Optical Transmitter and Receiver in Optical 100GbE DMT

IEEE802.3 Phoenix Interim, January, 2013

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

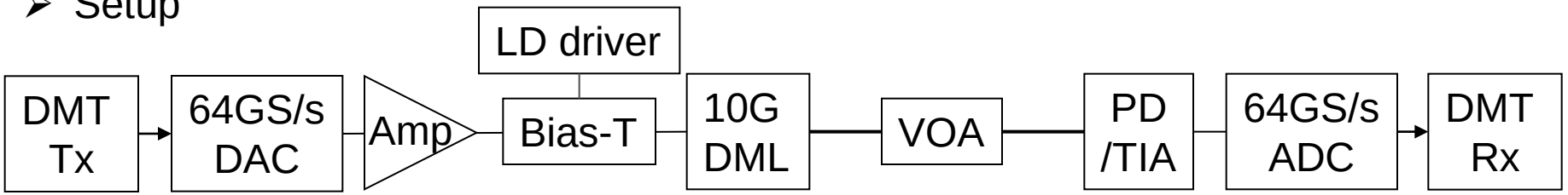
Fujitsu Laboratories Ltd.

Supporters

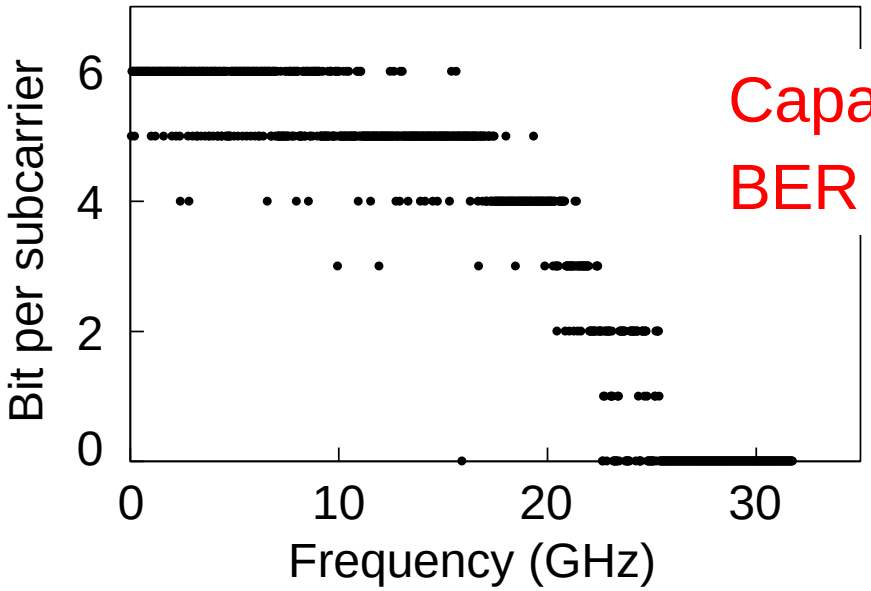
- Y. Kawatsu (Hitachi Cable)
- Song Shang (Semtech)
- Francois Tremblay(Semtech)
- Daniel Stevens (Fujitsu Semiconductor Europe)
- Hiroshi Hamano (Fujitsu Laboratories)

Experiment of Optical 100Gbps DMT

- Setup



- Bit allocation



Capacity = 114Gbps

BER = 4.85×10^{-4}

More than 112-Gbps capacity was achieved by using optical DMT.

