Feasibility of 1300nm Parallel Optics for 100GbE Short Reach SMF Interconnects

Jon Anderson, Opnext
Kiyo Hiramoto, Opnext

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Introduction

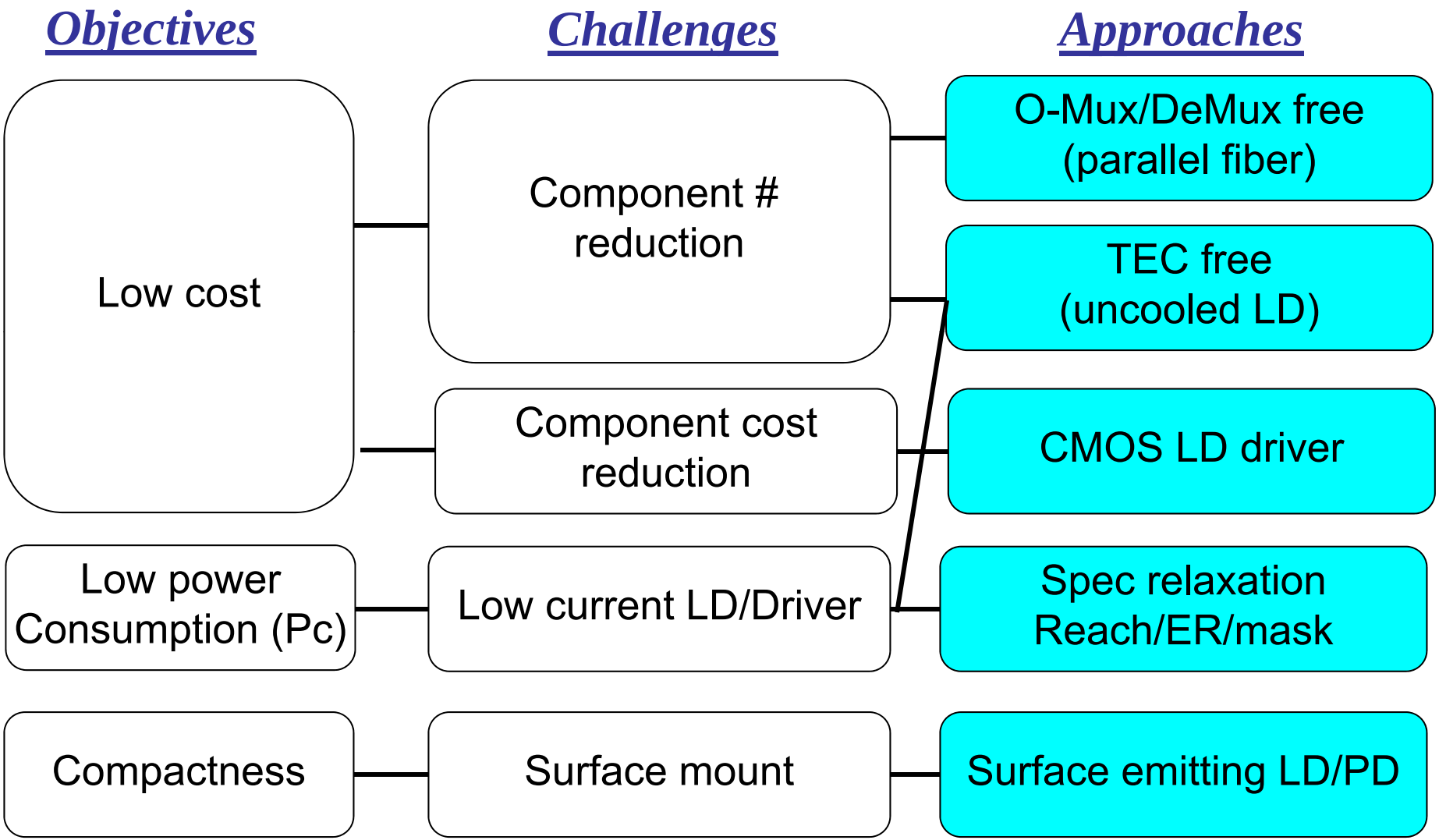
- At the Chicago, 2011 meeting of the Next Gen 100GbE Optical SG, alternative Single Mode technology was identified as a key area to be addressed.
- At the Atlanta, 2011 SG meeting Opnext proposed solutions to realize low cost and compact 100GbE optical transceiver for data center application: nR4 with single SMF with CWDM grids and nR4 with parallel SMF with transmission distance up to 550m and 2km, respectively. Ref: anderson_01_1111_NG100GOPTX
- This contribution focuses on technical feasibility of nR4 with parallel SMF.
- Relative cost between existing LR4 and the proposed interface is analyzed.

