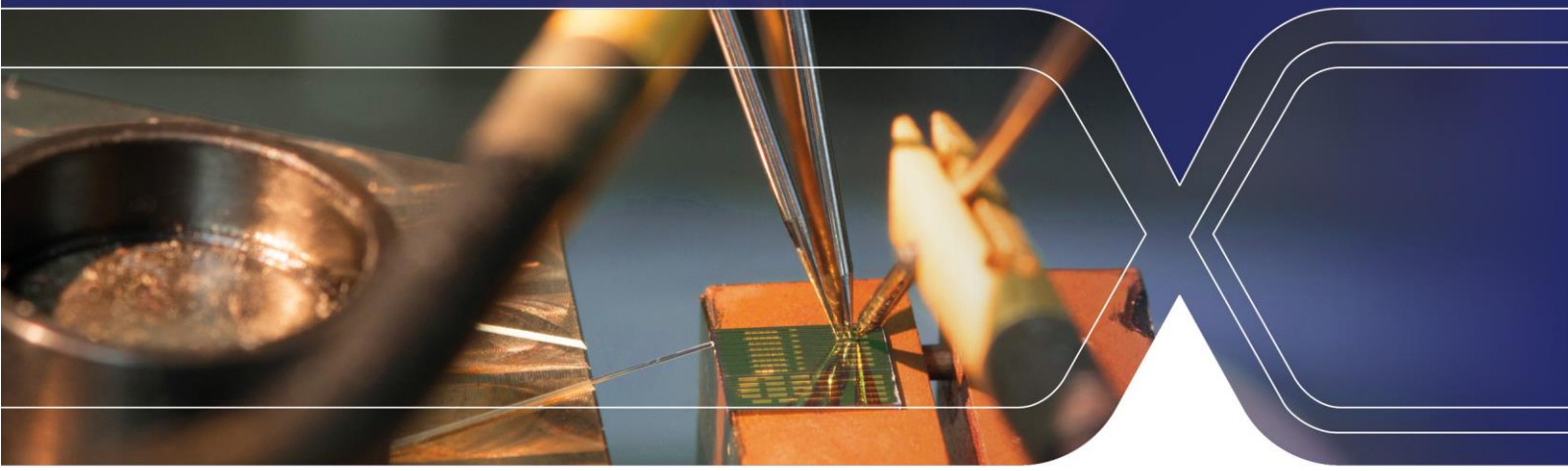

Coherent Communication

Current and emerging technologies like video-intensive applications such as video analytics for self-driving cars, virtual and augmented reality and an increasing connectivity between appliances as aspired by the Internet of Things (IoT) demand more and more bandwidth capacity of our current networks. Networks with “high-throughput, low-latency and high-reliability” are needed[1]. While deploying more fiber presents a costly and undesirable solution, increasing network capacity is implemented mostly by increasing network efficiency, segmentation into smaller cells and increasing bandwidth. Coherent optical communication supports higher data rates through fiber optic cables by not only encoding information in the amplitude of the optical signal but also in its phase and polarization. Driven by the exponential growth in demanded network capacity, on the one hand, and technological advancement in laser and integrated photonics technology and maturity on the other, coherent communication is gaining traction.

Photonic Integration

Coherent transceivers require the combination of a large number of photonic functions. This is where photonic integration can add value: The more complex the photonic system the greater the benefit

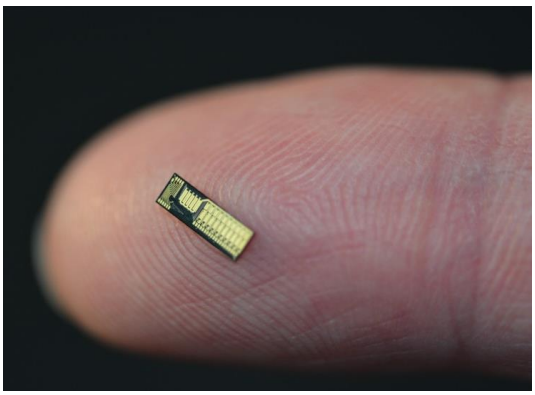

Figure 1: EFFECT Photonics optical ‘System-on-Chip’ – including actives and passives on a single chip, illustrating the potential for form factor reduction.

of integrating all these functions on a single chip. Fabrication, integration and packaging becomes more cost-effective compared to individual optical components, reducing size and power consumption while additionally improving performance[2]. Indium-Phosphide (InP) and Silicon Photonics (SiP) are the two main integration platforms for coherent optics. Out of these two, only InP PICs currently offer monolithic integration for coherent modules, leveraging high-performance and cost advantages.

