PMA/PMD for WWDM PHY

10GBASE-LX4

IEEE Draft P802.3ae/D3.2

Clause 53 Presentation

Outline

- Introduction
- Wave Division Multiplexing Overview
- Clause 53 WWDM PHY
- Conclusion

Introduction

- 10Gigabit Ethernet offers a serial PHY and a parallel PHY with multiple wavelengths.
- Clause 53 of IEEE Draft P802.3ae/D3.2 defines PMD sublayer and baseband medium for WWDM PHY, type 10GBASE-LX4.

Introduction

- 4 optical wavelengths, each at 3.125GBaud
- Each wavelength contains 8B/10B encoded data as described in Clause 48
- Compatible with XAUI/XGXS
- Able to run over both single and multimode fiber (SMF, MMF) up to 10km and 300m respectively

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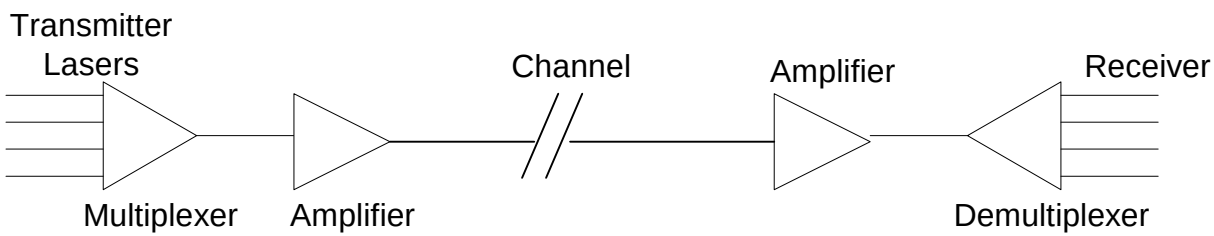
WDM Overview

- WDM (wave division multiplexing)
  - You can also have Dense, Coarse WDM
  - C/D depends on number of wavelengths
- Refers to the (de)multiplexing of multiple wavelengths over a single fiber
- One laser for each wavelength
- Why send one multi-gig stream over a fiber when you can send multiple?

WWDM Basics

- In General, a WDM system has the following main parts: Transmitter, Receiver, (De)Multiplexer, Amplifier, and Channel.



Transmitters

- Distributed feedback (DFB) lasers
  - 1310nm and 1550nm range
- Strict monitoring
  - Use feedback to control laser output
  - Temperature control
- High output power
- One laser for each wavelength

Amplifiers

- Power amplifiers
  - High gain before transmission
- Line amplifier
  - Restore signal to initial state
- Receiver amplifier
  - Recover signal from noise

Channel

- Long lengths of fiber
  - Attenuation
  - Chromatic dispersion (single mode fibers)
  - Broadening of pulses cause inter-symbol interference
  - This can cause major problems

Dispersion

- Dispersion is a function of the fiber
- Zero dispersion at 1300 nm
- Dispersion compensation fiber
- Dispersion shifted fiber
- Non-zero dispersion shifted fiber
  - Eliminate Four Wave Mixing

