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Applicability of Bidirectional Forwarding Detection (BFD) for Multi-point Networks in Virtual Router Redundancy Protocol (VRRP)

Abstract

   This document discusses the applicability of Bidirectional
   Forwarding Detection (BFD) for multipoint networks to provide
   Virtual Router Redundancy Protocol (VRRP) with sub-second Master
   convergence and defines the extension to bootstrap point-to-
   multipoint BFD session.

   This draft updates RFC 5798.

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1. Introduction

The [RFC5798] is the current specification of the Virtual Router
Redundancy Protocol (VRRP) for IPv4 and IPv6 networks. VRRPv3 allows
for a faster switchover to a Backup router. Using such capability
with the software-based implementation of VRRP may prove
challenging. But it still may be possible to deploy VRRP and provide
sub-second detection of Master router failure by Backup routers.

Bidirectional Forwarding Detection (BFD) [RFC5880] had been
originally defined detect failure of point-to-point (p2p) paths:
single-hop [RFC5881], multihop [RFC5883]. Single-hop BFD may be used
to enable Backup routers to detect a failure of the Master router
within 100 msec or faster.

[RFC8562] extends [RFC5880] for multipoint and multicast networks,
which matches the deployment scenarios for VRRP over the LAN
segment. This document demonstrates how point-to-multipoint (p2mp)
BFD can enable faster detection of Master failure and thus minimize
service disruption in a VRRP domain. The document also defines the
extension to VRRP [RFC5798] to bootstrap a VRRP Backup router to
join in p2mp BFD session.

1.1. Conventions used in this document

1.1.1. Terminology

BFD: Bidirectional Forwarding Detection

p2mp: Pont-to-Multipoint

VRRP: Virtual Router Redundancy Protocol

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
BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all
capitals, as shown here.

2. Problem Statement

A router may be part of several Virtual Router Redundancy groups, as
Master in some and as Backup in others. Supporting sub-second mode
for VRRPv3 [RFC5798] for all these roles without specialized support
in the data plane may prove challenging. BFD already has many
implementations based on HW that are capable of supporting multiple
sub-second sessions concurrently.

3. Applicability of p2mp BFD

[RFC8562] may provide an efficient and scalable solution for fast-
converging environment that uses the default route rather than
dynamic routing. Each redundancy group presents itself as a p2mp BFD
session, with its Master being the root and Backup routers being the
tails of the p2mp BFD session. Figure 1 displays the extension of
VRRP [RFC5798] to bootstrap a tail of the p2mp BFD session.

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|Version| Type  | Virtual Rtr ID|   Priority     |Count IPvX Addr|
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|Rsvd |B|    Max Adver Int      |            Checksum           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
+                                                               +
|                        IPvX Address(es)                       |
+                                                               +
+                                                               +
+                                                               +
+                                                               +
|                                                               |
+                                                               +
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                     Master Discriminator                      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
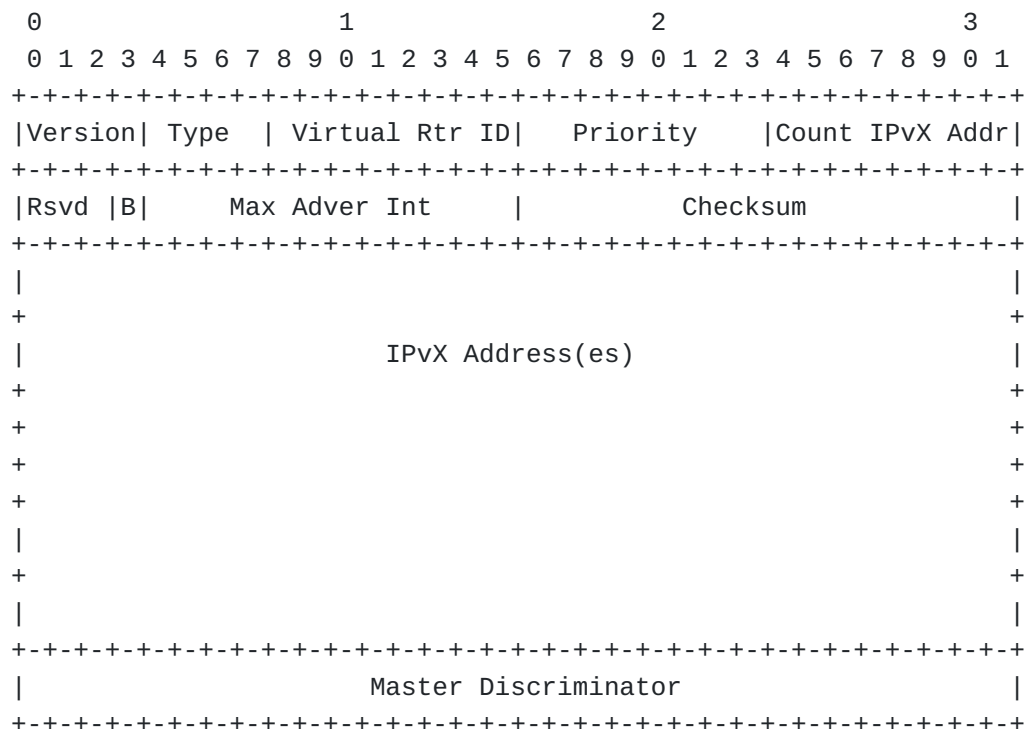
Figure 1: VRRP Extension to Bootstrap P2MP BFD session

