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**RSVP-TE Extensions to Establish Associated Bidirectional LSP**  
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Abstract

This document provides a method to bind two unidirectional Label Switched Paths (LSPs) into an associated bidirectional LSP, by increasing a new Association Type in the context of the Extended ASSOCIATION object.

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## **1. Introduction**

The associated bidirectional LSP, defined in the requirements of MPLS Transport Profile (MPLS-TP) [[RFC5654](#)], is constructed from a pair of unidirectional LSPs that are associated with each other at the LSP's ingress/egress points. It is useful for protection switching, for Operations, Administrations and Maintenance (OAM) messages that require a reply path. The corresponding requirements are also specified in as follow:

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.

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

Furthermore, these requirements are repeated in [[I-D.ietf-ccamp-mpls-tp-cp-framework](#)].

The notion of association as well as the corresponding Resource reSerVation Protocol (RSVP) ASSOCIATION object is defined in [[RFC4872](#)] and [[RFC4873](#)]. 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-info](#)] defines the Extended ASSOCIATION object that can be more generally applied.

This document defines a new association type to establish associated bidirectional LSPs in the context of 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. Association of Two Reverse Unidirectional LSPs**

#### **3.1. Provisioning Model**

The associated bidirectional LSP's forward and backward directions are set up, monitored, and protected independently [[RFC5654](#)], so the configurations about it can be sent to one end or two ends. Depending on this, there are two models of signaling associated bidirectional LSP, one is the single sided provisioning and the other is the double sided provisioning.

For the single sided provisioning, the configurations are sent to one end. Firstly, a unidirectional 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.

It can happen to bind two reverse unidirectional LSPs to be an associated bidirectional LSP not only when they are being created, but also when they have existed; or when one LSP exists, but the other one needs to be established. To all these scenarios, the provisioning models discussed above are applicable.

#### **3.2. Signaling Procedure**

Consider the topology described in figure 1, LSP1 [A,D,B] (from west to east) and LSP2 [B,D,C,A] (from east to west) are being established or have been established, which can be bound together to be an associated bidirectional LSP. LSP1 is uniquely identified by East-Global\_ID::East-Node\_ID::East-LSP\_Num; similarly LSP2 is identified by West-Global\_ID::West-Node\_ID::West-Tunnel\_Num::West-LSP\_Num [[I-D.ietf-mpls-tp-identifiers](#)].

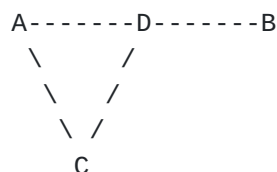


Figure 1: An example of associated bidirectional LSP



For single sided provisioning model, LSP1 is triggered by LSP2 or LSP2 is triggered by LSP1. When LSP2 is triggered by LSP1, LSP1 is initialized at node A with the Extended ASSOCIATION object inserted in the Path message, Association Type is set to "Association of two reverse unidirectional LSPs", Association ID set to East-LSP\_Num, Association Source set to East-Node\_ID, Global Association Source set to East-Global\_ID, and Extended Association ID set to East-Tunnel\_Num. Terminating node B is triggered to set up LSP2 by the received Extended ASSOCIATION object with the Association Type set to the value "Association of two reverse unidirectional 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.

For double sided provisioning model, LSP1 and LSP2 are concurrently initialized with the Extended ASSOCIATION object inserted in their Path messages, and Association Types are set to "Association of two reverse unidirectional LSPs". For LSP1, Association ID set to East-LSP\_Num, Association Source set to East-Node\_ID, Global Association Source set to East-Global\_ID, and Extended Association ID set to East-Tunnel\_Num; for LSP2, Association ID set to West-LSP\_Num, Association Source set to West-Node\_ID, Global Association Source set to West-Global\_ID, and Extended Association ID set to West-Tunnel\_Num. According to the general rules defined in [\[I-D.ietf-ccamp-assoc-info\]](#), the two LSPs cannot be bound together to be an associated bidirectional LSP because of the different values. In this case, the two edge nodes should firstly compare their Global-Node\_ID, then the bigger one sends Path refresh message, replacing the old Extended ASSOCIATION object with the new Extended ASSOCIATION object carried in the reverse LSP. Based on this Path refresh message, the two LSPs can be bounded together to be an associated bidirectional LSP also.

### **3.2.1. Asymmetric Bandwidth LSPs**

There are some kind of applications, such as internet services and the return paths of OAM messages, which MAY have different bandwidth requirements for each direction. [\[RFC5654\]](#) specifies the requirements as follow:

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 [\[I-D.ietf-ccamp-asymm-bw-bidir-lsps-bis\]](#), which introduces three new objects named UPSTREAM\_FLOWSPEC object, UPSTREAM\_TSPEC object and





UPSTREAM\_ADSPEC object to represent the asymmetric upstream traffic flow. For the asymmetric bandwidth associated bidirectional LSPs, the existing SENDER\_TSPEC, ADSPEC, and FLOWSPEC are complemented with the addition of new REVERSE\_TSPEC object, which is used in exactly the same fashion as the old SENDER\_TSPEC object, but refers to set up the reverse unidirectional LSP.

