



Recent Research

Wireless communication at a billion bits per second

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Millimeter-wave wireless communication using a frequency of 60 GHz is capable of multi-Gbps data rate, that is, billions of bits per second. This is a considerable improvement over current WiFi (IEEE 802.11n) using 2.4/5 GHz, which is limited to around 50 Mbps - a few hundred million bits per second.

However present millimeter-wave transceivers are implemented by a heterodyne architecture, which needs a large chip area and a very large power consumption of around 2 W. The phase-noise performance has to be improved for realizing a direct-conversion architecture to reduce the area and power consumption.

Now, Kenichi Okada and colleagues at Tokyo Institute of Technology have realized the world's first millimeter-wave direct-conversion transceiver using an injection-locked oscillator.

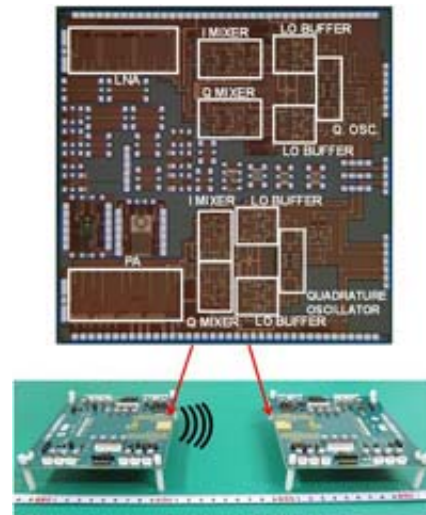
A 65-nm CMOS process was used to implement the direct-conversion transceiver. To improve the phase noise, an injection-locking technique was developed and applied to the transceiver to realize it in the direct-conversion architecture.

A combination of 20-GHz phase-locked loop and 60-GHz quadrature injection-locked oscillator has achieved a phase noise of -95 dBc/Hz@1 MHz-offset at 60 GHz. The phase noise is 20 dB better than in previous work. The direct-conversion transceiver using the injection-locked oscillator is capable of a range of modulation schemes including BPSK/QPSK/8PSK/16QAM, and a data rate of 11 Gbps is realized by 16QAM. The maximum communication distance is 2.7 m, and the power consumption is 252 mW for transmitting and 172 mW for receiving.

The developed chip is designed for IEEE 802.15.3c and IEEE 802.11ad conformance, and can be integrated into a smart phone with 6 Gbps wireless data rate.

Reference:

- Authors: Kenichi Okada, Ning Li, Kota Matsushita, Keigo Bunsen, Rui Murakami, Ahmed Musa, Takahiro Sato, Hiroki Asada, Naoki Takayama, Shogo Ito, Win Chaivipas, Ryo Minami, Tatsuya Yamaguchi, Yasuaki Takeuchi, Hiroyuki Yamagishi, Makoto Noda, and Akira Matsuzawa.
- Title of original paper: A 60-GHz 16QAM/8PSK/QPSK/BPSK direct-conversion transceiver for IEEE802.15.3c.
- Journal, volume, pages and year: *IEEE Journal of*



A 60 GHz CMOS direct-conversion transceiver (4 mm × 4 mm)

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