

Considerations on transmission distance of 400GbE

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Tomoo Takahara, Toshiki Tanaka, Masato Nishihara,
Jens C. Rasmussen

Fujitsu Laboratories Ltd.

Supporters

- David J. McCormick (Picometrix)
- Janis Valdmanis (Picometrix)
- Mark C. Aguilar (Picometrix)
- Matt Pope (Semtech)
- Craig Hornbuckle (Semtech)
- Song Shang (Semtech)
- Hideki Isono (Fujitsu Optical Components)

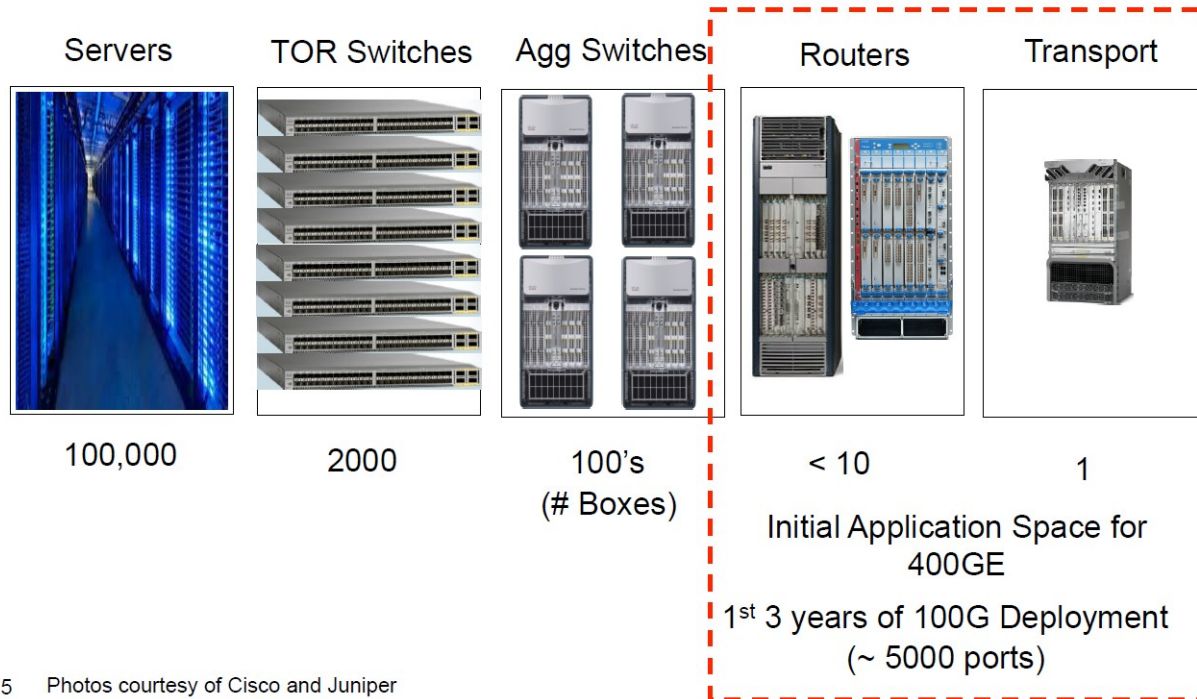
Initial Application Space for 400GbE

In “nicholl_400_01a_0513”

initial application space for 400GbE was emphasized.

Initial Application Space for 400GE

Massive Scale Data Center (MSDC) Example



5 Photos courtesy of Cisco and Juniper

Client side interface of transport is a good target for the initial adoption of 400GbE, also from the view point of network system suppliers !!

