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Label Distribution Protocol (LDP) 'Typed Wildcard' Forward Equivalence Class (FEC)

Abstract

The Label Distribution Protocol (LDP) specification for the Wildcard Forward Equivalence Class (FEC) element has several limitations. This document addresses those limitations by defining a Typed Wildcard FEC Element and associated procedures. In addition, it defines a new LDP capability to address backward compatibility.

Status of This Memo

This is an Internet Standards Track document.

This document is a product of the Internet Engineering Task Force (IETF). It represents the consensus of the IETF community. It has received public review and has been approved for publication by the Internet Engineering Steering Group (IESG). Further information on Internet Standards is available in Section 2 of RFC 5741.

Information about the current status of this document, any errata, and how to provide feedback on it may be obtained at http://www.rfc-editor.org/info/rfc5918.

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1. Introduction

LDP [RFC5036] distributes labels for Forwarding Equivalence Classes (FECs). LDP uses FEC TLVs in LDP messages to specify FECs. An LDP FEC TLV includes one or more FEC elements. A FEC element includes a FEC type and an optional type-dependent value.

RFC 5036 specifies two FEC types (Prefix and Wildcard), and other documents specify additional FEC types; e.g., see [RFC4447] and [MLDP].

As specified by RFC 5036, the Wildcard FEC Element refers to all FECs relative to an optional constraint. The only constraint RFC 5036 specifies is one that limits the scope of the Wildcard FEC Element to "all FECs bound to a given label".

The RFC 5036 specification of the Wildcard FEC Element has the following deficiencies that limit its utility:

1) The Wildcard FEC Element is untyped. There are situations where it would be useful to be able to refer to all FECs of a given type (as another constraint).

2) Use of the Wildcard FEC Element is limited to Label Withdraw and Label Release messages only. There are situations where it would be useful to have a Wildcard FEC Element, with type constraint, in Label Request messages.

This document:

- addresses the above limitations by defining a Typed Wildcard FEC Element and procedures for its use.

- specifies use of the LDP capability mechanism [RFC5561] at session establishment time for informing a peer that an LDP speaker is capable of handling the Typed Wildcard FEC.

- specifies use of the Typed Wildcard FEC Element in a Label Request message.

- specifies the Typed Wildcard FEC Element for the Prefix FEC Element specified by RFC 5036.

Note that this document does not change procedures specified for the LDP Wildcard FEC Element by RFC 5036.

2. Specification Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119].

LDP - Label Distribution Protocol

FEC - Forwarding Equivalence Class

TLV - Type Length Value

LSR - Label Switching Router

3. The Typed Wildcard FEC Element

The Typed Wildcard FEC Element refers to all FECs of the specified type that meet the constraint. It specifies a 'FEC Element Type' and an optional constraint, which is intended to provide additional information.

The format of the Typed Wildcard FEC Element is:

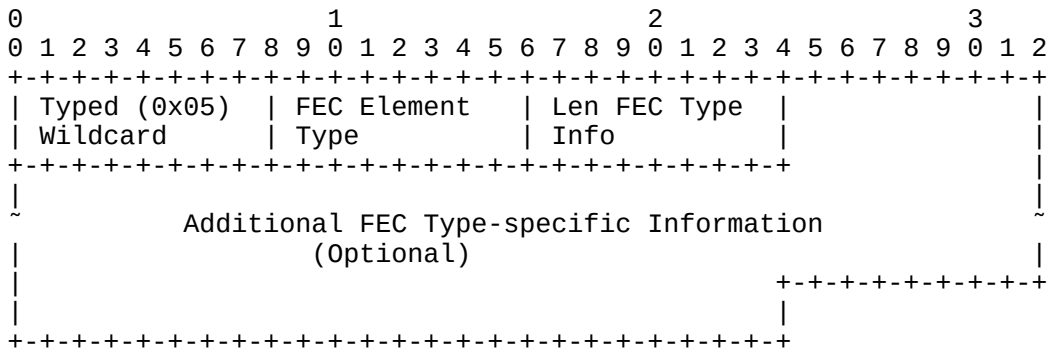

Figure 1: Typed Wildcard FEC Element

Where:

Typed Wildcard: One-octet FEC Element Type (0x05).

