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Bidirectional Forwarding Detection (BFD) Directed Return Path draft-ietf-mpls-bfd-directed-02

Abstract

Bidirectional Forwarding Detection (BFD) is expected to monitor bi-directional paths. When a BFD session monitors an explicit routed path there is a need to be able to direct egress BFD peer to use specific path for the reverse direction of the BFD session.

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1. Introduction

RFC 5880 [RFC5880], RFC 5881 [RFC5881], and RFC 5883 [RFC5883] established the BFD protocol for IP networks and RFC 5884 [RFC5884] set rules of using BFD asynchronous mode over IP/MPLS LSPs. These four standards implicitly assume that the egress BFD peer will use the shortest path route regardless of route being used to send BFD control packets towards it.

For the case where an LSP is explicitly routed, if it is desired that BFD control packets follow the same path in the reverse direction (for support of common fault detection for explicitly routed bidirectional co-routed LSPs, for example), it is likely that the shortest return path to the ingress BFD peer may not follow the same path as the LSP in the forward direction. The fact that BFD control packets are not guaranteed to cross the same links and nodes in both forward and reverse directions is a significant factor in producing

false positive defect notifications, i.e. false alarms, if used by the ingress BFD peer to deduce the state of the forward direction.

This document defines the BFD Reverse Path TLV as an extension to LSP Ping [RFC4379] and proposes that it to be used to instruct the egress BFD peer to use explicit path for its BFD control packets associated with the particular BFD session. The TLV will be allocated from the TLV and sub-TLV registry defined by RFC 4379 [RFC4379]. As a special case, forward and reverse directions of the BFD session can form a bi-directional co-routed associated channel.

1.1. Conventions used in this document

1.1.1. Terminology

BFD: Bidirectional Forwarding Detection

MPLS: Multiprotocol Label Switching

LSP: Label Switching Path

LoC: Loss of Continuity

1.1.2. 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 [RFC2119].

2. Problem Statement

BFD is best suited to monitor bi-directional co-routed paths. In most cases, given stable environments, the forward and reverse directions between two nodes are likely to be co-routed, thus fulfilling the implicit BFD requirement. If BFD is used to monitor unidirectional explicitly routed path, e.g. MPLS-TE LSP, BFD control packets in forward direction would be in-band using the mechanism defined in [RFC5884] and [RFC5586]. But the reverse direction of the BFD session would still follow the shortest path route and that might lead to the following problem in detecting failures on a unidirectional explicit path:

- a failure detection by ingress node on the reverse path cannot be interpreted as bi-directional failure with all the certainty and thus trigger, for example, protection switchover of the forward direction without possibility of being a false positive defect notification.

To address this scenario the egress BFD peer should be instructed to use a specific path for BFD control packets.

3. Direct Reverse BFD Path

3.1. Case of MPLS Data Plane

LSP ping, defined in [RFC4379], uses BFD Discriminator TLV [RFC5884] to bootstrap a BFD session over an MPLS LSP. This document defines a new TLV, BFD Reverse Path TLV, that MUST contain a single sub-TLV that can be used to carry information about the reverse path for the BFD session that is specified by value in BFD Discriminator TLV.

3.1.1. BFD Reverse Path TLV

The BFD Reverse Path TLV is an optional TLV within the LSP ping protocol. However, if used, the BFD Discriminator TLV MUST be included in an Echo Request message as well. If the BFD Discriminator TLV is not present when the BFD Reverse Path TLV is included, then it MUST be treated as malformed Echo Request, as described in [RFC4379].

The BFD Reverse Path TLV carries information about the path onto which the egress BFD peer of the BFD session referenced by the BFD Discriminator TLV MUST transmit BFD control packets. The format of the BFD Reverse Path TLV is as presented in Figure 1.

