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An In-Band Data Communication Network For the MPLS Transport Profile

Abstract

The Generic Associated Channel (G-ACh) has been defined as a generalization of the pseudowire (PW) associated control channel to enable the realization of a control/communication channel that is associated with Multiprotocol Label Switching (MPLS) Label Switched Paths (LSPs), MPLS PWs, MPLS LSP segments, and MPLS sections between adjacent MPLS-capable devices.

The MPLS Transport Profile (MPLS-TP) is a profile of the MPLS architecture that identifies elements of the MPLS toolkit that may be combined to build a carrier-grade packet transport network based on MPLS packet switching technology.

This document describes how the G-ACh may be used to provide the infrastructure that forms part of the Management Communication Network (MCN) and a Signaling Communication Network (SCN). Collectively, the MCN and SCN may be referred to as the Data Communication Network (DCN). This document explains how MCN and SCN messages are encapsulated, carried on the G-ACh, and demultiplexed for delivery to the management or signaling/routing control plane components on an MPLS-TP node.

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1. Introduction

The associated channel header (ACH) is specified in [RFC4385]. It is a packet header format for use on pseudowires (PWs) in order to identify packets used for Operations, Administration, and Maintenance (OAM) and similar functions.

The use of the ACH is generalized in [RFC5586] and can be applied on any Multiprotocol Label Switching (MPLS) Label Switching Path (LSP). This is referred to as the Generic Associated Channel (G-ACh) and is intended to create a control/management communication channel associated with the LSP that can be used to carry packets used for OAM and similar functions (e.g., control/management plane messages).

The purpose of a packet carried on the G-ACh is indicated by the value carried by the Channel Type field of the ACH and a registry of values is maintained by IANA ([RFC4446] and [RFC4385]). The ACH is referred to in this document as the G-ACh header.

The MPLS transport profile (MPLS-TP) is described in [MPLS-TP] and in [RFC5654]. MPLS-TP is the application of MPLS to construct a packet transport network. It constitutes a profile of MPLS that enables operational models typical in transport networks, which includes additional OAM, survivability, and other maintenance functions not previously supported by MPLS.

Label Switching Routers (LSRs) in MPLS networks may be operated using management protocols or control plane protocols. Messaging in these protocols is normally achieved using IP packets exchanged over IP-capable interfaces. However, some nodes in MPLS-TP networks may be constructed without support for direct IP encapsulation on their line-side interfaces and without access to an out-of-fiber data

communication network. In order that such nodes can communicate using management plane or control plane protocols, channels must be provided, and the only available mechanism is to use an MPLS label.

The G-ACh provides a suitable mechanism for this purpose, and this document defines processes and procedures to allow the G-ACh to be used to build a Management Communication Network (MCN) and a Signaling Communication Network (SCN), together known as the Data Communication Network (DCN) [G.7712].

It should be noted that the use of the G-ACh to provide connectivity for the DCN is intended for use only where the MPLS-TP network is not capable of encapsulating or delivering native DCN messages.

1.1. Requirements

The requirements presented in this section are based on those communicated to the IETF by the ITU-T.

1. A packet-encapsulation mechanism must be provided to support the transport of MCN and SCN packets over the G-ACh.
2. The G-ACh carrying the MCN and SCN packets shall support the following application scenarios:
 - a. The G-ACh interconnects two adjacent MPLS-TP nodes (used when the server layer does not provide a Management Communication Channel (MCC) or a Signalling Communication Channel (SCC)).
 - b. The G-ACh is carried by an MPLS-TP tunnel that traverses another operator's domain (the carrier's carrier scenario).
3. The G-ACh shall provide two independent channels: an MCC to build the MCN and an SCC to build the SCN. The G-ACh packet header shall indicate whether the packet is an MCC or an SCC packet in order to forward it to the management or control plane application for processing. This facilitates easy demultiplexing of control and management traffic from the DCN, and enables separate or overlapping address spaces and duplicate protocol instances in the management and control planes.
4. The channel-separation mechanism shall not preclude the use of separate rate limiters and traffic-shaping functions for each channel (MCC and SCC), ensuring that the flows do not exceed their assigned traffic profiles. The rate limiters and traffic shapers are outside the scope of the MCC and SCC definitions.

