mm-Wave Wireless Communications based on Silicon Photonics Integrated Circuits.

Rommel, Simon; Heck, Martijn; Vegas Olmos, Juan José; Tafur Monroy, Idelfonso

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Silicon Photonic Integrated Circuits

Why Silicon Photonic Integrated Circuits?

Silicon-on-insulator (SOI) photonic integrated circuits (PICs) are a prime candidate for photonic integration, due to a number of factors:

- Compatible to CMOS technology and fabrication infrastructure
  - Highly accurate, high-yield and mature technology
  - Hybrid photonic and electronic integration
- Operation in the 1.3μm and 1.55μm telecommunications windows
- Large selection of photonic components available
  - Filters
  - Modulators
  - (De-)Multiplexers
  - Mach-Zehnder Interferometers
  - Splitters
  - Photodetectors
- Active components with heterogeneous integration (III/V, InP etc)

Integration of mm-Wave Transmitter

Silicon photonic integrated circuits allow integration of the mm-wave generation setup, including generation of a wavelength comb or two appropriately spaced spectral lines and the modulation for data transmission or sensing.

Photonic-Wireless mm-Wave Systems

Applications

The large bandwidth made available by the use of mm-waves and the flexibility of hybrid photonic-wireless systems benefits not only data communications but also a large range of applications in radar and sensing:

Figure 2. Applications and use cases for mm-waves

System Architectures

Optical generation and delivery of the RF signal to the antenna site allows easy realisation of system setups for both communications and sensing.

Figure 3. System setups for radio-over-fibre communication and sensing systems

mm-Wave Wireless Transmission

Wireless transmission in the W-band based on discrete optical components is demonstrated in the lab at distances up to 70m.

Figure 4. W-band wireless transmission system schematic and experimental setup

millimeter Wave Silicon Photonics for Remote Sensing and Wireless Links

Project Goals

The project will demonstrate that mm-wave transmissions based on silicon photonic integrated circuits may enable the ubiquitous high-speed wireless networks of the future. To this end the steps and goals of the project are:

- Design and test of a PIC for mm-wave signal generation
- Photodiode design and test for mm-wave OE-conversion
- Demonstration of a high speed mm-wave wireless link supporting 100Gbit/s or more

Figure 1. Schematic transmitter setup for a high-capacity hybrid fibre-wireless data communication link and potential for photonic integration

Figure 5. Transmitter (a) and receiver (b-d) eye diagrams @ 2.5Gbit/s

Figure 6. BER as a function of power on the PD for distances of 30m – 70m

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