# Simplex PMD

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# P802.3av TF Objectives

- Support subscriber access networks using point to multipoint topologies on optical fiber

  (Passed by voice vote without opposition)

- PHY(s) to have a BER better than or equal to $10^{-12}$ at the PHY service interface

  (Passed by voice vote without opposition)

- Provide physical layer specifications:
  - **PHY for PON, 10 Gbps downstream / 1 Gbps upstream, single SM fiber**
  - **PHY for PON, 10 Gbps downstream / 10 Gbps upstream, single SM fiber**

    (Y:34, N:0, A:2)

- Define **up to 3 optical power budgets** that support split ratios of 1:16 and 1:32, and distances of at least 10 and at least 20 km.

  (Y:51, N:0, A:10)

# P802.3av Objectives Call for 12 New Port Types

- **ONU and OLT ports are different**
  - Burst mode reception at OLT
  - Burst mode transmission at ONU
  - Different upstream and downstream wavelengths
- **Symmetric and Asymmetric ports are different**
  - 10 Gb/s TX + 10 Gb/s RX
  - 10 Gb/s TX + 1 Gb/s RX or 1 Gb/s TX + 10 Gb/s RX
- **Different Power Budgets require different PMD parameters**

$$2\begin{bmatrix}\text{ONU}\\\text{OLT}\end{bmatrix}\times 2\begin{bmatrix}\text{Symmetric}\\\text{Asymmetric}\end{bmatrix}\times 3\begin{bmatrix}\text{Power Budget 1}\\\text{Power Budget 2}\\\text{Power Budget 3}\end{bmatrix}=12$$

# Notation

- Asymmetric PMD (10G downstream and 1G upstream) is designated **10/1GBASE-**

- PHY that uses 64b/66b in one direction and 8b/10b in another direction is designated **"PY"**
  Also note:
  – 64b/66b in both directions – "PR"
  – 8b/10b in both directions – "PX"

- Power budget class for 1:32 split @ 20 km is designated **"30"**
  Also note:
  – 1:16 @ 10 km is called "PX10" in IEEE 802.3ah
  – 1:16 @ 20 km is called "PX20" in IEEE 802.3ah

- Example: PMD in asymmetric ONU with power budget for 1:32 split at 20 km: **10/1GBASE-PY30-U**

- The above notation is not approved by the TF
- Used only in this presentation for clarity

# How Many is Too Many?

- 1 Gb/s EPON defined 4 PMDs for 2 power budgets
  - 1000BASE-PX10-D
  - 1000BASE-PX10-U
  - 1000BASE-PX20-D
  - 1000BASE-PX20-U

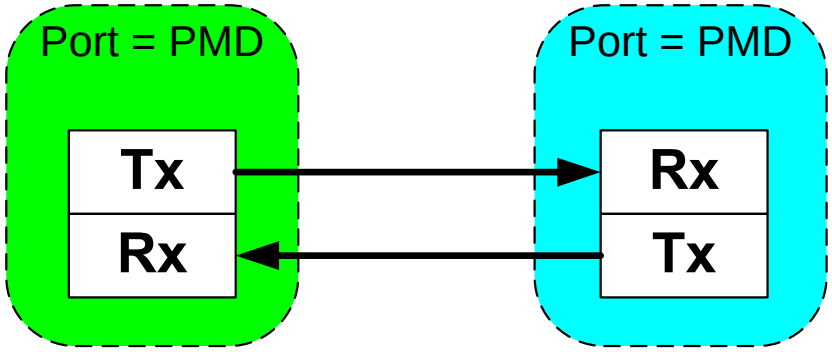
- Is 12 new PMDs for 10GEPON too many?

| **Symmetric 10G/10G** | **Asymmetric (10G/1G)** |
|---|---|
| – 10GBASE-PR10-D | - 10/1GBASE-PY10-D |
| – 10GBASE-PR10-U | - 10/1GBASE-PY10-U |
| – 10GBASE-PR20-D | - 10/1GBASE-PY20-D |
| – 10GBASE-PR20-U | - 10/1GBASE-PY20-U |
| – 10GBASE-PR30-D | - 10/1GBASE-PY30-D |
| – 10GBASE-PR30-U | - 10/1GBASE-PY30-U |

