

PRESS RELEASE

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First software-defined 5G New Radio demonstration over GEO satellite

Satellite-enabled 5G services have the potential to provide worldwide connectivity. For the first time now, selected extensions of 5G New Radio (NR) to support non-terrestrial networks (NTN) have been successfully demonstrated over a geostationary (GEO) satellite. The Munich Center for Space Communications of the Bundeswehr University Munich carried out the bidirectional over-the-air tests based on the Fraunhofer Institute for Integrated Circuits IIS's extended 5G New Radio protocol stack for satellite.

When transmitted via GEO satellites, radio signals have to bridge great distances. This leads to delays, so that an enhanced 5G air interface is required. These challenges are addressed in the current work program for Release 17 of 5G NR within the 3rd Generation Partnership Project (3GPP) standardization by specifying new features supporting non-terrestrial networks in 5G.

In order to provide an early proof of concept, Fraunhofer IIS and the Munich Center for Space Communications (Bundeswehr University Munich) recently tested some of the planned extensions for 5G NR via GEO satellite. The over-the-air demonstration was conducted within the 5G METEORS program, an ARTES MakerSpace for 5G and satellite communication funded by the European Space Agency (ESA).

Bidirectional transmission over GEO satellite

During the over-the-air tests, the user equipment (UE) performed the initial connection setup to the 5G base station (gNB) by using a specifically adapted random access procedure for 5G over satellite. After the successful setup of the connection, the 5G uplink and downlink transmission signals were decoded with two different modulation schemes, namely QPSK and 16-QAM. Furthermore, a 5G timing advance procedure, which worked smoothly, was tested to keep the UE synchronized to the gNB.

The transmissions utilized a bandwidth of 10 MHz in uplink and downlink. Both the UE and the gNB were located on ground. The round-trip time of the system from gNB to UE and back was measured between 530 and 570 milliseconds.

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Software-defined 5G New Radio

The 5G base station as well as the 5G user equipment used in the experiments are fully software-defined solutions. Both components are based on OpenAirInterface (OAI), an open-source implementation of the 5G New Radio protocol stack, which runs on general purpose platforms.

Fraunhofer IIS contributed to OAI with selected features of the 5G NR waveform and the adaptations for satellite communication. Important 5G protocol stack implementations for this successful test were funded as part of the European Union Horizon 2020 EU-Korea project 5G-ALLSTAR.

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The Fraunhofer-Gesellschaft, headquartered in Germany, is the world's leading applied research organization. Its research activities are conducted by 75 institutes and research units at locations throughout Germany. The Fraunhofer-Gesellschaft employs a staff of 29,000, who work with an annual research budget totaling more than 2.8 billion euros.

The **Fraunhofer Institute for Integrated Circuits IIS**, headquartered in Erlangen, Germany, conducts world-class research on microelectronic and IT system solutions and services. Today, it is the largest institute of the Fraunhofer-Gesellschaft. Research at Fraunhofer IIS revolves around two guiding topics:

In the area of **"Audio and Media Technologies"**, the institute has been shaping the digitalization of media for more than 30 years now.

Fraunhofer IIS was instrumental in the development of mp3 and AAC and played a significant role in the digitalization of the cinema. Current developments are opening up whole new sound worlds and are being used in virtual reality, automotive sound systems, mobile telephony, streaming and broadcasting.

In the context of **"cognitive sensor technologies"**, the institute researches technologies for sensor technology, data transmission technology, data analysis methods and the exploitation of data as part of data-driven services and their accompanying business models. This adds a cognitive component to the function of the conventional "smart" sensor.

More than 1100 employees conduct contract research for industry, the service sector and public authorities. Founded in 1985 in Erlangen, Fraunhofer IIS has now 16 locations in 12 cities: Erlangen (headquarters), Nuremberg, Fürth, Dresden, further in Ilmenau, Munich, Bamberg, Waischenfeld, Coburg, Würzburg, Deggendorf and Passau. The budget of 167.9 million euros is mainly financed by projects. 29 percent of the budget is subsidized by federal and state funds.

Detailed information on: www.iis.fraunhofer.de/en