                       Label Switched Path (LSP) Ping for
          Pseudowire Forwarding Equivalence Classes (FECs) Advertised over IPv6

Abstract

   The Multiprotocol Label Switching (MPLS) Label Switched Path (LSP)
   Ping and traceroute mechanisms are commonly used to detect and
   isolate data-plane failures in all MPLS LSPs, including LSPs used for
   each direction of an MPLS Pseudowire (PW). However, the LSP Ping and
   traceroute elements used for PWs are not specified for IPv6 address
   usage.

   This document extends the PW LSP Ping and traceroute mechanisms so
   they can be used with PWs that are set up and maintained using IPv6
   LDP sessions. This document updates RFC 4379.

Status of This Memo

   This is an Internet Standards Track document.

   This document is a product of the Internet Engineering Task Force
   (IETF). It represents the consensus of the IETF community. It has
   received public review and has been approved for publication by the
   Internet Engineering Steering Group (IESG). Further information on
   Internet Standards is available in Section 2 of RFC 5741.

   Information about the current status of this document, any errata,
   and how to provide feedback on it may be obtained at
   http://www.rfc-editor.org/info/rfc6829.

Copyright Notice

   Copyright (c) 2013 IETF Trust and the persons identified as the
   document authors. All rights reserved.

   This document is subject to BCP 78 and the IETF Trust's Legal
   Provisions Relating to IETF Documents
   (http://trustee.ietf.org/license-info) in effect on the date of
   publication of this document. Please review these documents
   carefully, as they describe your rights and restrictions with respect
   to this document. Code Components extracted from this document must
   include Simplified BSD License text as described in Section 4.e of
   the Trust Legal Provisions and are provided without warranty as
   described in the Simplified BSD License.

Table of Contents

1. Introduction

   Multiprotocol Label Switching (MPLS) Label Switched Path (LSP) Ping
   and traceroute are defined in [RFC4379]. These mechanisms can be
   used to detect data-plane failures in all MPLS LSPs, including
   Pseudowires (PWs). However, the PW LSP Ping and traceroute elements
   are not specified for IPv6 address usage.

   Specifically, the PW Forwarding Equivalence Class (FEC) sub-TLVs for
   the Target FEC Stack in the LSP Ping and traceroute mechanism are
   defined only for IPv4 Provider Edge (PE) routers and are not
   applicable for the case where PEs use IPv6 addresses. Three PW-
   related Target FEC sub-TLVs are currently defined (FEC 128
   Pseudowire-Deprecated, FEC 128 Pseudowire-Current, and FEC 129
   Pseudowire, see Sections 3.2.8 through 3.2.10 of [RFC4379]). These
   sub-TLVs contain the source and destination addresses of the LDP
   session, and currently only an IPv4 LDP session is covered. Despite

the fact that the PE IP address family is not explicit in the sub-TLV
definition, this can be inferred indirectly by examining the lengths
of the Sender's/Remote PE Address fields or calculating the length of
the sub-TLVs (see Section 3.2 of [RFC4379]). When an IPv6 LDP
session is used, these existing sub-TLVs cannot be used since the
addresses will not fit. Additionally, all other sub-TLVs are defined
in pairs, one for IPv4 and another for IPv6, but not the PW sub-TLVs.

This document updates [RFC4379] to explicitly constrain the existing
PW FEC sub-TLVs for IPv4 LDP sessions and extends the PW LSP Ping to
IPv6 LDP sessions (i.e., when IPv6 LDP sessions are used to signal
the PW, the Sender's and Receiver's IP addresses are IPv6 addresses).
This is done by renaming the existing PW sub-TLVs to indicate "IPv4"
and also by defining two new Target FEC sub-TLVs (FEC 128 Pseudowire
IPv6 sub-TLV and FEC 129 Pseudowire IPv6 sub-TLV) to extend the
application of PW LSP Ping and traceroute to IPv6 usage when an IPv6
LDP session [MPLS-LDP] is used to signal the Pseudowire. Note that
FEC 128 Pseudowire (Deprecated) is not defined for IPv6 in this
document.

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].

2. Pseudowire IPv4 Target FEC Stack Sub-TLVs

This document updates Section 3.2 and Sections 3.2.8 through 3.2.10
of [RFC4379] as follows and as indicated in Sections 4 and 6. This
is done to avoid any potential ambiguity and confusion and to clarify
that these TLVs carry only IPv4 addresses. Note that the changes are
limited to the names of fields; there are no semantic changes.