FEC Element Type: One-octet FEC Element Type that specifies the FEC Element Type to be wildcarded. Please see Section 3.4.1 of RFC 5036.

Any (future) document specifying a new FEC Element Type (not defined in RFC 5036) should prescribe whether typed wildcarding is needed for that FEC Element Type.

Len FEC Type Info: One octet that specifies the length in octets of the FEC Type Specific information field. It MUST be set to 0 if there is no Additional FEC Type-specific Information.

Additional FEC Type-specific Information (Optional): Additional information that is specific to the FEC Element Type and that is required to fully specify the Typed Wildcard. If this field is absent, then all FECs of the specified FEC Type would be matched.

Any (future) document specifying Typed wildcarding for any FEC Element Type should also specify the length and format of Additional FEC Type Specific Information, if included.

This document specifies one FEC Element Type instance (e.g., Prefix FEC) for the 'Typed Wildcard FEC Element' in Section 6.

4. Procedures for the Typed Wildcard FEC Element

When a FEC TLV contains a Typed Wildcard FEC Element, the Typed Wildcard FEC Element MUST be the only FEC Element in the TLV. If an LDP speaker receives a FEC TLV containing a Typed Wildcard FEC Element and any other FEC elements, then the LDP speaker should ignore the other FEC elements and continue processing as if the message only contains the Typed Wildcard FEC Element.

An LDP implementation that supports the Typed Wildcard FEC Element MUST support its use in Label Request, Label Withdraw, and Label Release messages.

An LDP implementation that supports the Typed Wildcard FEC Element MUST support it for every FEC Element Type defined in [RFC5036].

Receipt of a Label Request message with a FEC TLV containing a Typed Wildcard FEC Element is interpreted as a request to send one or more Label Mappings for all FECs of the type specified by the FEC Element Type field in the Typed Wildcard FEC Element encoding.

An LDP implementation that supports the Typed Wildcard FEC Element MUST support the following constraints whenever a Typed Wildcard FEC appears in a Label Withdraw or Label Release message:

1) If the message carries an optional Label TLV, the Typed Wildcard FEC Element refers to all FECs of the specified FEC type bound to the specified label.

2) If the message has no Label TLV, the Typed Wildcard FEC Element refers to all FECs of the specified FEC type.

Backwards compatibility with a router not supporting the Typed Wildcard FEC element is ensured by the FEC procedures defined in RFC 5036. Quoting from RFC 5036:

> If it [an LSR] encounters a FEC Element type it cannot decode, it SHOULD stop decoding the FEC TLV, abort processing the message containing the TLV, and send an "Unknown FEC" Notification message to its LDP peer signaling an error.

A router receiving a FEC TLV containing a Typed Wildcard FEC element for either a FEC Element Type that it doesn't support or for a FEC Element Type that doesn't support the use of wildcarding, MUST stop decoding the FEC TLV, abort processing the message containing the TLV, and send an "Unknown FEC" Notification message to its LDP peer to signal an error.

A router receiving a FEC TLV containing a Typed Wildcard FEC element MAY also leverage mechanisms defined in [RFC5919] (say, if it had zero label binding for the requested FEC type, etc.).

5. Typed Wildcard FEC Capability

As noted above, RFC 5036 FEC procedures provide for backward compatibility with an LSR not supporting the Typed Wildcard FEC Element. However, they don't provide means for an LSR that wishes to use the Typed Wildcard FEC Element to determine whether a peer supports it other than to send a message that uses the FEC Element and to wait and see how the peer responds.

An LDP speaker that supports the Typed Wildcard FEC Element MUST inform its peers of the support by including a Typed Wildcard FEC Element Capability Parameter [RFC5561] in its Initialization messages only.

The Capability Parameter for the Typed Wildcard FEC capability is a TLV with the following format:

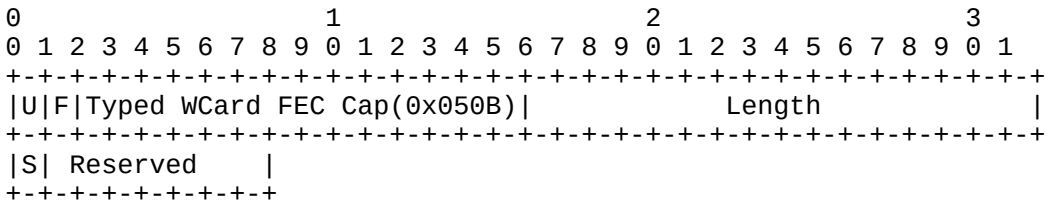

Figure 2: Typed Wildcard FEC Capability Format

Where:

U and F bits: MUST be 1 and 0, respectively, as per Section 3 of LDP Capabilities [RFC5561].

