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MPLS Upstream Label Assignment for RSVP-TE

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Abstract

This document describes procedures for distributing upstream-assigned labels for Resource Reservation Protocol - Traffic Engineering (RSVP-TE). It also describes how these procedures can be used for avoiding branch LSR traffic replication on a LAN for RSVP-TE point-to-multipoint (P2MP)LSPs.

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1. Specification of requirements

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. Introduction

This document describes procedures for distributing upstream-assigned labels [MPLS-UPSTREAM] for Resource Reservation Protocol with Traffic Engineering (RSVP-TE). These procedures follow the architecture for MPLS Upstream Label Assignment described in [MPLS-UPSTREAM].

This document describes extensions to RSVP-TE that a LSR can use to advertise to its neighboring LSRs whether the LSR supports upstream label assignment.

This document also describes extensions to RSVP-TE to distribute upstream-assigned labels.

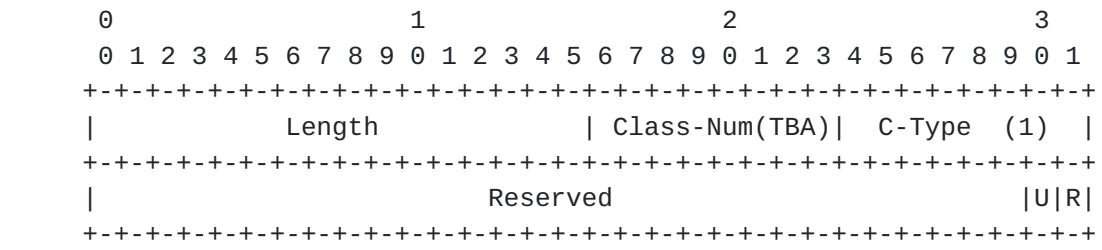
The usage of MPLS upstream label assignment using RSVP-TE for avoiding branch LSR [RSVP-P2MP] traffic replication on a LAN for RSVP-TE P2MP TE LSPs [RSVP-TE-P2MP] is also described.

3. RSVP-TE Upstream Label Assignment Capability

According to [MPLS-UPSTREAM], upstream-assigned label bindings MUST NOT be used unless it is known that a downstream LSR supports them. This implies that there MUST be a mechanism to enable a LSR to advertise to its RSVP-TE neighbor LSR(s) its support of upstream-assigned labels.

[RSVP-RESTART] defines a CAPABILITY object to be carried within Hello messages, and used to indicate the set of capabilities supported by a node. Currently one flag is defined, the R flag indicating the support for RecoveryPath Srefresh. This document defines a new flag, the U flag, to signal a LSR's support of upstream label assignment to its RSVP-TE neighbors.

The format of a Capability object is:



Recovery Path Srefresh Capable (R): 1 bit, defined in [RSVP-RESTART].

Upstream Label Assignement Capable (U): 1 bit When set this means that the LSR is capable of both distributing upstream-assigned label bindings and receiving upstream-assigned label bindings

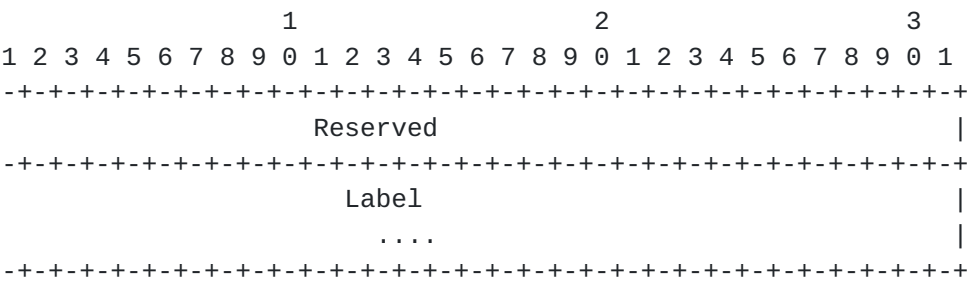
Reserved bits MUST be set to zero on transmission and MUST be ignored on receipt.

The usage of RSVP-TE Hello messages for exchanging upstream label assignment capability implies that a LSR MAY exchange RSVP-TE Hellos with a neighbor before sending/receiving any other RSVP-TE messages to/from that neighbor.

4. Distributing Upstream-Assigned Labels in RSVP-TE

An optional RSVP-TE object, the UPSTREAM_ASSIGNED_LABEL object is introduced to signal an upstream-assigned label. The Class-Num for this object comes from the 0bbbbbbb space and is to be determined by IANA.

UPSTREAM_ASSIGNED_LABEL C-Num = TBD



The label can be encoded as in [RFC3209] when the C-Type is 1 or as a Generalized Label [RFC3473] when the C-Type is 2 or 3.

4.1. Procedures

A RSVP-TE LSR that assigns Upstream-Assigned Labels, distributes them to the downstream LSRs by including them in RSVP-TE Path messages.

A RSVP-TE LSR MUST NOT distribute the UPSTREAM_ASSIGNED_LABEL Object to a downstream LSR if the downstream LSR had not previously advertised the CAPABILITY object with the U bit set in its RSVP-TE Hello messages.

