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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 and defines no new formats or mechanisms. It relies on mechanisms already defined as part of RSVP-TE and simply describes a sequence of actions to be executed.

Table of Contents

1	Introduction	3
1.1	Conventions used in this document	4
2	Reroute Requests	4
2.1	Processing at Requesting Node	4
2.1.1	Reroute Request Timeouts	5
2.2	Processing at Upstream Node	5
2.3	Processing at Ingress	6
3	IANA Considerations	6
4	Security Considerations	6
5	References	6
5.1	Normative References	6
5.2	Informative References	7
6	Acknowledgments	7
7	Author's Addresses	8
8	Full Copyright Statement	8
9	Intellectual Property	8

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.

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 node desires to request the rerouting of an established LSP, it MUST first determine if it can act on the reroute request locally. A reroute request may 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 with the error code "Notify" and a value of either "Local link maintenance required" or "Local node maintenance required". The error value is based on the local reroute request. If the local request directs a reroute around the local node, the error value "Local node maintenance required" MUST be used and the local node MUST be indicated in the ERROR_SPEC object.

If the local request does not direct a reroute around the local node, the error value "Local link maintenance required" MUST be used, and 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 by the error code and value of "Notify/Local (link or node) maintenance required" in a received PathErr message. A transit node MAY act on a reroute request locally when the ERO received in the LSP's incoming Path message does not preclude 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 by the error code and value of "Notify/Local (link or node) maintenance required" in a received PathErr message. 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

No new IANA administered values are requested by this document.

4. Security Considerations

This document introduces no new security considerations as this document describes usage of existing formats and mechanisms. 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

- [RFC2205] Braden, R., Zhang, L., Berson, S., Herzog, S. and S. Jamin, "Resource ReSerVation Protocol (RSVP) -- Version 1, Functional Specification", [RFC 2205](#), September 1997.

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- [RFC3209] Awduche, D., Berger, L., Gan, D., Li, T., Srinivasan, V. and G. Swallow, "RSVP-TE: Extensions to RSVP for LSP Tunnels", [RFC 3209](#), December 2001.
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5.2. Informative References

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- [PATHERR] Vasseur, JP., Ed. "Node behavior upon originating and receiving Resource ReserVation Protocol (RSVP) Path Error message", [draft-ietf-mpls-3209-patherr-02.txt](#), Work in Progress, February 2008.
- [PREEMPTION] Meyer, M., Ed. "MPLS Traffic Engineering Soft Preemption", [draft-ietf-mpls-soft-preemption-10.txt](#), Work in Progress, February 2008.

6. Acknowledgments

This document was conceived along with Matthew Meyer.

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