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BFD Stability  
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## Abstract

This document describes extensions to the Bidirectional Forwarding Detection (BFD) protocol to measure BFD stability. Specifically, it describes a mechanism for detection of BFD packet loss.

## Status of This Memo

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## [1.](#) Introduction

The Bidirectional Forwarding Detection ( BFD) [[RFC5880](#)] protocol operates by transmitting and receiving BFD control packets, generally at high frequency, over the datapath being monitored. In order to prevent significant data loss due to a datapath failure, BFD session detection time as defined in BFD [[RFC5880](#)] is set to the smallest feasible value.

This document proposes a mechanism to detect lost packets in a BFD session in addition to the datapath fault detection mechanisms of BFD. Such a mechanism presents significant value to measure the stability of BFD sessions and provides data to the operators for the

cause of a BFD failure.

This document does not propose any BFD extension to measure data traffic loss or delay on a link or tunnel and the scope is limited to BFD packets.

## [2.](#) Terminology

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 [RFC 2119](#) [RFC2119] and [RFC 8174](#) [RFC8174].

The reader is expected to be familiar with the BFD [\[RFC5880\]](#), Optimizing BFD Authentication [\[I-D.ietf-bfd-optimizing-authentication\]](#) and BFD Secure Sequence Numbers [\[I-D.ietf-bfd-secure-sequence-numbers\]](#).

## [3.](#) Use Cases

Bidirectional Forwarding Detection as defined in BFD [\[RFC5880\]](#) cannot detect any BFD packet loss if the loss does not last for detection time. This document proposes a method to detect a dropped packet on the receiver. For example, if the receiver receives BFD control packet  $k$  at time  $t$  but receives packet  $k+3$  at time  $t+10\text{ms}$ , and never receives packet  $k+1$  and/or  $k+2$ , then it has experienced a drop.

This proposal enables BFD implementations to generate diagnostic information on the health of each BFD session that could be used to preempt a failure on a datapath that BFD was monitoring by allowing time for a corrective action to be taken.

In a faulty datapath scenario, an operator can use BFD health information to trigger delay and loss measurement OAM protocol, Connectivity Fault Management (CFM) [\[IEEE802.1ag\]](#) or Loss Measurement (LM)-Delay Measurement (DM)) as defined by A One-way Active Measurement Protocol (OWAMP) [\[RFC4656\]](#) to further isolate the issue.

## [4.](#) BFD NULL-Authentication Type

The functionality proposed for BFD stability measurement is achieved by appending an authentication section with the NULL Authentication

type (as defined in Optimizing BFD Authentication [[I-D.ietf-bfd-optimizing-authentication](#)] ) to the BFD control packets that do not have authentication enabled.

## [5.](#) Theory of Operation

This mechanism allows operators to measure the loss of BFD control packets.

When using MD5 or SHA authentication, BFD uses an authentication section that carries the Sequence Number. However, if non-meticulous authentication is being used, or no authentication is in use, then

the non-authenticated BFD control packets MUST include an authentication section with the NULL Authentication type.

### [5.1.](#) Loss Measurement

Loss measurement counts the number of BFD control packets missed at the receiver during any Detection Time period. The loss is detected by comparing the Sequence Number field in the Auth TLV (NULL or otherwise) in successive BFD control packets. The Sequence Number in each successive control packet generated on a BFD session by the transmitter is incremented by one. This loss count can then be exposed using the YANG module defined in the subsequent section.

The first BFD authentication section with a non-zero sequence number, in a valid BFD control packet, processed by the receiver is used for bootstrapping the logic. When using secure sequence numbers, if the expected values are pre-calculated, the value must be matched to detect lost packets as defined in BFD secure sequence numbers [[I-D.ietf-bfd-secure-sequence-numbers](#)].

