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Signaling MSD (Maximum SID Depth) using IS-IS
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Abstract

This document defines a way for an Intermediate System to Intermediate System (IS-IS) 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 only defines one type of MSD maximum label imposition, but defines an encoding that can support other MSD types.

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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 a given SR path to insure that the Segment Identifier (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 extensions draft [I-D.ietf-pce-segment-routing] signals MSD in SR Path Computation Element (PCE) 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 Intermediate System to Intermediate System(IS-IS) router in the network.

Other types of MSD are known to be useful. For example, [I-D.ietf-isis-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 could be read by transit nodes.

This document defines an extension to IS-IS used to advertise one or more types of MSD at node and/or link granularity. It also creates an IANA registry for assigning MSD type identifiers. 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. Note that in a non-SR MPLS network, label depth is what is defined by the MSD advertisements.

1.1. Terminology

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

MSD: Maximum SID Depth - the number of SIDs a node or a link on a node can support

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 sub-TLV is defined within the body of the IS-IS Router Capability TLV [RFC7981], to carry the provisioned SID depth of the router originating the Router Capability TLV. 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
     0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5

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

Figure 1: Node MSD Sub-TLV

Type: 23 (allocated by IANA via the early assignment process)

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

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

MSD-Type is a value defined in the IGP MSD Types registry created by the IANA Section of this document.

MSD-Value is a number in the range of 0-255. For all MSD-Types, 0 represents lack of the ability to support SID 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 IS-IS instance.

This sub-TLV is optional. The scope of the advertisement is specific to the deployment.

If there exist multiple Node MSD advertisements for the same MSD-Type originated by the same router, the procedures defined in [RFC7981] apply.

3. Link MSD Advertisement

The link MSD sub-TLV is defined for TLVs 22, 23, 25, 141, 222, and 223 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
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5

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

Figure 2: Link MSD Sub-TLV

Type: 15 (allocated by IANA via the early assignment process)

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

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

MSD-Type is a value defined in the MSD Types registry created by the IANA Section of this document.

MSD-Value is a number in the range of 0-255. For all MSD-Types, 0 represents lack of the ability to support SID stack of any depth; any other value represents that of the link when used as an outgoing link.

This sub-TLV is optional.

If multiple Link MSD advertisements for the same MSD-Type and the same link are received, the procedure used to select which copy is used is undefined.

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 signaled but the Node MSD type is, then the Node MSD type value MUST be considered as the MSD value for that link.

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. Base MPLS Imposition MSD

Base MPLS Imposition MSD (BMI-MSD) signals the total number of MPLS labels a node is capable of imposing, including all service/transport/special labels.

Absence of BMI-MSD advertisements indicates solely that the advertising node does not support advertisement of this capability.

6. IANA Considerations

This document requests IANA to allocate a sub-TLV type for the new sub TLV proposed in Section 2 of this document from IS-IS Router Capability TLV Registry as defined by [RFC7981].

IANA has allocated the following value through the early assignment process:

Value	Description	Reference
23	Node MSD	This document

Figure 3: Node MSD

This document requests IANA to allocate a sub-TLV type as defined in Section 3 from Sub-TLVs for TLVs 22, 23, 25, 141, 222, and 223 registry.

IANA has allocated the following value through the early assignment process:

Value	Description	Reference
15	Link MSD	This document

Figure 4: Link MSD

Per TLV information where Link MSD sub-TLV can be part of:

TLV	22	23	25	141	222	223
	y	y	y	y	y	y

Figure 5: TLVs where LINK MSD Sub-TLV can be present

This document requests creation of an IANA managed registry under the category of "Interior Gateway Protocol (IGP) Parameters" IANA registries to identify MSD types as proposed in Section 2 and Section 3. The registration procedure is "Expert Review" as defined in [RFC8126]. Suggested registry name is "IGP MSD Types". Types are an unsigned 8 bit number. The following values are defined by this document

Value	Name	Reference
0	Reserved	This document
1	Base MPLS Imposition MSD	This document
2-250	Unassigned	This document
251-254	Experimental	This document
255	Reserved	This document

Figure 6: MSD Types Codepoints Registry

Guidance for the Designated Experts is as defined in [RFC7370]

7. Security Considerations

Security considerations as specified by [RFC7981] are applicable to this document.

Advertisement of the additional information defined in this document that is false, e.g., an MSD that is incorrect, may result in a path computation failing, having a service unavailable, or instantiation of a path that can't be supported by the head-end (the node performing the imposition).

The presence of this information also may inform an attacker of how to induce any of the aforementioned conditions.

8. Contributors

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