5. The G-ACh that carries the MCC and SCC shall be capable of carrying different OSI layer 3 (network layer) PDUs. These shall include IPv4, IPv6, and OSI PDUs. The G-ACh header of the MCC/SCC packet shall indicate which layer 3 PDU is contained in the payload field of the packet such that the packet can be delivered to the related layer 3 process within the management and control plane application, respectively, for further processing.
6. The G-ACh is not required to provide specific security mechanisms. However, the management or control plane protocols that operate over the MCC or SCC are required to provide adequate security mechanisms in order to not be susceptible to security attacks.

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 RFC-2119 [RFC2119].

2. Procedures

Figure 1 depicts the format of an MCC/SCC packet that is sent on the G-ACh. The Channel Type field indicates the function of the ACH message and so, to send an MCC/SCC packet on the G-ACh, the MCC/SCC message is prepended with an ACH with the Channel Type set to indicate that the message is an MCC or SCC message. The ACH MUST NOT include the ACH TLV Header [RFC5586], meaning that no ACH TLVs can be included in the message. A two-byte Protocol Identifier (PID) field indicates the protocol type of the payload DCN message.

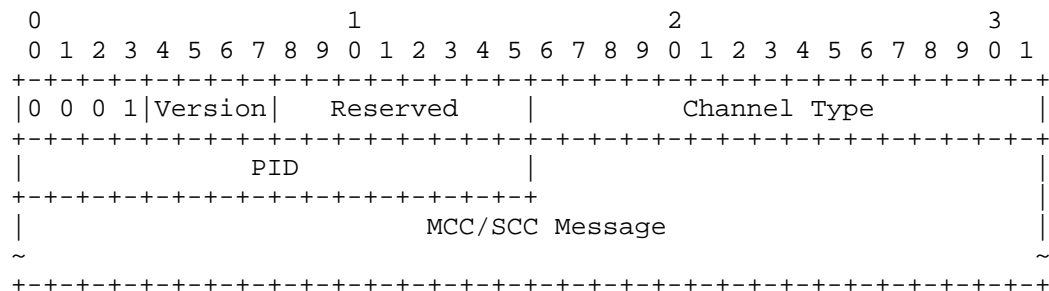


Figure 1: G-ACh MCC/SCC Packet

- o The Channel Type field determines whether the message is an MCC or an SCC message. See Section 5 for the codepoint assignments.

- o The presence of the PID field is deduced from the Channel Type value indicating MCC or SCC. The field contains an identifier of the payload protocol using the PPP protocol identifiers ([RFC1661], [RFC3818]).

When the G-ACh sender receives an MCC message that is to be sent over the MCC, the sender creates the G-ACh header, sets the Channel Type field to MCC, fills in the PID to indicate the MCC layer 3 PDU type, and prepends the MCC message with the G-ACh header. The same procedure is applied when a control plane message is to be sent over the SCC. In this case, the sender sets the Channel Type field to SCC.

If the G-ACh is associated with an MPLS section, the Generic Associated Channel Label (GAL) is added to the message as defined in [RFC5586]. The Time to Live (TTL) field MUST be set to 1, and the S-bit of the GAL MUST be set to 1.

If the G-ACh is associated with an LSP, the GAL is added to the packet and the LSP label is pushed on top of the GAL as defined in [RFC5586]. The TTL field of the GAL MUST be set to 1, and the S-bit of the GAL MUST be set to 1.

Note that packet processing for DCN packets in the G-ACh is, in common with all G-ACh MPLS packets, subject to the normal processing of the Traffic Class (TC) field of the MPLS header. This could be used to enable prioritization of different DCN packets.

