

A proposal of Si-photonics for automobile

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**IEEE P802.3cz Multi-Gigabit Optical
Automotive Ethernet Task Force**

Foreword

Proposal of Si-Photonics in response to PMD proposal by Steve Swanson that we need more technical discussion as I commented on 4th March.

Si photonics can contribute to technical discussion for reliable automobile optical network for the draft.

Contents

Proposal of PMD baseline for the link up to 25Gbps at 1310nm based on 100G-Base SR4 (bm) and 400G-Base SR16 (bs) with FEC (many TBDs). Also propose PMD matrix of possible implementation options for open discussion.

Supporters

- Shigeru Kobayashi, AIO Core
- Hideki Isono, FOC
- Satoshi Takahashi, POF Promotion
- Takeo Masuda, OITDA
- Hiroshi Sawano, OITDA

Si-photonics to meet OMEGA objectives as presented on 19th Jan. 2021

I.Ogura and K. Kurata, " Thoughts on PMD baseline proposal for automobile based on Si-Photonics,"
19th Jan, OMEGA TF.

1. 25Gbps transmission

40m with OM2,OM3 MMF and 300m with 1310nm-optimized MMF are feasible

2. Reliability assessment

Estimated lifetime of QD laser light source (20years at 105°C)
may satisfy mission profile for automobile.

3. Comply Class 1 Eye safety

Approx. 20 times higher eye-safety power level for Si-photonics at 1310nm
than 850nm-VCSEL may relax constraints of power and handling

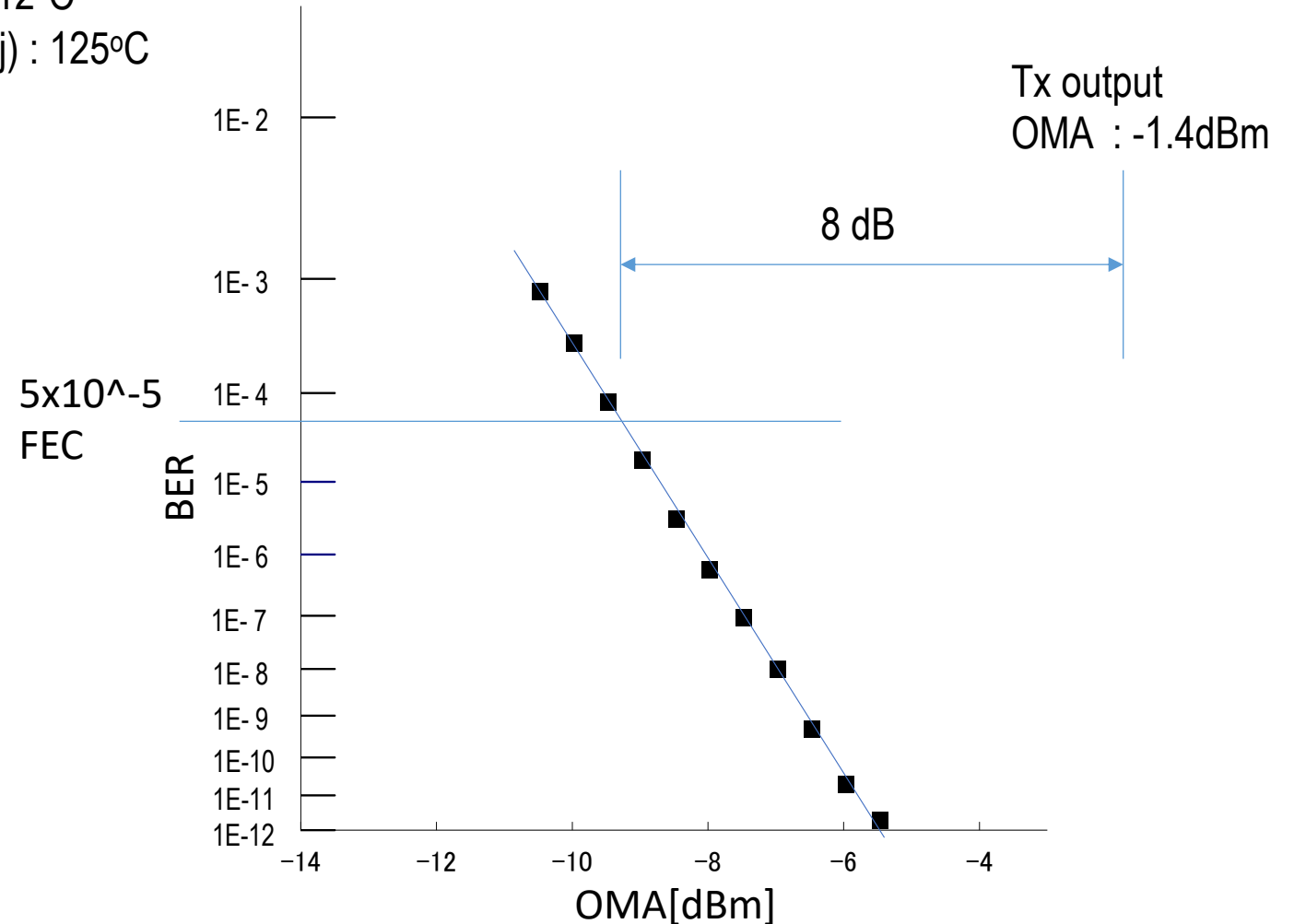
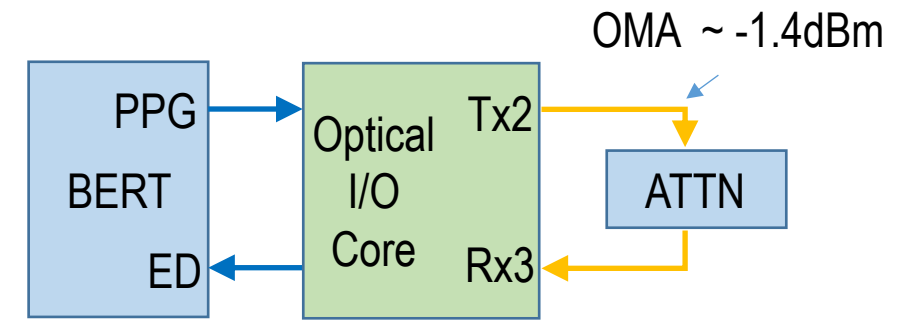
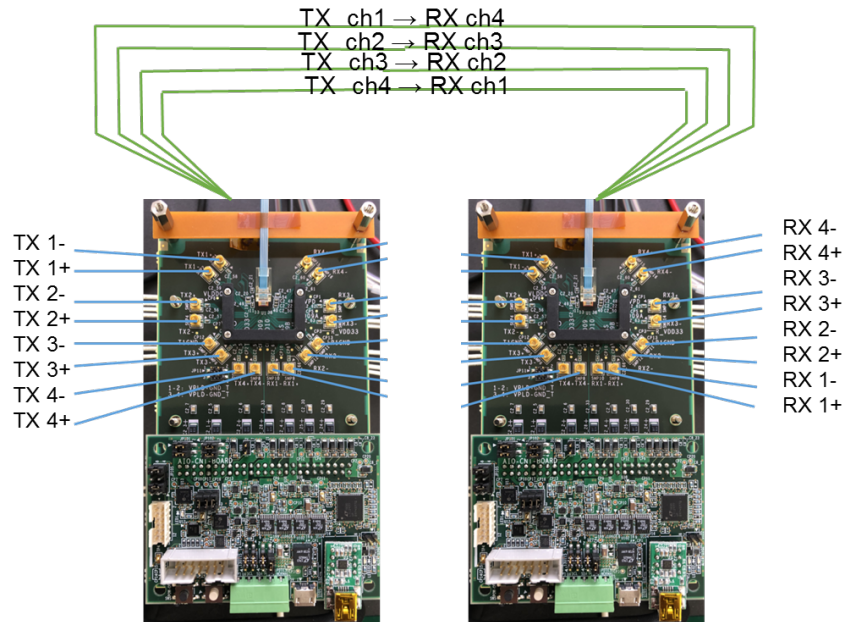
Baseline proposal for automobile

