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LSP Attribute in ERO
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Abstract

RFC5420 extends RSVP-TE to specify or record generic attributes which apply to the whole of the path of an Label Switched Path (LSP). This document defines an extension to the RSVP Explicit Route Object (ERO) and Record Route Object (RRO) objects to allow it to specify or record generic attributes which apply to a given hop.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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1. Introduction

Generalized MPLS (GMPLS) Traffic Engineering (TE) Label Switched Paths (LSPs) can be route-constrained by making use of the Explicit Route object (ERO) and related sub-objects as defined in [RFC3209], [RFC3473], [RFC3477], [RFC4873], [RFC4874], [RFC5520] and [RFC5553]. Several documents have identified the need for attributes that can be targeted at specific hops in the path of an LSP, including [RFC6163], [I-D.ietf-ccamp-wson-signaling], [I-D.ietf-teas-rsvp-te-li-lb] or [I-D.ali-ccamp-rc-objective-function-metric-bound]. This document provides a generic mechanism for use by these other documents.

RSVP already supports generic extension of LSP Attributes in [RFC5420]. In order to support current and future ERO constraint extensions this document provides a mechanism to define per-Hop attributes.

The document describes a generic mechanism for carrying information related to specific nodes when signaling an LSP. This document does not restrict what that information can be used for. The defined approach builds on LSP Attributes defined in [RFC5420], and enables attributes to be expressed in ERO and Secondary Explicit Route object (SERO) objects. A new ERO sub-object is defined, containing a list of generic per-Hop attributes.

1.1. Requirements 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 RFC 2119 [RFC2119].

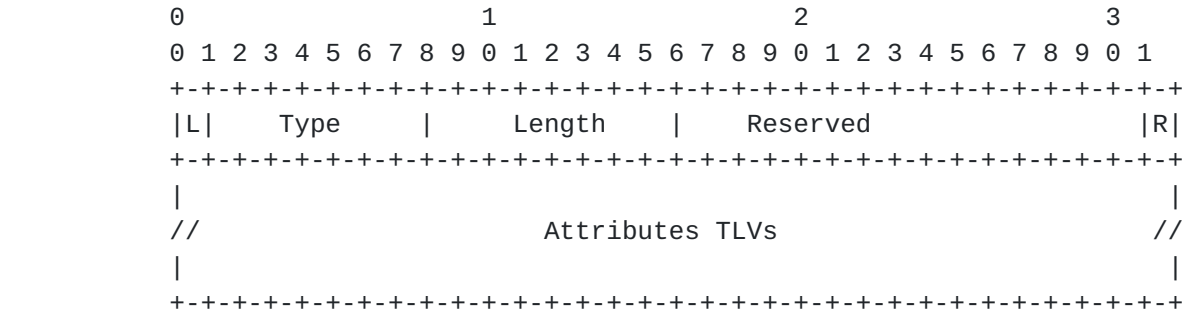
2. ERO Hop Attributes Subobject

The ERO Hop Attributes subobject MAY be carried in the ERO or SERO object if they are present. The subobject uses the standard format of an ERO subobject.

2.1. Encoding

The length is variable and content is a list of HOP Attributes TLVs defined in Section 2.2. The size of the ERO sub-object limits the size of the attribute TLV to 250 bytes. The typical size of currently defined and forthcoming LSP_ATTRIBUTE TLVs applicable to a specific hop (WSON_SIGNALING, Objective Function (OF) and Metric) is not foreseen to exceed this limit.

The ERO Hop Attributes subobject is defined as follows:



The L, Type and Length parameters are as defined in [RFC3209] Section 4.3.3. The L bit MUST be set to 0. The Type for the ERO Hop Attributes subobject is TBA by IANA. The attributes TLV are encoded as defined in Section 2.2.

Reserved Reserved, MUST be set to 0 when the subobject is inserted in the ERO, MUST NOT be changed when a node processes the ERO and MUST be ignored on the node addressed by the preceding ERO subobjects.

R This bit reflects the LSP_REQUIRED_ATTRIBUTE and LSP_ATTRIBUTE semantic defined in [RFC5420]. When set it indicates required hop attributes to be processed by the node. When cleared, it indicates that the hop attributes are not required as described in Section 2.3.

