Power Budget Class (PBC) and PMD naming

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Short introduction …

- PMD and PBC naming:
  - **3av_0705_remein_1.pdf** discussed possible PBC / PMD naming options in the case of simplex and standard PBC / PMD definitions
  - It would be nice to have PBC / PMD names in D1.0
    - we should not keep on using tentative PBC / PMD names – creates bad habits …
    - No official decision on PBC / PMD naming for now
    - PMD naming must be resolved in compliance with IEEE naming rules
    - PBC naming can be more flexible

Symmetric PBC names [1]

First, let's focus on the symmetric PBC names

- Legacy PBC names inherited from IEEE P802.3ah:
  - **1000BASE-PX10** – 10 km link, 1:16 split, 20 / 19.5 dB ChIL
  - **1000BASE-PX20** – 20 km link, 1:16 split, 24 / 23.5 dB ChIL
- New PBCs under definition in IEEE P802.3av:
  - symmetric 10G, 20 dB ChIL
  - symmetric 10G, 24 dB ChIL
  - symmetric 10G, 29 dB ChIL

Symmetric PBC names [2]

- We grew used to using these abbreviated forms of PBC names (see e.g. our reflector):
  - **PR10 -** symmetric 10G, 20 dB ChIL
  - **PR20 -** symmetric 10G, 24 dB ChIL
  - **PR30 -** symmetric 10G, 29 dB ChIL
- Question:
  - Can we specify them as official PBC names for symmetric 10G EPON links?
- Answer: seems we can …
    - they are short,
    - do not cause confusion,
    - have all the parameters we expect from PBC (PBC class, R indicates symmetric through channel coding)
    - we never had any confusion on the reflector, had we?

Asymmetric PBC names [1]

Then, let's focus on the asymmetric PBC names

- No legacy PBC names inherited from IEEE P802.3ah:
  - need to remain compliant with the general IEEE naming rules
  - no precedence to follow – more freedom to chose naming format and style, though need to include channel data rate, encoding ...
  - DS and US channels have various data rates (10G / 1G) and different encoding (8B10B and 64B66B)

- New PBCs under definition in the IEEE P802.3av:
  - asymmetric 1/10G, 20 dB ChIL
  - asymmetric 1/10G, 24 dB ChIL
  - asymmetric 1/10G, 29 dB ChIL

Asymmetric PBC names [2]

Obstacles to be overcome ...

- Two different channel encodings are used
  - 8B10B (X) in US, 64B66B (R) in DS
  - PRX looks strange and does not follow standard IEEE link naming policy (one letter channel encoding indicator)
  - a new channel encoding may be attributed e.g. (Y) to describe this particular situation – asymmetric link would then be designated as PY ...
- Two different data rates for a single PBC
  - US and DS operate at 1G and 10G respectively
  - We do not need data rate indicator in the PBC
  - why not use a shorthand notation PYxx (xx – 10/20/30) ?
    - provocative, yet contains everything we need
    - simpler to remember, shorter and more crisp
    - PMD names will be already long – no need to multiply 0s in PBCs

Asymmetric PBC names [3]

- Shorthand asymmetric PBC names in the IEEE P802.3av:
  - **PRX10** - asymmetric 1/10G, 20 dB ChIL
  - **PRX20** - asymmetric 1/10G, 24 dB ChIL
  - **PRX30** - asymmetric 1/10G, 29 dB ChIL

PMDs for IEEE P802.3av [1]

- IEEE P802.3av project shall specify at most the following PMDs:
  - D & U PMD for PR10, D & U PMD for PR20 and D & U PMD for PR30
  - D & U PMD for PY10, D & U PMD for PY20 and D & U PMD for PY30

- Total PMD count (maximum): 12 (ONU and OLT PMDs),
  - 6 PMDs for symmetric data rate PBCs: 10GBASE-PR-D1, 10GBASE-PR-D2, 10GBASE-PR-D3, 10GBASE-PR-U1, 10GBASE-PR-U3, 10GBASE-PR-U3
  - 6 PMDs for asymmetric data rate PBCs : 10/1GBASE-PY-D1, 10/1GBASE-PY-D2, 10/1GBASE-PY-D3, 10/1GBASE-PY-U1, 10/1GBASE-PY-U3, 10/1GBASE-PY-U3
  - Asymmetric and symmetric PMDs will share some parameters e.g. 10GBASE-PR-D1 and 10/1GBASE-PY-D1 will share Tx path, 10GBASE-PR-U1 and 10/1GBASE-PY-U1 will share the Rx path

