

# 100GBASE-CWDM Baseline Proposal

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# INTRODUCTION

This presentation provides a baseline specification proposal for a retimed PMD to address the P802.3bm objective:

*Define a 100 Gb/s PHY for operation up to at least 500 m of SMF*

Baseline 100GBASE-CWDM proposal has been proposed

[vlsov\\_01a\\_1112\\_optx](#)

[vlsov\\_01\\_0113\\_optx](#)

[vlsov\\_01a\\_0313\\_optx](#)

[vlsov\\_01a\\_0413\\_smf](#)

Baseline 100GBASE-CWDM proposal summary:

- ✓ 4 lane CWDM, 25.78125 GBd/lane, Single mode optical PMD, Retimed, 500m;
- ✓ **Technical Feasibility:** proposed and supported by multiple optical module suppliers
- ✓ **Economic Feasibility:** independent cost analysis showed potential to reduce cost over 60% vs cost-reduced 100GBASE-LR4
- ✓ **Broad Market Potential:** CWDM optical modules can be deployed for several markets as datacenters, carrier IP, server backplanes, etc. Proposal is supported by multiple component and systems suppliers.

# INTRODUCTION (CONT'ED)

CWDM PMD has been discussed extensively:

Extensive discussion at 802.3ba:

examples: [traverso 03 0308](#)  
[traverso 02 0308](#)  
[traverso 01 0308](#)

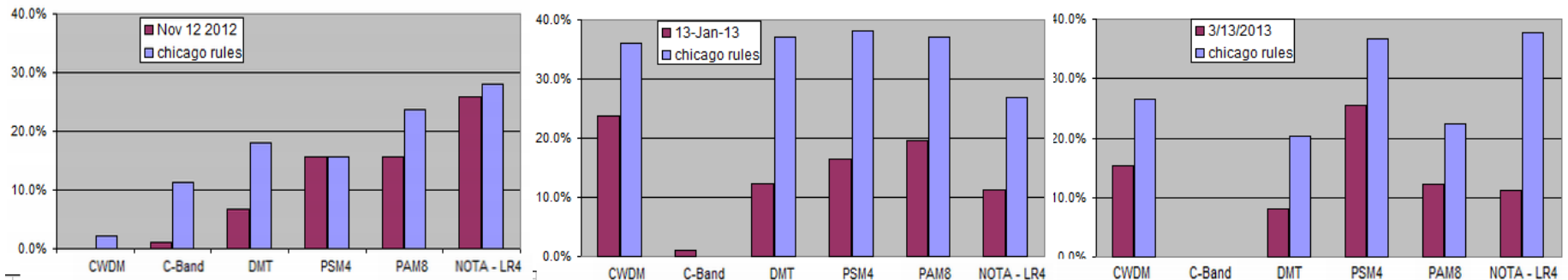
802.3bm Task Force:

[martin 01 0712 optx](#) [shen 01 0113 smf](#)  
[weirich 01 0712 optx](#) [yu 01 0313 optx](#)  
[martin 01 0912 optx](#) [shen 01a 0313 smf](#)  
[martin 02 0912 optx](#) [shen 01 0313 optx](#)  
[gill 01b 1112 optx](#) [petrilla 02a 0413 smf](#)  
[martin 01 1112 optx](#) [martin 01 0513 optx](#)  
[vlasov 01a 0113 smf](#) [mok 01 0513 optx](#)  
[shen 01 0113 optx](#) [shen 01 0513 optx](#)

Study Group NG100G:

[anderson 01 1111 NG100GOPTX](#)  
[way 01a 0112 NG100GOPTX](#)  
[vlasov 01 0312 NG100GOPTX](#)

CWDM PMD has gained considerable support:

