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Generalized MPLS (GMPLS) Support for Metro Ethernet Forum and G.8011 User Network Interface (UNI)

Abstract

This document describes a method for controlling two specific types of Ethernet switching via a GMPLS-based User Network Interface (UNI). This document supports the types of switching required by the Ethernet services that have been defined in the context of the Metro Ethernet Forum (MEF) and International Telecommunication Union (ITU) G.8011. This document is the UNI companion to "Generalized MPLS (GMPLS) Support for Metro Ethernet Forum and G.8011 Ethernet Service Switching". This document does not define or limit the underlying intra-domain or Internal NNI (I-NNI) technology used to support the UNI.

Status of This Memo

This is an Internet Standards Track document.

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1. Introduction

[MEF6] and [G.8011] provide parallel frameworks for defining network-oriented characteristics of Ethernet services in transport networks. The framework discusses general Ethernet connection characteristics, Ethernet User Network Interfaces (UNIs), and Ethernet Network-Network Interfaces (NNIs). Within this framework, [G.8011.1] defines the Ethernet Private Line (EPL) service and [G.8011.2] defines the Ethernet Virtual Private Line (EVPL) service. [MEF6] covers both service types. [MEF10.1] defines service parameters and [MEF11] provides UNI requirements and framework.

This document provides a method for GMPLS-based control of Label Switched Paths (LSPs) that support the transport services defined in the above documents at the UNI network reference points. This document does not define or limit the underlying intra-domain or Internal NNI (I-NNI) technology used to support the UNI. This document makes use of the GMPLS extensions defined in [RFC6004] and [RFC6002].

The scope of this document covers Ethernet UNI applications, and it is intended to be consistent with the GMPLS overlay model presented in [RFC4208] and aligned with GMPLS Core Network signaling. The scope and reference model used in this document are represented in Figure 1, which is based on Figure 1 of [RFC4208].

Figure 1 shows two core networks, each containing two core nodes. The core nodes are labeled 'CN'. Connected to each CN is an edge node. The edge nodes are labeled 'EN'. Each EN supports Ethernet Networks and use Ethernet services provided by the core nodes via a UNI. Two services are represented: one EPL and one EVPL type service. Signaling within the core network is out of scope of this document and may include any technology that supports overlay UNI services. The UNI function in the edge node can be referred to as the UNI client, or UNI-C, and in the CN as UNI network, or UNI-N.

```
     Ethernet                                          Ethernet
     Network       +----------+    +-----------+       Network
   +---------+     |          |    |           |     +---------+
   |  +----+ |     |  +-----+ |    |  +-----+  |     | +----+  |
------+    | | EPL |  |     | |    |  |     |  | EPL | |    +------
------+ EN +-+-----+--+ CN  +---------+  CN +--+-----+-+ EN +------
   |  |    | |  +--+--|     +---+  |  |     +--+-----+-+    |  |
   |  +----+ |  |  |  +--+--+ | |  |  +--+--+  |     | +----+  |
   |         |  |  |     |    | |  |     |     |     |         |
   +---------+  |  |     |    | |  |     |     |     +---------+
                |  |     |    | |  |     |     |
   +---------+  |  |     |    | |  |     |     |     +---------+
   |         |  |  |  +--+--+ | |  |  +--+--+  |     |         |
   |  +----+ |  |  |  |     | | +-----+     |  |     | +----+  |
------+    +-+--+  |  | CN  +---------+ CN  |  |     | |    +------
------+ EN +-+-----+--+     | |    |  |     +--+-----+-+ EN +------
   |  |    | |EVPL |  +-----+ |    |  +-----+  |EVPL | |    |  |
   |  +----+ |     |          |    |           |     | +----+  |
   |         |     +----------+    |-----------+     |         |
   +---------+            Core Network(s)            +---------+
     Ethernet  UNI                                UNI   Ethernet
     Network <----->                            <-----> Network
                       Scope of This Document

                     Legend:   EN  -  Edge Node
                               CN  -  Core Node
```

Figure 1: Ethernet UNI Reference Model

1.1. Overview

This document uses a common approach to supporting the switching implied by the Ethernet services defined in [MEF6], [G.8011.1], and [G.8011.2]. The approach builds on standard GMPLS mechanisms to deliver the required control capabilities. This document reuses the GMPLS mechanisms specified in [RFC6004], [RFC4208], and [RFC4974].

