Integrated Components for Optical QPSK Transmission

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Abstract: $LiNbO_3$ Z-cut QPSK modulators, $LiNbO_3$ 90° hybrids co-packaged with balanced photoreceiver OEICs and SiGe/CMOS circuits for digital signal processing are being developed as key components for a 40-Gb/s synchronous QPSK polarization division multiplex transmission testbed.

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Synchronous quadrature phase shift keying (QPSK) transmission combined with polarization division multiplex is an extremely attractive modulation format for metropolitan area and long haul fiber communication [1−3]. All linear optical distortions (polarization transformations [4], polarization mode and chromatic dispersions) can in principle be equalized without losses in the electrical domain. OSNR performance is superior, and dispersion tolerances are relaxed compared to 40 Gb/s intensity modulation. The European Commission funds in its FP6 under contract 004631 research on “Key components for synchronous optical quadrature phase shift keying transmission”. This “synQPSK” project (http://ont.upb.de/synQPSK) aims to realize all components which are not readily found on the market: $LiNbO_3$ QPSK modulators in the transmitter, $LiNbO_3$ optical 90° hybrids, InP balanced photoreceivers and SiGe/CMOS integrated electronic circuits for signal conditioning in the receiver. Standard DFB lasers are expected to be tolerable for signal and local oscillator lasers due to a carrier recovery concept that requires no phase-locked loop. It shall be implemented in the receiver by analog-to-digital conversion and subsequent CMOS signal processing. The targeted symbol rate is 10 Gbaud which amounts to 40 Gb/s, plus FEC overhead. All components and contributions shall be validated in a testbed (Fig. 1).

Currently a QPSK modulator with *Z*− domain inversion [5] and a 25 GHz bandwidth, optical 90° hybrids [6] reliably co-packaged with photodetector arrays and 10 Gbaud transimpedance amplifiers, and first designs of the electronic components have been developed. We will concentrate on achieved integrated optical component results. These have so far enabled the first real-time QPSK transmission [7]. The planned European „synQPSK“ technology is challenging but tempting to solve several urgent problems of future lightwave communication systems. Due to its high performance we expect a lower cost per bit than for competing technologies.

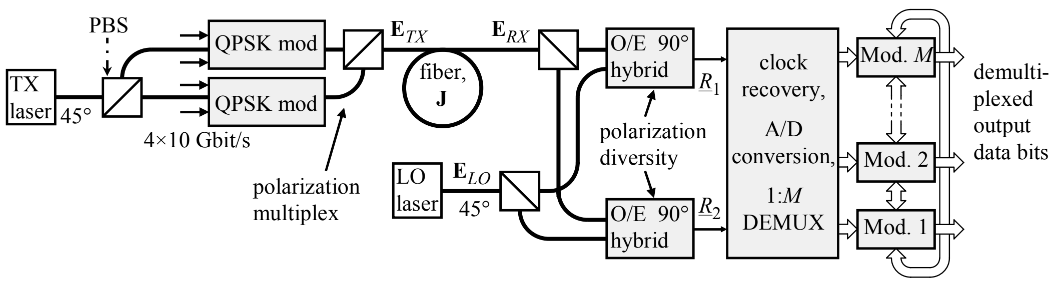

Fig. 1. Planned synchronous QPSK polarization division multiplex transmission testbed, with shaded key components.

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