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RSVP-TE Extensions for Associated Bidirectional LSPs
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Abstract

The MPLS Transport Profile (MPLS-TP) requirements document [RFC5654], describes that MPLS-TP MUST support associated bidirectional point-to-point LSPs.

This document provides a method to bind two unidirectional Label Switched Paths (LSPs) into an associated bidirectional LSP. The association is achieved by using a new Association Type in the Extended ASSOCIATION object.

Status of this Memo

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1. Introduction

The MPLS Transport Profile (MPLS-TP) requirements document [RFC5654] describes that MPLS-TP MUST support associated bidirectional point-to-point LSPs. Furthermore, an associated bidirectional LSP is useful for protection switching, for Operations, Administrations and Maintenance (OAM) messages that require a reply path.

The requirements described in [RFC5654] are specifically mentioned in Section 2.1. (General Requirements), and are repeated below:

7. MPLS-TP MUST support associated bidirectional point-to-point LSPs.

11. The end points of an associated bidirectional LSP MUST be aware of the pairing relationship of the forward and reverse LSPs used to support the bidirectional service.

12. Nodes on the LSP of an associated bidirectional LSP where both the forward and backward directions transit the same node in the same (sub)layer as the LSP SHOULD be aware of the pairing relationship of the forward and the backward directions of the LSP.

14. MPLS-TP MUST support bidirectional LSPs with asymmetric bandwidth requirements, i.e., the amount of reserved bandwidth differs between the forward and backward directions.

50. The MPLS-TP control plane MUST support establishing associated bidirectional P2P LSP including configuration of protection functions and any associated maintenance functions.

The above requirements are also repeated in [RFC6373].

The notion of association, as well as the corresponding Resource reSerVation Protocol (RSVP) ASSOCIATION object, is defined in [RFC4872], [RFC4873] and [I-D.ietf-ccamp-assoc-info] . In that context, the object is used to associate recovery LSPs with the LSP they are protecting. This object also has broader applicability as a mechanism to associate RSVP state, and [I-D.ietf-ccamp-assoc-ext] defines the Extended ASSOCIATION object that can be more generally applied.

This document provides a method to bind two reverse unidirectional Label Switched Paths (LSPs) into an associated bidirectional LSP. The association is achieved by using a new Association Type in the Extended ASSOCIATION object.

2. 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].

3. Overview

3.1. Provisioning Model

The associated bidirectional LSP's forward and backward directions are set up, monitored, and protected independently as required by [RFC5654]. Configuration information regarding the LSPs can be sent to one end or both ends of the LSP. Depending on the method chosen, there are two models of signaling associated bidirectional LSP. The first model is the single sided provisioning, the second model is the double sided provisioning.

For the single sided provisioning, the configurations are sent to one end. Firstly, a unidirectional tunnel is configured on this end, then a LSP under this tunnel is initiated with the Extended ASSOCIATION object carried in the Path message to trigger the peer end to set up the corresponding reverse TE tunnel and LSP.

For the double sided provisioning, the two unidirectional TE tunnels are configured independently, then the LSPs under the tunnels are signaled with the Extended ASSOCIATION objects carried in the Path message to indicate each other to associate the two LSPs together to be an associated bidirectional LSP.

A number of scenarios exist for binding LSPs together to be an associated bidirectional LSP. These include: (1) both of them do not exist; (2) both of them exist; (3) one LSP exists, but the other one need to be established. In all scenarios described, the provisioning models discussed above are applicable.

3.2. Signaling Procedure

This section describes the signaling procedures for associating bidirectional LSPs.

Consider the topology described in Figure 1. (An example of associated bidirectional LSP). The LSP1 [via nodes A,D,B] (from A to B) and LSP2 [via nodes B,D,C,A] (from B to A) are being established or have been established, which can form an associated bidirectional LSP between node A and node B.

LSP1 and LSP2 are referenced at the data plane level by the identifiers: A-Node_ID::A-Tunnel_Num::A-LSP_Num::B-Node_ID and B-Node_ID::B-Tunnel_Num::B-LSP_Num::A-Node_ID, respectively [RFC6370].

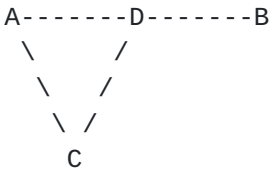


Figure 1: An example of associated bidirectional LSP

3.2.1. Single Sided Provisioning Model

For the single sided provisioning model, LSP1 is triggered by LSP2 or LSP2 is triggered by LSP1. When LSP2 is triggered by LSP1, LSP1 is initialized or refreshed (if LSP1 already exists) at node A with the Extended ASSOCIATION object inserted in the Path message, Association Type is set to "Associated Bidirectional LSPs", Association ID set to a value that uniquely identifies the sessions to be associated within the context of the Association Source field, Association Source set to A-Node_ID, Global Association Source set to A-Global_ID. The Extended Association ID field must be included when the Association ID field is insufficient to uniquely identify association. As described in [I-D.ietf-ccamp-assoc-ext], when included, this field must be set to a value that, together with the other fields in the object, uniquely identifies the sessions to be associated. Terminating node B is triggered to set up LSP2 by the received Extended ASSOCIATION object with the Association Type set to the value "Associated Bidirectional LSPs", the Association Object inserted in LSP2's Path message is the same as in LSP1's Path message.

