100GbE SMF PMD Specification
- Wavelengths -

WE *light* IT UP

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Supporters: High Speed Optical Components Suppliers

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- ***Hiroshi Nakano (NEC electronics, Ltd.)*** [1]
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- ***Atsushi Takai (Opnext, Inc.)*** [1]
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(Note 1) XLMD MSA was formed in march 2007 by leading optical device suppliers , Eudyna Devices Inc., Mitsubishi Electric Corp., NEC Electronics Corp., Oki Electric Industry Co., Ltd., Opnext, Inc. and Sumitomo Electric Industries, Ltd., to establish compatible sources of optical transmitter and receiver devices for use in 40Gbit/s optical transceiver modules.

Outline

- Objective
- CWDM and LAN WDM comparison
- Further Discussion on wavelength
- Specification

Objectives

- To specify wavelength considering both the first generation and future generation in the view point of cost
- (This will help the optical device suppliers to concentrate on the laser development.)

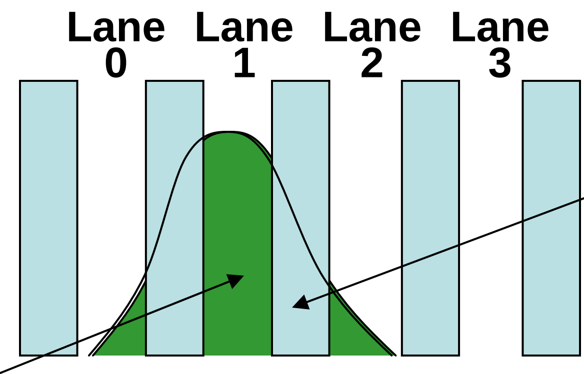
CWDM and LAN WDM Comparison

- The Supporters compared the CWDM and LAN WDM solutions for the first generation of 10km SMF application in [*1].
- Supporters recommend CWDM from the view point of manufacturing and cost.
- We updated the summary shown in a later foil to confirm the CWDM superiority.
- Continue to propose CWDM wavelengths.

[1] "SMF 1310nm PMD Link Comments", HSSG material, traverso_01_1107, Nov, 2007

Wavelength Yield Impact

LAN WDM

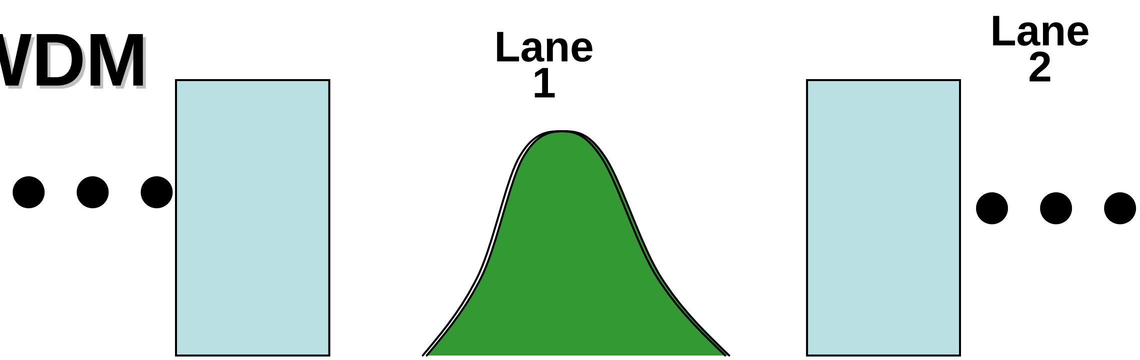


Dead zone is defined by mux/demux and temperature tuning has a limit to compensate for dead zone

