Extended EPON PMD Parameters

ZTE中兴

Jidong Xu, Zhiming Fu
Marek Hajduczenia

Finisar

Wen Li

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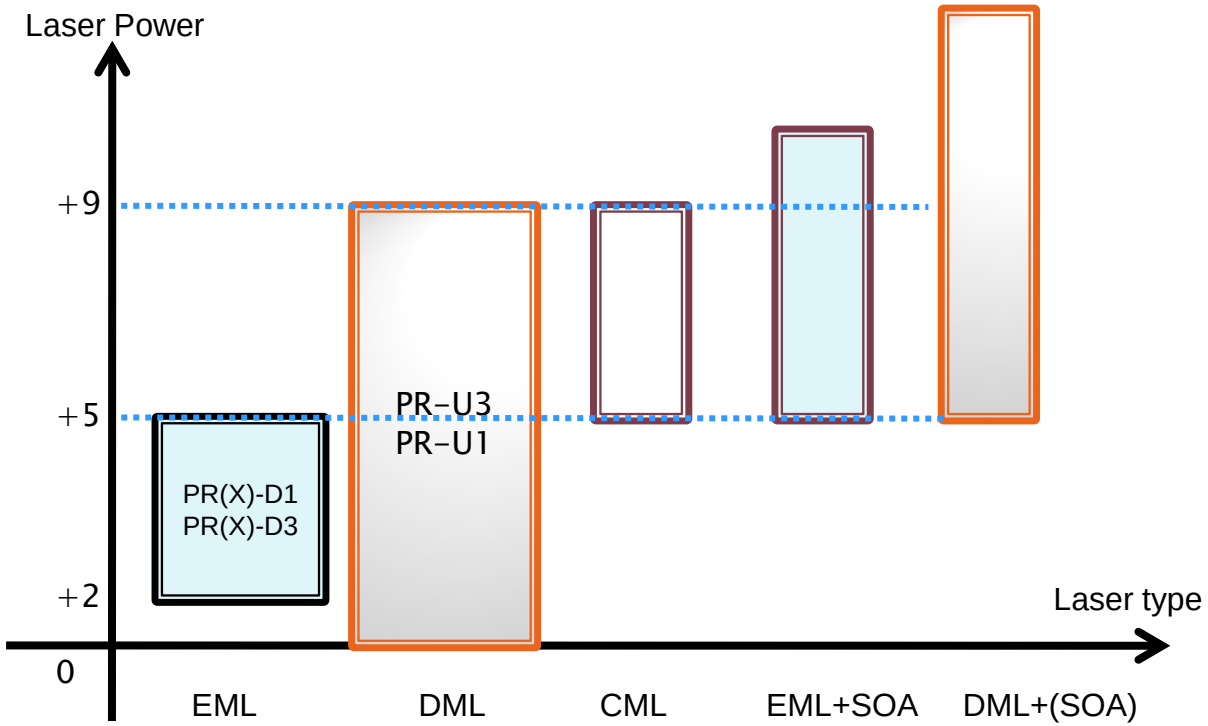
Agenda

