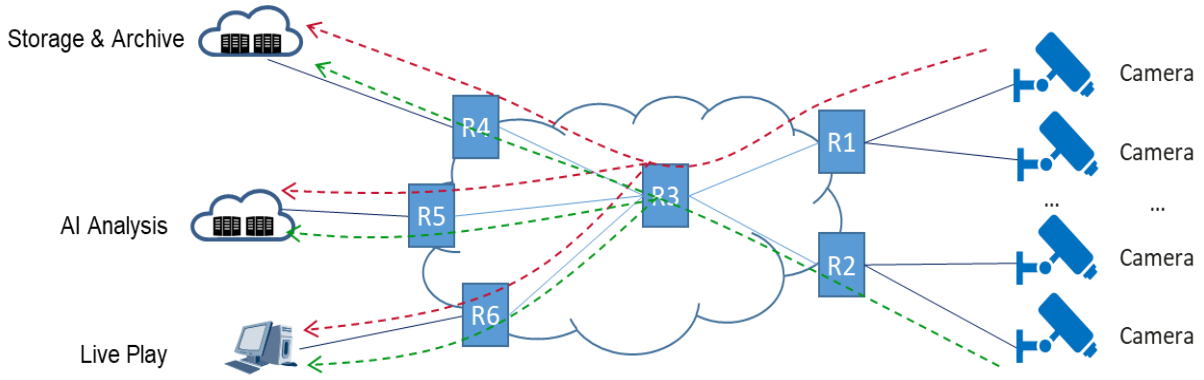
DCN is a Large Scale Network with multiple multicast services

- Dual-homes hosts for reliability
- Scalability: Switches ~ 3k, links ~ 60k;

MSR6 provides packet encoding multicast tree decoupled with network scale and the number of multicast services

- Avoid per-flow status for soft-state protocol or too many protocol messages
- Prefer selective over inclusive mode multicast
- Avoid excessive packet encapsulation overhead and multicast forwarding table entries

Multicast for Enterprise – Host-initiated Multicast



Multicast for Surveillance Camera Data Transmission

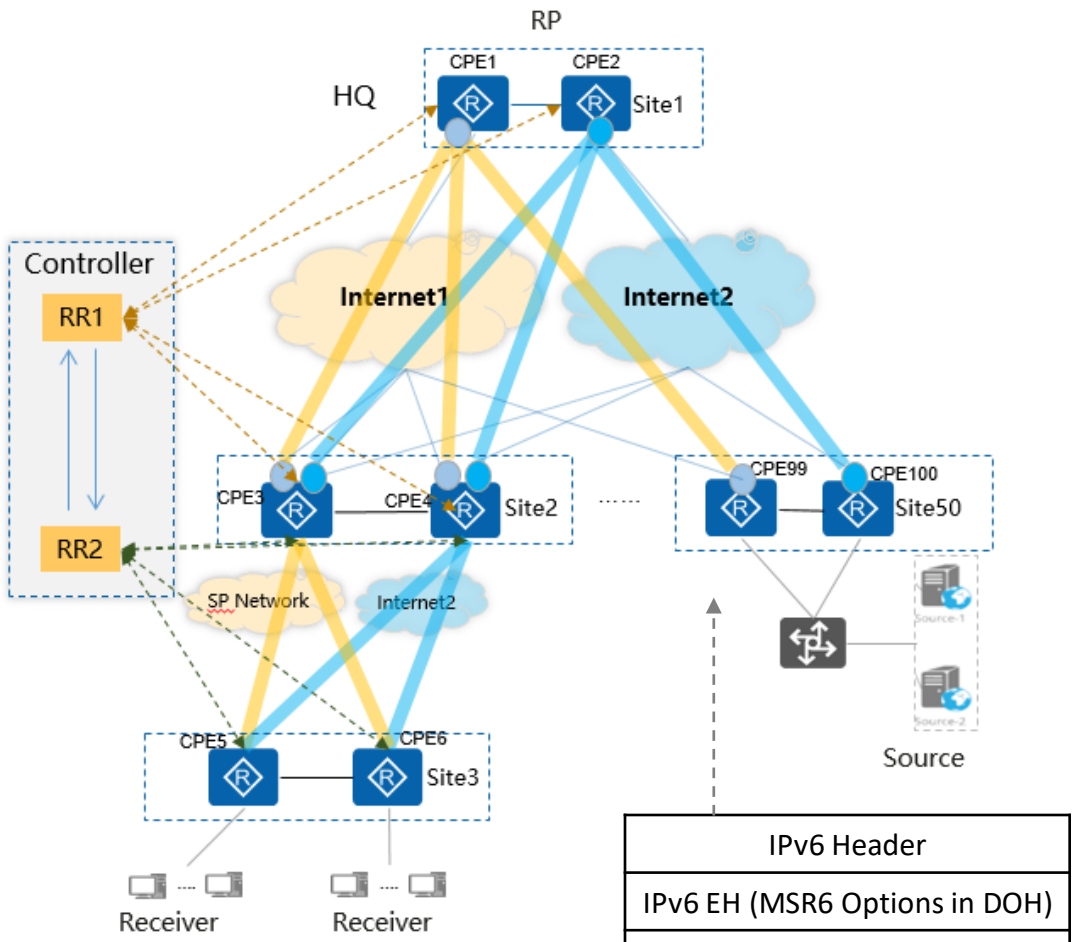
Host-initiated multicast is requested in some enterprise use case where the hosts and network device are managed and maintained in the same domain：

