      UDP Return Path for Packet Loss and Delay Measurement for MPLS Networks

Abstract

   RFC 6374 defines a protocol for Packet Loss and Delay Measurement for
   MPLS networks (MPLS-PLDM). This document specifies the procedures to
   be used when sending and processing out-of-band MPLS performance
   management Responses over an UDP/IP return path.

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 7841.

   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/rfc7876.

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1. Introduction

   This document describes how MPLS-PLDM [RFC6374] out-of-band Responses
   can be delivered to the querier using UDP/IP.

   The use of UDP may be required to support data-path management such
   as passage through firewalls or to provide the necessary multiplexing
   needed in bistatic operation where the querier and the collector are
   not co-located and the collector is gathering the Response
   information for a number of responders. In a highly scaled system,
   some MPLS-PLDM sessions may be off-loaded to a specific node within
   the distributed system that comprises the Label Switching Router
   (LSR) as a whole. In such systems, the Response may arrive via any
   interface in the LSR and needs to be forwarded internally to the
   processor tasked with handling the particular MPLS-PLDM measurement.
   Currently, the MPLS-PLDM protocol does not have any mechanism to
   deliver the PLDM Response message to a particular node within a
   multi-CPU LSR.

   The procedure described in this specification describes how the
   querier requests delivery of the MPLS-PLDM Response over IP to a
   dynamic UDP port. It makes no other changes to the protocol and thus
   does not affect the case where the Response is delivered over an MPLS
   Associated Channel [RFC5586].

2. Requirements Language

   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 [RFC2119].

3. Solution Overview

   This document specifies that, unless configured otherwise, if a UDP
   Return Object (URO) is present in an MPLS-PLDM Query, the responder
   SHOULD use the IP address and UDP port in the URO to reply back to
   the querier. The querier MAY include multiple UROs in an MPLS-PLDM
   Query indicating to the responder that an identical Response SHOULD
   be sent to each address-port pair. A responder MAY be designed or
   configured to only transmit a single Response, in which case the
   Response MUST be sent using the parameters specified in the first URO
   in the Query packet that it is able to use (see Section 4.3).

   The procedures defined in this document may be applied to both
   unidirectional and bidirectional Label Switched Paths (LSPs). In
   this document, the term "bidirectional LSP" includes the co-routed
   bidirectional LSP defined in [RFC3945] and the associated
   bidirectional LSP that is constructed from a pair of unidirectional

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LSPs (one for each direction) that are associated with one another at
the LSP's ingress/egress points [RFC5654]. The mechanisms defined in
this document can apply to both IP/MPLS and to the MPLS Transport
Profile (MPLS-TP) [RFC5654] [RFC5921].

3.1. UDP Return Object

The format of the UDP Return Object (URO) 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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   | URO Type      | Length={6,18} |    UDP-Destination-Port       |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   ~                            Address                            ~
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
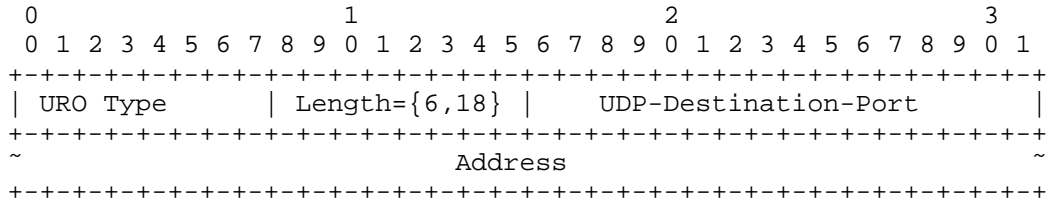
The Type and Length fields are each 8 bits long. The Length field
indicates the size in bytes of the remainder of the object (i.e., it
is the size of the address in bytes plus 2). When the address is
IPv4, the Length field is thus 6; when the address is IPv6, the
Length field is thus 18. The Length field therefore acts as both the
TLV parsing parameter and the address family type indicator.

