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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.

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.

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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:
0:0:0: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         |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
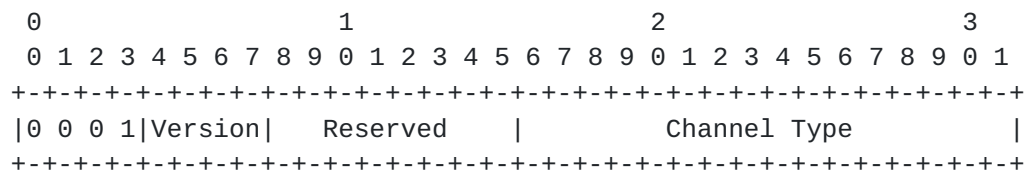
Figure 1: Associated Channel Header

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                        ~
~                                                             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
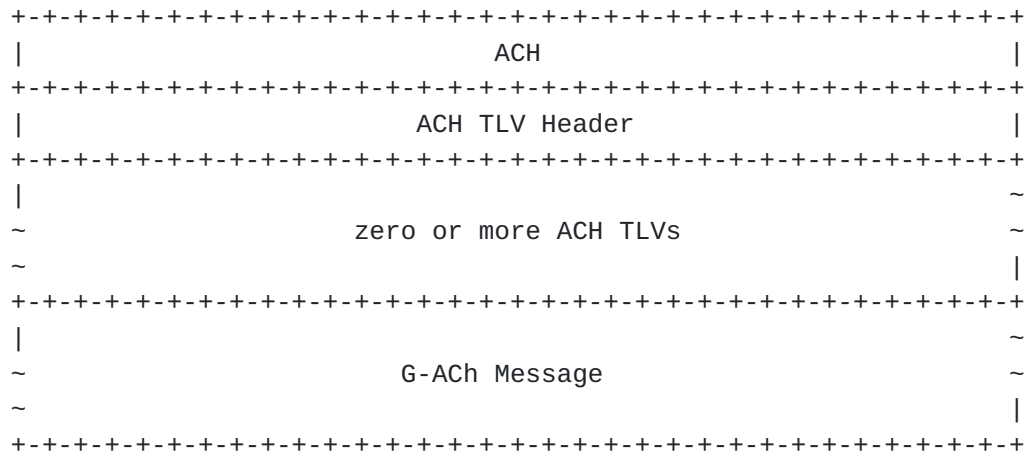
                   Figure 2: G-ACh Packet Payload

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           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
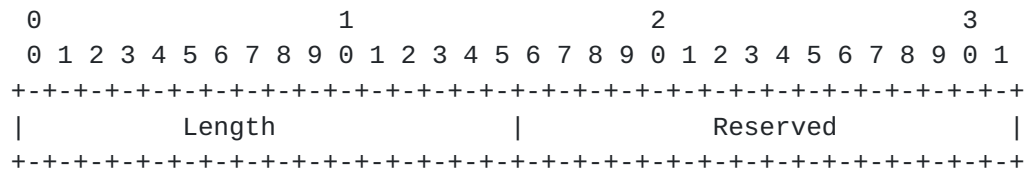
                     Figure 3: ACH TLV Header

   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                             ~
~                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
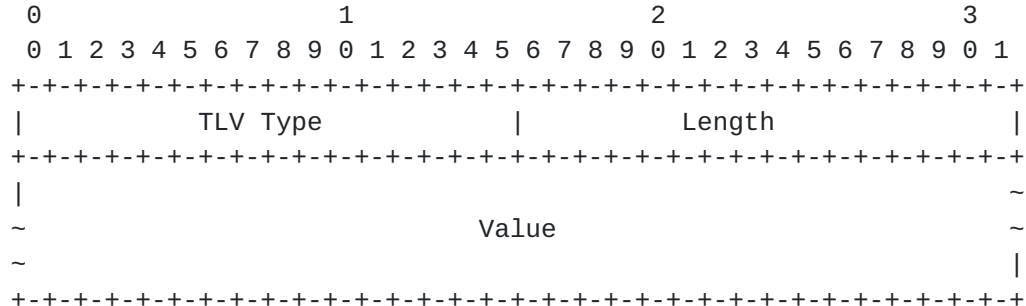
Figure 4: ACH TLV Format