Support for Point-to-Point (P2P) and Multipoint-to-Multipoint (MP2MP) service is required by [G.8011] and [MEF11]. P2P service delivery support is based on the GMPLS support for Ethernet services covered in [RFC6004]. As with [RFC6004], the definition of support for MP2MP service is left for future study and is not addressed in this document.

[MEF11] defines multiple types of control for UNI Ethernet services. In MEF UNI Type 1, services are configured manually. In MEF UNI Type 2, services may be configured manually or via a link management interface. In MEF UNI Type 3, services may be established and

managed via a signaling interface. As with [RFC6004], this document is aimed at supporting the MEF UNI Type 3 mode of operation (and not MEF UNI Types 1 and 2). As mentioned above, this document is limited to covering UNI-specific topics.

Common procedures used to signal Ethernet connections are described in Section 2 of this document. Procedures related to signaling switching in support of EPL services are described in Section 3. Procedures related to signaling switching in support of EVPL services are described in Section 4.

1.2. 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].

2. Common Signaling Support

This section describes the common mechanisms for supporting a UNI reference point for LSPs that provide the Ethernet Services described in [RFC6004].

Except as specifically modified in this document, the procedures related to the processing of Resource ReSerVation Protocol (RSVP) objects is not modified by this document. The relevant procedures in existing documents, notably [RFC6002], [RFC6004], [RFC4208], and [RFC4974], MUST be followed in all cases not explicitly described in this document.

2.1. UNI Addressing

LSPs providing Ethernet connections controlled via the mechanisms defined in this document MUST use the addressing and other procedures defined in [RFC4208]. Of note, this includes the use of the egress edge node's IP address in the endpoint address field in the SESSION object.

One issue that presents itself with the addressing approach taken in [RFC4208] is that an ingress edge node may not receive the egress edge node's IP address as part of the management, or other, request that results in the initiation of a new Ethernet connection. This case is covered as described in Section 7.2 of [RFC4974] and modified below in Section 2.2.1.

2.2. Ethernet Endpoint (UNI) Identification

UNI identification, except as noted below, MUST follow Ethernet endpoint (UNI) identification as defined in [RFC6004]. There is one additional case that is covered in this document where the scope of the Ethernet endpoint identifier is relevant beyond the typical case of just ingress and egress nodes.

2.2.1. Address Resolution

At the UNI reference point, it is possible for the ingress edge node to not have the egress edge node's IP address when initiating an LSP. This presents an issue as the egress edge node's IP address is carried in the SESSION object. This case is handled leveraging the approach described in Section 7.2 of [RFC4974] to address call ID assignment by the first core node.

When an edge node (the UNI-C) initiates an LSP and it has the egress Ethernet endpoint identifier, but does not have its IP address, the edge node MUST create a Notify message as described in [RFC4974]. The Notify message MUST include the CALL_ATTRIBUTES object with the Endpoint ID TLV defined [RFC6004]. The tunnel endpoint address field of the SESSION object in the Notify message MUST be set to zero (0). The message MUST be addressed and sent to an address associated with the first core node.

When a core node, i.e., the node providing the network side of the UNI (the UNI-N), receives a Notify message with the tunnel endpoint address field of the SESSION object set to zero, it MUST locate the Endpoint ID TLV in the CALL_ATTRIBUTES object. If the object or TLV are not present, the node MUST discard the message. In this case, a Message ID Acknowledgment MUST NOT be sent for the Notify message.

