6G-RIC
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Photonic Reservoir Computing-based Signal Equalization of Mobile Fronthaul Systems

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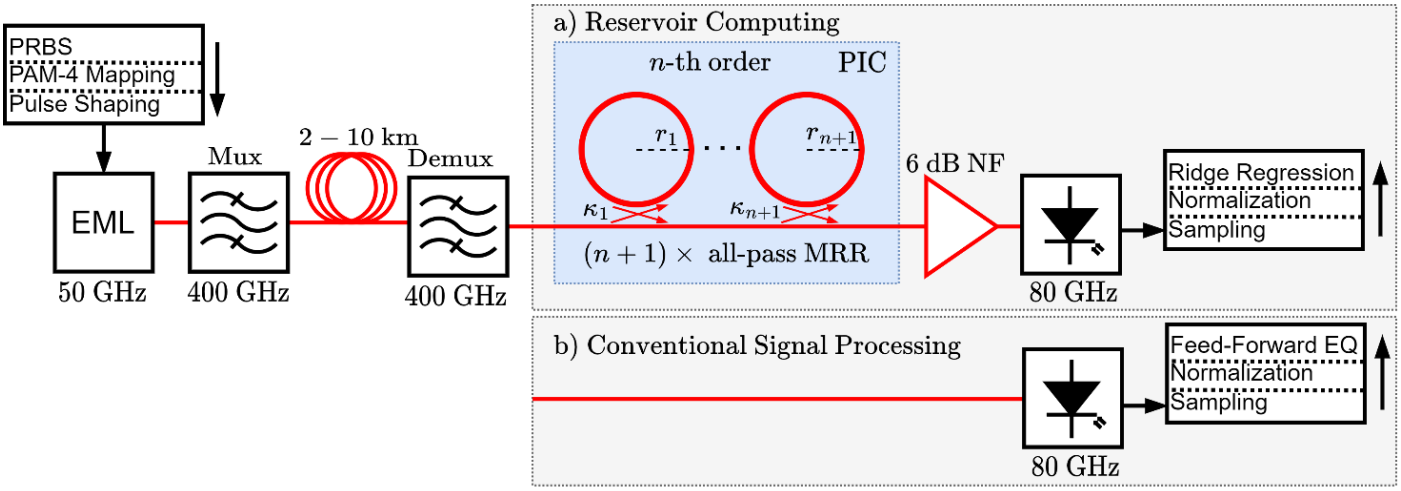
Next-generation mobile fronthaul systems will be based on fiber optic transmission systems, which are capable of transmitting ultra-highspeed signals. Increasing symbol rates pose a challenge for digital signal processing (DSP) algorithms required to equalize the transmitted signals, as digital implementations will eventually reach the fundamental physical limits of electric components. How can neuromorphic signal processing be used as an all-optical reservoir computer to (partially) replace digital signal processing?



The picture shows the optical system setup used for short distance communications as used in mobile fronthaul. Neuromorphic signal processing (a) using a Silicon photonics based integrated circuit (PIC) with micro-ring resonators can be used to replace conventional signal processing (b) based on digital equalizers

KEY FINDINGS

We introduced a photonic reservoir computer based on higher-order parallel silicon all-pass micro-ring resonators (MRRs) that can be used for signal equalization of 112 Gbaud PAM-4 signals. We show that the presented reservoir reduces the bit-error ratio by up to an order of magnitude compared to conventional DSP-based feed-forward equalization (FFE) while being real-time capable.

S. Kühl, L. E. Kruse, S. Pachnicke, "56 Gbaud PAM-4 Transmission Equalization using Implicitly Masked Parallel Micro-Ring Resonator Reservoir Computing", European Conference on Optical Communication (ECOC), Basel, Switzerland, September 2022.

S. Kühl, L. E. Kruse, S. Pachnicke, "Comparison of passive photonic reservoir computing architectures for signal equalization of future generation intra-DCN and mobile fronthaul systems", International Conference on Transparent Optical Networks (ICTON), Bukarest, Romania, July 2023.