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RSVP-TE Extensions For Signaling GMPLS Restoration LSP
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Abstract

Generalized Multi-Protocol Label Switching (GMPLS) RSVP-TE recovery signaling extensions are specified in [RFC4872] and [RFC4873]. In transport networks, there are requirements where GMPLS recovery scheme need to employ restoration LSP while keeping resources for the working and/ or protecting LSPs reserved in the network. Currently GMPLS recovery procedures do not address these requirements. This document proposes RSVP-TE extensions for GMPLS recovery with restoration LSP.

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1. Introduction

Generalized Multi-Protocol Label Switching (GMPLS) extends MPLS to include support for different switching technologies [RFC3471] [RFC3473]. These switching technologies provide several protection schemes [RFC4426][RFC4427] (e.g. 1+1, 1:N and M:N). GMPLS RSVP-TE signaling has been extended to support various recovery schemes to establish Label Switched Paths (LSPs) [RFC4872][RFC4873], typically working LSP and protecting LSP. [RFC4427] Section 7 specifies various schemes for GMPLS restoration.

In GMPLS recovery schemes currently considered, restoration LSP is signaled after the failure has been detected and notified on the working LSP. These schemes assume that working LSP is removed from the network before restoration LSP is signaled. In transport network, as working LSP are typically signaled over a nominal path, there are many scenarios where service providers would like to keep resources associated with the working LSP reserved. This is to make sure that the service (working LSP) can use the nominal path when the failure is repaired. Consequently, in transport networks one can employ a recovery scheme where a new restoration LSP is signaled while working LSP and/ or protecting LSP are not torn down in control plane due to a failure. Restoration LSP differs from a secondary LSP in the way that secondary LSP does not reserve resources in the data plane and is not able to carry any traffic until it is refreshed whereas restoration LSP does reserve resources and is able to carry traffic.

One example of the recovery scheme considered in this draft is 1:R recovery. 1:R recovery is exemplified in Figure 1. In this example, working LSP on path A-B-C-Z is pre-established. Typically after a failure detection and notification on the working LSP, a second LSP on path A-H-I-J-Z is established as a restoration LSP. Unlike protection LSP, restoration LSP is signaled on as needed basis.

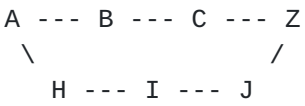


Figure 1: An example of 1:R recovery scheme

During failure, working LSP resources are not released and working and restoration LSPs coexist in the network. Nonetheless, working and restoration LSPs can share network resources. Typically when failure is recovered on the working LSP, restoration LSP is no longer required and torn down (e.g. revertive mode).

Another example of the recovery scheme considered in this draft is 1+1:R. In 1+1:R, a restoration LSP is signaled for the working LSP and/ or the protecting LSP after the failure has been detected and notified on the working LSP or the protecting LSP. The 1+1:R recovery is exemplified in Figure 2. In this example, working LSP on path A-B-C-Z and protecting LSP on path A-D-E-F-Z are pre-established. After a failure detection and notification on a working LSP or protecting LSP, a third LSP on path A-H-I-J-Z is established as a restoration LSP. The restoration LSP in this case provides protection against a second order failure. Restoration LSP is torn down when the failure on the working or protecting LSP is repaired.

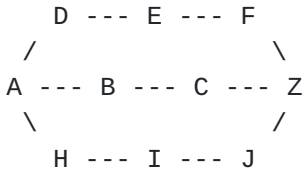


Figure 2: An example of 1+1:R recovery scheme

[RFC4872] Section 14 defines PROTECTION object for GMPLS recovery signaling. The PROTECTION object is used to identify primary and secondary LSPs using S bit and protecting and working LSPs using P bit. However, the PROTECTION object does not have a way to identify restoration LSP or signal protection type for the type of recovery considered by this document. This document defines a new flag in the RSVP PROTECTION object [RFC4872] [RFC4873] to identify the GMPLS restoration LSP and new LSP flags to signal LSP protection types addressed by this draft.

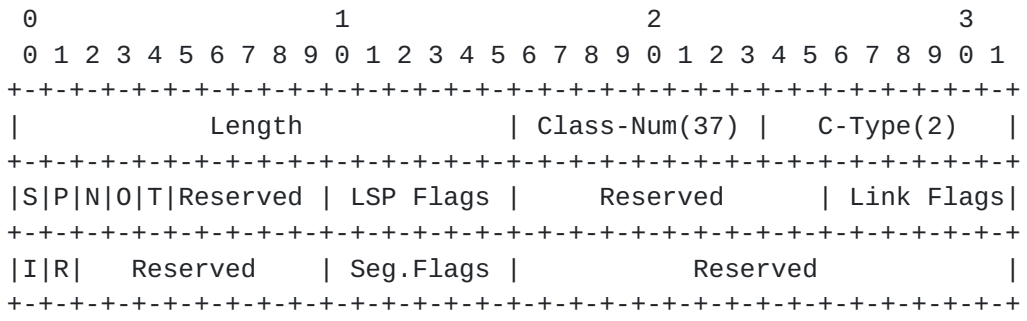
2. Conventions used in this document

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].

