SRv6 for Inter-Layer Network Programming

draft-dong-spring-srv6-inter-layer-programming-08

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SPRING WG IETF 120 Meeting July 2024

Background Recap

- Operators usually have a multi-layered network, the layer-3 is normally IP, while different technologies can be used in layer-2 and below
  - Cross-layer network planning and optimization is expected for better efficiency and resiliency
- SRv6 enables network programming by encoding network instructions in IPv6 packet header
  - Currently only the network instructions related to IP packet layer are defined
  - The SRv6 network programming concept can be further extended for inter-layer network integration
- This document describes the typical use cases of inter-layer network integration, and proposes SRv6 based mechanisms for inter-layer network programming
  - New SRv6 behaviors are defined to instruct a node to send packet through (non-IP) underlay links or connections

Use Cases of Inter-layer Network Programming

- IP and Optical network integration
  - Redundant optical paths may not be fully used by IP layer
  - Optical paths may exist between non-adjacent IP nodes, thus not visible in the L3 topology

- IP and MTN（Metro Transport Network） inter-layer integration
  - The MTN architecture is defined in ITU-T G.8310
    - MTN nodes can support both per-hop IP forwarding and MTN Path (MTNP) cross-connect
    - An MTN path can be set up between two remote MTN nodes
  - Traffic can be carried using an IP path, an MTN path or the combination of IP and MTN path segments

SRv6 Behavior for Inter-layer Programming

- Two new SRv6 Endpoint Behaviors are proposed
  - End.XU: a variant of End.X
  - End.BXC: a variant of SRv6 binding SID
- The functionality in the data plane are similar
  - Both of the SRv6 behaviors can enable the programing of inter-layer TE paths
- Each option has different implications on the management plane and control plane functions
  - Operators may choose either one of the options that best suits their use cases, network management and operation models
  - The management and control plane extensions will be specified in separate documents

Option 1: SRv6 End.XU Behavior

- Endpoint with Underlay cross-connect
  - A variant of the End.X behavior
  - SID instance of this behavior is associated with an underlay interface, which connects to a remote node via underlay links or connections
  - The line S15 from the End processing is replaced by the following

> S15. Send the packet through one of the underlay links
>
> associated with the underlay interface identified by S

Option 2: SRv6 End.BXC Behavior

- Endpoint Bound to an underlay Channel
  - A variant of the SRv6 End Behavior, an instantiation of a binding SID
  - SID instance of this behavior is associated with an underlay tunnel (e.g. L1 channel) X
  - The line S15 from the End processing is replaced by the following

> S15. Forward the packet to the new destination via underlay tunnel X.

- Optionally, an SRv6 End.BXC behavior may require additional information (i.e. ARG) for its processing
  - For example, the high part of ARG may be used to encode the Channel Type, and the low part of ARG may be used to carry the Channel ID
  - An underlay tunnel is uniquely identified by Channel Type + Channel ID

Updates since Last Presentation

- The End.BXC behavior defined in draft-han-spring-srv6-underlay-tunnel-programming is merged as another option
- Elaborates the reason of introducing new SRv6 behavior rather than using existing “End.X”
  - End.X is defined to “send packet via one of a group layer-3 adjacencies”, the behavior is similar
  - The underlay connections (e.g. MTN paths, ODUk or DWDM connections) can be unidirectional, which does not meet the bidirectional check for a functional layer-3 adjacency
  - Operators may want these underlay connections being invisible in L3 topology, so that they can only be used by a controller for cross-layer traffic engineering for specific types of services
  - Endpoints of an underlay connection may reside in different areas or domains, which makes the establishment of layer-3 adjacency difficult
- Clarifies the possible mechanisms of obtaining layer-2 information required for packet encapsulation
  - Mechanisms such as static Neighbor Discovery (ND) Cache can be used
- Editorial changes to improve the readability

Next Steps

- This document is in a good shape, all the received comments have been addressed
- Operators have interests to deploy it in SRv6 networks for inter-layer integration
- Further feedbacks on the two new SRv6 behavior options are appreciated
- Request for WG adoption

Thank You