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Problem Statement of Signal Degrade Indication for Segment Routing over MPLS Network

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Abstract

This document outlines the problem statements and the use cases needed to be taken into account when the signal degrade is detected and indicated in the networks of Segment Routing (SR) over MPLS.

Requirements Language

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 RFC 2119 [RFC2119].

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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1. Introduction

Signal Failure (SF) and Signal Degradation (SD) are categorized as the trigger to bring the survivability challenge to the network in [RFC6372]. Signal Failure (SF) can be interpreted as the absence of the network resources, and Signal Degradation (SD) can be regarded as the decrease of the signal quality quantifiable measurement. The meanings of signal failure is straightforward, indicating the failure of the interfaces, links or nodes. Meanwhile, fiber aging, fiber impairment, fiber pollution, optical module mismatch or WDM transmission error are the potential reasons to generate signal degrade.

In [RFC6378], linear protection mechanisms for the MPLS Transport Profile (MPLS-TP) are introduced, and the protection switching

protocol associated with Signal Failure (SF) is specified. Similarly, [RFC7271] specifies the mechanisms of linear protection functions for SDH, OTN and Ethernet transport networks, and the capability of supporting the protection against Signal Degrade (SD) in Section 7. The drafts [I-D.rkhd-mpls-tp-sd] and [I-D.zhl-mpls-tp-sd] also gives detailed descriptions about the Signal Degrade (SD) detection and the consequent triggered protection mechanism.

In the era of the source routing paradigm, Segment Routing over MPLS (SR-MPLS) [RFC8402] would be widely utilized for any kinds of network scenarios, not only the Ethernet metro/IP core or data center, but also the IP Radio Access Networks (RAN). It is evaluable to investigate the necessity of supporting detection of Signal Degrade (SD) and the protection mechanisms against it in the source routing paradigm.

This document gives the problem statements as well as several use cases for the Signal Degrade indication and advertisement in the networks of SR over MPLS (SR-MPLS). The approach of signal degrade detection has been explicitly defined in IEEE 802.3 series standard. The triggered protection mechanism is irrelevant to Signal Degrade indication and consequently is out of scope.

2. Terminology

TBD

3. Problem Statement and Use Case

3.1. Overview of Signal Degrade in SR over MPLS Network

In the present mobile backhaul network, 3G/4G services are operated on different flavors of MPLS. Figure 1 depicts the overview of the signal degrade detection in the segment routing over MPLS network.

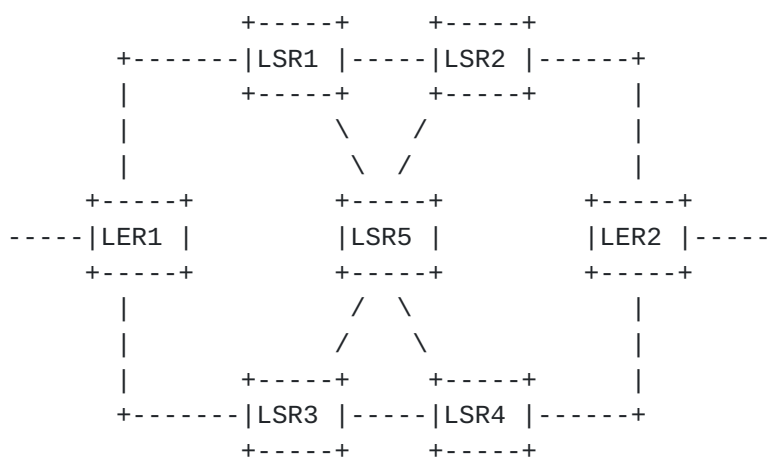

Figure 1: Overview of Signal Degrade in SR over MPLS Network

LER1 and LER2 are the Label Edge Routers, and LSR1 to LSR5 are the Label Switching Routers. The signal degrade can happen at any links in the SR over MPLS network, not only the links connected to LERs, but also the links between LSRs. There is no signal degradation is defined in the current OAM [I-D.ietf-spring-sr-oam-requirement] or BFD [I-D.ali-spring-bfd-sr-policy] mechanisms designed for SR over MPLS network.

3.2. Influence on Voice and Data Service

In the mobile backhaul network, take VoLTE as an example, voice service is extremely sensitive to signal degradation. The bit error on the packets can bring noise, carton, voice call delay, drop line or even the base station disconnection.

Moreover, the download speed of data service is also dramatically decreased when the packet loss rate is increasing, although the packet loss rate stays in a very low level in all cases. The detailed network statistics is shown in Table 1.

Packet Loss Rate	Decrease of Download Rate
0	No affect
<0.01%	No affect
0.05%	23%
0.2%	58%
1%	75%

Table 1 Relation between Packet Loss Rate and Decrease of Download Rate

Signal degradation won't cause the entire service interruption, however it impairs the services and dissatisfies the Service Level Agreements (SLAs) significantly.

3.3. Engineering Considerations

3.3.1. Signal Degrade in Diversity of PHYs

From the perspective of engineering, there are a variety of PHYs defined in IEEE 802.3. The PHYs without Forward Error Correction (FEC) generates the defects/alarms, PHYs with the FEC correct the bit errors. There is no uniform mechanism to guarantee the control of the bit errors.

3.3.2. Performance Management Detection

The approaches of OAM performance management can be used as the tools to detect the signal degrade. On one hand, active performance management cannot fulfill the Signal Degrade detection all the time. On the other hand, passive performance management consumes too much resource of the equipment so that operators can hardly use it in the networks. The current performance management mechanism is not feasible to detect signal degrade conveniently and efficiently.

3.3.3. BFD Detection

For the worst case, when signal degrade happens on LSRs, the current best practice is to make use of the result of BFD protocol on LERs to trigger the protection mechanism. The detection time is at least 3.3ms*3 later than the time when the signal degrade happens. If the LSRs can trigger the protection protocol in a more direct and efficient way, the network service interruption time can be reduced.

3.4. LER and LSR Consideration

There are local and remote request logics about the signal degrade defined in [RFC6378]. Meanwhile, the Protection State Coordination (PSC) process and the messages are utilized to advertise and exchange the signal degrade state between LERs. In the network of MPLS-TP, the LSRs stay dumb in the transmission of OAM messages.

In the SR over MPLS networks, only the headend LER knows all the segments in the label stack, the other LSRs and LER2 does not know the entire label stack. As for the signal degradation happens on either headend LER or other LSRs and LER, the mechanism of the signal degrade indication would be differently designed.

3.5. Signal Degrade Approach

In Section 4.1 of [RFC6372], approaches of detection or recognition of network defect such as signal degrade are specified. The signal degrade indication can be detected from a network defect, or advertised by an in-band data-plane-based OAM mechanism, or by in-band or out-of-band control-plane signaling, or triggered from the centralized Network Management System (NMS) or a SDN controller. The appropriate approaches should be wisely selected.

3.6. Isolation of Signal Degrade Detection and Protection

The signal degrade detection is monitored based on the physical link, however the signal degrade can be processed and notified at the transport path level (e.g. LSP level). As a result, the protection can be triggered based on the granularity like LSPs.

3.7. Parameter Threshold

Parameters like BER or PLR are the different quantitative measurement methods. It is flexible for the service providers to set different values of threshold based on the geographical site investigations. For an even more complicated scenario, the threshold may be defined differently in terms of services, for example to differentiate the requirements of the eMBB or URLLC applications in 5G era.

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

TBD

7. References

7.1. Normative References

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