Network Working Group
Request for Comments: 5586
Updates: 3032, 4385, 5085
Category: Standards Track
M. Bocci, Ed.
M. Vigoureux, Ed.
Alcatel-Lucent
S. Bryant, Ed.
Cisco Systems
June 2009

MPLS Generic Associated Channel

Status of This Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

Copyright Notice

Abstract

This document generalizes the applicability of the pseudowire (PW) Associated Channel Header (ACH), enabling the realization of a control channel associated to MPLS Label Switched Paths (LSPs) and MPLS Sections in addition to MPLS pseudowires. In order to identify the presence of this Associated Channel Header in the label stack, this document also assigns one of the reserved MPLS label values to the Generic Associated Channel Label (GAL), to be used as a label based exception mechanism.

Table of Contents

1. Introduction

There is a need for Operations, Administration, and Maintenance (OAM) mechanisms that can be used for fault detection, diagnostics, maintenance, and other functions on a pseudowire (PW) and a Label Switched Path (LSP). These functions can be used between any two Label Edge Routers (LERs)/Label Switching Router (LSRs) or Terminating Provider Edge routers (T-PEs)/Switching Provider Edge routers (S-PEs) along the path of an LSP or PW, respectively [MPLS-TP]. Some of these functions can be supported using existing tools such as Virtual Circuit Connectivity Verification (VCCV) [RFC5085], Bidirectional Forwarding Detection for MPLS LSPs (BFD-MPLS) [BFD-MPLS], LSP-Ping [RFC4379], or BFD-VCCV [BFD-VCCV]. However, a requirement has been indicated to augment this set of maintenance functions, in particular when MPLS networks are used for packet transport services and transport network operations [OAM-REQ]. Examples of these functions include performance monitoring, automatic protection switching, and support for management and signaling communication channels. These tools MUST be applicable to, and function in essentially the same manner (from an operational point of view) on MPLS PWs, MPLS LSPs, and MPLS Sections. They MUST also operate in-band on the PW or LSP such that they do not depend on Packet Switched Network (PSN) routing or on user traffic, and MUST NOT depend on dynamic control plane functions.

VCCV [RFC5085] can use an Associated Channel Header (ACH) to provide a PW associated control channel between a PW's endpoints, over which OAM and other control messages can be exchanged. This document generalizes the applicability of the ACH to enable the same associated control channel mechanism to be used for Sections, LSPs, and PWs. The associated control channel thus generalized is known as the Generic Associated Channel (G-ACh). The ACH, specified in RFC 4385 [RFC4385], may be used with additional code points to support additional MPLS maintenance functions on the G-ACh.

Generalizing the applicability of the ACH to LSPs and Sections also requires a method to identify that a packet contains an ACH followed by a non-service payload. Therefore, this document also defines a label-based exception mechanism that serves to inform an LSR (or LER) that a packet it receives on an LSP or Section belongs to an associated control channel. The label used for that purpose is one of the MPLS reserved labels and is referred to as the GAL (G-ACh Label). The GAL mechanism is defined to work together with the ACH for LSPs and MPLS Sections.

RFC 4379 [RFC4379] and BFD-MPLS [BFD-MPLS] define alert mechanisms that enable an MPLS LSR to identify and process MPLS OAM packets when these are encapsulated in an IP header. These alert mechanisms are based, for example, on Time To Live (TTL) expiration and/or on the use of an IP destination address in the range of 127.0.0.0/8 or 0:0:0:0:FFFF:127.0.0.0/104 for IPv4 and IPv6, respectively. These mechanisms are the default mechanisms for identifying MPLS OAM packets when encapsulated in an IP header. However, it may not always be possible to use these mechanisms in some MPLS applications, e.g., MPLS Transport Profile (MPLS-TP) [MPLS-TP], particularly when IP-based demultiplexing cannot be used. This document defines a mechanism that is RECOMMENDED for identifying and encapsulating MPLS OAM and other maintenance messages when IP based mechanisms such as those used in [RFC4379] and [BFD-MPLS] are not available. Yet, this mechanism MAY be used in addition to IP-based mechanisms.