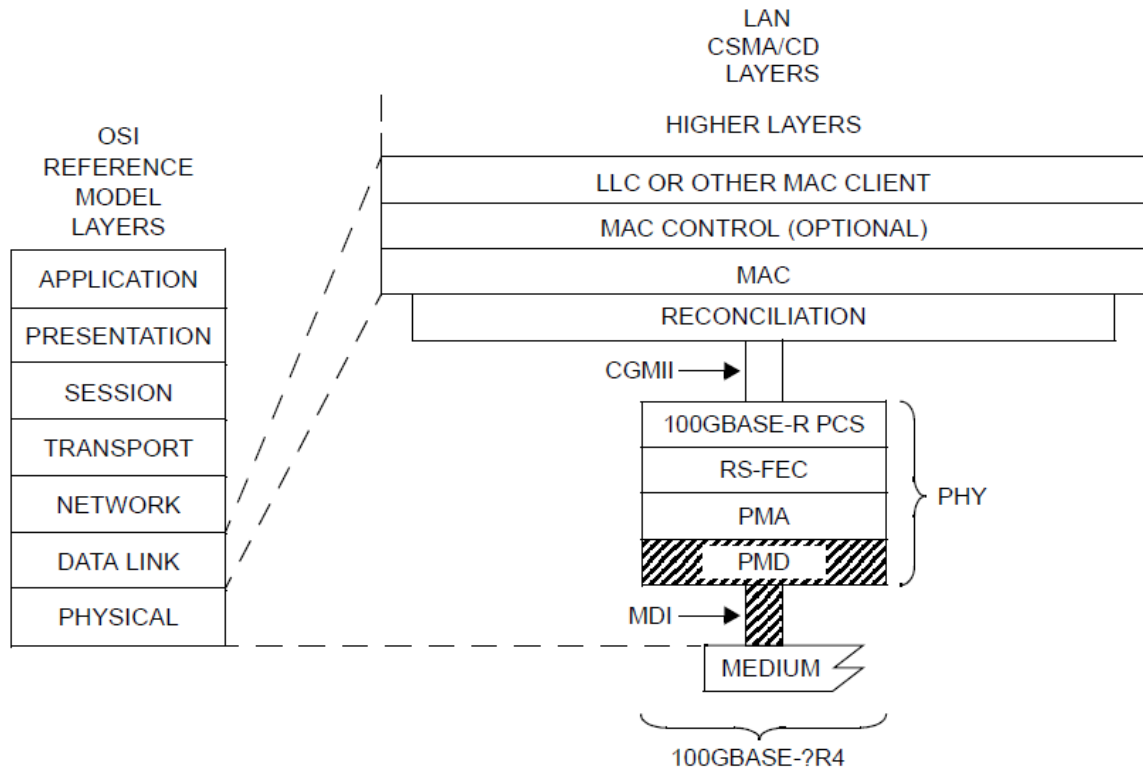


Results of three consecutive straw polls

## Draft Clause 96

- Draft Clause 96 language has been provided to the Task Force Chair for a complete wording of the CWDM specification. The following 8 pages of this contribution provide excerpts of the key points of the consensus built baseline proposal
- The TBD values in the proposed baseline language will be determined by technical contributions and consensus building by the entire task force once the CWDM approach have been adopted

# Proposed Position in 802.3 Architecture



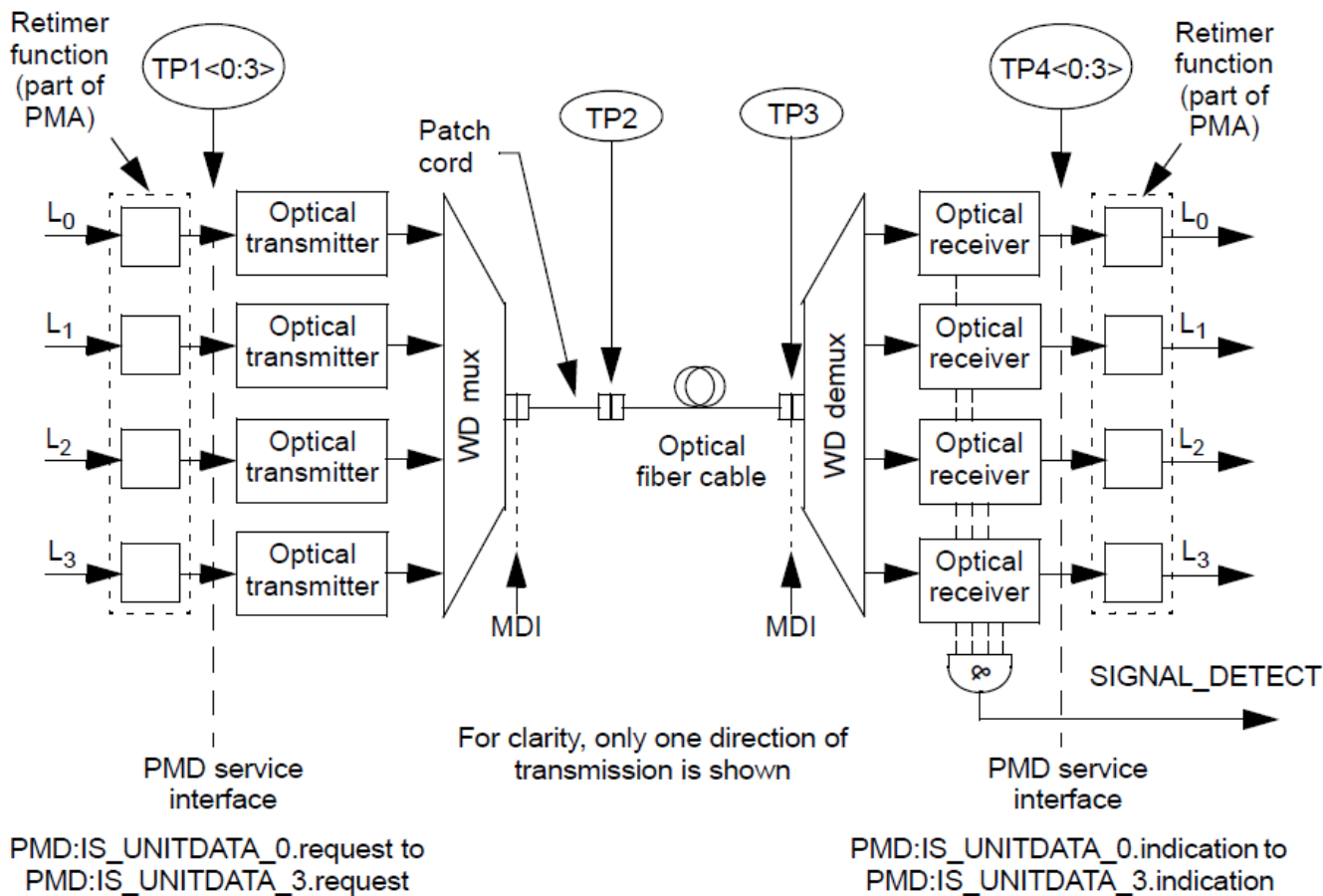
CGMII = 100 Gb/s MEDIA INDEPENDENT INTERFACE  
 LLC = LOGICAL LINK CONTROL  
 MAC = MEDIA ACCESS CONTROL  
 MDI = MEDIUM DEPENDENT INTERFACE  
 PCS = PHYSICAL CODING SUBLAYER

