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RFC 9089
Signaling Entropy Label Capability and Entropy Readable Label Depth Using OSPF

Abstract

Multiprotocol Label Switching (MPLS) has defined a mechanism to load-balance traffic flows using Entropy Labels (EL). An ingress Label Switching Router (LSR) cannot insert ELs for packets going into a given Label Switched Path (LSP) unless an egress LSR has indicated via signaling that it has the capability to process ELs, referred to as the Entropy Label Capability (ELC), on that LSP. In addition, it would be useful for ingress LSRs to know each LSR's capability for reading the maximum label stack depth and performing EL-based load-balancing, referred to as Entropy Readable Label Depth (ERLD). This document defines a mechanism to signal these two capabilities using OSPFv2 and OSPFv3, and Border Gateway Protocol - Link State (BGP-LS).

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1. Introduction

[RFC6790] describes a method to load-balance Multiprotocol Label Switching (MPLS) traffic flows using Entropy Labels (EL). It also introduces the concept of Entropy Label Capability (ELC) and defines the signaling of this capability via MPLS signaling protocols. Recently, mechanisms have been defined to signal labels via link-state Interior Gateway Protocols (IGP) such as OSPFv2 [RFC8665] and OSPFv3 [RFC8666]. This document defines a mechanism to signal the ELC using OSPFv2 and OSPFv3.

In cases where Segment Routing (SR) is used with the MPLS data plane (e.g., SR-MPLS [RFC8660]), it would be useful for ingress LSRs to know each intermediate LSR's capability of reading the maximum label stack depth and performing EL-based load-balancing. This capability, referred to as Entropy Readable Label Depth (ERLD) as defined in [RFC8662], may be used by ingress LSRs to determine the position of the EL label in the stack, and whether it is necessary to insert multiple ELs at different positions in the label stack. This document defines a mechanism to signal the ERLD using OSPFv2 and OSPFv3.

2. Terminology

This memo makes use of the terms defined in [RFC6790] and [RFC8662].

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.

The key word OSPF is used throughout the document to refer to both OSPFv2 and OSPFv3.

3. Advertising ELC Using OSPF

Even though ELC is a property of the node, in some cases it is advantageous to associate and advertise the ELC with a prefix. In multi-area networks, routers may not know the identity of the prefix originator in a remote area or may not know the capabilities of such an originator. Similarly, in a multi-domain network, the identity of the prefix originator and its capabilities may not be known to the ingress LSR.

If a router has multiple interfaces, the router **MUST NOT** announce ELC unless all of its interfaces are capable of processing ELs.

If the router supports ELs on all of its interfaces, it **SHOULD** advertise the ELC with every local host prefix it advertises in OSPF.

3.1. Advertising ELC Using OSPFv2

[RFC7684] defines the OSPFv2 Extended Prefix TLV to advertise additional attributes associated with a prefix. The OSPFv2 Extended Prefix TLV includes a one-octet Flags field. A new flag in the Flags field is used to signal the ELC for the prefix:

0x20 - E-Flag (ELC Flag):
: Set by the advertising router to indicate that the prefix originator is capable of processing ELs.

The ELC signaling **MUST** be preserved when an OSPF Area Border Router (ABR) distributes information between areas. To do so, an ABR **MUST** originate an OSPFv2 Extended Prefix Opaque Link State Advertisement (LSA) [RFC7684] including the received ELC setting.

When an OSPF Autonomous System Border Router (ASBR) redistributes a prefix from another instance of OSPF or from some other protocol, it **SHOULD** preserve the ELC signaling for the prefix if it exists. To do so, an ASBR **SHOULD** originate an Extended Prefix Opaque LSA [RFC7684] including the ELC setting of the redistributed prefix. The flooding scope of the Extended Prefix Opaque LSA **MUST** match the flooding scope of the LSA that an ASBR originates as a result of the redistribution. The exact mechanism used to exchange ELC between protocol instances on an ASBR is outside of the scope of this document.

3.2. Advertising ELC Using OSPFv3

[RFC5340] defines the OSPFv3 PrefixOptions field to indicate capabilities associated with a prefix. A new bit in the OSPFv3 PrefixOptions field is used to signal the ELC for the prefix:

0x40 - E-Flag (ELC Flag):
: Set by the advertising router to indicate that the prefix originator is capable of processing ELs.

The ELC signaling **MUST** be preserved when an OSPFv3 Area Border Router (ABR) distributes information between areas. The setting of the ELC Flag in the Inter-Area-Prefix-LSA [RFC5340] or in the Inter-Area-Prefix TLV [RFC8362], generated by an ABR, **MUST** be the same as the value the ELC Flag associated with the prefix in the source area.

When an OSPFv3 Autonomous System Border Router (ASBR) redistributes a prefix from another instance of OSPFv3 or from some other protocol, it **SHOULD** preserve the ELC signaling for the prefix if it exists. The setting of the ELC Flag in the AS-External-LSA, Not-So-Stubby Area LSA (NSSA-LSA) [RFC5340], or in the External-Prefix TLV [RFC8362], generated by an ASBR, **MUST** be the same as the value of the ELC Flag associated with the prefix in the source domain. The exact mechanism used to exchange ELC between protocol instances on the ASBR is outside of the scope of this document.

4. Advertising ERLD Using OSPF

The ERLD is advertised in a Node Maximum SID Depth (MSD) TLV [RFC8476] using the ERLD-MSD type defined in [RFC9088].

If a router has multiple interfaces with different capabilities of reading the maximum label stack depth, the router **MUST** advertise the smallest value found across all of its interfaces.

The absence of ERLD-MSD advertisements indicates only that the advertising node does not support advertisement of this capability.

When the ERLD-MSD type is received in the OSPFv2 or OSPFv3 Link MSD sub-TLV [RFC8476], it **MUST** be ignored.

The considerations for advertising the ERLD are specified in [RFC8662].

5. Signaling ELC and ERLD in BGP-LS

The OSPF extensions defined in this document can be advertised via BGP-LS (distribution of Link-State and TE information using BGP) [RFC7752] using existing BGP-LS TLVs.

The ELC is advertised using the Prefix Attribute Flags TLV as defined in [RFC9085].

The ERLD-MSD is advertised using the Node MSD TLV as defined in [RFC8814].

6. IANA Considerations

IANA has completed the following actions for this document:

- Flag 0x20 in the "OSPFv2 Extended Prefix TLV Flags" registry has been allocated to the E-Flag (ELC Flag).
- Bit 0x40 in the "OSPFv3 Prefix Options (8 bits)" registry has been allocated to the E-Flag (ELC Flag).

7. Security Considerations

This document specifies the ability to advertise additional node capabilities using OSPF and BGP-LS. As such, the security considerations as described in [RFC5340], [RFC7684], [RFC7752], [RFC7770], [RFC8476], [RFC8662], [RFC8814], and [RFC9085] are applicable to this document.

Incorrectly setting the E-Flag during origination, propagation, or redistribution may lead to poor or no load-balancing of the MPLS traffic or to the MPLS traffic being discarded on the egress node.

Incorrectly setting of the ERLD value may lead to poor or no load-balancing of the MPLS traffic.

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