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Extensions to RSVP to Handle Establishment of Alternate Label-Switched Paths for Fast Re-route

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Status

Abstract

This document describes the RSVP extensions that may facilitate creation of an alternative label switched path to handle fast data packet reroute upon failure in a primary label switched path in an Multi-protocol Label Switching (MPLS) network as described in [3]. As such, this draft is a companion draft to [3]. The proposed extensions present no backward compatibility issues.

1. Introduction

A mechanism to establish an alternate label-switched path (LSP) that is used for quickly re-routing traffic in the event of a network element failure or congestion along the primary LSP is described in [3]. Only one alternate LSP needs to be created in this approach as opposed to an approach that requires multiple alternate LSPs to be created at each intermediate switch along the LSP. Such an approach reduces computational complexity and the associated signalling overhead. It is required that the alternate backup LSP does not share any network elements (links or label-switched routers (LSR)) with the exception of the source and destination LSRs of the primary LSP.

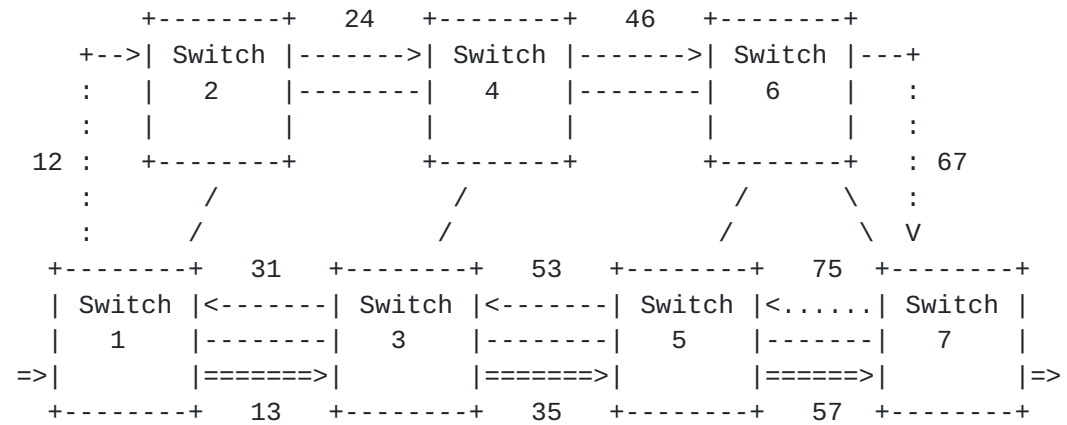
This document defines objects necessary for signalling the creation and establishment of the alternate LSP when the primary and alternative LSPs are initiated from a single router using RSVP [4].

2. Description of the Approach

The main idea behind the approach in [3] is to redirect traffic at the point of failure in the primary LSP back to the source end-point of the primary LSP in the reverse direction after which the traffic flow is sent along via the alternate disjoint LSP between source and destination switches of the protected primary LSP.

Referring to Figure 1, there is an MPLS network consisting of 7 interconnected switches.

Figure 1:



A primary LSP between switches 1 and 7 is shown by a double-dashed links labeled 13, 35, and 57. Arrows indicate direction of the data

traffic.

The initial segment of the alternative LSP runs between the destination LSR and the source LSR in the reverse direction of the primary path traversing through every switch between the last hop switch and the source LSR. The dashed line between switches 5 and 1 illustrates such a segment of the alternative path.

The second and final segment of the alternative path is set between the source switch and the destination switch along a transmission path disjoint from the primary LSP. The dashed line between Switches 1 and 7 through Switches 2, 4, and 6 illustrates the final segment of the alternative LSP.

The initial and final segments of the alternative path are linked to form an entire alternative path from the last hop switch to the destination switch. In Figure 1 the entire alternative path consists of the LSP links labeled 53, 31, 12, 24, 46, and 67 if the alternative path originates at the last hop switch.

As soon as a link failure or congestion along the protected path is detected an operational switch at ingress of failed link reroutes incoming traffic around of the failure or congestion by linking upstream portion of the primary path to the downstream portion of the alternative path. Thus if the link between Switches 3 and 5 fails, the primary and alternative paths are linked at Switch 3 forming the following label switched path for the traffic flow: 13->31->12->24->46->67.

3. Extensions to RSVP for Alternate LSP Establishment

Clearly, a label-switched path needs to be set up similar to the establishment of the primary LSP. The presence of LABEL-REQ object in the PATH message and LABEL object in the RESV message enables the downstream-on-demand label allocation policy by which the labels are exchanged among the neighbors. As shown in Figure 1, the alternate LSP is composed of two components: the disjoint segment between the source end-point and the destination end-point of the primary LSP (12->24->46->67 in the example) and the segment in the reverse direction between the destination end-point and the source end-point traversing the same network elements as the primary LSP (75->53->31).

