IP Flow Information Export
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Information Elements for Data Link Layer Traffic Measurement
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Abstract

This document describes Information Elements related to data link layer. They are used by the IP Flow Information Export (IPFIX) protocol for encoding measured data link layer traffic information.

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 April 29, 2011.

Table of Contents

1. Introduction

Ethernet [IEEE802.1D] and VLAN (Virtual LAN) [IEEE802.1Q] technologies used to be used only in Local Area Networks. Recently, they have been used in Wide Area Networks, e.g., L2-VPN services. Accordingly, the IEEE802.1Q standard has been enhanced to [IEEE802.1ad] and [IEEE802.1ah]. And, Ethernet in data center also has been enhanced for server virtualization and I/O consolidation.

While these renovations provide flexibility, scalability, and mobility to an existing network architecture, it increases the complexity of traffic measurement due to the existence of various Ethernet header formats. To cope with this, a more sophisticated method is required.

IPFIX/PSAMP helps to resolve these problems. However, the PSAMP Information Model [RFC5477] and the IPFIX Information Model [RFC5101] are not yet enough for Information Elements related to data link layer, e.g., Ethernet header forms. This document describes the Information Elements related to data link layers that enable a more sophisticated traffic measurement method.

1.1. 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. Extended Ethernet Technology

2.1. Wide-Area Ethernet Network Summary

Provider Bridge [IEEE802.1ad] and Provider Backbone Bridge [IEEE802.1ah], which are standards for the Wide-Area Ethernet, are described below.

- In Provider Bridge [IEEE802.1ad], there are two VLAN IDs: Service VLAN Identifier (S-VID) and Customer VLAN Identifier (C-VID). S-VID is assigned to an Ethernet frame by a service provider, while C-VID is independently assigned to an Ethernet frame by a customer. Frame switching in a service provider network is based on only S-VID.
- In Provider Backbone Bridge [IEEE802.1ah], new Ethernet fields, such as Backbone VLAN Identifier (B-VID) and Backbone Service Instance Identifier (I-SID), are introduced to overcome the limitations on the VLAN identifier space on [IEEE802.1ad] and to isolate the service provider and customer identifier spaces.

Frame switching is based on a 12-bit B-VID, and customer identification is based on a 24-bit I-SID. A flexible network design has become possible because network management is separated from customer management. Other Ethernet fields that indicate quality of service (QoS) class are B-PCP, B-DEI, I-PCP, and I-DEI.

Provider Backbone Bridge enables a wide-area Ethernet service to be improved from a flat network to a hierarchical network co-existing Provider Bridge and Provider Backbone Bridge.

Frame formats used in Wide-Area Ethernet are shown in Appendix A.

2.2. Data Center Network Summary

In data center networks, Ethernet needs to be enhanced to provide the flexibility, mobility for server virtualization, and I/O consolidation. In IEEE802.1 Data Center Bridging Task Group, several Ethernet header formats are proposed to enable a simplifying networks and server managements.

The one of the enhanced methods is Bridge Port Extension [IEEE802.1Qbh], which brings a traffic exchange point to upper bridges. Bridge Port Extension introduces a Ethernet format named Multicast Replication Tag (M-TAG) in addition to existing Service VLAN Tag (S-TAG) and Customer VLAN Tag (C-TAG) to move the policy enhancement to upper bridges in data center network. On the other hand, the complexity for traffic measurement would be increased, because multiple Ethernet header formats as shown in Appendix B co-exist in the same link and in the same network.

3. Future Traffic Measurement

After the implementations of [IEEE802.1ah] and [IEEE802.1Qbh], traffic measurement methods need to absorb the complexity caused by multiple header formats.

This requirement means that it is possible to apply the IPFIX/PSAMP architecture. Therefore, we propose an Ethernet traffic measurement method using IPFIX/PSAMP, as follows.

The device (Exporter) filters and/or samples Ethernet frames using PSAMP Selector, extracts the header of the frame, and exports the header information encoded by IPFIX protocol to the Collector. The Collector sums up the number of frames and the number of octets for each Ethernet header field (e.g., B-VID, I-SID, B-PCP, I-PCP, and Replication Identifier) and for each Ethernet frame type (e.g., multicast or broadcast).

Furthermore, the device (Exporter) filters and samples traffic for each VPN using a Composite Selector of PSAMP [RFC5475]. This makes it possible to change the granularity of the traffic monitoring for each VPN.

