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Signaling MSD (Maximum SID Depth) using OSPF
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Abstract

This document defines a way for an Open Shortest Path First (OSPF) Router to advertise multiple types of supported Maximum SID Depths (MSDs) at node and/or link granularity. Such advertisements allow entities (e.g., centralized controllers) to determine whether a particular SID stack can be supported in a given network. This document defines only one type of MSD, but defines an encoding that can support other MSD types. Here the term OSPF means both OSPFv2 and OSPFv3.

Status of This Memo

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1. Introduction

When Segment Routing (SR) paths are computed by a centralized controller, it is critical that the controller learns the Maximum SID Depth (MSD) that can be imposed at each node/link on a given SR path to insure that the SID stack depth of a computed path doesn't exceed the number of SIDs the node is capable of imposing.

Path Computation Element Protocol(PCEP) SR draft [I-D.ietf-pce-segment-routing] signals MSD in SR Path Computation Element Capability TLV and METRIC Object. However, if PCEP is not supported/configured on the head-end of an SR tunnel or a Binding-SID anchor node and controller does not participate in IGP routing, it has no way to learn the MSD of nodes and links. BGP-LS (Distribution of Link-State and TE Information using Border Gateway Protocol) [RFC7752] defines a way to expose topology and associated attributes and capabilities of the nodes in that topology to a centralized controller. MSD signaling by BGP-LS has been defined in [I-D.ietf-idr-bgp-ls-segment-routing-msd]. Typically, BGP-LS is configured on a small number of nodes that do not necessarily act as head-ends. In order for BGP-LS to signal MSD for all the nodes and

links in the network MSD is relevant, MSD capabilities should be advertised by every OSPF router in the network.

Other types of MSD are known to be useful. For example, [I-D.ietf-ospf-mpls-elc] defines Readable Label Depth Capability (RLDC) that is used by a head-end to insert an Entropy Label (EL) at a depth that can be read by transit nodes.

This document defines an extension to OSPF used to advertise one or more types of MSD at node and/or link granularity. It also defines the Base MPLS Imposition MSD type. In the future it is expected, that new MSD types will be defined to signal additional capabilities e.g., entropy labels, SIDs that can be imposed through recirculation, or SIDs associated with another dataplane e.g., IPv6. Although MSD advertisements are associated with Segment Routing, the advertisements MAY be present even if Segment Routing itself is not enabled.

1.1. Terminology

This memo makes use of the terms defined in [RFC7770]

BGP-LS: Distribution of Link-State and TE Information using Border Gateway Protocol

BMI: Base MPLS Imposition is the number of MPLS labels that can be imposed inclusive of all service/transport/special labels

OSPF: Open Shortest Path First

MSD: Maximum SID Depth - the number of SIDs a node or one of its links can support

PCC: Path Computation Client

PCE: Path Computation Element

PCEP: Path Computation Element Protocol

SR: Segment Routing

SID: Segment Identifier

LSA: Link state advertisement

RI: OSPF Router Information LSA

1.2. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

2. Node MSD Advertisement

The node MSD TLV within the body of the OSPF RI Opaque LSA [RFC7770] is defined to carry the provisioned SID depth of the router originating the RI LSA. Node MSD is the smallest MSD supported by the node on the set of interfaces configured for use by the advertising IGP instance. MSD values may be learned via a hardware API or may be provisioned.

```
     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

    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |    Type                       |  Length                       |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
    |    MSD-Type   |  MSD-Value    |  MSD-Type...  |  MSD-Value... |
    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 1: Node MSD TLV

The Type: TBD1

Length: variable (multiple of 2 octets) and represents the total length of value field in octets.

Value: consists of one or more pairs of a 1 octet MSD-type and 1 octet MSD-Value.

MSD-Type: one of the values defined in the IGP MSD Types registry defined in [I-D.ietf-isis-segment-routing-msd].

MSD-Value: a number in the range of 0-255. For all MSD-Types, 0 represents lack of the ability to impose MSD stack of any depth; any other value represents that of the node. This value MUST represent the lowest value supported by any link configured for use by the advertising OSPF instance.

This TLV is applicable to OSPFv2 and to OSPFv3 and is optional. The scope of the advertisement is specific to the deployment.

When multiple Node MSD TLVs are received from a given router, the receiver MUST use the first occurrence of the TLV in the Router Information LSA. If the Node MSD TLV appears in multiple Router Information LSAs that have different flooding scopes, the Node MSD TLV in the Router Information LSA with the area-scoped flooding scope MUST be used. If the Node MSD TLV appears in multiple Router Information LSAs that have the same flooding scope, the Node MSD TLV in the Router Information (RI) LSA with the numerically smallest Instance ID MUST be used and subsequent instances of the Node MSD TLV MUST be ignored. The RI LSA can be advertised at any of the defined opaque flooding scopes (link, area, or Autonomous System (AS)). For the purpose of Node MSD TLV advertisement, area-scoped flooding is REQUIRED.

3. Link MSD sub-TLV

The link sub-TLV is defined to carry the MSD of the interface associated with the link. MSD values may be learned via a hardware API or may be provisioned.