When LSP1 is triggered by LSP2, the same rules are applicable. Based on the same values of the Association objects in the two LSPs' Path message, the two LSPs can be bound together to be an associated bidirectional LSP.

3.2.2. Double Sided Provisioning Model

For the double sided provisioning model, the values used in the Extended ASSOCIATION object are outside the scope of this document. For example they may be communicated via the management plane. No matter how the values are communicate, identification of the LSPs as being Associated Bidirectional LSPs occurs based on the identical

contents in the LSPs' Extended ASSOCIATION objects.

3.2.3. Asymmetric Bandwidth LSPs

A variety of applications, such as internet services and the return paths of OAM messages, exist and which MAY have different bandwidth requirements for each direction. Additional [RFC5654] also specifies an asymmetric bandwidth requirement. This requirement is specifically mentioned in Section 2.1. (General Requirements), and is repeated below:

14. MPLS-TP MUST support bidirectional LSPs with asymmetric bandwidth requirements, i.e., the amount of reserved bandwidth differs between the forward and backward directions.

The approach for supporting asymmetric bandwidth co-routed bidirectional LSPs is defined in [RFC6387]. As to the asymmetric bandwidth associated bidirectional LSPs, the existing SENDER_TSPEC object must be carried in the REVERSE_LSP object as a sub-object in the initialized LSP's Path message to specify the reverse LSP's traffic parameters in case single sided provisioning model is adopted. Consider the topology descirbed in Figure 1 in the context of asymmetric associated bidirectional LSP, and take LSP2 triggered by LSP1 as an example. Node B is triggered to set up the reverse LSP2 with the corresponding asymmetric bandwidth by the Extended ASSOCIATION object with Association Type "Associated Bidirectional LSPs" and the SENDER_TSPEC sub-object in LSP1's Path message, and the SENDER_TSPEC object in the LSP2' Path message is the same as the the SENDER_TSPEC sub-object in LSP1's Path message. When double sided provisioning model is used, the two opposite LSPs with asymmetric bandwidths are concurrently initialized, and this requirement will be satisfied simultanously.

3.2.4. Recovery Considerations

Consider the topology described in Figure 1, LSP1 and LSP2 form the associated bidirectional LSP. Under the scenario of recovery, a third LSP (LSP3) may be used to protect LSP1. LSP3 can be established before or after the failure occurs, it can share the same TE tunnel with LSP1 or not.

When node A detects that LSP1 is broken, LSP3 will be initialized or refreshed with the Extended ASSOCIATION object inherited from LSP1's Path message. In this way, based on the same Extended ASSOCIATION object, LSP2 and LSP3 will compose a new associated bidirectional LSP.

4. Association of LSPs

The Extended ASSOCIATION object is defined in [I-D.ietf-ccamp-assoc-ext], which enables MPLS-TP required identification. In order to bind two reverse unidirectional LSPs to be an associated bidirectional LSP, a new Association Type is defined in this document:

o Association Type:

Value	Type
4 (TBD)	Associated Bidirectional LSPs (A)

See [I-D.ietf-ccamp-assoc-ext] for the definition of other fields and values.

As described in [I-D.ietf-ccamp-assoc-ext], association is always done based on matching Path state or Resv state. Upstream initializted association is represented in Extended ASSOCIATION objects carried in Path message and downstream initializted association is represented in Extended ASSOCIATION objects carried in Resv messages. The new defined Association Type in this document is only defined for use in upstream initialized association. Thus it can only appear in Extended ASSOCIATION objects signaled in Path message.

The rules associated with the processing of the Extended ASSOCIATION objects in RSVP message are discussed in [I-D.ietf-ccamp-assoc-ext]. It said that in the absence of Association Type-specific rules for identifying association, the included Extended ASSOCIATION objects MUST be identical. This document adds no specific rules, the association will always operate based on the same Extended ASSOCIATION objects.

