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Resource Reservation Protocol (RSVP) Message Formats for Label Switched Path (LSP) Attributes Objects

Abstract

Multiprotocol Label Switching (MPLS) Label Switched Paths (LSPs) established using the Resource Reservation Protocol Traffic Engineering (RSVP-TE) extensions may be signaled with a set of LSP-specific attributes. These attributes may be carried in both Path and Resv messages. This document specifies how LSP attributes are to be carried in RSVP Path and Resv messages using the Routing Backus-Naur Form and clarifies related Resv message formats. This document updates RFC 4875 and RFC 5420.

Status of This Memo

This is an Internet Standards Track document.

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1. Introduction

Signaling in support of Multiprotocol Label Switching (MPLS) and Generalized MPLS (GMPLS) point-to-point Label Switched Paths (LSPs) is defined in [RFC3209] and [RFC3473]. [RFC4875] defines signaling support for point-to-multipoint (P2MP) Traffic Engineering (TE) LSPs.

Two LSP Attributes objects are defined in [RFC5420]. These objects may be used to provide additional information related to how an LSP should be set up when carried in a Path message and, when carried in a Resv message, how an LSP has been established. The definition of the objects includes a narrative description of related message formats (see Section 9 of [RFC5420]). This definition does not provide the related Routing Backus-Naur Form (BNF) [RFC5511] that is typically used to define how messages are to be constructed using RSVP objects. The current message format description has led to the open question of how the LSP Attributes objects are to be processed in Resv messages of P2MP LSPs (which are defined in [RFC4875]).

This document provides the BNF for Path and Resv messages carrying the LSP Attributes object. The definition clarifies how the objects are to be carried for all LSP types. Both Path and Resv message BNF is provided for completeness.

This document presents the related RSVP message formats as modified by [RFC5420]. This document modifies formats defined in [RFC3209], [RFC3473], and [RFC4875]. See [RFC5511] for the syntax used by RSVP. Unmodified formats are not listed. An example of a case where the modified formats are applicable is described in [RFC6511].

1.1. Conventions Used in This Document

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].

2. Path Messages

This section updates [RFC4875]. Path message formatting is unmodified from the narrative description provided in Section 9 of [RFC5420]:

> The LSP_ATTRIBUTES object and the LSP_REQUIRED_ATTRIBUTES object MAY be carried in a Path message....
>
> The order of objects in RSVP-TE messages is recommended, but implementations must be capable of receiving the objects in any meaningful order.
>
> On a Path message, the LSP_ATTRIBUTES object and LSP_REQUIRED_ATTRIBUTES objects are RECOMMENDED to be placed immediately after the SESSION_ATTRIBUTE object if it is present, or otherwise immediately after the LABEL_REQUEST object.
>
> If both the LSP_ATTRIBUTES object and the LSP_REQUIRED_ATTRIBUTES object are present, the LSP_REQUIRED_ATTRIBUTES object is RECOMMENDED to be placed first.
>
> LSRs MUST be prepared to receive these objects in any order in any position within a Path message. Subsequent instances of these objects within a Path message SHOULD be ignored and MUST be forwarded unchanged.

2.1. Path Message Format

This section presents the Path message format as modified by [RFC5420]. Unmodified formats are not listed.

```
<Path Message> ::=     <Common Header> [ <INTEGRITY> ]
                       [ [<MESSAGE_ID_ACK> | <MESSAGE_ID_NACK>] ...]
                       [ <MESSAGE_ID> ]
                       <SESSION> <RSVP_HOP>
```

```
                        <TIME_VALUES>
                        [ <EXPLICIT_ROUTE> ]
                        <LABEL_REQUEST>
                        [ <PROTECTION> ]
                        [ <LABEL_SET> ... ]
                        [ <SESSION_ATTRIBUTE> ]
                        [ <LSP_REQUIRED_ATTRIBUTES> ... ]
                        [ <LSP_ATTRIBUTES> ... ]
                        [ <NOTIFY_REQUEST> ]
                        [ <ADMIN_STATUS> ]
                        [ <POLICY_DATA> ... ]
                        <sender descriptor>
                        [<S2L sub-LSP descriptor list>]
```

Note that PathErr and PathTear messages are not impacted by the introduction of the LSP Attributes objects.

3. Resv Messages

This section updates [RFC4875] and [RFC5420]. Section 9 of [RFC5420] contains the following text regarding Resv messages:

> The LSP_ATTRIBUTES object MAY be carried in a Resv message.
>
> The order of objects in RSVP-TE messages is recommended, but implementations must be capable of receiving the objects in any meaningful order.
>
> ...
>
> On a Resv message, the LSP_ATTRIBUTES object is placed in the flow descriptor and is associated with the FILTER_SPEC object that precedes it. It is RECOMMENDED that the LSP_ATTRIBUTES object be placed immediately after the LABEL object.
>
> LSRs MUST be prepared to receive this object in any order in any position within a Resv message, subject to the previous note. Only one instance of the LSP_ATTRIBUTES object is meaningful within the context of a FILTER_SPEC object. Subsequent instances of the object SHOULD be ignored and MUST be forwarded unchanged.