Laser wafer wavelength distribution at T_0

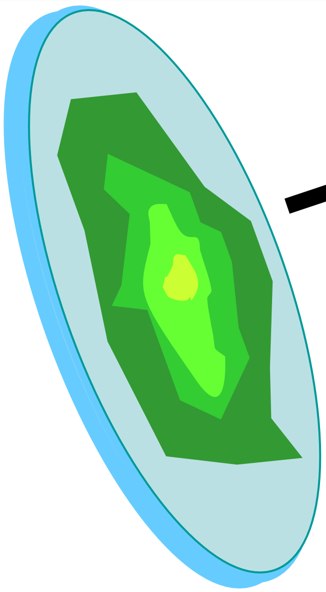
Likely that four different wafers need to be manufactured to support all lanes in LAN WDM proposal

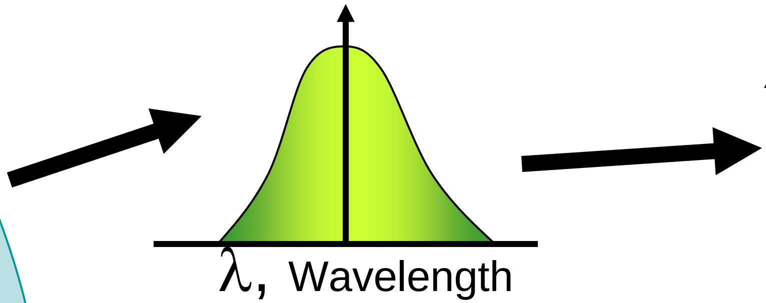
CWDM

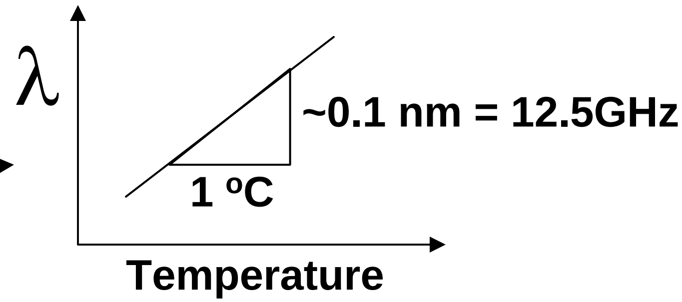


No Wavelength yield, testing, or temperature tuning. However, four different wafers MUST be manufactured to support all lanes in CWDM.

Limits of Temperature tuning



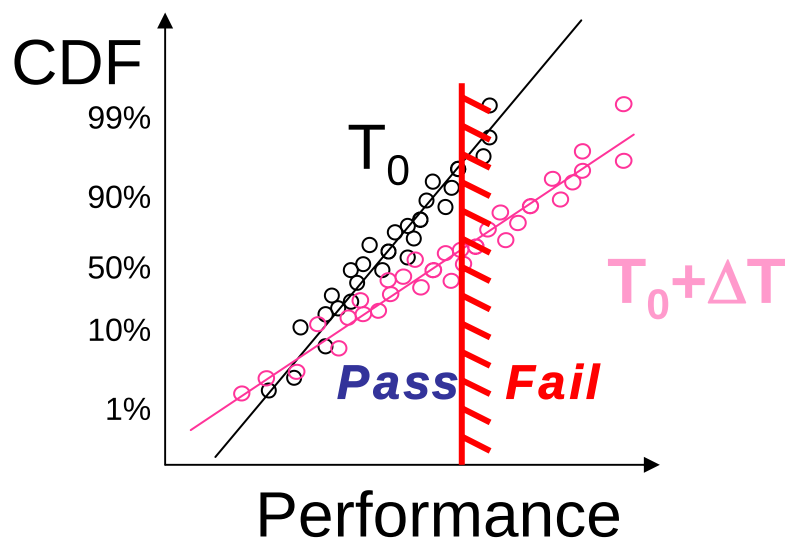




Laser wavelength can be tuned individually to shift the wavelength

Laser wafer will have some wavelength distribution at Temperature, T_0

However, transmission performance degrades as the laser set temperature is shifted from T_0.