5. Single Sided Provisioning

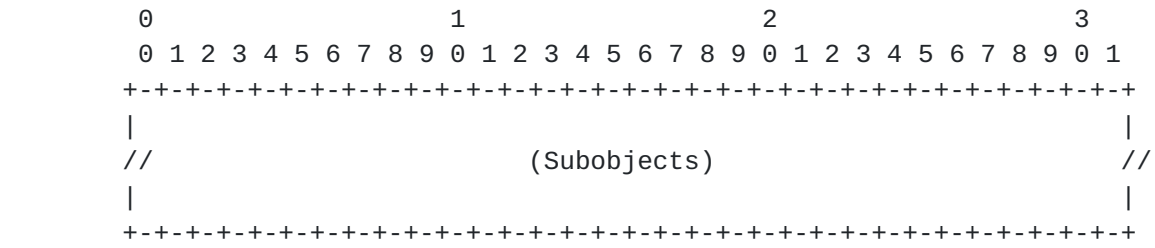
Path Computation Element (PCE)-based approaches, see [RFC4655], may be used for path computation of a GMPLS LSP, and consequently an associated bidirectional LSP, across domains and in a single domain. The ingress Label Switching Router (LSR), maybe serve as a PCE or Path Computation Client (PCC), have more information about the reverse LSP. When the forward LSP is signaled, the reverse LSP's traffic parameters, explicit route, LSP attributes, etc, can be

carried in the REVERSE_LSP object of the forward LSP's Path message. The Egress LSR can be triggered to establish the reverse LSP according to the control information.

5.1. REVERSE_LSP Object

The information of the reverse LSP is specified via the REVERSE_LSP object, which is optional with class numbers in the form 11bbbbbb has the following format:

Class = TBD (of the form 11bbbbbb), C_Type = 1 (TBD)



This object MUST NOT be used when the Extended ASSOCIATION object do not exist or exist but the Association Type is not "Associated Bidirectional LSPs".

Subojects

The contents of a REVERSE_LSP object are a series of variable-length data items called subobjects, which can be SENDER_TSPCE, EXPLICIT_ROUTE object (ERO), Session Attribute Object, Admin Status Object, LSP_ATTRIBUTES Object, LSP_REQUIRED_ATTRIBUTES Object, PROTECTION Object, ASSOCIATION Object, Extended ASSOCIATION Objects, etc.

5.2. LSP Control

The signaling procedure without the REVERSE_LSP object carried in the LSP1's Path message is described in section 3.2.1, which is the default option. A node includes a REVERSE_LSP object and Extended ASSOCIATION object with an "Associated Bidirectional LSPs" Association Type in an outgoing Path message when it wishes to control the reverse LSP, and the receiver node B MUST convert the subobjects of the REVERSE_LSP object into the corresponding objects that carried in LSP2's Path message. The case of a non-supporting egress node is outside of this document. If node A want to tear down the associated bidirectional lSP, a PathTear message will be sent out

and Node B is triggered to tear down LSP2.

5.3. Updated RSVP Message Formats

This section presents the RSVP message-related formats as modified by this document. Unmodified RSVP message formats are not listed.

The format of a Path message is as follows:

```
<Path Message> ::= <Common Header> [ <INTEGRITY> ]
                   [ [<MESSAGE_ID_ACK> | <MESSAGE_ID_NACK>] ... ]
                   [ <MESSAGE_ID> ]
                   <SESSION> <RSVP_HOP>
                   <TIME_VALUES>
                   [ <EXPLICIT_ROUTE> ]
                   <LABEL_REQUEST>
                   [ <PROTECTION> ]
                   [ <LABEL_SET> ... ]
                   [ <SESSION_ATTRIBUTE> ]
                   [ <NOTIFY_REQUEST> ... ]
                   [ <ADMIN_STATUS> ]
                   [ <EXTENDED_ASSOCIATION> ... ]
                   [ <REVERSE_LSP]
                   [ <POLICY_DATA> ... ]
                   <sender descriptor>
```

The format of the <sender descriptor> is not modified by the present document.

5.4. Compatibility

The REVERSE_LSP object is defined with class numbers in the form 11bbbbbb, which ensures compatibility with non-supporting nodes. Per [RFC2205], nodes not supporting this extension will ignore the object but forward it, unexamined and unmodified, in all messages resulting from this message. Especially, this object received in PathTear, or PathErr messages should be forwarded immediately in the same message, but should be saved with the corresponding state and forwarded in any refresh message resulting from that state when received in Path message.

6. IANA Considerations

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

6.1. Association Type

Within the current document, a new Association Type is defined in the Extended ASSOCIATION object.

Value	Type
4 (TBD)	Associated Bidirectional LSPs (A)

6.2. REVERSE_LSP Object

A new class named REVERSE_LSP has been created in the 11bbbbbb rang (TBD) with the following definition:

Class Types or C-types (1, TBD):

There are no other IANA considerations introduced by this document.

7. Security Considerations

This document introduces a new Association Type, and except this, there are no security issues about the Extended ASSOCIATION object are introduced here.

The procedures defined in this document result in an increase in the amount of topology information carried in signaling messages since the presence of the REVERSE_LSP object necessarily means that there is more information about associated bidirectional LSPs. Thus, in the event of the interception of a signaling message, slightly more could be deduced about the state of the network than was previously the case, but this is judged to be a very minor security risk as this information is already available via routing.

Otherwise, this document introduces no additional security considerations. For a general discussion on MPLS and GMPLS related security issues, see the MPLS/GMPLS security framework [RFC5920].

8. Acknowledgement

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9. References

9.1. Normative references

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9.2. Informative References

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