This means that LSP attributes may be present per sender (LSP) and allows for the LSP Attributes object to be modified using make-before-break (see [RFC3209]). This definition is sufficient for point-to-point ([RFC3209] and [RFC3473]) LSPs and the special case where all point-to-multipoint source-to-leaf (S2L) sub-LSPs ([RFC4875]) report the same operational status (as used in [RFC5420]). However, this definition does not allow for different

egress Label Switching Routers (LSRs) to report different operational statuses. In order to allow such reporting, this document adds the following definition:

> An LSR that wishes to report the operational status of a (point-to-multipoint) S2L sub-LSP may include the LSP Attributes object in a Resv message or update the object that is already carried in a Resv message. LSP Attributes objects representing S2L sub-LSP status MUST follow a S2L_SUB_LSP object. Only the first instance of the LSP Attributes object is meaningful within the context of a S2L_SUB_LSP object. Subsequent instances of the object SHOULD be ignored and MUST be forwarded unchanged.
>
> When an LSP Attributes object is present before the first S2L_SUB_LSP object, the LSP Attributes object represents the operational status of all S2L sub-LSPs identified in the message. Subsequent instances of the object (e.g., in the filter spec or the S2L sub-LSP flow descriptor) SHOULD be ignored and MUST be forwarded unchanged. When a branch node is combining Resv state from multiple receivers into a single Resv message and an LSP Attributes object is present before the first S2L_SUB_LSP object in a received Resv message, the received LSP Attributes object SHOULD be moved to follow the first received S2L_SUB_LSP object and then SHOULD be duplicated for, and placed after, each subsequent S2L_SUB_LSP object.

3.1. Resv Message Format -- Per LSP Operational Status

This section presents the Resv message format for LSPs as modified by [RFC5420] and can be used to report operational status per LSP. Unmodified formats are not listed. The following is based on [RFC4875].

```
<FF flow descriptor list> ::= <FF flow descriptor>
                              [ <FF flow descriptor list> ]

<FF flow descriptor>      ::= [ <FLOWSPEC> ] <FILTER_SPEC> <LABEL>
                              [ <LSP_ATTRIBUTES> ... ]
                              [ <RECORD_ROUTE> ]
                              [ <S2L sub-LSP flow descriptor list> ]

<SE flow descriptor>      ::= <FLOWSPEC> <SE filter spec list>

<SE filter spec list>     ::= <SE filter spec>
                              [ <SE filter spec list> ]
```

```
<SE filter spec>          ::= <FILTER_SPEC> <LABEL>
                              [ <LSP_ATTRIBUTES> ... ]
                              [ <RECORD_ROUTE> ]
                              [ <S2L sub-LSP flow descriptor list> ]
```

3.2. Resv Message Format -- Per S2L Operational Status

This section presents the Resv message format for LSPs as modified by this document and [RFC5420], and can be used to report operational status per S2L sub-LSP. Unmodified formats are not listed. The following is based on [RFC4875].

```
<FF flow descriptor> ::= [ <FLOWSPEC> ] <FILTER_SPEC> <LABEL>
                         [ <RECORD_ROUTE> ]
                         [ <S2L sub-LSP flow descriptor list> ]

<SE filter spec>     ::= <FILTER_SPEC> <LABEL> [ <RECORD_ROUTE> ]
                         [ <S2L sub-LSP flow descriptor list> ]

<S2L sub-LSP flow descriptor list> ::=
                           <S2L sub-LSP flow descriptor>
                           [ <S2L sub-LSP flow descriptor list> ]

<S2L sub-LSP flow descriptor>      ::= <S2L_SUB_LSP>
                           [ <LSP_ATTRIBUTES> ... ]
                           [ <P2MP_SECONDARY_RECORD_ROUTE> ]
```

3.2.1. Compatibility

A node that supports [RFC4875] and [RFC5420], but not this document, will interpret the first LSP Attributes object present in a received message, which is formatted as described in this document, as representing LSP operational status rather than S2L sub-LSP status. It is unclear if this is a significant issue as the LSP Attributes object is currently considered to be an unsuitable mechanism for reporting operational status of P2MP LSPs, for example, see Section 2.1 of [RFC6511]. The intent of this document is to correct this limitation; it is expected that networks that wish to make use of such operational reporting will deploy this extension.

4. Security Considerations

This document clarifies usage of objects defined in [RFC5420]. No new information is conveyed; therefore, no additional security considerations are included here. For a general discussion on MPLS- and GMPLS-related security issues, see the MPLS/GMPLS security framework [RFC5920].

5. Acknowledgments

The authors would like to acknowledge the contributions of Adrian Farrel.

6. References

6.1. Normative References

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6.2. Informative References

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[RFC6511] Ali, Z., Swallow, G., and R. Aggarwal, "Non-Penultimate Hop Popping Behavior and Out-of-Band Mapping for RSVP-TE Label Switched Paths", RFC 6511, February 2012.

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