MPLS
Internet-Draft
Intended status: Standards Track
Expires: October 10, 2013

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April 08, 2013

MPLS-TP Next-Hop Ethernet Addressing
draft-ietf-mpls-tp-ethernet-addressing-07

Abstract

The Multiprotocol Label Switching (MPLS) Transport Profile (MPLS-TP) is the set of MPLS protocol functions applicable to the construction and operation of packet-switched transport networks. This document presents considerations for link-layer addressing of Ethernet frames carrying MPLS-TP packets.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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This Internet-Draft will expire on October 10, 2013.

1. Introduction

The MPLS Transport Profile (MPLS-TP) [RFC5921] is the set of protocol functions that meet the requirements [RFC5654] for the application of MPLS to the construction and operation of packet-switched transport networks. The MPLS-TP data plane consists of those MPLS-TP functions concerned with the encapsulation and forwarding of MPLS-TP packets and is described in [RFC5960].

This document presents considerations for link-layer addressing of Ethernet frames carrying MPLS-TP packets. Since MPLS-TP packets are MPLS packets, existing procedures ([RFC3032], [RFC5332]) for the encapsulation of MPLS packets over Ethernet apply. Because IP functionality is only optional in an MPLS-TP network, IP-based protocols for Media Access Control (MAC) address learning, such as the Address Resolution Protocol (ARP) [RFC0826] and IP version 6 Neighbor Discovery [RFC4861], may not be available. This document specifies the options for the determination and selection of the next-hop Ethernet MAC address when MPLS-TP is used between nodes that do not have an IP dataplane.

1.1. Terminology

Term	Definition
ARP	Address Resolution Protocol
G-ACh	Generic Associated Channel
LSP	Label Switched Path
LSR	Label Switching Router
MAC	Media Access Control
MPLS-TP	MPLS Transport Profile

Additional definitions and terminology can be found in [RFC5960] and [RFC5654].

1.2. Requirements Language

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. Point-to-Point Link Addressing

When two MPLS-TP nodes are connected by a point-to-point Ethernet link, the question arises as to what destination Ethernet Media Access Control (MAC) address should be specified in Ethernet frames transmitted to the peer node over the link. The problem of determining this address does not arise in IP/MPLS networks because of the presence of the Ethernet Address Resolution Protocol (ARP) [RFC0826] or IP version 6 Neighbor Discovery protocol [RFC4861], which allow the unicast MAC address of the peer device to be learned dynamically.

If existing mechanisms are available in an MPLS-TP network to determine the destination unicast MAC addresses of peer nodes -- for example, if the network also happens to be an IP/MPLS network, or if Link Layer Discovery Protocol (LLDP) [LLDP] is in use, or if it implements the procedures in Section 4 of this document -- such mechanisms SHOULD be used. The remainder of this section discusses the available options when this is not the case.

Each node MAY be statically configured with the MAC address of its peer. Note however that static MAC address configuration can present an administrative burden and lead to operational problems. For example, replacement of an Ethernet interface to resolve a hardware fault when this approach is used requires that the peer node be manually reconfigured with the new MAC address. This is especially problematic if the peer is operated by another provider.

Another approach which may be considered is to use the Ethernet broadcast address FF-FF-FF-FF-FF-FF as the destination MAC address in frames carrying MPLS-TP packets over a link that is known to be point-to-point. This may, however, lead to excessive frame distribution and processing at the Ethernet layer. Broadcast traffic may also be treated specially by some devices and this may not be desirable for MPLS-TP data frames.

In view of the above considerations, the approach which SHOULD be used, is therefore to configure both nodes to use the method described in this document which uses, as a destination MAC address, an Ethernet multicast address reserved for MPLS-TP for use over point-to-point links. The address allocated for this purpose by the Internet Assigned Numbers Authority (IANA) is 01-00-5E-90-00-00. An MPLS-TP implementation MUST process Ethernet frames received over a point-to-point link with this destination MAC address by default.

