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Using LDP Multipoint Extensions on Targeted LDP Sessions

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Abstract

Label Distribution Protocol (LDP) can be used to set up Point-to-Multipoint (P2MP) and Multipoint-to-Multipoint (MP2MP) Label Switched Paths. The existing specification for this functionality assumes that a pair of LDP neighbors are directly connected. However, the LDP base specification allows for the case where a pair of LDP neighbors are not directly connected; the LDP session between such a pair of neighbors is known as a "Targeted LDP" session. This document specifies the use of the LDP P2MP/MP2MP extensions over a Targeted LDP session.

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1. Introduction

1.1. Specification of requirements

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].

1.2. Targeted mLDP

The Label Distribution Protocol (LDP) extensions for setting up Point-to-MultiPoint (P2MP) Label Switched Paths (LSPs) and Multipoint-to-Multipoint (MP2MP) LSPs are specified in [mLDP]. This set of extensions is generally known as "Multipoint LDP" (mLDP).

A pair of Label Switched Routers (LSRs) that are the endpoints of an LDP session are considered to be "LDP neighbors". When a pair of LDP neighbors are "directly connected" (e.g., they are connected by a layer 2 medium, or are otherwise considered to be neighbors by the a network's interior routing protocol), the LDP session is said to be a "directly connected" LDP session. When the pair of LDP neighbors are not directly connected, the session between them is said to be a "Targeted" LDP session.

The base specification for mLDP does not explicitly cover the case where the LDP multipoint extensions are used over a targeted LDP session. This document provides that specification.

We will use the term "Multipoint" to mean "either P2MP or MP2MP".

1.3. Targeted mLDP and the Upstream LSR

1.3.1. Selecting the Upstream LSR

In mLDP, a multipoint LSP (MP-LSP) has a unique identifier that is an ordered pair of the form <root, opaque value>. The first element of the ordered pair is the IP address of the MP-LSP's "root node". The second element of the ordered pair is an identifier that is unique in the context of the root node.

If LSR D is setting up the MP-LSP <R, X>, D must determine the "upstream LSR" for <R, X>. In [mLDP], the upstream LSR for <R, X>, U, is defined to be the "next hop" on D's path to R, and "next hop" is tacitly assumed to mean "IGP next hop". It is thus assumed that there is a direct LDP session between D and U. In this specification, we extend the notion of "upstream LSR" to cover the

following cases:

- U is the "BGP next hop" on D's path to R, where U and D are not IGP neighbors, and where there is a Targeted LDP session between U and D. In this case, we allow D to select U as the "upstream LSR" for <R,X>.

- If the "next hop interface" on D's path to R is an RSVP-TE P2P tunnel whose remote endpoint is U, and if there is known to be an RSVP-TE P2P tunnel from U to D, and if there is a Targeted LDP session between U and D, then we allow D to select U as the "upstream LSR" for <R,X>. This is useful when D and U are part of a network area that is fully meshed via RSVP-TE P2P tunnels.

The particular method used to select an "upstream LSR" is determined by the SP. Other methods than the ones above MAY be used.

1.3.2. Sending data from U to D

By using Targeted mLDP, we can construct an MP-LSP <R,X> containing an LSR U, where U has one or more downstream LSR neighbors (D1, ..., Dn) to which it is not directly connected. In order for a data packet to travel along this MP-LSP, U must have some way of transmitting the packet to D1, ..., Dn. We will cover two methods of transmission:

- Unicast Replication.

  In this method, U creates n copies of the packet, and unicasts each copy to exactly one of D1, ..., Dn.

- Multicast tunneling.

  In this method, U becomes the root node of a multicast tunnel, with D1, ..., Dn as leaf nodes. When a packet traveling along the MP-LSP <R,X> arrives at U, U transmits it through the multicast tunnel, and as a result it arrives at D1, ..., Dn.

  When this method is used, it may be desirable to carry traffic of multiple MP-LSPs through a single multicast tunnel. We specify procedures that allow for the proper demultiplexing of the MP-LSPs at the leaf nodes of the multicast tunnel. We do not assume that all the leaf nodes of the tunnel are on all the MP-LSPs traveling through the tunnel; thus some of the tunnel leaf nodes may need to discard some of the packets received through the tunnel. For example, suppose MP-LSP <R1,X1> contains node U with downstream LSRs D1 and D2, while MP-LSP <R2,X2> contains node U

with downstream LSRs D2 and D3. Suppose also that there is a multicast tunnel with U as root and with D1, D2, and D3 as leaf nodes. U can aggregate both MP-LSPs in this one tunnel. However, D1 will have to discard packets that are traveling on <R2,X1>, while D3 will have to discard packets that are traveling on <R1,X2>.