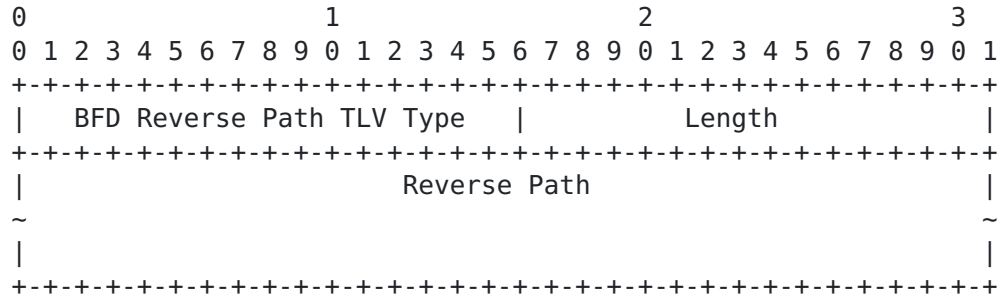

Figure 1: BFD Reverse Path TLV

BFD Reverse Path TLV Type is 2 octets in length and has a value of TB1 (to be assigned by IANA as requested in Section 5).

Length field is 2 octets long and defines the length in octets of the Reverse Path field.

Reverse Path field contains a sub-TLV. Any Target FEC sub-TLV (already defined, or to be defined in the future) for TLV Types 1, 16, and 21 of MPLS LSP Ping Parameters registry MAY be used in this

field. Exactly one sub-TLV MUST be included in the Reverse Path TLV. If more than one sub-TLV is present in the Reverse Path TLV, then, in order to avoid ambiguity of which of TLVs to use, the egress BFD peer MUST send Echo Reply with the received Reverse Path TLVs and set the Return Code to "Too Many TLVs Detected" Section 3.4.

If the egress LSR cannot find the path specified in the Reverse Path TLV it MUST send Echo Reply with the received Reverse Path TLV and set the Return Code to "Failed to establish the BFD session. The specified reverse path was not found" Section 3.4. The egress BFD peer MAY establish the BFD session over IP network as defined in [RFC5884].

3.1.2. Static and RSVP-TE sub-TLVs

When an explicit path on an MPLS data plane is set either as Static or RSVP-TE LSP respective sub-TLVs defined in [RFC7110] MAY be used to identify the explicit reverse path for the BFD session.

3.1.3. Segment Routing: MPLS Data Plane Case

In addition to Static and RSVP-TE, Segment Routing with MPLS data plane can be used to set an explicit path. In this case a new sub-TLV is defined in this document as presented in Figure 2.

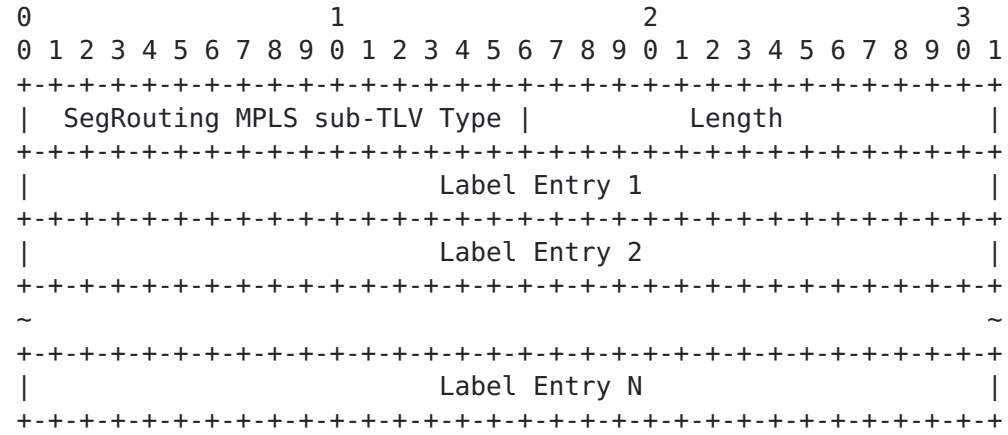

Figure 2: Segment Routing MPLS Tunnel sub-TLV

The Segment Routing Tunnel sub-TLV Type is two octets in length, and has a value of TB2 (to be assigned by IANA as requested in Section 5).