   The new fields are interpreted as follows:

      B(FD) - a one-bit flag that indicates that the Master
      Discriminator field is appended to VRRP packet defined in
      [RFC5798];

      Master Discriminator - the four-octet field. The value MUST NOT
      be zero, and it equals the My Discriminator value allocated by
      the root of the p2mp BFD session.

   The Master router, configured to use p2mp BFD to support faster
   convergence of VRRP, starts transmitting BFD control packets with
   VRID as a source IP address and the locally allocated value as the
   value of the My Discriminator field ([RFC5880]). The same non-zero
   value of My Discriminator MUST be set as the value of the Master
   Discriminator field. The BFD flag MUST be set in the VRRP packet. A
   Backup router demultiplexes p2mp BFD test sessions based on VRID
   that it has been configured with and the non-zero My Discriminator
   value it learns from the received VRRP packet. When a Backup router
   detects the failure of the Master router, it re-evaluates its role
   in the VRID. As a result, the Backup router may become the Master
   router of the given VRID or continue as a Backup router. If the
   former is the case, then the new Master router MUST select My
   Discriminator and start transmitting p2mp BFD control packets using
   Master IP address as the source IP address for p2mp BFD control
   packets. If the latter is the case, then the Backup router MUST wait
   for the VRRP packet from the new VRRP Master router that will
   bootstrap the new p2mp BFD session.

3.1. Multipoint BFD Encapsulation

   The MultipointHead of p2mp BFD session when transmitting BFD control
   packet:

      MUST set TTL or Hop Limit value to 255 (Section 5 [RFC5881]).
      Similarly, all received BFD Control packets that are
      demultiplexed to the session MUST be discarded if the received
      TTL or Hop Limit is not equal to 255;

      SHOULD use group address VRRP ('224.0.0.18' for IPv4 and
      'FF02:0:0:0:0:0:0:12' for IPv6) as destination IP address

      MAY use network broadcast address for IPv4 or link-local all
      nodes multicast group for IPv6 as destination IP address;

      MUST set destination UDP port value to 3784 when transmitting BFD
      control packets, as defined in [RFC8562];

MUST use the Master IP address as the source IP address.

4. IANA Considerations

This document makes no requests for IANA allocations. This section
may be deleted by RFC Editor.

5. Security Considerations

This document defines an alternative way, to the one defined in
[RFC5798], to accelerate detecting a failure that affects VRRP
functionality using p2mp BFD. The operation of either protocol is
not changed.

Security considerations discussed in [RFC5798], [RFC5880],
[RFC5881], and [RFC8562], apply to this document.

6. Acknowledgements

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