Encoding of Attributes of LSP intermediate hops using RSVP-TE
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Abstract

RFC5420 specifies a general framework to support signaling and reporting of generic attributes relevant for a signaled LSP. This document extends the concept and defines a new Explicit Route subobject for RSVP-TE to allow the specification and reporting of attributes relevant to a particular hop of the signaled LSP.
1. Introduction

Generic encoding of LSP attributes is defined in [RFC5420]. It defines two objects: the LSP_ATTRIBUTES and the LSP_REQUIRED_ATTRIBUTES. These two objects are designed to be flexible placeholders in order to carry general LSP related attributes. The content of these new objects are processed by not only the endpoints, but may be interpreted by any intermediate node along the LSP. This procedure allows intermediate nodes to access, extend or modify these attributes.

The Explicit Route Object [RFC3209] allows the ingress node to partially or fully specify the route of an LSP. The route is encoded as a sequence of hops that identifies a node or interface that must be crossed. Further attributes assigned to each hop can be added to the route such as per-hop label control [RFC3473] and list of prohibited resources between two nodes [RFC4874]. These additional attributes are inserted into the ERO as subsequent subobjects and are relevant to the preceding hop describing subobject.
2. Problem statement

[RFC5420] primarily deals with attributes that are relevant to the whole LSP. Currently, it is not possible to declare and signal attributes to a specific intermediate hop of the LSP.

There are two straightforward options to signal attributes for intermediate hops:

1. Define a new HOP_ATTRIBUTES TLV in the LSP_REQUIRED_ATTRIBUTES Object, where sub-TLVs would identify hops (similarly as in the ERO) and specify attributes for that specific hop. If attributes for multiple hops need to be specified, multiple hop identifying sub-TLVs can be used.

2. Introduce a new sub-object in the ERO to carry the attributes of the associated hop specified in the ERO.

The first option detaches the encoding of the hop related attributes from route description (from the ERO). This may create problems if for any reason the hops specified in the ERO and the hops identified in the LSP_REQUIRED_ATTRIBUTES Object get mismatched. The second option binds the hop related attributes to the route description avoiding a possible mismatch of cross-references.

In this document we introduce (2), i.e, a new ERO sub-object that encodes attributes relevant to a particular internal node or interface of the LSP. To be extensible the objects consist of TLVs.
3. HOP_ATTRIBUTES subobject

The HOP_ATTRIBUTES subobject can be inserted into route specifying and route recording objects specified for RSVP-TE: Explicit Route Object (ERO)/Secondary Explicit Route Object (SERO) and Record Route Object (RRO)/Secondary Record Route Object (SRRO); and it follows an IPv4 or IPv6 prefix or Unnumbered Interface ID subobject. The carrying object provides the scope of the HOP_ATTRIBUTES subobject as well as processing rules of its content. Regardless the carrying object, content of a HOP_ATTRIBUTES subobject is always relevant to the preceding hop encoding subobject.

Note that the HOP_ATTRIBUTES subobject defines a new TLV space that is independent to the TLV space allocated in [RFC5420].

3.1. Format

HOP_ATTRIBUTES Type = 0x06 (IANA to assign), same value allocated in ERO and RRO TLV spaces.

```
0                   1                   2                   3
+------------------+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|0|    Type     |     Length    |        Reserved               |
+------------------+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                    Attribute TLVs                             |
+------------------+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

3.2. Processing HOP_ATTRIBUTES subobject

3.2.1. Processing rules for ERO embedding

A HOP_ATTRIBUTES subobject follows an IPv4 or IPv6 prefix or Unnumbered Interface ID subobject. The attributes carried in the HOP_ATTRIBUTES subobject is relevant to the associated (preceding) interface or node.

A node that does not recognize the type of a TLV carried in the HOP_ATTRIBUTES object must reject the PATH message and issue a PATH_TEAR message with Error Code "Unknown HOP_ATTRIBUTE TLV" and the Error Value is set to the type code of the unknown TLV.

When a node recognizes the TLV type code but does not support the attributes of that TLV, it must act according to the document describing the TLV.
3.2.2. Processing Rules for RRO embedding

An intermediate node may want to notify the endpoints on e.g., hop related status information or values used/selected for specific attributes. In this case the information to be reported is included in a HOP_ATTRIBUTES subobject, which is inserted into the RRO and follows an IPv4 or IPv6 prefix of an Unnumbered Interface ID subobject.
4. IANA to Consider

- The HOP_ATTRIBUTES subobject can be inserted into any route describing objects specified for RSVP-TE: Explicit Route Object (ERO)/Secondary Explicit Route Object (SERO) and Record Route Object (RRO)/Secondary Record Route Object (SRRO). A new type needs to be assigned for the HOP_ATTRIBUTES subobject, for both the ERO and RRO. The suggested value is 0x06 (IANA to assign).

- The HOP_ATTRIBUTES subobject consist of TLVs; a new TLV space is required from which TLVs will be assigned.

- A node that does not recognize the type of a TLV carried in the HOP_ATTRIBUTES object must issue a PATH_TEAR message with Error Code "Unknown HOP_ATTRIBUTE TLV" (IANA to assign) and the Error Value is set to the type code of the unknown TLV.
5. Security Considerations

This document adds a new subobject to Explicit Route, Record Route and Secondary Explicit Route objects. It does not introduce any new direct security issues than listed in [RFC5420].

Any passing node may provide unauthorized access to the attributes relevant to downstream nodes and may alter the attributes. Any passing node may provide unauthorized access to the attribute or state information reported by any downstream node and may alter them. This document does not provide solution for this issue, that could be handled through encoding and/or digitally signing the objects.
6. References


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