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Advertising L2 Bundle Member Link Attributes in OSPF
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Abstract

There are deployments where the Layer 3 interface on which OSPF operates is a Layer 2 interface bundle. Existing OSPF advertisements only support advertising link attributes of the Layer 3 interface. If entities external to OSPF wish to control traffic flows on the individual physical links which comprise the Layer 2 interface bundle link attribute information about the bundle members is required.

This document introduces the ability for OSPF to advertise the link attributes of layer 2 (L2) Bundle members.

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1. Introduction

There are deployments where the Layer 3 interface on which an OSPF adjacency is established is a Layer 2 interface bundle, for instance a Link Aggregation Group (LAG) [IEEE802.1AX]. This reduces the number of adjacencies that need to be maintained by the routing protocol in cases where there are parallel links between the neighbors. Entities external to OSPF such as Path Computation Elements (PCE) [RFC4655] may wish to control traffic flows on individual members of the underlying Layer 2 bundle. To do so, link attribute information about individual bundle members is required. The protocol extensions defined in this document provide the means to advertise this information.

This document introduces new sub-TLVs to advertise link attribute information for each of the L2 Bundle members which comprise the Layer 3 interface on which OSPF operates. Similar capabilities were introduced in IS-IS via [RFC8668].

[RFC8665] and [RFC8666] introduced the adjacency segment identifier (Adj-SID) link attribute for OSPFv2 and OSPFv3 respectively which can be used as an instruction to forwarding to send traffic over a specific link [RFC8402]. This document enables the advertisement of the Adj-SIDs using the same Adjacency SID sub-TLV at the granularity level of each L2 Bundle member link so that traffic may be steered over that specific member link.

Note that the new advertisements at the L2 Bundle member link level in this document are intended to be provided to external (to OSPF) entities and does not alter or change the OSPF route computation

process. The following items are intentionally not defined and/or are outside the scope of this document:

- What link attributes will be advertised. This is determined by the needs of the external entities.
- A minimum or default set of link attributes.
- How these attributes are configured
- How the advertisements are used
- What impact the use of these advertisements may have on traffic flow in the network
- How the advertisements are passed to external entities

1.1. 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. L2 Bundle Member Attributes

A new L2 Bundle Member Attributes sub-TLV is introduced to advertise L2 Bundle member attributes in both OSPFv2 and OSPFv3. In the case of OSPFv2, this sub-TLV is an optional sub-TLV of the OSPFv2 Extended Link TLV that is used to describe link attributes via the OSPFv2 Extended Link Opaque LSA [RFC7684]. In case of OSPFv3, this sub-TLV is an optional sub-TLV of the Router Link TLV of the OSPFv3 E-Router-LSA [RFC8362].

When the OSPF adjacency is associated with an L2 Bundle interface, this sub-TLV is used to advertise the underlying L2 Bundle member links along with their respective link attributes. Inclusion of this information implies that the identified link is a member of the L2 bundle associated with an OSPF L3 link and that the member link is operationally up. Therefore advertisements of member links MUST NOT be done when the member link becomes operationally down or it is no longer a member of the identified L2 Bundle.

The L2 Bundle Member Attributes sub-TLV has the following format:

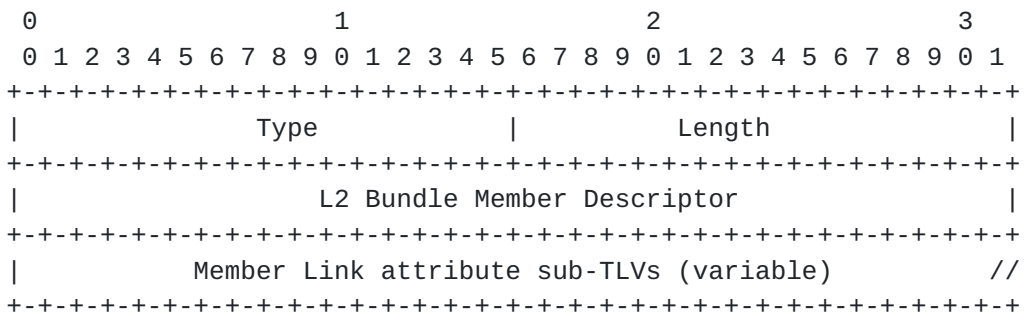


Figure 1: L2 Bundle Member Attributes sub-TLV Format

Where:

Type: 24 for OSPFv2 and 29 for OSPFv3

Length: Variable.

L2 Bundle Member Descriptor: A 4 octet Link Local Identifier as described in [RFC4202] and used in [RFC8510] for the member link.

Link attributes for L2 Bundle Member Links are advertised as sub-TLVs of the L2 Bundle Member Attribute sub-TLV.