Note: Due to this temperature effect there will be some yield hit for LAN WDM

CWDM and LAN WDM Summary (Update the presented material [*1])

Item		CWDM	LAN WDM	Note
Specification	Grid	1271 - 1331	1312 center	
	Pitch	20 nm	2 – 4 nm	
	Tolerance	+/- 6 nm	+/- 0.36 – 0.8 nm	
Laser for 1st generation		Cooled EA-DFB		
Laser development	Technical Issue	25G 1310nm EA-DFB 25G Operation is the major challenge Wavelength grid is very minor challenge		
Laser Manufacturing	Wafer fabrication	4 kinds wafer		
	Wavelength yield	100%	Lower yield	
	Wavelength test	No	Required	
Laser Availability		Same		
Optical MUX/DMUX[2]		compact	Large and/or high cost	Similar to DWDM performance
Future		Cooled DFB, Uncooled EA-DFB, Uncooled DFB	Cooled DFB	

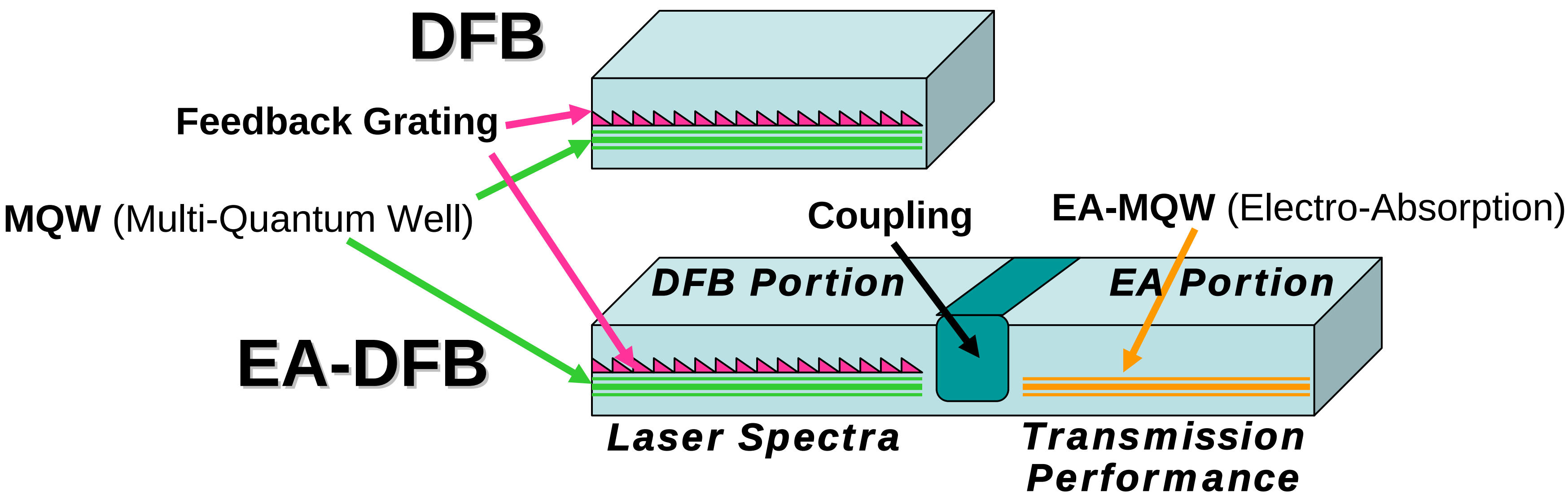
[1] "SMF 1310nm PMD Link Comments", HSSG material, traverso_01_1107, Nov, 2007

[2] Updated

Further Discussion on wavelength

- We also discussed the future cost reduction scenario and concluded uncooled DFB with the CWDM wavelengths will give the lowest cost. (see the next foil)
- We also reviewed the technologies that are used in 2.5 and 10Gbit/s SMF applications and we confirmed DFB technology has achieved the lowest solution. (see the next next foil)
- As a result we confirmed CWDM wavelengths will give the low cost solutions.

