           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.

Status of This Memo

   This is an Internet Standards Track document.

   This document is a product of the Internet Engineering Task Force
   (IETF). It represents the consensus of the IETF community. It has
   received public review and has been approved for publication by the
   Internet Engineering Steering Group (IESG). Further information on
   Internet Standards is available in Section 2 of RFC 5741.

   Information about the current status of this document, any errata,
   and how to provide feedback on it may be obtained at
   http://www.rfc-editor.org/info/rfc7571.

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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

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Authors' Addresses

   Jie Dong
   Huawei Technologies
   Huawei Campus, No.156 Beiqing Rd.
   Beijing 100095
   China

   Email: jie.dong@huawei.com

   Mach(Guoyi) Chen
   Huawei Technologies
   Huawei Campus, No.156 Beiqing Rd.
   Beijing 100095
   China

   Email: mach.chen@huawei.com

   Zhenqiang Li
   China Mobile
   Unit2, Dacheng Plaza, No. 28 Xuanwumenxi Ave.
   Beijing 100053
   China

   Email: lizhenqiang@chinamobile.com

   Daniele Ceccarelli
   Ericsson
   Via A. Negrone 1/A
   Genova - Sestri Ponente
   Italy

   Email: daniele.ceccarelli@ericsson.com