4. New Information Elements

The following Information Elements are necessary for enabling the IPFIX/PSAMP traffic measurement for data link layer, which is not limited to Ethernet because the method can be applied to other data link protocols as well. Note that these are proposed IDs, subject to approval by IANA.

ID	Name	ID	Name
312	dataLinkFrameSize	347	dataLinkFrameType
315	dataLinkFrameSection	348	dataLinkFrameOffset
		349	dataLinkFrameSectionObservedOctets

4.1. dataLinkFrameSize

Description:

This Information Element specifies the length of the selected data link frame.

The data link layer is defined in [ISO_IEC.7498-1_1994].

Abstract Data Type: unsigned16

Data Type Semantics: quantity

ElementId: 312

Status: current

4.2. dataLinkFrameSection

Description:

This Information Element carries n octets from the data link frame of a selected frame, starting dataLinkFrameOffset octets into the frame.

When the dataLinkFrameSectionObservedOctets field corresponding to this Information Element does not exist, this Information Element MUST have a variable length and MUST NOT be padded. In this case, the size of the exported section may be constrained due to limitations in the IPFIX protocol.

When the dataLinkFrameSectionObservedOctets field corresponding to this Information Element exists, this Information Element MAY have a fixed length and MAY be padded, or MAY have a variable length.

The dataLinkFrameSectionObservedOctets expresses how much data was observed, while the remainder is padding.

Further Information Elements, i.e., dataLinkFrameType and dataLinkFrameSize are needed to specify the data link type and the size of the data link frame of this Information Element. A set of these Information Elements MAY be contained in a structured data type, as expressed in another IPFIX WG draft. Or a set of these Information Elements MAY be contained in one Flow Record as shown in Appendix C.

The data link layer is defined in [ISO_IEC.7498-1_1994].

Abstract Data Type: octetArray

ElementId: 315

Status: current

4.3. dataLinkFrameType

Description:

This Information Element specifies the type of the selected data link frame.

The following data link types are defined here.

- 0x01 ETHERNET

Further values may be assigned by IANA.

The data link layer is defined in [ISO_IEC.7498-1_1994].

Abstract Data Type: unsigned16

Data Type Semantics: identifier

ElementId: 347

Status: current

4.4. dataLinkFrameOffset

Description:

This Information Element specifies the offset of the observed dataLinkFrameSection within the data link frame. If this Information Element is omitted, it defaults to zero.

The data link layer is defined in [ISO_IEC.7498-1_1994].

Abstract Data Type: unsigned16

Data Type Semantics: quantity

ElementId: 348

Status: current

4.5. dataLinkFrameSectionObservedOctets

Description:

This Information Element specifies the observed length of the dataLinkFrameSection.

This Information Element is especially needed for NetFlow version 9 [RFC3954] because NetFlow does not support a variable-length Information Element.

The dataLinkFrameSection may be of a fixed size larger than the dataLinkFrameSectionObservedOctets. In this case, octets in the dataLinkFrameSection beyond the dataLinkFrameSectionObservedOctets MUST follow the rules for padding (ie, be composed of zero (0) valued octets).

The data link layer is defined in [ISO_IEC.7498-1_1994].

Abstract Data Type: unsigned16

Data Type Semantics: quantity

ElementId: 349

Status: current

5. Security Considerations

The recommendations in this document do not introduce any additional security issues to those already mentioned in [RFC5101] and [RFC5477].

6. IANA Considerations

This document requests that the Information Element IDs are allocated as shown in section 4.

In addition, the dataLinkFrameType Information Element requires the creation of new IANA registries.

7. References

7.1. Normative References

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

7.2. Informative References

[IEEE802.1D]
IEEE Computer Society, "IEEE Standards for Local and Metropolitan Area Networks: Media Access Control (MAC) Bridges", IEEE Std 802.1D-2004, June 2004.

[IEEE802.1Q]
IEEE Computer Society, "IEEE Standards for Local and Metropolitan Area Networks: Virtual Bridged Local Area Networks", IEEE Std 802.1Q-2005, May 2006.

[IEEE802.1Qbh]
IEEE Computer Society, "Draft Standards for Local and Metropolitan Area Networks: Virtual Bridged Local Area Networks Amendment: Bridge Port Extension", IEEE Std P802.1Qbh/D0.4, August 2010.

[IEEE802.1ad]
IEEE Computer Society, "IEEE Standards for Local and Metropolitan Area Networks: Virtual Bridged Local Area Networks Amendment 4: Provider Bridges", IEEE Std 802.1ad-2005, May 2006.

