PON TC Layer/MAC Layer Specification Comparison

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Introduction

- ITU-T and IEEE have specified multiple PON standards
  - APON, BPON, 1G-EPON, GPON
  - 10G-EPON, XG(S)-PON, NGPON2
- IEEE P802.3ca has been working on 25/50G EPON specifications for some time
- ITU-T Q2 is also considering >10G PON standardization

- This contribution compares ITU-T TC layers to IEEE PHY/MAC layers for PONs and discusses possible ways of converging protocol specification

Identifications (IDs)

Protocol Area	ITU	IEEE	
	XG(S)-PON	10G-EPON	P802.3ca
Service identification	GEM Port-ID	LLID	MLID, ULID
US granting unit	Alloc-ID	LLID	PLID, MLID, ULID, or GLID
Physical ONU Address (Pre/Post registration)	SN / ONU-ID	MAC add. / LLID	MAC add. / PLID

P802.3ca split LLID into four types:

- PLID – Physical Link ID
- MLID – Management Link ID
- ULID – User Link ID
- GLID – Group Link ID (allows arbitrary grouping of LLIDs on the PON)

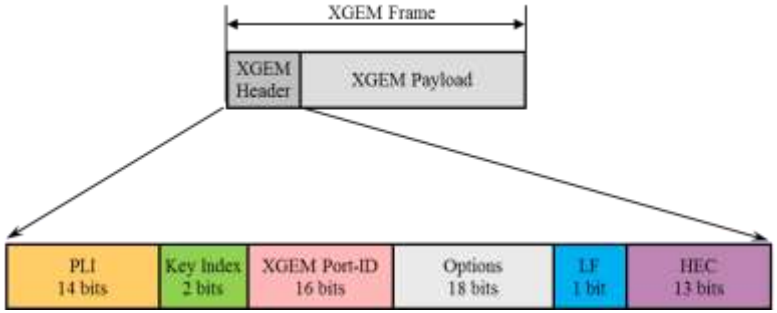
- IDs in ITU-T and IEEE PONs are functionally equivalent: they identify ONUs, services, and upstream traffic bearers

Framing

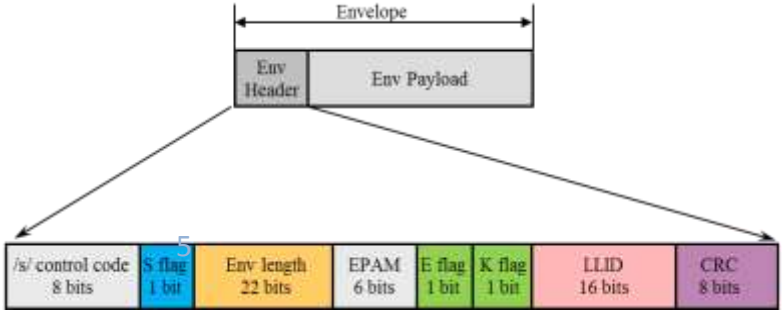
Protocol Area	ITU	IEEE	
	XG(S)-PON	10G-EPON	P802.3ca
Fragmentation basis	XGEM	Not allowed	EQ (8 bytes @ 25Gb/s) P802.3ca introduces fragmentation in EPON
Frame delimiting	Length field in XGEM header	Preamble / IPG	Length field in envelope header
Base clock	155.52MHz	156.25MHz	TBD (~390 MHz)
FEC	Subrate, FEC shortening, FEC on/off	Subrate	DS LDPC, US TBD, details TBD

- Envelope-based mechanism supports user data fragmentation, this reduces framing gap between ITU-T and IEEE PON TC spec

ITU-T XGEM and P802.3ca Envelope



	XGEM	Envelope
Header size	8 bytes	
Payload granularity	8 bytes	
Payload length field	PLI	Env length
Encryption Key field	Key index	E flag, K flag
Service port ID field	XGEM Port-ID	LLID
Header error control field	HEC	CRC
Start/end of fragmentation field	LF	/S/ /T/ control codes
Start/continuation of Envelope		S flag
Offset field	Options (?)	EPAM



Management

Protocol Area	ITU	IEEE	
	XG(S)-PON	10G-EPON	P802.3ca
Service and ONU management	OMCI	P1904.1, eOAM over LLID	eOAM / YANG(?) over MLID P802.3.2 adding YANG model for EPON, expected completion 2H 2018
User Service path	GEM Port-ID	LLID	ULID
PON and Physical layer management	Embedded OAM, PLOAM	MPCP / LLID	MPCP+ over PLID

- Envelope-based mechanism supports user data fragmentation, this reduces framing gap between ITU-T and IEEE PON TC spec

Discovery & Registration

Protocol Area	ITU	IEEE	
	XG(S)-PON	10G-EPON	P802.3ca
Ranging/ Registration	Similar mechanisms in both PON standards; OLT grants a window, ONU responds, OLT registers ONU on the PON and conducts ranging measurement.		
Ranging messaging	directed ranging grant	DISCOVERY;	
	registration PLOAM	REGISTER_REQ;	
	Ranging_Time PLOAM	REGISTER;	
		REGISTRATION_ACK;	
US collision avoidance	ONU upstream burst transmission time is adjusted by using ranging results		
Ranging/ Registration	Similar mechanisms in both PON standards; OLT grants a window, ONU responds, OLT registers ONU on the PON and conducts ranging measurement.		

- ITU-T and IEEE PONs share similar registration steps and same ranging mechanism

DBA

Protocol Area	ITU	IEEE	
	XG(S)-PON	10G-EPON	P802.3ca
Buffer status reporting	DBRu field in burst	MPCP Report	MPCP+ REPORT; P802.3ca allows 7 LLIDs (PLID, MLID, ULID or GLID) to be reported in a single REPORT
Report basis	Alloc-ID	Queue	LLID (PLID, MLID, ULID or GLID)
Report units	4 bytes block	bytes	EQ (8 byte block)
Report size	2^24 blocks	8 * 2^16 kB	2^24 EQ per LLID (7 LLIDs per REPORT PDU)
Grant messaging	BWmap field in DS frame	MPCP GATE; P802.3ca allows 7 LLIDs (PLID, MLID, ULID or GLID) per GATE, back-to-back GATES can concatenate to single burst	
Grant basis	Alloc-ID	LLID	LLID (PLID, MLID, ULID or GLID)

- Both support status report and dynamic bandwidth allocation

Summary

- There are huge similarities between ITU-T and IEEE PON protocols
- P802.3ca PLID, MLID, & GLID on ID spec and packet fragmentation further reduces gaps between protocols
- Little or no functional differences between the two protocols now
- It is very promising to converge PON protocol spec for future PONs

Thank You