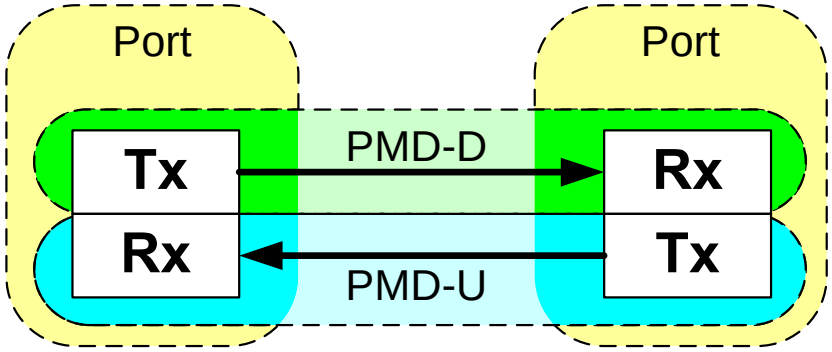
# What is simplex PMD anyway?

- **Traditional PMD** defines Tx and Rx parameters at one end of a link
  - Traditional PMD type has a one-to-one correspondence with port type

- **Simplex PMD** defines Tx and Rx parameters in one direction of a link (Rx opposing the Tx)
  - A port type can be defined as a combination of Tx from simplex PMD ***X*** and Rx from simplex PMD ***Y***.




**Traditional PMD**

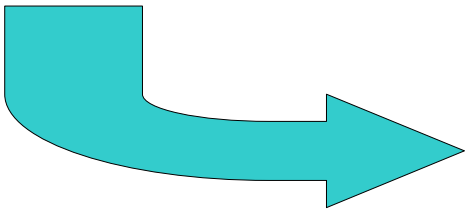



**Simplex PMD**

# Why Simplex PMDs?

- **Port is a combination of 2 Simplex PMDs at one end of a link**
- **Only 7 simplex PMDs are required to define all 12 port types**

| | |
|---|---|
| PMD A | 10Gb/s downstream, PR10 |
| PMD B | 10Gb/s downstream, PR20 |
| PMD C | 10Gb/s downstream, PR30 |
| PMD D | 10Gb/s upstream, PR10 |
| PMD E | 10Gb/s upstream, PR20 |
| PMD F | 10Gb/s upstream, PR30 |
| PMD G | 1Gb/s upstream, PX30 |



| Port type | Defined in |
|---|---|
| OLT, 10/10 symmetric, PR10 | TX: PMD **A**<br>RX: PMD **D** |
| ONU, 10/10 symmetric, PR10 | TX: PMD **D**<br>RX: PMD **A** |
| OLT, 10/10 symmetric, PR20 | TX: PMD **B**<br>RX: PMD **E** |
| ONU, 10/10 symmetric, PR20 | TX: PMD **E**<br>RX: PMD **B** |
| OLT, 10/10 symmetric, PR30 | TX: PMD **C**<br>RX: PMD **F** |
| ONU, 10/10 symmetric, PR30 | TX: PMD **F**<br>RX: PMD **C** |
| OLT, 10/1 asymmetric, PY10 | TX: PMD **A**<br>RX: 1000BASE-PX10-D |
| ONU, 10/1 asymmetric, PY10 | TX: 1000BASE-PX10-U<br>RX: PMD **A** |
| OLT, 10/1 asymmetric, PY20 | TX: PMD **B**<br>RX: 1000BASE-PX20-D |
| ONU, 10/1 asymmetric, PY20 | TX: 1000BASE-PX20-U<br>RX: PMD **B** |
| OLT, 10/1 asymmetric, PY30 | TX: PMD **C**<br>RX: PMD **G** |
| ONU, 10/1 asymmetric, PY30 | TX: PMD **G**<br>RX: PMD **C** |