The egress LSR MUST use the Value field as label stack for BFD control packets for the BFD session identified by the source IP

address of the MPLS LSP Ping packet and the value in the BFD Discriminator TLV. Label Entries MUST be in network order.

The Segment Routing Tunnel sub-TLV MAY be used in Reply Path TLV defined in [RFC7110]

3.2. Segment Routing: IPv6 Data Plane Case

IPv6 can be used as the data plane of choice for Segment Routed tunnels [I-D.previdi-6man-segment-routing-header]. In this case the BFD Reverse Path TLV described in Section 3.1.1 can be used as well. To specify the reverse path of a BFD session for an IPv6 explicitly routed path the BFD Discriminator TLV MUST be used along with the BFD Reverse Path TLV. The BFD Reverse Path TLV in IPv6 network MUST include the Segment Routing IPv6 Tunnel sub-TLV.

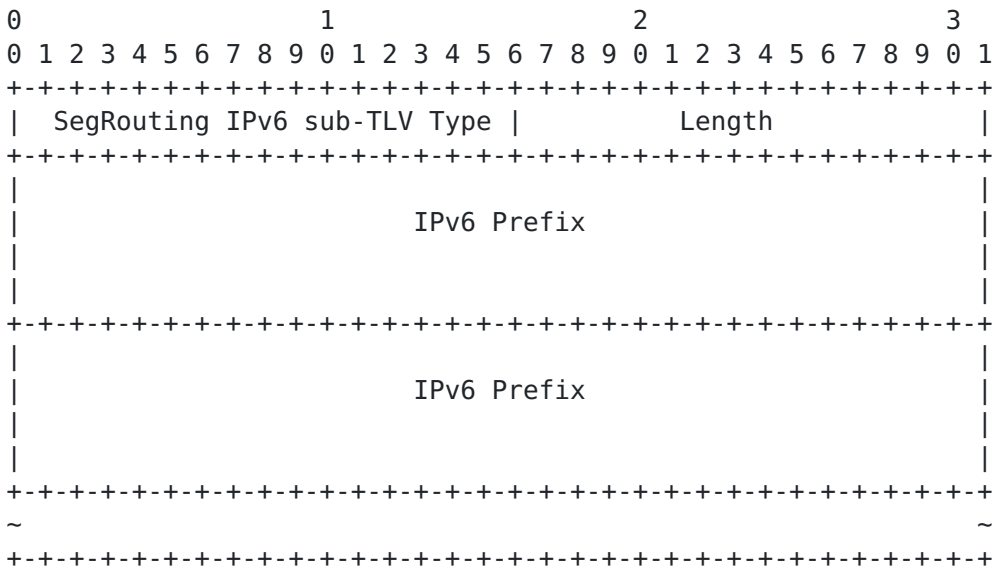

Figure 3: Segment Routing IPv6 Tunnel sub-TLV

The Segment Routing IPv6 Tunnel sub-TLV Type is two octets in length, and has a value of TB3 (to be assigned by IANA as requested in Section 5).

3.3. Bootstrapping BFD session with BFD Reverse Path over Segment Routed tunnel

As discussed in [I-D.kumarkini-mpls-spring-lsp-ping] introduction of Segment Routing network domains with an MPLS data plane adds three new sub-TLVs that MAY be used with Target FEC TLV. Section 6.1 addresses use of the new sub-TLVs in Target FEC TLV in LSP ping and

LSP traceroute. For the case of LSP ping the [I-D.kumarkini-mpls-spring-lsp-ping] states that:

"Initiator MUST include FEC(s) corresponding to the destination segment. "

"Initiator, i.e. ingress LSR, MAY include FECs corresponding to some or all of segments imposed in the label stack by the ingress LSR to communicate the segments traversed. "

When LSP ping is used to bootstrap BFD session this document updates the statement and defines that LSP Ping MUST include the FEC corresponding to the destination segment and SHOULD NOT include FECs corresponding to some or all of other segments imposed by the ingress LSR. Operationally such restriction would not cause any problem or uncertainty as LSP ping with FECs corresponding to some or all segments or traceroute that validate the segment route MAY precede the LSP ping that bootstraps the BFD session.