3.1 Establishing the Disjoint Segment of the Alternate LSP.

No new RSVP objects are necessary for establishing the disjoint segment of the alternate LSP. Procedures similar to the creation of the primary LSP can be used to establish this disjoint segment. As mentioned earlier, care should be exercised to make sure that this segment of the alternate path is completely disjoint from the

primary LSP. For instance, the disjoint segment can be explicitly specified using the Explicit Route Object (ERO) in the PATH message [4].

3.2 Establishing the Reverse Segment of the Alternate LSP.

New RSVP objects are required in the PATH and RESV messages to establish the reverse segment of the alternate LSP.

A new Flag option is defined in the Flags field of the SESSION-ATTRIBUTE object that specifies Fast-reroute based on reverse-path setup.

Flags

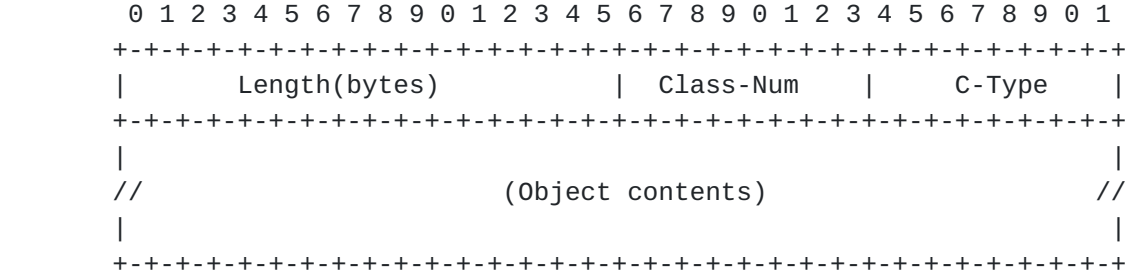
0x08 = Fast reroute based on reverse-path alternate LSP. When this flag is set, all transit LSRs set up an alternate LSP based on the mechanism specified in this document.

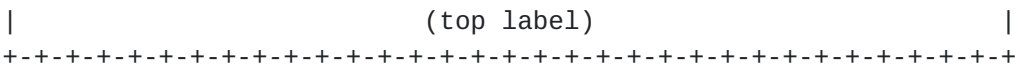
Two new optional objects are required: a REVERSE-LABEL-REQ object in the RESV message and REVERSE-LABEL object in the PATH message are used for setting up the reverse segment of the alternate LSP. The term REVERSE refers to the establishment of an alternate LSP in the reverse direction of the primary LSP. The function and format of these objects are similar to the LABEL-REQ and the LABEL object used to set-up the primary LSP.

When the destination end-point of the primary LSP receives a PATH message consisting of the SESSION-ATTRIBUTE object, it includes the optional REVERSE-LABEL-REQ object in the corresponding RESV message if Fast-reroute is enabled in the SESSION-ATTRIBUTE object. Each LSR in the path of the primary LSP allocates a label for the reverse segment of the alternate LSP and stores the label in the PSB for inclusion in the corresponding PATH message. An LSR that receives a RESV message with the REVERSE-LABEL-REQ object should allocate and include the REVERSE-LABEL object in the corresponding PATH message, unless it is unable to allocate a label in the specified label range in the REVERSE-LABEL-REQ object. In that case, the LSR should send a PATHERR message with the appropriate error codes.

REVERSE-LABEL object

REVERSE-LABEL Class = [TBD] C-Type = 1




(top label)

The contents of the REVERSE-LABEL object are a stack of labels, and the top of the stack is in the right four octets of the contents.

REVERSE-LABEL-REQ object

REVERSE-LABEL-REQ Class = [TBD] C-Type = 1

The format of the REVERSE-LABEL-REQ object is similar to that of the LABEL-REQ object with the exception of the Class number. Three possible C-Types are supported: Label request without a label range, Label request with an ATM label range and a Label request with a Frame Relay label range.

The source end-point of the LSP allocates a label in the PATH message for the reverse segment of the alternate LSP, in response to a label request from its downstream neighbor. This label is used as the incoming label in its cross-connect table while the outgoing label used by the source end-point is allocated by its immediate downstream neighbor in the disjoint segment of the alternate LSP. The proposed extensions are backward compatible with those LSRs that do not recognize the optional REVERSE-LABEL_REQ and REVERSE-LABEL objects.

4. References

[1] Rosen, E. et al., "Multiprotocol Label Switching Architecture", Internet Draft, draft-ietf-mpls-arch-05.txt, April 1999.

[2] Awduche, D. et al., "Requirements for Traffic Engineering over MPLS", Internet Draft, draft-ietf-mpls-traffic-eng-00.txt, October 1998.

[3] Haskin, D. et al., "A Method for Setting an Alternate Label-Switched Paths to Handle Fast Re-route", work in progress, draft-haskin-fast-reroute-00.txt, June 1999.

[4] Awduche, D. et al., "Extensions to RSVP for LSP tunnels", work in progress, draft-ietf-mpls-rsvp-lsp-tunnel-01.txt, March 1999.

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