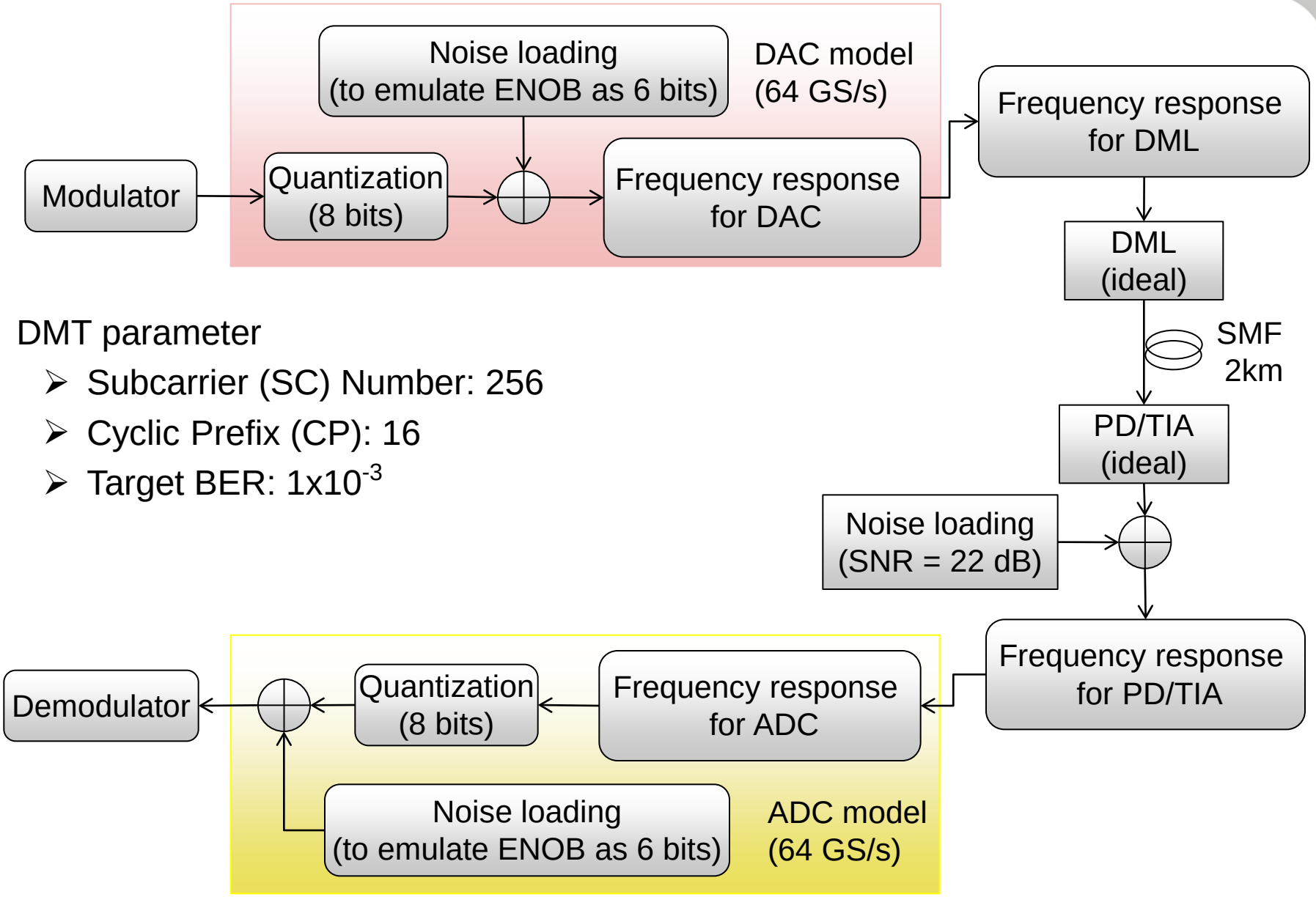
Parameter of Optical 100Gbps DMT

	Experiment	Product Target
DAC-3dB bandwidth	10 GHz (*1)	15 GHz
DML-3dB bandwidth (*2)	25 GHz	14 GHz
DML-RIN	-130dB/Hz	←
DML-output power	+10 dBm	+5 dBm
PD/TIA-input power	+4 dBm	+1 dBm
PD/TIA-bandwidth	20 GHz	10 GHz
PD/TIA-noise	15 pA/√Hz	←
ADC-3dB bandwidth	10 GHz (*1)	18 GHz

We can reduce the required bandwidth of the optical transmitter and receiver because there is margin for bandwidth of DAC and ADC.