Attributes TLVs The TLVs as defined in Section 2.2.

2.2. HOP Attributes TLVs

ERO Attributes carried by the new objects defined in this document are encoded within TLVs. One or more TLVs MAY be present in each object. There are no ordering rules for TLVs, and interpretation SHOULD NOT be placed on the order in which TLVs are received. The TLV format is defined in [RFC5420] Section 3.

The Attribute Flags TLV defined in [RFC5420] MAY be carried in an ERO Hop Attributes Subobject. Flags set in the an Attribute Flags TLV [RFC5420] carried in a ERO Hop Attributes Subobject SHALL be interpreted in the context of the received ERO. Only a subset of defined flags are defined as valid for use in Attribute Flags TLV carried in a ERO Hop Attributes Subobject. Invalid flags SHALL be silently ignored. Unknown flags SHOULD trigger the generation of a PathErr with Error Code "Unknown Attributes Bit" as defined in [RFC5420] Section 5.2. The set of valid flags are defined in Section 4.3.

2.3. Procedures

As described in [RFC3209] and [RFC3473] the ERO is managed as a list where each hop information starts with a subobject identifying an abstract node or link. The ERO Hop Attributes subobject MAY be appended after any of the existing subobjects defined in [RFC3209], [RFC3473], [RFC3477], [RFC4873], [RFC4874], [RFC5520] and [RFC5553]. Several ERO Hop Attributes subobject MAY be present, for each hop.

Document defining specific Hop attribute TLV has to describe after which kind of subobject they are valid and if TLV modification rules applies. For instance, subobject presence rules can be defined by describing rules similar to [RFC4990] Section 6.1.

If a node is processing an ERO Hop Attributes subobject and does not support handling of the subobject it will behave as described in

[RFC3209] when an unrecognized ERO subobject is encountered. This node will return a PathErr with error code "Routing Error" and error value "Bad EXPLICIT_ROUTE object" with the EXPLICIT_ROUTE object included, truncated (on the left) to the offending unrecognized subobject.

When the R bit is set a node MUST examine the attribute TLV present in the subobject following the rules described in [RFC5420] Section 5.2. When the R bit is not set a node MUST examine the attribute TLV present in the subobject following the rules described in [RFC5420] Section 4.2.

A node processing an ERO Hop Attributes subobject with an HOP Attributes TLV longer than the ERO subobject SHOULD return a PathErr with error code "Routing Error" and error value "Bad EXPLICIT_ROUTE object" with the EXPLICIT_ROUTE object included, truncated (on the left) to the offending malformed subobject. A processing node MUST NOT originates a HOP Attributes TLV longer than the ERO HOP Attributes Subobject. The processing of the Hop attribute TLVs SHOULD be described in the documents defining them.

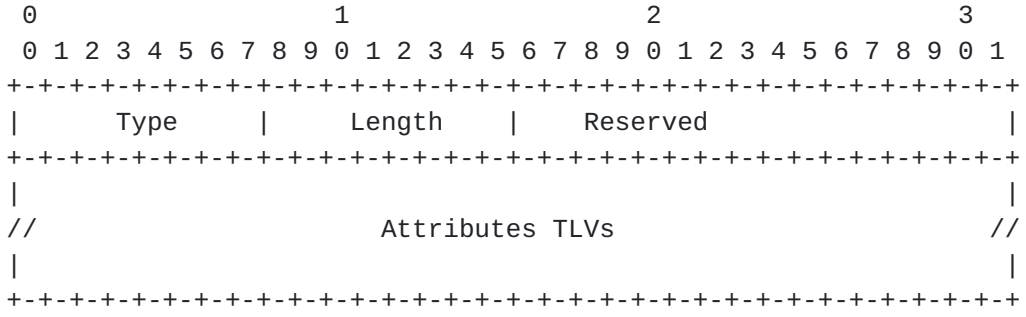
3. RRO Hop Attributes Subobject

In some cases it is important to determine if an OPTIONAL Hop attribute has been processed by a node.

