

DQPSK / TDM Technology and Costs

Reach (Technical) Feasibility of 100GE alternatives

SMF	10km 1310nm	40km 1310nm	10km 1550nm	40km 1550nm
10x10G DML	yes (10λ span can not be un-cooled)	yes (need new DML, RX APD or SOA)	yes (need new DML)	maybe (need new DML, RX APD or SOA)
10x10G EML	yes	yes (need RX APD or SOA)	yes	yes (need RX APD or SOA)
5x20G / 4x25G DML	yes (need new DML)	maybe (need new DML & RX SOA)	maybe (need new DML)	no
5x20G / 4x25G EML	yes (need new EML)	yes (need new EML & RX SOA)	yes	yes (need RX DC)
2x50G DQPSK ML	yes (need I/Q ML)	yes (need I/Q ML & RX DC & OA)	yes (need I/Q ML & RX DC)	yes (need I/Q ML & RX DC)
1x100G TDM ML	yes (need new ML & maybe RX DC)	yes (need new ML & RX DC & OA)	yes (need new ML & RX DC (& OA?))	yes (need new ML & RX DC (& OA?))

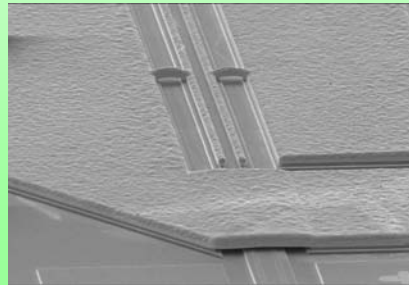
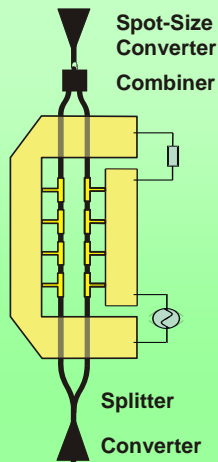
Green shading designates alternatives under detailed study by Fiber Optic Ad Hoc contributors.

Technically feasible ?
At which costs ?

Finisar

High Speed InP Modulators

InP Mach-Zehnder Modulator ...



- capacitively loaded travelling wave electrode for frequencies of 50 GHz and above
- quasi push-pull configuration for zero chirp

... and its utilization potential in higher integration components

Integrated multiple MZI structures for applications of:

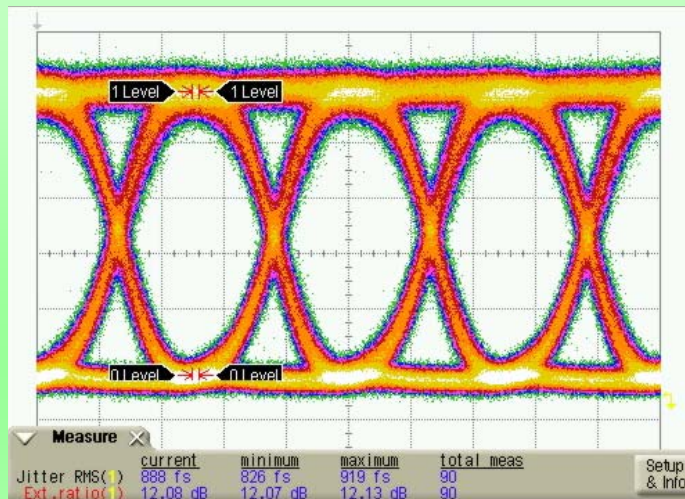
- advanced modulation formats (e.g. DPSK; DQPSK)
- electronic dispersion pre-compensation operating within the full C-Band

