Export of Gigabit Passive Optical Network Encapsulation Mode in IPFIX

draft-netana-opsawg-ipfix-gpon-gem

Enabling **data plane visibility** in passive optical transport
of the optical distribution network in broadband access

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Export of GPON Encapsulation Mode in IPFIX
ITU-T G.984.1 defines the General characteristics

- [ITU-T G.984.1](#) defines the General characteristics of GPON.

- Figure 2 in Section 5.2 shows the Reference Configuration.

- Red marked highlights the Optical Distribution Network (ODN) where GPON Encapsulation Mode (GEM) is used between ONU/ONT and OLT.
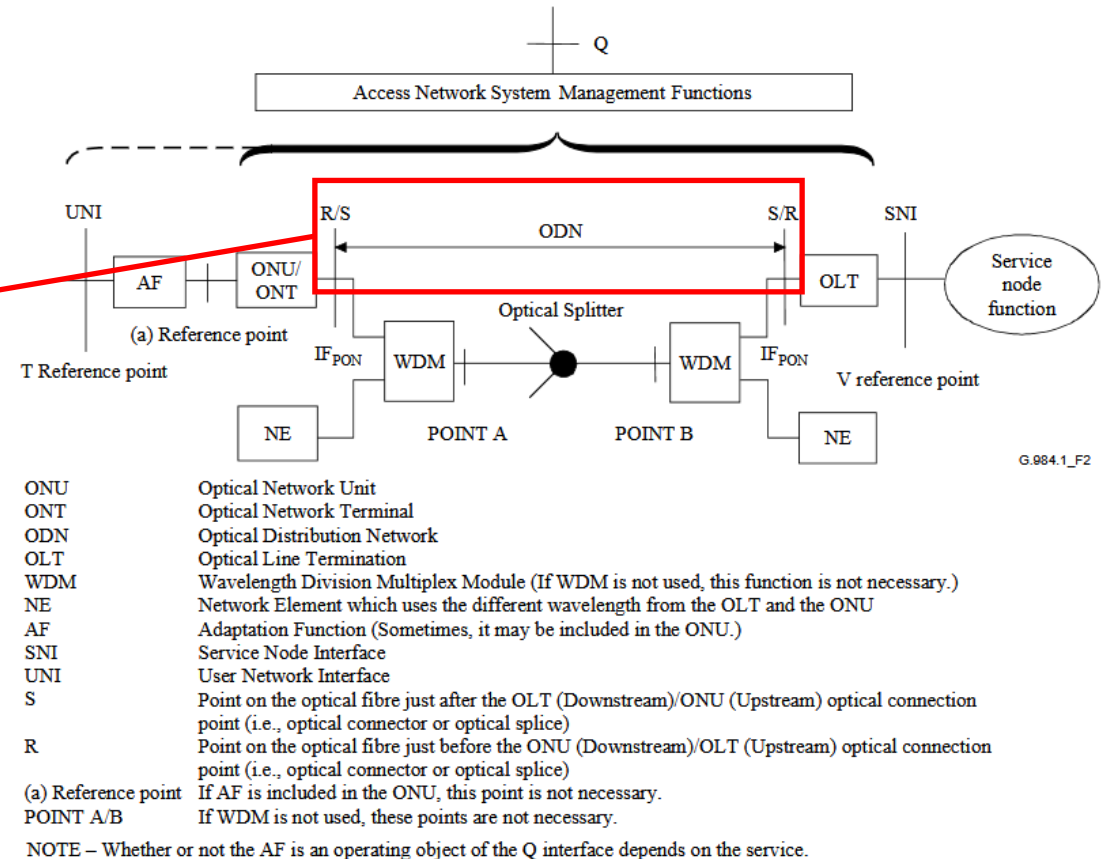