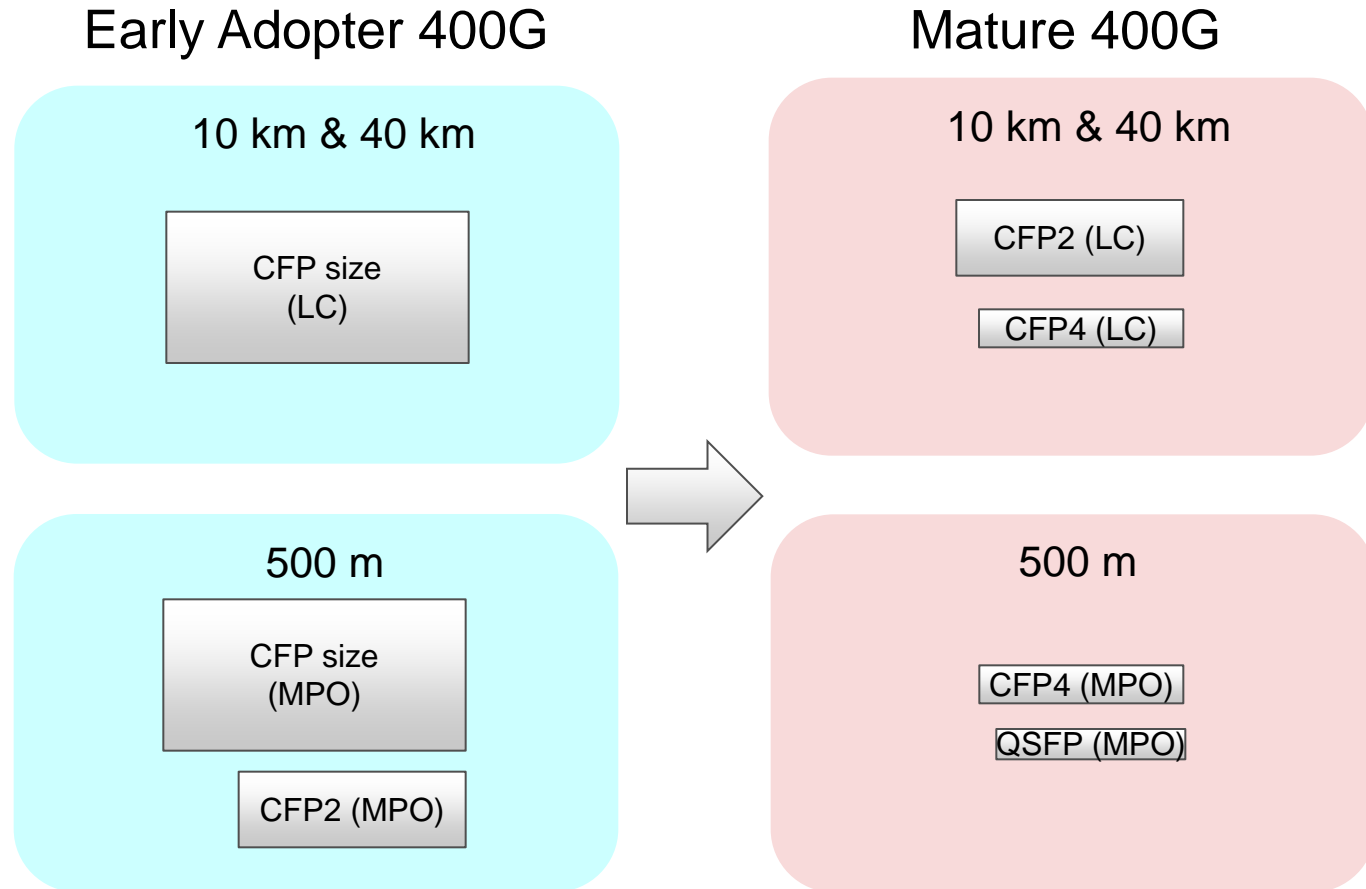
From the Single Mode Fiber 100GbE

PMD	100GbE Standard	400GbE Standard
SMF (At least 500 m)	On-going discussions	Required
SMF (At least 10 km)	100GBASE-LR4	Strongly required
SMF (At least 40 km)	100GBASE-ER4	Strongly required
SMF (At least 80 km)	None	?

For client side interface of transport, transmission distance is an important factor to specify the equipment performance.

