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Advertising a Router's Local Addresses in OSPF Traffic Engineering (TE) Extensions

Abstract

OSPF Traffic Engineering (TE) extensions are used to advertise TE Link State Advertisements (LSAs) containing information about TE-enabled links. The only addresses belonging to a router that are advertised in TE LSAs are the local addresses corresponding to TE-enabled links, and the local address corresponding to the Router ID.

In order to allow other routers in a network to compute Multiprotocol Label Switching (MPLS) Traffic Engineered Label Switched Paths (TE LSPs) to a given router's local addresses, those addresses must also be advertised by OSPF TE.

This document describes procedures that enhance OSPF TE to advertise a router's local addresses.

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1. Introduction

1.1. Motivation

In some cases, it is desirable to set up constrained shortest path first (CSPF) computed Multiprotocol Label Switching (MPLS) Traffic Engineered Label Switched Paths (TE LSPs) to local addresses of a router that are not currently advertised in the TE LSAs, i.e., loopback and non-TE interface addresses.

For instance, in a network carrying VPN and non-VPN traffic, it is often desirable to use different MPLS TE LSPs for the VPN traffic and the non-VPN traffic. In this case, one loopback address may be used as the BGP next-hop for VPN traffic while another may be used as the BGP next-hop for non-VPN traffic. It is also possible that different BGP sessions are used for VPN and non-VPN services. Hence, two separate MPLS TE LSPs are desirable -- one to each loopback address.

However, current routers in an OSPF network can only use CSPF to compute MPLS TE LSPs to the router ID or the local addresses of a remote router's TE-enabled links. This restriction arises because OSPF TE extensions [RFC3630, RFC5329] only advertise the router ID and the local addresses of TE-enabled links of a given router. Other routers in the network can populate their traffic engineering database (TED) with these local addresses belonging to the advertising router. However, they cannot populate the TED with the advertising router's other local addresses, i.e., loopback and non-TE interface addresses. OSPFv2 stub links in the router LSA [RFC2328] provide stub reachability information to the router but are not sufficient to learn all the local addresses of a router. In particular for a subnetted point-to-point (P2P) interface the stub, link ID is the subnet address. While for a non-subnetted interface, the stub link ID is the neighbor address. Intra-prefix LSAs in OSPFv3 [RFC5340] are also not sufficient to learn the local addresses.

For the above reasons, this document defines an enhancement to OSPF TE extensions to advertise the local addresses of a node.

2. 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].

3. Rejected Potential Solution

A potential solution would be to advertise a TE link TLV for each local address, possibly with a new link type. However, this is inefficient since the only meaningful information is the address. Furthermore, this would require implementations to process these TE link TLVs differently from others; for example, the TE metric is normally considered a mandatory sub-TLV, but would have no meaning for a local address.

4. Solution

The solution is to advertise the local addresses of a router in a new OSPF TE LSA Node Attribute TLV. It is anticipated that the Node Attribute TLV will also prove more generally useful.

4.1. Node Attribute TLV

The Node Attribute TLV carries the attributes associated with a router. The TLV type is 5 and the length is variable. It contains one or more sub-TLVs. This document defines the following sub-TLVs:

1. Node IPv4 Local Address sub-TLV
2. Node IPv6 Local Address sub-TLV

The Node IPv4 Local Address sub-TLV has a type of 1 and contains one or more local IPv4 addresses. It has the following format:

```
 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|              1                |             Length            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
| Prefix Len 1  |          IPv4 Prefix 1                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|Prefix 1 cont. |                                               :
+-+-+-+-+-+-+-+-+                                               ~
:                               .                               :
~                               .               +-+-+-+-+-+-+-+-+
:                               .               | Prefix Len n  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                          IPv4 Prefix n                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Each local IPv4 address is encoded as a <Prefix Length, Prefix> tuple. Prefix Length is encoded in 1 byte. It is the number of bits in the Address and can be at most 32. Prefix is an IPv4 address prefix and is encoded in 4 bytes with zero bits as necessary.

The Node IPv4 Local Address sub-TLV length is in octets. It is the sum of the lengths of all n IPv4 Address encodings in the sub-TLV, where n is the number of local addresses included in the sub-TLV.

The Node IPv6 Local Address sub-TLV has a type of 2 and contains one or more local IPv6 addresses. It has the following format:

```
  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
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |              2                |            Length             |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 | Prefix Len 1  | Prefix 1 Opt. | IPv6 Prefix 1                 |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |   IPv6 Prefix 1 cont.                                         :
 :                               .                               ~
 ~                               .
 :                               .
 :                               +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 :                               | Prefix Len n  | Prefix n Opt. |
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |                          IPv6  Prefix n                       :
 |                                                               :
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+--
```

Each local IPv6 address is encoded using the procedures in [RFC5340]. Each IPv6 address MUST be represented by a combination of three fields: PrefixLength, PrefixOptions, and Address Prefix. PrefixLength is the length in bits of the prefix and is an 8-bit field. PrefixOptions is an 8-bit field describing various capabilities associated with the prefix [RFC5340]. Address Prefix is an encoding of the prefix itself as an even multiple of 32-bit words, padding with zero bits as necessary. This encoding consumes (PrefixLength + 31) / 32) 32-bit words.

The Node IPv6 Local Address sub-TLV length is in octets. It is the sum of the lengths of all n IPv6 Address encodings in the sub-TLV, where n is the number of local addresses included in the sub-TLV.

4.2. Operation

A router announces one or more local addresses in the Node Attribute TLV. The local addresses that can be learned from TE LSAs, i.e., router address and TE interface addresses SHOULD NOT be advertised in the node local address sub-TLV. The local addresses advertised will depend on the local configuration of the advertising router. The default behavior MAY be to advertise all the loopback interface addresses.

The Node Attribute TLV MUST NOT appear in more than one TE LSA originated by a router. Furthermore, such an LSA MUST NOT include more than one Node Attribute TLV. A Node Attribute TLV MUST NOT carry more than one Node IPv4 Local Address sub-TLV. A Node Attribute TLV MUST NOT carry more than one Node IPv6 Local Address sub-TLV.

5. Security Considerations

This document does not introduce any further security issues other than those discussed in [RFC3630] and [RFC5329].

6. IANA Considerations

IANA has assigned the Node Attribute TLV (value 5) type from the range 3-32767 as specified in [RFC3630], from the top level types in TE LSAs registry maintained by IANA at http://www.iana.org.

IANA has created and now maintains the registry for the sub-TLVs of the Node Attribute TLV. Value 1 is reserved for Node IPv4 Local Address sub-TLV and value 2 for Node IPv6 Local Address sub-TLV.

The guidelines for the assignment of types for sub-TLVs of the Node Attribute TLV are as follows:

- o Types in the range 3-32767 are to be assigned via Standards Action.

- o Types in the range 32768-32777 are for experimental use; these will not be registered with IANA, and MUST NOT be mentioned by RFCs.

- o Types in the range 32778-65535 are not to be assigned at this time. Before any assignments can be made in this range, there MUST be a Standards Track RFC that specifies IANA Considerations that covers the range being assigned.

7. Acknowledgements

We would like to thank Nischal Sheth for his contribution to this work. We would also like to thank Jean Philippe Vasseur, Acee Lindem, Venkata Naidu, Dimitri Papadimitriou, and Adrian Farrel for their comments.

8. References

8.1. Normative References

[RFC2328] Moy, J., "OSPF Version 2", STD 54, RFC 2328, April 1998.

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

[RFC3630] Katz, D., Kompella, K., and D. Yeung, "Traffic Engineering (TE) Extensions to OSPF Version 2", RFC 3630, September 2003.

[RFC5340] Coltun, R., Ferguson, D., Moy, J., and A. Lindem, "OSPF for IPv6", RFC 5340, July 2008.

8.2. Informative References

[RFC5329] Ishiguro, K., Manral, V., Davey, A., and A. Lindem, Ed., "Traffic Engineering Extensions to OSPF Version 3", RFC 5329, September 2008.

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