- Overview Tx and Rx technologies
- PX30/PX40 for 1G-EPON
- PR(X)40 for 10G-EPON

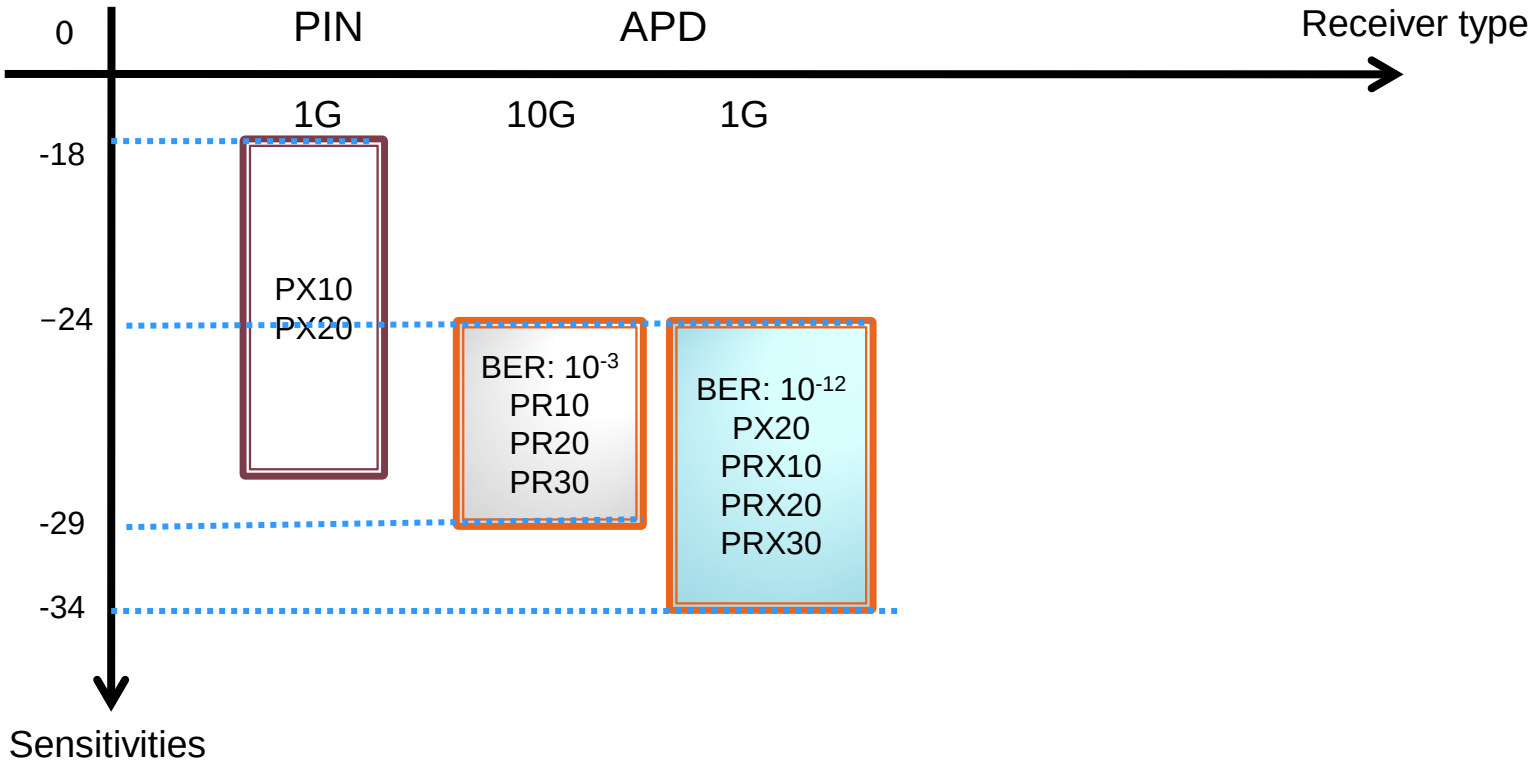
High power Tx technologies

High Power Laser types	
CML	Chirp Managed Laser
DML	Direct Modulated Laser (DFB)
EML	Electro-absorption Modulated Laser
DML+SOA	Monolithic SOA integration DML
EML+SOA	Monolithic SOA integration EML



- **High power transmitter**
  - There are five types of LD for high power transmitter
  - For general application EML and DML are sufficient
  - For very high power requirement, we will need SOA to add more output power or use a new laser type

High sensitivity Rx technologies



- **High sensitivity Receiver**
  - There are two types of receiver in Rx technology
  - APD is the best choice for high power budget and cost-constrained solutions
  - Receiver with optical pre-AMP could be also used, but the solution cost and technical complexity is increased