Note that, in this document, maintenance functions and packets should be understood in the broad sense. That is, a set of maintenance and management mechanisms that include OAM, Automatic Protection Switching (APS), Signaling Communication Channel (SCC), and Management Communication Channel (MCC) messages.

Also note that the GAL and ACH are applicable to MPLS and PWs in general. This document specifies general mechanism and uses MPLS-TP as an example application. The application of the GAL and ACH to other specific MPLS uses is outside the scope of this document.

1.1. Objectives

This document defines a mechanism that provides a solution to the extended maintenance needs of emerging applications for MPLS. It creates a generic control channel mechanism that may be applied to MPLS LSPs and Sections, while maintaining compatibility with the PW associated channel. It also normalizes the use of the ACH for PWs in a transport context, and defines a label-based exception mechanism to alert LERs/LSRs of the presence of an ACH after the bottom of the label stack.

1.2. Scope

This document defines the encapsulation header for Section, LSP, and PW associated control channel messages.

This document does not define how associated control channel capabilities are signaled or negotiated between LERs/LSRs or between PEs, nor does it define the operation of various OAM functions.

This document does not deprecate existing MPLS and PW OAM mechanisms.

1.3. Requirements Language and Terminology

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 [RFC2119].

This document uses the following additional terminology:

ACH: Associated Channel Header

G-ACh: Generic Associated Channel

GAL: G-ACh Label

G-ACh packet: Any packet containing a message belonging to a protocol that is carried on a PW, LSP, or MPLS Section associated control channel. Examples include maintenance protocols such as OAM functions, signaling communications, or management communications.

The terms "Section" and "Concatenated Segment" are defined in [TP-REQ] as follows (note that the terms "Section" and "Section Layer Network" are synonymous):

Section Layer Network: A section layer is a server layer (which may be MPLS-TP or a different technology) that provides for the transfer of the section layer client information between adjacent nodes in the transport path layer or transport service layer. Note that G.805 [G805] defines the section layer as one of the two layer networks in a transmission media layer network. The other layer network is the physical media layer network.

Concatenated Segment: A serial-compound link connection as defined in [G805]. A concatenated segment is a contiguous part of an LSP or multi-segment PW that comprises a set of segments and their interconnecting nodes in sequence.

2. Generic Associated Channel Header

VCCV [RFC5085] defines three Control Channel (CC) Types that may be used to exchange OAM messages through a PW. CC Type 1 uses an ACH and is referred to as "In-band VCCV"; CC Type 2 uses the MPLS Router Alert Label to indicate VCCV packets and is referred to as "Out-of-Band VCCV"; CC Type 3 uses the TTL to force the packet to be processed by the targeted router control plane and is referred to as "MPLS PW Label with TTL == 1".

2.1. Definition

The use of the ACH, previously limited to PWs, is here generalized to also apply to LSPs and to Sections. Note that for PWs, the PWE3 control word [RFC4385] MUST be present in the encapsulation of user packets when the ACH is used to realize the associated control channel.

The ACH used by CC Type 1 is depicted in figure below:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|0 0 0 1|Version|   Reserved    |         Channel Type          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 1: Associated Channel Header

In the above figure, the first nibble is set to 0001b to indicate a control channel associated with a PW, LSP, or Section. The Version field is set to 0, as specified in RFC 4385 [RFC4385]. Bits 8 to 15 of the ACH are reserved and MUST be set to 0 and ignored on reception. Bits 16 to 31 are used to encode the possible Channel Types. This 16-bit field is in network byte order.

Note that VCCV [RFC5085] also includes mechanisms for negotiating the Control Channel and Connectivity Verification (i.e., OAM function) Types between PEs. It is anticipated that similar mechanisms will be applied to LSPs. Such application will require further specification. However, such specification is beyond the scope of this document.