Multiplexing/Demultiplexing

- Prisms
- Diffraction Gratings
- Arrayed waveguide grating

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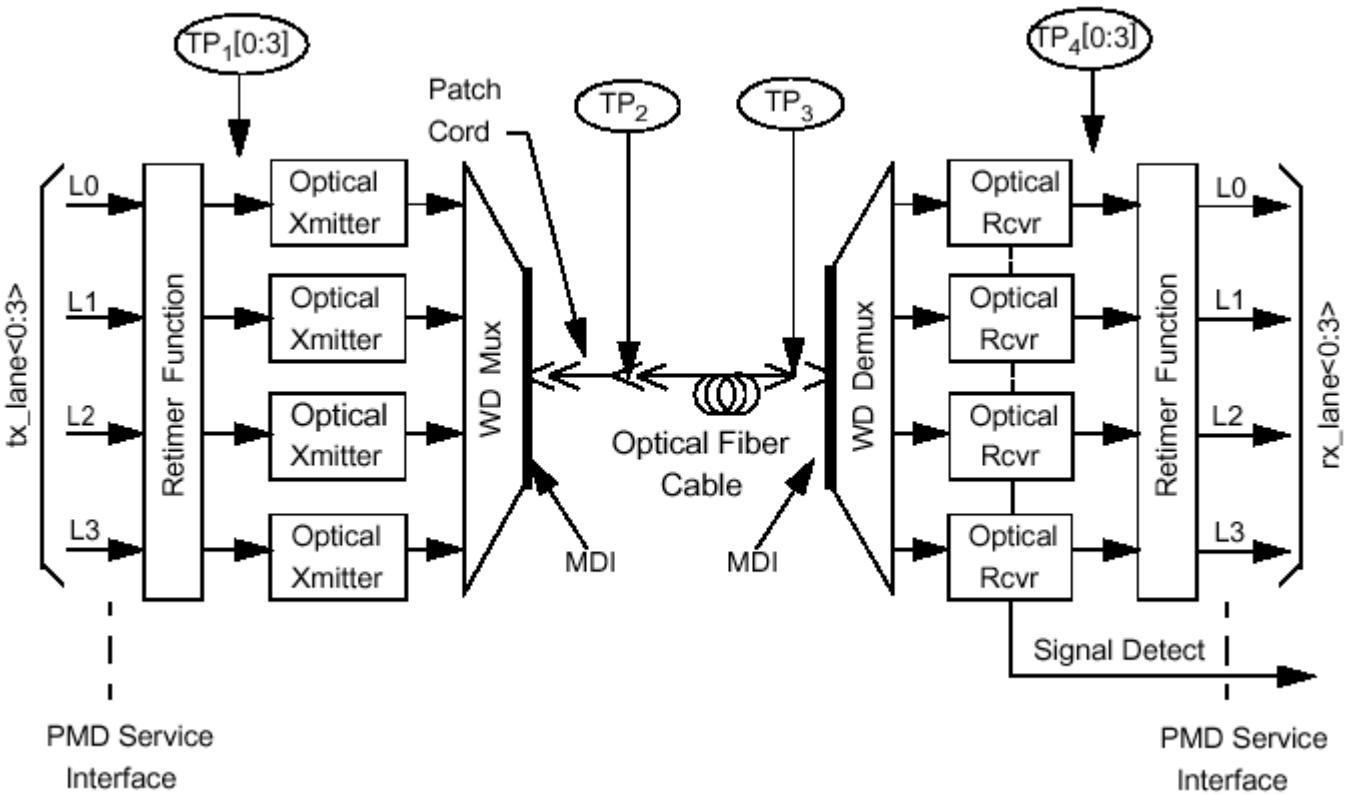
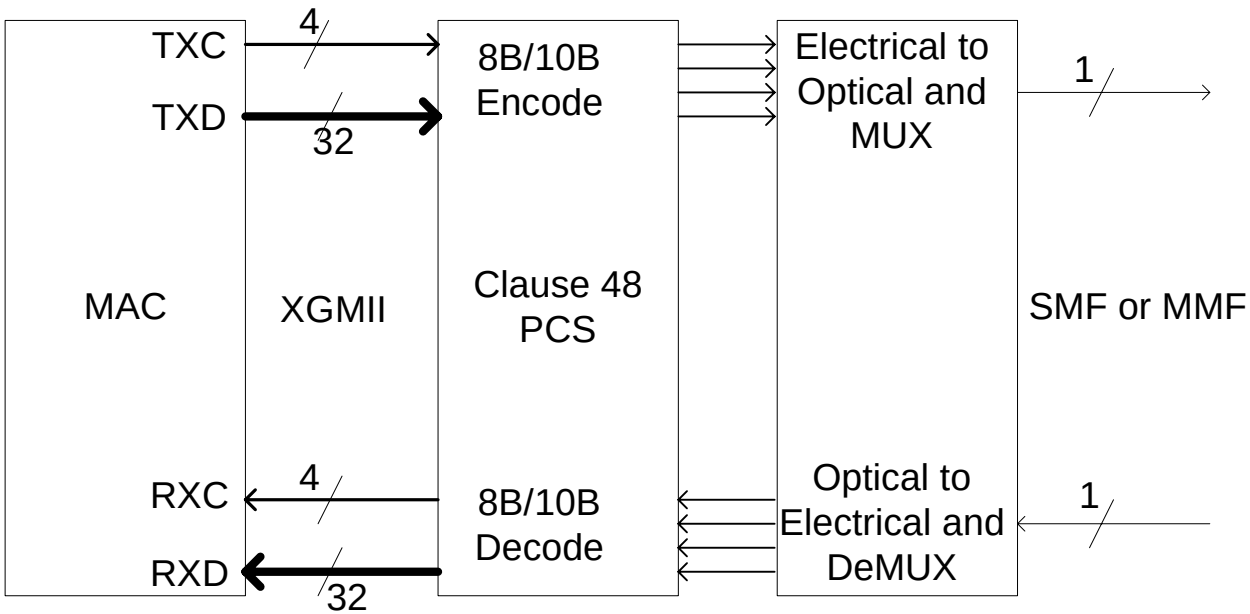
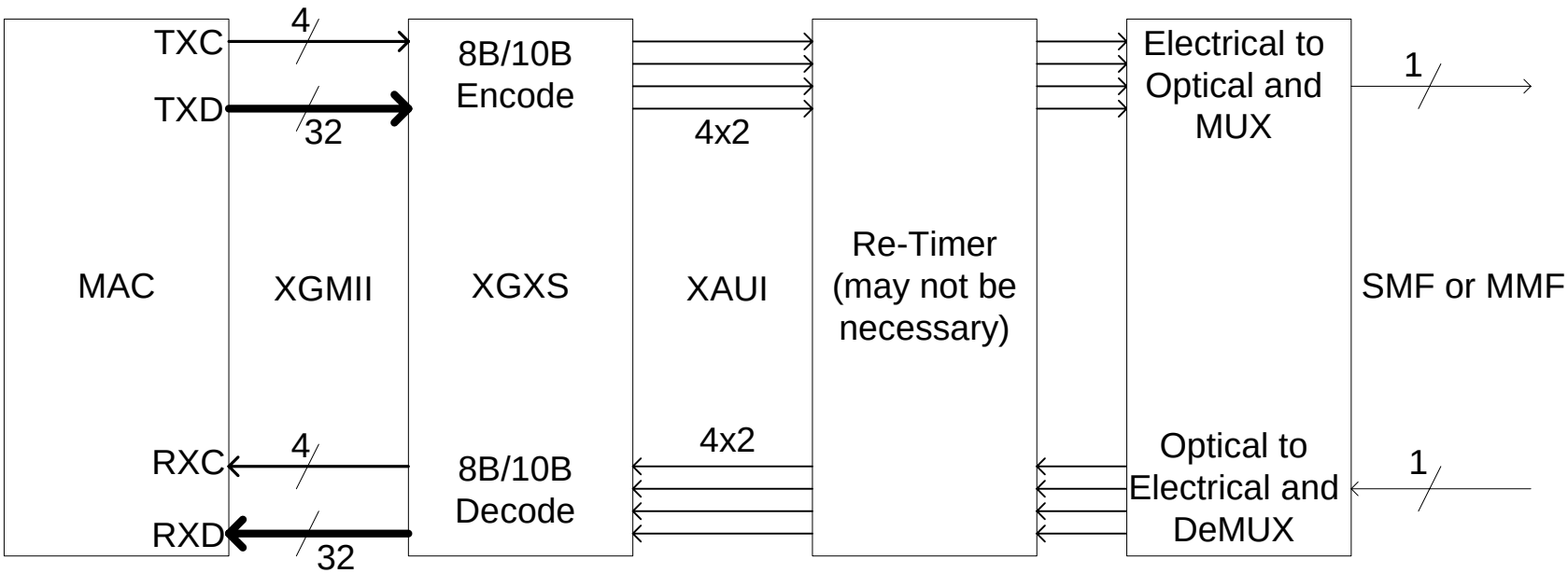
PMD Block Diagram