[IEEE802.1ah]

IEEE Computer Society, "IEEE Standards for Local and Metropolitan Area Networks: Virtual Bridged Local Area Networks Amendment 7: Provider Backbone Bridges", IEEE Std 802.1ah-2008, August 2008.

[ISO_IEC.7498-1_1994]
International Organization for Standardization, "Information technology -- Open Systems Interconnection -- Basic Reference Model: The Basic Mode", ISO Standard 7498-1:1994, June 1996.

[RFC2863] McCloghrie, K. and F. Kastenholz, "The Interfaces Group MIB", RFC 2863, June 2000.

[RFC3954] Claise, B., "Cisco Systems NetFlow Services Export Version 9", RFC 3954, October 2004.

[RFC5101] Claise, B., "Specification of the IP Flow Information Export (IPFIX) Protocol for the Exchange of IP Traffic Flow Information", RFC 5101, January 2008.

[RFC5475] Zseby, T., Molina, M., Duffield, N., Niccolini, S., and F. Raspall, "Sampling and Filtering Techniques for IP Packet Selection", RFC 5475, March 2009.

[RFC5477] Dietz, T., Claise, B., Aitken, P., Dressler, F., and G. Carle, "Information Model for Packet Sampling Exports", RFC 5477, March 2009.

Appendix A. Frame Formats in Wide-Area Ethernet Network