In the case of OSPFv2, the L2 Bundle Member Attributes sub-TLV shares the sub-TLV space of the Extended Link TLV and the sub-TLVs of the Extended Link TLV MAY be used to describe the attributes of the member link. Figure 2 below lists sub-TLVs and their applicability for L2 Bundle member links. The sub-TLVs that are not applicable MUST NOT be used as sub-TLVs for the L2 Bundle Member Attributes sub-TLV. Specifications that introduce new sub-TLVs of the Extended Link TLV MUST indicate their applicability for the L2 Bundle Member Attributes sub-TLV. An implementation MUST ignore any sub-TLVs received that are not applicable in the context of the L2 Bundle Member Attribute sub-TLV.

Y - applicable
N - not-applicable

1 SID/Label (N)
2 Adj-SID (Y)
3 LAN Adj-SID/Label (Y)
4 Network-to-Router Metric (N)
5 RTM Capability (N)
6 OSPFv2 Link MSD (N)
7 Graceful-Link-Shutdown (N)
8 Remote IPv4 Address (N)
9 Local/Remote Interface ID (N)
10 Application Specific Link Attributes (Y)
11 Shared Risk Link Group (Y)
12 Unidirectional Link Delay (Y)
13 Min/Max Unidirectional Link Delay (Y)
14 Unidirectional Delay Variation (Y)
15 Unidirectional Link Loss (Y)
16 Unidirectional Residual Bandwidth (Y)
17 Unidirectional Available Bandwidth (Y)
18 Unidirectional Utilized Bandwidth (Y)
19 Administrative Group (Y)
20 Extended Administrative Group (Y)
21 Maximum Link Bandwidth (Y)
22 Traffic Engineering Metric (Y)
24 L2 Bundle Member Attributes (N)

Figure 2: Applicability of OSPFv2 Link Attribute sub-TLVs for L2 Bundle Members

In the case of OSPFv3, the L2 Bundle Member Attributes sub-TLV shares the sub-TLV space of the Router Link TLV and the sub-TLVs of the Router Link TLV MAY be used to describe the attributes of the member link. Figure 3 below lists sub-TLVs that are applicable for Router Link TLV and their applicability for L2 Bundle member links. The sub-TLVs that are not applicable MUST NOT be used as sub-TLVs for the L2 Bundle Member Attributes sub-TLV. Specifications that introduce new sub-TLVs of the Router Link TLV MUST indicate their applicability for the L2 Bundle Member Attributes sub-TLV. An implementation MUST ignore any sub-TLVs received that are not applicable in the context of the L2 Bundle Member Attribute sub-TLV.

```
Y - applicable
N - not-applicable

 5  Adj-SID (Y)
 6  LAN Adj-SID (Y)
 7  SID/Label (N)
 8  Graceful-Link-Shutdown (N)
 9  OSPFv3 Link MSD (N)
10  Application Specific Link Attributes (Y)
11  Shared Risk Link Group (Y)
12  Unidirectional Link Delay (Y)
13  Min/Max Unidirectional Link Delay (Y)
14  Unidirectional Delay Variation (Y)
15  Unidirectional Link Loss (Y)
16  Unidirectional Residual Bandwidth (Y)
17  Unidirectional Available Bandwidth (Y)
18  Unidirectional Utilized Bandwidth (Y)
19  Administrative Group (Y)
20  Extended Administrative Group (Y)
21  Traffic Engineering Metric (Y)
22  Maximum Link Bandwidth (Y)
23  Local Interface IPv6 Address (N)
24  Remote Interface IPv6 Address (N)
29  L2 Bundle Member Attributes (N)
```

Figure 3: Applicability of OSPFv3 Link Attribute sub-TLVs for L2 Bundle Members

3. IANA Considerations

This document adds new sub-TLVs to the OSPFv2 and OSPFv3 registry.

The following code-point has been assigned via early allocation in the OSPFv2 Extended Link TLV sub-TLVs registry under the OSPFv2 Parameters IANA registry:

Value: 24

Name: L2 Bundle Member Attributes

The following code-point has been assigned via early allocation in the OSPFv3 Extended LSA sub-TLVs registry under the OSPFv3 Parameters IANA registry:

Value: 29

Name: L2 Bundle Member Attributes

4. Security Considerations

The OSPF protocol has supported the advertisement of link attribute information, including link identifiers, for many years. The advertisements defined in this document are identical to existing advertisements defined in [RFC3630], [RFC4203], [RFC5329], [RFC7471], [RFC8665] and [RFC8666] - but are associated with L2 links which are part of a bundle interface on which the OSPF protocol operates. There are therefore no new security issues introduced by the extensions in this document.

As always, if the protocol is used in an environment where unauthorized access to the physical links on which OSPF packets are sent occurs then attacks are possible. The use of authentication as defined in [RFC5709], [RFC7474], [RFC4552] and [RFC7166] is recommended for preventing such attacks.

5. Acknowledgements

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