PHY = PHYSICAL LAYER DEVICE  
 PMA = PHYSICAL MEDIUM ATTACHMENT  
 PMD = PHYSICAL MEDIUM DEPENDENT  
 RS-FEC = REED-SOLOMON FORWARD ERROR CORRECTION  
 ?R = PMD FOR SINGLE-MODE FIBER — 500 m

**Figure 96-1—100GBASE-?R4 PMD relationship to the ISO/IEC Open Systems Interconnection (OSI) reference model and the IEEE 802.3 CSMA/CD LAN model**

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# Proposed link architecture



WD = Wavelength division

NOTE—Specification of the retimer function and the electrical implementation of the PMD service interface is beyond the scope of this standard.

**Figure 96-2—Block diagram for 100GBASE-R4 transmit/receive paths**

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# 100GBASE-CWDM lane assignment and operating range

**Table 96-5—Wavelength-division-multiplexed lane assignments**

Lane	Center wavelength	Wavelength range
L <sub>0</sub>	1271 nm	1264.5 to 1277.5 nm
L <sub>1</sub>	1291 nm	1284.5 to 1297.5 nm
L <sub>2</sub>	1311 nm	1304.5 to 1317.5 nm
L <sub>3</sub>	1331 nm	1324.5 to 1337.5 nm

**Table 96-6—100GBASE-?R4 operating range**

PMD type	Required operating range
100GBASE-?R4	500 m

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# 100GBASE-CWDM transmit characteristics

## 96.7.1 100GBASE-R4 transmitter optical specifications

The 100GBASE-R4 transmitter shall meet the specifications defined in Table 96–7 per the definitions in 96.8.

**Table 96–7—100GBASE-R4 transmit characteristics**

Parameter	Value	Unit
Signaling rate, each lane (range)	25.78125 ± 100 ppm	Gbd
Side-mode suppression ratio (SMSR), (min)	30	dB
Total average launch power (max)	9	dBm
Average launch power <sup>a</sup> , each lane (max)	3	dBm
Average launch power, each lane (min)	-4.3	dBm
Optical modulation amplitude (OMA), each lane (max)	3	dBm
Optical modulation amplitude (OMA), each lane (min) <sup>b</sup>	-2	dBm
Difference in launch power between any two lanes (OMA), (max)	4	dB
Launch power in OMA minus TDP, each lane, (min)	-3	dBm
Transmitter and dispersion penalty (TDP), each lane (max)	2.2	dB
Average launch power of OFF transmitter, each lane (max)	-30	dBm

# 100GBASE-CWDM transmit characteristics (cont'ed)

Parameter	Value	Unit
Average launch power of OFF transmitter, each lane (max)	-30	dBm
Extinction ratio (min)	4	dB
RIN <sub>20</sub> OMA (max)	-130	dB/Hz
Optical return loss tolerance (max)	20	dB
Transmitter reflectance <sup>c</sup> (max)	-12	dB
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}	{0.25, 0.4, 0.45, 0.25, 0.28, 0.4}	

<sup>a</sup>Average launch power, each lane (min) is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.