Q

Access Network System Management Functions

UNI R/S ODN S/R SNI

AF ONU/ONT OLT Service node function

(a) Reference point

T Reference point

IF_PON WDM Optical Splitter WDM IF_PON

V reference point

NE POINT A POINT B NE

G.984.1_F2

ONU	Optical Network Unit
ONT	Optical Network Terminal
ODN	Optical Distribution Network
OLT	Optical Line Termination
WDM	Wavelength Division Multiplex Module (If WDM is not used, this function is not necessary.)
NE	Network Element which uses the different wavelength from the OLT and the ONU
AF	Adaptation Function (Sometimes, it may be included in the ONU.)
SNI	Service Node Interface
UNI	User Network Interface
S	Point on the optical fibre just after the OLT (Downstream)/ONU (Upstream) optical connection point (i.e., optical connector or optical splice)
R	Point on the optical fibre just before the ONU (Downstream)/OLT (Upstream) optical connection point (i.e., optical connector or optical splice)
(a) Reference point	If AF is included in the ONU, this point is not necessary.
POINT A/B	If WDM is not used, these points are not necessary.

NOTE – Whether or not the AF is an operating object of the Q interface depends on the service.

Figure 2 – Reference configuration for GPON

2

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ITU-T G.984.3 defines the transmission convergence layer

- ITU-T G.984.3 defines the transmission convergence layer.

- Figure 8-11 in Section 8.3.1 shows the GEM header.

- The GEM header contains the payload length indicator (PLI), Port-ID, payload type indicator (PTI) and a 13-bit header error control (HEC) field.

- Red marked highlights the GEM Port-ID and PTI which is of interest to account frames and bytes in IPFIX [RFC 7011], [RFC 7012] and [RFC 7015].
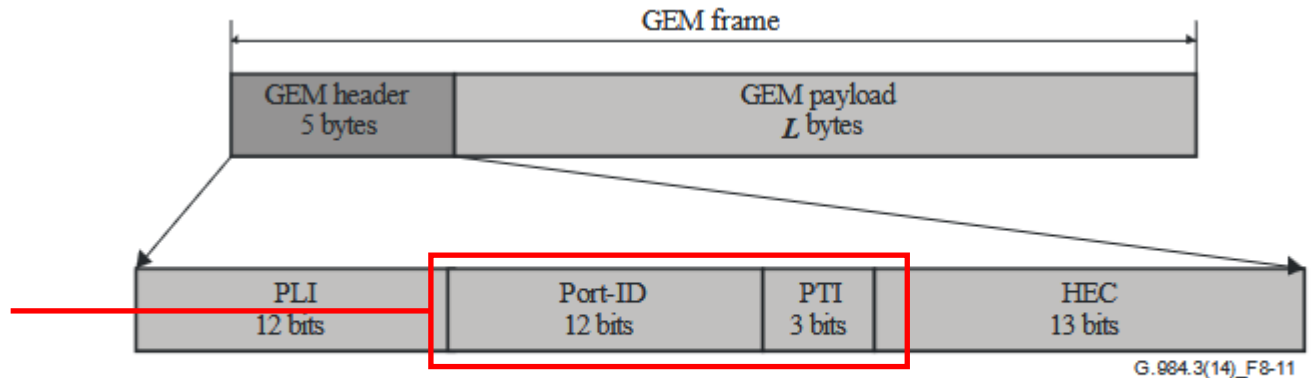
- PLI and HEC are

Figure 8-11 – GEM header and frame structure

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ITU-T G.984.3 defines the PTI registry

- ITU-T G.984.3 defines in Section 8.3.1 the PTI registry with below code points. Differentiate between user and OAM resp. not the end and end of the frame.

PTI code	Meaning
000	User data fragment, not the end of a frame
001	User data fragment, end of a frame
010	Reserved
011	Reserved
100	GEM OAM, not the end of a frame
101	GEM OAM, end of a frame
110	Reserved
111	Reserved

The reporting of congestion via PTI code points 2 and 3 is for future study.