PMDs for IEEE P802.3av [2]

Visible tendency to minimize the number of PMDs

- see baseline proposals #16 - #21 and #22 - #26 from Seoul meeting, 2007.09
- reflector discussion and analysis of the wavelength allocation and/or power budgets suggests we will have to define 3 OLT PMDs for 10G EPONs and at least 2 ONU PMDs (x2, due to symmetric and asymmetric configurations)
- since target PMD count is smaller than PBC count $\times$ 2, we will have to map the PMDs into PBCs:
  - some PMDs will be shared by more than 1 PBC;
  - we cannot use standard PMD names e.g. : 10GBASE-PR10-U, since it may be shared by 1PR10 and PR20

PMDs for IEEE P802.3av [3]

Proposed PMD names (symmetric PMDs)

- OLT PMDs
  - 10GBASE-PR-D1: 10G DS, 10G US, 20 dB ChIL
  - 10GBASE-PR-D2: 10G DS, 10G US, 24 dB ChIL
  - 10GBASE-PR-D3: 10G DS, 10G US, 29 dB ChIL
- ONU PMDs
  - 10GBASE-PR-U1: 10G DS, 10G US, 20 dB ChIL
  - 10GBASE-PR-U3: 10G DS, 10G US, 29 dB ChIL

Proposed PMD names (asymmetric PMDs)

- OLT PMDs
  - 10/1GBASE-PY-D1: 10G DS, 1G US, 20 dB ChIL
  - 10/1GBASE-PY-D2: 10G DS, 1G US, 24 dB ChIL
  - 10/1GBASE-PY-D3: 10G DS, 1G US, 29 dB ChIL
- ONU PMDs
  - 10/1GBASE-PY-U1: 10G DS, 1G US, 20 dB ChIL
  - 10/1GBASE-PY-U2: 10G DS, 1G US, 24 dB ChIL
  - 10/1GBASE-PY-U3: 10G DS, 1G US, 29 dB ChIL

Clause 91, PMD – link mapping

Table 91–4—PMD – link mapping for symmetric links (PR type)

PMD	Location	10GBASE–PR10	10GBASE–PR20	10GBASE–PR30
10GBASE–PR–D1	OLT	X		
10GBASE–PR–D2			X	
10GBASE–PR–D3				X
10GBASE–PR–U1	ONU	X		
10GBASE–PR–U2			X	
10GBASE–PR–U3				X

Table 91–5—PMD – link mapping for asymmetric links (PY type)

PMD	Location	10/1GBASE–PY10	10/1GBASE–PY20	10/1GBASE–PY30
10/1GBASE–PY–D1	OLT	X		
10/1GBASE–PY–D2			X	
10/1GBASE–PY–D3				X
10/1GBASE–PY–U1	ONU	X		
10/1GBASE–PY–U2			X	
10/1GBASE–PY–U3				X

- tentative PBC names were used in D0.91 for C91

Clause 91, OLT PMD, PR/PY type, Tx path

Table 91–6—PR and PY type OLT PMD transmit characteristics

Description	10GBASE –PR–D1 and 10/1GBASE –PY–D1	10GBASE –PR–D2 and 10/1GBASE –PY–D2	10GBASE –PR–D3 and 10/1GBASE –PY–D3	Unit
Nominal transmitter type[a]	Longwave Laser	Longwave Laser	Longwave Laser	
Signaling speed (range)	10.3125 ± 100 ppm	10.3125 ± 100 ppm	10.3125 ± 100 ppm	GBd
Wavelength[b] (range)	15xx to 15yy	15xx to 15yy	1574 to 1580	nm
RMS spectral width (max)	*see Table 91–7*	*see Table 91–8*	*see Table 91–9*	nm
Average launch power (max)	*TBD*	*TBD*	*TBD*	dBm
Average launch power (min)	*TBD*	*TBD*	*TBD*	dBm
Average launch power of OFF transmitter (max)	*TBD*	*TBD*	*TBD*	dBm
Extinction ratio (min)	*TBD*	*TBD*	*TBD*	dB
$RIN_{15}OMA$ (max)	*TBD*	*TBD*	*TBD*	dB/Hz
Launch OMA (min)	*TBD*	*TBD*	*TBD*	dBm (mW)
Transmitter eye mask definition {X1, X2, Y1, Y2, Y3}	*TBD*	*TBD*	*TBD*	UI
Ton (max)	N/A	N/A	N/A	ns
Toff (max)	N/A	N/A	N/A	ns
Optical return loss tolerance (max)	*TBD*	*TBD*	*TBD*	dB
Optical return loss of ODN (min)	*TBD*	*TBD*	*TBD*	dB
Transmitter reflectance (max)	*TBD*	*TBD*	*TBD*	dB
Transmitter and dispersion penalty (max)	*TBD*	*TBD*	*TBD*	dB
Decision timing offset for transmitter and dispersion penalty (min)	*TBD*	*TBD*	*TBD*	UI