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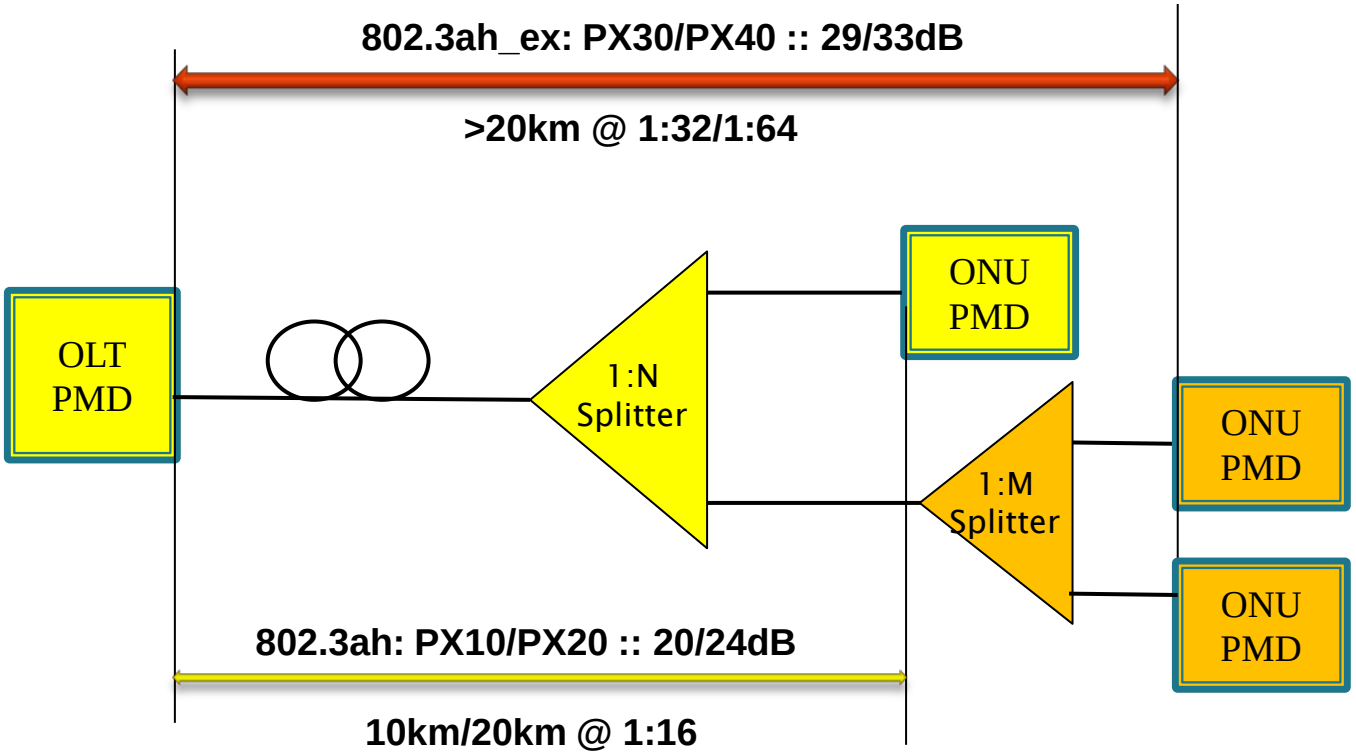
From PX10/PX20 to PX30/PX40



- Extended power budget PX30/PX40
  - PX30/PX40 can support higher distance and/or split when compared with PX20
  - PX10/PX20 satisfy very limited market. Most operators (e.g. CTC) even today require support for higher power budget class right to make their deployments cost efficient. They even deploy non-802.3 standard compliant PMDs to achieve their networking goals

Power budgets (PX10/PX20/PX30/PX40) for 1G-EPON

Items	PX10		PX20		PX30		PX40		Units
Number of Fiber, Fiber type	1,SMF								-
Transmit Direction	US	DS	US	DS	US	DS	US	DS	-
Line rate	1.25								GBd
Transmit Wavelength	1310	1490	1310	1490	1310	1490	1310	1490	nm
Transmit Wavelength tolerance	±50	±10	±50	±10	±50	±10	±20	±10	nm
Maximum Reach	0.5m—10km		0.5m—20km		0.5m –30km		0.5m –40km		km
Maximum Channel insertion loss	20	19.5	24	23.5	29	29	33	33	dB
Minimum Channel insertion loss	5		10		10		15		dB

- The new power budget classes **PX30/PX40** will enable 1G-EPON to reach longer distance (up to **30km/ 40km@1:16**) without in-line amplifier
- **PX30/PX40** will also enable high split ratio (up to **10km@1:64 / 1:128**), which is ideal for deployments in population dense areas, or dense applications like mobile backhauling.

