

Bidirectional PAM-4 Experimental Proof-of-Concept to Double Capacity per Fiber in 2-km Data Center Links

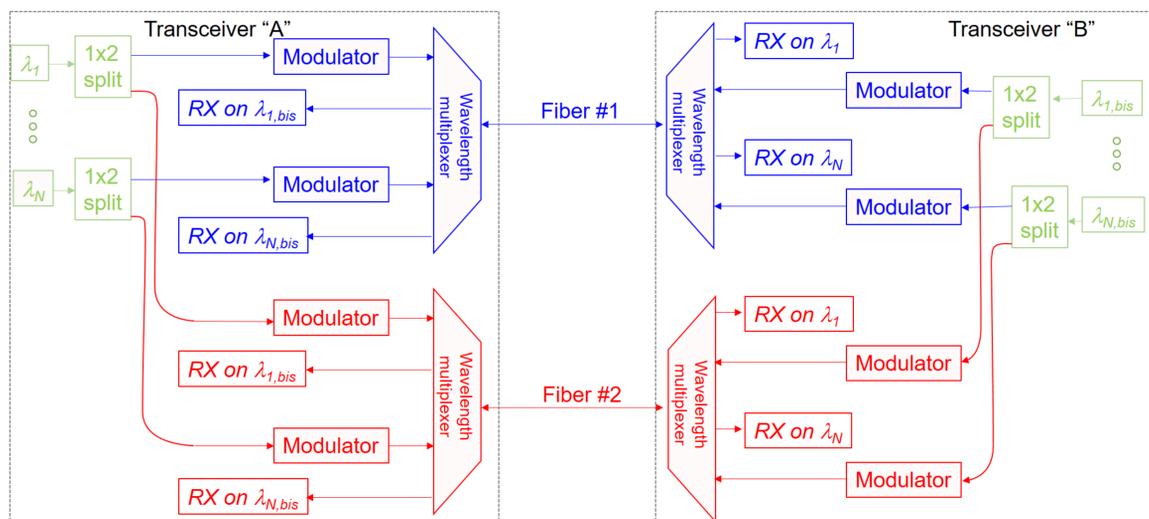
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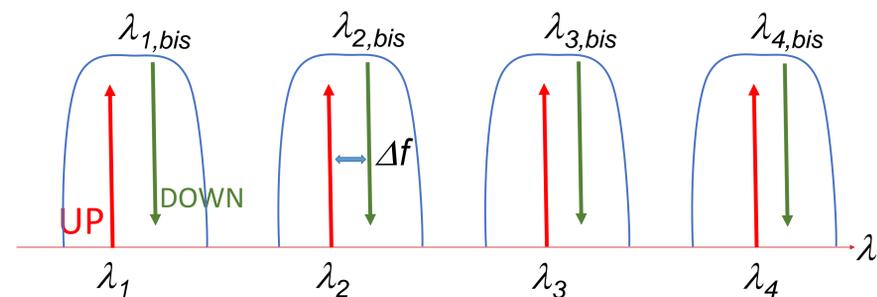
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Abstract: We propose the use of bidirectional transmission to double the effective capacity over (each available) fiber in short-reach (2km) data-center links using direct-detection PAM-4. In particular, we experimentally show the conditions under which spurious reflections give a limited power penalty.



