Bandwidth for ubiquitous 5G and beyond might be just around the corner with this new microsystem

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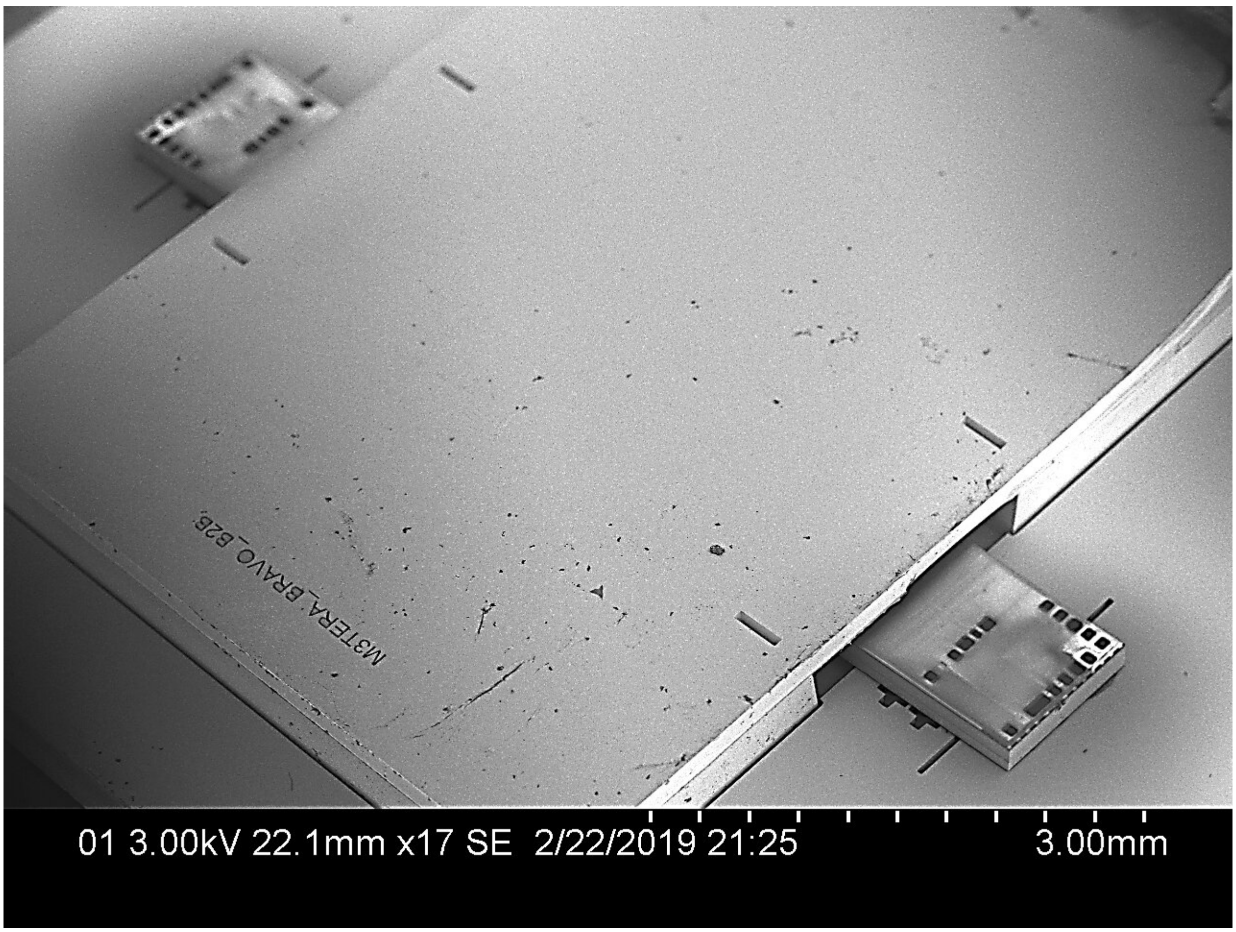

A close-up look at the system created for commercial exploitation of the THz band. Credit: James Campion

A new way to exploit the terahertz (THz) radio spectrum could prove cost-effective and reliable enough to commercialize new, under-used frequencies for high volume applications for 5G and beyond.

Developed at KTH Royal Institute of Technology, a new generation of methods and micro hardware is currently being used in a testbed by networks supplier Ericsson to run a fully-functional wireless link operating between 110-170 GHz at its Lindholmen lab facility in Sweden.

Lead author James Campion from the Department of Micro and Nanosystems at KTH, says the solution involves exploiting silicon to create affordable, scalable alternatives to existing hardware solutions. The authors reported their results recently in *IEEE Transactions on Terahertz Science and Technology*.

"We introduce the first integration of silicon-germanium active circuitry with silicon-micromachined waveguides," he says. "And for the first time, industrial-grade processes are being used to manufacture all system components, with automated assembly of the THz systems."

He says the integrated microelectromechanical actuators, which are possible in silicon-micromachined processes, enable the creation of low-cost tuneable systems in this approach. The micromachined waveguides are fabricated at KTH's Electrum Laboratory in Kista, with state-of-the-art integrated circuits designed by researchers at Ericsson and Chalmers fabricated at Infineon Technologies.

The recognition that THz frequencies are needed to support continued growth in data traffic around the world has led to a hunt for ways to enable the 100-500 GHz band for commercial use. In the U.S., the bands between 100-300 GHz have been allocated by the Federal Communications Commission for use in communications applications, providing a pathway for future commercialization.

Campion says that the solution overturns two major barriers to providing compact, low-cost point-to-point high-speed communication links in this frequency space. First is the cost of active circuitry, which is now based on fragile, thin substrates that can only be fabricated in small volumes; second, the metallic waveguides requiring precision on the order of tens of microns.

"This limits THz frequencies to one-off prototypes or scientific and research applications only," Campion says. These traditional systems also require precise manual assembly and cannot be produced in bulk, he says.

"The terahertz frequency spectrum must be used to support the continuous increases in global wireless data traffic," he says. "5G will not be sufficient—new solutions with higher bandwidth are required beyond 5G."

"Our approach can greatly reduce the cost of hardware and thereby enable widespread use of the THz spectrum, while the scalability allows for distributed applications for the internet-of-things and massive networks of miniaturized sensors."

More information: James Campion et al. Toward Industrial Exploitation of THz Frequencies: Integration of SiGe MMICs in Silicon-Micromachined Waveguide Systems, *IEEE Transactions on Terahertz Science and Technology* (2019). DOI: 10.1109/TTHZ.2019.2943572

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