Integrated transmitters for OOK and advanced modulation formats with

- Tunable laser
- DBR or DFB laser
- SOA

Mach Zehnder High Frequency behavior

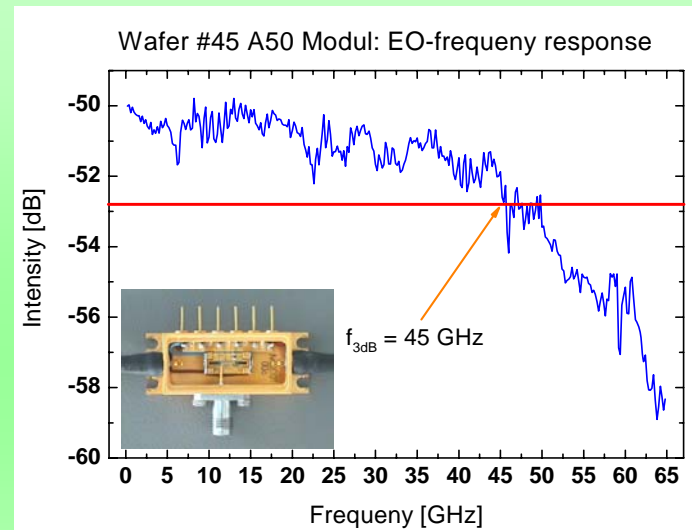
Excellent eye opening ...



NRZ 40 Gbit; PRBS: $2^{31}-1$

Clear Eye opening demonstrated for 40 Gbit NRZ

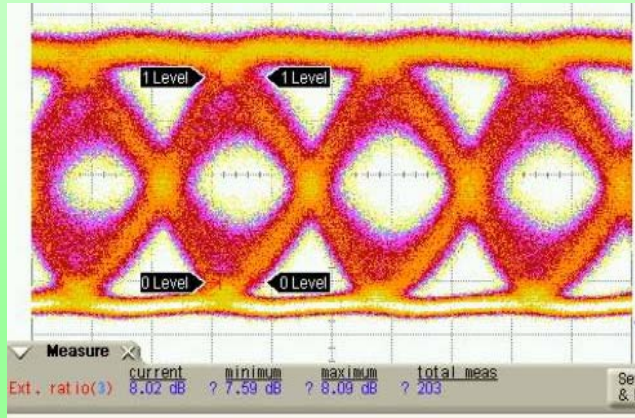
... and high frequency response



Low drive voltage:
 $V_{pp} = 2.8$ V (@ 40 Gbit)