Clause 91, OLT PMD, PR type, Rx path

Table 91–10—PR type OLT PMD receive characteristics

Description	10GBASE –PR–D1	10GBASE –PR–D2	10GBASE –PR–D3	Unit
Signaling speed (range)	10.3125 ± 100 ppm	10.3125 ± 100 ppm	10.3125 ± 100 ppm	GBd
Wavelength (range)	1260 to 1280	1260 to 1280	1260 to 1280	nm
Bit error ratio (max)	10^{-12}			
Average receive power (max)	*TBD*	*TBD*	*TBD*	dBm
Damage threshold (max)	*TBD*	*TBD*	*TBD*	dBm
Receiver sensitivity (max)	*TBD*	*TBD*	*TBD*	dBm
Receiver sensitivity OMA (max)	*TBD*	*TBD*	*TBD*	dBm (μW)
Signal detect threshold (min)	*TBD*	*TBD*	*TBD*	dBm
Receiver reflectance (max)	*TBD*	*TBD*	*TBD*	dB
Stressed receive sensitivity (max)[a]	*TBD*	*TBD*	*TBD*	dBm
Stressed receive sensitivity OMA (max)	*TBD*	*TBD*	*TBD*	dBm (μW)
Vertical eye–closure penalty (min)[b]	*TBD*	*TBD*	*TBD*	dB
Treceiver_settling[c] (max)	*TBD*	*TBD*	*TBD*	ns
Stressed eye jitter (min)	*TBD*	*TBD*	*TBD*	UI pk to pk
Jitter corner frequency	*TBD*	*TBD*	*TBD*	kHz
Sinusoidal jitter limits for stressed receiver conformance test (min, max)	*TBD*	*TBD*	*TBD*	UI

Clause 91, OLT PMD, PY type, Rx path

Table 91–11—PY type OLT PMD receive characteristics

Description	10/1GBASE –PY–D1	10/1GBASE –PY–D2	10/1GBASE –PY–D3	Unit
Signaling speed (range)	same as 1000BASE–PX10–D receive parameters (see Table 60–5)	same as 1000BASE–PX20–D receive parameters (see Table 60–8)	1.25 ± 100 ppm	GBd
Wavelength (range)			1260 to 1360	nm
Bit error ratio (max)			10^{-12}	
Average receive power (max)			*TBD*	dBm
Damage threshold (max)			*TBD*	dBm
Receiver sensitivity (max)			*TBD*	dBm
Receiver sensitivity OMA (max)			*TBD*	dBm (µW)
Signal detect threshold (min)			*TBD*	dBm
Receiver reflectance (max)			*TBD*	dB
Stressed receive sensitivity (max)[a]			*TBD*	dBm
Stressed receive sensitivity OMA (max)			*TBD*	dBm (µW)
Vertical eye–closure penalty (min)[b]			*TBD*	dB
Treceiver_settling[c] (max)			*TBD*	ns
Stressed eye jitter (min)			*TBD*	UI pk to pk
Jitter corner frequency			*TBD*	kHz
Sinusoidal jitter limits for stressed receiver conformance test (min, max)			*TBD*	UI