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 |
     +---+                +---+                +---+                +---+
```
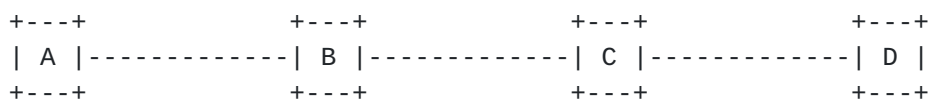
                      Figure 5: Maintenance over an LSP

   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                             ~
~                                                              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
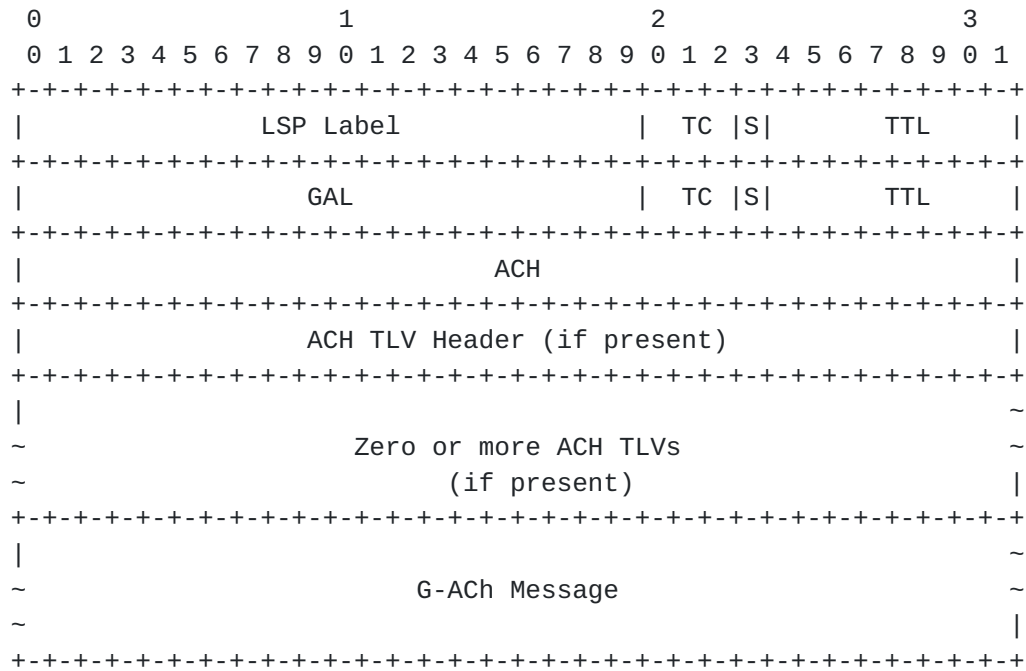
Figure 6: G-ACh Packet Format for an LSP

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                           ~
~                                                              |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
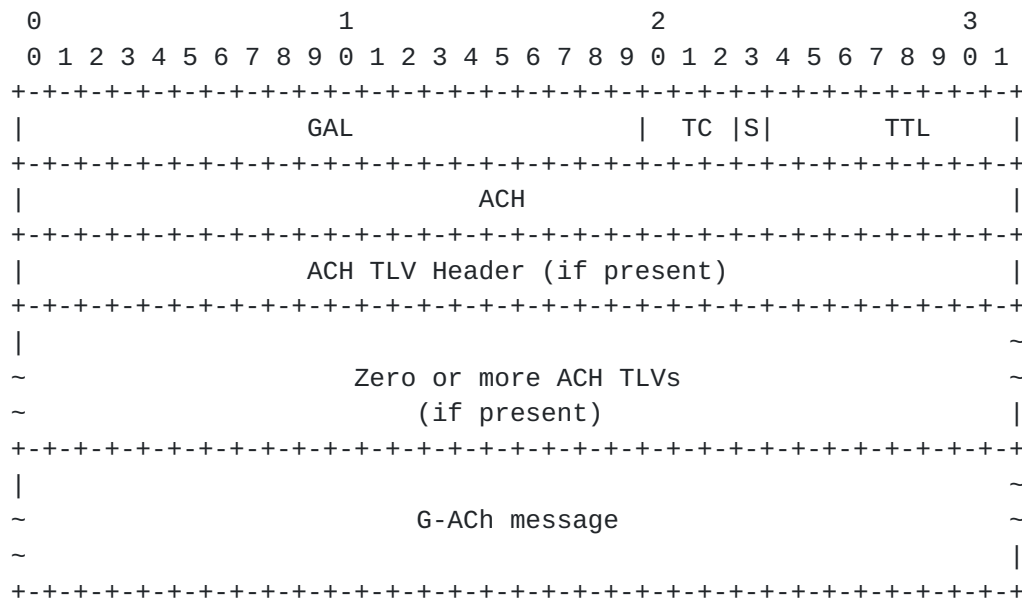
                Figure 8: G-ACh Packet Format for an MPLS Section

   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.

   o 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.

   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.

   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

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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   Description                 Reference
                  (octets)
```

                      Figure 10: ACH TLV Registry

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