Silicon Photonics Integrated Circuits for 5th Generation mm-Wave Wireless Communications

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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:

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.

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 2. Applications and use cases for mm-waves

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

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

Figure 5. Large scale fading behavior of the W-band wireless channel, showing good agreement with the Friis loss model

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