PMD Optical Specifications

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Outline

- Wavelength Choice
  - 1.31 μm upstream / 1.49 μm downstream
- Dispersion
  - Limited by fiber and laser choice
- Power Budgets
  - Multiple classes for optimal cost/performance
- Isolation
  - Optical Filter Performance

Wavelength Choice

- Spectral plan for PON (per G.983.3)
  - Upstream wavelength: 1260nm ~ 1360nm
  - Downstream wavelength: 1480nm ~ 1500nm
  - Upgrade band: 1539nm ~ 1565nm
- Spectral plan alone dictates that OLT laser must be a SLM laser
  - Highly stable wavelength over temperature
  - Eliminates dispersion as an issue

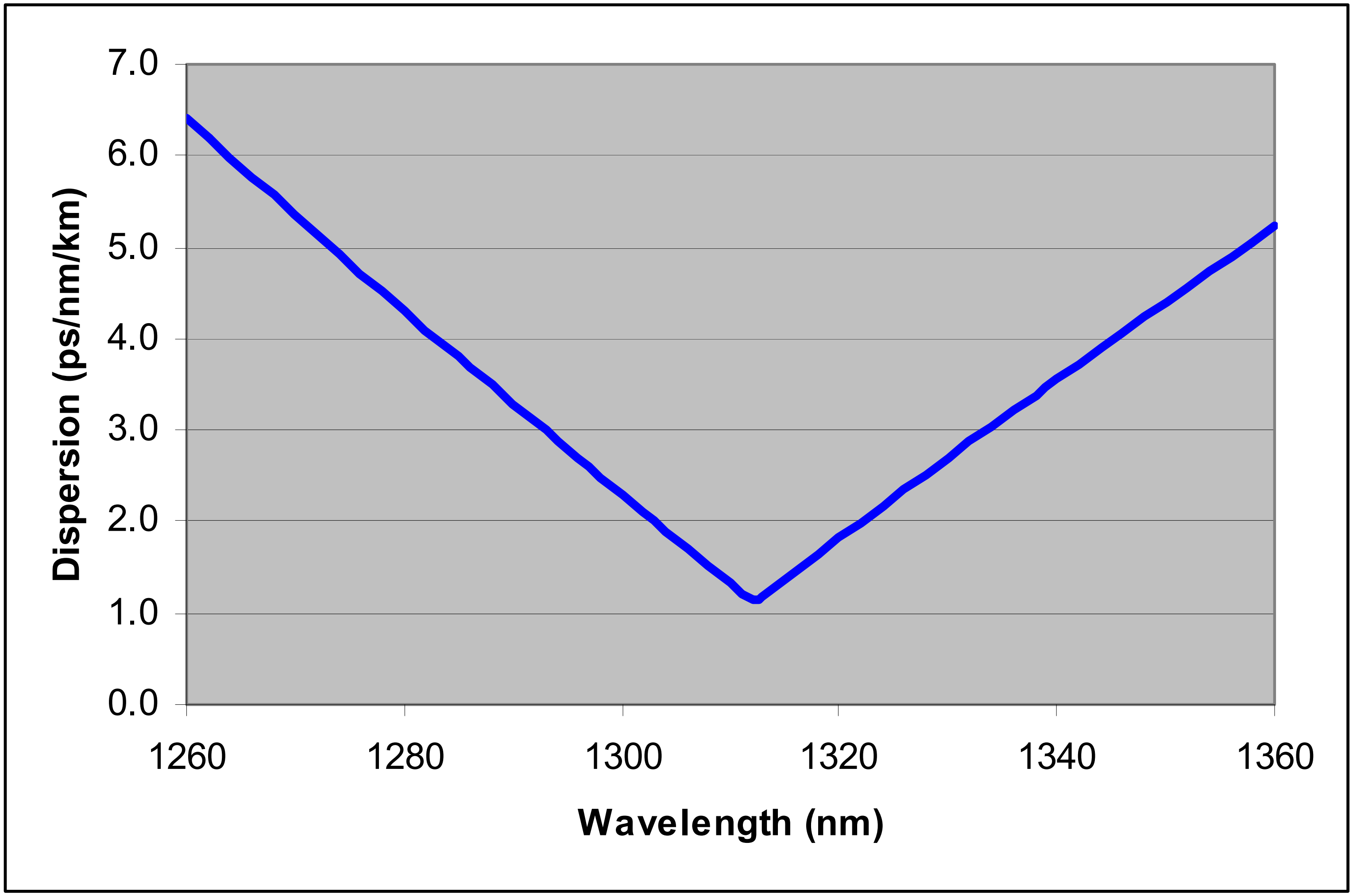
Dispersion

- Fiber dispersion plays a role at ~1.25 Gb/s
- Traditional engineering makes budget for dispersion (e.g. 1~2 dB system penalty)
- Governing equation:

$$\varepsilon > B\ D\ L\ \Delta\Lambda$$

  - ε is penalty constant
  - B is bit rate
  - L is length
  - $\Delta\Lambda$ is laser spectral line width
- Downstream is in high dispersion window: SLM.
- Upstream is in lower dispersion window: MLM?

Dispersion in G.652 fiber



Dispersion Limits on MLM Lasers

Center Wavelength ranges

Penalty and Fiber Length

Spectral Width (nm)	1288 nm 1338 nm	1280 nm 1350 nm
1 dB, 10 km	2.7 nm	2.1 nm
2 dB, 10 km	3.4 nm	2.7 nm
1 dB, 20 km	1.35 nm	1.1 nm
2 dB, 20 km	1.7 nm	1.35 nm

Dispersion Limits

- Downstream must be a SLM laser
- Upstream laser must be SLM laser if 20 km reach is to be met
  - No practical laser selection rule is possible
- Wavelength and line width selected MLM lasers might reach 5~10km
  - Is the cost savings enough to justify two types of lasers?

Power Budgets

- Class B budget is an important goal
  - Commonly considered to be the ‘table stakes’
- Maximum loss is 25 dB
