Consideration for possible synergies between next generations ITU-T GPON and IEEE EPON

Leopold Diouf, Alcatel-Lucent
Geneva, Switzerland
June 20, 2008

Agenda

GPON and IEEE EPON comparison

Consideration for synergies between NG GPON & EPON

Conclusions

Current GPON and EPON comparison

TC / MAC Comparison between ITU GPON and IEEE EPON

Two access technologies carrying Ethernet traffic

- Yet, two different TC and MAC layers

	IEEE EPON	ITU GPON
	802.3ah	984.x
Framing	802.3 (variable time base)	GPON TC (125 us fixed time base)
Encapsulation	N/A	GPON Encapsulation Method (GEM)
Fragmentation	N/A	On Per GEM port-id basis
Encryption	Not Specified	AES-128 Counter Mode
DBA	Not Specified. (non-standard extensions)	Part of ITU specification

PHY Comparison between ITU GPON and IEEE EPON

	IEEE EPON	ITU GPON
	802.3ah	984.x
FEC	Frame based RS(255,239)	Stream based RS(255,239)
Scrambling	N/A	Yes
Encoding	8B/10B	N/A
GBaud	1.25	2.48832,1.24416
Power Leveling	N/A	Yes

OLT Optical Rx Timing and OAM comparison

	IEEE EPON	ITU GPON
	802.3ah	984.x
Guard	512ns	32 bits (25.7 ns at 1.24416 Gbps)
Preamble	T_{AGC}= 400ns T_{CDR} = 400ns	Up to 128bytes – Guard time - Delimiter = 121.5 bytes (721 ns at 1.24416 Gbps)
Delimiter	32ns	16 or 20 bits (12.8 ns or 16.1 ns)

	IEEE EPON	ITU GPON
	802.3ah	984.x
PON Management	MPCP	PLOAM
ONT Management	Outside Standard	OMCI

Consideration for synergies between NG GPON & EPON

TC / MAC Comparison

	IEEE EPON	ITU GPON	Comments
	802.3av	NG GPON	
Framing	802.3 (variable time base)	TBD	Is a fixed timing base still a requirement for NG PON?
Encapsulation	N/A	TBD (assumed to be GEM)	
Fragmentation	N/A	TBD	Fragmentation brings in better PON BW efficiency but also brings in some buffering complexity at the OLT
Encryption	Not Specified	TBD (Assumed to be AES-128 Counter Mode)	Required by ITU operators. IEEE defers to higher layers for security
DBA	Not Specified (Probable non-standard extensions)	TBD (Assumed DBA similar to GPON)	ITU has the only existing standardized DBA definition.

PHY Comparison

	IEEE EPON	ITU GPON	Comments
	802.3av	NG GPON	
FEC	Stream based RS 255/223 Mandatory	TBD	Are better approaches available?
Scrambling	Yes	TBD	Is there any reason for these to be different?
Encoding	64B/66B	TBD	Is there any reason for these to be different?
GBaud	1.25, 10.3125	TBD	FSAN currently considering numerous approaches.
Power Leveling	N/A	TBD	Would this alleviate some of the difficulties associated with a 10 Gbps Burst Mode Receiver?

OLT Optical Rx Timing

	IEEE EPON	ITU GPON	Comments
	802.3av	NG GPON	Comments
Guard	≤ 512ns	TBD	Should timing be based on absolute time rather than bit timing?
Preamble	T_{AGC} ≤ 400ns T_{CDR} ≤ 400ns	TBD	Should timing be based on absolute time rather than bit timing?
Delimiter	32ns	TBD	Should timing be based on absolute time rather than bit timing?

Observation:

- At current IC geometries the cost difference between the IEEE TC/MAC and the ITU TC/MAC are negligible.
- The feature differences that drove these two approaches still appear to exist.

OAM Comparison

	IEEE EPON	ITU GPON	Comments
	802.3av	NG GPON	Comments
PON Management	MPCP w/ extensions for 10G and ONU capabilities	TBD (assumed to be PLOAM)	Backward compatibility is assumed required
ONx Management	EFM	TBD (Assumed to be OMCI)	

Where do Synergies lie between IEEE and ITU?

Synergies at the TC/MAC layer appear to be difficult to attain.

- However, the differences in cost are not significant.

Synergies at the optical level:

- In contrast to the TC/MAC layer, synergy at the Optical level is strongly driven by the need to achieve the lowest possible cost.

Possible Optical Layer Synergies

Min/Max TX and Min/Max Rx power:

- Alignment in terms of optical specifications (Min/Max Tx power; Min/Max Rx power; total optical budget) for a variety of different classes of optics clearly makes sense

Optical monitoring

- Alignment on optical monitoring parameters and approaches (Temperature, Bias current, Supply voltage and input/output power): again probably makes sense to align

Downstream line rates:

- 10G Serial downstream alignment is a reasonable goal.

Upstream line rates:

- There is a perception that 1G may not meet the future services requirements.
- 10G may not be cost effective in the next 3-4 years, and may continue to exhibit a significant cost differential to a lower US line rate, such as 2.5 Gbps.

Synergies challenges

Link budget:

- The maximum link budget the IEEE standard has considered is 29dB, whereas ITU carriers are looking for 30-32 dB

Optical wavelength

- The Optical wavelengths in IEEE 10GBASE-PR is somewhat narrow (±3nm). However, wavelength definition in both standards bodies has been controversial. Obtaining commonality between IEEE and ITU may be challenging at best.

Extended reach opportunities

- At the moment IEEE carriers have not defined reach-extender solutions. Some ITU carriers are looking to push PON reach to 100km. So while IEEE has settled on 1260-1280nm, ITU carriers approaches using the C-band inherently have lower losses along with potential use of EDFAs to achieve the 100 km reach.

Conclusions

Conclusions

EPON and GPON had

- Regional applications differences and
- Regional requirement differences due to the different standard bodies they originated from

NG GPON and NG EPON will inherit part of

- The regional applications differences
- The regional requirements differences,

So it is unlikely to have common specifications for both NG GPON and NG EPON.

However, it is surely possible to support compatible building blocks that can benefit both NG GPON and NG EPON.

- Min/Max TX and Min/Max Rx power
- Optical monitoring
- Exploration of PHY layer commonalties between IEEE and ITU.