The G-ACh MUST NOT be used to transport user traffic.

2.2. Allocation of Channel Types

The Channel Type field indicates the type of message carried on the associated control channel, e.g., IPv4 or IPv6 if IP demultiplexing is used for messages sent on the associated control channel, or OAM or other maintenance function if IP demultiplexing is not used. For associated control channel packets where IP is not used as the multiplexer, the Channel Type indicates the specific protocol carried in the associated control channel.

Values for the Channel Type field currently used for VCCV are specified elsewhere, e.g., in RFC 4446 [RFC4446] and RFC 4385 [RFC4385]. Additional Channel Type values and the associated maintenance functionality will be defined in other documents. Each document, specifying a protocol solution relying on the ACH, MUST also specify the applicable Channel Type field value.

Note that these values are allocated from the PW Associated Channel Type registry [RFC4446], but this document modifies the existing policy to accommodate a level of experimentation. See Section 10 for further details.

3. ACH TLVs

In some applications of the generalized associated control channel, it is necessary to include one or more ACH TLVs to provide additional context information to the G-ACh packet. One use of these ACH TLVs might be to identify the source and/or intended destination of the associated channel message. However, the use of this construct is not limited to providing addressing information nor is the applicability restricted to transport network applications.

If the G-ACh message MAY be preceded by one or more ACH TLVs, then this MUST be explicitly specified in the definition of an ACH Channel Type. If the ACH Channel Type definition does state that one or more ACH TLVs MAY precede the G-ACh message, an ACH TLV Header MUST follow the ACH. If no ACH TLVs are required in a specific associated channel packet, but the Channel Type nevertheless defines that ACH TLVs MAY be used, an ACH TLV Header MUST be present but with a length field set to zero to indicate that no ACH TLV follow this header.

If an ACH Channel Type specification does not explicitly specify that ACH TLVs MAY be used, then the ACH TLV Header MUST NOT be used.

3.1. ACH TLV Payload Structure

This section defines and describes the structure of an ACH payload when an ACH TLV Header is present.