1.4. Applicability of Targeted mLDP

When LSR D is setting up MP-LSP <R,X>, it MUST NOT use targeted mLDP unless D can select the "upstream LSR" for <R,X> using one of the procedures discussed in section 1.3.1.

Whether D uses Targeted mLDP when this condition holds is determined by provisioning, or by other methods that are outside the scope of this specification.

When Targeted mLDP is used, the choice between unicast replication and multicast tunneling is determined by provisioning, or by other methods that are outside the scope of this specification.

1.5. LDP Capabilities

Per [mLDP], any LSR that needs to set up an MP-LSP must support the procedures of [LDP-CAP], and in particular must send and receive the P2MP Capability and/or the MP2MP Capability. This specification does not define any new capabilities; the advertisement of the P2MP and/or MP2MP Capabilities on a Targeted LDP session means that the advertising LSR is capable of following the procedures of this document.

Some of the procedures of this document require the use of upstream-assigned labels [LDP-UP]. In order to use upstream-assigned labels as part of Targeted mLDP, an LSR must advertise the LDP Upstream-Assigned Label Capability [LDP-UP] on the Targeted LDP session.

2. Targeted mLDP with Unicast Replication

When unicast replication is used, the mLDP procedures are exactly the same as described in [mLDP], with the following exception. If LSR D is setting up MP-LSP <R,X>, its "upstream LSR" is selected according to the procedures of section 1.3.1, and is not necessarily the "IGP next hop" on D's path to R.

Suppose that LSRs D1 and D2 are both setting up the P2MP MP-LSP

<R,X>, and that LSR U is the upstream LSR on each of their paths to R. D1 and D2 each binds a label to <R,X>, and each uses a label mapping message to inform U of the label binding. Suppose D1 has assigned label L1 to <R,X> and D2 has assigned label L2 to <R,X>. (Note that L1 and L2 could have the same value or different values; D1 and D2 do not coordinate their label assignments.) When U has a packet to transmit on the MP-LSP <R,X>, it makes a copy of the packet, pushes on label L1, and unicasts the resulting packet to D1. It also makes a second copy of the packet, pushes on label L2, and then unicasts the resulting packet to D2.

This procedure also works when the MP-LSP <R,X> is a MP2MP LSP. Suppose that in addition to labels L1 and L2 described above, U has assigned label L3 for <R,X> traffic received from D1, and label L4 for <R,X> traffic received from D2. When U processes a packet with label L3 at the top of its label stack, it knows the packet is from D1, so U sends a unicast copy of the packet to D2, after swapping L3 for L2. U does not send a copy back to D1.

Note that all labels used in this procedure are downstream-assigned labels.

The method of unicast is a local matter, outside the scope of this specification. The only requirement is that D1 will receive the copy of the packet carrying label L1, and that D1 will process the packet by looking up label L1. (And similarly, D2 must receive the copy of the packet carrying label L2, and must process the packet by looking up label L2.)

Note that if the method of unicast is MPLS, U will need to push another label on each copy of the packet before transmitting it. This label needs to ensure that delivery of the packet to the appropriate LSR, D1 or D2. Use of penultimate-hop popping for that label is perfectly legitimate.

3. Targeted mLDP with Multicast Tunneling

Suppose that LSRs D1 and D2 are both setting up MP-LSP <R,X>, and that LSR U is the upstream LSR on each of their paths to R. Since multicast tunneling is being used, when U has a packet to send on this MP-LSP, it does not necessarily send two copies, one to D1 and one to D2. It may send only one copy of the packet, which will get replicated somewhere downstream in the multicast tunnel. Therefore, the label that gets bound to the MP-LSP must be an upstream-assigned label, assigned by U. This requires a change from the procedures of [mLDP]. D1 and D2 do not send label mapping messages to U; instead they send label request messages to U, asking U to assign a label to

the MP-LSP <R,X>. U responds with a label mapping message containing an upstream-assigned label, L (using the procedures specified in [LDP-UP]). As part of the same label mapping message, U also sends an Interface TLV (as specified in [LDP-UP]) identifying the multicast tunnel in which data on the MP-LSP will be carried. When U transmits a packet on this tunnel, it first pushes on the upstream-assigned label L, and then pushes on the label that corresponds to the multicast tunnel.