Especially 10 km and 40 km will be “must” two categories.

Possible roadmap for 400GbE



Single fiber solution is extremely important for long reach applications such as 10km and 40km, considering the extension feasibility of early adopter solutions.

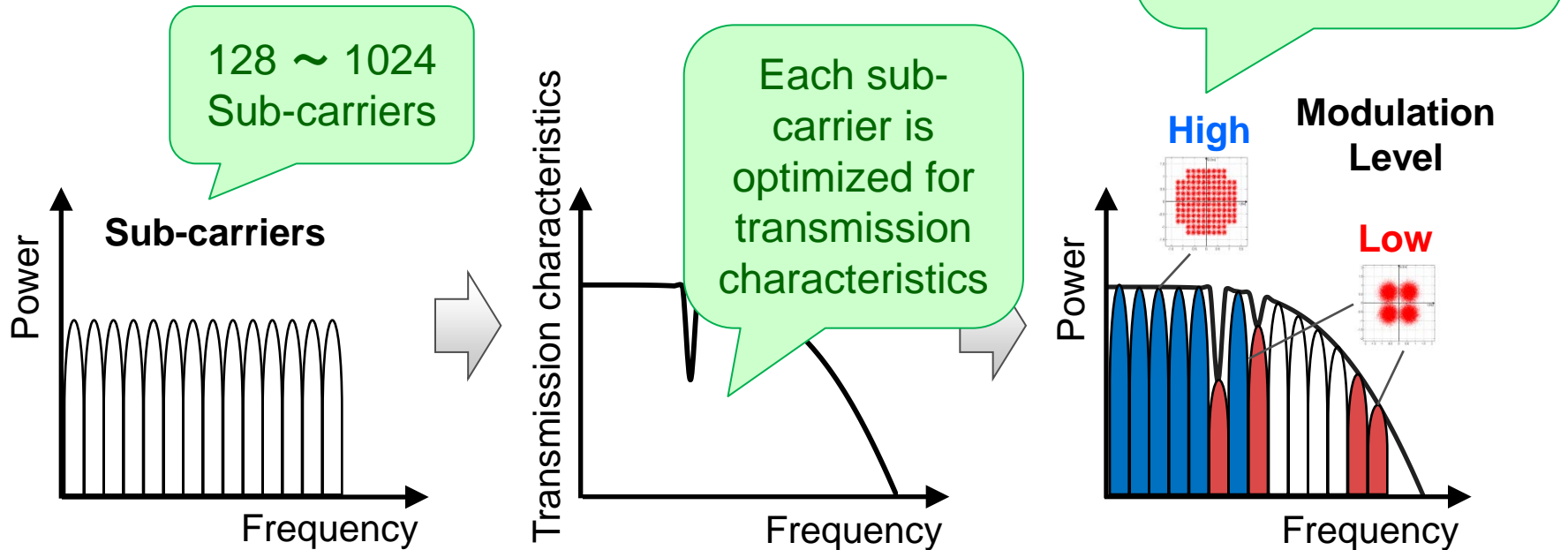
Link configuration study

Combination of WDM technologies and advanced modulation format is a reasonable solution for duplex fiber 400GbE, from the efficiency of link usage.

