Extended Bidirectional Forwarding Detection
draft-mirmin-bfd-extended-00

Abstract

This document describes a mechanism to extend the capabilities of Bidirectional Forwarding Detection (BFD). These extensions enable BFD to measure performance metrics like packet loss and packet delay.

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1. Introduction

[RFC5880] provided the base specification of Bidirectional Detection (BFD) as the light-weight mechanism to monitor a path continuity between two systems and detect a failure in the data-plane. Since its introduction, BFD became has been broadly deployed. There was a number of attempts to introduce new capabilities in the protocol, some more successful than others. One of the significant obstacles to extending BFD capabilities may be seen in the compact format of the BFD control message. This document introduces an extended BFD control message and describes the use of the new format for new BFD capabilities.

2. Conventions used in this document

2.1. Terminology

BFD: Bidirectional Forwarding Detection

G-ACh Generic Associated Channel

MTU Maximum Transmission Unit

PMTUD Path MTU Discovery

p2p: Point-to-Point

TLV Type, Length, Value
2.2. 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 BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

3. Extended BFD Control Message

Figure 1: Extended BFD Control Message Format

where fields are defined as the following:

- BFD control message as defined [RFC5880].

- Guard word - four octets long field to identify the role of the BFD system - sender or responder.

- TLVs - variable length field that contains commands and/or data encoded as type-length-value (TLV).

If an extended BFD control message encapsulated in IP/UDP, the value of the Total Length in the IP header includes the length of the extended BFD control message while the value of the Length field of the BFD control message equals the value as defined in [RFC5880]. If an extended BFD control message to be used over Generic Associated Channel (G-ACh), e.g., [RFC6428] new code point for G-ACh may be allocated.

Figure 2 displays the generic TLV format. A TLV MAY include sub-TLVs that have the same format as presented in Figure 2.
where fields are defined as the following:

- **Type** - two octets long field that defines the encoding of the Value field

- **Length** - two octets long field equals length on the Value field in octets.

- **Value** - depends on the Type.

TLVs may be included within other TLVs, in which case the former TLVs are referred to as sub-TLVs. Sub-TLVs have independent types.

### 3.1. Theory of Operation

A BFD system, also referred to as a node in this document, that supports extended BFD first MUST discover whether other nodes in the given BFD session support the extended BFD. The node MUST send extended BFD control message initiating the Poll sequence as defined in [RFC5880]. If the remote system fails to respond with the extended BFD control message and the Final flag set, then the initiator node MUST conclude that the BFD peer does not support the use of the extended BFD control messages.

The first extended BFD control message SHOULD include the Capability TLV that lists capabilities that may be used at some time during the lifetime of the BFD session. The format of the Capability TLV is presented in Figure 3.
where fields are defined as the following:

- **Type** - TBA1 allocated by IANA Section 4

- **Length** - two octets long field equals length on the Capability field in octets. The value of the Length field MUST be a multiple of 4.

- **Capability** - variable number of octets -

  Figure 4 presents defined in this document the capabilities that use the extended BFD control message:

  ![Capability Encoding Format](image)

  where fields are defined as the following:

  - **Loss** - two bits size field. The least significant of two bits is set if the node is capable of measuring packet loss using periodically transmitted extended BFD control message. The most significant of two bits is set if the node is capable of measuring packet loss using the Poll sequence with extended BFD control message.

  - **Delay** - two bits size field. The least significant of two bits is set if the node is capable of measuring packet delay using periodically transmitted extended BFD control message. The most significant of two bits is set if the node is capable of measuring packet delay using the Poll sequence with extended BFD control message.

  - **MTU** - one-bit size field. Set if the node is capable of using the extended BFD control message in Path MTU Discovery (PMTUD). [Ed.note: Definition of the PMTUD using the extended BFD control message is for further version.]

  - **Reserved** - MUST be zeroed on transmission and ignored on receipt.

  The remote BFD node that supports this specification MUST respond to the Capability TLV with the extended BFD control message that includes the Capability TLV listing capabilities the responder
supports. The responder MUST set the Final flag in the extended BFD control message.

3.2. Performance Measurement with Extended BFD Control Message

Loss measurement, delay measurement, and loss/delay measurement messages can be used in the extended BFD control message to support one-way and round-trip measurements. All the messages are encapsulated as TLVs with Type values allocated by IANA, Section 4.

To perform one-way loss and/or delay measurement the BFD node MAY periodically transmit the extended BFD message with the appropriate TLV in Asynchronous mode. To perform synthetic loss measurement the sender MUST monotonically increment the counter of transmitted test packets. Also, direct-mode loss measurement, as described in [RFC6374], is supported.

For the one-way measurement the sender MAY use the Performance Metric TLV (presented in Figure 5) to obtain the measurement report from the receiver.

```
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|   Type  = Performance Metric  |           Length              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
~                       Metric Sub-TLVs                         ~
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 5: Performance Metric TLV Format

where fields are defined as the following:

- **Type** - TBA6 allocated by IANA Section 4
- **Length** - two octets long field equals length on the Metric sub-TLVs field in octets. The value of the Length field MUST be a multiple of 4.
- **Metric sub-TLVs** - various performance metrics directly measured and/or calculated at the receiver encoded as TLV. [Ed.note: Definition of Metric sub-TLVs is for further version.]

To measure the round-trip loss and/or delay metrics the BFD node transmits the extended BFD control message with the appropriate TLV with the Poll flag set. Before the transmission of the extended BFD
control message, the receiver MUST clear the Poll flag and set the Final flag.

4. IANA Considerations

IANA is requested to create the Extended BFD Message Types registry. All code points in the range 1 through 32759 in this registry shall be allocated according to the "IETF Review" procedure as specified in [RFC8126]. Code points in the range 32760 through 65279 in this registry shall be allocated according to the "First Come First Served" procedure as specified in [RFC8126]. Remaining code points are allocated according to Table 1:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Reserved</td>
<td>This document</td>
</tr>
<tr>
<td>1- 32767</td>
<td>Mandatory TLV, unassigned</td>
<td>IETF Review</td>
</tr>
<tr>
<td>32768 - 65279</td>
<td>Optional TLV, unassigned</td>
<td>First Come First Served</td>
</tr>
<tr>
<td>65280 - 65519</td>
<td>Experimental</td>
<td>This document</td>
</tr>
<tr>
<td>65520 - 65534</td>
<td>Private Use</td>
<td>This document</td>
</tr>
<tr>
<td>65535</td>
<td>Reserved</td>
<td>This document</td>
</tr>
</tbody>
</table>

Table 1: Extended BFD Type Registry

This document defines the following new values in Extended BFD Type registry:

<table>
<thead>
<tr>
<th>Value</th>
<th>Description</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>TBA1</td>
<td>Extra Padding</td>
<td>This document</td>
</tr>
<tr>
<td>TBA2</td>
<td>Capability</td>
<td>This document</td>
</tr>
<tr>
<td>TBA3</td>
<td>Loss Measurement</td>
<td>This document</td>
</tr>
<tr>
<td>TBA4</td>
<td>Delay Measurement</td>
<td>This document</td>
</tr>
<tr>
<td>TBA5</td>
<td>Loss and Delay Measurement</td>
<td>This document</td>
</tr>
<tr>
<td>TBA6</td>
<td>Performance Metric</td>
<td>This document</td>
</tr>
</tbody>
</table>

Table 2: Extended BFD Types
5. Security Considerations

This document does not introduce new security aspects but inherits all security considerations from [RFC5880], [RFC6428], and [RFC6374].

6. Normative References


Appendix A. Acknowledgements

TBD

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