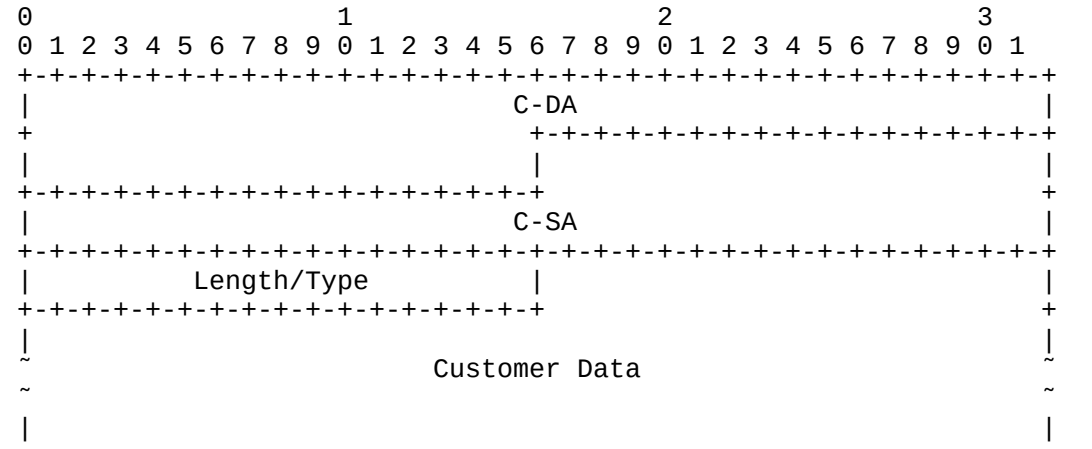

Figure A-1: IEEE802.1D Frame Format in Customer Bridged Network

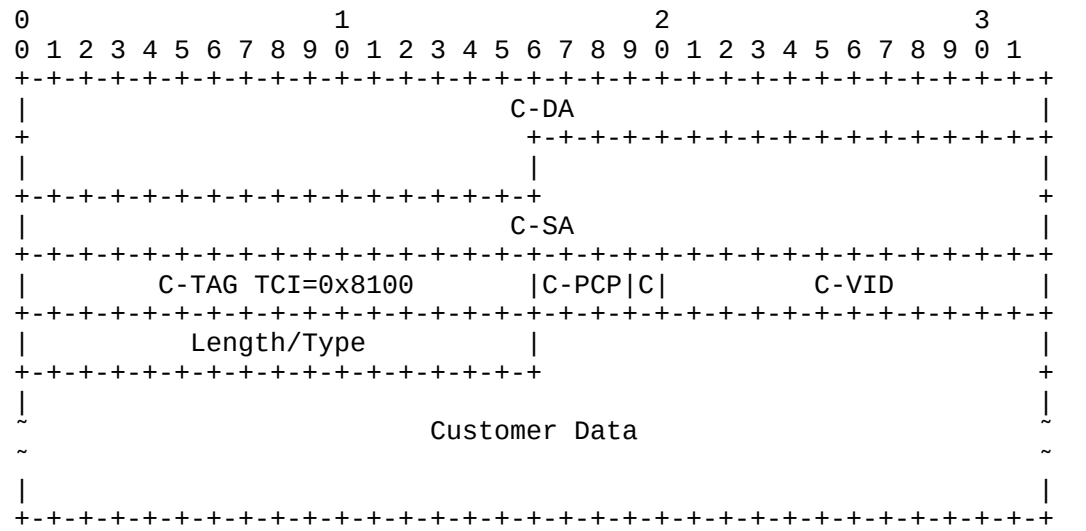

Figure A-2: IEEE802.1Q Frame Format in Customer Bridged Network

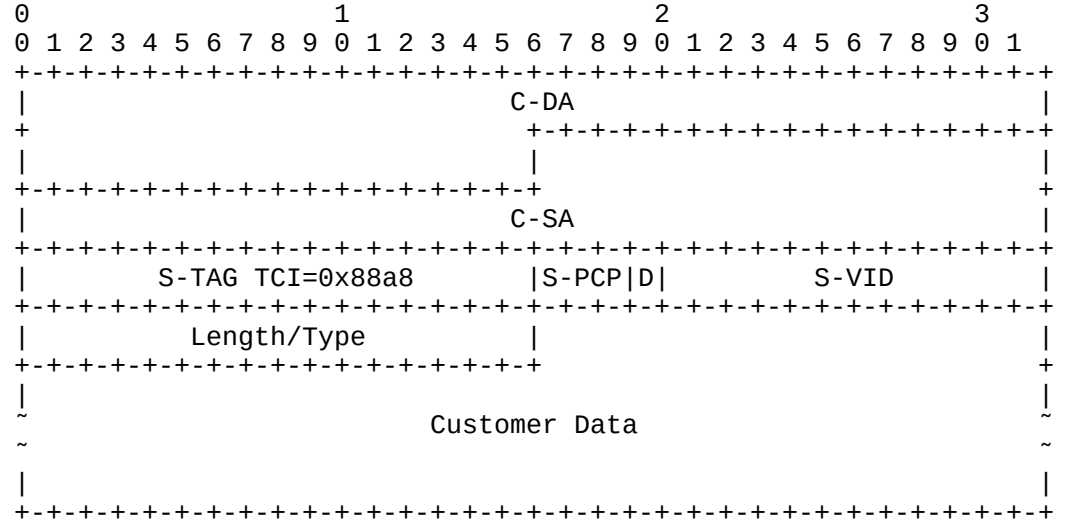

Figure A-3: IEEE802.1ad (no C-Tag) Frame Format in Provider Bridged Network

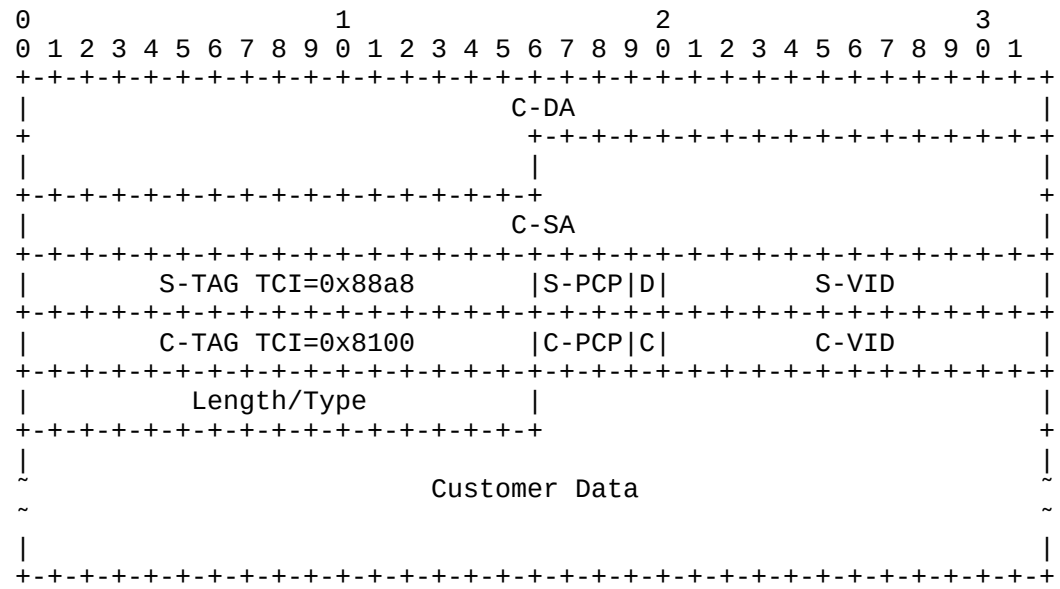

Figure A-4: IEEE802.1ad (C-Tagged) Frame Format in Provider Bridged Network

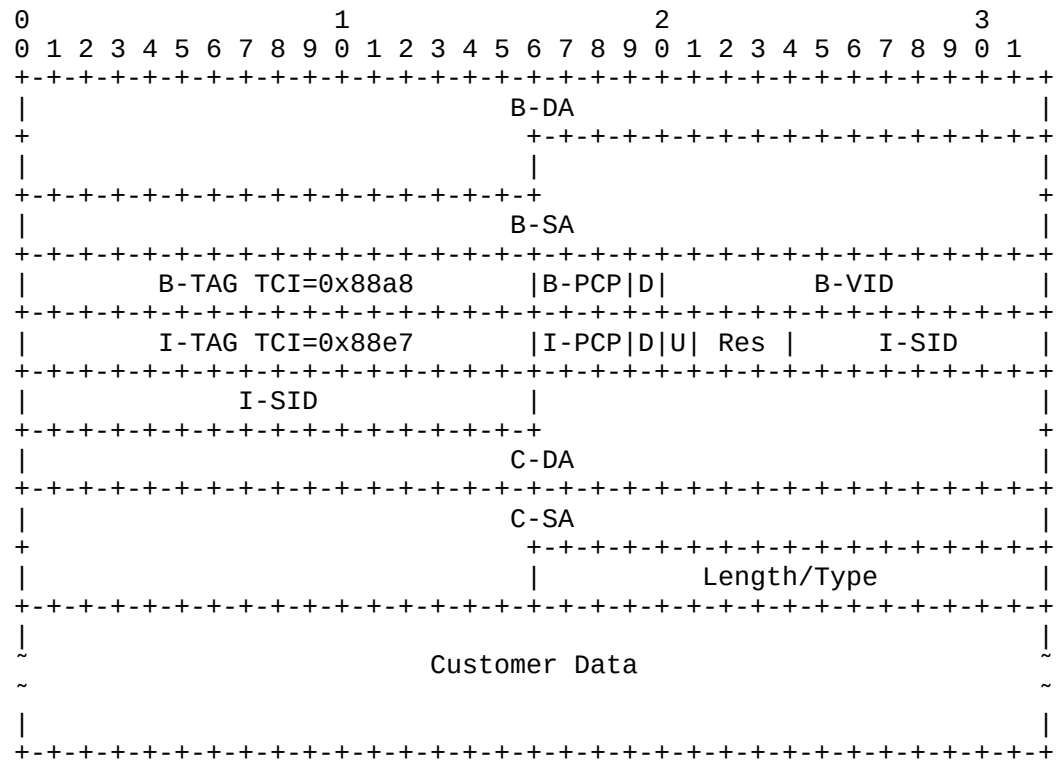

Figure A-5: IEEE802.1ah (no C-Tag) Frame Format in Provider Backbone Bridged Network