The UDP Return Object Type (URO Type) has a value of 131.

The UDP-Destination-Port is a UDP destination port as specified in
[RFC768].

The Address is either an IPv4 or an IPv6 address.

The URO MUST NOT appear in a Response and MUST be ignored if it is
found to be present.

To prevent any ambiguity as to which address the responder needs to
reply to, an MPLS-PLDM Query message containing a URO MUST NOT
include an RFC 6374 Return Address TLV (TLV 1). Additionally, the
method of constructing the return address from the Source Address TLV
(TLV 130) described in Section 3.5.2 of [RFC6374] MUST NOT be used to
construct a Response to a Query message that contains a URO.

4. Theory of Operation

   This document defines the UDP Return Object to enable the MPLS-PLDM
   querier to specify the return path for the MPLS-PLDM reply using UDP/
   IP encapsulation.

   When the MPLS-PLDM Response is requested out-of-band by setting the
   Control Code of the MPLS-PLDM Query to "Out-of-band Response
   Requested", and the URO is present, the responder SHOULD send the
   Response back to querier on the specified destination UDP port at the
   specified destination IP address contained in the URO.

   If the URO is expected but is not present in a Query message and an
   MPLS-PLDM Response is requested out-of-band, the Query message MUST
   NOT be processed further, and if possible, an "Error - Invalid
   Message" ([RFC6374], Section 3.1) SHOULD be sent to the querier and
   the operator notified via the management system (see Section 4.2 for
   further details).

4.1. Sending an MPLS-PLDM Query

   When sending an MPLS-PLDM Query message, in addition to the rules and
   procedures defined in [RFC6374], the Control Code of the MPLS-PLDM
   Query MUST be set to "Out-of-band Response Requested", and a URO MUST
   be carried in the MPLS-PLDM Query message.

   If the querier uses the UDP port to de-multiplex the Response for a
   different measurement type, there MUST be a different UDP port for
   each measurement type (delay, loss, and delay-loss combined).

   An implementation MAY use multiple UDP ports for the same measurement
   type to direct the Response to the correct management process in the
   LSR.

4.2. Receiving an MPLS-PLDM Query Request

   The processing of MPLS-PLDM Query messages as defined in [RFC6374]
   applies in this document. In addition, when an MPLS-PLDM Query
   message is received, with the Control Code of the MPLS-PLDM Query set
   to "Out-of-band Response Requested" with a URO present, then the
   responder SHOULD use that IP address and UDP port to send an MPLS-
   PLDM Response back to the querier.

   If an out-of-band Response is requested and the URO is missing, the
   Query SHOULD be dropped in the case of a unidirectional LSP. If the
   TLV is missing on a bidirectional LSP, the Control Code of the
   Response message SHOULD set to 0x1C indicating "Error - Invalid
   Message" ([RFC6374], Section 3.1), and the Response SHOULD be sent

over the reverse LSP. The receipt of such a malformed request SHOULD
be reported to the operator through the management system, with
normal precautions taken in respect to the prevention of overload of
the error-reporting system.

4.3. Sending an MPLS-PLDM Response

As specified in [RFC6374], the MPLS-PLDM Response can be sent either
over the reverse MPLS LSP for a bidirectional LSP or over an IP path.
It MUST NOT be sent other than in Response to an MPLS-PLDM Query
message.

When the requested return path is an IP forwarding path and this
method is in use, the destination IP address and UDP port are copied
from the URO. The source IP address and the source UDP port of the
Response packet are left to the discretion of the responder, subject
to the normal management and security considerations. If the querier
has included URO(s) for only one IP address family and a return path
of that type is not available, then the Query message MUST be
discarded, and the operator SHOULD be informed of the error through
the management system using the normal rate-limited approach. If the
responder is configured to only respond with a single Response, and a
path using the IP address family in the first URO is not available,
the responder MAY search the UROs for the first URO specifying a
return address family for which it does have a path and use the
parameters in that URO to respond. If the responder is designed or
configured not to search for a URO that it can respond to, then the
operator SHOULD be informed of the error through the management
system using the normal rate-limited approach.

