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Distribution of MPLS Traffic Engineering (TE) LSP State using BGP
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Abstract

This document describes a mechanism to collect the Traffic Engineering (TE) LSP information using BGP. Such information can be used by external components for path reoptimization, service placement and network visualization.

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 RFC 2119 [RFC2119].

Status of this Memo

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1. Introduction

In some network environments, the states of established Multi-Protocol Label Switching (MPLS) Traffic Engineering (TE) Label Switched Paths (LSPs) in the network are required by some components external to the network domain. Usually this information is directly maintained by the ingress Label Edge Routers (LERs) of the MPLS TE LSPs.

One example of using the LSP information is stateful Path Computation Element (PCE) [I-D.ietf-pce-stateful-pce], which could provide benefits in path reoptimization . While some extensions are proposed in Path Computation Element Communication Protocol (PCEP) for the Path Computation Clients (PCCs) to report the LSP states to the PCE, this mechanism may not be applicable in a management-based PCE architecture as specified in section 5.5 of [RFC4655]. As illustrated in the figure below, the PCC is not an LSR in the routing domain, thus the head-end nodes of the TE-LSP may not implement the PCEP protocol. In this case some general mechanism to collect the TE-LSP states from the ingress LERs is needed. This document proposes an LSP state collection mechanism complementary to the mechanism defined in [I-D.ietf-pce-stateful-pce].

```
                                   -----------
                                  |   -----   |
              Service             |  | TED |<-+------------>
              Request             |   -----   |  TED synchronization
                 |                |     |     |  mechanism (for example,
                 v                |     |     |  routing protocol)
           ------------- Request/ |     v     |
          |             | Response|   -----   |
          |     NMS     |<--------+> | PCE |  |
          |             |         |   -----   |
           -------------           -----------
         Service |
         Request |
                 v
            ----------  Signaling   ----------
           | Head-End | Protocol   | Adjacent |
           |  Node    |<---------->|   Node   |
            ----------              ----------
```

Figure 1. Management-Based PCE Usage

In networks with composite PCE nodes as specified in section 5.1 of [RFC4655], the PCE is implemented on several routers in the network, and the PCCs in the network can use the mechanism described in [I-D.ietf-pce-stateful-pce] to report the LSP information to the PCE

nodes. An external component may further need to collect the LSP information from all the PCEs in the network to get a global view of the LSP states in the network.

In some networks, a centralized controller is used for service placement. Obtaining the TE LSP state information is quite important for making appropriate service placement decisions with the purpose of both meeting the application's requirements and utilizing the network resource efficiently.

The Network Management System (NMS) may need to provide global visibility of the TE LSPs in the network as part of the network visualization function.

BGP has been extended to distribute link-state and traffic engineering information and share with some external components [I-D.ietf-idr-ls-distribution]. Using the same protocol to collect other network layer information would be desired by the external components, which avoids introducing multiple protocols for network information collection. This document describes a mechanism to distribute the TE LSP information to external components using BGP.

2. Carrying LSP State Information in BGP

2.1. LSP Identifier Inforation

The TE LSP Identifier information is advertised in BGP UPDATE messages using the MP_REACH_NLRI and MP_UNREACH_NLRI attributes [RFC4760]. The "Link State NLRI" defined in [I-D.ietf-idr-ls-distribution] is extended to carry the TE LSP information. BGP speakers that wish to exchange TE LSP information MUST use the BGP Multiprotocol Extensions Capability Code (1) to advertise the corresponding (AFI, SAFI) pair, as specified in [RFC4760].

The format of the Link State NLRI is shown in the following figure.

```
      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
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
     |        NLRI Type              |      Total NLRI Length        |
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
     |                     Link State NLRI (variable)                |
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 2. Link State NLRI Format

Two new "NLRI Type" are defined for TE LSP Identifier Information as following:

o NLRI Type = 5: IPv4 LSP NLRI

o NLRI-Type = 6: IPv6 LSP NLRI

If the NLRI Type value is set to 5, the Link State NLRI field is the IPv4-LSP-IDENTIFER structured as below:

```
      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
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
     |                   IPv4 Tunnel Sender Address                  |
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
     |             Tunnel ID         |             LSP ID            |
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
     |                  IPv4 Tunnel End-point Address                |
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 3. IPv4-LSP-IDENTIFIER

If the NLRI Type value is set to 6, the Link State NLRI field is the IPv6-LSP-IDENTIFIER structured as below:

```
      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
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
     |                                                               |
     +                                                               +
     |                  IPv6 Tunnel Sender Address                   |
     +                          (16 octets)                          +
     |                                                               |
     +                                                               +
     |                                                               |
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
     |          Tunnel ID            |             LSP ID            |
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
     |                                                               |
     +                                                               +
     |                 IPv6 Tunnel End-point Address                 |
     +                          (16 octets)                          +
     |                                                               |
     +                                                               +
     |                                                               |
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                      Figure 4. IPv6-LSP-IDENTIFIER
```

The fields in the IPv4-LSP-IDENTIFIER and IPv6-LSP-IDENTIFIER are the same as specified in [RFC3209].

2.2. LSP State Attribute

The LSP State Attribute is an optional non-transitive BGP attribute which is used to describe the characteristics of the LSPs. The LSP State Attribute consists of a set of objects defined in [RFC3209], [RFC3473] and [RFC5440] . This Attribute SHOULD only be used with IPv4/IPv6 LSP NLRI.

```
      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
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
     |                                                               |
     ~                   Objects (variable)                          ~
     |                                                               |
     +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                    Figure 5. LSP State Attribute
```

Currently the Objects that can be carried in the LSP State Attribute include:

- o LSP Attributes (LSPA) Object
- o Explicit Route Object (ERO)
- o Record Route Object (RRO)
- o BANDWIDTH Object
- o METRIC Object
- o Protection Object
- o Admin Status Object

Other objects may also be carried in the LSP State Attribute, which would be specified in a future version.

3. IANA Considerations

IANA needs to assign an new code point for the LSP State Attribute from the "BGP Path Attributes" registry.

4. Security Considerations

TBD

5. Acknowledgements

TBD

6. References

6.1. Normative References

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6.2. Informative References

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