Focus of Proposal for 4ch x 25G Optical Interface

- Reduction of number of components is key to achieve the lowest cost solution for data center application.
- Propose new interface with parallel SMF up to 2,000 m transmission.

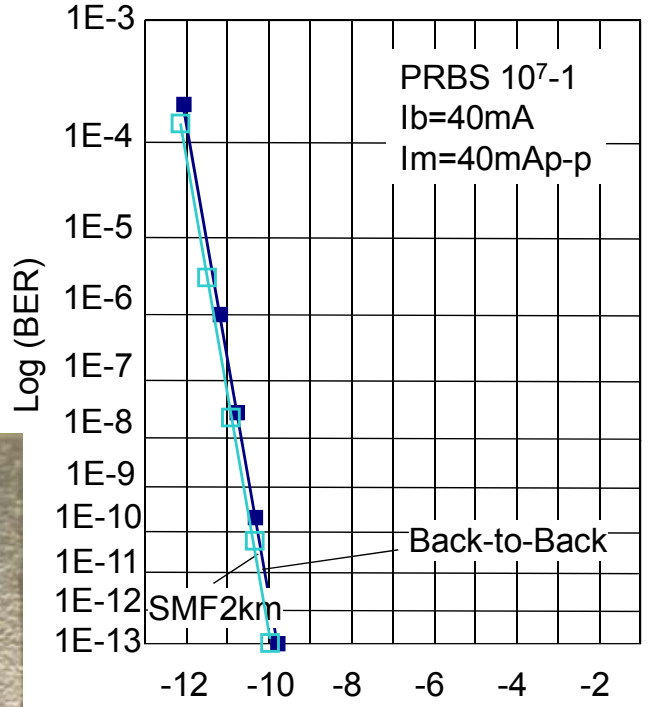
Standard	Fiber Type	Wave-length	Reach	O-MUX deMUX	TEC	LD
LR4	SMF (WDM)	1.3μm	10km	Req.	Req.	Cooled-EML/DML
nR4	SMF (parallel)	1.3μm	2,000m	**No**	**No**	Low power consumption Un-cooled Surface emitting DML
SR4	MMF (parallel)	850nm	60~ 100m	No	No	VCSEL 850nm

Objectives and Approaches

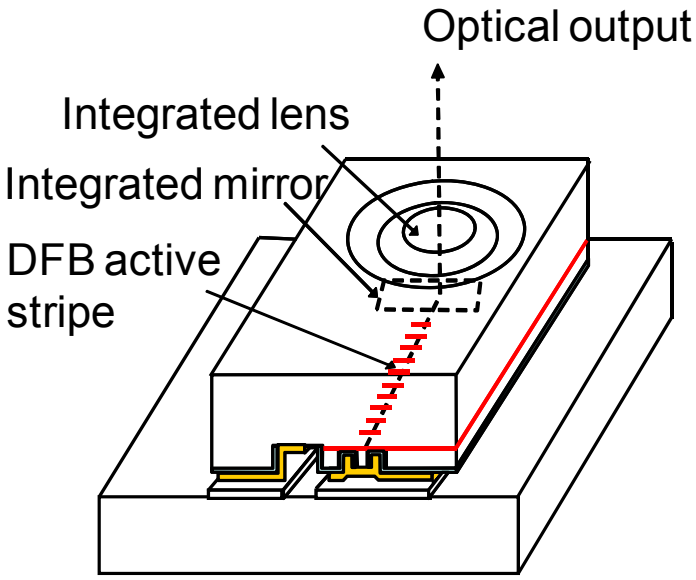


Lens Integrated Surface Emitting Laser (LISEL)

