DSP-free coherent receivers in frequency-synchronous optical networks for next-generation datacenter interconnects

Lei Liu,[a,b,c] Feng Liu,[a,c] Cheng Peng,[a] Bo Xue,[a] William Shieh [a,b,c,*]
[a] Westlake University, School of Engineering, No. 600 Dunyu Road, Xihu District, Hangzhou, China, 310030
[b] Westlake Institute for Optoelectronics, No. 68 Jiangnan Road, Fuyang, Hangzhou, China, 311421
[c] Westlake Institute for Advanced Study, Institute of Advanced Technology, No. 18 Shilongshan Road, Hangzhou, China, 310024

Caption List

Note 1 Comparison of power consumption among proposed system with traditional coherent detection system and other DSP-free system.

Fig. S1 Tree-distributed homology nodes with number of tree layers and branches per layer.

Fig. S2 Different pilot-tone power in the modulation signal impact on receiver optical power penalty.

Fig. S3 Detailed BER performance for the X- and Y-polarization of 4 tributaries dual-polarization 16-QAM signals.

Fig. S4 Impact of I-path pilot-tone power on the received data signal SNR.

Fig. S5 200 Gbps power consuming of proposed scheme, DSP-based system and other DSP-free scheme.

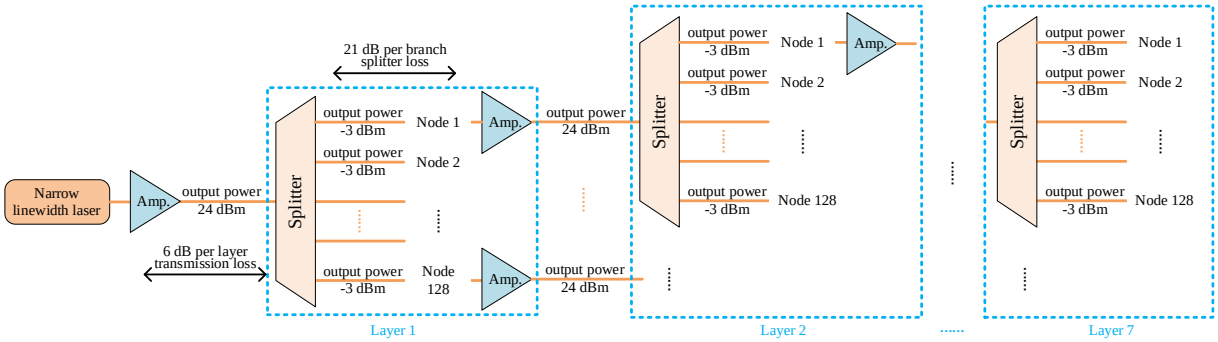

Fig. S1. Tree-distributed homology nodes with number of tree layers and branches per layer.

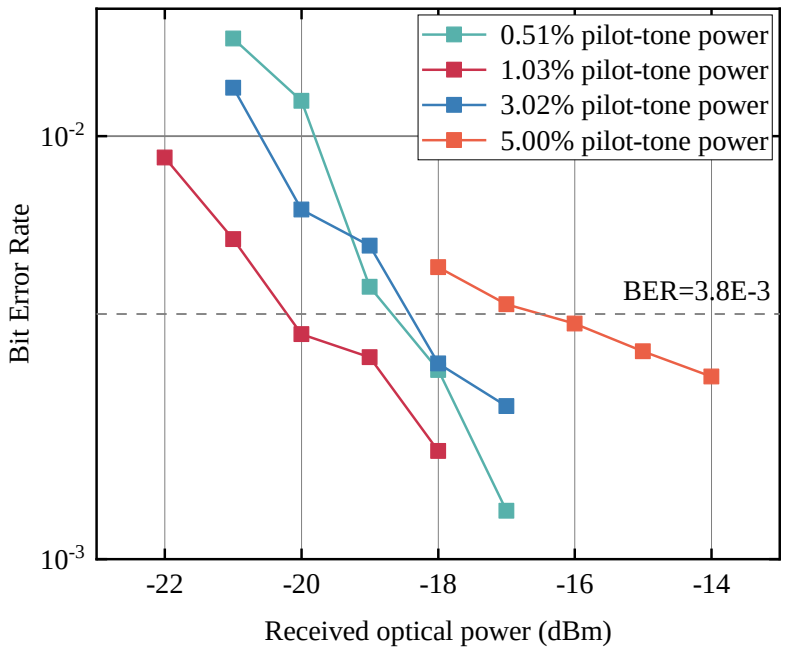

Figure S2. Different pilot-tone power in the modulation signal impact on receiver optical power penalty.