The recommended PMD parameters for PX30

Parameters	Units	OLT		Units	Parameters
		PX30-D	PX30-U		
Transmitter type	-	DFB	APD	-	Receiver type
Signaling speed (range)	GBd	1.25±100 ppm	10^{-12}	-	Bit error ratio (max)
Wavelength (range)	nm	1480-1500	-6	dBm	Average receive power (max)
Average launch power (min, max)	dBm	+3~+7	-3	dBm	Damage threshold (max)
Transmitter and dispersion penalty (max)	dB	1.0	-30	dBm	Receiver sensitivity (max)
		ONU			
Receiver type	-	PIN	FP/DFB	-	Transmitter type
Bit error ratio (max)	-	10^{-12}	1.25±100 ppm	GBd	Signaling speed (range)
Average receive power (max)	dBm	-3	1260 -1360	nm	Wavelength (range)
Damage threshold (max)	dBm	+4	+1~+4	dBm	Average launch power (min, max)
Receiver sensitivity (max)	dBm	-27	2.0	dB	Transmitter and dispersion penalty (max)

The recommend PMD parameters for PX40

Parameters	Units	OLT		Units	Parameters
		PX40-D	PX40-U		
Transmitter type	-	DFB	APD	-	Receiver type
Signaling speed (range)	GBd	1.25±100 ppm	10^{-12}	-	Bit error ratio (max)
Wavelength (range)	nm	1480-1500	-8	dBm	Average receive power (max)
Average launch power (min, max)	dBm	+4~+7	-3	dBm	Damage threshold (max)
Transmitter and dispersion penalty (max)	dB	1.0	-32	dBm	Receiver sensitivity (max)
		ONU			
Receiver type	-	APD	DFB	-	Transmitter type
Bit error ratio (max)	-	10^{-12}	1.25±100 ppm	GBd	Signaling speed (range)
Average receive power (max)	dBm	-8	1290-1330	nm	Wavelength (range)
Damage threshold (max)	dBm	-3	+2~+7	dBm	Average launch power (min, max)
Receiver sensitivity (max)	dBm	-30	1.0	dB	Transmitter and dispersion penalty (max)

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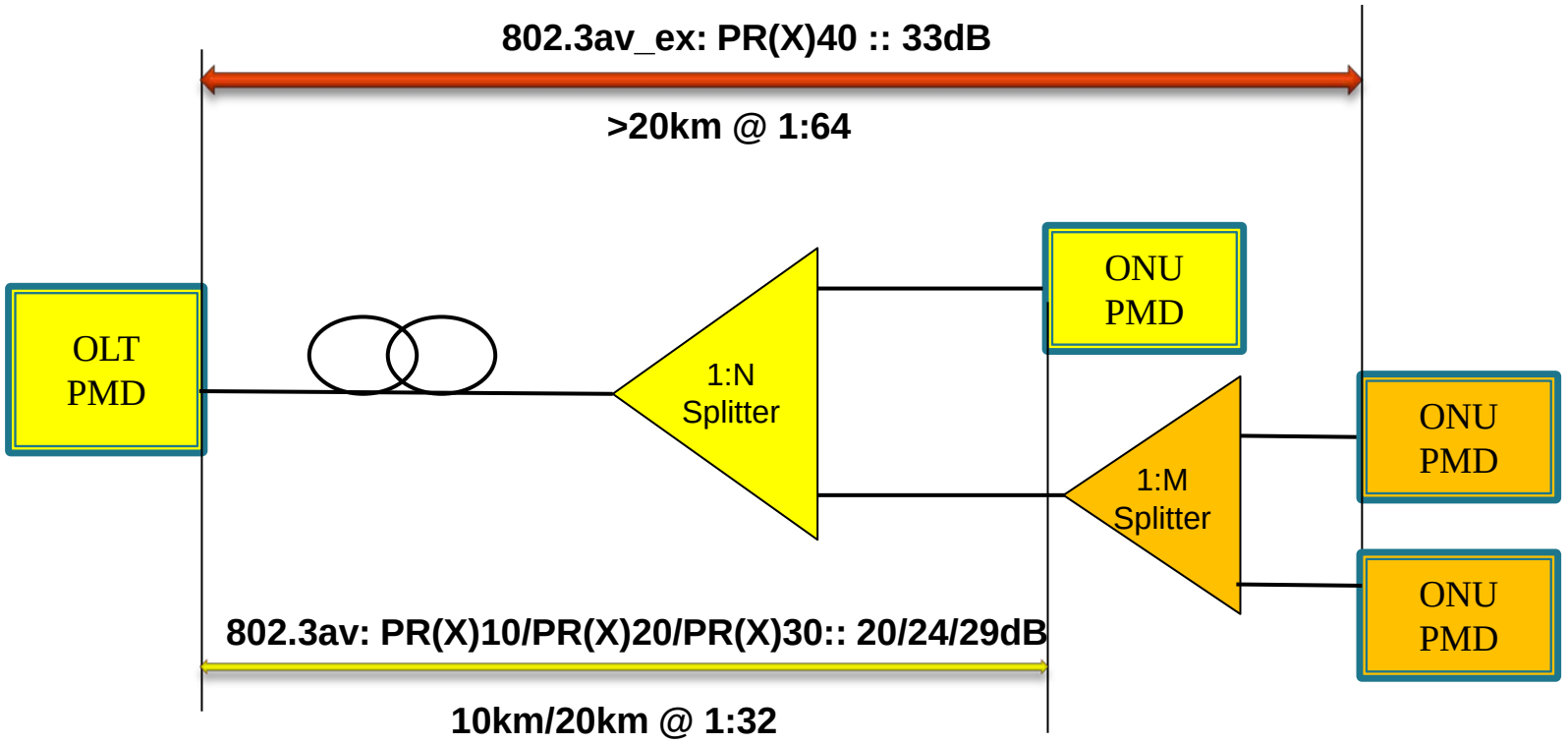
From PR(X)10/PR(X)20/PR(X)30 to PR(X)40