- Cameras as a multicast Sources are stable but the number of which is large;
- The data of camera is supposed to synchronized with different sites for different processing
- Multicast could save bandwidth during video transmission.

MSR6 could be used to simplify multicast deployment without control plane protocol for multicast joining and leaving.

- An alternative way to associate host and network.
- The host can be a multicast source and send different multicast flow , massive multicast services i.e. many many multicast trees

Multicast for SD-WAN – A Holistic Use Case with Add-on Features/Value



IPv6 Header
IPv6 EH (MSR6 Options in DOH)
IPv6 ESP (IPSec Header)
Payload

Multicast in SD-WAN

A large-scale network that might cross Telco-, cloud-, enterprise- and the public Internet:

- National Wide: 100k CPE

Encryption is required to traverse the Internet:

- SD-WAN can be deployed based on public Internet, where the underlay network is providing nothing else but a simple service normally called "Best Effort" unicast. In this case, security is one of the fundamental requirement in SD-WAN network. Multicast services for SD- WAN also request encryption.

MSR6: Reuse IPv6 Authentication header and Encapsulating Security Payload header. Same for other functionalities.

- Challenges of Independent layer for multicast: new IPSec Header has to be defined
- Avoid maintaining per flow status in intermediate nodes

Native Stateless IPv6 Multicast is Necessary

- **Native IPv6 is requested**
  - Multicast is supposed to align with the progress of Unicast deployment, for example IPv6/SRv6 based network is well accepted in IETF and industry;
  - P2MP communications among Hosts could benefit from Native IP multicast solution, eliminating protocols between host and network, such as IGMP, MLD;
- **Stateless is important**
  - Maintaining excessive multicast stream state inside the network causes excessive network overhead that may lead to network stability challenge and operational complexity.
  - Large size network brings challenge for existing stateless multicast solutions

Existing Work & MSR6

Traditional Multicast Solutions

- Request multicast tree-building on control plane
- Maintain end-to-end tree state per flow
- E.g., PIM, P2MP RSVP-TE

