PRESS RELEASE

Project on energy-saving mobile radio base stations wins silver in innovation competition

The Fraunhofer Institutes IIS and IAF together with the University of Freiburg/INATECH win second place with their joint project "EdgeLimit – Evaluation of Power Electronics in Modern Edge Cloud Systems" in the innovation competition "Electronics for Energy-Saving Information and Communications Technology" launched by the German Federal Ministry of Education and Research (BMBF). The project consortium is funded by the BMBF to realize their solution for energy-saving mobile radio base stations.

With the aim of promoting innovative solutions for energy-saving information and communication technologies (ICT), the German Federal Ministry of Education and Research (BMBF) launched the "Electronics for Energy-Saving ICT" innovation competition last year as part of its Green ICT Initiative. The Fraunhofer Institutes IIS and IAF and the University of Freiburg/INATECH were able to prevail among ten top-class research teams with its project proposal for energy-saving mobile phone base stations and won the second place. As a winner, their project proposal EdgeLimit will receive exclusive funding from the BMBF for its realization.

"The resource consumption of advancing digitization is taking on ever greater dimensions. We must ensure through research and development that digitization becomes part of the solution in the fight against climate change and not part of the problem," is the appeal of the Federal Research Minister Anja Karliczek. This is particularly true for information and communication technologies, which will have to become much more energy-efficient in the future. New key technologies and a shift in thinking toward demand-based performance requirements are needed for ICT. This is exactly where Fraunhofer IAF and its partners come in with their project EdgeLimit.

The project consortium researched innovative semiconductor technologies and approaches towards more energy-efficient mobile communication antenna systems in their prize-winning preliminary project "EdgeLimit – Evaluation of Power Electronics in Modern Edge Cloud Systems." New mobile communications systems achieve enormous increases in data rates, but the energy consumption of these systems must be reduced at least to the same extent.

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The project EdgeLimit presents a concept for the use of novel power semiconductors for high-frequency amplifiers in 5G base stations for the new mm-wave frequency range at 26-34 GHz based on aluminum scandium nitride (AlScN). The project not only offers enormous potential savings in energy consumption and CO2 emissions, but also an extraordinary level of innovation in the field of high-frequency electronics with a major leverage effect for microelectronics in Germany. This finds expression in the significant participation of industry in the second phase of the project, with a planned cooperation with Nokia Bell Labs, United Monolithic Semiconductors GmbH, Deutsche Telekom AG (associated) and Nokia Solutions and Networks GmbH & Co. KG.

More efficient antenna amplifiers

Modern networked ICT systems increasingly have capacities for collecting and processing information at the edge of the network in addition to the central data-processing infrastructures (cloud), as well as systems for transferring data between cloud and edge. "This is where the EdgeLimit project comes in. Our goal is to realize a complete antenna system, a so-called Remote Radio Head (RRH), which will enable more energy-efficient transmission in the millimeter-wave range of 5G while halving losses at the same time," explains project coordinator Prof. Dr. Rüdiger Quay, deputy director of Fraunhofer IAF and professor for Energy-Efficient Radio-Frequency Electronics.

"As a concrete example, we are working on edge AI solutions that take energy consumption into account at the design stage, keeping it as low as possible," says Prof. Dr. Albert Heuberger, Executive Director of the Fraunhofer Institute for Integrated Circuits IIS. By looking at the energy consumption of the radio units (massive MIMO antennas) in the 5G Testbed Industry 4.0 at Fraunhofer IIS, energy-efficient, distributed, secure edge cloud systems can be built and tested.

The project partners are using the novel power semiconductor AlScN to develop pioneering high-frequency components. "The semiconductor technology we are pursuing, with which we have already gained a lot of experience at IAF, has the potential to fundamentally increase power efficiency in integrated circuits (MMICs) through better matching, higher gain and higher power density," elucidates Prof. Quay. Due to its high current-carrying capacity, AlScN allows significant advantages over established semiconductors such as silicon, GaAs and AlGaN/GaN. Based on this material, Edge-Limit aims to at least double power efficiency at the amplifier-level in new cellular frequencies as well as halve losses in power converters.

Intelligent and demand-oriented ICT

More energy-efficient electronics alone cannot counter the exponentially increasing energy consumption of ICT. The horizon of physical energy efficiency is closer than that of the realizable data throughput, which is growing faster and thus promoting a rebound effect. One solution is the intelligent and adaptive management of mobile

communications systems, which ensures that energy is used as needed - an approach with enormous energy-saving potential.

To enable smart ICT, innovative power electronics architectures are required that allow electronics to be switched on and off as needed without compromising the latency of data transmissions. "At the network level, large amounts of energy should be saved by intelligently networking transmission modules and antennas with on-demand control, for example in factory networks such as the new Bosch semiconductor fab in Dresden or for fast video transmission to cars," says Prof. Quay. "For this purpose, we are developing the necessary high-frequency electronics in EdgeLimit that are capable of being connected to intelligent network management. Because one thing is certain: In the further development of ICT, we must give resource efficiency at least the same priority as performance enhancement. This is the only way to reduce CO2 emissions as digitization advances."

About the project EdgeLimit

The joint project "EdgeLimit – Evaluation of Power Electronics in Modern Edge Cloud Systems" aims to significantly improve the power density and efficiency of high-frequency amplifiers in 5G base stations on the basis of aluminum scandium nitride (AlScN) and thus make a sustainable contribution to more resource-efficient ICT. Intended project partners: Fraunhofer Institute for Applied Solid State Physics IAF, Fraunhofer Institute for Integrated Circuits IIS, University of Freiburg (Department of Sustainable Systems Engineering – INATECH), Nokia Bell Labs, United Monolithic Semiconductors GmbH, Deutsche Telekom AG (associated), Nokia Solutions and Networks GmbH & Co. KG

About the innovation competition "Green ICT"

The innovation competition "Electronics for Energy-Saving Information and Communications Technology" is part of the initiative "Green ICT" in the action plan "Natürlich.Digital.Nachhaltig." of the German Federal Ministry of Education and Research (BMBF) and is a building block of the Climate Protection Program 2030 of the German Federal Government. Three winning teams were selected, including Fraunhofer IAF and its partners. The winning teams can now submit their research project designed in the competition to the BMBF for further funding and will receive funds of 12 million euros for this purpose.

About the 5G Testbed Industry 4.0 at Fraunhofer IIS

Connected manufacturing: The 5G Industry 4.0 test bed at Fraunhofer IIS is an open environment for testing specific customer use cases in industry and logistics. It employs the latest mobile technology under real-life conditions in a stand-alone 5G campus network. 5G can considerably boost the performance of wireless connections in an industrial setting, thereby opening up new possibilities for implementing more complex and security-critical applications wirelessly. Testing applications with 5G early on accelerates the move toward fully connected, flexibly customizable production, assembly and logistics processes.
More information: https://www.iis.fraunhofer.de/5Gtestbed

About Fraunhofer IAF

The Fraunhofer Institute for Applied Solid State Physics IAF is one of the world's leading research institutions in the fields of III-V semiconductors and synthetic diamond. Based on these materials, Fraunhofer IAF develops components for future-oriented technologies, such as electronic circuits for innovative communication and mobility solutions, laser systems for real-time spectroscopy, novel hardware components for quantum computing as well as quantum sensors for industrial applications.
With its research and development, the Freiburg research institute covers the entire value chain - from materials research, design and processing to modules, systems and demonstrators.