## [6.](#) ietf-bfd-stability YANG Module

### [6.1.](#) Data Model Overview

This YANG module augments the "ietf-bfd" module to add to the per-session set of counters a 'loss-packet-count' for BFD packets that are lost but do not necessarily result in the BFD session going down.

```
module: ietf-bfd-stability
  augment /rt:routing/rt:control-plane-protocols
    /rt:control-plane-protocol/bfd:bfd/bfd-ip-sh:ip-sh
    /bfd-ip-sh:sessions/bfd-ip-sh:session
    /bfd-ip-sh:session-statistics:
    +--ro lost-packet-count?   yang:counter32
  augment /rt:routing/rt:control-plane-protocols
    /rt:control-plane-protocol/bfd:bfd/bfd-ip-mh:ip-mh
    /bfd-ip-mh:session-groups/bfd-ip-mh:session-group
    /bfd-ip-mh:sessions/bfd-ip-mh:session-statistics:
    +--ro lost-packet-count?   yang:counter32
  augment /rt:routing/rt:control-plane-protocols
    /rt:control-plane-protocol/bfd:bfd/bfd-lag:lag
    /bfd-lag:sessions/bfd-lag:session/bfd-lag:member-links
    /bfd-lag:micro-bfd-ipv4/bfd-lag:session-statistics:
    +--ro lost-packet-count?   yang:counter32
  augment /rt:routing/rt:control-plane-protocols
    /rt:control-plane-protocol/bfd:bfd/bfd-lag:lag
    /bfd-lag:sessions/bfd-lag:session/bfd-lag:member-links
    /bfd-lag:micro-bfd-ipv6/bfd-lag:session-statistics:
    +--ro lost-packet-count?   yang:counter32
  augment /rt:routing/rt:control-plane-protocols
```

```

        /rt:control-plane-protocol/bfd:bfd/bfd-mpls:mpls
        /bfd-mpls:session-groups/bfd-mpls:session-group
        /bfd-mpls:sessions/bfd-mpls:session-statistics:
+--ro lost-packet-count?   yang:counter32

```

## 6.2. YANG Module

This YANG module imports Common YANG Types [[RFC6991](#)], A YANG Data Model for Routing [[RFC8349](#)], and YANG Data Model for Bidirectional Forwarding Detection (BFD) [[I-D.ietf-bfd-yang](#)].

```

<CODE BEGINS> file "ietf-bfd-stability@2021-04-11.yang"
module ietf-bfd-stability {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-bfd-stability";
  prefix "bfd";

  import ietf-yang-types {
    prefix "yang";
    reference
      "RFC 6991: Common YANG Data Types";
  }

  import ietf-routing {
    prefix "rt";
    reference

```

```

    "RFC 8349: A YANG Data Model for Routing Management
    (NMDA version)";
  }

  import ietf-bfd {
    prefix bfd;
    reference
      "I-D.ietf-bfd-yang: YANG Data Model for Bidirectional
      Forwarding Detection.";
  }

  import ietf-bfd-ip-sh {
    prefix bfd-ip-sh;
    reference
      "I-D.ietf-bfd-yang: YANG Data Model for Bidirectional

```

```

        Forwarding Detection.";
    }

import ietf-bfd-ip-mh {
    prefix bfd-ip-mh;
    reference
        "I-D.ietf-bfd-yang: YANG Data Model for Bidirectional
        Forwarding Detection.";
}

import ietf-bfd-lag {
    prefix bfd-lag;
    reference
        "I-D.ietf-bfd-yang: YANG Data Model for Bidirectional
        Forwarding Detection.";
}

import ietf-bfd-mpls {
    prefix bfd-mpls;
    reference
        "I-D.ietf-bfd-yang: YANG Data Model for Bidirectional
        Forwarding Detection.";
}

organization
    "IETF BFD Working Group";

contact
    "WG Web:    <http://tools.ietf.org/wg/bfd>
    WG List:    <bfd@ietf.org>

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description

"This YANG module augments the base BFD YANG model to add

attributes related to BFD Stability. In particular it adds a per session count for BFD packets that are lost.

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This version of this YANG module is part of RFC XXXX (<https://www.rfc-editor.org/info/rfcXXXX>); see the RFC itself for full legal notices.

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](#) ([RFC 2119](#)) ([RFC 8174](#)) when, and only when, they appear in all capitals, as shown here.";

```
revision "2021-04-11" {
  description
    "Initial Version.";
  reference
    "RFC XXXX, BFD Stability.";
}

augment "/rt:routing/rt:control-plane-protocols/" +
  "rt:control-plane-protocol/bfd:bfd/bfd-ip-sh:ip-sh/" +
  "bfd-ip-sh:sessions/bfd-ip-sh:session/" +
  "bfd-ip-sh:session-statistics" {
  leaf lost-packet-count {
    type yang:counter32;
    description
      "Number of BFD packets that were lost without bringing the
      session down.";
  }
}
```