Sections 3.2.8 through 3.2.10 of [RFC4379] list the PW sub-TLVs and
state:

    "FEC 128" Pseudowire (Deprecated)

    "FEC 128" Pseudowire

    "FEC 129" Pseudowire

These names and titles are now changed to:

    "FEC 128" Pseudowire - IPv4 (Deprecated)

    "FEC 128" Pseudowire - IPv4

    "FEC 129" Pseudowire - IPv4

Additionally, when referring to the PE addresses, Sections 3.2.8
through 3.2.10 of [RFC4379] state:

    Sender's PE Address

    Remote PE Address

These are now updated to say:

    Sender's PE IPv4 Address

    Remote PE IPv4 Address

3. Pseudowire IPv6 Target FEC Stack Sub-TLVs

3.1. FEC 128 Pseudowire

    The FEC 128 Pseudowire IPv6 sub-TLV has a structure consistent with
    the FEC 128 Pseudowire sub-TLV as described in Section 3.2.9 of
    [RFC4379]. The encoding of the FEC 128 Pseudowire IPv6 sub-TLV is as
    follows:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|      FEC 128 PW IPv6 Type       |            Length            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
~                  Sender's PE IPv6 Address                      ~
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
~                  Remote PE IPv6 Address                        ~
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                           PW ID                                |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|           PW Type               |         Must Be Zero         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

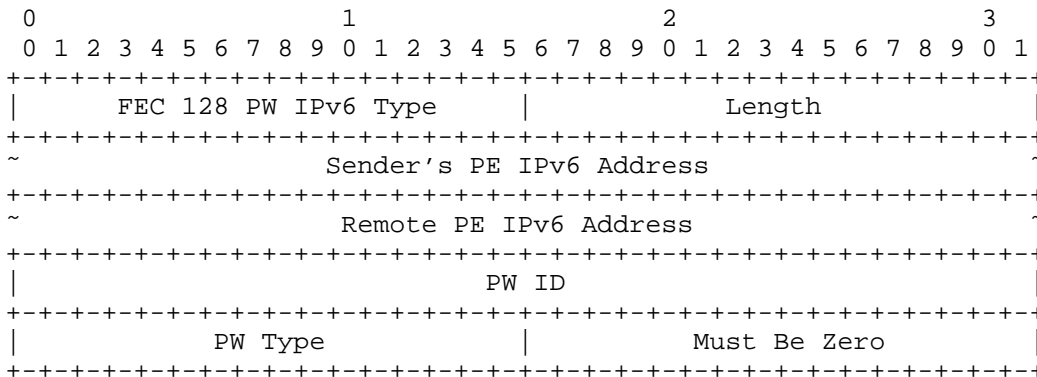   Figure 1: FEC 128 Pseudowire - IPv6

    FEC 128 PW IPv6 Type: 24. 2 octets.

    Length: Defines the length in octets of the value field of the sub-
    TLV and its value is 38. 2 octets.

    Sender's PE IPv6 Address: The source IP address of the target IPv6
    LDP session. 16 octets.

    Remote PE IPv6 Address: The destination IP address of the target IPv6
    LDP session. 16 octets.

   PW ID: Same as FEC 128 Pseudowire IPv4 [RFC4379].

   PW Type: Same as FEC 128 Pseudowire IPv4 [RFC4379].

3.2. FEC 129 Pseudowire

   The FEC 129 Pseudowire IPv6 sub-TLV has a structure consistent with
   the FEC 129 Pseudowire sub-TLV as described in Section 3.2.10 of
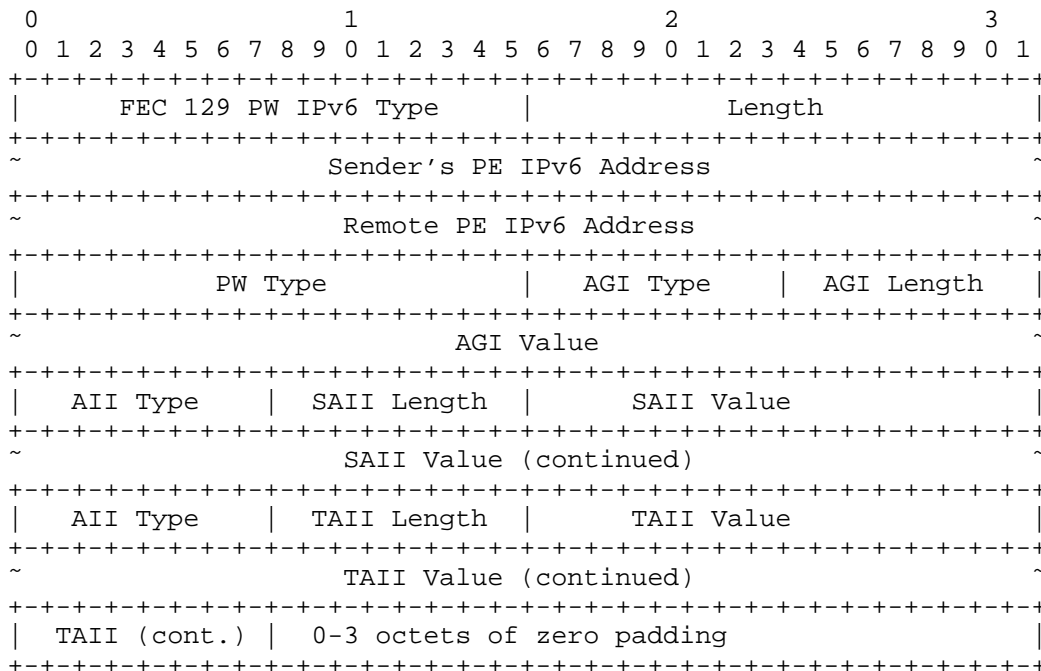   [RFC4379]. The encoding of FEC 129 Pseudowire IPv6 is as follows:

```
    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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |     FEC 129 PW IPv6 Type       |             Length            |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   ~                    Sender's PE IPv6 Address                   ~
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   ~                    Remote PE IPv6 Address                     ~
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |           PW Type              |   AGI Type    |  AGI Length   |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   ~                          AGI Value                            ~
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |   AII Type    |  SAII Length  |          SAII Value           |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   ~                     SAII Value (continued)                    ~
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |   AII Type    |  TAII Length  |          TAII Value           |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   ~                     TAII Value (continued)                    ~
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |  TAII (cont.) |  0-3 octets of zero padding                   |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

                 Figure 2: FEC 129 Pseudowire - IPv6

   FEC 129 PW IPv6 Type: 25. 2 octets.

   Length: Defines the length in octets of the value field of the sub-
   TLV. 2 octets

   The length of this TLV is 40 + AGI (Attachment Group Identifier)
   length + SAII (Source Attachment Individual Identifier) length + TAII
   (Target Attachment Individual Identifier) length. Padding is used to
   make the total length a multiple of 4; the length of the padding is
   not included in the Length field.

Sender's PE IPv6 Address: The source IP address of the target IPv6
LDP session. 16 octets.

Remote PE IPv6 Address: The destination IP address of the target IPv6
LDP session. 16 octets.

The other fields are the same as FEC 129 Pseudowire IPv4 [RFC4379].

4. Summary of Changes

Section 3.2 of [RFC4379] tabulates all the sub-TLVs for the Target
FEC Stack. Per the change described in Sections 2 and 3, the table
would show the following:

```
Sub-Type        Length        Value Field
--------        ------        -----------
   ...
      9            10         "FEC 128" Pseudowire - IPv4 (Deprecated)
     10            14         "FEC 128" Pseudowire - IPv4
     11            16+        "FEC 129" Pseudowire - IPv4
   ...
     24            38         "FEC 128" Pseudowire - IPv6
     25            40+        "FEC 129" Pseudowire - IPv6
```

5. Operation

This document does not define any new procedures. The process
described in [RFC4379] MUST be used.

6. IANA Considerations

IANA has made the following assignments in the "Multi-Protocol Label
Switching (MPLS) Label Switched Paths (LSPs) Ping Parameters"
registry.

The following sub-TLV changes, which comprise three updates and two
additions, are made for the TLV Type 1 "Target FEC Stack" in the
"TLVs and sub-TLVs" sub-registry.

The names of the Value fields of these three Sub-TLVs have been
updated to include the "IPv4" qualifier (see Section 2), and the
Reference has been updated to point to this document:

```
Type        Sub-Type       Value Field
----        --------       -----------
   1            9          "FEC 128" Pseudowire - IPv4 (Deprecated)
   1           10          "FEC 128" Pseudowire - IPv4
   1           11          "FEC 129" Pseudowire - IPv4
```

Two new entries for the Sub-Type field of the Target FEC TLV (see
Section 3) have been created:

```
Type        Sub-Type          Value Field
----        --------          -----------
   1           24             "FEC 128" Pseudowire - IPv6
   1           25             "FEC 129" Pseudowire - IPv6
```

7. Security Considerations

   This document does not introduce any new security issues; the
   security mechanisms defined in [RFC4379] apply here.

8. Acknowledgements

   The authors gratefully acknowledge the review and comments of Vanson
   Lim, Tom Petch, Spike Curtis, Loa Andersson, and Kireeti Kompella.

9. References

9.1. Normative References

   [RFC2119]   Bradner, S., "Key words for use in RFCs to Indicate
                Requirement Levels", BCP 14, RFC 2119, March 1997.

   [RFC4379]   Kompella, K. and G. Swallow, "Detecting Multi-Protocol
                Label Switched (MPLS) Data Plane Failures", RFC 4379,
                February 2006.

9.2. Informative References

   [MPLS-LDP]   Asati, R., Manral, V., Papneja, R., and C. Pignataro,
                "Updates to LDP for IPv6", Work in Progress, June 2012.

Authors' Addresses

   Mach(Guoyi) Chen
   Huawei Technologies Co., Ltd
   No. 3 Xinxi Road, Shang-di, Hai-dian District
   Beijing 100085
   China

   EMail: mach@huawei.com

   Ping Pan
   Infinera
   US

   EMail: ppan@infinera.com

   Carlos Pignataro
   Cisco Systems
   7200-12 Kit Creek Road
   Research Triangle Park, NC 27709
   US

   EMail: cpignata@cisco.com

   Rajiv Asati
   Cisco Systems
   7025-6 Kit Creek Road
   Research Triangle Park, NC 27709
   US

   EMail: rajiva@cisco.com