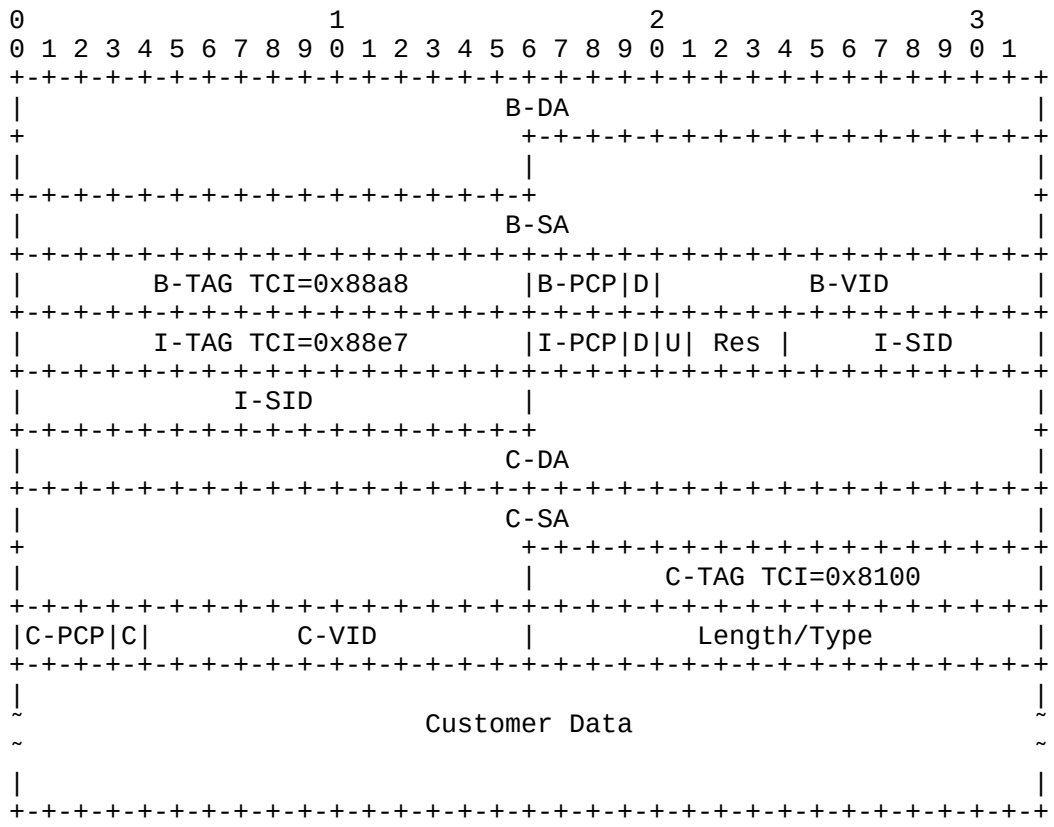

Figure A-6: IEEE802.1ah (C-Tagged) Frame Format in Provider Backbone Bridged Network

