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OSPF Prefix Originator Extensions
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Abstract

This document defines OSPF extensions to include information associated with the node originating a prefix along with the prefix advertisement.

Status of This Memo

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1. Introduction

Prefix attributes are advertised in OSPFv2 [RFC2328] using the Extended Prefix Opaque Link State Advertisement (LSA) [RFC7684] and in OSPFv3 [RFC5340] using the various Extended Prefix LSA types [RFC8362].

The identification of the originating router for a prefix in OSPF varies by the type of the prefix and is currently not always possible. For intra-area prefixes, the originating router is identified by the Advertising Router field of the area-scoped LSA used for those prefix advertisements. However, for the inter-area prefixes advertised by the Area Border Router (ABR), the Advertising Router field of their area-scoped LSAs is set to the ABR itself and the information about the router originating the prefix advertisement is lost in this process of prefix propagation across areas. For Autonomous System (AS) external prefixes, the originating router may be considered as the Autonomous System Border Router (ASBR) and is identified by the Advertising Router field of the AS-scoped LSA used. However, the actual originating router for the prefix may be a remote router outside the OSPF domain. Similarly, when an ABR performs translation of Not-So-Stubby Area (NSSA) [RFC3101] LSAs to AS-external LSAs, the information associated with the NSSA ASBR (or the router outside the OSPF domain) is not conveyed across the OSPF domain.

While typically the originator of information in OSPF is identified by its OSPF Router ID, it does not necessarily represent a reachable address for the router. The IPv4/IPv6 Router Address as defined in [RFC3630] and [RFC5329] for OSPFv2 and OSPFv3 respectively provide an address to reach that router.

The primary use case for the extensions proposed in this document is to be able to identify the originator of a prefix in the network. In cases where multiple prefixes are advertised by a given router, it is also useful to be able to associate all these prefixes with a single router even when prefixes are advertised outside of the area in which they originated. It also helps to determine when the same prefix is being originated by multiple routers across areas.

This document proposes extensions to the OSPF protocol for inclusion of information associated with the router originating the prefix along with the prefix advertisement. These extensions do not change the core OSPF route computation functionality. They provide useful information for topology analysis and traffic engineering, especially on a controller when this information is advertised as an attribute of the prefixes via mechanisms such as Border Gateway Protocol Link-State (BGP-LS) [RFC7752] [I-D.ietf-idr-bgp-ls-segment-routing-ext].

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. Protocol Extensions

This document defines the Prefix Source OSPF Router-ID and the Prefix Source Router Address Sub-TLVs for inclusion of the Router ID and a reachable address information for the router originating the prefix as a prefix attribute.

2.1. Prefix Source OSPF Router-ID Sub-TLV

For OSPFv2, the Prefix Source OSPF Router-ID Sub-TLV is an optional Sub-TLV of the OSPFv2 Extended Prefix TLV [RFC7684]. For OSPFv3, the Prefix Source OSPF Router-ID Sub-TLV is an optional Sub-TLV of the Intra-Area-Prefix TLV, Inter-Area-Prefix TLV, and External-Prefix TLV [RFC8362] when originating either an IPv4 [RFC5838] or an IPv6 prefix advertisement.

The Prefix Source OSPF Router-ID Sub-TLV 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|               Type            |               Length          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                         OSPF Router ID                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 1: Prefix Source OSPF Router-ID Sub-TLV Format

Where:

- o Type: 4 for OSPFv2 and 27 for OSPFv3
- o Length: 4
- o OSPF Router ID : the OSPF Router ID of the OSPF router that originated the prefix advertisement in the OSPF domain.

The parent TLV of a prefix advertisement MAY include more than one Prefix Source OSPF Router-ID sub-TLV, one corresponding to each of the Equal-Cost Multi-Path (ECMP) nodes that originated the given prefix.

For intra-area prefix advertisements, the Prefix Source OSPF Router-ID Sub-TLV MUST be considered invalid and ignored if the OSPF Router ID field is not the same as Advertising Router field in the containing LSA. Similar validation cannot be reliably performed for inter-area and external prefix advertisements.

A received Prefix Source OSPF Router-ID Sub-TLV with OSPF Router ID set to 0 MUST be considered invalid and ignored. Additionally, reception of such Sub-TLV SHOULD be logged as an error (subject to rate-limiting).

2.2. Prefix Source Router Address Sub-TLV

For OSPFv2, the Prefix Source Router Address Sub-TLV is an optional Sub-TLV of the OSPFv2 Extended Prefix TLV [RFC7684]. For OSPFv3, the Prefix Source Router Address Sub-TLV is an optional Sub-TLV of the Intra-Area-Prefix TLV, Inter-Area-Prefix TLV, and External-Prefix TLV [RFC8362] when originating either an IPv4 [RFC5838] or an IPv6 prefix advertisement.

