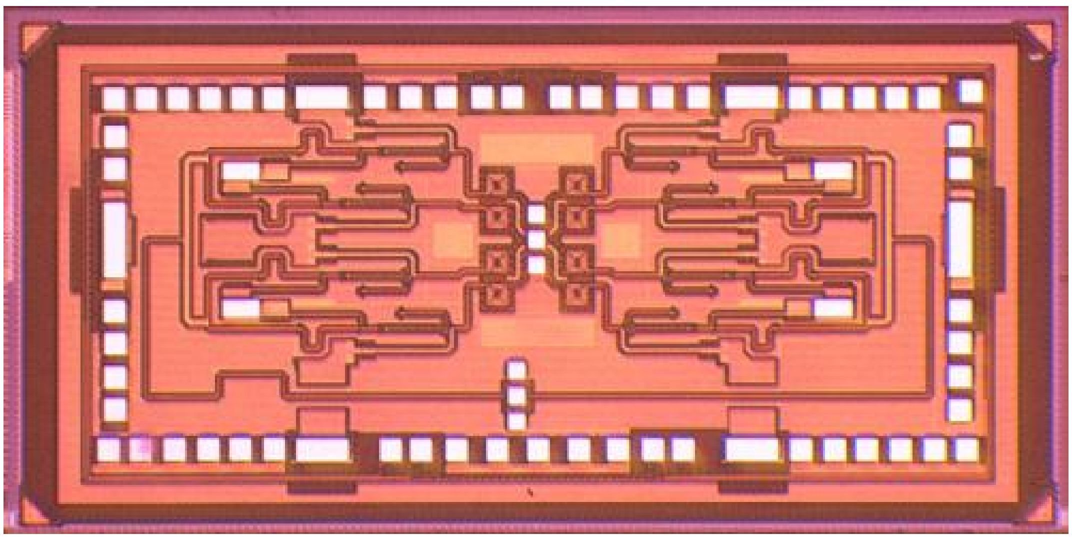
World record silicon-based millimeter-wave power amplifiers

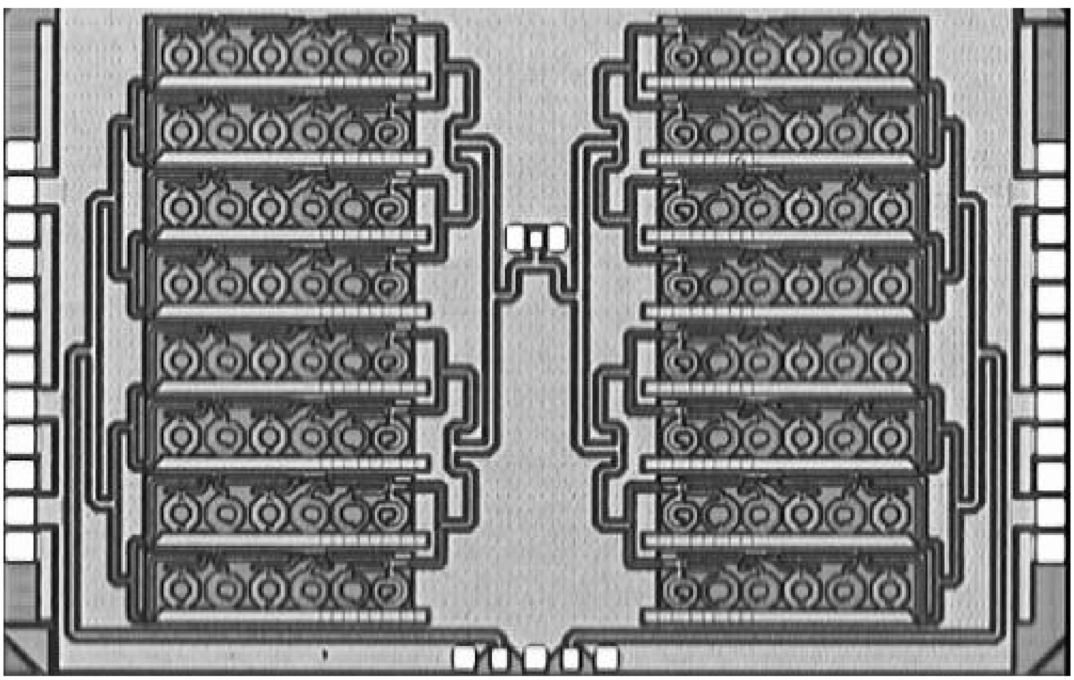
March 27 2013



Credit: Columbia University

Two teams of DARPA performers have achieved world record power output levels using silicon-based technologies for millimeter-wave power amplifiers. RF power amplifiers are used in communications and sensor systems to boost power levels for reliable transmission of signals over the distance required by the given application. Further integration efforts may unlock applications in low-cost satellite communications and millimeter-wave sensing.

The first team, composed of performers at the University of Southern California and Columbia University, achieved output power levels of nearly 0.5 W at 45 gigahertz with a 45 nanometer silicon complementary metal oxide semiconductor (CMOS) chip. This world record result for CMOS-based power amplifiers doubles output power compared to the next best reported CMOS millimeter-wave power amplifier. The chip design used multiple stacked 45 nanometer silicon-on-insulator CMOS devices for increased effective output voltage swing and efficient 8-way on-chip power-combining. Results will be reported at the 2013 Institute of Electrical and Electronics Engineers Radio Frequency Integrated Circuits Symposium.



Credit: MIT

The second team, made up of MIT and Carnegie Mellon University researchers, demonstrated a 0.13 micrometer silicon-germanium (SiGe) BiCMOS power amplifier employing multistage power amplifier cells and efficient 16-way on-chip power-combining. This amplifier has achieved power output of 0.7 W at 42 gigahertz, a 3.5 times increase in output power compared to the next best reported silicon-based millimeter-wave power amplifier; this result was reported at the 2013 International Solid-State Circuits Conference (ISSCC).

"Millimeter-wave power amplifiers have been demonstrated at this power level before, but this is a record with silicon-based technologies," said Sanjay Raman, DARPA program manager. "Producing this level of output with silicon may allow integration on a chip with complex analog and digital signal processing. In the 42-25 GHz range, this would enable high bandwidth/data-rate transmitters needed for satellite communications at potentially very low cost and size, weight and power."

Silicon-based circuit techniques developed under the ELASTx program may eventually be applied to even higher performance compound semiconductor devices, such as gallium nitride high electron mobility transistors. These architectural breakthroughs will be investigated for such integration opportunities under a different DARPA effort, the Diverse Accessible Heterogeneous Integration (DAHI) program.

More information: These breakthroughs were achieved under the Efficient Linearized All-Silicon Transmitter ICs (ELASTx) program.

Provided by DARPA

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