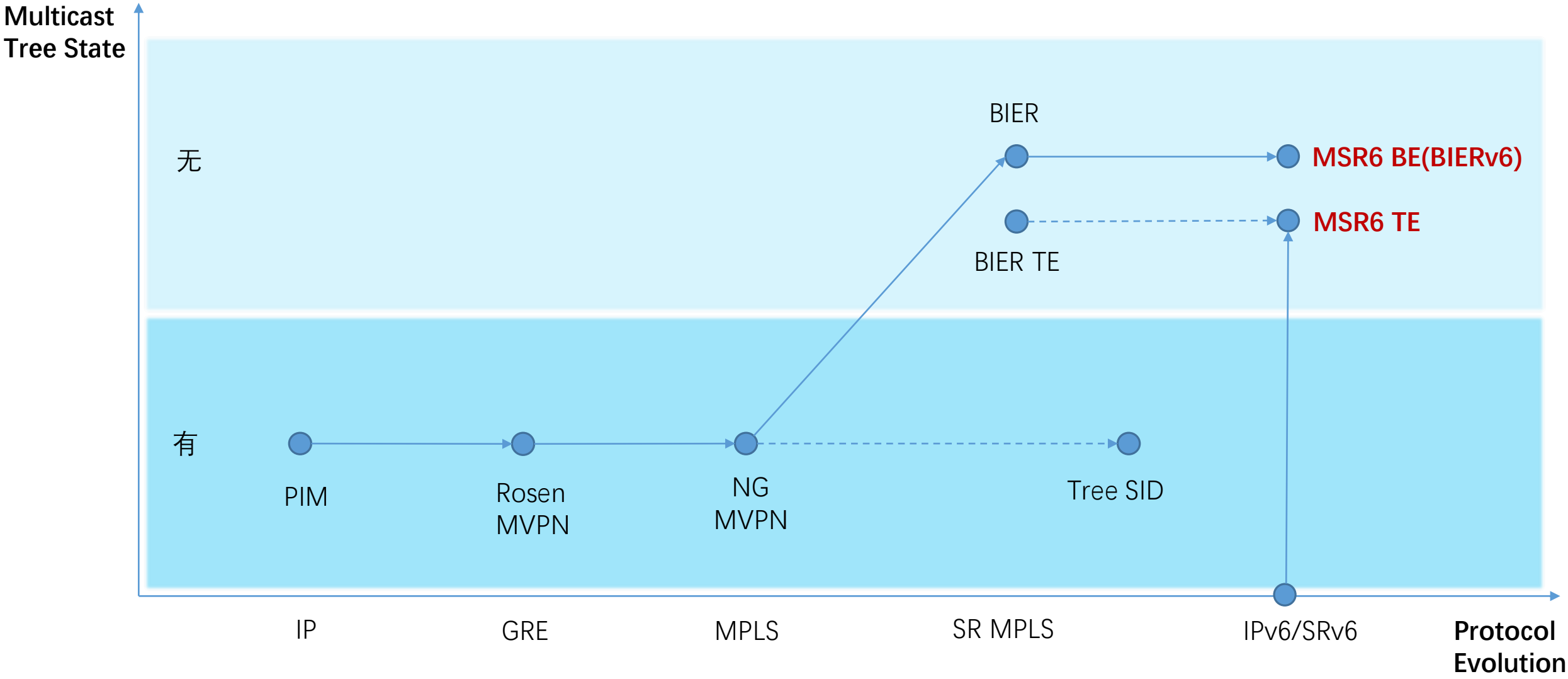
Source Routing Technologies

- Reduce the state of intermediate nodes
- Indicate forwarding behaviors in the ingress nodes near to the service source
- Simplify deployment and maintenance
- E.g., SRv6, BIER

IPv6 + Multicast + Source Routing

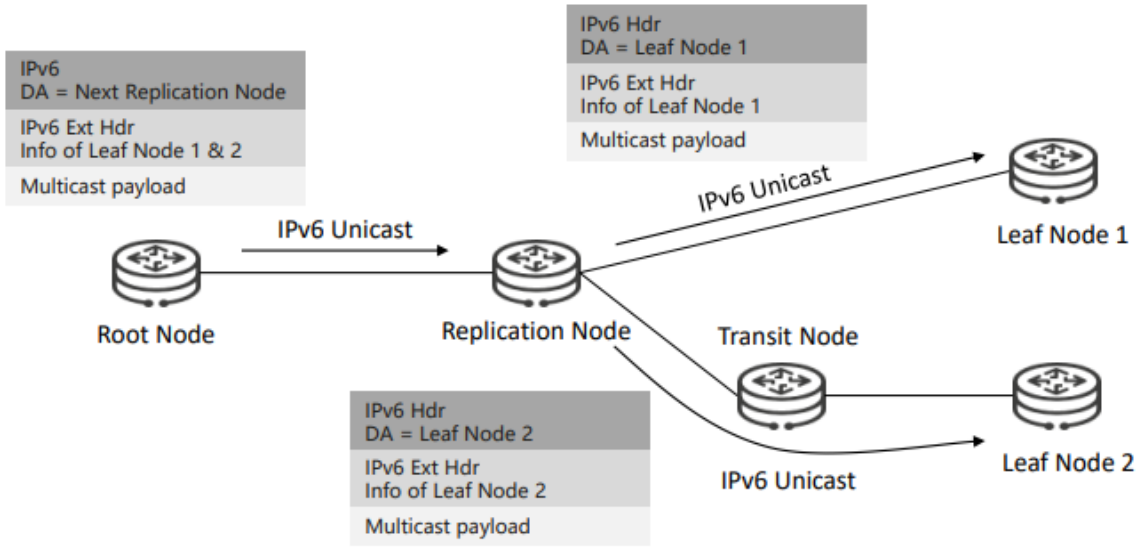
IPv6 multicast source routing (MSR6) solution is requested in the IPv6 network