If the numerical value L of the upstream-assigned label is the value 3, defined in [LDP] and [RFC3032] as "Implicit NULL", then the specified multicast tunnel will carry only the specified MP-LSP. That is, aggregation of multiple MP-LSPs into a single multicast tunnel is not being done. In this case, no upstream-assigned label is pushed onto a packet that is transmitted through the multicast tunnel.

Various types of multicast tunnel may be used. The choice of tunnel type is determined by provisioning, or by some other method that is outside the scope of this document. [LDP-UP] specifies encodings allowing U to identify an mLDP MP-LSP, and RSVP-TE P2MP LSP, as well as other types of multicast tunnel.

This document does not specify procedures for tunneling one or more MP2MP LSPs through P2MP tunnels. While it is possible to do this, it is highly RECOMMENDED that MP2MP LSPs be tunneled through MP2MP LSPs (unless, of course, unicast replication is being used).

If the multicast tunnel is an mLDP MP-LSP or an RSVP-TE P2MP LSP, when U transmits a packet on the MP-LSP <R,X>, the upstream-assigned label L will be the second label in the label stack. Penultimate-hop popping MUST NOT be done, because the top label provides the context in which the second label is to be interpreted. See [RFC5331].

When LSR U uses these procedures to inform LSR D that a particular MP-LSP is being carried in a particular multicast tunnel, U and D MUST take appropriate steps to ensure that packets U sends into this tunnel will be received by D. The exact steps to take depend on the tunnel type. As long as U is D's upstream LSR for any MP-LSP that has been assigned to this tunnel, D must remain joined to the tunnel.

Note that U MAY assign the same multicast tunnel for multiple different MP-LSPs. However, U MUST assign a distinct upstream-assigned label to each MP-LSP. This allows the packets traveling through the tunnel to be demultiplexed into the proper MP-LSPs.

If U has an MP-LSP <R1,X1> with downstream LSRs D1 and D2, and an MP-LSP <R2,X2> with downstream LSRs D2 and D3, U may assign both MP-LSPs

to the same multicast tunnel. In this case, D3 will receive packets traveling on <R1,X1>. However, the upstream-assigned label carried by those packets will not be recognized by D3, hence D3 will discard those packets. Similarly, D1 will discard the <R2,X2> packets.

This document does not specify any rules for deciding whether to aggregate two or more MP-LSPs into a single multicast tunnel. Such rules are outside the scope of this document.

Except for the procedures explicitly detailed in this document, the procedures of [mLDP] and [LDP-UP] apply unchanged.

4. IANA Considerations

This document has no considerations for IANA.

5. Security Considerations

This document raises no new security considerations beyond those discussed in [LDP], [LDP-UP], and [RFC5331].

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8. Normative References

[LDP] Loa Andersson, Ina Minei, Bob Thomas, editors, "LDP Specification", RFC 5036, October 2007

[LDP-CAP] Bob Thomas, Kamran Raza, Shivani Aggarwal, Rahul Aggarwal, Jean-Louis Le Roux, "LDP Capabilities", RFC 5561, July 2009

[mLDP] IJsbrand Wijnands, Ina Minei, Kireeti Kompella, Bob Thomas, "Label Distribution Protocol Extensions for Point-to-Multipoint and Multipoint-to-Multipoint Label Switched Paths", RFC 6388, November 2011

[LDP-UP] Rahul Aggarwal, Jean-Louis Le Roux, "MPLS Upstream Label Assignment for LDP", RFC 6389, November 2011

[RFC2119] "Key words for use in RFCs to Indicate Requirement Levels.", Bradner, March 1997

[RFC3032] Eric Rosen, et. al., "MPLS Label Stack Encoding", RFC 3032, January 2001

[RFC5331] Rahul Aggarwal, Yakov Rekhter, Eric Rosen, "MPLS Upstream Label Assignment and Context-Specific Label Space", RFC 5331, August 2009