General schematic

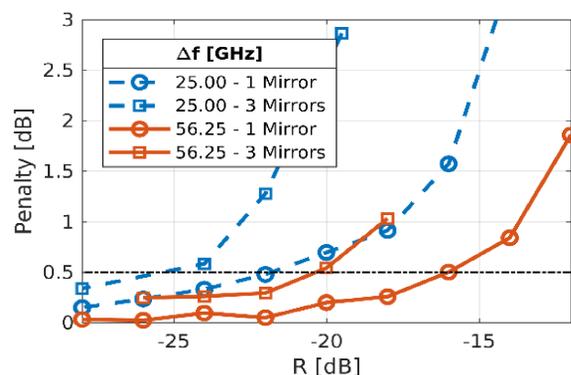
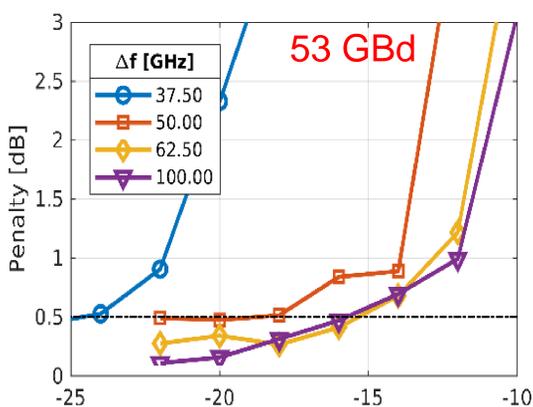
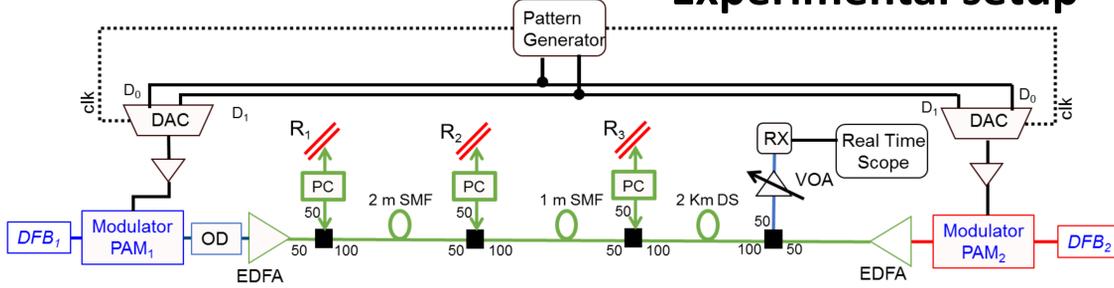


Proposed frequency allocation

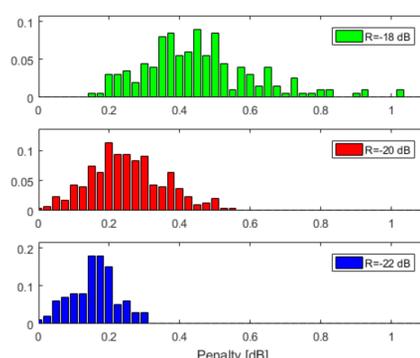
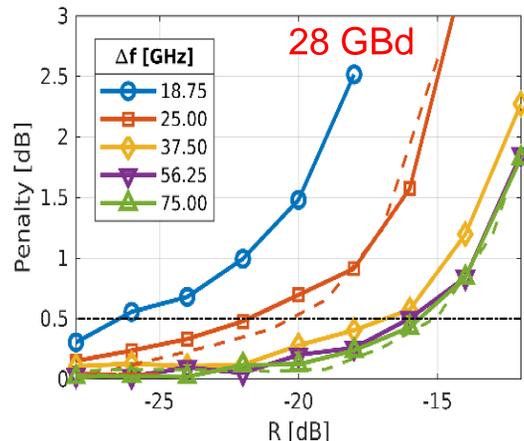
Modulation Format	PAM-4
Net bit rate	50 or 100 Gbps
Gross baud rate	28 or 53 GBd
Target BER (KP4 FEC)	$2 \cdot 10^{-4}$
TX: EML DFB	2 MHz linewidth
RX:	PIN receiver

Experimental parameters

Experimental setup



Power penalty vs. Reflection for one and three reflection points, at 28 GBd and for different spectral separation Δf .



Histograms of the measured penalty for repeated BER measurements for three different reflection values and three reflections. Parameters: 28 GBd, $\Delta f=56$ GHz.

Conclusions

We have experimentally demonstrated that high baud rate (28 GBd and 53 GBd), short distance (2Km) PAM-4 transmission can be made bidirectional on each single fiber, thus doubling system capacity, with less than 0.5 dB power penalty, provided that:

- 1) The spectral separation Δf between the two lasers is greater than twice of the baud rate.
- 2) Individual reflection points generate reflections smaller than $R=-20$ dB.

The only issue to implement the proposed scheme will be developing a suitable servo-mechanism to keep the spectral separation of the lasers always above twice the baud rate. At 53 GBd this would mean a tuning range of the lasers of less than 1 nm in O-Band, which can be also split between the two interfering lasers. This requirement is well within the thermal tuning range of currently used lasers for the short-reach market segments.