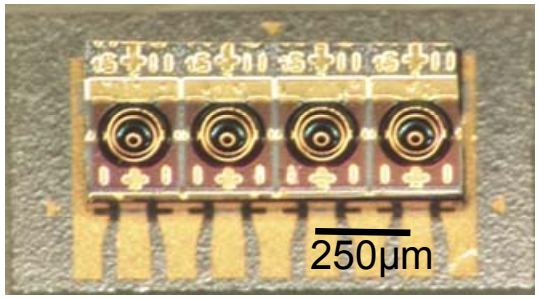
- 1.3μm operation with low Ith (~15 mA @85°C)
- High speed (25Gb/s) up to 100 °C
- Surface emitting/ Flip-chip mount
- 2km error free transmission demonstrated



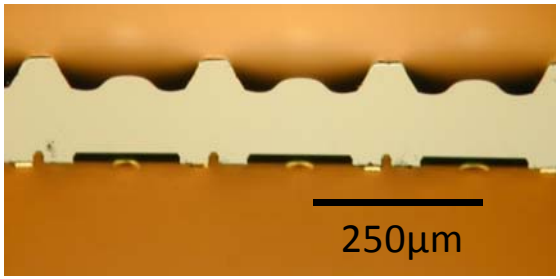
Structure of LISEL

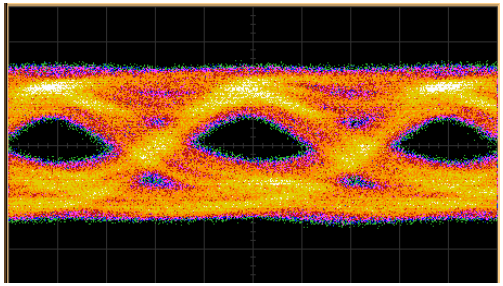


4ch-LISEL array



Cross section





Eye pattern (Back-to-Back)

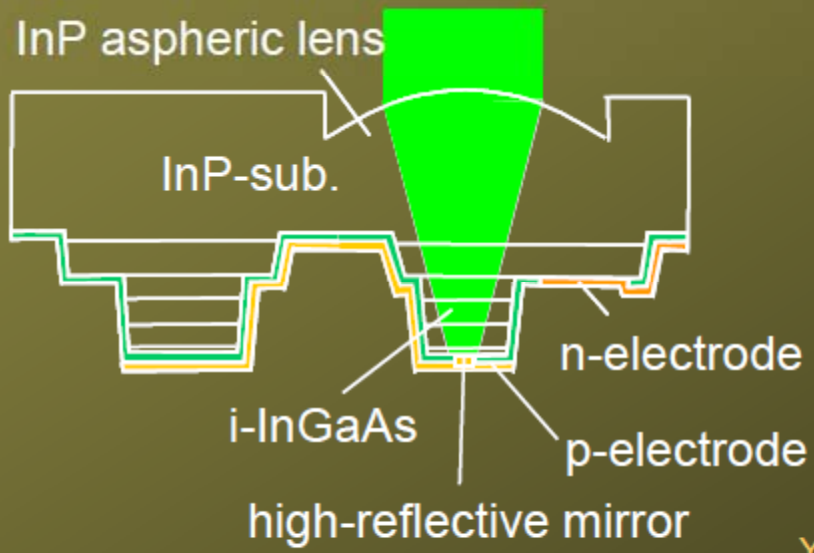
Ref: K. Adachi et al., J. Lightwave Tech. 29, 2899 (2011)