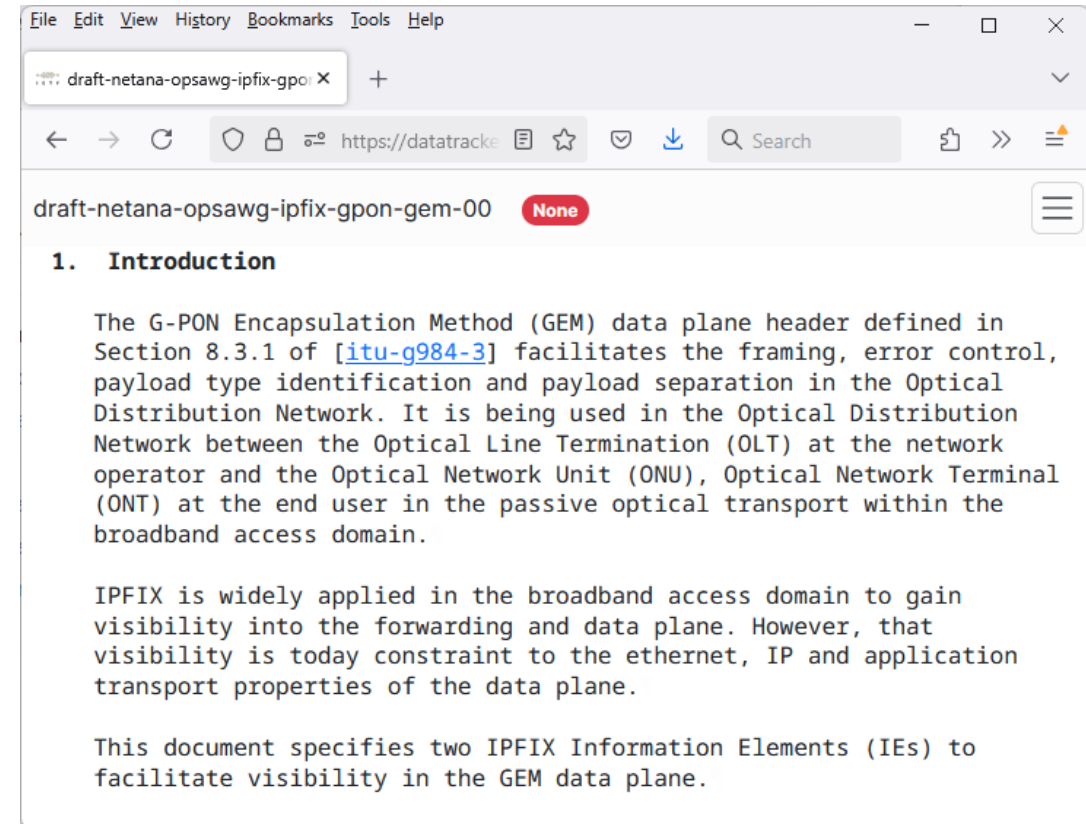# Export of GPON Encapsulation Mode in IPFIX
draft-netana-opsawg-ipfix-gpon-gem defines IPFIX entities

- **5.1.1. gponGemPti**

Name:	gponGemPti
ElementID:	TBD1
Description:	The 3-bit GEM PTI content type field defined in Section 8.3.1 of [itu-g984-3].
Abstract Data Type:	unsigned8
Data Type Semantics:	flags
Additional Information:	See Section 8.3.1 of [itu-g984-3] for the content type list.
Reference:	[RFC-to-be]

- **5.1.2. gponGemPortId**

Name:	gponGemPortId
ElementID:	TBD2
Description:	The 12-bit GEM Port-ID field defined in Section 8.3.1 of [itu-g984-3].
Abstract Data Type:	unsigned16
Data Type Semantics:	identifier
Additional Information:	See Section 8.3.1 of [itu-g984-3] for the content type list.
Reference:	[RFC-to-be]

draft-netana-opsawg-ipfix-gpon-gem-00   None

1. **Introduction**

The G-PON Encapsulation Method (GEM) data plane header defined in Section 8.3.1 of [itu-g984-3] facilitates the framing, error control, payload type identification and payload separation in the Optical Distribution Network. It is being used in the Optical Distribution Network between the Optical Line Termination (OLT) at the network operator and the Optical Network Unit (ONU), Optical Network Terminal (ONT) at the end user in the passive optical transport within the broadband access domain.