Typed WCard FEC Cap: 0x050B

Length: Two octets. It MUST be set to 0x0001.

S-bit: MUST be 1 (indicates that capability is being advertised).

6. Typed Wildcard FEC Element for Prefix FEC Element

RFC 5036 defines the Prefix FEC Element, but it does not specify a Typed Wildcard for it. This section specifies the Typed Wildcard FEC Element for Prefix FEC Elements.

The format of the Prefix FEC Typed Wildcard FEC Element ("Prefix FEC Wildcard" for short), based on Figure 1, is:

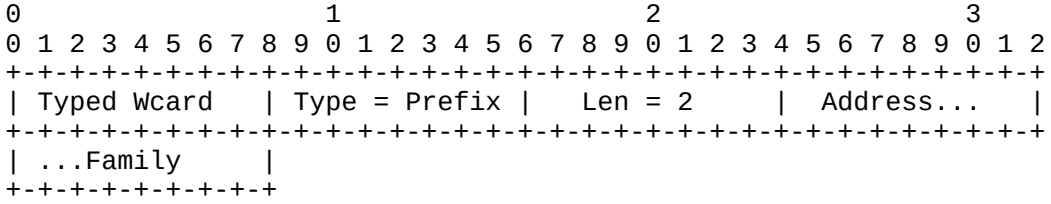

Figure 3: Format of Prefix FEC Element Using Typed Wildcard

Where:

FEC Element Type: "Prefix" FEC Element (0x02, per RFC 5036).

Len FEC Type Info: Two octets. It MUST be set to 0x0002.

Address Family: Two-octet quantity containing a value from the "ADDRESS FAMILY NUMBERS" registry on http://www.iana.org.

The procedures described in Section 4 apply to the Prefix FEC Wildcard processing.

7. Typed Wildcard FEC Element for Host and Wildcard FEC Elements

There is no need to specify Typed Wildcard FEC Elements for the Host FEC Element specified by [RFC3036], nor for the Wildcard FEC Element specified by RFC 5036. The [RFC3036] Host FEC Element has been removed from RFC 5036, and the Wildcard FEC Element is untyped by definition.

In other words, the 'FEC Element Type' field in 'Typed Wildcard FEC Element' MUST NOT be either 0x01 or 0x03.

8. IANA Considerations

This document introduces a new LDP FEC Element Type and a new LDP Capability, both of which have been assigned by IANA.

IANA has assigned a 'Typed Wildcard FEC Element' code point (0x05) from the LDP FEC Type Name Space. [RFC5036] partitions the FEC Type Name Space into 3 regions: IETF Consensus region, First Come First Served region, and Private Use region. The code point 0x05 is from the IETF Consensus range.

IANA has assigned a 'Typed Wildcard FEC Capability' code point (0x050B) from the TLV Type name space. [RFC5036] partitions the TLV TYPE name space into 3 regions: IETF Consensus region, Vendor Private Use region, and Experimental Use region. The code point 0x050B is from the IETF Consensus range.

9. Security Considerations

No security considerations beyond those that apply to the base LDP specification [RFC5036] and that are further described in [RFC5920] apply to use of the Typed Wildcard FEC Elements as described in this document.

One could deduce that the security exposure is reduced by this document, since an LDP speaker using the Typed Wildcard FEC Element could use a single message to request, withdraw, or release all the label mappings of a particular type (a particular Address Family Identifier (AFI), for example), whereas an LDP speaker using the Wildcard FEC Element, as defined in the base LDP specification [RFC5036], could use a single message to request, withdraw, or release all the label mappings of all types (all AFIs, for example).

10. Acknowledgments

The authors would like to thank Yakov Rekhter for suggesting that the limitations of the Wildcard FEC be addressed. Also, thanks to Adrian Farrel, Kamran Raza, and Richard L. Barnes for extensive review of this document.

11. References

11.1. Normative References

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11.2. Informative References

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