Modulator: 80 Gbit/s Eye Diagram

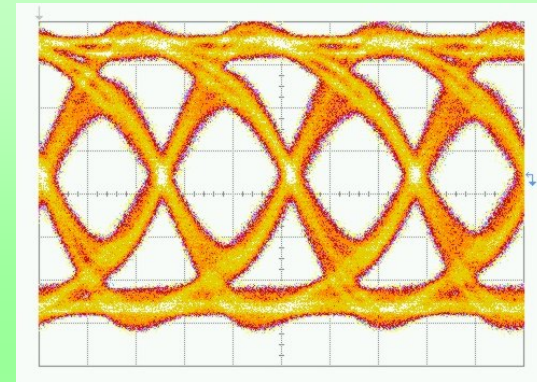
Optical 80 Gbit NRZ Eye Diagram



NRZ 80 Gbit; PRBS: $2^{31}-1$

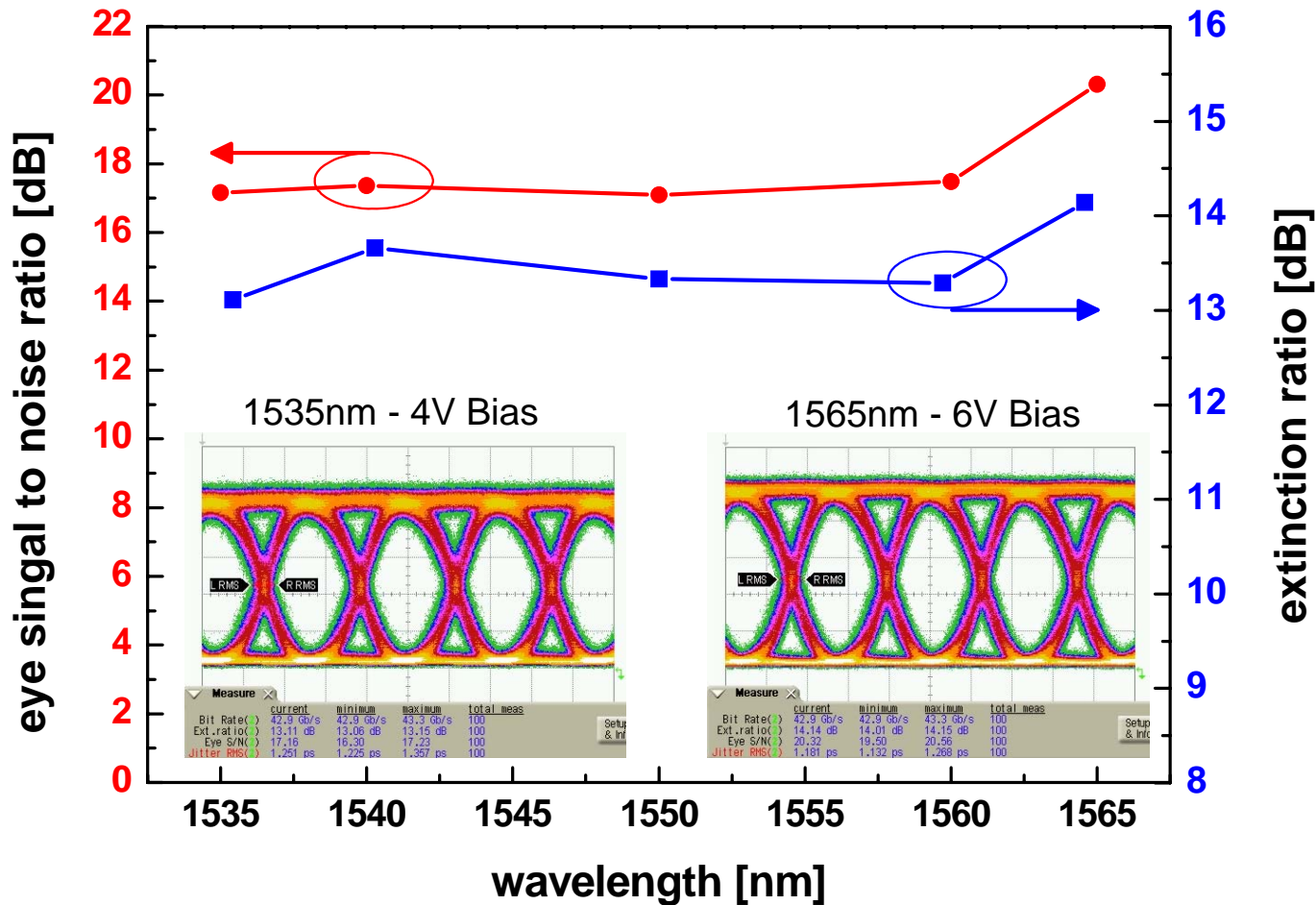
extinction ratio: 8.0 dB
PRBS: $2^{31}-1$
optical power: 15 dBm
 V_{pp} : 2.8V
DC-Bias: 4.5 V

Input Modulator: Electrical 80 Gbit Eye Diagram



Amplifier 80 Gbit/s Signal

Performance over 1535-1565 nm (43 Gbit/s)



limited < 1535 nm by optical filter

limited > 1565 nm by EDFA

$V\pi = 2.8$ V

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Jan 20, 2007

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Feasibility and costs

No show stopper expected for switch to 1300 nm operation

No show stopper expected for development of 100G OOK operation

Potential for uncooled operation / full C-band operation

Cost position optochip relative to 10 Gbit 1300nm DFB opto chip :

MZ 100G OOK:	5-10 times
MZ IQ DQPSK:	10-15 times
MZ + DFB 100G OOK	7-12 times
MZ + DFB IQ DQPSK	12-17 times

Major savings vs non-serial (WDM or multi fiber) from OSA and driver costs likely