Institute of Microelectronics
A*STAR

TECHNICAL RELEASE

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A*STAR IME DEVELOPS SILICON-BASED 135 GHZ CIRCUIT TECHNOLOGY FOR FUTURE GENERATION WIRELESS COMMUNICATIONS

Researchers from A*STAR Institute of Microelectronics (IME) are exploiting high radio frequency to develop future high speed wireless communication products. Using silicon-based materials, the team have successfully realised high speed chips that can wirelessly communicate data at a rate of 10 Gbps on 135 GHz band — more than 100 times faster than present day Wi-Fi[1]. The new millimetre-wave communication system will allow three Blu-ray movies (each of 25 GB[2] capacity) to be wirelessly downloaded in a minute. IME's research will open up a myriad of consumer applications for home entertainment, mobile electronics and can potentially eradicate messy cables for communicating information between multiple devices.

The speed at which wireless data can be transferred is largely limited by the carrier radio waves. Today's fastest wireless technologies such as Wi-Fi operate in the gigahertz frequency range. Until recently, millimetre-wave frequencies were limited to niche areas for military and space applications as conventional approaches use costly materials based on Group III-V elements such as gallium arsenide. The ability to fabricate millimetre-wave technology with traditional silicon-based materials is a significant milestone to extend millimetre-wave frequencies to commercial applications since mature chip making processes can now be utilised.

Elaborating on their research milestone, Dr Xiong Yong Zhong, Principal Investigator of IME's Millimetre-wave and Terahertz programme, said, "We have adopted a multi-pronged approach to build the high-speed millimetre-wave transmitter and receiver chip set that comprises critical technologies in the form of a low noise amplifier – with enhanced gain-boosting 3D configuration to improve gain and noise performance; a high speed modulator; a high speed variable gain amplifier – includes circuits that allow high speed communication over wide dynamic range of 36 dB and a 3D micromachining microstrip to waveguide transition structure – integral for minimising signal loss."

"In order to enable such high data rate of 10 Gbps on 135 GHz carrier signal, the modulator plays an important role to convert message signals to a suitable form before 135 GHz wireless transmission. To attain high fidelity of the data signals transmitted, shielding ground structures and a novel combination of bias and matching networks were applied to reduce the noise interferences to less than 10 dB. Without these structures, noise levels can be as high as 15 dB," continued Dr Xiong.

[1] Wi-Fi technology for wireless communication based on newest IEEE standard 802.11 n that can support data rates of more than 100 Mbps.
[2] 25 GB = 200 Gb

Professor Dim-Lee Kwong, Executive Director of IME, said, “After two years of intensive research and development, we have developed critical building blocks for receivers and transmitters based on our established millimetre-wave and terahertz platform that will enable millimetre-wave chips to be produced cost-effectively. Our team will be carrying out 3D circuit structure design study for increasing the strength of signals for better communication performance.

About the Institute of Microelectronics (IME)

The Institute of Microelectronics (IME) is a research institute of the Science and Engineering Research Council of the Agency for Science, Technology and Research (A*STAR). Positioned to bridge the R&D between academia and industry, IME's mission is to add value to Singapore's semiconductor industry by developing strategic competencies, innovative technologies and intellectual property; enabling enterprises to be technologically competitive; and cultivating a technology talent pool to inject new knowledge to the industry. Its key research areas are in integrated circuits design, advanced packaging, bioelectronics and medical devices, MEMS, nanoelectronics, and photonics. For more information, visit IME on the Internet: http://www.ime.a-star.edu.sg.

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A*STAR supports Singapore's key economic clusters by providing intellectual, human and industrial capital to its partners in industry. It also supports extramural research in the universities, hospitals, research centres, and with other local and international partners.

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