Appendix B. Frame Formats in Data Center Network

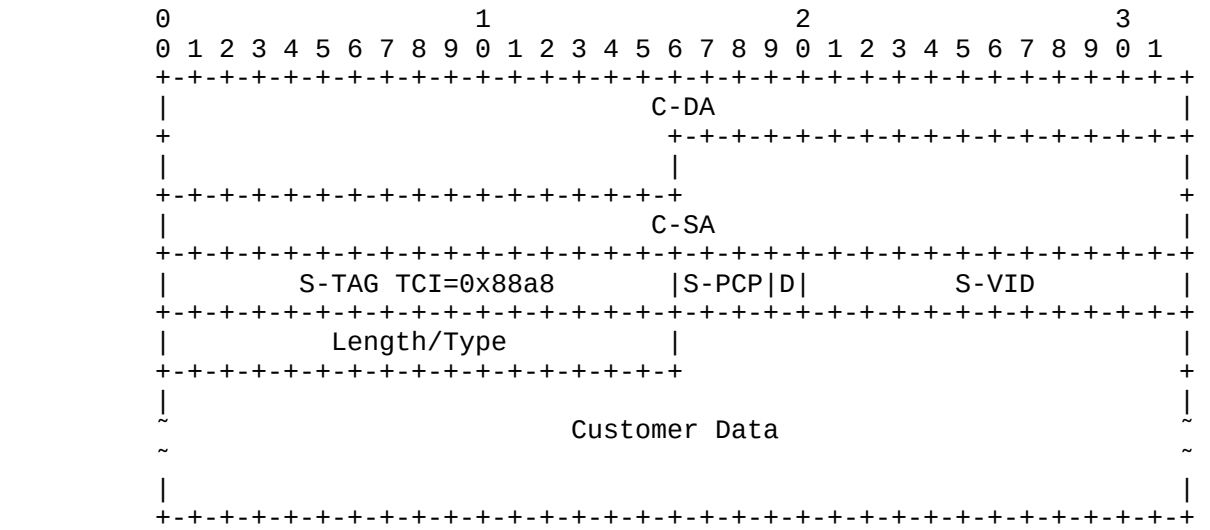

Figure B-1: IEEE802.1Qbh (S-TAG) Frame Format in Data Center Network

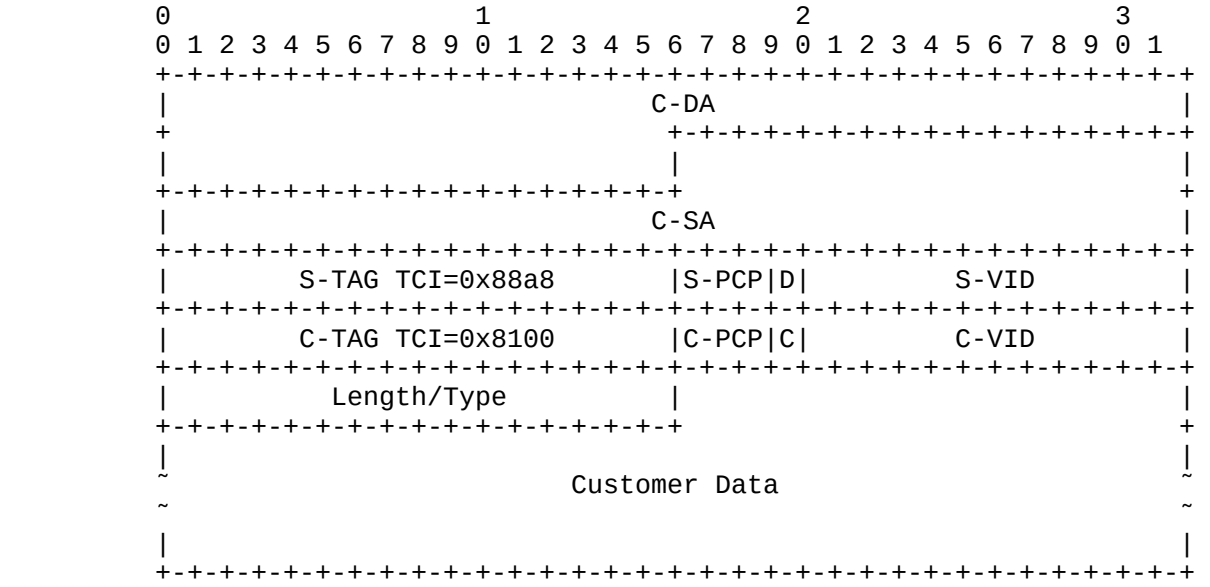

Figure B-2: IEEE802.1Qbh (S-TAG+C-TAG) Frame Format in Data Center Network

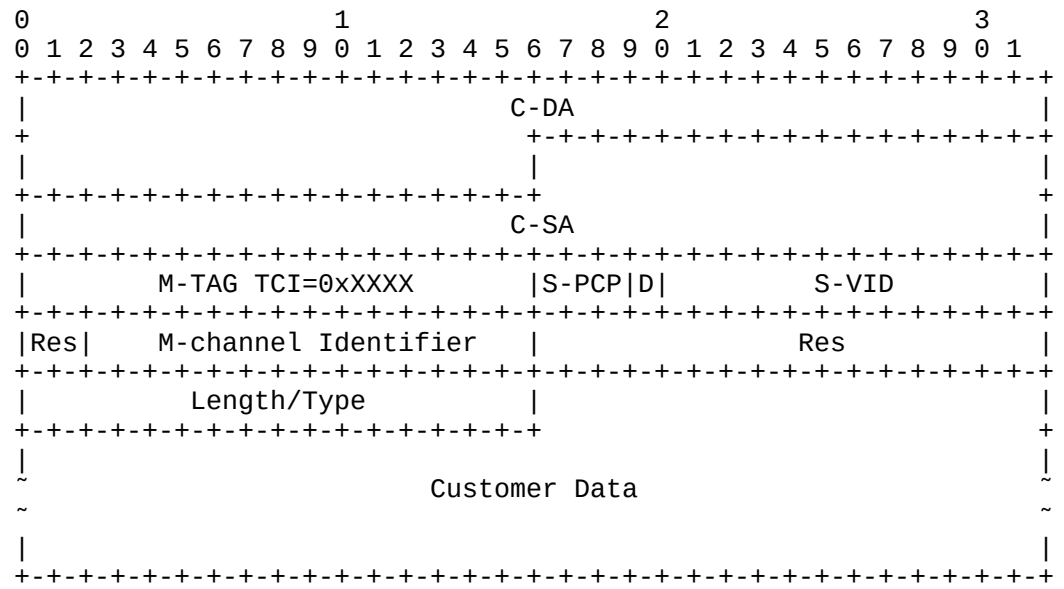