In the context of asymmetric associated bidirectional LSP, the REVERSE\_TSPEC object MUST be carried in the LSP's Path message together with the Extended ASSOCIATION object whose Association Type is "Association of two reverse unidirectional LSPs" to trigger the peer end to set up the reverse LSP with the corresponding asymmetric bandwidth. For the single sided provisioning, the peer end just copies the value of the REVERSE\_TSPEC object into the SENDER\_TSPEC object in the Path message. For the double sided provisioning, the ends need to compare the values of the SENDER\_TSPEC and REVERSE\_TSPEC objects in the two Path messages. If match, the end with the bigger Global-Node\_ID sends Path refresh message, carrying the Extended ASSOCIATION object of the reverse LSP.

Nodes not supporting this extension will not recognize the new class number and should respond with an "Unknown Object Class".

### **3.3. Recovery Considerations**

Assume that LSP3 is used to protect LSP1, which can be established before or after the failure occurs, can share the same TE tunnel with LSP1 or not. LSP3 SHOULD inherit the associated bidirectional attributes between LSP1 and LSP2 when the traffic is switched from LSP1 to LSP3. This can be done by inserting the Extended ASSOCIATION object in LSP3's Path message with the same value as in LSP1's Path message.

## **4. Extensions to the Extended ASSOCIATION object**

The Extended ASSOCIATION object is defined in [\[I-D.ietf-ccamp-assoc-info\]](#), which enables MPLS-TP required identification.

o Association Type:

In order to bind two reverse unidirectional LSPs to be an associated bidirectional LSP, this document defines a new Association Type:

Value	Type
-----	----



TBD            Association of two reverse unidirectional LSPs (A)

If the downstream nodes do not know this Association Type, MUST return a PathErr message with error code/sub-code "LSP Admission Failure/Bad Association Type".

Under the context of this Association Type, any node associating an associated bidirectional LSP MUST insert an ASSOCIATION object with the following setting:

o Association ID:

The Association ID MUST be set to its own signaled LSP ID (default); if known, it MAY be set to the LSP ID of the associated reverse LSP.

o Association Source:

The Association source MUST be set to the tunnel sender address of this LSP (default); if known, it May be set to the tunnel sender address of the peer node.

o Global Association Source:

The format is described in [[I-D.ietf-ccamp-assoc-info](#)].

o Extended Association ID:

Because the two LSPs (one is from west to east, and the other is from east to west) are in different tunnels, the Association ID is insufficient to uniquely identify association for associated bidirectional LSP. Hence, this document adds specific rules: the first 16-bits MUST be set to its own tunnel ID (default); if known, it May be set to the tunnel ID of the the associated reverse tunnel.

As described in [[I-D.ietf-ccamp-assoc-info](#)], association is always done based on matching Path state or Resv state. Upstream initialized association is represented in Extended ASSOCIATION objects carried in Path message and downstream initialized 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-info](#)]. 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. REVERSE\_TSPEC Object

The REVERSE\_TSPEC object is used in Path, PathTear, PathErr, and Notify message (via sender descriptor). This includes the definition of class type and format. It's class number is TBD (of the form 0bbbbbbb), and class type and format is the same as the SENDER\_TSPEC object.

This object modifies the RSVP message-related formats defined in [RFC2205], [RFC3209] and [RFC3473]. See [RFC5511] for the syntax used by RSVP. The format of the sender description for asymmetric associated bidirectional LSPs is:

```
<sender descriptor>::= <SENDER_TEMPLATE> <SENDER_TSPEC>
                        [<ADSPEC>]
                        [<RCEORD_ROUTE>]
                        [<SUGGESTED_LABEL>]
                        [<RECOVERY_LABEL>]
                        <REVERSE_TSPEC>
```

## 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
TBD	Association of two reverse unidirectional LSPs (A)



## **6.2. REVERSE\_TSPEC Object**

A new class named REVERSE\_TSPEC has been created in the 0bbbbbbb rang (TBD) with the following definition:

Class Types or C-types:

Same values as SENDER\_TPSCE object (C-Num 12)

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.

Furthermore, this document introduces the REVERSE\_TSPEC object for use in GMPLS signaling [[RFC3473](#)], which is parallel the existing SENDER\_TSPEC object. As such, any vulnerabilities that are due to the use of the old SENDER\_TSPEC object now apply here also.

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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