Abstract

This document analyses the technical requirements that Layer 3 bounded latency forwarding scheme should satisfy.

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1. Introduction

DetNet is chartered to provide deterministic forwarding over Layer 3. Deterministic forwarding means packet forwarding with bounded latency, loss and delay variation [draft-ietf-detnet-problem-statement]. In current DetNet’s discussion, low packet loss is mainly achieved through PREOF (Packet Replication, Elimination, and Ordering Functions)[draft-ietf-detnet-architecture]. This document focuses on bounded latency.

Common IP/MPLS forwarding has long tail effect that couldn’t guarantee bounded latency. DetNet has to have an approach to identify DetNet flows, and divert them into a DetNet forwarding plane in which some schemes are adapted to guarantee bounded latency. There are several schemes are proposed for bounded latency forwarding such as dedicated tunnel, light load with per-flow per-hop shaping, Time Aware Shaping[IEEE802.1Qbv], Cyclic Queuing and Forwarding[IEEE802.1Qch], Scalable Deterministic Forwarding[draft-qiang-detnet-large-scale-detnet], and SR based bounded latency[draft-chen-detnet-sr-based-bounded-latency]. This document is not going to compare and analyze these schemes, but to propose some factors (Layer 3 specific) worth to be considered when selecting Layer 3 bounded latency forwarding scheme.

1.1. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119][RFC8174] when, and only when, they appear in all capitals, as shown here.
1.2. Terminology & Abbreviations

This document uses the terminology defined in [draft-ietf-detnet-architecture].

TSN: Time Sensitive Network

2. Tolerance of Time Deviation

One of DetNet’s objectives is to stitch TSN domains together as shown in Figure 1. We know that devices inside a TSN domain are time-synchronized, and most of TSN forwarding schemes rely on precise time synchronization. However, two TSN domains have a high probability of being asynchronous, while DetNet needs to connect them together and provide end-to-end deterministic forwarding. Therefore, it is worthy of having a DetNet forwarding plane which can keep the bounded latency even under an unsynchronized situation. Otherwise, buffer is needed to absorb the time deviation, and end-users have to bear the latency and cost increase introduced by buffer.

Moreover, there are

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+-------------+                             +-------------+
|              |      DetNet Forwarding      |              |
| TSN Domain I | -----------------------------+ TSN Domain II|
|              |                             |              |
+-------------+                             +-------------+
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Figure 1: DetNet Scenario

3. Long Link Propagation Delay

In contrast to Layer 2 TSN that deployed in LAN, Layer 3 DetNet is expected to be deployed in larger scale network that has longer link propagation delay. Long link propagation delay can cause some troubles to simple cyclic forwarding schemes, like [IEEE802.1Qch]. IEEE 802.1 Qch works on the basis of time synchronization, and one hop forwarding (include packet sending, packet transmission on link, and packet receiving three operations) is required to be finished within one cycle as shown in Figure 2. Long links whose latency exceed the cycle time will make IEEE 802.1 Qch doesn’t work. One possible solution is to set cycle time to be a bigger value, in order to absorb long link propagation delay. However, this solution will lead to larger jitter. The reason is that cyclic forwarding schemes only try to ensure the packet arrives at a node within a certain cycle, and packet’s arrival time may vary within that cycle.

Considering the features of TSN applications we can speculate that the number of TSN flows will not dramatically change with time. While DetNet targets at larger-scale deployment. There are more time-sensitive applications such as VR communication, they may require establishment or tear-down of the DetNet connections frequently. Meanwhile, layer 3 device may serve millions of traffic flows simultaneously. Hence those schemes that need complex calculations may not be applicable in DetNet. More importantly, forwarding schemes need to avoid impact on those in-transit flows when new flows are added (or old flows are removed).

5. IANA Considerations

This document makes no request of IANA.

6. Security Considerations

This document will not introduce new security problems.

7. Acknowledgements

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8. Normative References

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