<sup>b</sup>Even if the TDP < 0.8dB, the OMA (min) must exceed this value.

<sup>c</sup>Transmitter reflectance is defined looking into the transmitter.

# 100GBASE-CWDM receive characteristics

## 96.7.2 100GBASE-?R4 receive optical specifications

The 100GBASE-?R4 receiver shall meet the specifications defined in Table 96–8 per the definitions in 96.8.

**Table 96–8—100GBASE-?R4 receive characteristics**

Parameter	Value	Unit
Signaling rate, each lane (range)	25.78125 ± 100 ppm	Gbd
Damage threshold <sup>a</sup> (min)	TBD	dBm
Average receive power , each lane <sup>b</sup> (max)	3	dBm
Average receive power , each lane (min)	-8.3	dBm
Receive power, each lane (OMA) (max)	3	dBm
Difference in receive power between any two lanes (OMA), (max)	4	dB
Receiver reflectance (max)	-26	dB
Receiver sensitivity (OMA), each lane <sup>c</sup> (max)	-7	dBm
Receiver 3dB electrical upper cutoff frequency, each lane (max)	31	GHz

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# 100GBASE-CWDM receive characteristics (cont'ed)

Parameter	Value	Unit
Stressed receiver sensitivity <sup>d</sup> , each lane (OMA)	TBD	dBm
Conditions of stressed receiver sensitivity test		
Vertical eye closure penalty <sup>e</sup> , each lane	TBD	dB
Stressed eye J2 Jitter <sup>e</sup> each lane	TBD	UI
Stressed eye J9 Jitter <sup>e</sup> each lane	TBD	UI

<sup>a</sup>The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level

<sup>b</sup>Average receive power, each lane (min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.

<sup>c</sup>Receiver sensitivity (OMA), each lane (max) is informative.

<sup>d</sup>Measured with conformance test signal at TP3 (see 96.8.11) for BER = 10<sup>-12</sup>.

<sup>e</sup>Vertical eye closure penalty, stressed eye J2 Jitter, and stressed eye J9 Jitter are test conditions for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

# 100GBASE-CWDM illustrative link power budget

## 96.7.3 100GBASE-?R4 illustrative link power budget

An illustrative power budget and penalties for 100GBASE-?R4 channels are shown in Table 96–9.

**Table 96–9—100GBASE-?R4 illustrative link power budget**

Parameter	Value	Unit
Power budget (for maximum TDP)	6.2	dB
Operating distance	0.5	km
Channel insertion loss <sup>a</sup>	4.0	dB
Maximum discrete reflectance	-26	dB
Allocation for penalties <sup>b</sup> (for maximum TDP)	2.2	dB
Additional insertion loss allowed	0	dB

<sup>a</sup>The channel insertion loss is calculated using the maximum distance specified in Table 96–6 and cabled optical fiber attenuation of 0.47 dB/km at 1264.5 nm plus an allocation for connection and splice loss given in 96.11.2.1.

<sup>b</sup>Link penalties are used for link budget calculations. They are not requirements and are not meant to be tested.

### 96.11.2.2 Maximum discrete reflectance

The maximum discrete reflectance shall be less than –26 dB.

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## Relevance to 802.3bm Distinct Identity

“The amendment will define a new 100 Gb/s SMF PMD in addition to these if it can be shown that a SMF PMD with a shorter reach than 100GBASE-LR4 has sufficient **cost**, **density**, or **power** difference to justify an additional SMF PMD type.”

The CWDM baseline proposal :

- meets a required significant **cost reduction** (potentially over **60%** vs cost-reduced 100GBASE-LR4) for reaching the 802.3bm TF objective
- provides a significant module **power** reduction
- provides a significant reduction of a module **form-factor**
- provides smallest add-on **latency**
- is **scalable** : reach can be extended to 2km without sacrificing cost advantages
- is **compatible** with installed SMF cable base
- WDM concept is extendable to **400GbE and beyond**

# CONCLUSION

- 100GBASE-CWDM PMD baseline proposal is presented supporting SMF 500m objective of 802.3bm TF
- The proposal has been extensively discussed during NG100G Study Group meetings, 802.3bm meetings and SMF AdHocs
- Current draft of Clause 96 is the result of consensus building between several component and systems suppliers
- It is proposed **to move** this proposal forward to become a baseline for 802.3bm 500m SMF PMD

**THANK YOU!**