*1: Including frequency characteristics of evaluation board of DAC and ADC
*2: Depending on LD bias current
Including relaxation oscillation frequency where there is large degradation in the case of NRZ

Simulation Platform



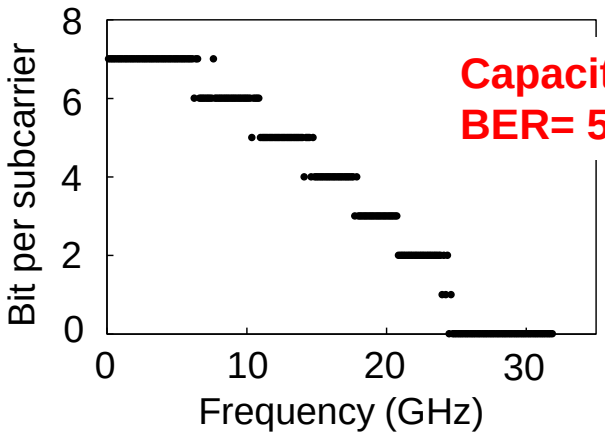
- DMT parameter
  - Subcarrier (SC) Number: 256
  - Cyclic Prefix (CP): 16
  - Target BER: $1x10^{-3}$

Simulation Results

(EVB: Evaluation board, BT: Bessel Thomson filter)

Case1:

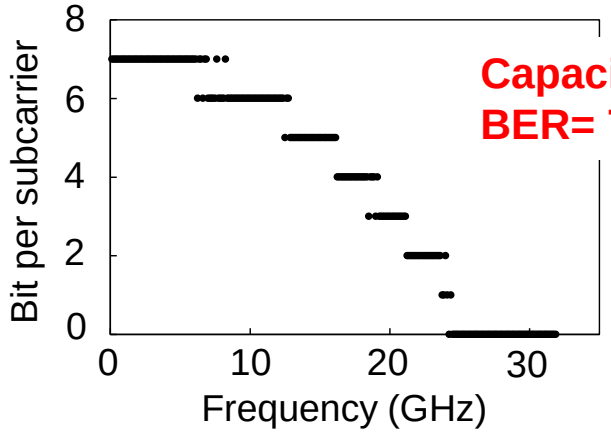
DAC/ADC with EVB: 10 GHz(1th BT)
DML: 14 GHz(4th BT), PD/TIA: 20 GHz(4th BT)



Capacity= 115 Gbps
BER= 5.0 x 10^{-4}

Case2:

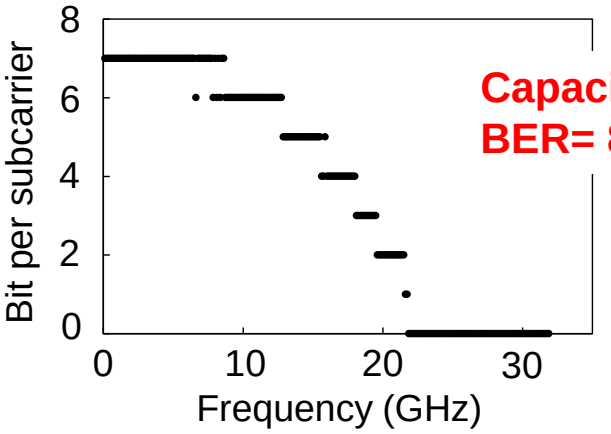
DAC: 15 GHz(4th BT), ADC: 18 GHz(4th BT)
DML: 14 GHz(4th BT), PD/TIA: 20 GHz(4th BT)



Capacity= 119 Gbps
BER= 7.2 x 10^{-4}

Case3:

DAC: 15 GHz(4th BT), ADC: 18 GHz(4th BT)
DML: 14 GHz(4th BT), PD/TIA: 10 GHz(4th BT)



Capacity= 113 Gbps
BER= 8.6 x 10^{-4}

Summary

- Experimental result for optical 100GbE DMT

- Discussion for device candidates
  - 10-Gbps class Tx/Rx

    *Take care of shape of frequency response

Case	DAC	ADC	Tx	Rx	Capacity	BER
1	10 GHz, 1th BT	10 GHz, 1th BT	14 GHz, 4th BT	20 GHz, 4th BT	**115 Gbps**	5.0×10^{-4}
2	15GHz, 4th BT	18GHz, 4th BT	14 GHz, 4th BT	20GHz, 4th BT	**119 Gbps**	7.2×10^{-4}
3	15GHz, 4th BT	18GHz, 4th BT	14 GHz, 4th BT	10 GHz, 4th BT	**113 Gbps**	8.6×10^{-4}

Parameter Impacts on Link Impairment

		Impact	Note
Transmitter	Output power	+++++	
	RIN	++	
	Linewidth	+	
	Chirp	+	2km
	Bandwidth	+++	
	Linearity	++++	
Receiver	Thermal noise	++	
	Responsivity	++++	
	Bandwidth	++	
	Linearity	++++	

Thank you