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PathErr Message Triggered MPLS and GMPLS LSP Reroute

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Abstract

This document describes how Resource ReserVation Protocol (RSVP) PathErr Messages may be used to trigger rerouting of Multi-Protocol Label Switching (MPLS) and Generalized MPLS (GMPLS) Traffic Engineering (TE) Label Switched Paths (LSPs) without first removing LSP state or resources. Such LSP rerouting may be desirable in a number of cases including, for example, soft-preemption and graceful shutdown. This document describes the usage of existing Standards Track mechanisms to support LSP rerouting. In this case, it relies on mechanisms already defined as part of RSVP-TE and simply describes a sequence of actions to be executed. While existing protocol

definition can be used to support reroute applications, this document also defines a new reroute-specific error code to allow for the

future definition of reroute application-specific error values.

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## **1. Introduction**

Resource ReserVation Protocol (RSVP), see [[RFC2205](#)], has been extended to support the control of Traffic Engineering (TE) Label Switched Paths (LSPs) for both Multi-Protocol Label Switching (MPLS) and Generalized MPLS (GMPLS) in, respectively, [[RFC3209](#)] and [[RFC3473](#)]. In all cases, a PathErr message is used to report errors to nodes upstream of the error detecting node. As defined in [[RFC2205](#)], and left unmodified by [[RFC3209](#)], PathErr messages "do not change path state in the nodes through which they pass".

Notwithstanding this definition, PathErr messages are most commonly used to report errors during LSP establishment, i.e. the RSVP-TE processing that occurs prior to the ingress receiving a Resv message. (See [[PATHERR](#)] for a broader discussion on PathErr message handling.) Support for such usage was enhanced via the introduction of the Path\_State\_Removed flag in [[RFC3473](#)], which enables a processing node to free related LSP state and resources. The usage of PathErr messages during LSP establishment was further covered in [[RFC4920](#)] which describes in detail how a node may indicate that the node or one of its associated resources should be avoided, i.e., routed around, during LSP establishment.

PathErr messages can also be used to support a number of other cases that can occur after an LSP is established. This document focuses on the cases where PathErr messages can be used for a node to indicate that it desires an upstream node to reroute an LSP around the indicating node or a resources associated with the indicating node. Some examples of such cases are soft-preemption and graceful shutdown. (See [[PREEMPTION](#)] and [[GRACEFUL](#)]).

This document uses the terminology "reroute request" to refer to the indication by a node that an upstream reroute should take place. This document how a node can initiate a reroute request without disrupting LSP data traffic or, when so desired, with the disruption of data traffic and removal of LSP associated state and resources.

The mechanisms used to indicate reroute requests are derived from the mechanisms described in [[RFC4920](#)], and the error codes defined in [[RFC4736](#)]. This document describes (1) how a non-disruptive reroute request may be issued and, (2) based on an optional "timeout" period, how rerouting may be forced by removing LSP state and associated resources and signaling such removal. While this document describes how existing protocol definitions can be used to support rerouting, it also defines a new reroute-specific error code to allow for the future definition of reroute application-specific error values.



### **1.1. 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](#)].

## **2. Reroute Requests**

This section describes how a downstream node can indicate that it desires a node upstream (along the LSP path) to initiate the re-routing of an LSP, and how the upstream nodes can respond to such a request. Initiating nodes, transit nodes, and ingress nodes are described separately.

### **2.1. Processing at Requesting Node**

When a transit or egress node desires to request the rerouting of an established LSP, it first determines if it can act on the reroute request locally. A reroute request SHOULD be acted on locally if the ERO received in the LSP's incoming Path message does not preclude the reroute and the node's policy allows local repair. Examples of reroute requests that may be permissible are reroutes avoiding outgoing interface, component, label resource, or next hops not explicitly listed in the ERO. When the reroute request can be processed locally, standard local repair processing MUST be followed. The node SHOULD limit the number of local repair attempts. The expected norm is for local repair and, thereby, this case to be precluded by policy.

When the requesting node cannot act on a reroute request locally, it MUST issue a PathErr message indicating a reroute request. A reroute request MUST be indicated via one of the following combinations of error codes and error values:

1. "Notify/Local node maintenance required" to support backwards compatibility and to reroute around the local node.
2. "Notify/Local link maintenance required" to support backwards compatibility and to reroute around a local interface.
3. "Reroute/<any Reroute error value>" for future compatibility and when backwards compatibility is not a concern.

The rest of the ERROR\_SPEC object is constructed based on the local reroute request. When the local reroute request directs a reroute around the local node, the local node MUST be indicated in the



ERROR\_SPEC object. When the local request does not direct to reroute around the local node, the impacted interface MUST be indicated in the ERROR\_SPEC object. The IF\_ID ERROR\_SPEC SHOULD also be used when supported. The TLVs defined in [\[RFC4920\]](#) MAY also be used when supported and when they can provide specific additional reroute request information, e.g., reroute around a specific label. The principles related to ERROR\_SPEC object construction defined in [section 6.3.1. of \[RFC4920\]](#) SHOULD be followed.