The following figure (Figure 2) shows the structure of a G-ACh packet payload.

```
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                              ACH                              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                         ACH TLV Header                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               ~
~                     zero or more ACH TLVs                     ~
~                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               ~
~                         G-ACh Message                         ~
~                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 2: G-ACh Packet Payload

3.2. ACH TLV Header

The ACH TLV Header defines the length of the set of ACH TLVs that follow.

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|          Length               |            Reserved           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 3: ACH TLV Header

The Length field specifies the length in octets of the complete set of TLVs including sub-TLVs that follow the ACH TLV Header. A length of zero indicates that no ACH TLV follow this header. Note that no padding is required for the set of ACH TLVs.

The Reserved field is for future use and MUST be set to zero on transmission and ignored on reception.

3.3. ACH TLV Object

ACH TLVs MAY follow an ACH TLV Header. The structure of ACH TLVs is defined and described in this section.

An ACH TLV consists of a 16-bit Type field, followed by a 16-bit Length field that specifies the number of octets of the Value field, which follows the Length field. This 32-bit word is followed by zero or more octets of Value information. The format and semantics of the Value information are defined by the TLV Type as recorded in the TLV

Type registry. See Section 10 for further details. Note that the Value field of ACH TLVs MAY contain sub-TLVs. Note that no padding is required for individual TLVs or sub-TLVs.

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|           TLV Type            |          Length               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               ~
~                             Value                             ~
~                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 4: ACH TLV Format

4. Generalized Exception Mechanism

Generalizing the associated control channel mechanism to LSPs and Sections also requires a method to identify that a packet contains an ACH followed by a non-service payload. This document specifies that a label is used for that purpose and calls this special label the G-ACh Label (GAL). One of the reserved label values defined in RFC 3032 [RFC3032] is assigned for this purpose. IANA assigned the value 13 to the GAL.

The GAL provides an alert based exception mechanism to:

- o differentiate specific packets (i.e., G-ACh packets) from others, such as user-plane ones.
- o indicate that the ACH appears immediately after the bottom of the label stack.

The GAL MUST only be used where both these purposes apply.

4.1. Relationship with Existing MPLS OAM Alert Mechanisms

RFC 4379 [RFC4379] and BFD-MPLS [BFD-MPLS] define alert mechanisms that enable an MPLS LSR to identify and process MPLS OAM packets when these are encapsulated in an IP header. These alert mechanisms are based, for example, on Time To Live (TTL) expiration and/or on the use of an IP destination address in the range of 127.0.0.0/8 or 0:0:0:0:0:FFFF:127.0.0.0/104 for IPv4 and IPv6, respectively.

These mechanisms are the default mechanisms for identifying MPLS OAM packets when encapsulated in an IP header although the mechanism defined in this document MAY also be used.

4.2. GAL Applicability and Usage

In MPLS-TP, the GAL MUST be used with packets on a G-ACh on LSPs, Concatenated Segments of LSPs, and with Sections, and MUST NOT be used with PWs. It MUST always be at the bottom of the label stack (i.e., S bit set to 1). However, in other MPLS environments, this document places no restrictions on where the GAL may appear within the label stack or its use with PWs. Where the GAL is at the bottom of the label stack (i.e., S bit set to 1), then it MUST always be followed by an ACH.

The GAL MUST NOT appear in the label stack when transporting normal user-plane packets. Furthermore, when present, the GAL MUST NOT appear more than once in the label stack.

A receiving LSR, LER, or PE MUST NOT forward a G-ACh packet to another node based on the GAL label.

4.2.1. GAL Processing

The Traffic Class (TC) field (formerly known as the EXP field) of the Label Stack Entry (LSE) containing the GAL follows the definition and processing rules specified and referenced in [RFC5462].

The Time-To-Live (TTL) field of the LSE that contains the GAL follows the definition and processing rules specified in [RFC3443].

4.2.1.1. MPLS Label Switched Paths and Segments

The following figure (Figure 5) depicts two LERs (A and D) and two LSRs (B and C) for a given LSP that is established from A to D and switched in B and C.

```
+---+                 +---+                 +---+                 +---+
| A |-----------------| B |-----------------| C |-----------------| D |
+---+                 +---+                 +---+                 +---+
```

Figure 5: Maintenance over an LSP

In this example, a G-ACh exists on the LSP that extends between LERs A and D, via LSRs B and C. Only A and D may initiate new G-ACh packets. A, B, C, and D may process and respond to G-ACh packets.

The following figure (Figure 6) depicts the format of an MPLS-TP G-ACh packet when used for an LSP.

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                LSP Label              |  TC |S|       TTL     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                   GAL                 |  TC |S|       TTL     |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                              ACH                              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                  ACH TLV Header (if present)                  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               ~
~                     Zero or more ACH TLVs                     ~
~                           (if present)                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               ~
~                         G-ACh Message                         ~
~                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 6: G-ACh Packet Format for an LSP

Note that it is possible that the LSP may be tunneled in another LSP (e.g., if an MPLS Tunnel exists between B and C), and as such other LSEs may be present in the label stack.

To send a G-ACh message on the LSP associated control channel, the LER (A) generates a G-ACh message, to which it MAY prepend an ACH TLV Header and appropriate ACH TLVs. It then adds an ACH, onto which it pushes a GAL LSE. Finally, the LSP Label LSE is pushed onto the resulting packet.

- o The TTL field of the GAL LSE MUST be set to at least 1. The exact value of the TTL is application specific. See Section 4.2.1 for definition and processing rules.

- o The S bit of the GAL MUST be set according to its position in the label stack (see Section 4.2).

- o The setting of the TC field of the GAL is application specific. See Section 4.2.1 for definition and processing rules.

LSRs MUST NOT modify the G-ACh message, the ACH or the GAL towards the targeted destination.

Note: This is because once a G-ACh packet has been sent on an LSP, no node has visibility of it unless the LSP label TTL expires or the GAL is exposed when the LSP label is popped. If this is at the targeted destination, for example, indicated by an address in an ACH TLV, then processing can proceed as specified below. If this is not the targeted destination, but the node has agreed to process packets on that ACH channel, then the processing applied to the packet is out of scope of this document.

Upon reception of the labeled packet, the targeted destination, after having checked both the LSP Label and GAL LSEs fields, SHOULD pass the whole packet to the appropriate processing entity.

4.2.1.2. MPLS Section

The following figure (Figure 7) depicts an example of an MPLS Section.