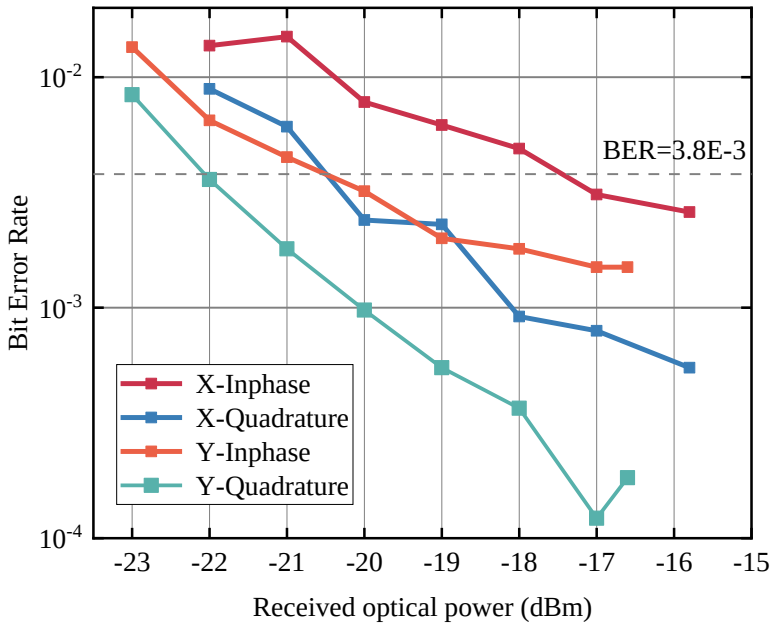

Figure S3. Detailed BER performance for the X- and Y-polarization of 4 tributaries dual-polarization 16-QAM signals.

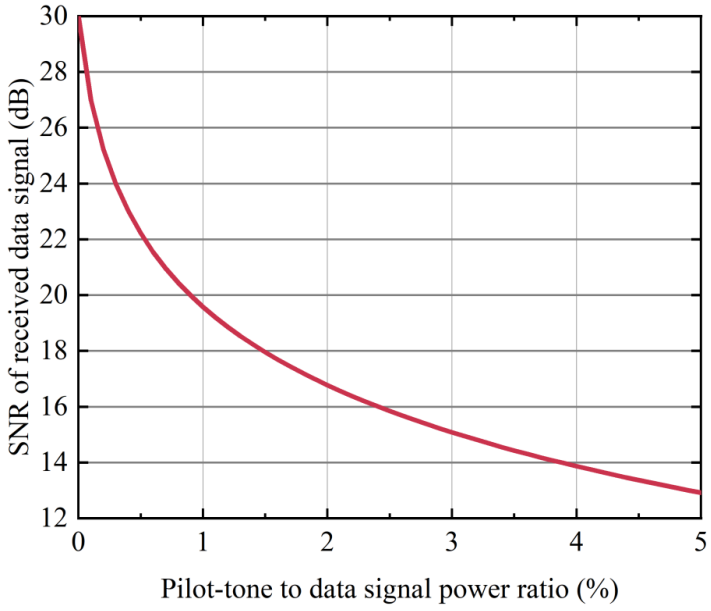

Figure S4. Impact of I-path pilot-tone power on the received data signal SNR

Note 1- Comparison of power consumption among proposed system with traditional coherent detection system and other DSP-free system.

In our proposed system, we focus on the power-efficient polarization and phase demultiplexing in optical domain, which are unrelated to the modulation speed and format. We assume the power consumption for polarization demultiplexing of the three phase shifting sections is approximately 75 mW in reference 25. The AOM power consumption can be used for carrier phase recovery is typical 3 W. We can save the narrow linewidth laser by using the FSON architecture. After polarization control and carrier-phase recovery in the optical domain, we can directly use the CDR functions in the existing IMDD systems. This enables the implementation of cost-effective short-reach coherent optical communication.

According the reference 26, the traditional coherent transmission system laser and TEC controller power is 3.015 W. The receiver DSP power (including ADC) in 200 Gbps traditional coherent transmission system is 0.654 W (5 nm process node). According the reference 9, they estimate conservatively that the high-speed analog electronics of an electrical PLL-based coherent receiver consume nearly 4 W for 200 Gbit/s DP-QPSK, assuming a 90-nm complementary metal-oxide semiconductor process. The comparison of power consumption among schemes is shown in Figure S5. It should be noted that we can save power consuming from laser sources and receiver DSP section, which is the advantage of proposed FSON architecture.

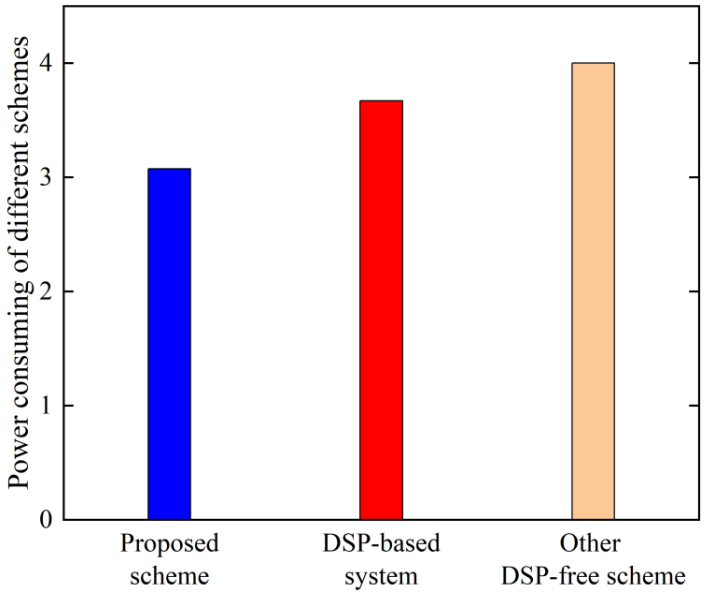

Figure S5. 200 Gbps power consuming of proposed scheme, DSP-based system and other DSP-free scheme.