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Signalling Unnumbered Links in CR-LDP (Constraint-Routing Label Distribution Protocol)

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Abstract

Current signalling used by Multi-Protocol Label Switching Traffic Engineering (MPLS TE) does not provide support for unnumbered links. This document defines procedures and extensions to Constraint-Routing Label Distribution Protocol (CR-LDP), one of the MPLS TE signalling protocols that are needed in order to support unnumbered links.

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 BCP 14, RFC 2119 [RFC2119].

1. Overview

Supporting MPLS TE over unnumbered links (i.e., links that do not have IP addresses) involves two components: (a) the ability to carry (TE) information about unnumbered links in IGP TE extensions (ISIS or OSPF), and (b) the ability to specify unnumbered links in MPLS TE signalling. The former is covered in [GMPLS-ISIS, GMPLS-OSPF]. The focus of this document is on the latter.

Current signalling used by MPLS TE does not provide support for unnumbered links because the current signalling does not provide a way to indicate an unnumbered link in its Explicit Route Objects. This document proposes simple procedures and extensions that allow CR-LDP signalling [CR-LDP] to be used with unnumbered links.

2. Link Identifiers

An unnumbered link has to be a point-to-point link. An LSR at each end of an unnumbered link assigns an identifier to that link. This identifier is a non-zero 32-bit number that is unique within the scope of the LSR that assigns it. If one is using OSPF or ISIS as the IGP in support of traffic engineering, then the IS-IS and/or OSPF and CR-LDP modules on an LSR must agree on the identifiers.

There is no a priori relationship between the identifiers assigned to a link by the LSRs at each end of that link.

LSRs at the two end points of an unnumbered link exchange with each other the identifiers they assign to the link. Exchanging the identifiers may be accomplished by configuration, by means of a protocol such as LMP ([LMP]), by means of CR-LDP (especially in the case where a link is a Forwarding Adjacency, see below), or by means of IS-IS or OSPF extensions ([ISIS-GMPLS], [OSPF-GMPLS]).

Consider an (unnumbered) link between LSRs A and B. LSR A chooses an identifier for that link. So does LSR B. From A's perspective, we refer to the identifier that A assigned to the link as the "link local identifier" (or just "local identifier"), and to the identifier that B assigned to the link as the "link remote identifier" (or just "remote identifier"). Likewise, from B's perspective, the identifier that B assigned to the link is the local identifier, and the identifier that A assigned to the link is the remote identifier.

In the context of this document, the term "Router ID" means a stable IP address of an LSR that is always reachable if there is any connectivity to the LSR. This is typically implemented as a "loopback address"; the key attribute is that the address does not become unusable if an interface on the LSR is down. In some cases, this value will need to be configured. If one is using OSPF or ISIS as the IGP in support of traffic engineering, then it is RECOMMENDED for the Router ID to be set to the "Router Address" as defined in [OSPF-TE], or "Traffic Engineering Router ID" as defined in [ISIS-TE].

This section is equally applicable to the case of unnumbered component links (see [LINK-BUNDLE]).

3. Unnumbered Forwarding Adjacencies

If an LSR that originates an LSP advertises this LSP as an unnumbered Forwarding Adjacency in IS-IS or OSPF (see [LSP-HIER]), or the LSR uses the Forwarding Adjacency formed by this LSP as an unnumbered component link of a bundled link (see [LINK-BUNDLE]), the LSR MUST allocate an identifier to that Forwarding Adjacency (just like for any other unnumbered link). Moreover, the REQUEST message used for establishing the LSP that forms the Forwarding Adjacency MUST contain an LSP_TUNNEL_INTERFACE_ID TLV (described below), with the LSR's Router ID set to the head end's Router ID, and the Interface ID set to the identifier that the LSR allocated to the Forwarding Adjacency.

If the REQUEST message contains the LSP_TUNNEL_INTERFACE_ID TLV, then the tail-end LSR MUST allocate an identifier to that Forwarding Adjacency (just like for any other unnumbered link). Furthermore, the MAPPING message for the LSP MUST contain an LSP_TUNNEL_INTERFACE_ID TLV, with the LSR's Router ID set to the tail-end's Router ID, and the Interface ID set to the identifier allocated by the tail-end LSR.