If a downstream RSVP-TE LSR receives a Path message that carries an UPSTREAM_ASSIGNED_LABEL Object and the LSR does not support the object C-Num/C-Type it will return an "Unknown Object C-Num/C-Type" error. If the LSR does support the object, but is unable to process the upstream-assigned label as described in [MPLS-UPSTREAM] it SHOULD send a PathErr with the error code "Routing problem" and the error value "MPLS Upstream Assigned Label Processing Failure". If the LSR successfully processes the Path message and the upstream-assigned label it MUST send a Resv message upstream as per [RFC3209] but it MUST NOT include the LABEL object with a downstream assigned label in the Resv Message. This is because as described in [MPLS-UPSTREAM] two LSRs Ru and Rd for a LSP that is bound to FEC F, MUST use either downstream-assigned label distribution or upstream-assigned label distribution,for FEC F, but NOT both, for packets that are to be transmitted on the LSP from Ru to Rd.

5. RSVP-TE Tunnel Identifier Exchange

As described in [MPLS-UPSTREAM] an upstream LSR Ru MAY transmit a MPLS packet, the top label of which (L) is upstream-assigned, to a downstream LSR Rd, by encapsulating it in an IP or MPLS tunnel. In this case the fact that L is upstream-assigned is determined by Rd by the tunnel on which the packet is received. There must be a mechanism for Ru to inform Rd that a particular tunnel from Ru to Rd will be used by Ru for transmitting MPLS packets with upstream-assigned MPLS labels.

When RSVP-TE is used for upstream label assignment, the IF_ID RSVP_HOP object is used for signaling the Tunnel Identifier. If Ru uses an IP or MPLS tunnel to transmit MPLS packets with upstream assigned labels to Rd, Ru MUST include the IF_ID RSVP_HOP object [RFC3473] in Path messages along with the UPSTREAM_ASSIGNED_LABEL Object.

Two new TLVs are introduced in the IF_ID RSVP_HOP object [RFC3471] to support RSVP-TE P2MP LSPs and IP Multicast Tunnels. The TLV value acts as the tunnel identifier.

1. RSVP-TE P2MP LSP TLV. Type = TBD. Value of the TLV is the RSVP-TE P2MP Session Object and optionally the P2MP Sender Template Object [RSVP-TE-P2MP]. The TLV value identifies the RSVP-TE P2MP LSP. This mechanism extends RSVP-TE P2P Hierarchy [LSP-HIER] to RSVP-TE P2MP Hierarchy. It allows Ru to tunnel an "inner" P2MP LSP, the label for which is upstream assigned, over an "outer" P2MP LSP that has leaves <Rd1...Rdn>. The P2MP LSP IF_ID TLV allows Ru to signal to <Rd1...Rdn> the binding of the inner P2MP LSP to the outer P2MP LSP. The control plane signaling between Ru and <Rd1...Rdn> for the inner P2MP LSP uses directed RSVP-TE signaling messages as in [LSP-HIER].

2. IP Multicast Tunnel TLV. Type = TBD. In this case the TLV value is a <Source Address, Multicast Group Address> tuple.

6. RSVP-TE Point-to-Multipoint LSPs on a LAN

This section describes one application of upstream label assignment using RSVP-TE. Further applications are to be described in separate documents.

[RSVP-TE-P2MP] describes how to setup RSVP-TE P2MP LSPs. On a LAN the solution described in [RSVP-TE-P2MP] relies on "ingress replication". A LSR on a LAN, that is a branch LSR for a P2MP LSP, (say Ru) sends a separate copy of a packet that it receives on the P2MP LSP to each of

the downstream LSRs on the LAN (say <Rd1...Rdn> that are adjacent to it in the P2MP LSP.

In order to increase efficiency of bandwidth utilization, it is desirable for Ru to send a single copy of the packet for the P2MP LSP on the LAN, when there are multiple downstream routers on the LAN that are adjacent in that P2MP LSP. This requires that each of <Rd1...Rdn> must be able to associate the label L, used by Ru to transmit packets for the P2MP LSP on the LAN, with that P2MP LSP. It is possible to achieve this using RSVP-TE upstream-assigned labels with the following procedures. Assume that Ru and <Rd1...Rdn> support upstream label assignment.

Ru sends a Path message for the P2MP LSP to each of <Rd1...Rdn> that is adjacent on the P2MP LSP, with the same UPSTREAM_ASSIGNED_LABEL object. This object carries an upstream assigned label, L. <Rd1...Rdn> "reserve" the upstream assigned label in the separate Upstream Neighbor Label Space that they maintain for Ru [MPLS-UPSTREAM]. Ru can then transmit a single packet for the P2MP LSP to <Rd1..Rdn> with a top label L using procedures defined in [MPLS-UPSTREAM] and [MPLS-MCAST-ENCAPS].

If a subset of <Rd1...Rdn> does not support upstream label assignment these procedures can still be used between Ru and the remaining sub-set of <Rd1...Rdn>. Ingress replication and downstream label assign-ment will continue to be used for LSRs that do not support upstream label assignment.

7. Acknowledgements

Thanks to Yakov Rekhter for his contribution. Thanks to Ina Minei and Thomas Morin for their comments.

8. References

8.1. Normative References

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