Bidirectional RSVP-TE Tunnel
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Abstract

Through the binding of two unidirectional RSVP-TE tunnels established between a pair of LSRs destined to each other, a bidirectional RSVP-TE tunnel is formed. Like GRE tunnel, the bidirectional RSVP-TE tunnel can be used to establish L3VPN with virtual router or policy routing technology. In contrast to RSVP-MPLS VPN defined in [RFC2547bis], multicast is easier to be implemented and multicast traffics can travel in RSVP-TE tunnel with such L3VPN. This L3VPN fully inherits the property of RSVP-TE, such as TE, QoS and fast convergence features. In addition, the bidirectional RSVP-TE tunnel has many other purposes, such as interconnection of two separate routing domains through a RSVP-TE tunnel and implementing LDP over TE.

Conventions used in this document

In examples, "C:" and "S:" indicate lines sent by the client and server respectively.

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 [1].
1. Introduction

[RFC2547bis] specifies a set of procedures to provide an IP unicast VPN service in MPLS/IP networks, which is called BGP/MPLS VPN. But the procedures of BGP/MPLS VPN, especially multicast in BGP/MPLS VPN are complicated.

Virtual router technology provides a more easy and flexible procedure to implement L3VPN, which is as follows: first, a GRE tunnel is established between a pair of PEs; second, the GRE tunnel interface and an interface connected to CE with each PE are bound to the same VRF; lastly, some routing protocols can be run over the VRF interfaces and a L3VPN is completed. In such L3VPN, multicast is supported natively as long as multicast routing protocol is enabled on the VRF interfaces.

But as GRE tunnel has no properties such as TE, QoS and fast convergence features, the L3VPN implemented on GRE tunnel is not popular with service providers.

RSVP-TE is very suitable to provide MPLS VPN service with the requirement of high availability and QoS assurance because it consists of many good features such as TE, QoS and fast convergence. As RSVP-TE tunnel is unidirectional, it can not be used to implement L3VPN through virtual router or policy routing technology as GRE tunnel.

This document specifies a procedure to realize bidirectional RSVP-TE tunnel with an extension to RSVP-TE. Through the binding of two unidirectional RSVP-TE tunnels established between a pair of LSRs destined to each other, a bidirectional RSVP-TE tunnel is formed.

Like GRE tunnel, the bidirectional RSVP-TE tunnel can be used to establish L3VPN with virtual router or policy routing technology. This L3VPN fully inherits the property of RSVP-TE, such as TE, QoS and fast convergence features. In contrast to BGP/MPLS VPN defined in RFC2547bis, multicast is easier to be implemented in such L3VPN.

In addition, the bidirectional RSVP-TE tunnel has many other purposes, such as interconnection between two separate routing domains through a RSVP-TE tunnel and implementing LDP over TE.
2. Implementing of bidirectional RSVP-TE tunnel

2.1. Basic principle

Through the binding of two unidirectional RSVP-TE tunnels established between a pair of LSRs destined to each other, a bidirectional RSVP-TE tunnel is formed.

The decision factors of RSVP-TE tunnel binding include tunnel source address, tunnel destination address and binding key. Two unidirectional RSVP-TE tunnels between a pair of LSRs destined to each other will be bound successfully if all these decision factors are matched, that is to say, the tunnel source address of one tunnel is the tunnel destination address of the other one, the tunnel destination address of one tunnel is the tunnel source address of the other one, and the binding keys of both tunnels are the same. The reason for making binding key as one of the decision factors is that a LSR can setup different RSVP-TE tunnels with the same pair of tunnel source address and tunnel destination address, but these tunnel interfaces must be configured with different binding keys.

In order to identify through which tunnel a received packet is transmitted by the egress LSR, penultimate-hop-popping (PHP) function must be disabled on egress LSR.

Like GRE tunnel, the bidirectional RSVP-TE tunnel can be used to establish L3VPN with virtual router or policy routing technology. The routing protocols, such as OSPF and PIM, can also be run over the bidirectional RSVP-TE tunnel interface.

As we all known, the value of TTL field in the header of MPLS frame will be reduced as the frame is transmitted through LSP tunnel in order to avoiding loop in MPLS networks. Generally the TTL value of protocol packet is set to 1. In order to run routing protocol, such as OSPF or PIM, over bidirectional RSVP-TE tunnel interface, the TTL value of routing protocol packet with TTL of 1 should not be copied to the EXP field of MPLS frame as it enters RSVP-TE tunnel.

2.2. Extension to RSVP-TE

Signaling the bidirectional RSVP-TE tunnel requires an extension to RSVP-TE. A new binding object is added to RSVP-TE message, the format of which is defined as follows:

Class = TBD (not defined) C_Type = TBD (not defined)
The definition of the above fields is as follows:

- **Reserved**: 16 bits, it must be zero.
- **Flag**: 8 bits, the value 0x1 means requesting binding, which is available only in Path message, and the value 0x2 means confirming binding, which is available only in Resv message.
- **Key Length**: 8 bits, it specifies the length of the field of Binding Key.
- **Binding Key**: a variable-length field, it is used to distinguish the different tunnel interfaces of a LSR with the same pair of tunnel source address and tunnel destination address.

### 2.3. Procedure of implementing bidirectional RSVP-TE tunnel

When a LSR initializes a RSVP-TE tunnel with a request of binding, it will send a RSVP Path message with the extension mentioned above, and the Flag field of which is set to 0x1 and the Binding Key field carry the Binding Key string configured for the tunnel.

Middle-hop LSRs process the Path message in ordinary way with the binding object unchanged.

As the egress LSR of the tunnel receives the Path message, it will compare the binding decision factors in the message, including tunnel source address, tunnel destination address and binding key with the configure information of local tunnel interfaces.
If there is a tunnel which matches the above three decision factors, the egress LSR will bind the matched tunnel with the tunnel initialized by the ingress LSR, and reply a RSVP Resv message with the extension mentioned above, and the Flag field of which is set to 0x2, and the assigned label in the RSVP Resv message is a local unique label, not implicit null label.

If there is no matched tunnel, the egress LSR will reply with a Path Error message with a special error type code of binding failure which is to be defined.

When the Resv message is received by the ingress LSR, it will know the binding is success and the state of tunnel interface will be up.

Establishing a return RSVP-TE tunnel with a request of binding from the above egress LSR to the above ingress LSR is in the same way as that mentioned above.

Through the above procedures, a bidirectional RSVP-TE tunnel is formed.

3. Application of bidirectional RSVP-TE tunnel

Like GRE tunnel, the bidirectional RSVP-TE tunnel can be used to establish L3VPN with virtual router or policy routing technology. This L3VPN fully inherits the property of RSVP-TE, such as TE, QoS and fast convergence features. In contrast to BGP/MPLS VPN defined in RFC2547bis, multicast is easier to be implemented in such a L3VPN.

In addition, the bidirectional RSVP-TE tunnel has many other purposes, such as interconnection of two separate routing domains through a RSVP-TE tunnel and interconnection of two separate LDP-base MPLS networks through a RSVP-TE tunnel, which is also called as LDP over TE. The transit network does not need to know the routing information of the separate routing domains.

4. Formal Syntax

5. Security Considerations

The bidirectional RSVP-TE tunnel inherits all the security features of RSVP-TE.
6. Conclusions

According to the special decision factors, two unidirectional RSVP-TE tunnels established between a pair of LSRs destined to each other can be bound to form a bidirectional RSVP-TE tunnel.

7. Acknowledgments

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8. References

8.1. Normative References


8.2. Informative References


[4] [RFC 3209] RSVP-TE: Extensions to RSVP for LSP Tunnels
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