The Prefix Source Router Address Sub-TLV 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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|              Type             |               Length          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|             Router Address (4 or 16 octets)                   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 2: Prefix Source Router Address Sub-TLV Format

Where:

- Type: 5 (suggested) for OSPFv2 and 28 (suggested) for OSPFv3

- Length: 4 or 16

- Router Address: A reachable IPv4 or IPv6 router address for the router that originated the IPv4 or IPv6 prefix advertisement respectively. Such an address would be semantically equivalent to what may be advertised in the OSPFv2 Router Address TLV [RFC3630] or in the OSPFv3 Router IPv6 Address TLV [RFC5329].

The parent TLV of a prefix advertisement MAY include more than one Prefix Source Router Address Sub-TLV, one corresponding to each of the Equal-Cost Multi-Path (ECMP) nodes that originated the given prefix.

A received Prefix Source Router Address Sub-TLV that has an invalid length (i.e. not consistent with the prefix's address family) MUST be considered invalid and ignored. Additionally, reception of such Sub-TLV SHOULD be logged as an error (subject to rate-limiting).

3. Elements of Procedure

This section describes the procedure for advertisement of the Prefix Source OSPF Router-ID and Prefix Source Router Address Sub-TLVs along with the prefix advertisement.

The OSPF Router ID of the Prefix Source OSPF Router-ID is set to the OSPF Router ID of the node originating the prefix in the OSPF domain.

If the originating node is advertising an OSPFv2 Router Address TLV [RFC3630] or an OSPFv3 Router IPv6 Address TLV [RFC5329], then the same address MUST be used in the Router Address field of the Prefix Source Router Address Sub-TLV. When the originating node is not advertising such an address, implementations can determine a unique and reachable address (i.e., advertised with the N-flag set [RFC7684] or N-bit set [RFC8362]) belonging to the originating node to set in the Router Address field.

When an ABR generates inter-area prefix advertisements into its non-backbone areas corresponding to an inter-area prefix advertisement from the backbone area, the only way to determine the originating node information is based on the Prefix Source OSPF Router-ID and Prefix Source Router Address Sub-TLVs present in the inter-area prefix advertisement originated into the backbone area by an ABR from another non-backbone area. The ABR performs its prefix calculation to determine the set of nodes that contribute to the best prefix reachability. It MUST use the prefix originator information only from this set of nodes. The ABR MUST NOT include the Prefix Source OSPF Router-ID or the Prefix Source Router Address Sub-TLVs when it is unable to determine the information of the best originating node.

Implementations may support the propagation of the originating node information along with a redistributed prefix into the OSPF domain from another routing domain. The details of such mechanisms are outside the scope of this document. Such implementations may also provide control on whether the Router Address in the Prefix Source Router Address Sub-TLV is set as the ABSR node address or as the address of the actual node outside the OSPF domain that owns the prefix.

When translating the NSSA prefix advertisements [RFC3101] to the AS external prefix advertisements, the NSSA ABR, follows the same procedures as an ABR generating inter-area prefix advertisements for the propagation of the originating node information.

4. Security Considerations

Since this document extends the OSPFv2 Extended Prefix LSA, the security considerations for [RFC7684] are applicable. Similarly, since this document extends the OSPFv3 E-Intra-Area-Prefix-LSA, E-Inter-Area-Prefix-LSA, E-AS-External LSA and E-NSSA-LSA, the security considerations for [RFC8362] are applicable. The new sub-TLVs introduced in this document are optional and do not affect the OSPF route computation and therefore do not affect the security aspects of OSPF protocol operations. A rogue node that can inject prefix advertisements may use the new extensions introduced in this document to indicate incorrect prefix source information.

5. Operational Considerations

Consideration should be given to the operation impact of the increase in the size of the OSPF Link-State Database as a result of the protocol extensions in this document. Based on deployment design and requirements, a subset of prefixes may be identified for which the originating node information needs to be included with their prefix advertisements.

The propagation of the prefix source node information when doing prefix advertisements across OSPF area or domain boundaries results in the exposure of node information outside of an area or domain within which it is normally hidden or abstracted by the base OSPF protocol. Based on deployment design and requirements, a subset of prefixes may be identified for which the propagation of the originating node information across area boundaries is disabled at the ABRs.

The identification of the node that is originating a specific prefix in the network may aid in debugging of issues related to prefix reachability within an OSPF network.

6. IANA Considerations

This document requests IANA for the allocation of the codepoints from the "OSPFv2 Extended Prefix TLV Sub-TLVs" registry under the "Open Shortest Path First v2 (OSPFv2) Parameters" registry.

Code Point	Description	IANA Allocation Status
4	Prefix Source OSPF Router-ID	early allocation done
5	Prefix Source Router Address	suggested

Figure 3: Codepoints in OSPFv2 Extended Prefix TLV Sub-TLVs

This document requests IANA for the allocation of the codepoints from the "OSPFv3 Extended-LSA Sub-TLVs" registry under the "Open Shortest Path First v3 (OSPFv3) Parameters" registry.

Code Point	Description	IANA Allocation Status
27	Prefix Source OSPF Router-ID	early allocation done
28	Prefix Source Router Address	suggested

Figure 4: Codepoints in OSPFv3 Extended-LSA Sub-TLVs

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