```
+---+             +---+
| A |-------------| Z |
+---+             +---+
```

Figure 7: Maintenance over an MPLS Section

With regard to the MPLS Section, a G-ACh exists between A and Z. Only A and Z can insert, extract, or process packets on this G-ACh.

The following figure (Figure 8) depicts the format of a G-ACh packet when used for an MPLS Section. The GAL MAY provide the exception mechanism for a control channel in its own right without being associated with a specific LSP, thus providing maintenance-related communications across a specific link interconnecting two LSRs. In this case, the GAL is the only label in the stack.

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                  GAL                  |  TC |S|      TTL      |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                              ACH                              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                  ACH TLV Header (if present)                  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               ~
~                     Zero or more ACH TLVs                     ~
~                         (if present)                          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               ~
~                         G-ACh message                         ~
~                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 8: G-ACh Packet Format for an MPLS Section

To send a G-ACh message on a control channel associated to the Section, the head-end LSR (A) of the Section generates a G-ACh message, to which it MAY prepend an ACH TLV Header and appropriate ACH TLVs. Next, the LSR adds an ACH. Finally, it pushes a GAL LSE.

- The TTL field of the GAL MUST be set to at least 1. The exact value of the TTL is application specific. See Section 4.2.1 for definition and processing rules.

- The S bit of the GAL MUST be set according to its position in the label stack. (see Section 4.2).

- The setting of the TC field of the GAL is application specific. See Section 4.2.1 for definition and processing rules.

Intermediate nodes of the MPLS Section MUST NOT modify the G-ACh message, the ACH and the GAL towards the tail-end LSR (Z). Upon reception of the G-ACh packet, the tail-end LSR (Z), after having checked the GAL LSE fields, SHOULD pass the whole packet to the appropriate processing entity.

4.3. Relationship with RFC 3429

RFC 3429 [RFC3429] describes the assignment of one of the reserved label values, defined in RFC 3032 [RFC3032], to the "OAM Alert Label" that is used by user-plane MPLS OAM functions for the identification of MPLS OAM packets. The value of 14 is used for that purpose.

Both this document and RFC 3429 [RFC3429] therefore describe the assignment of reserved label values for similar purposes. The rationale for the assignment of a new reserved label can be summarized as follows:

- o Unlike the mechanisms described and referenced in RFC 3429 [RFC3429], G-ACh messages will not reside immediately after the GAL but instead behind the ACH, which itself resides after the bottom of the label stack.
- o The set of maintenance functions potentially operated in the context of the G-ACh is wider than the set of OAM functions referenced in RFC 3429 [RFC3429].
- o It has been reported that there are existing implementations and running deployments using the "OAM Alert Label" as described in RFC 3429 [RFC3429]. It is therefore not possible to modify the "OAM Alert Label" allocation, purpose, or usage. Nevertheless, it is RECOMMENDED that no further OAM extensions based on "OAM Alert Label" (Label 14) usage be specified or developed.

5. Compatibility

Procedures for handling a packet received with an invalid incoming label are specified in RFC 3031 [RFC3031].