For the purpose of processing the Explicit Route TLV and the Interface ID TLV, an unnumbered Forwarding Adjacency is treated as an unnumbered (TE) link or an unnumbered component link as follows. The LSR that originates the Adjacency sets the link local identifier for that link to the value that the LSR allocates to that Forwarding Adjacency, and the link remote identifier to the value carried in the Interface ID field of the Reverse Interface ID TLV (for the definition of Reverse Interface ID TLV see below). The LSR that is a tail-end of that Forwarding Adjacency sets the link local identifier for that link to the value that the LSR allocates to that Forwarding Adjacency, and the link remote identifier to the value carried in the Interface ID field of the Forward Interface ID TLV (for the definition of Forward Interface ID see below).

3.1. LSP_TUNNEL_INTERFACE_ID TLV

The LSP_TUNNEL_INTERFACE ID TLV has Type 0x0836 and length 8. The format is given below.

Figure 1: LSP_TUNNEL_INTERFACE_ID TLV

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|0|0|            Type           |            Length             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                        LSR's Router ID                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                    Interface ID (32 bits)                     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

This TLV can optionally appear in either a REQUEST message or a MAPPING message. In the former case, we call it the "Forward Interface ID" for that LSP; in the latter case, we call it the "Reverse Interface ID" for the LSP.

4. Signalling Unnumbered Links in Explicit Route TLV

A new Type of ER-Hop TLV of the Explicit Route TLV is used to specify unnumbered links. This Type is called Unnumbered Interface ID, and has the following format:

The Type is 0x0837, and the Length is 12. The L bit is set to indicate a loose hop, and cleared to indicate a strict hop.

The Interface ID is the identifier assigned to the link by the LSR specified by the router ID.

Figure 2: Unnumbered Interface ID

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|0|0|          Type             |            Length = 12        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|L|                          Reserved                           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                           Router ID                           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                     Interface ID (32 bits)                    |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

4.1. Processing the IF_ID TLV

When an LSR receives a REQUEST message containing the IF_ID (Interface ID) TLV (see [GMPLS-CRLDP]) with the IF_INDEX TLV, the LSR processes this TLV as follows. The LSR must have information about the identifiers assigned by its neighbors to the unnumbered links between the neighbors and the LSR. The LSR uses this information to find a link with tuple <Router ID, local identifier> matching the tuple <IP Address, Interface ID> carried in the IF_INDEX TLV. If the matching tuple is found, the match identifies the link for which the LSR has to perform label allocation.

Otherwise, the LSR SHOULD return an error.

4.2. Processing the Unnumbered Interface ID ER-Hop TLV

The Unnumbered Interface ID ER-Hop is defined to be a part of a particular abstract node if that node has the Router ID that is equal to the Router ID field in the Unnumbered Interface ID ER-Hop, and if the node has an (unnumbered) link or an (unnumbered) Forwarding Adjacency whose local identifier (from that node's point of view) is equal to the value carried in the Interface ID field of the Unnumbered Interface ID ER-Hop.

With this in mind, the Explicit Route TLV processing in the presence of the Unnumbered Interface ID ER-Hop follows the rules specified in section 4.8.1 of [CR-LDP].

As part of the Explicit Route TLV processing, or to be more precise, as part of the next hop selection, if the outgoing link is unnumbered, the REQUEST message that the node sends to the next hop MUST include the IF_ID TLV, with the IP address field of that TLV set to the Router ID of the node, and the Interface ID field of that TLV set to the identifier assigned to the link by the node.

5. IANA Considerations

RFC 3036 [LDP] defines the LDP TLV name space. RFC 3212 [CD-LDP] further subdivides the range of that TLV space for TLVs associated with the CR-LDP in the range 0x0800 - 0x08FF, and defines the rules for the assignment of TLVs within that range using the terminology of BCP 26, RFC 2434, "Guidelines for Writing an IANA Considerations Section in RFCs". Those rules apply to the assignment of TLV Types for the Unnumbered Interface ID and LSP_TUNNEL_INTERFACE_ID TLVs defined in this document.

6. Security Considerations

This document extends CR-LDP and raises no new security issues. CR-LDP inherits the same security mechanism described in Section 4.0 of [LDP] to protect against the introduction of spoofed TCP segments into LDP session connection streams.

7. Acknowledgments

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8. References

8.1. Normative References

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