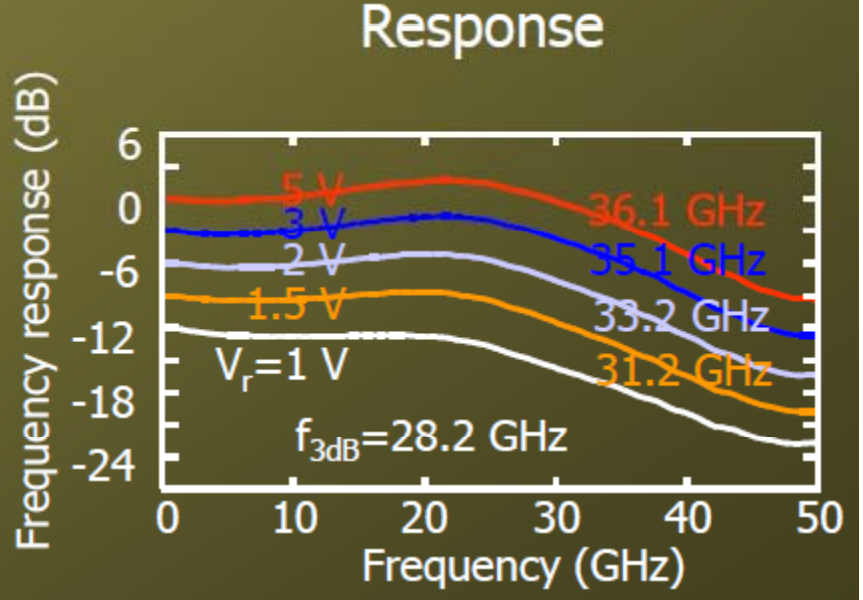
A part of this work was performed under management of the PETRA supported by NEDO.

Lens Integrated Photodiode (LIPD)

- High speed: ~35GHz ------ Small area p-i-n
- High responsivity: >0.8A/W --- High reflect. mirror
- Wide align. tolerance: >20μm -- Lens integration

(Bottom) (Surface)