Figure B-3: IEEE802.1Qbh (M-TAG) Frame Format in Data Center Network

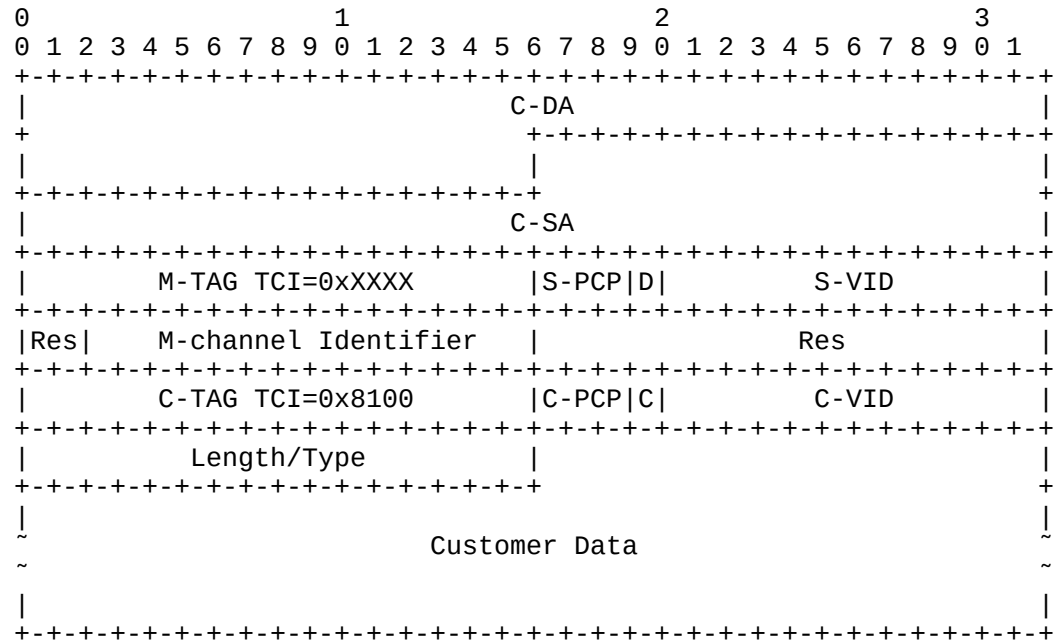

Figure B-4: IEEE802.1Qbh (M-TAG+C-TAG) Frame Format in Data Center

Network

Appendix C. Template Formats Example

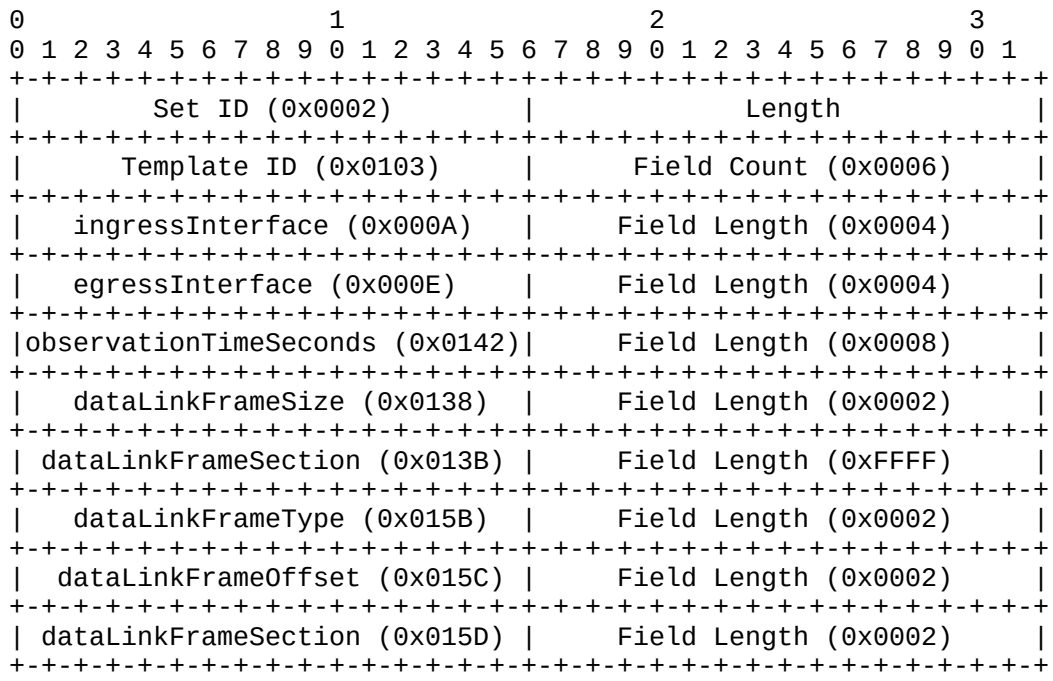

Figure C-1: Template Fortmat Example

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