- Typical laser output power ~ 0 dBm
- High sensitivity required
  - Exceeds current GbE transceiver specs
  - This must include diplexer loss and burst-mode penalty

Potential Solution for Class B

The following numbers are purely an example

- OLT can afford some extra cost
  - More powerful laser (+1dBm MIN / +4dBm MAX)
  - More sensitive receiver (–29dBm MIN / -7dBm MAX)
    - Assumes 2 dB penalty
- ONT needs to be cheap
  - Low power laser (-2 dBm MIN / +3 dBm MAX)
  - Insensitive receiver (-25 dBm MIN / -6 dBm MAX)
    - Assumes 1 dB penalty

Potential Solution for Class A

The following numbers are purely an example

- OLT can be relaxed for class A
  - Transmitter (-4 dBm MIN / -1 dBm MAX)
  - More sensitive receiver (–24dBm MIN / -2dBm MAX)
    - Assumes 2 dB penalty
- ONT remains the same as class B
  - Low power laser (-2 dBm MIN / +3 dBm MAX)
  - Insensitive receiver (-25 dBm MIN / -6 dBm MAX)
    - Assumes 1 dB penalty

OLT Isolation

- OLT has filter to select 1310nm (-29 dBm)
- Interference from two sources
  - 1490 downstream laser reflections
    - +4 dBm – 25 dBm R.L. = - 21 dBm
  - Enhancement band power (video)
    - +18 dBm – 25 dBm R.L. = - 9 dBm
- Isolation in 1490nm window: >21dB
- Isolation in 1550nm window: >33dB

ONT Isolation

- ONT has filter to select 1490nm (-25 dBm)
- Interference from two sources
  – 1310 upstream laser reflections
    - +3 dBm – 32 dBm R.L. = -29 dBm
  – Enhancement band power (video)
    - -5 dBm = - 5 dBm
- Isolation in 1310nm window: >9dB
- Isolation in 1550nm window: >33dB

Summary

- PMD must work over operator's OSP
- Dispersion and compatibility have strong impacts on laser choices
  - Need input from component vendors
- Power budget is a challenge
- Isolation requirements are feasible