105°C Evaluation result

Power budget specs on going

Test conditions :

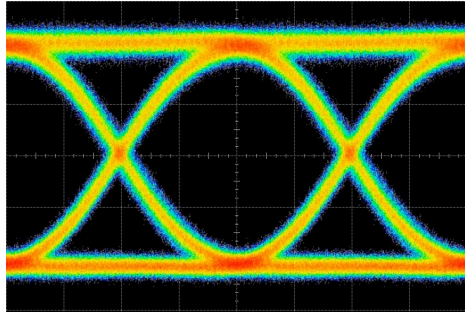
- Thermostatic chamber : Ambient temperature (T_a) 112°C
IC Junction Temperature (T_j) : 125°C
- Data Rate : 25.781Gbps
- Test Pattern : PRBS-31



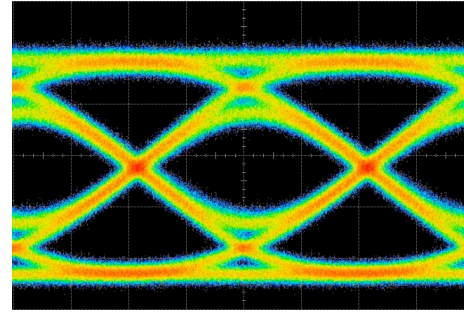
MMF transmission results at 25Gbps

OM2 (500MHz·km@1310nm) and OM3

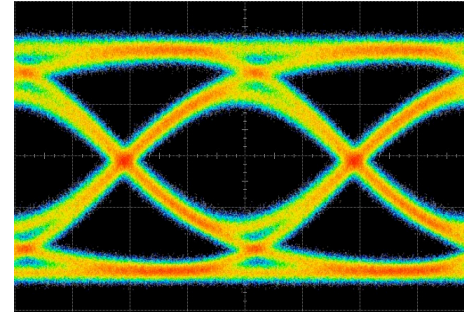
BtoB



OM2 40m



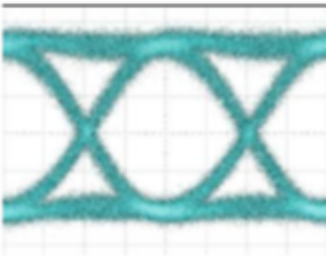
OM3 40m



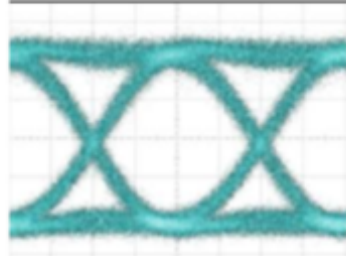
40m with OM2-5 with OFL500MHz·km@1310nm may work (open for discussion).
OM2 can be a low cost solution