Implementation Example



Implementation Example



PMD functions

- PMD Transmit function
  - Convert 4 electronic bit streams, tx_bit[0:3], requested by PMD service interface into four separate optical signal streams.
  - Four optical streams are converted, through WDM, to a single stream delivered to the MDI.

PMD functions

- PMD Receive function
  - Demultiplex the received optical signal into four separate optical streams.
  - Convert optical streams to electrical signals, rx_bit[3:0]

PMD functions

- Signal detect function
  - Reports to PMD service interface, the presence of optical signals on all four lanes.
  - Received signal needs to be greater than –30 dBm, greater than the receiver sensitivity, and compliant with 10GBASE-WWDM signal input.

Wavelength assignments

Lane	Wavelength Ranges
Lane 0	1269.0 – 1282.4 nm
Lane 1	1293.5 – 1306.9 nm
Lane 2	1318.0 – 1331.4 nm
Lane 3	1342.5 – 1355.9 nm

Operating ranges

Fiber Type	MHz*km	Minimum range (meters)
62.5 µm MMF	500	300
50 µm MMF	400	240
50 µm MMF	500	300
SMF	n/a	10,000

Conclusions

- For LAN WDM PHY
  - XAUI to XAUI implementation
  - Well-known coding scheme (8B/10B)
  - 4 lanes at 3.125 Gbps
  - 300m of MMF, 10km of SMF
  - Leaves room for future expansion
    - More wavelengths
    - Higher speeds

To Learn More

- For more information regarding 10 Gigabit Ethernet, or the 10 Gigabit Ethernet Consortium, feel free to contact me via email: Eric Lynskey elynskey@iol.unh.edu

  Or visit our website:

  UNH IOL 10 Gigabit Ethernet Consortium