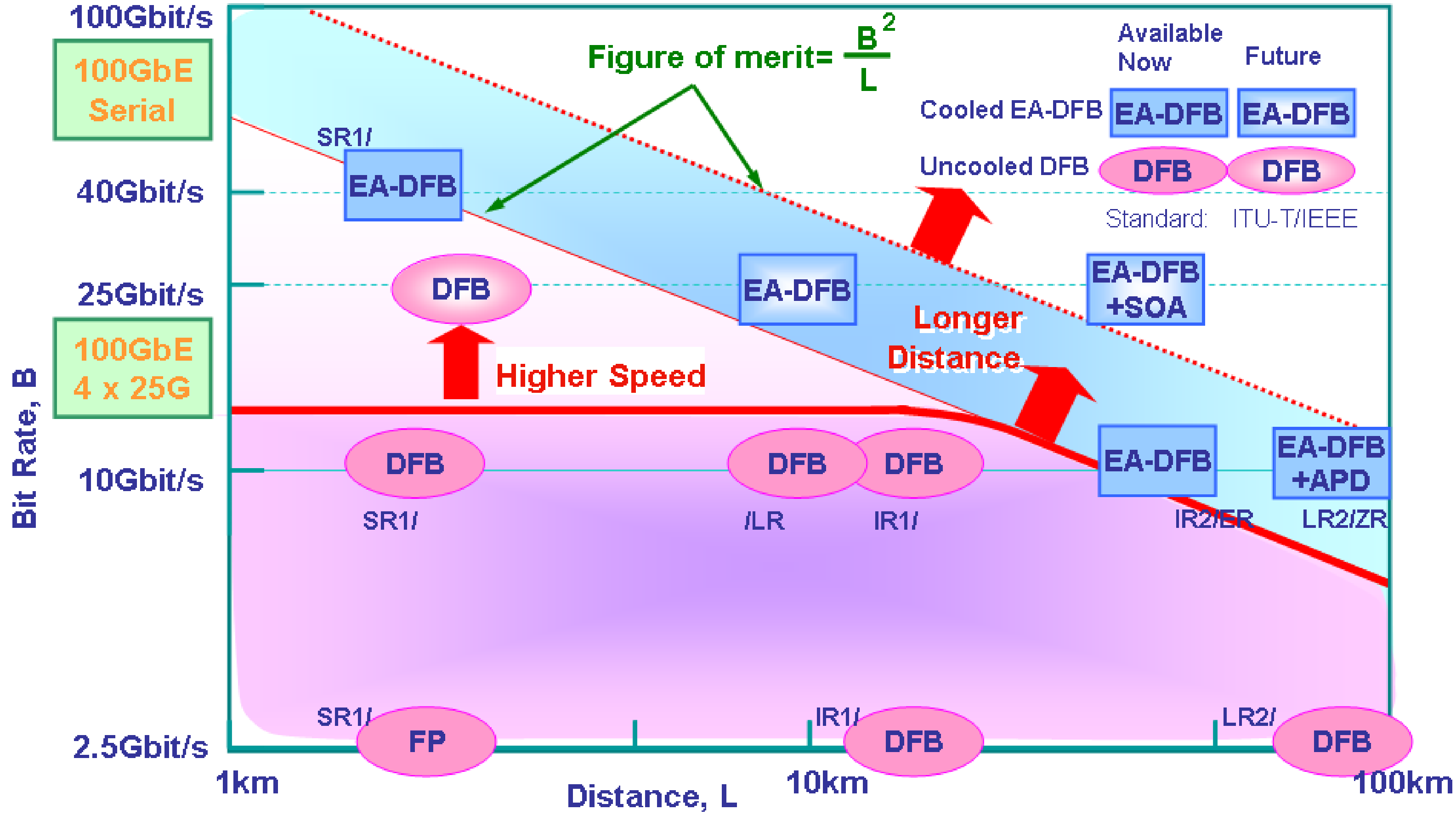
Likely Laser Structures for 802.3ba SMF PMD



- DFB (Distributed FeedBack) Laser
  - Simple Structure
  - Simple control and operation
  - Commercially used in 10GBASE-LR, 1000BASE-ZX
- EA-DFB (Electro-Absorption DFB) Laser
  - Requires optimization of two MQW sections
  - Larger chip/die size
  - In addition to APC (Automatic Power Control), EA bias control is also required
  - Temperature control and thermo electric cooler required
  - Commercially used in 10GBASE-ER, ZR, XFP DWDM products

