1550nm Long Distance CWDM Transceivers

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PMD Solutions - 4 CHANNEL 1.5µm CWDM TRANSCEIVERS

- Full-Duplex CWDM Transceivers Utilizing 4 Channels in the 1.5µm Window
  - 4 Uncooled DFB Lasers/PIN Diodes with an Integrated Optical MUX/DEMUX
  - 20nm Channel Spacing
  - 10, 20 and 40 km Transmission Distances

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1.5 µm CWDM Technical Feasibility

- Transceiver Performance Has Been Verified at Test Sites On 50km SMF-28 Fiber
- Uses Field-Proven Technology in a Low-Cost, Reliable Format
- Transceivers Are Currently Shipping To Customers

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Why Use 1550nm CWDM Technology?

- 40 km and *Beyond* Demonstrated Over Fiber with Excellent Performance
- Uses Reliable, Proven Technologies
- Less Susceptible To Laser Chirp / Dispersion
- Technology is Available Today--No Waiting
- High Volumes Available July 1

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Why Use 1550nm CWDM Technology?

- Lowest Cost Technology for Long Distance 10 Gigabit Ethernet Transmission
- TIA — Available CMOS Technology
- PHY — Available CMOS Technology
- Detectors — Available InGaAs Technology
- Lasers — Available Directly Modulated Non-cooled

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1.5 um CWDM Transceiver Performance

Description	10 km	20 km	40 km	Unit
Transmitter Type	DFB-Laser			
Signaling speed per channel (range)	3.125			GBd
Wavelength (range), four channels	1495.5 to 1566.5			nm
Channel center wavelengths	1501, 1521, 1541, 1561 ± 5.5			nm
Channel separation	20			nm
Trise/Tfall (max. 20-80% response time)	100			ps
RMS spectral width (max. @ -20 dB)	0.2			nm
Extinction Ratio	6			dB
RIN	-120			dB/Hz
Average launch power, four channels (max)	2.5	5.3	8.0	dBm
Average launch power per channel (max)	-3.5	-0.7	2.0	dBm
Average launch power per channel (min)	-7.0	-4.0	-1.0	dBm

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Table 38-8 Receiver

Description	10 km	20 km	40 km	Unit
Signaling speed per channel (range)	3.125			GBaud
Wavelength (range), four channels	1495.5 to 1566.5			nm
Channel center wavelengths	1501, 1521, 1541, 1561 ± 5.5			nm
Channel separation	20			nm
Return loss	12			dB
Receiver saturation, four channels	6.0	6.0	3.5	dBm
Receiver saturation, per channel	0.0	0.0	-2.5	dBm
Stressed receiver sensitivity, four channels (max)	-6.5	-6.5	-9.0	dBm
Stressed receiver sensitivity, per channel (max)	-12.5	-12.5	-15.0	dBm

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Table 39-9 Link Power Budget

Parameter	10 km	20 km	40 km	Unit
Dispersion bandwidth as measured at 1.5 µm	150	150	150	GHz*km
Minimum TX Output	-7.0	-4.0	-1.0	dBm
Stressed RX Sensitivity	-12.5	-12.5	-15.0	dBm
Link power budget	5.5	8.5	14.0	dB
Fiber Loss	0.3	0.3	0.3	dB/km
Connector Loss	0.4	0.4	0.4	
Unallocated margin in link power budget	2.1	2.1	1.6	dB