The packet format for the MPLS-PLDM Response after the UDP header is
as specified in [RFC6374]. As shown in Figure 1, the Associated
Channel Header (ACH) [RFC5586] is not included. The information
provided by the ACH is not needed since the correct binding between
the Query and Response messages is achieved through the UDP port and
the session identifier contained in the RFC 6374 message.

```
+------------------------------------------------------------+
|  IP Header                                                 |
.     Source Address = Responders IP Address                 |
.     Destination Address = URO.Address                      |
.     Protocol = UDP                                         .
.                                                            .
+------------------------------------------------------------+
| UDP Header                                                 |
.    Source Port = As chosen by Responder                    .
.    Destination Port = URO.UDP-Destination-Port             .
.                                                            .
+------------------------------------------------------------+
| Message as specified in RFC 6374                           |
.                                                            .
+------------------------------------------------------------+
```
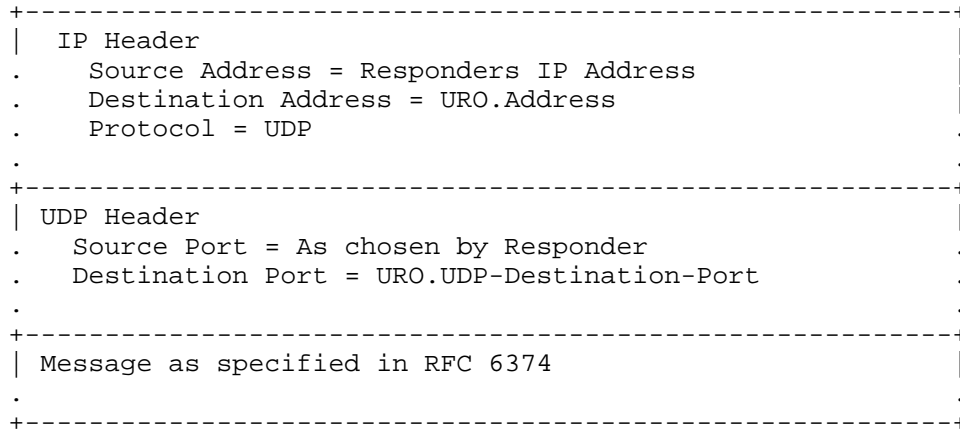
                   Figure 1: Response Packet Format

   If the return path is an IP path, only one-way delay or one-way loss
   measurement can be carried out. In this case, timestamps 3 and 4
   MUST be zero as specified in [RFC6374].

4.4. Receiving an MPLS-PLDM Response

   If the Response was received over UDP/IP and an out-of-band Response
   was expected, the Response message SHOULD be directed to the
   appropriate measurement process as determined by the destination UDP
   port and processed using the corresponding measurement type procedure
   specified in [RFC6374].

   If the Response was received over UDP/IP and an out-of-band Response
   was not requested, that Response SHOULD be dropped, and the event
   SHOULD be reported to the operator through the management system,
   with normal precautions taken in respect to the prevention of
   overload of the error-reporting system.

5. Congestion Considerations

   This protocol MUST be run in accordance with the guidance provided in
   [RFC5405]. As advised in Section 3.1.2 of RFC 5405, operators that
   wish to run this protocol at rates in excess of one packet per three
   seconds need to ensure that the MPLS path being monitored and any IP
   path that may be used to carry the Response are provisioned such that
   there is a negligible chance of this protocol causing congestion.
   Additionally, if a significant number of Response packets are lost,
   the querier MUST reduce the sending rate to a point where there is a
   negligible chance that this protocol is contributing to network
   congestion. The operator should also take precautions that Response

packets do not leak out of the network domain being used and cause
congestion elsewhere. If a default IP address is configured by the
equipment vendor, this MUST be an address known to contain the
Response packet within the responder. A responder receiving a Query
specifying this as a return address, and not being configured to
expect such a return address, SHOULD notify the operator in a
suitably rate-limited manner.