### **2.1.1. Reroute Request Timeouts**

Reroute request timeouts are used to remove an LSP when there is no response to a reroute request. Reroute request timeouts MUST NOT be used, when the LSP is not to be removed at the expiration of the Reroute request timeout period. When such LSP removal is desired and after initiating a reroute request, the initiating node MUST initiate a timeout during which it expects to receive a response to the reroute request. Valid responses are a PathTear message or a trigger Path message with an ERO avoiding the resource that was indicated in the reroute request. If either type of message is received, the timeout period MUST be canceled and no further action is needed. Note, normal refresh processing is not modified by the introduction of reroute request timeouts. Such processing may result in Path state being removed during the timeout period, in which case the timeout period MUST also be canceled.

If the reroute request timeout is reached, the initiating node MUST remove the LSP and its associated state and resources. Removal of LSP state is indicated downstream via a corresponding PathTear message. Removal is indicated upstream via a PathErr message with the error code of "Service preempted". The Path\_State\_Removed flag MUST be set if supported. When the Path\_State\_Removed flag is not supported, a corresponding ResvTear MUST also be sent.

### **2.2. Processing at Upstream Node**

When a transit node's policy permits it to support reroute request processing and local repair, the node MUST examine incoming PathErr messages to see if the node can perform a requested reroute. A reroute request is indicated in a received PathErr message which carries one of the error code and value combinations listed above in [Section 2.1](#). Note that a conformant implementation MUST check for any of the the three combinations listed in [Section 2.1](#).

A transit node MAY act on a reroute request locally when the ERO received in the LSP's incoming Path message does not precluded the





reroute. As before, examples include loosely routed LSP next hops. When the reroute request can be processed locally, standard local repair processing **MUST** be followed. The node **SHOULD** limit the number of local repair attempts. Again, the expected norm is for local repair and, thereby, this case to be precluded due to policy.

When the transit node supports [\[RFC4920\]](#), is a boundary node and Boundary Re-routing is allowed, it **SHOULD** use a route request as a trigger to reroute the LSP. (Per [\[RFC4920\]](#), the Flags field of the LSP\_ATTRIBUTES object of the initial Path message indicate "Boundary re-routing".) In the case the node triggers rerouting, it first **MUST** identify an alternate path within the domain. When such a path is available, the node **MUST** terminate the PathErr message and issue a Path message reflecting the identified alternate path. Processing then continues per [\[RFC4920\]](#). When an alternate path is not available, the node cannot act on the reroute request.

When a transit node cannot act on a reroute request locally, per standard processing, it **MUST** propagate the received PathErr message to the previous hop.

### **[2.3. Processing at Ingress](#)**

When reroute processing is supported, an ingress node **MUST** check received PathErr messages to identify them as indicating reroute requests. A reroute request is indicated in a received PathErr message which carries one of the error code and value combinations listed above in [Section 2.1](#). Note that a conformant implementation **MUST** check for any of the three combinations listed in [Section 2.1](#).

Upon receiving a reroute request, the ingress **MUST** attempt to identify an alternate path, avoiding the node, interface, resource, etc. identified within the ERROR\_SPEC object. When an alternate path cannot be identified the reroute request **MUST** be discarded. When an alternate path is identified, a corresponding make-before-break LSP **SHOULD** be initiated, and standard make-before-break procedures **MUST** be followed.

## **[3. IANA Considerations](#)**

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

Upon approval of this document, the IANA will make the assignment in the "Error Codes and Globally-Defined Error Value Sub-Codes" section



of the "RSVP Parameters" registry located at  
<http://www.iana.org/assignments/rsvp-parameters>:

34\* Reroute [This document]

This Error Code has the following defined Error Value sub-code:

0 = Generic LSP reroute request

Reroute error values should be allocated based on the following allocation policy as defined in [\[RFC5226\]](#).

| Range       | Registration Procedures |
|-------------|-------------------------|
| -----       | -----                   |
| 0-32767     | IETF Consensus          |
| 32768-65535 | Private Use             |

(\*) Suggested value.

#### **[4. Security Considerations](#)**

This document introduces no new security considerations as this document describes usage of existing formats and mechanisms. This document does introduce a new error code value, but this value is functionally equivalent to existing semantics. The [Section 9 of \[RFC4920\]](#) and [\[RFC4736\]](#) should be used as the starting point for reviewing the security considerations related to the formats and mechanisms discussed in this document.

#### **[5. References](#)**

##### **[5.1. Normative References](#)**

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## **[6. Acknowledgments](#)**

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