# Another View

| | | New Simplex PMDs (Tx Side) | | | | | | | 1000BASE- | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | PMD A | PMD B | PMD C | PMD D | PMD E | PMD F | PMD G | PX10-U | PX20-U |
| New Simplex PMDs (Rx Side) | PMD A | | | | ONU, 10/10, PR10 | | | | ONU, 10/1, PY10 | |
| | PMD B | | | | | ONU, 10/10, PR20 | | | | ONU, 10/1, PY20 |
| | PMD C | | | | | | ONU, 10/10, PR30 | ONU, 10/1, PY30 | | |
| | PMD D | OLT, 10/10, PR10 | | | | | | | | |
| | PMD E | | OLT, 10/10, PR20 | | | | | | | |
| | PMD F | | | OLT, 10/10, PR30 | | | | | | |
| | PMD G | | | OLT, 10/1, PY30 | | | | | | |
| 1000BASE- | PX10-D | OLT, 10/1, PY10 | | | | | | | | |
| | PX20-D | | OLT, 10/1, PY20 | | | | | | | |

# Simplex PMD vs. Traditional PMD

| Simplex PMD | Traditional PMD |
|---|---|
| • Always has the same speed for Tx and Rx. | • Can send and receive at different speeds<br>  • Asymmetric EPON: 10G down/1G up |
| • Both Rx and Tx always operate in the same mode: both burst mode or both continuous mode. | • Rx and Tx may operate in the different modes<br>  • ONU receives continuously, but sends in bursts. |
| • Always has the same line coding for Tx and Rx (PCS issue). | • Tx and Rx can use different line coding. |
| • **How to designate components (ports) defined in two simplex PMDs?** | • **How to designate PMDs that have asymmetric speeds and different line coding schemes?** |
| • **How simplex PMD can be integrated in the 802.3 layering diagram?**<br>  • **PMD is a sublayer. Simplex PMD is half of a sublayer?** | |

# Possible Directions for 802.3av TF

**Method 1:** - Keep traditional PMD definition.
- Define 12 new PMD types.

**Method 2:** - Define Simplex PMD.
- Define 7 new simplex PMD types.
- Define 12 port types by referring to new and old PMDs.

# Other Options

- **Reduce the number of optical power budgets to 2**
  - Let's say, we keep low budget (PR10/PY10) and high budget (PR30/PY30)

- **This will require defining**
  **5 simplex PMDs or**
  **8 traditional PMDs**

| Simplex PMDs | |
|---|---|
| 1 | 10Gb/s downstream, PR10 |
| 2 | 10Gb/s downstream, PR30 |
| 3 | 10Gb/s upstream, PR10 |
| 4 | 10Gb/s upstream, PR30 |
| 5 | 1Gb/s upstream, PX30 |

| Traditional PMDs | |
|---|---|
| 1 | 10GBASE-PR10-D |
| 2 | 10GBASE-PR10-U |
| 3 | 10GBASE-PR30-D |
| 4 | 10GBASE-PR30-U |
| 5 | 10/1GBASE-PY10-D |
| 6 | 10/1GBASE-PY10-U |
| 7 | 10/1GBASE-PY30-D |
| 8 | 10/1GBASE-PY30-U |

**2 {PR10,PR30} × 2 {OLT,ONU} × 2 {sym, asym}**

# More Directions for 802.3av TF

**Method 3:** - Reduce number of optical power budgets to 2.

- Keep traditional PMD definition.
- Define 8 new PMD types.

**Method 4:** - Reduce number of optical power budgets to 2.

- Define 5 new simplex PMD types.
- Define 8 port types by referring to new and old PMDs.

# Straw Poll

- P802.3av should define …

| | All | 802.3 |
|---|---|---|
| **Method 1: 12 traditional PMDs:** | ___ | ___ |
| **Method 2: 7 simplex PMDs:** | ___ | ___ |
| **Method 3: 8 traditional PMDs:** | ___ | ___ |
| **Method 4: 5 simplex PMDs:** | ___ | ___ |
| **No opinion / Don't care:** | ___ | ___ |