The use of broadcast or multicast addressing for the purpose described in this section, i.e. as a placeholder for the unknown unicast MAC address of the destination, is applicable only when the attached Ethernet link is known to be point-to-point. If a link is not known to be point-to-point, these forms of broadcast or multicast

addressing MUST NOT be used. Thus the implementation MUST provide a means for the operator to declare that a link is point-to-point if it supports these addressing modes. Moreover, the operator is cautioned that it is not always clear whether a given link is, or will remain, strictly point-to-point, particularly when the link is supplied by an external provider; point-to-point declarations must therefore be used with care. Because of these caveats it is RECOMMENDED that implementations support the procedures in Section 4 so that unicast addressing can be used.

3. Multipoint Link Addressing

When a multipoint Ethernet link serves as a section [RFC5960] for a point-to-multipoint MPLS-TP LSP, and multicast destination MAC addressing at the Ethernet layer is used for the LSP, the addressing and encapsulation procedures specified in [RFC5332] SHALL be used.

When a multipoint Ethernet link -- that is, a link which is not known to be point-to-point -- serves as a section for a point-to-point MPLS-TP LSP, unicast destination MAC addresses MUST be used for Ethernet frames carrying packets of the LSP. According to the discussion in the previous section, this implies the use of either static MAC address configuration or a protocol that enables peer MAC address discovery.

4. MAC Address Discovery via the G-ACh Advertisement Protocol

The G-ACh Advertisement Protocol (GAP) [I-D.ietf-mpls-gach-adv] provides a simple means of informing listeners on a link of the sender's capabilities and configuration. When used for this purpose on an Ethernet link, GAP messages are multicast to the address 01-00-5e-80-00-0d (see [I-D.ietf-mpls-gach-adv] Section 7). If these messages contain the unicast MAC address of the sender, then listeners can learn this address and use it in the future when transmitting frames containing MPLS-TP packets. Since the GAP does not rely on IP, this provides a means of unicast MAC discovery for MPLS-TP nodes without IP support.

This document defines a new GAP application "Ethernet Interface Parameters" (TBD1), to support the advertisement of Ethernet-specific parameters associated with the sending interface. The following Type-Length-Value (TLV) objects are defined for this application; the TLV format is as defined in [I-D.ietf-mpls-gach-adv]:

Source MAC Address (type = 0, length = 8): The Value of this object is an EUI-64 [EUI-64] unicast MAC address assigned to one of the interfaces of the sender that is connected to this data link. The IEEE-defined mapping from 48-bit MAC addresses to EUI-64 form is used.

Maximum Frame Size (MFS) (type = 1, length = 4): The Value of this object is a 32-bit unsigned integer encoded in network byte order that specifies the maximum frame size octets of an an Ethernet Frame that can be sent over the sending interface. Where MAC address learning occurs by some other means, this TLV group MAY be used to advertise only the MFS. If multiple advertisements are made for the same parameter, use of these advertisements is undefined.