The DCN channel MUST NOT be used to transport user traffic and SHALL only be used to carry management or control plane messages. Procedures that ensure this (such as deep packet inspection) are outside the scope of this specification.

When a receiver has received a packet on the G-ACh with the ACh Channel Type set to MCC or SCC, it SHALL look at the PID field. If the PID value is known by the receiver, it delivers the MCC/SCC message to the appropriate processing entity. If the PID value is unknown, the receiver SHALL silently discard the received packet, MAY increment a counter that records discarded or errored messages, and MAY log an event.

It must be noted that according to [RFC5586], a receiver MUST NOT forward a GAL packet based on the GAL label as is normally the case for MPLS packets. If the GAL appears at the bottom of the label stack, it MUST be processed as described in the previous paragraph.

Note that there is no requirement for MPLS-TP devices to support IP or OSI forwarding in the fast (forwarding) path. Thus, if a message is received on the MCC or SCC and is not targeted to an address of the receiving MPLS-TP node, the packet might not be forwarded in the fast path. A node MAY apply layer 3 forwarding procedures in the slow or fast path and MAY discard or reject the message using the layer 3 protocol if it is unable to forward it. Thus, protocols making use of the DCN should make no assumptions about the forwarding capabilities unless they are determined a priori or through the use of a routing protocol. Furthermore, it is important that user data (i.e., data traffic) is not routed through the DCN, as this would potentially cause the traffic to be lost or delayed and might significantly congest the DCN.

2.1. Pseudowire Setup

Provider Edge nodes (PEs) may wish to set up PWs using a signaling protocol that uses remote adjacencies (such as LDP [RFC5036]). In the absence of an IP-based control plane network, these PEs MUST first set up an LSP tunnel across the MPLS-TP network. This tunnel can be used both to carry the PW once it has been set up and to provide a G-ACh-based DCN for control plane communications between the PEs.

3. Applicability

The DCN is intended to provide connectivity between management stations and network nodes, and between pairs of network nodes, for the purpose of exchanging management plane and control plane messages.

Appendix A of [NM-REQ] describes how Control Channels (CCh) that are the links in an MPLS-TP DCN can be out-of-fiber and out-of-band, in-fiber and out-of-band, or in-band with respect to the user data carried by the MPLS-TP network. That appendix also explains how the DCN can be constructed from a mix of different types of links and how routing and forwarding can be used within the DCN to facilitate multi-hop delivery of management and control plane messages.

The G-ACh used as described in this document allows the creation of a "data channel associated CCh" (type 6 in Appendix A of [NM-REQ]) and an "in-band CCh" (type 7 in Appendix A of [NM-REQ]). In the former case, the G-ACh is associated with an MPLS-TP section. In the latter case, the G-ACh is associated with an MPLS-TP LSP or PW and may span one or more hops in the MPLS-TP network.

There is no need to create a CCh for every LSP between a pair of MPLS-TP nodes. Indeed, where the nodes are physically adjacent, the G-ACh associated with the MPLS-TP section would normally be used. Where nodes are virtually adjacent (that is, connected by LSP tunnels), one or two of the LSPs might be selected to provide the CCh and a back-up CCh.

4. Security Considerations

The G-ACh provides a virtual link between MPLS-TP nodes and might be used to induce many forms of security attack. The MPLS data plane does not include any security mechanisms of its own; therefore, it is important that protocols using the DCN apply their own security. Protocols that operate over the MCN or SCN are REQUIRED to include adequate security mechanisms, and implementations MUST allow operators to configure the use of those mechanisms.

5. IANA Considerations

Channel Types for the Generic Associated Channel are allocated from the IANA PW Associated Channel Type registry defined in [RFC4446] and updated by [RFC5586].

IANA has allocated two further Channel Types as follows:

- 0x0001 Management Communication Channel (MCC)
- 0x0002 Signaling Communication Channel (SCC)

6. References

6.1. Normative References

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6.2. Informative References

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