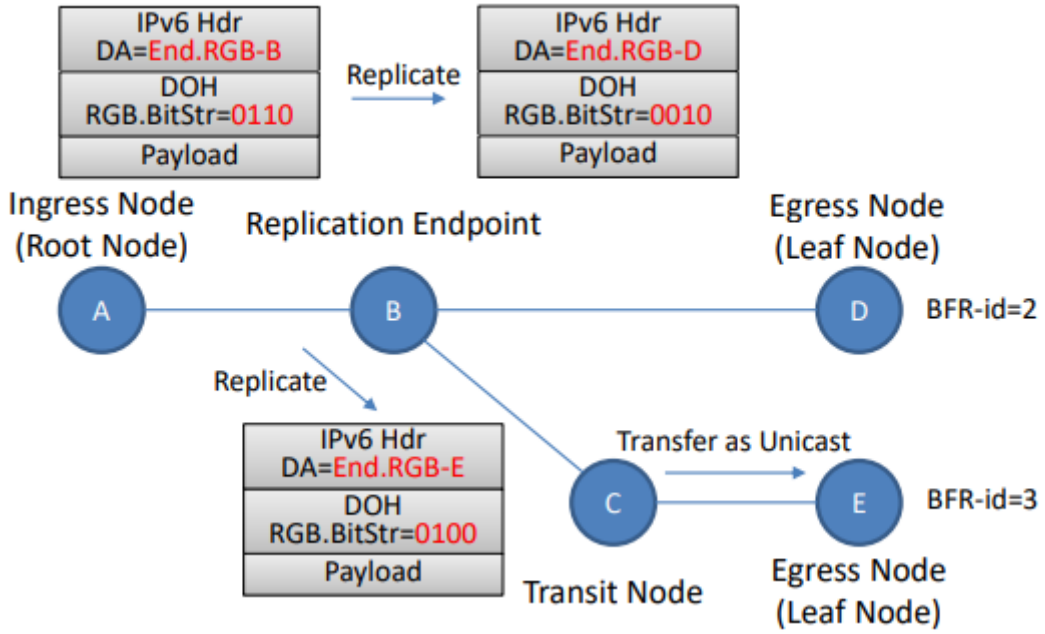
Multicast Evolution



MSR6 BE

- Root node indicates the target leaf nodes in the packet.
- Replication nodes replicate packets according to the leaf node information in the incoming packet.
- The packets are transferred as IPv6 unicast along the shortest path. Transit Nodes are MSR6 un-aware.