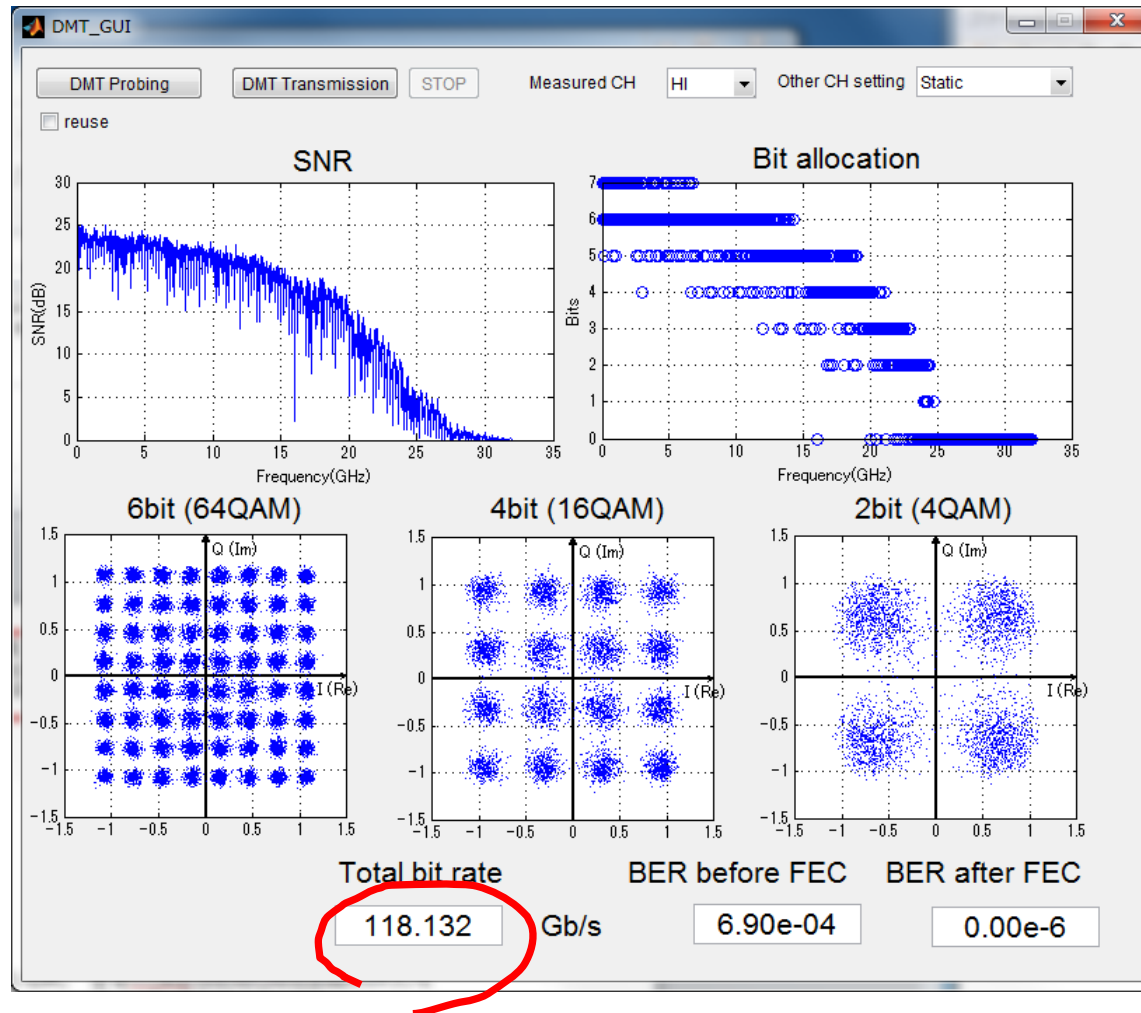
Rate	Wavelength	Link	Distance	Note
25G NRZ	1	16	500 m	Parallel link Up to 500 m
50G NRZ	1	8	500 m	
25G NRZ	4 (WDM)	4	500 m	
100G DMT	4 (WDM)	1	10 km	No compensation
100G DMT	4 (WDM)	1	40 km	With amplification? (Under investigation)

Discrete Multi-tone

Multi carrier and Multi level



Experimental Result



**100 Gbps transmission using single wavelength is already feasible.
Single fiber 400GbE is also achievable, if DMT & WDM are combined.**

Summary

- 10 km & 40 km are needed for 400GbE from the view point of industry demand.
- Single fiber solution will be the point, especially for 10km and 40km, from the extension feasibility of early adopters solution.
- Discrete Multi-Tone feasibility for 100 Gbps transmission was already reported to the group, with the evidence of data.
- DMT with combined WDM technology is a promising feasible solution for 400GbE.

Thank you