Clause 91, ONU PMD, PR type, Tx path

Table 91–12—PR type ONU PMD transmit characteristics

Uescription	10GBASE –PR–U1	10GBASE –PR–U2	10GBASE –PR–U3	Unit
Nominal transmitter type[a]	Longwave Laser	Longwave Laser	Longwave Laser	
Signaling speed (range)	10.3125 ± 100 ppm	10.3125 ± 100 ppm	10.3125 ± 100 ppm	GBd
Wavelength[b] (range)	1260 to 1280	1260 to 1280	1260 to 1280	nm
RMS spectral width (max)	*see Table 91–14*	*see Table 91–15*	*see Table 91–16*	nm
Average launch power (max)	*TBU*	*TBU*	*TBU*	dBm
Average launch power (min)	*TBU*	*TBU*	*TBU*	dBm
Average launch power of OFF transmitter (max)	*TBU*	*TBU*	*TBU*	dBm
Extinction ratio (min)	*TBU*	*TBU*	*TBU*	dB
$RIN_{15}OMA$ (max)	*TBU*	*TBU*	*TBU*	dB/Hz
Launch OMA (min)	*TBU*	*TBU*	*TBU*	dBm (μW)
Transmitter eye mask definition {X1, X2, Y1, Y2, Y3}	*TBU*	*TBU*	*TBU*	UI
Ton (max)	*TBU*	*TBU*	*TBU*	ns
Toff (max)	*TBU*	*TBU*	*TBU*	ns
Optical return loss tolerance (max)	*TBU*	*TBU*	*TBU*	dB
Optical return loss of OUN (min)	*TBU*	*TBU*	*TBU*	dB
Transmitter reflectance (max)	*TBU*	*TBU*	*TBU*	dB
Transmitter and dispersion penalty (max)	*TBU*	*TBU*	*TBU*	dB
Uecision timing offset for transmitter and dispersion penalty (min)	*TBU*	*TBU*	*TBU*	UI

Clause 91, ONU PMD, PY type, Tx path

Table 91–13—PY type ONU PMD transmit characteristics

Uescription	10/1GBASE –PY–U1	10/1GBASE –PY–U2	10/1GBASE –PY–U3	Unit
Nominal transmitter type[a]	same as 1000BASE–PX10–U transmit parameters (see Table 60–3)	same as 1000BASE–PX20–U transmit parameters (see Table 60–6)	Longwave Laser	
Signaling speed (range)			1.25 ± 100 ppm	GBd
Wavelength[b] (range)			1260 to 1360	nm
RMS spectral width (max)			*see Table 91–17*	nm
Average launch power (max)			*TBU*	dBm
Average launch power (min)			*TBU*	dBm
Average launch power of OFF transmitter (max)			*TBU*	dBm
Extinction ratio (min)			*TBU*	dB
$RIN_{15}OMA$ (max)			*TBU*	dB/Hz
Launch OMA (min)			*TBU*	dBm (μW)
Transmitter eye mask definition {X1, X2, Y1, Y2, Y3}			*TBU*	UI
Ton (max)			*TBU*	ns
Toff (max)			*TBU*	ns
Optical return loss tolerance (max)			*TBU*	dB
Optical return loss of OUN (min)			*TBU*	dB
Transmitter reflectance (max)			*TBU*	dB
Transmitter and dispersion penalty (max)			*TBU*	dB
Uecision timing offset for transmitter and dispersion penalty (min)			*TBU*	UI

Clause 91, ONU PMD, PR/PY type, Rx path

Table 91–18—PR and PY type ONU PMD receive characteristics

Description	10GBASE –PR–D1 and 10/1GBASE –PY–D1	10GBASE –PR–D2 and 10/1GBASE –PY–D2	10GBASE –PR–D3 and 10/1GBASE –PY–D3	Unit
Signaling speed (range)	10.3125 ± 100 ppm	10.3125 ± 100 ppm	10.3125 ± 100 ppm	GBd
Wavelength (range)	15xx to 15yy	15xx to 15yy	15xx to 15yy	nm
Bit error ratio (max)	10^{-12}			
Average receive power (max)	*TBD*	*TBD*	*TBD*	dBm
Damage threshold (max)	*TBD*	*TBD*	*TBD*	dBm
Receiver sensitivity (max)	*TBD*	*TBD*	*TBD*	dBm
Receiver sensitivity OMA (max)	*TBD*	*TBD*	*TBD*	dBm (μW)
Signal detect threshold (min)	*TBD*	*TBD*	*TBD*	dBm
Receiver reflectance (max)	*TBD*	*TBD*	*TBD*	dB
Stressed receive sensitivity (max)[a]	*TBD*	*TBD*	*TBD*	dBm
Stressed receive sensitivity OMA (max)	*TBD*	*TBD*	*TBD*	dBm (μW)
Vertical eye–closure penalty (min)[b]	*TBD*	*TBD*	*TBD*	dB
Treceiver_settling[c] (max)	NA	NA	NA	ns
Stressed eye jitter (min)	*TBD*	*TBD*	*TBD*	UI pk to pk
Jitter corner frequency	*TBD*	*TBD*	*TBD*	kHz
Sinusoidal jitter limits for stressed receiver conformance test (min, max)	*TBD*	*TBD*	*TBD*	UI