Coherent Optical Transceivers

The combination of digital, analog and photonic functions needed for modern coherent transceivers is illustrated in Fig.2. Application-Specific Integrated Circuits (ASICs) are frequently used to combine the digital signal processor, digital-to-analog converter

[1] Jia, Z., & Campos, L. A. (Eds.). (2019). Coherent Optics for Access Networks. CRC Press.

[2] https://www.infinera.com/wp-content/uploads/The-Advantages-of-InP-Photonic-Integration-in-High-Performance-Coherent-Optics-0223-WP-RevA-1219.pdf

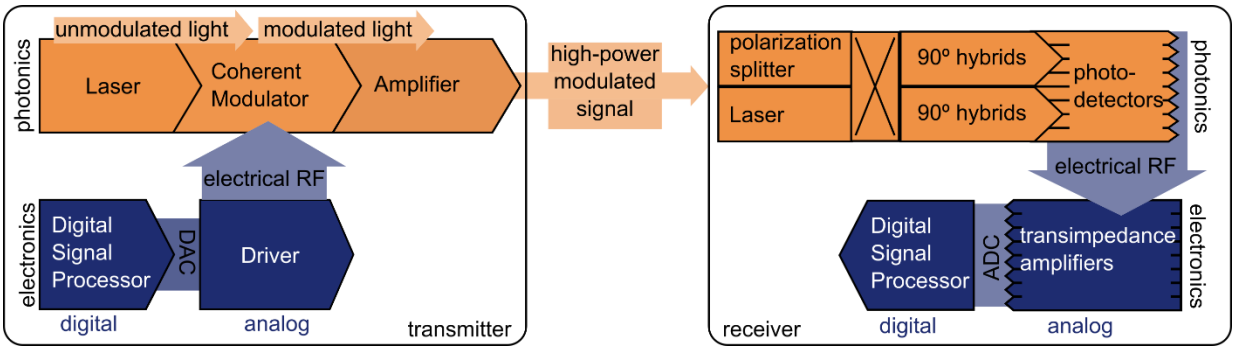

Figure 2: Photonic and electronic components of modern coherent transceivers.

(DAC) and analog-to-digital converter (ADC), in one single chip for transmitter and receiver to reduce the size, cost and complexity of the system[3]. Analog electronics interface with the photonic functions: the driver provides the voltages needed for the modulator based on the DAC signals and transimpedance amplifiers translate the current from the photodetectors to voltages for the ADC. The photonics on the transmitter side include a laser, a coherent modulator and an amplifier. The coherent modulator makes use of splitters, phase shifters, polarization rotators, and polarization beam combiners. On the receiver side, polarization splitters, 90º hybrids; and photodetectors are combined – all of which can be realized in a generic InP integration platform.

InP Photonic Integration

InP photonic integration offers the possibility to combine all of the optical transmit and receive functions on a single chip, offering monolithic integration of lasers, amplifiers, coherent modulators and photodetectors. Even though thermo-electric stabilization is required for InP coherent modulators, the InP photonics platform offers a far higher level of integration as well as ultra-high baud rate modulators for high-performing transceivers, which are lacking in SiP[2].
EFFECT Photonics has recently announced,

"the world's first fully integrated coherent PIC"

for a pluggable coherent transceiver[4]. Integrating an ultra-narrow linewidth full band tunable laser, wavelength locking and on-chip amplification for transmitter and receiver on a single chip, advertising it with unprecedented optical signal-to-noise-ratio and reduced power consumption.

Discuss your application with us

If you are interested in knowing more about the capabilities and use of InP PIC technology for coherent communication, contact JePPIX. The JePPIX Pilot Line provides low entrance-threshold to mature-manufacturing, enabling high-TRL development in a scalable design kit driven process, taking open access InP PICs from proof of concept to industrial prototyping levels.

InP Photonic Integrated Circuits (PICs)

Optical chips or PICs can contain tens to hundreds of optical components. While electronic integrated circuits (EICs) consist of transistors, capacitors, and resistors, a PIC consists of, for example, lasers, modulators, photodetectors, and filters, all integrated on a single substrate. Several application fields, such as data- and telecom, sensing, and lidar are already using or are considering the use of PICs for their products. This PIC technology is accessible to users without a cleanroom, through so-called multi-project wafer runs and open access foundries. InP based technology is commercially available through SMART Photonics and Fraunhofer Heinrich-Hertz-Institut. Access is individually coordinated by JePPIX.

[3] https://www.ciena.com/insights/articles/Coherent-optical-turns-10-Heres-how-it-was-made-prx.html

[4] https://effectphotonics.nl/press-release/effect-photonics-tapes-out-worlds-first-full-photonic-integration-coherent-pic/