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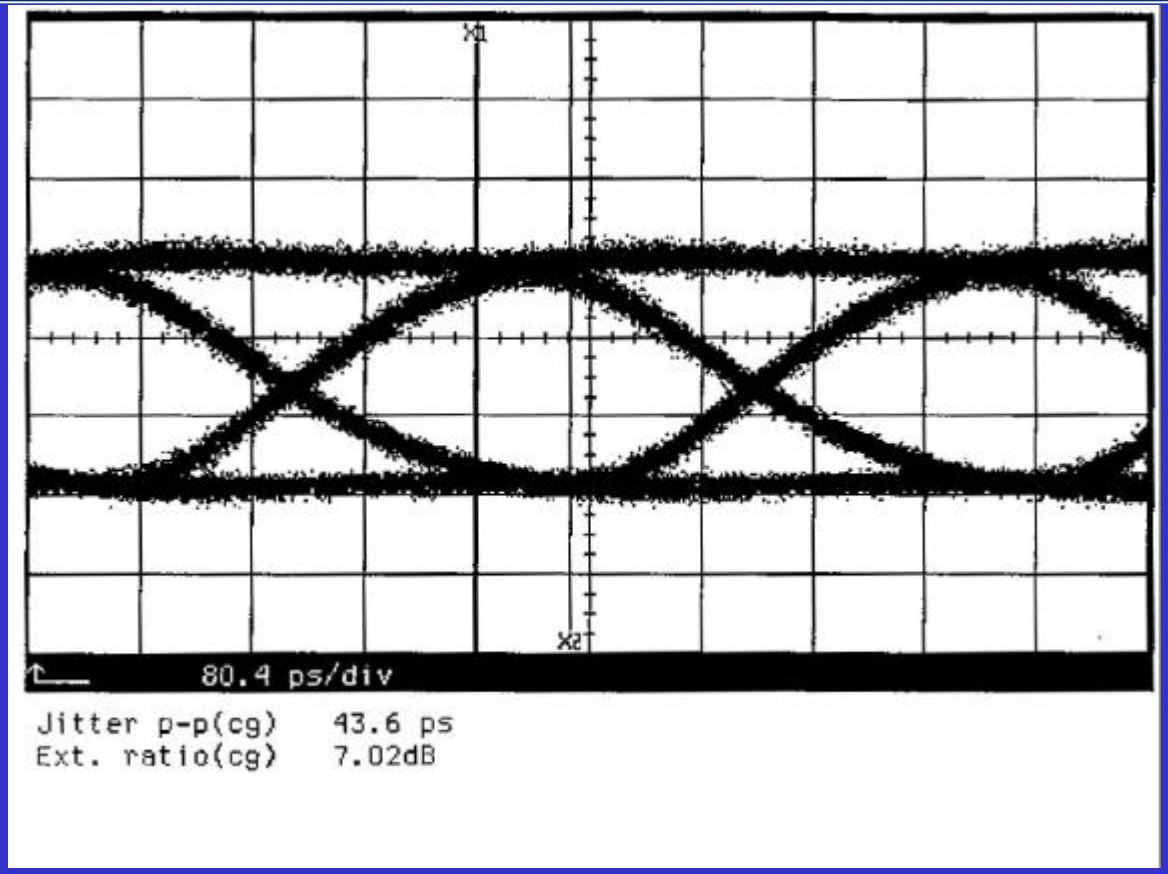
1.5 µm CWDM Performance



