Abstract

One of the goals of DetNet is to provide bounded end-to-end latency for critical flows. This document defines how to leverage Segment Routing over IPv6 (SRv6) to implement bounded latency. Specifically, new SRv6 SID function is used to specify transmission time (cycles) of a packet. When forwarding devices along the path follow the instructions carried in the packet, the bounded latency is achieved. This mechanism of latency guarantee is called Cycle Specified Queuing and Forwarding (CSQF) which is defined in [I-D.chen-detnet-sr-based-bounded-latency].
Deterministic Networking (DetNet) provides a capability to carry specified data flows with extremely low data loss rates and bounded latency within a network domain. DetNet is enabled by a group of technologies, such as resource allocation, service protection and explicit routes. ([I-D.ietf-detnet-architecture])

Segment Routing (SR) leverages the source routing paradigm. A ingress node steers a packet through an ordered list of instructions, called "segments". SR can be applied over IPv6 data plane using Routing Extension Header (SRH). Besides routing, the segment of SRv6 can indicate functions which are executed locally in the node where they are defined. SRv6 network programming makes it convenient to add sophisticated operations in the network. ([RFC8402])

This document describes how to implement DetNet with SRv6. It can provide: 1. Source routing, which can steer the DetNet flows go...
through the network according to an explicit route with allocated resource by segment list in SRH; 2. Network programming, which can give packet instructions in every node along the path to guarantee bounded latency. DetNet SRv6 encapsulation and new SRv6 functions for DetNet are defined in this document.

Control plane and OAM are not in the scope of this document.

2. Terminology and Conventions

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119].

2.1. Terminology

Terminologies for DetNet go along with the definition in [I-D.ietf-detnet-architecture]. Other terminologies are defined as follows:

- NH: The IPv6 next-header field.
- SID: A Segment Identifier which represents a specific segment in a segment routing domain ([RFC8402]).
- SRH: The Segment Routing Header ([I-D.ietf-6man-segment-routing-header]).

2.2. Conventions

Conventions in the document are defined as follows:

- NH=SRH means that NH is 43 with routing type 4.
- A SID list is represented as <S1, S2, S3> where S1 is the first SID to visit, S2 is the second SID to visit and S3 is the last SID to visit along the SR path.
- SRH[SL] represents the SID pointed by the SL field in the first SRH. In our example, SRH[2] represents S1, SRH[1] represents S2 and SRH[0] represents S3.
- (SA, DA) (S3, S2, S1; SL) represents an IPv6 packet with:
  IPv6 header with source and destination addresses SA and DA respectively, and next-header SRH, with SID list <S1, S2, S3> with SegmentsLeft = SL
The payload of the packet is not represented
(S3, S2, S1; SL) represents the same SID list as <S1, S2, S3>, but encoded in the SRH format where the rightmost SID in the SRH is the first SID and the leftmost SID in the SRH is the last SID.

3. SRv6 DetNet Data Plane Overview

[I-D.chen-detnet-sr-based-bounded-latency] defines a new segment that is called a Cycle SID, which is used to identify a cycle.

A Cycle SID has two meanings: 1) identify an interface/link, just like the adjacency segment does; 2) identify a cycle of the interface/link. To specify to which interface and in which cycle a packet should be transmitted. By attaching a list of Cycle Segments to a packet in SRH, it can not only implement the explicit route of the packet that is required by DetNet [I-D.ietf-detnet-architecture], but also specify the sending cycle at each node along the path without maintaining per-flow states at the intermediate and egress nodes.

SRv6 Cycle SID can be represented as LOC:FUNCT:ARG::, where LOC, abbreviated for "LOCATION", directs the explicit route, FUNCT, abbreviated for "FUNCTION", directs the packet processing in the local node, and ARG, abbreviated for "ARGUMENTS", provides the cycle information. New SID functions for DetNet is defined in section 3.2.

3.1. Encapsulation

The SRH for DetNet in the outer IPv6 header is showed as follows:
### 3.2. Functions

New SID functions are defined as follows:

**End.X.Cycle.Indication**

1. IF NH=SRH and SL > 0  
2. decrement SL  
3. reserve the value of cycle information field  
4. update the IPv6 DA with SRH[SL]  
5. forward to layer-3 adjacency bound to the Location
6. put the packet in the queue corresponding to the cycle information reserved

7. ELSE

8. drop the packet

4. IANA Considerations

This document makes no request of IANA.

Note to RFC Editor: this section may be removed on publication as an RFC.

5. Security Considerations

TBD

6. Acknowledgements

7. Normative References

[I-D.chen-detnet-sr-based-bounded-latency]

[I-D.filsfils-spring-srv6-network-programming]

[I-D.ietf-6man-segment-routing-header]

[I-D.ietf-detnet-architecture]


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