3.1. Encoding

The RRO Hop Attributes subobject MAY be carried in the RECORD_ROUTE object if it is present. The subobject uses the standard format of an RRO subobject.

The RRO Hop Attributes subobject is defined as follows:



The Type and Length parameters are as defined in [RFC3209] Section 4.4.1. The Type for the RRO Hop Attributes subobject is TBA by IANA. The attributes TLV are encoded as defined in Section 2.2.

Reserved Reserved, MUST be set to 0 when the subobject is inserted in the RRO, MUST NOT be changed when a node process the RRO and MUST be ignored on the node addressed by the preceding RRO subobjects.

Attributes TLVs The processed or additional HOP Attributes, using the format defined in Section 2.2.

3.2. Procedures

3.2.1. Subobject Presence Rule

The RRO rules defined in [RFC3209] are not changed. The RRO Hop Attributes subobject MUST be pushed after the RRO Attributes subobject (if present) defined in [RFC5420]. The RRO Hop Attributes subobject MAY be present between a pair of subobjects identifying Label Switching Router (LSR) or links. Unless local policy apply all such subobjects SHOULD be forwarded unmodified by transit LSRs.

It is noted that a node (e.g., a domain edge node) MAY edit the RRO to prune/modify the RRO, including the RRO Hop Attribute subobject before forwarding due to confidentiality policy or other reasons (for instance RRO size reduction).

3.2.2. Reporting Compliance with ERO Hop Attributes

To report that an ERO Hop attribute has been considered, or to report an additional attribute, an LSR MAY add a RRO Hop Attributes subobject with the HOP Attribute TLV which describes the attribute to be reported. The requirement to report compliance MUST be specified in the document that defines the usage of an Hop attribute.

3.2.3. Compatibility with RRO Attributes subobject

The RRO Hop Attributes subobject extends the capability of the RRO Attributes subobject defined in [RFC5420] Section 7.2 by allowing the node to report the attribute value. The mechanism defined in this document is compatible with the RRO Attributes subobject using the following procedures.

For LSP attributes signaled in the LSP_ATTRIBUTES or LSP_REQUIRED_ATTRIBUTES objects, a node SHOULD use the RRO Attributes subobject to report processing of those attributes.

For LSP attributes signaled in the ERO Hop Attributes subobject and not in the LSP_ATTRIBUTES or LSP_REQUIRED_ATTRIBUTES objects, if a node desires to report the attributes, it SHOULD use the RRO Hop Attributes subobject and SHOULD NOT use the RRO Attributes subobject.

Ingress nodes not supporting the RRO Hop Attributes subobject will drop the information, as described in [RFC3209] Section 4.4.5.

A node MAY use the RRO Hop Attribute to report a LSP Attribute signaled in LSP_ATTRIBUTES or LSP_REQUIRED_ATTRIBUTES only if the following conditions are met:

The Attribute and its corresponding flag is allowed on both the LSP_ATTRIBUTES or LSP_REQUIRED_ATTRIBUTES and LSP Hop Attributes subobject.

The document defining this Attribute specify this specific behavior.

4. IANA Considerations

4.1. ERO Hop Attribute Subobject

IANA manages the "RSVP PARAMETERS" registry located at http://www.iana.org/assignments/rsvp-parameters/rsvp-parameters.xml. We request IANA to make an allocation in the Sub-object type 20 EXPLICIT_ROUTE - Type 1 Explicit Route registry.

This document introduces a new ERO sub-object:

Value	Description	Reference
TBA	Hop Attributes	This document, Section 2

4.2. RRO LSP Attribute Subobject

IANA manages the "RSVP PARAMETERS" registry located at http://www.iana.org/assignments/rsvp-parameters/rsvp-parameters.xml. We request IANA to make an allocation in the Sub-object type 21 ROUTE_RECORD - Type 1 Route Record registry. We request the value to be the same as Section 4.1.