An LER, LSR, or PE MUST discard received associated channel packets on which all of the MPLS or PW labels have been popped if any one of the following conditions is true:

- o It is not capable of processing packets on the Channel Type indicated by the ACH of the received packet.
- o It has not, through means outside the scope of this document, indicated to the sending LSR, LER, or PE that it will process associated channel packets on the Channel Type indicated by the ACH of the received packet.
- o The packet is received on an Experimental Channel Type that is locally disabled.
- o If the ACH was indicated by the presence of a GAL, and the first nibble of the ACH of the received packet is not 0001b.
- o The ACH version is not recognized.

In addition, the LER, LSR, or PE MAY increment an error counter and MAY also issue a system and/or Simple Network Management Protocol (SNMP) notification.

6. Congestion Considerations

The congestion considerations detailed in RFC 5085 [RFC5085] apply.

7. Major Contributing Authors

The editors would like to thank George Swallow, David Ward, and Rahul Aggarwal who made a major contribution to the development of this document.

George Swallow
Cisco Systems
Email: swallow@cisco.com

David Ward
Cisco Systems
Email: dward@cisco.com

Rahul Aggarwal
Juniper Networks
Email: rahul@juniper.net

8. Acknowledgments

The editors gratefully acknowledge the contributions of Sami Boutros, Italo Busi, Marc Lasserre, Lieven Levrau, and Siva Sivabalan.

The authors would also like to thank Malcolm Betts, ITU-T Study Group 15, and all members of the teams (the Joint Working Team, the MPLS Interoperability Design Team in IETF and the MPLS-TP Ad Hoc Team in ITU-T) involved in the definition and specification of the MPLS Transport Profile.

9. Security Considerations

The security considerations for the associated control channel are described in RFC 4385 [RFC4385]. Further security considerations MUST be described in the relevant associated channel type specification.

RFC 5085 [RFC5085] provides data plane related security considerations. These also apply to a G-ACh, whether the alert mechanism uses a GAL or only an ACH.

10. IANA Considerations

IANA allocated label value 13 to the GAL from the pool of reserved labels in the "Multiprotocol Label Switching Architecture (MPLS) Label Values" registry.

Channel Types for the Associated Channel Header are allocated from the IANA "PW Associated Channel Type" registry [RFC4446]. The PW Associated Channel Type registry is currently allocated based on the IETF consensus process (termed "IETF Review" in [RFC5226]). This allocation process was chosen based on the consensus reached in the PWE3 working group that pseudowire associated channel mechanisms should be reviewed by the IETF and only those that are consistent with the PWE3 architecture and requirements should be allocated a code point.

However, a requirement has emerged (see [OAM-REQ]) to allow for optimizations or extensions to OAM and other control protocols running in an associated channel to be experimented without resorting to the IETF standards process, by supporting experimental code points. This would prevent code points used for such functions from being used from the range allocated through the IETF standards and thus protects an installed base of equipment from potential inadvertent overloading of code points. In order to support this requirement, IANA has changed the code point allocation scheme for the PW Associated Channel Type be changed as follows:

0 - 32751 : IETF Review

32760 - 32767 : Experimental

Code points in the experimental range MUST be used according to the guidelines of RFC 3692 [RFC3692]. Functions using experimental G-ACh code points MUST be disabled by default. The Channel Type value used for a given experimental OAM function MUST be configurable, and care MUST be taken to ensure that different OAM functions that are not inter-operable are configured to use different Channel Type values.