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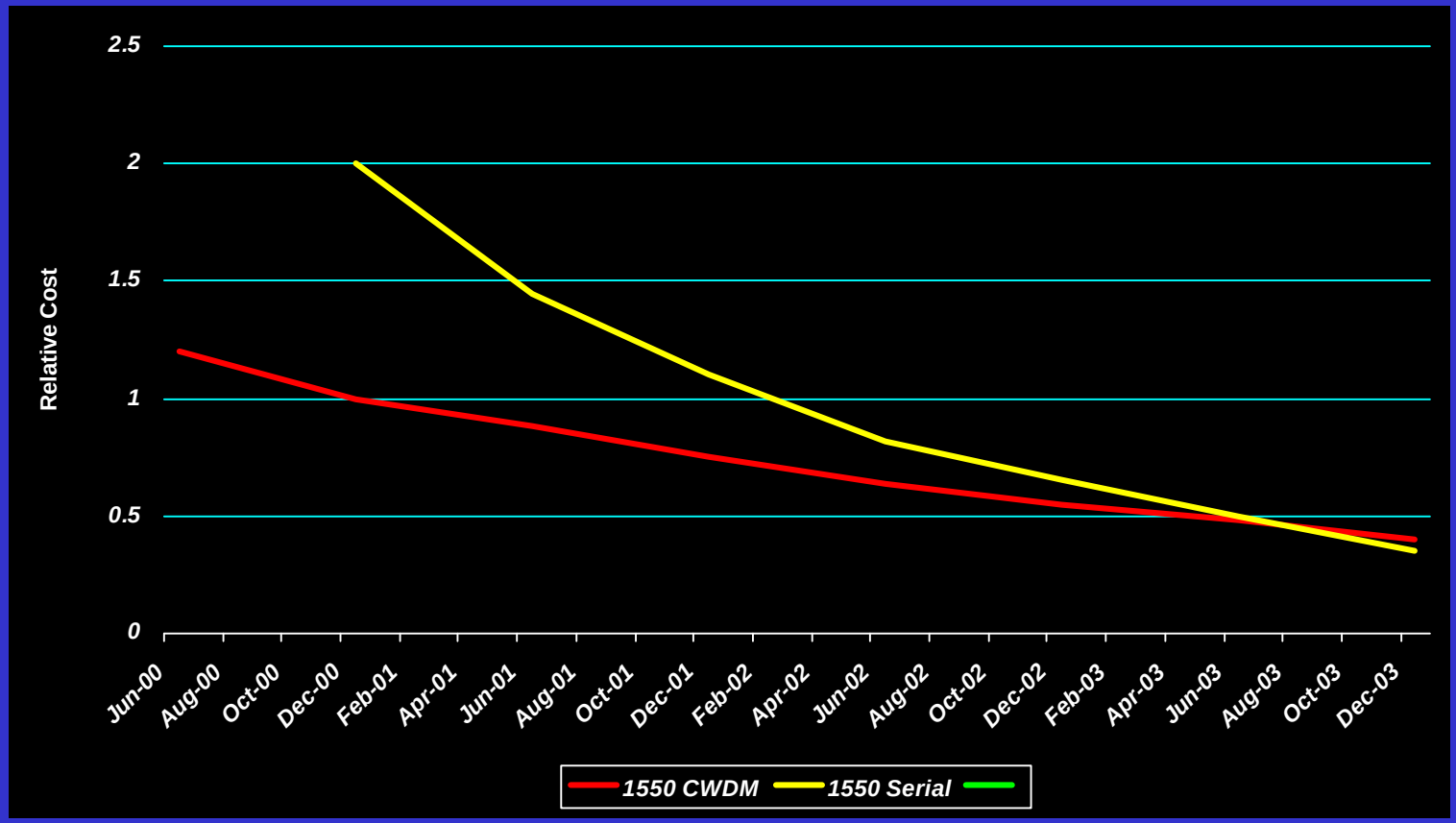
Cost Comparison



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So, What Happens In 2003?

- 1550nm CWDM Transceivers Can Be Upgraded To 4 x 10GigE Gbaud.
- Upgrade Will Be Inexpensive with Proven Technology
- Distances Up To 20 km
- It Doesn't Have To Be Serial vs. CWDM: Serial & CWDM are Complimentary Technologies

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1.5 µm CWDM Open Issues

- Open Architecture
  - Converter Boxes Being Developed By Two Independent Companies.
- Skew
  - Skew Compensation Is Readily Available.
- Size
  - The Current Design Has Been Accepted at Multiple Equipment Manufacturers
  - Smaller Size is Currently Under Design

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Comparison of Proposed Solutions

	Comparison of Proposed Technologies			
PMD Proposal	Cost Effective	Available Today	Easily Upgradable To 40GE	PHY Available
CWDM 850nm	**Yes**	No	No	No
Serial 850nm	No	No	No	No
Serial 1300nm (FP)	No	No	No	No
Serial 1300nm (DFB/VCSEL)	No	No	No	No
CWDM 1300nm	**Yes**	**Maybe**	No	No
Serial 1300nm (Cooled DFB)	No	No	No	No
CWDM 1550nm	**Yes**	**Yes**	**Yes**	**Yes**
Serial 1500nm	No	No	No	No

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Summary

- 10, 20 & 40 km Transmission Distances Are Available Now
- Utilizing Field-Proven Technologies Insures Reliable Performance
- Cost Is Favorable To Other Proposed Technologies
- Easily Upgradable To 4x10 Gigabit Ethernet
- Complimentary With Serial Development

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