This document introduces a new RRO sub-object:

Value	Description	Reference
TBA	Hop Attributes	This document, Section 3

4.3. Existing Attribute Flags

IANA manages the "Attribute Flags" registry as part of the "RSVP-TE PARAMETERS" registry located at http://www.iana.org/assignments/rsvp-te-parameters/rsvp-te-parameters.xml. A new column in the registry

is introduced by this document. This column indicates if the flag is permitted to be used in a Attribute Flags TLV carried in the ERO Hop Attributes Subobject. The column uses the heading "ERO" and the registry is to be updated as follows:

Bit	Name	Attribute FlagsPath	Attribute FlagsResv	RRO	ERO	Reference
0	End-to-end re-routing	Yes	No	No	No	[RFC4920]
1	Boundary re-routing	Yes	No	No	No	[RFC4920]
2	Segment-based re-routing	Yes	No	No	No	[RFC4920]
3	LSP Integrity Required	Yes	No	No	No	[RFC4875]
4	Contiguous LSP	Yes	No	Yes	No	[RFC5151]
5	LSP stitching desired	Yes	No	Yes	No	[RFC5150]
6	Pre-Planned LSP Flag	Yes	No	No	No	[RFC6001]
7	Non-PHP behavior flag	Yes	No	Yes	No	[RFC6511]
8	OOB mapping flag	Yes	No	Yes	No	[RFC6511]
9	Entropy Label Capability	Yes	Yes	No	No	[RFC6790]
10	OAM MEP entities desired	Yes	Yes	Yes	No	[RFC7260]
11	OAM MIP entities desired	Yes	Yes	Yes	No	[RFC7260]
12	SRLG collection Flag (TEMPORARY - registered 2014-09-11, expires 2015-09-11)	Yes	Yes	Yes	No	[I.D.draft-ietf-teas-rsvp-te-srlg-collect]

New allocation requests to this registry SHALL indicate the value to be used in the ERO column.

4.4. Existing LSP Attribute TLVs

IANA manages the "RSVP-TE PARAMETERS" registry located at http://www.iana.org/assignments/rsvp-te-parameters/rsvp-te-parameters.xml. The "Attributes TLV Space" registry manage the following attributes, as defined in [RFC5420]:

- TLV Type (T-field value)
- TLV Name
- Whether allowed on LSP_ATTRIBUTES object
- Whether allowed on LSP_REQUIRED_ATTRIBUTES object

We request IANA to add the following information for each TLV in the RSVP TLV type identifier registry.

o Whether allowed on LSP Hop Attributes ERO subobject

The existing registry is modified for existing TLVs as follows: The following abbreviation are used in the table:

LSP_A Whether allowed on LSP_ATTRIBUTES object.

LSP_RA Whether allowed on LSP_REQUIRED_ATTRIBUTES object.

HOP_A Whether allowed on LSP Hop Attributes subobject.

T	Name	LSP_A	LSP_RA	HOP_A	Ref.
1	Attribute Flags	Yes	Yes	Yes	[RFC5420]
2	Service ID TLV	Yes	No	No	[RFC6060]
3	OAM Configuration TLV	Yes	Yes	No	[RFC7260]

5. Security Considerations

This document adds new subobject in the EXPLICIT_ROUTE and the ROUTE_RECORD object carried in RSVP message used in MPLS and GMPLS signaling. It builds on mechanism defined in [RFC3209] and [RFC5420] and does not introduce any new security. The existing security considerations described in [RFC2205], [RFC3209], [RFC3473] and [RFC5420] do apply.

As any RSVP-TE signaling request, the procedures defined in this document permit the transfer and reporting of functional preferences on specific node. The mechanism added in this document does allow more control of LSP attributes at a given node. As other inputs, a node SHOULD check the Hop Attributes against his policies and admission procedures. A node MAY reject the message using existing RSVP error code like "Policy Control Failure" or "Admission Control Failure". The node MAY also, depending on the specific TLV procedures, modify the requested attribute. This can reveal information about the LSP request and status to anyone with unauthorized access. The mechanism described in this document do not contribute to this issue, which can be only resolved by encrypting the content of the whole signaling message.

In addition the reporting of attributes using the RRO can reveal details about the node that the operator wishes to remains confidential. The same strategy and policies that apply to other RRO subobjects also apply to this new mechanism. It is RECOMMENDED that domain boundary policies take the releasing of RRO hop attributes into consideration.

6. Acknowledgments

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