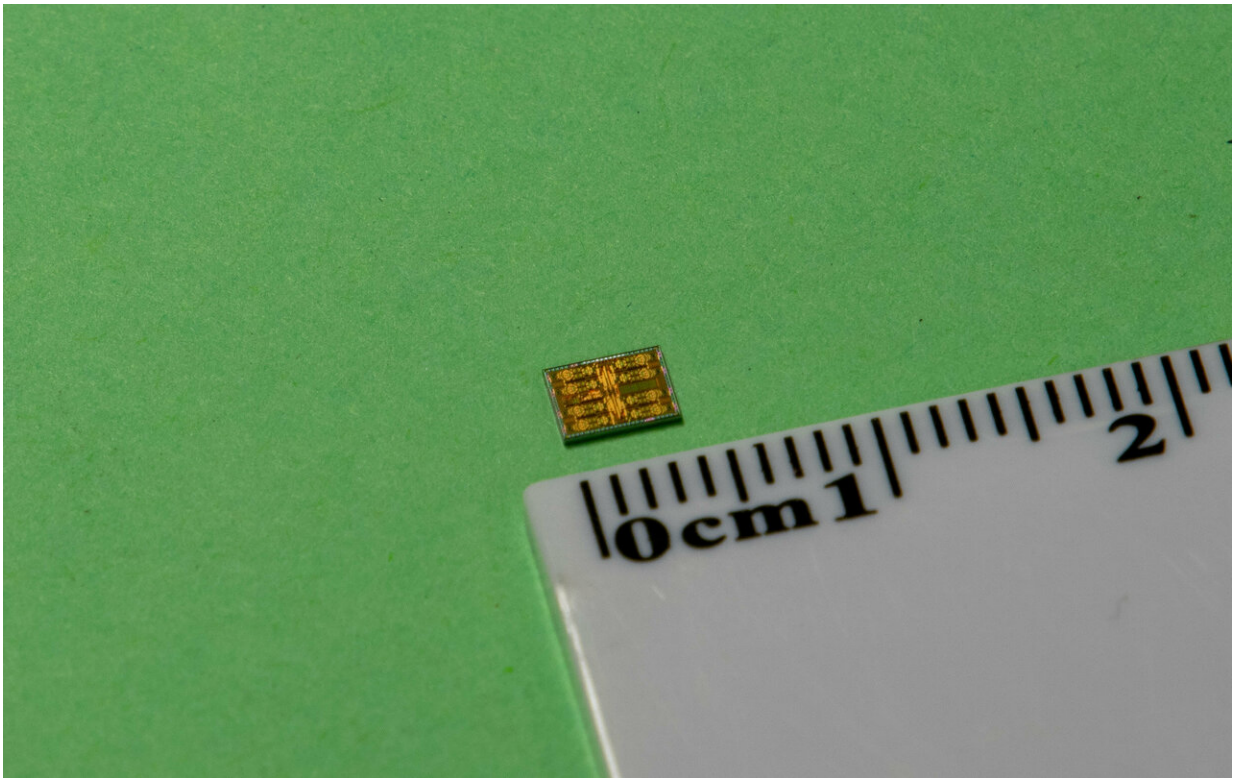
Gearing up for 5G: A miniature, low-cost transceiver for fast, reliable communications

February 19 2019



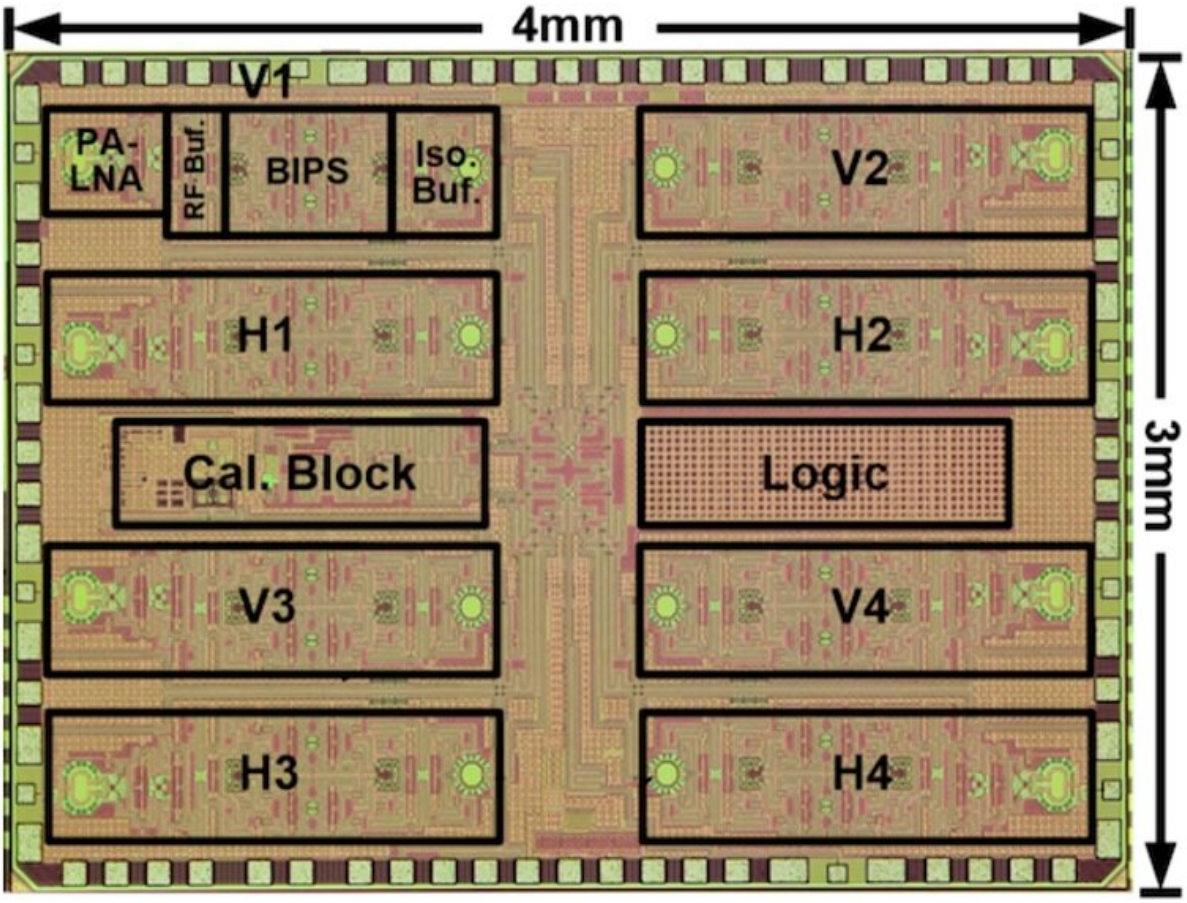
The proposed chip, fabricated in a standard 65-nanometer CMOS process, takes up a total area of just 12 mm^2. Credit: Atsushi Shirane