```
 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

+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    Type                       |  Length                       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|    MSD-Type   |  MSD-Value    |  MSD-Type...  |  MSD-Value... |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 2: Link MSD Sub-TLV

Type:

For OSPFv2, the Link level MSD value is advertised as an optional Sub-TLV of the OSPFv2 Extended Link TLV as defined in [RFC7684], and has a type of TBD2.

For OSPFv3, the Link level MSD value is advertised as an optional Sub-TLV of the E-Router-LSA TLV as defined in [RFC8362], and has a type of TBD3.

Length: variable and same as defined in Section 2.

Value: consists of one or more pairs of a 1 octet MSD-type and 1 octet MSD-Value.

MSD-Type: one of the values defined in the MSD Types registry defined in [I-D.ietf-isis-segment-routing-msd].

MSD-Value field contains Link MSD of the router originating the corresponding LSA as specified for OSPFv2 and OSPFv3. Link MSD is a number in the range of 0-255. For all MSD-Types, 0 represents lack of the ability to impose MSD stack of any depth; any other value represents that of the particular link when used as an outgoing interface.

If this sub-TLV is advertised multiple times in the same OSPFv2 Extended Link Opaque LSA/E-Router-LSA, only the first instance of the TLV MUST be used by receiving OSPF routers. This situation SHOULD be logged as an error.

If this sub-TLV is advertised multiple times for the same link in different OSPF Extended Link Opaque LSAs/E-Router-LSAs originated by the same OSPF router, the OSPFv2 Extended Link TLV in the OSPFv2 Extended Link Opaque LSA with the smallest Opaque ID or in the OSPFv3 E-Router-LSA with the smallest Link State ID is used by receiving OSPF routers. This situation MAY be logged as a warning.

4. Using Node and Link MSD Advertisements

When Link MSD is present for a given MSD type, the value of the Link MSD MUST take preference over the Node MSD. When a Link MSD type is not signalled but the Node MSD type is, then the value of that Link MSD type MUST be considered as the corresponding Node MSD type value. In order to increase flooding efficiency, it is RECOMMENDED, that routers with homogenous link MSD values advertise just the Node MSD value.

The meaning of the absence of both Node and Link MSD advertisements for a given MSD type is specific to the MSD type. Generally it can only be inferred that the advertising node does not support advertisement of that MSD type. However, in some cases the lack of advertisement might imply that the functionality associated with the MSD type is not supported. The correct interpretation MUST be specified when an MSD type is defined.

5. IANA Considerations

This document requests IANA to allocate TLV type (TBD1) from the OSPF Router Information (RI) TLVs Registry as defined by [RFC7770]. IANA has allocated the value 12 through the early assignment process.

Also, this document requests IANA to allocate a sub-TLV type (TBD2) from the OSPFv2 Extended Link TLV Sub-TLVs registry. IANA has allocated the value 6 through the early assignment process. Finally, this document requests IANA to allocate a sub-TLV type (TBD3) from the OSPFv3 Extended-LSA Sub-TLV registry.

6. Security Considerations

Security concerns for OSPF are addressed in [RFC7474]. Further security analysis for OSPF protocol is done in [RFC6863] Security considerations, as specified by [RFC7770], [RFC7684] and [RFC8362] are applicable to this document.

Advertisement of an incorrect MSD value may result: in a path computation failing and the service unavailable or instantiation of a path that can't be supported by the head-end (the node performing the imposition).

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