```

    "Augment the 'bfd' container to add attributes related to BFD
    stability.";
}

augment "/rt:routing/rt:control-plane-protocols/" +
    "rt:control-plane-protocol/bfd:bfd/bfd-ip-mh:ip-mh/" +
    "bfd-ip-mh:session-groups/bfd-ip-mh:session-group/" +
    "bfd-ip-mh:sessions/bfd-ip-mh:session-statistics" {
    leaf lost-packet-count {
        type yang:counter32;
        description
            "Number of BFD packets that were lost without bringing the
            session down.";
    }
    description
        "Augment the 'bfd' container to add attributes related to BFD
        stability.";
}

augment "/rt:routing/rt:control-plane-protocols/" +
    "rt:control-plane-protocol/bfd:bfd/bfd-lag:lag/" +
    "bfd-lag:sessions/bfd-lag:session/bfd-lag:member-links/" +
    "bfd-lag:micro-bfd-ipv4/bfd-lag:session-statistics" {
    leaf lost-packet-count {
        type yang:counter32;
        description
            "Number of BFD packets that were lost without bringing the
            session down.";
    }
    description
        "Augment the 'bfd' container to add attributes related to BFD
        stability.";
}

augment "/rt:routing/rt:control-plane-protocols/" +
    "rt:control-plane-protocol/bfd:bfd/bfd-lag:lag/" +
    "bfd-lag:sessions/bfd-lag:session/bfd-lag:member-links/" +
    "bfd-lag:micro-bfd-ipv6/bfd-lag:session-statistics" {
    leaf lost-packet-count {
        type yang:counter32;
        description
            "Number of BFD packets that were lost without bringing the
            session down.";
    }
    description
        "Augment the 'bfd' container to add attributes related to BFD
        stability.";
}

```

```
}

augment "/rt:routing/rt:control-plane-protocols/" +
    "rt:control-plane-protocol/bfd:bfd/bfd-mpls:mpls/" +
    "bfd-mpls:session-groups/bfd-mpls:session-group/" +
    "bfd-mpls:sessions/bfd-mpls:session-statistics" {
  leaf lost-packet-count {
    type yang:counter32;
    description
      "Number of BFD packets that were lost without bringing the
       session down.";
  }
  description
    "Augment the 'bfd' container to add attributes related to BFD
     stability.";
}
}
<CODE ENDS>
```

## [7.](#) IANA Considerations

### [7.1.](#) The "IETF XML" Registry

This document registers one URIs in the "ns" subregistry of the "IETF XML" registry [[RFC3688](#)]. Following the format in [[RFC3688](#)], the following registration is requested:

URI: urn:ietf:params:xml:ns:yang:ietf-bfd-stability  
Registrant Contact: The IESG  
XML: N/A, the requested URI is an XML namespace.

### [7.2.](#) The "YANG Module Names" Registry

This document registers one YANG module in the "YANG Module Names" registry YANG [[RFC6020](#)]. Following the format in YANG [[RFC6020](#)], the following registrations are requested:

name: ietf-bfd-stability  
namespace: urn:ietf:params:xml:ns:yang:ietf-bfd-stability  
prefix: bfds  
reference: RFC XXXX

## [8.](#) Security Consideration

The YANG module specified in this document defines a schema for data that is designed to be accessed via network management protocols such

as NETCONF [[RFC6241](#)] or RESTCONF [[RFC8040](#)]. The lowest NETCONF layer is the secure transport layer, and the mandatory-to-implement secure

transport is Secure Shell (SSH) [[RFC6242](#)]. The lowest RESTCONF layer is HTTPS, and the mandatory-to-implement secure transport is TLS [[RFC8446](#)]. The NETCONF Access Control Model (NACM) [[RFC8341](#)] provides the means to restrict access for particular NETCONF or RESTCONF users to a preconfigured subset of all available NETCONF or RESTCONF protocol operations and content.

The YANG module does not define any writeable/creatable/deletable data nodes.

The only readable data nodes in YANG module may be considered sensitive or vulnerable in some network environments. It is thus important to control read access (e.g., via get, get-config, or notification) to these data nodes. The model does not define any readable subtrees and data nodes.

The YANG module does not define any RPC operations.

## [9.](#) Contributors

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## [10.](#) Acknowledgements

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