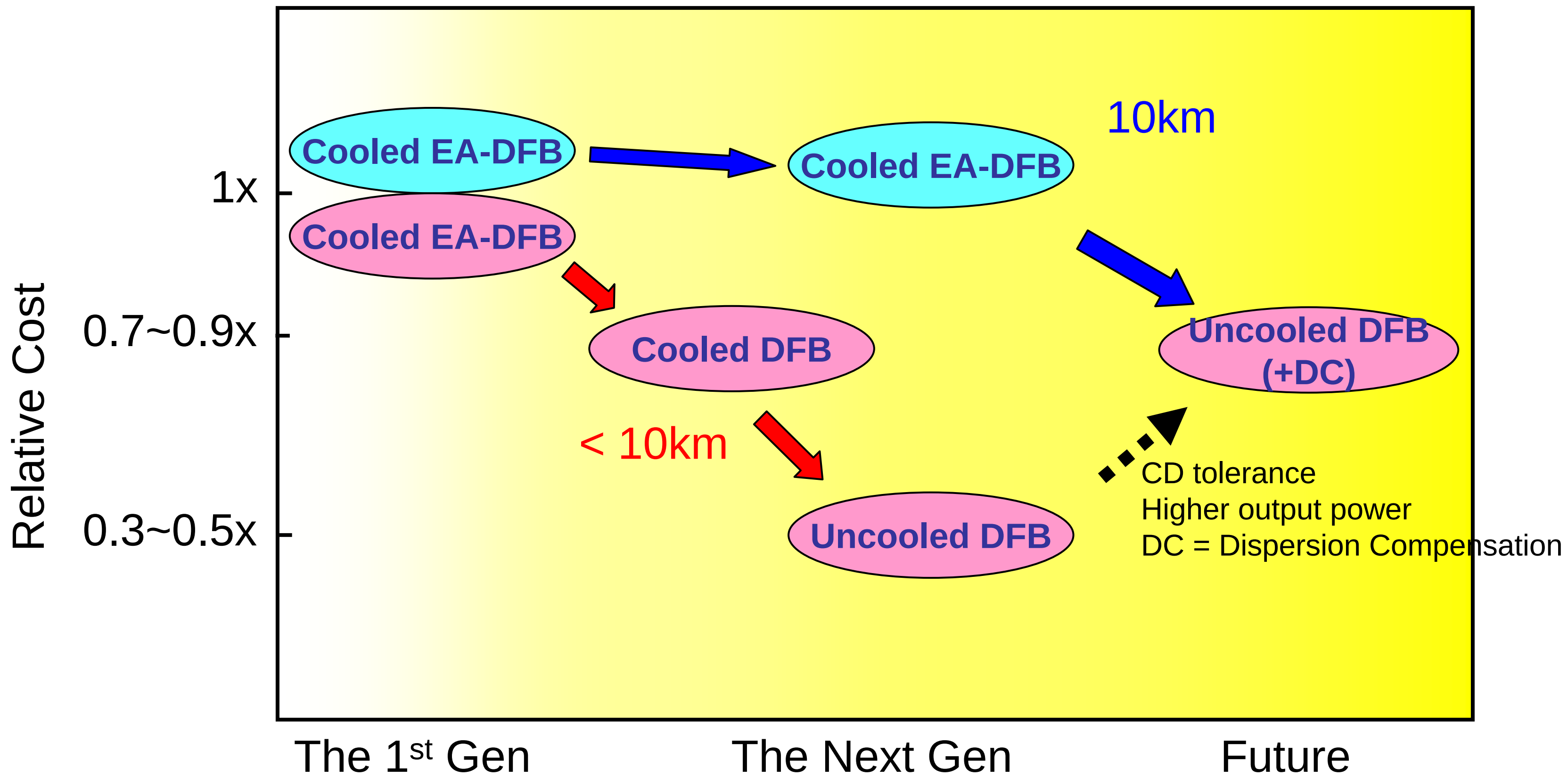
DFB is the Lowest Cost Solution

- DFB gave the low cost solution <=10Gbit/s SMF applications, which we can expect the same solution in 100GbE (4ch).

