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GMPLS RSVP-TE Extensions for Lock Instruct and Loopback

Abstract

This document specifies extensions to Resource Reservation Protocol - Traffic Engineering (RSVP-TE) to support Lock Instruct (LI) and Loopback (LB) mechanisms for Label Switched Paths (LSPs). These mechanisms are applicable to technologies that use Generalized MPLS (GMPLS) for the control plane.

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1. Introduction

The requirements for Lock Instruct (LI) and Loopback (LB) in the Multiprotocol Label Switching Transport Profile (MPLS-TP) are specified in [RFC5860], and the framework of LI and LB is specified in [RFC6371]. A Label Switched Path (LSP) that is locked, using LI, is prevented from carrying user data traffic. The LB function can only be applied to an LSP that has been previously locked.

In general, the LI and LB are useful Operations, Administration, and Maintenance (OAM) functions for technologies that use Generalized MPLS (GMPLS) for the control plane, e.g., time-division multiplexing, wavelength-division multiplexing, and packet switching. It is natural to use and extend the GMPLS control-plane protocol to provide a unified approach for LI and LB provisioning in all these technologies.

[RFC7487] specifies the RSVP-TE extensions for the configuration of proactive MPLS-TP OAM functions, such as Continuity Check (CC), Connectivity Verification (CV), Delay Measurement (DM), and Loss Measurement (LM). The provisioning of on-demand OAM functions such as LI and LB are not covered in that document.

This document specifies extensions to Resource Reservation Protocol-Traffic Engineering (RSVP-TE) to support lock instruct and loopback mechanisms for LSPs. The mechanisms are applicable to technologies

that use GMPLS for the control plane. For a network supporting MPLS-TP, the mechanisms defined in this document are complementary to [RFC6435].

1.1. Requirements Language

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 RFC 2119 [RFC2119].

2. Flag Definitions for LI and LB

2.1. Lock Instruct Indication

In order to indicate the lock/unlock status of the LSP, the A (Administratively down) bit in the Administrative Status (ADMIN_STATUS) Object [RFC3471] [RFC3473] is used.

2.2. Extensions for Loopback

In order to indicate the loopback mode of LSP, a new bit flag is defined in the Attribute Flags TLV [RFC5420].

Loopback flag:

This flag indicates a particular node on the LSP is required to enter loopback mode. This can also be used for specifying the loopback state of the node.

- Bit number: 13

- Attribute flag carried in Path message: Yes

- Attribute flag carried in Resv message: No

- Attribute flag carried in the Record Route Object (RRO) Attributes subobject: Yes

3. Operational Procedures

3.1. Lock Instruct

When an ingress node intends to put an LSP into lock mode, it MUST send a Path message with the Administratively down (A) bit used as specified above and the Reflect (R) bit in the ADMIN_STATUS Object set.

On receipt of this Path message, the egress node SHOULD try to take the LSP out of service. If the egress node locks the LSP successfully, it MUST send a Resv message with the A bit in the ADMIN_STATUS Object set. Otherwise, it MUST send a PathErr message with the Error Code "OAM Problem" [RFC7260] and the new Error Value "Lock Failure", and the following Resv messages MUST be sent with the A bit cleared.

When an LSP is put in lock mode, the subsequent Path and Resv messages MUST keep the A bit in the ADMIN_STATUS Object set.

When the ingress node intends to take the LSP out of the lock mode, it MUST send a Path message with the A bit in the ADMIN_STATUS Object cleared.

On receipt of this Path message, the egress node SHOULD try to bring the LSP back to service. If the egress node unlocks the LSP successfully, it MUST send a Resv message with the A bit in the ADMIN_STATUS Object cleared. Otherwise, it MUST send a PathErr message with the Error Code "OAM Problem" [RFC7260] and the new Error Value "Unlock Failure", and the following Resv messages MUST be sent with the A bit set.

When an LSP is taken out of lock mode, the subsequent Path and Resv messages MUST keep the A bit in the ADMIN_STATUS Object cleared.

3.2. Loopback

The loopback request can be sent either to the egress node or to a particular intermediate node. The mechanism defined in [RFC7570] is used for addressing the loopback request to a particular node on the LSP. The ingress node MUST ensure that the LSP is in lock mode before it requests setting a particular node on the LSP into loopback mode.

When an ingress node intends to put a particular node on the LSP into loopback mode, it MUST send a Path message with the Loopback Attribute Flag defined above in the Attribute Flags TLV set. The mechanism defined in [RFC7570] is used to address the loopback request to the particular node. The ingress node MUST ensure that the entity at which loopback is intended to occur is explicitly identified by the immediately preceding subobject of the Explicit Route Object (ERO) Hop Attributes subobject. The Administratively down (A) bit in the ADMIN_STATUS Object MUST be kept set to indicate that the LSP is still in lock mode.