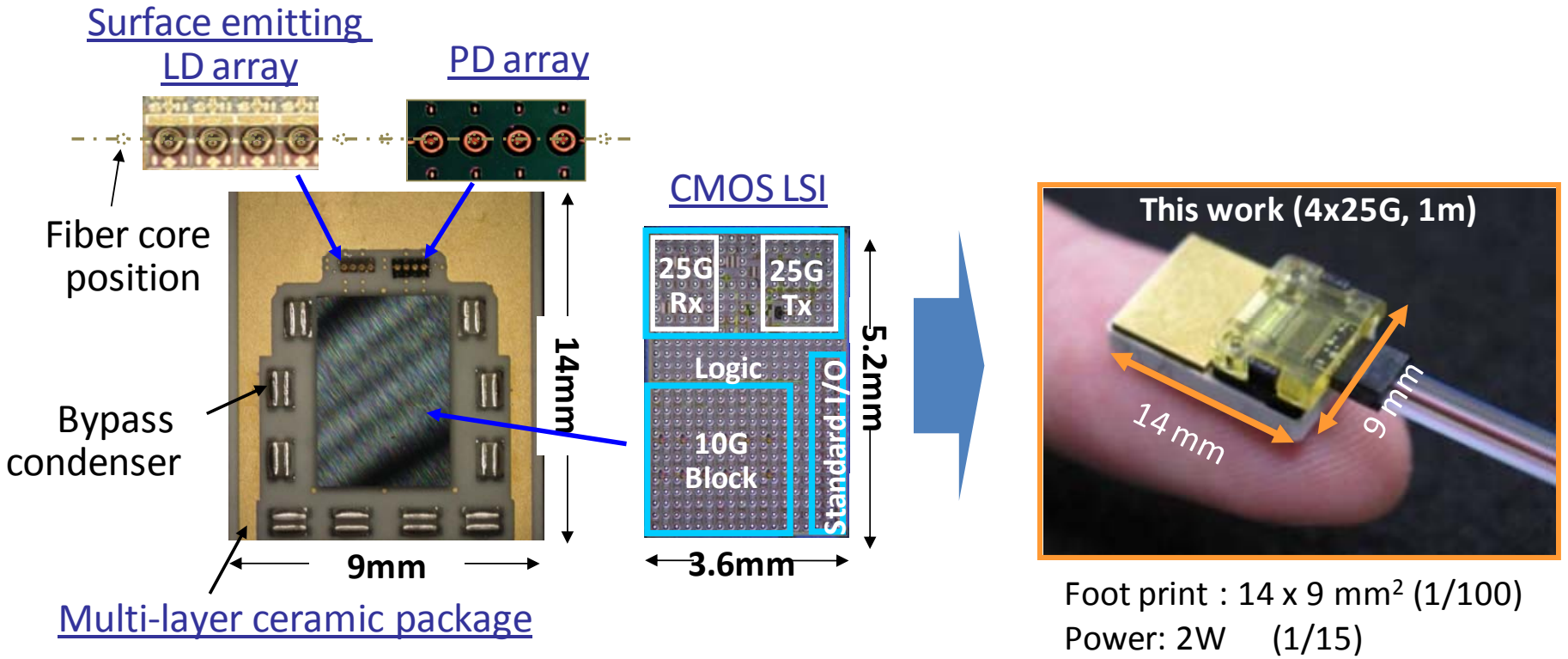




Y. Lee, et al., IEICE Trans. Electron. **E94-C**,p. 116 (2010)

Prototype 4 x 25G transceiver

- Surface mount with passive alignment enables low cost module.
- Use of lens-integrated optical devices reduces components and assembly costs in transceiver design.



Foot print : 14 x 9 mm^2 (1/100)
Power: 2W (1/15)

Ref: T. Takemoto et al., ECOC 2011, Th.12.B.5 (2011).
A part of this work was performed under management of the PETRA supported by NEDO.

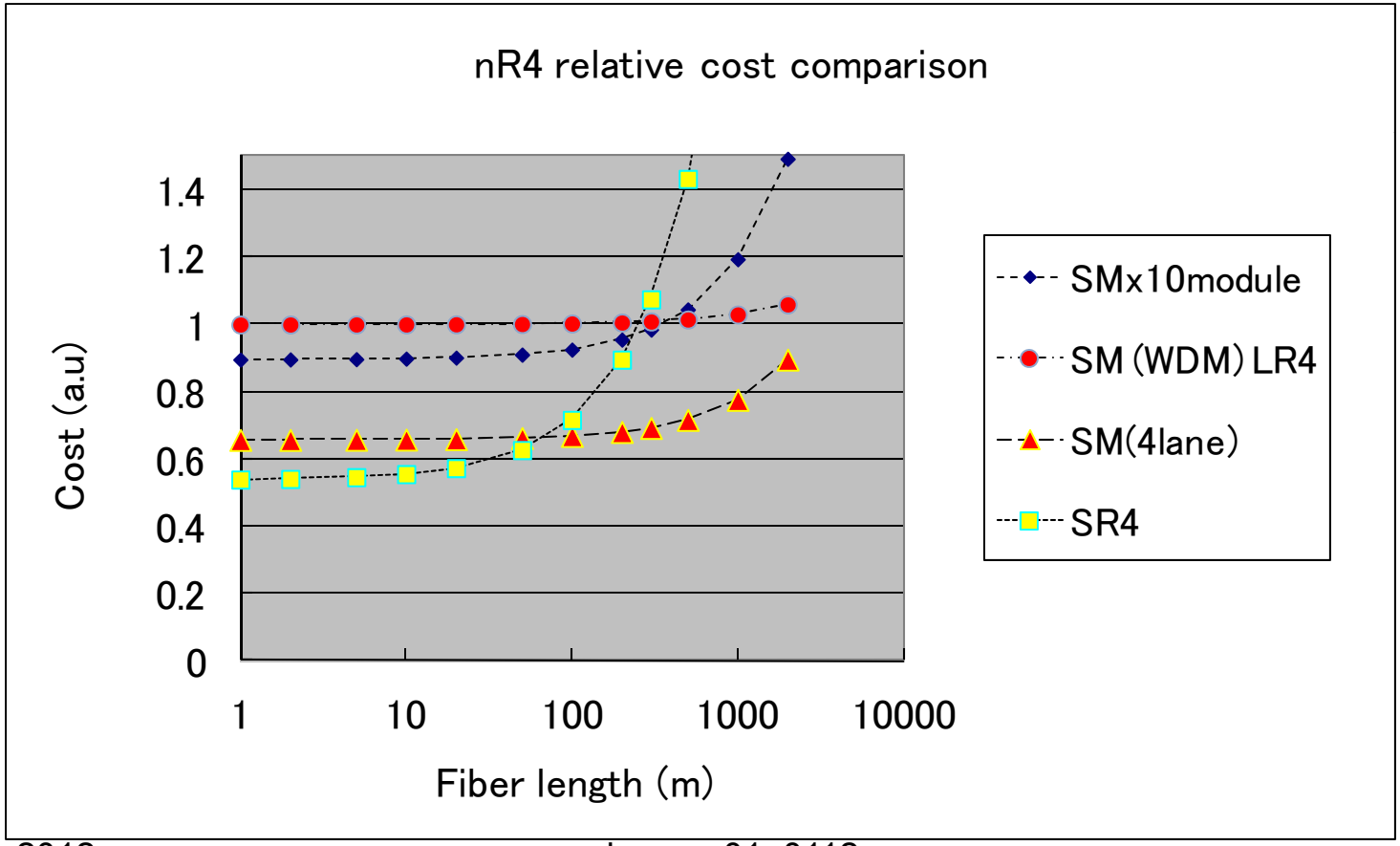
Link budget proposal for parallel nR4 (2km)