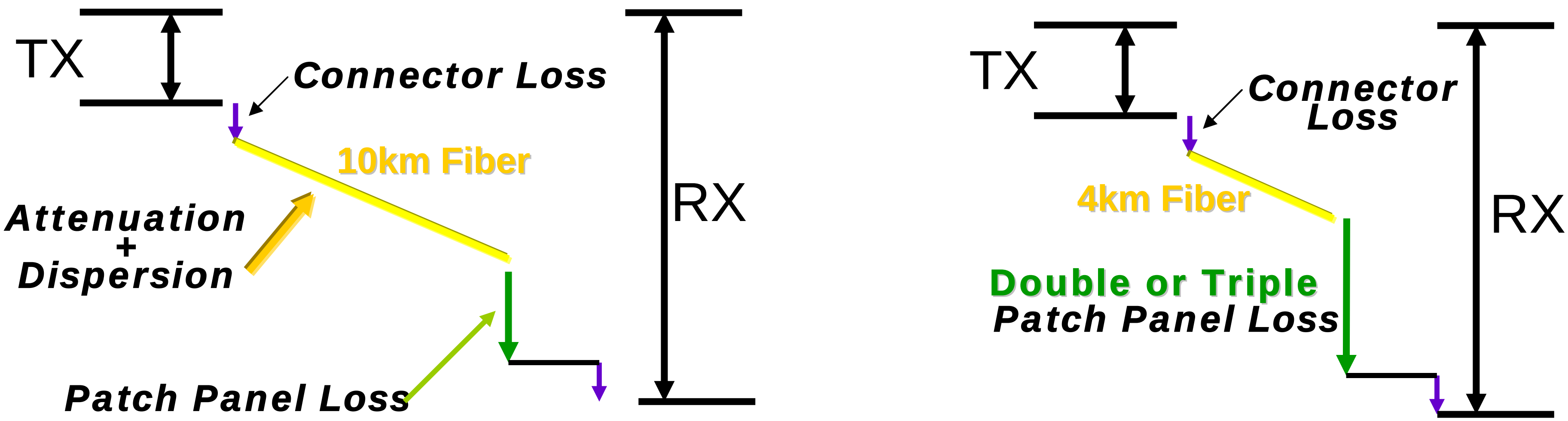


Scenario for cost reduction for the future

- Uncooled DFB solutions will achieve the lowest cost, while they accept only CWDM wavelengths



Link Budgets: Attenuation ≠ Dispersion



- Feedback for greater distance from end users included many comments on much higher patch panel counts with shorter distances
- Consider alternate model with shorter fiber length but higher patch panel loss budget
- Key merit is that the dispersive effects would be limited
- It's much easier and cost effective to build devices which have high attenuation than to build devices with high attenuation and dispersion

Link budget specification alternatives

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• A 4km solution with high attenuation (for additional penalties from patch panels etc.) is less costly than a 10km reach and has more un-allocated budget

Parameter	4km (more attenuation budget than 10km spec.)		10km (Ref)	
	Min.	Max.	Min.	Max.
Tx output power (dBm)	+1.8 (OMA)	P_O limited by Eye Safety	+1.8 (OMA)	P_O limited by Eye Safety
Extinction ratio (dB)	3.5		3.5	
Power budget (dB)	9.3		9.3	
Connector loss (dB)	2.0		2.0	
Fiber loss (dB)	1.7		4.2	
Allocation for penalties (dB)	5.6		3.1	
Rx sensitivity (dBm)	-7.5 (OMA)		-7.5 (OMA)	

Note: CWDM Wavelength detailed specification to be defined in conjunction with mux/demux specifications

Summary

- We demonstrated CWDM cost and link budget superiority over another alternative

- We recommend to use 4km CWDM link specification for cost effective SMF links