When the Endpoint ID TLV is located, the node MUST map the Endpoint ID into an IP address associated with the egress edge node. If the node is unable to obtain an egress address, it MUST issue an error response Notify messages according to Section 6.2.2. of [RFC4974]. The Error code and value SHOULD be "Routing Problem/Unknown Endpoint" (Error code 24, Error value 35).

When the node is able to obtain an egress address, the endpoint address field of the SESSION object MUST be set to the obtained address, and the Notify message should be sent according to the standard processing defined in [RFC4974]. The downstream nodes will then process the Notify according to standard processing rules.

When the ingress receives the response Notify message, it SHOULD identify the call based on the Endpoint ID TLV and, when not set to zero on the corresponding setup Notify message, the short and long Call IDs. The endpoint address field of the SESSION object carried in the response Notify message will include the egress's IP address. This returned address MUST be used in all subsequent messages associated with the Ethernet connection.

Note that the procedure described in this section MAY be used when the Call IDs are generated by the initiating UNI or generated by the first core node.

2.3. Connection Identification

With one exception, UNI signaling for Ethernet connections MUST follow the Connection Identification procedures defined in [RFC6004]. The exception is that the procedures defined in Section 7.2 of [RFC4974] MAY be used to provide support for allocation of Call IDs by the first core node rather than by the initiating edge node.

3. EPL Service

There are no additional UNI-specific requirements for signaling LSPs supporting Ethernet Private Line (EPL) services. The procedures defined in [RFC6004], as modified above, MUST be followed when signaling an LSPs supporting an EPL Service.

4. EVPL Service

There is one additional UNI-specific requirement for signaling LSPs supporting an EVPL type service as described in Section 4.1. Except as modified above and by this section, the procedures defined in [RFC6004] MUST be followed when signaling an EVPL Service.

4.1. Egress VLAN ID Control and VLAN ID Preservation

Per [MEF6], the mapping of the single VLAN ID used at the ingress UNI to a different VLAN ID at the egress UNI is allowed for EVPL services that do not support both bundling and VLAN ID preservation. Such a mapping MUST be requested and signaled based on the explicit label control mechanism defined in [RFC4208], and not the mechanisms defined in [RFC6004].

As is the case in [RFC6004], when the explicit label control mechanism is not used VLAN IDs MUST be preserved, i.e., not modified, across the LSP.

5. IANA Considerations

IANA has assigned new values for namespaces defined in this document and summarized in this section.

5.1. Error Value: Routing Problem/Unknown Endpoint

IANA has made the following assignment in the "Error Codes and Globally-Defined Error Value Sub-Codes" section of the "RSVP Parameters" registry located at http://www.iana.org:

```
Error Code      Meaning
  24  Routing Problem                            [RFC3209]

Under "This Error Code has the following globally-defined Error
       Value sub-codes:"

      35 =  Unknown Endpoint                     [RFC6005]
```

6. Security Considerations

This document makes use of the mechanisms defined in [RFC6004] and [RFC4974]. It does not in itself change the security models offered in each. (Note that the address resolution discussed in Section 2.2 above, parallels the replacement of information that occurs per Section 7.2 of [RFC4974].) See [RFC6004] and [RFC4974] for the security considerations that are relevant to and introduced by the base mechanisms used by this document.

7. References

7.1. Normative References

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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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[RFC6002] Berger, L. and D. Fedyk, "Generalized MPLS (GMPLS) Data Channel Switching Capable (DCSC) and Channel Set Label Extensions", RFC 6002, October 2010.

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[G.8011.2] ITU-T G.8011.2/Y.1307.2, "Ethernet virtual private line service", September 2005.

[MEF6] The Metro Ethernet Forum, "Ethernet Services Definitions - Phase I", MEF 6, June 2004.

[MEF10.1] The Metro Ethernet Forum, "Ethernet Services Attributes Phase 2", MEF 10.1, November 2006.

[MEF11] The Metro Ethernet Forum , "User Network Interface (UNI) Requirements and Framework", MEF 11, November 2004.

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