IPFIX is widely applied in the broadband access domain to gain visibility into the forwarding and data plane. However, that visibility is today constraint to the ethernet, IP and application transport properties of the data plane.

This document specifies two IPFIX Information Elements (IEs) to facilitate visibility in the GEM data plane.

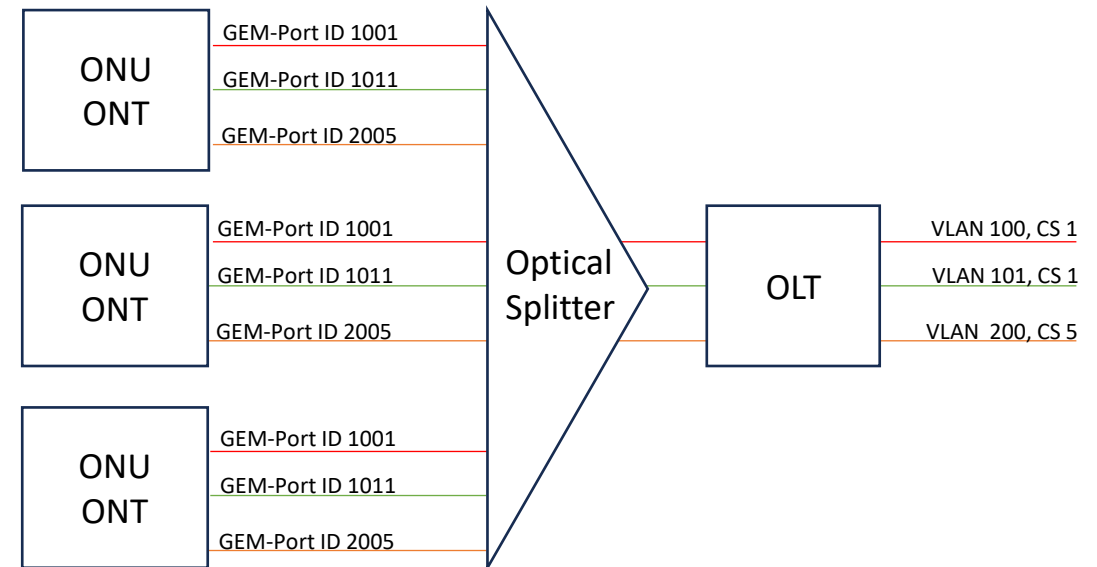# Export of GPON Encapsulation Mode in IPFIX
Sample Use Case

GEM Port-ID is usually mapped to IEEE 802.1Q into VLAN identifier (VID) and Priority code point (PCP, IEEE 802.1p class of service) which is used for Network Slicing related use cases. Differentiate between different application and their Quality-of-Service properties.

The IPFIX IEs **gponGemPti (TBD1) or gponGemPortId (TBD2),** sourceMacAddress (56), destinationMacAddress (80), ingressInterface (10), egressInterface (14) and forwardingStatus (89)[RFC5102] [RFC7270] [IANA-IPFIX], and some existing counter information's [IANA-IPFIX] providing answers to the following questions (amongst others):

- **How many user or OAM frames are forwarded or dropped to which ONU on which egress interface and GEM Port-ID?**

- **If dropped, for which reasons?**

The received ONU frames on an OLT are mapped and forwarded depending on GEM Port-ID to a dot1qVlanId (243) and dot1qPriority (244) upstream to the provider network.

ONU ONT — GEM-Port ID 1001, GEM-Port ID 1011, GEM-Port ID 2005

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Optical Splitter

OLT — VLAN 100, CS 1; VLAN 101, CS 1; VLAN 200, CS 5

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Document Status and Next Steps

- First document revision published on April 7th 2025.

- Implementation planned on Huawei MA5800T-X17 with IETF hackathon verification.

- **Request feedback and review from CCAMP.**

- Considering to establish ITU-T Liaison and adoption at OPSAWG.

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