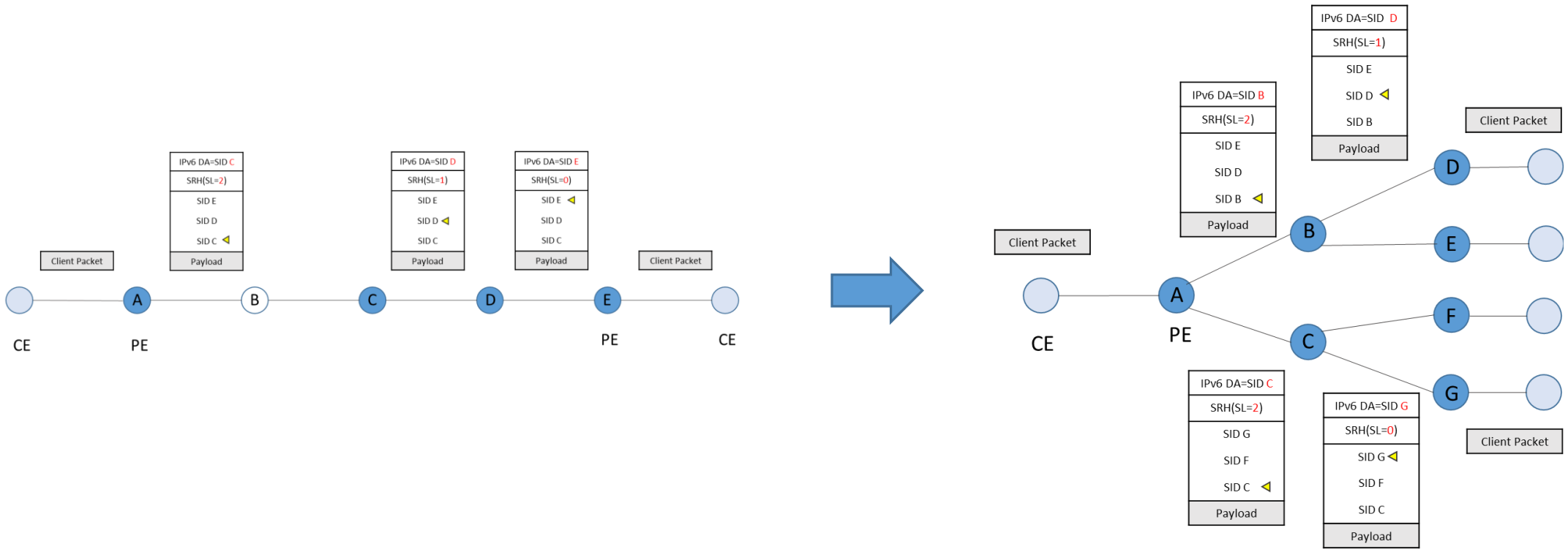


MSR6 TE

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



MSR6 Documents

Topic	I-D	Link
MSR6 Requirement	draft-cheng-spring-ipv6-msr-design-consideration	https://www.ietf.org/archive/id/draft-cheng-spring-ipv6-msr-design-consideration-01.txt
	draft-li-spring-ipv6-msr-gap-analysis	https://datatracker.ietf.org/doc/html/draft-li-spring-ipv6-msr-gap-analysis
	draft-liu-msr6-use-cases	https://datatracker.ietf.org/doc/draft-liu-msr6-use-cases/
MSR6 BE	draft-lx-msr6-rgb-segment	https://datatracker.ietf.org/doc/draft-lx-msr6-rgb-segment/
	draft-chen-pim-be-mrh	https://datatracker.ietf.org/doc/draft-chen-pim-mrh6/
MSR6 MVPN	draft-xl-msr6-source-segment	https://datatracker.ietf.org/doc/html/draft-xl-msr6-source-segment
MSR6 TE	draft-geng-msr6-traffic-engineering	https://datatracker.ietf.org/doc/html/draft-geng-msr6-traffic-engineering-01
	draft-geng-msr6-rlb-segment-00	https://datatracker.ietf.org/doc/draft-geng-msr6-rlb-segment/
	draft-chen-pim-srv6-p2mp-path	https://datatracker.ietf.org/doc/draft-chen-pim-srv6-p2mp-path/
	draft-chen-pim-mrh6	https://datatracker.ietf.org/doc/draft-chen-pim-mrh6/
	draft-xu-msr6-rbs	https://datatracker.ietf.org/doc/draft-xu-msr6-rbs/
	draft-chen-pim-mrh6	https://datatracker.ietf.org/doc/draft-chen-pim-mrh6/
	draft-eckert-msr6-rbs	https://datatracker.ietf.org/doc/draft-eckert-msr6-rbs/

Thanks