1310nm-optimized (2000MHz·km) :300m-500m

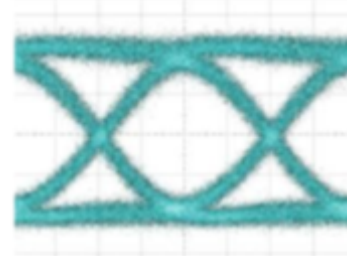
B to B



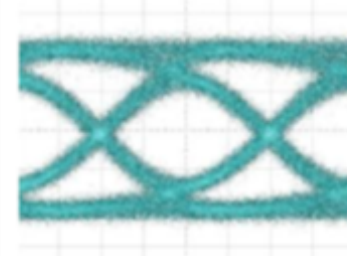
100 m



300 m



500 m



TX

Longer reach is feasible upon standardization.

Proposal for automobile PMD @25G

Follow 802.3-bm(100G-SR4) or bs(400G-SR16) specs excepting the wavelength to be 1310nm.

Raw BER with FEC= 5×10^{-5}

Description	unit	Si-photonics +OM2,3,4	Si-photonics +Optimized MMF
Nominal wavelength	nm	1310	1310
Fiber Type		OM2,OM3,OM4	1310nm-optimized MMF (Informative)
Bandwidth	MHz • km	500 OFL	2000 (informative) Laser launch
40m reach		○	○ (300m)
Power budget	dB	TBD	TBD

PMD options in response to Steve on 4th March,

Description	unit	VCSEL+ OM3	VCSEL+ POF	VCSEL+ OM3	Si-photonics +OM2,3,4	Si-photonics +Optimized MMF
Nominal wavelength	nm	850	850	980 (Steve)	1310	1310
Fiber Type		OM3	POF	OM3	OM2,OM3,OM4	1310nm-optimized MMF (Informative)
Bandwidth	MHz•km	2000 Laser launch	To be specified	950 Laser launch	500 OFL	2000 (informative) Laser launch
Attenuation	dB/km	3.5	To be specified	2.0	1.5	1.5 (informative)

Fibre Optic Attenuation and Loss Values

Maximum Cable Attenuation (dB/km) as per AS/NZS 3080 (Table 26 P49)

MMF 50/125µm		MMF 62.5/125µm		SMF 9/125µm	
850nm	1300nm	850nm	1300nm	1310nm	1550nm
3.5	1.5	3.5	1.5	1.0	1.0

PMD must be open for discussion toward consensus

Description	unit	VCSEL+ OM3	VCSEL+ POF	VCSEL+ OM3	Si-photonics +OM2,3,4	Si-photonics +Optimized MMF
Nominal wavelength	nm	850	850	980	1310	1310
Fiber Type		OM3	POF	OM3	OM2,OM3,OM4	1310nm-optimized MMF (Informative)
Bandwidth	MHz • km	2000 Laser launch	To be specified	950 Laser launch	500 OFL	2000 (informative) Laser launch
Discussion						
40m reach		○	? (not likely) Good <10G?	○	○	○ (300m)
Reliability 105C environment 320H (TBD)	H (mission Profile)	?	? Limited speed	To be proven	Likely (20Y @105C LD test)	Likely (20Y @105C LD test)
Relative cost		Test cost for reliability	Limited leach for min. cost ?	New to test	Low cost integration with Si (auto diag).	Low cost integration with Si (auto diag).
...		To be discussed				

Summary

1. Si-photonics proposal for PMD up to 25Gbps
2. PMD matrix is presented based on the discussion in TF.
 - Reliability is still issue for discussion to choose the technology (from scratch).
 - Cost comparison is not enough (POF, Si Photonics)
3. Proposal to continue technology discussion for D1.1.

Proposal on PMD selection

(We have not discussed the technologies enough for automobile applications)

Wavelength for each Line rate is selected among the PMD matrix
before proceeding to D1.1

Description	unit	VCSEL+ OM3	VCSEL+ POF	VCSEL+ OM3	Si-photonics +OM2,3,4	Si-photonics +Optimized MMF
Nominal wavelength	nm	850	850	980 (Steve)	1310	1310
Fiber Type		OM3	POF	OM3	OM2,OM3,OM4	1310nm-optimized MMF (Informative)
Bandwidth	MHz • km	2000 Laser launch	To be specified	950 Laser launch	500 OFL	2000 (informative) Laser launch
Attenuation	dB/km	3.5	To be specified	2.0	1.5	1.5 (informative)