3.4. Return Codes

This document defines the following Return Codes for MPLS LSP Echo Reply:

- "Too Many TLVs Detected", (TBD4). When more than one Reverse Path TLV found in the recieved Echo Request by the egress BFD peer, an Echo Reply with the return code set to "Too Many TLVs Detected" MUST be sent to the ingress BFD peer Section 3.1.1.

- "Failed to establish the BFD session. The specified reverse path was not found", (TBD5). When a specified reverse path is not available at the egress BFD peer, an Echo Reply with the return code set to "Failed to establish the BFD session. The specified reverse path was not found" MUST be sent back to the ingress BFD peer Section 3.1.1.

4. Use Case Scenario

In the network presented in Figure 4 node A monitors two tunnels to node H: A-B-C-D-G-H and A-B-E-F-G-H. To bootstrap a BFD session to monitor the first tunnel, node A MUST include a BFD Discriminator TLV with Discriminator value (e.g. foobar-1) and MAY include a BFD Reverse Path TLV that references H-G-D-C-B-A tunnel. To bootstrap a BFD session to monitor the second tunnel, node A MUST include a BFD Discriminator TLV with a different Discriminator value (e.g. foobar-2) [RFC7726] and MAY include a BFD Reverse Path TLV that references H-G-F-E-B-A tunnel.

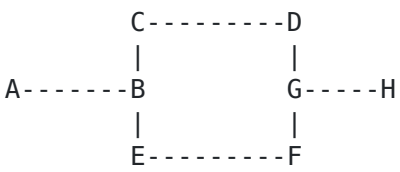

Figure 4: Use Case for BFD Reverse Path TLV

If an operator needs node H to monitor a path to node A, e.g. H-G-D-C-B-A tunnel, then by looking up list of known Reverse Paths it MAY find and use the existing BFD session.

5. IANA Considerations

5.1. TLV

The IANA is requested to assign a new value for BFD Reverse Path TLV from the "Multiprotocol Label Switching Architecture (MPLS) Label Switched Paths (LSPs) Ping Parameters - TLVs" registry, "TLVs and sub-TLVs" sub-registry.

Value	Description	Reference
X (TBD1)	BFD Reverse Path TLV	This document

Table 1: New BFD Reverse Type TLV

5.2. Sub-TLV

The IANA is requested to assign two new sub-TLV types from "Multiprotocol Label Switching Architecture (MPLS) Label Switched Paths (LSPs) Ping Parameters - TLVs" registry, "Sub-TLVs for TLV Types 1, 16, and 21" sub-registry.

Value	Description	Reference
X (TBD2)	Segment Routing MPLS Tunnel sub-TLV	This document
X (TBD3)	Segment Routing IPv6 Tunnel sub-TLV	This document

Table 2: New Segment Routing Tunnel sub-TLV

5.3. Return Codes

The IANA is requested to assign a new Return Code value from the "Multi-Protocol Label Switching (MPLS) Label Switched Paths (LSPs) Ping Parameters" registry, "Return Codes" sub-registry, as follows using a Standards Action value.

Value	Description	Reference
X (TBD4)	Too Many TLVs Detected.	This document
X (TBD5)	Failed to establish the BFD session. The specified reverse path was not found.	This document

Table 3: New Return Code

6. Security Considerations

Security considerations discussed in [RFC5880], [RFC5884], and [RFC4379], apply to this document.

7. Acknowledgements

Authors greatly appreciate thorough review and the most helpful comments from Eric Gray.

8. Normative References

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