The PW Associated Channel Type registry has been updated to include a column indicating whether the ACH is followed by a ACH TLV header (Yes/No). There are two ACH Channel Type code-points currently assigned and in both cases no ACH TLV header is used. Thus, the new format of the PW Channel Type registry is:

Registry:

Value	Description	TLV Follows	Reference
0x21	ACH carries an IPv4 packet	No	[RFC4385]
0x57	ACH carries an IPv6 packet	No	[RFC4385]

Figure 9: PW Channel Type Registry

IANA created a new registry called the Associated Channel Header TLV Registry. The allocation policy for this registry is IETF review. This registry MUST record the following information. There are no initial entries.

Name	Type	Length (octets)	Description	Reference

Figure 10: ACH TLV Registry

11. References

11.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC3031] Rosen, E., Viswanathan, A., and R. Callon, "Multiprotocol Label Switching Architecture", RFC 3031, January 2001.

[RFC3032] Rosen, E., Tappan, D., Fedorkow, G., Rekhter, Y., Farinacci, D., Li, T., and A. Conta, "MPLS Label Stack Encoding", RFC 3032, January 2001.

[RFC3443] Agarwal, P. and B. Akyol, "Time To Live (TTL) Processing in Multi-Protocol Label Switching (MPLS) Networks", RFC 3443, January 2003.

[RFC3692] Narten, T., "Assigning Experimental and Testing Numbers Considered Useful", BCP 82, RFC 3692, January 2004.

[RFC4385] Bryant, S., Swallow, G., Martini, L., and D. McPherson, "Pseudowire Emulation Edge-to-Edge (PWE3) Control Word for Use over an MPLS PSN", RFC 4385, February 2006.

[RFC4446] Martini, L., "IANA Allocations for Pseudowire Edge to Edge Emulation (PWE3)", BCP 116, RFC 4446, April 2006.

[RFC5085] Nadeau, T. and C. Pignataro, "Pseudowire Virtual Circuit Connectivity Verification (VCCV): A Control Channel for Pseudowires", RFC 5085, December 2007.

[RFC5226] Narten, T. and H. Alvestrand, "Guidelines for Writing an IANA Considerations Section in RFCs", BCP 26, RFC 5226, May 2008.

[RFC5462] Andersson, L. and R. Asati, "Multiprotocol Label Switching (MPLS) Label Stack Entry: "EXP" Field Renamed to "Traffic Class" Field", RFC 5462, February 2009.

11.2. Informative References

[BFD-MPLS] Aggarwal, R., Kompella, K., Nadeau, T., and G. Swallow, "BFD For MPLS LSPs", Work in Progress, June 2008.

[BFD-VCCV] Nadeau, T. and C. Pignataro, "Bidirectional Forwarding Detection (BFD) for the Pseudowire Virtual Circuit Connectivity Verification (VCCV)", Work in Progress, May 2009.

[G805] International Telecommunication Union, "Generic Functional Architecture of Transport Networks", ITU-T G.805, March 2000.

[MPLS-TP] Bocci, M., Bryant, S., and L. Levrau, "A Framework for MPLS in Transport Networks", Work in Progress, November 2008.

[OAM-REQ] Vigoureux, M., Ed., Ward, D., Ed., and M. Betts, Ed., "Requirements for OAM in MPLS Transport Networks", Work in Progress, March 2009.

[RFC3429] Ohta, H., "Assignment of the 'OAM Alert Label' for Multiprotocol Label Switching Architecture (MPLS) Operation and Maintenance (OAM) Functions", RFC 3429, November 2002.

[RFC4379] Kompella, K. and G. Swallow, "Detecting Multi-Protocol Label Switched (MPLS) Data Plane Failures", RFC 4379, February 2006.

[TP-REQ] Niven-Jenkins, B., Ed., Brungard, D., Ed., Betts, M., Ed., Sprecher, N., and S. Ueno, "MPLS-TP Requirements", Work in Progress, May 2009.

Authors' Addresses

Matthew Bocci (editor)
Alcatel-Lucent
Voyager Place, Shoppenhangers Road
Maidenhead, Berks SL6 2PJ
UK

EMail: matthew.bocci@alcatel-lucent.com

Martin Vigoureux (editor)
Alcatel-Lucent
Route de Villejust
Nozay,   91620
France

EMail: martin.vigoureux@alcatel-lucent.com

Stewart Bryant (editor)
Cisco Systems

EMail: stbryant@cisco.com