- Propose 2km base link budget to relax specifications of min Transmitter Optical Modulation Amplitude and Receiver sensitivity which allow wider tolerance of coupling between fiber and array LD/PD for low cost assembly.

Parameter			IEEE 802.3ba (10 km)	2 km proposal
Transmitter Optical Modulation Amplitude, each lane (max)		dBm_OMA	4.5	4.5
Transmitter Optical Modulation Amplitude , each lane (min)	= A = B + 1	dBm_OMA	-1.3	-3.3
Launch power in OMA minus TDP, each lane (min)	= B	dBm_OMA	-2.3	-4.3
Extinction Ratio (min)		dB	4	4
Power budget (for maximum TDP)	= C = D + E + F	dB	8.5	4.9
Fiber Loss (0.43 dB/km)	= D	dB	4.3	1.0
Connector loss	= E	dB	2.0	2.0
Transmitter and dispersion penalty (TDP), each lane (max)	= F = G + H	dB	2.2	1.9
Dispersion Penalty	= G	dB	1.3	1.0 *
Other Penalty	= H	dB	0.9	0.9
Receiver sensitivity (OMA), each lane (max)	= J = B - (D + E)	dBm_OMA	-8.6	- 7.3

Relative Cost Analysis

- Compared total cost including module cost, connecter cost and fiber cost. As references, cost for 10 x 10GBASE-LR SFP+ is added.
- It is observed that fiber + connecter cost does not contribute much in the case of SMF. It is module cost itself which matters.
- In the case of SMF, cost difference between 1 SMF and 4 SMFs are trivial. On the other hand, O-Mux/DeMux make the cost difference between WDM LR4 and parallel nR4 significant.



Summary

- Technical feasibility of 1310nm optical device for short reach SMF (< 2 km over parallel SMF fibers) is demonstrated.
- Relative cost analysis indicates significant cost reduction in optical transceiver may be possible with the proposed approach compared with existing 100GBASE-LR4 standard based one.
- Link budget is proposed with relaxed 2km base specifications which allow wider tolerance of coupling between fiber and alley LD/PD for low cost assembly.

End of Contribution

Thanks!