Researchers at Tokyo Institute of Technology (Tokyo Tech) have designed a 28 GHz transceiver that integrates beamforming with dual-polarized, multiple-input and multiple-output (MIMO) technology.

Measuring just three by four millimeters, this tiny transceiver could improve the performance of fifth-generation cellular network (5G) and Internet of Things (IoT) devices.

A team of researchers led by Kenichi Okada at Tokyo Tech's Department of Electrical and Electronic Engineering has devised a strategy with a clear eye on supporting high-speed mobile data access using the millimeter-wave spectrum for next-generation 5G wireless networks. Their proposed 28-GHz transceiver combines beamforming, a highly efficient signal processing method, with dual-polarized MIMO capabilities, meaning that its array of antennas can respond to both horizontal and vertical radio waves at the same time.

Preliminary testing showed that the maximum data rate achieved was 15 gigabits per second (Gb/s) in the 64-QAM format. This data rate is 25 percent higher than that achieved by previous comparable models. As a continuation of the group's work on developing top-level transceivers using minimal components, the researchers achieved a design around half the size of current technology. The smaller the chip, the better for 5G, owing to the anticipated demand for high-performance, area-efficient transceivers for use in tiny and portable sensors and devices.



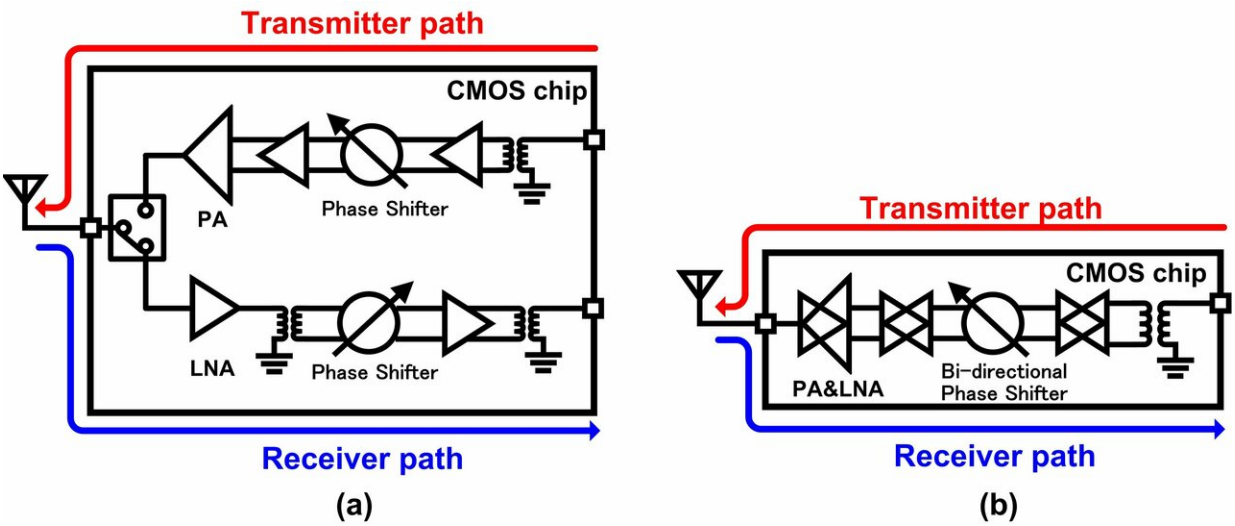
The transceiver consists of a total of four horizontal (H1-4) and four vertical (V1-4) array orientations. Credit: Atsushi Shirane

"Compared with the conventional switch-based bi-directional approach, our bi-directional amplifier completely shares the inter-stage matching networks between the transceiver and the receiver. Thus, the required on-chip area is further minimized," Okada explains.

Japan is currently stepping up efforts to prepare for 5G ahead of the Tokyo 2020 Olympic and Paralympic Games. There are expectations for 5G services to enable higher data throughput for applications such as live-streaming high-definition video and for potentially trillions of new IoT

devices that can share data around the clock, as well as to increase the speed and responsiveness of communication networks overall.

Further details of the study are being presented as part of the 4G/5G Transceivers Session at the 2019 International Solid-State Circuits Conference (ISSCC) to be held in San Francisco from 17 to 21 February 2019.



(a) The conventional transceiver structure and (b) the newly proposed bi-directional transceiver structure, which is much more compact. Credit: Atsushi Shirane

Provided by Tokyo Institute of Technology