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Signaling Entropy Label Capability and Entropy Readable Label Depth Using IS-IS

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 IS-IS and Border Gateway Protocol - Link State (BGP-LS).

Status of This Memo

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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 IS-IS [RFC8667]. This document defines a mechanism to signal the ELC using IS-IS.

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's necessary to insert multiple ELs at different positions in the label stack. This document defines a mechanism to signal the ERLD using IS-IS.

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.

3. Advertising ELC Using IS-IS

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 a multi-area network, routers may not know the identity of the prefix originator in a remote area or may not know the capabilities of such originator. Similarly, in a multi-domain network, the identity of the prefix originator and its capabilities may not be known to the ingress LSR.

Bit 3 in the Prefix Attribute Flags [RFC7794] is used as the ELC Flag (E-Flag), as shown in Figure 1. If a router has multiple interfaces, the router MUST NOT announce the ELC for any local host prefixes unless all of its interfaces are capable of processing ELs. If a router supports ELs on all of its interfaces, it SHOULD set the ELC for every local host prefix it advertises in IS-IS.

```
 0 1 2 3 4 5 6 7...
+-+-+-+-+-+-+-+-+...
|X|R|N|E|        ...
+-+-+-+-+-+-+-+-+...
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Figure 1: Prefix Attribute Flags

E-Flag:
ELC Flag (Bit 3) - Set for local host prefix of the originating node if it supports ELC on all interfaces.

The ELC signaling MUST be preserved when a router propagates a prefix between IS-IS levels [RFC5302].

When redistributing a prefix between two IS-IS protocol instances or redistributing from another protocol to an IS-IS protocol instance, a router SHOULD preserve the ELC signaling for that prefix if it exists. The exact mechanism used to exchange ELC between protocol instances running on an Autonomous System Border Router is outside of the scope of this document.

4. Advertising ERLD Using IS-IS

A new MSD-Type [RFC8491], called ERLD-MSD, is defined to advertise the ERLD [RFC8662] of a given router. An MSD-Type code 2 has been assigned by IANA for ERLD-MSD. The MSD-Value field is set to the ERLD in the range between 0 to 255. The scope of the advertisement depends on the application. 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 its interfaces.

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

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

If the ERLD-MSD type is received in the Link MSD sub-TLV, it MUST be ignored.

5. Signaling ELC and ERLD in BGP-LS

The IS-IS 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:

* Bit 3 in the "Bit Values for Prefix Attribute Flags Sub-TLV" registry has been assigned to the ELC Flag. IANA has updated the registry to reflect the name used in this document: ELC Flag (E-Flag).

* Type 2 in the "IGP MSD-Types" registry has been assigned for the ERLD-MSD. IANA has updated the registry to reflect the name used in this document: ERLD-MSD.

7. Security Considerations

This document specifies the ability to advertise additional node capabilities using IS-IS and BGP-LS. As such, the security considerations as described in [RFC7752], [RFC7794], [RFC7981], [RFC8491], [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 MPLS traffic being discarded on the egress node.

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

8. References

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