6. Manageability Considerations

   The manageability considerations described in Section 7 of [RFC6374]
   are applicable to this specification. Additional manageability
   considerations are noted within the elements of procedure in this
   document.

   Nothing in this document precludes the use of a configured UDP/IP
   return path in a deployment in which configuration is preferred to
   signaling. In these circumstances, the URO MAY be omitted from the
   MPLS-PLDM messages.

7. Security Considerations

   The MPLS-PLDM system is not intended to be deployed on the public
   Internet. It is intended for deployment in well-managed private and
   service provider networks. The security considerations described in
   Section 8 of [RFC6374] are applicable to this specification, and
   particular attention should be paid to the last two paragraphs.
   Cryptographic measures may be enhanced by the correct configuration
   of access-control lists and firewalls.

   To prevent the use of this protocol as a reflection attack vector,
   the operator should ensure that the IP address in the URO addresses a
   system that is expecting to act as a receiver of PLDM Responses.

   There is no additional exposure of information to pervasive
   monitoring systems observing LSPs that are being monitored.

8. IANA Considerations

   IANA has assigned a new optional TLV type from the "MPLS Loss/Delay
   Measurement TLV Object" registry contained within the "Generic
   Associated Channel (G-ACh) Parameters" registry set:

      Code   Description   Reference
       131   UDP Return   [RFC7876]

9. References

9.1. Normative References

   [RFC768]   Postel, J., "User Datagram Protocol", STD 6, RFC 768,
               DOI 10.17487/RFC0768, August 1980,
               <http://www.rfc-editor.org/info/rfc768>.

   [RFC2119]   Bradner, S., "Key words for use in RFCs to Indicate
               Requirement Levels", BCP 14, RFC 2119,
               DOI 10.17487/RFC2119, March 1997,
               <http://www.rfc-editor.org/info/rfc2119>.

   [RFC3945]   Mannie, E., Ed., "Generalized Multi-Protocol Label
               Switching (GMPLS) Architecture", RFC 3945,
               DOI 10.17487/RFC3945, October 2004,
               <http://www.rfc-editor.org/info/rfc3945>.

   [RFC5405]   Eggert, L. and G. Fairhurst, "Unicast UDP Usage Guidelines
               for Application Designers", BCP 145, RFC 5405,
               DOI 10.17487/RFC5405, November 2008,
               <http://www.rfc-editor.org/info/rfc5405>.

   [RFC5586]   Bocci, M., Ed., Vigoureux, M., Ed., and S. Bryant, Ed.,
               "MPLS Generic Associated Channel", RFC 5586,
               DOI 10.17487/RFC5586, June 2009,
               <http://www.rfc-editor.org/info/rfc5586>.

   [RFC5654]   Niven-Jenkins, B., Ed., Brungard, D., Ed., Betts, M., Ed.,
               Sprecher, N., and S. Ueno, "Requirements of an MPLS
               Transport Profile", RFC 5654, DOI 10.17487/RFC5654,
               September 2009, <http://www.rfc-editor.org/info/rfc5654>.

   [RFC6374]   Frost, D. and S. Bryant, "Packet Loss and Delay
               Measurement for MPLS Networks", RFC 6374,
               DOI 10.17487/RFC6374, September 2011,
               <http://www.rfc-editor.org/info/rfc6374>.

9.2. Informative References

   [RFC5921]   Bocci, M., Ed., Bryant, S., Ed., Frost, D., Ed., Levrau,
               L., and L. Berger, "A Framework for MPLS in Transport
               Networks", RFC 5921, DOI 10.17487/RFC5921, July 2010,
               <http://www.rfc-editor.org/info/rfc5921>.

Acknowledgements

Authors' Addresses

   Stewart Bryant
   Independent

   Email: stewart.bryant@gmail.com

   Siva Sivabalan
   Cisco Systems

   Email: msiva@cisco.com

   Sagar Soni
   Cisco Systems

   Email: sagsoni@cisco.com