On receipt of this Path message, the target node of the loopback request MUST check if the LSP is in lock mode by verifying that the Administratively down (A) bit is set in the ADMIN_STATUS Object. If the bit is not set, the loopback request MUST be ignored. If the bit is set, the node MUST check that the desired loopback entity is explicitly identified by the ERO subobject prior to the ERO Hop Attributes subobject. Currently, the type value MUST be verified to be less than 32 (i.e., able to identify a specific entity where a loopback can occur; see Section 4.3), and for type values 1 (IPv4 prefix) and 2 (IPv6 prefix), the prefix length MUST be 32 and 128, respectively. If the desired loopback entity is not explicitly identified, the request MUST be ignored and a "Bad EXPLICIT_ROUTE object" error SHOULD be generated. Otherwise, the node SHOULD try to put the LSP into loopback mode. The loopback SHOULD be enabled on the entity identified by the ERO subobject immediately prior to the ERO Hop Attributes subobject. If the immediately preceding subobject is a label subobject [RFC3473], the loopback SHOULD be enabled for the direction indicated by the U bit of the label subobject.

If the node puts the LSP into loopback mode successfully, it MUST set the Loopback Attribute Flag if it adds, per [RFC7570], an RRO Hop Attributes subobject to the RRO of a Path or Resv message. The Administratively down (A) bit in the ADMIN_STATUS Object MUST be kept set in the message. If the node cannot put the LSP into loopback mode, it MUST send a PathErr message with the Error Code "OAM Problem" [RFC7260] and the new Error Value "Loopback Failure".

When the ingress node intends to take the particular node out of loopback mode, it MUST send a Path message with the Loopback Attribute Flag in the Attribute Flags TLV cleared. The mechanism defined in [RFC7570] is used to indicate that the particular node SHOULD exit loopback mode for this LSP. The Administratively down (A) bit in the ADMIN_STATUS Object MUST be kept set to indicate the LSP is still in lock mode.

On receipt of this Path message, the target node SHOULD try to take the LSP out of loopback mode. If the node takes the LSP out of loopback mode successfully, it MUST clear the Loopback Attribute Flag in the RRO Hop Attributes subobject and push this subobject onto the RRO object in the corresponding Path or Resv message. The Administratively down (A) bit in the ADMIN_STATUS Object MUST be kept set in the message. Otherwise, the node MUST send a PathErr message with the Error Code "OAM Problem" [RFC7260] and the new Error Value "Exit Loopback Failure".

After the loopback mode is cleared successfully, the ingress node MAY remove the Lock Instruct using the mechanism defined in Section 3.1. The ingress node MUST NOT request to exit lock mode if the LSP is

still in loopback mode. The egress node MUST ignore such a request when the LSP is still in loopback mode.

4. IANA Considerations

IANA has assigned new values defined in this document and summarized in this section.

4.1. Attribute Flags

IANA maintains a registry called "Resource Reservation Protocol-Traffic Engineering (RSVP-TE) Parameters" with a sub-registry called "Attribute Flags".

IANA has assigned a new bit flag as follows:

Bit No.	Name	Attribute Flags Path	Attribute Flags Resv	RRO	ERO	Reference
13	Loopback	Yes	No	Yes	Yes	this document

4.2. RSVP Error Value Sub-Codes

IANA maintains a registry called "Resource Reservation Protocol (RSVP) Parameters" with a sub-registry called "Error Codes and Globally-Defined Error Value Sub-Codes".

IANA has assigned four new Error Value sub-codes for the "OAM Problem" Error Code:

Value	Description	Reference
26	Lock Failure	this document
27	Unlock Failure	this document
28	Loopback Failure	this document
29	Exit Loopback Failure	this document

4.3. Allocation Rule for ERO Subobjects

IANA maintains a registry called "Resource Reservation Protocol (RSVP) Parameters" with a sub-registry called "Class Names, Class Numbers, and Class Types".

For Explicit Route Object, the allocation rule for subobject types in the range 5-31 (0x05 - 0x1F) has been updated as:

5-31 Unassigned (For explicit resource identification)

5. Security Considerations

This document does not introduce any new security issues beyond those identified in [RFC3209], [RFC3473], and [RFC7570]. For a more comprehensive discussion of GMPLS security and attack mitigation techniques, please see "Security Framework for MPLS and GMPLS Networks" [RFC5920].

In addition, the reporting of the loopback status using the RRO may reveal details about the node that the operator wishes to remain confidential. The privacy considerations as described in paragraph 3 of Section 5 of [RFC7570] also apply to this document.

6. References

6.1. Normative References

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