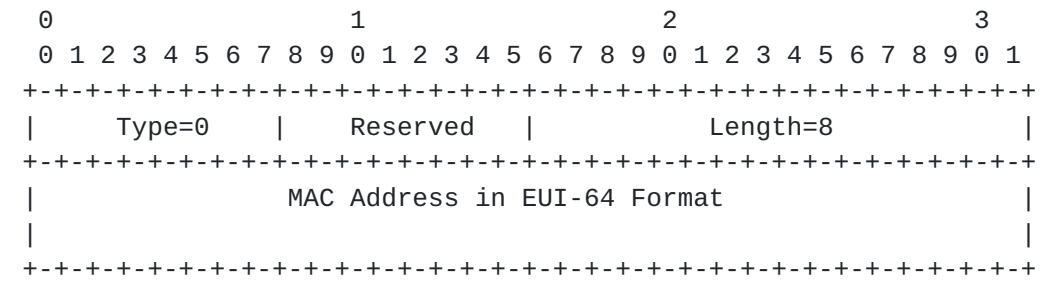

Figure 1: Source MAC Address Object Format

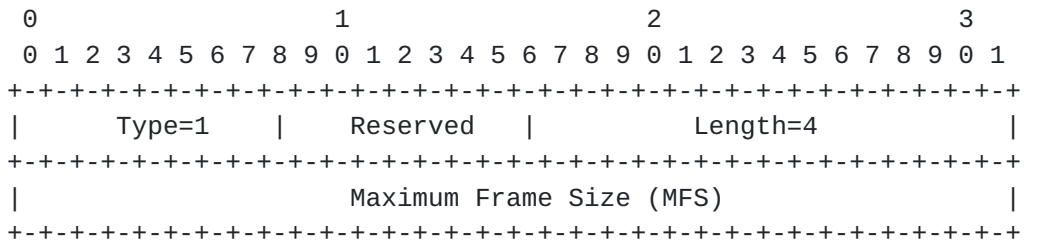

Figure 2: MFS Object Format

Per [I-D.ietf-mpls-gach-adv], MAC Address Discovery information needs to be periodically retransmitted and is to be retained by a receiver based on the period of time indicated by the associated Lifetime field. To expedite the initialization of a link it is RECOMMENDED that a node that has been reconfigured, rebooted or is aware that it have been disconnected from its peer send a GAP Ethernet Interface Parameter message, and that it issues a GAP request message for the Ethernet parameters at the earliest opportunity.

When the MAC address in the received Source MAC Address TLV changes the new MAC address MUST be used (see Section 5.2 of [I-D.ietf-mpls-gach-adv]).

If a minimum MFS is configured for a link and the MFS advertised by the peer is lower than that minimum, the operator MUST be notified of the MFS mismatch. Under these circumstances the operator may choose to configure the LSR to shut the link, thereby triggering a fault, and hence causing the end-to-end path to be repaired. Alternatively the operator may choose to configure the LSR to leave the link up so that an OAM message can be used to verify the actual MFS.

In the event a GAP message is not received within the previously received associated Lifetime, the receiving node MUST assume that it is now connected to a node that does not support these advertisements and must behave as configured for this eventuality.

5. Manageability Considerations

The values sent and received by this protocol MUST be made accessible for inspection by network operators, and where local configuration is updated by the received information, it MUST be clear why the configured value has been changed. The advertised information SHOULD be persistent across restarts. Received advertisements MUST be discarded across restarts. If the received values change, the new values MUST be used and the change made visible to the network operators.

6. Security Considerations

The use of broadcast or multicast Ethernet destination MAC addresses for frames carrying MPLS-TP data packets can potentially result in such frames being distributed to devices other than the intended destination node or nodes when the Ethernet link is not point-to-point. The operator SHOULD take care to ensure that MPLS-TP nodes are aware of the Ethernet link type (point-to-point or multipoint). In the case of multipoint links, the operator SHOULD either ensure that no devices are attached to the link that are not authorized to receive the frames, or take steps to mitigate the possibility of excessive frame distribution, for example by configuring the Ethernet switch to appropriately restrict the delivery of multicast frames to authorized ports.

An attacker could disrupt communications by modifying the Source MAC Address or the MFS values, however this is mitigated by the use of cryptographic authentication as described in [I-D.ietf-mpls-gach-adv] which also describes other considerations applicable to the GAP protocol. Visibility into the contents of either of the TLVs could

provide information that is useful for an attacker. This is best addressed by physical security of the links.

7. IANA Considerations

7.1. Ethernet Multicast Address Allocation

IANA has allocated an Ethernet multicast address from the "IANA Multicast 48-bit MAC Addresses" address block in the "Ethernet Numbers" registry for use by MPLS-TP LSRs over point-to-point links as described in Section 2. The allocated address is 01-00-5E-90-00-00. IANA is requested to update the reference to point to the RFC number assigned to this document.

7.2. G-ACh Advertisement Protocol Allocation

IANA is requested to allocate a new Application ID in the "G-ACh Advertisement Protocol Applications" registry [I-D.ietf-mpls-gach-adv] (currently located in the "Pseudowire Name Spaces (PWE3)"), as follows:

Application ID	Description	Reference
TBD1 to be assigned by IANA	Ethernet Interface Parameters	(this draft)

7.3. Creation of Ethernet Interface Parameters Registry

IANA is requested to create a new registry, "G-ACh Advertisement Protocol: Ethernet Interface Parameters" within the "Pseudowire Name Spaces (PWE3)" with fields and initial allocations as follows:

Type Name	Type ID	Reference
Source MAC Address	0	(this draft)
Maximum Frame Size	1	(this draft)

The range of the Type ID field is 0 - 255.

The allocation policy for this registry is IETF Review.

8. Acknowledgements

We thank Adrian Farrel for his valuable review comments on this document.

9. References

9.1. Normative References

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9.2. Informative References

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