3. Signaling Extensions

3.1. Signaling Procedure

The PROTECTION object [RFC4873] [RFC4872] format has been defined as follows. A new bit named T bit is defined in this object to indicate GMPLS restoration LSP.



Restoration (T) : 1 bit

When set to 1, this bit indicates that the request LSP is a restoration LSP. Working LSP is signaled with P bit set to 0 and T bit set to 0. Protecting LSP is signaled with P set to 1 and T bit set to 0.

When a restore LSP is signaled due to a failed protecting LSP, P bit and T bit MUST be set to 1. When a restore LSP is signaled due to failed working LSP, P bit is set to 0 and T bit is set to 1. When T bit is set to 1 and S bit set 1 is permitted but usage is outside the scope of this document.

LSP (Protection Type) Flags: 6 bits

Indicates the desired end-to-end LSP protection type. Following new values are defined in this document in addition to the ones defined in [RFC4872].

0x20 (TBD)	(Full) Rerouting with Restoration (1:R)
0x21 (TBD)	1:N:R Protection with Extra-Traffic with Restoration
0x22 (TBD)	1+1:R Unidirectional Protection with Restoration
0x23 (TBD)	1+1:R Bidirectional Protection with Restoration

The procedure for signaling all other fields in the PROTECTION object is specified in [RFC4872] and does not change other than specified in this section. As P bit and S bit are preserved when using restoration LSP, LSP protection types and LSP recovery procedures defined in [RFC4872] and [RFC4873] apply. Specifically, protection schemes defined in [RFC4872] namely 1+1 unidirectional protection, 1+1 bidirectional protection, (full) LSP rerouting, 1:N protection with extra-traffic do not change with the introduction of the restoration LSP.

A GMPLS recovery scheme "Rerouting without Extra-Traffic with Restoration LSP" is outside the scope of this document.

When using a GMPLS recovery mode, where working or protecting LSP are destroyed, and restoration LSP assumes the role of a working LSP or a protecting LSP, restoration LSP RSVP Path message MUST be refreshed by clearing the T-bit in the PROTECTION object.

3.2. Resource Sharing

Resource sharing may be desired between working LSP and restoration LSP or protecting LSP and restoration LSP. Resource sharing is typically achieved using the make-before-break procedures defined in [RFC3209]. It may not be desired to share resources between a working LSP and a protecting LSP. ASSOCIATION object with association type "resource sharing" defined in [RFC4873] is used to identify LSPs that can share resources by matching ASSOCIATION objects in the LSPs. When ASSOCIATION object is signaled with association type "resource sharing", reservation style present in the LSP is ignored and for all matching LSPs with identical ASSOCIATION objects are requested to share resources. For LSPs with non matching ASSOCIATION object or absence of the ASSOCIATION object, reservation style [FF/SE] present in the LSP is used for resource sharing as per [RFC3209].

3.3. Protection Switchover

Specific use case of the restoration LSP with protection switchover is outside the scope of this document. Also, protecting switching co-ordination (PSC) [RFC6378] mechanism is outside the scope of this document.

3.4. Compatibility

The PROTECTION object has already been defined with class numbers in the form 11bbbbbb, which ensures compatibility with non-supporting nodes. Per [RFC2205], nodes not supporting this extension will ignore the object or the new T bit and LSP flag but forward it, unexamined and unmodified, in all messages resulting from this message.

4. IANA Considerations

IANA is requested to administer assignment of new values for namespace defined in this document and summarized in this section.

Within the current document, one new flag is defined in the PROTECTION object.

Value	Type
T bit (TBD)	Restoration LSP Type

Within the current document, following new LSP flags are defined in the PROTECTION object.

0x20 (TBD)	(Full) Rerouting with Restoration (1:R)
0x21 (TBD)	1:N:R Protection with Extra-Traffic with Restoration
0x22 (TBD)	1+1:R Unidirectional Protection with Restoration
0x23 (TBD)	1+1:R Bidirectional Protection with Restoration

5. Security Considerations

This document introduces no additional security considerations. For a general discussion on MPLS and GMPLS related security issues, see the MPLS/GMPLS security framework [RFC5920]. In addition, the considerations specified in [RFC4872] and [RFC4873] will apply.

6. Acknowledgement

The authors would like to thank George Swallow for the discussion on the GMPLS restoration.

7. References

7.1. Normative references

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[RFC5920] Fang, L., "Security Framework for MPLS and GMPLS Networks", RFC 5920, July 2010.

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