- **Extended power budget PR(X)40**
  - It can extend the **10km** distance from PR30 or double the split from PR30
  - Even though **PR10/PR20** are **lower cost solutions**, most operators deploying 10G-EPON right now prefer **PR(X)30 cl**ass power budgets for their **higher subscriber density and ability to support long reach**.
  - However, **higher power budget class supporting longer reach and higher split ratio** is also needed to further **lower the CAPEX and OPEX.**

Power budgets (PR(X)30 and PR(X)40) for 10G-EPON

Items	PRX30		PR30		PRX40		PR40		Units
Number of Fiber, Fiber type	1, SMF								-
Transmit Direction	US	DS	US	DS	US	DS	US	DS	-
Transmit line rate	1.25	10.3125			1.25	10.3125			GBd
Transmit Wavelength	1310	1577	1270	1577	1310	1577	1270	1577	nm
Transmit Wavelength tolerance	±50	-2~+3	±10	-2~+3	±20	-2~+3	±10	-2~+3	nm
Maximum Reach	≥20				≥30				km
Maximum Channel insertion loss	29				33				dB
Minimum Channel insertion loss	15				18				dB

- The new power budget classes PR(X)40 aim to support longer distance (at least 30km@1:32)
- For a short distance, it can support very high split ratio ODN (1:128@10 km)
- This PMD is ideal for rural area and metro-city deployments

The recommend PMD parameters for PR(X)40

Parameters	Units	PR(X)40-D	PRX40-U	PR40-U
Transmitter characteristics				
Transmitter type	-	EML/DML/…+SOA	DFB	DFB
Signaling speed (range)	GBd	10.3125±100ppm	1.25±100ppm	10.3125±100ppm
Wavelength (range)	nm	1575-1580	1290-1330	1260-1280
Average launch power (max)	dBm	+9	+7	+10
Average launch power (min)	dBm	+5	+2	+6
Transmitter and dispersion penalty (max)	dB	1.5	1.0	2
Receiver characteristics				
Receiver type	-	APD	APD	APD
Signaling speed (range)	GBd	10.3125±100ppm	1.25±100ppm	10.3125±100ppm
Wavelength (range)	nm	1575-1580	1260-1360	1260-1280
Bit error ratio (max)	-	10^{-3}	10^{-12}	10^{-3}
Average receive power (max)	dBm	-9	-11	-9
Receiver sensitivity (max)	dBm	-29.5	-32	-29

The orange part parameters for PR40 can be supported by some of optical module company.

The pink part parameters can get the support by most of optical module company.

Summary

- We reviewed currently available technologies for EPON
  - High power Tx devices
  - High sensitivity Rx devices
- We proposed parameters for the new power budget class for 1G-EPON, meeting projects objectives
  - 29dB of PX30 power budget
  - 33dB of PX40 power budget
- We propose a new power budget class for 10G-EPON and its PMD parameters
  - 33dB of PRX40 power budget
  - 33dB of PR40 power budget

Thank You!

Deliver the future-extended EPON for better life and greener earth