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Ultrafast 5G mobile broadband thanks to millimeter-wave band technology

The great ambition of the networked society is to connect everything, everywhere, all the time. But the ideal of seamless communications poses fundamental challenges to legacy networks that the new **5G communication networks** currently under development need to solve. One of such challenges is supporting the significant growth of traffic demands. **Next generation services** such as **mobile cloud service, gaming, social-networking applications and 3D immersive applications** require massive capacity and higher data rates than current 4G networks are unable to sustain.

In the framework of the **mmMAGIC 5GPPP European research project**, researchers at **IMDEA Networks** in collaboration with 18 partner organizations, have developed and designed a new mobile radio access technology for deployment in mm-wave frequencies, a highly promising candidate solution for efficient high capacity data delivery.

Millimeter-wave (mm-wave) systems exploit frequencies above 10 GHz. Communications at such high frequencies pose unique challenges. On the one hand, mm-wave systems achieve data rates that are orders of magnitude higher than current systems operating at lower frequencies. On the other hand, mm-wave links experience high variability in channel quality due to high propagation loss and unfavorable atmospheric absorption. Hence, the fundamental question the **mmMAGIC** project aimed to answer is: how can we efficiently overcome the challenges and benefit from the potential gains arising from the use of mm-wave frequencies?

The mmMAGIC solution is a **new radio system concept for mobile broadband communications targeting operation in wide-contiguous bands in mm-wave frequencies**. The new radio is a ready-to-use solution that meets the anticipated end-user and traffic demands of the networked society in the 2020 time-frame and addresses the specific challenges of mm-wave bands. In particular, the new radio concept takes advantage of novel channel models proposed in the framework of the project and provides a new antenna design with hybrid beamforming capabilities. The antenna design addresses important practical constraints for real deployment, such as antenna size, cost and complexity. The validity of the system design has been corroborated by hardware-in-the-loop experiments, showing its effectiveness under real channel conditions and with actual hardware.

Within the mmMAGIC project, conceptual enablers that will compose the new mm-wave 5G architecture have been identified and assessed. In addition to the enablers, radio access network and transport functionalities for network integration of mm-wave radio access technology have been introduced. Within the former category, a predictive beam-steering approach has been proposed to improve performance of mm-wave links and relieve part of the time burden caused by beam training procedures. The approach exploits history information about the users' movement patterns and can also be employed for accurate indoor localization systems.

mmMAGIC was an **industry-driven project**, bringing together major infrastructure vendors (**Samsung, Ericsson, Alcatel-Lucent, Huawei, Intel, Nokia**), major European operators (**Orange, Telefonica**), leading research institutes and universities (**Fraunhofer HHI, CEA LETI, IMDEA Networks, Universities Aalto, Bristol, Chalmers and Dresden**), measurement equipment vendors (**Keysight Technologies, Rohde & Schwarz**) and one SME (**Qamcom**). The project operated from June 2015 to June 2017.

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More info:

- Website of the mmMAGIC project: <https://5g-ppp.eu/mmmagic/>
- IMDEA Networks working on ultrafast 5G mobile broadband in millimetre wave bands
- IMDEA Networks research on millimeter-wave communications wins PIMRC 2016 Best Student Paper Award
- AlphaGalileo news service:
 - 'Ultrafast 5G mobile broadband thanks to millimeter-wave band technology'
 - 'Banda ancha móvil ultrarrápida 5G gracias a la tecnología de banda de ondas milimétricas'
- Madri+d Notiweb: 'Banda ancha móvil ultrarrápida 5G gracias a la tecnología de banda de ondas milimétricas'
- EurekAlert! Science News:
 - 'Ultrafast 5G mobile broadband thanks to millimeter-wave band technology'
 - 'Banda ancha móvil ultrarrápida 5G gracias a la tecnología de banda de ondas milimétricas'
- Agencia SINC: 'Banda ancha móvil ultrarrápida 5G con frecuencias de ondas milimétricas'

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IMDEA Networks Institute is a **research organization on computer and communication networks** whose multinational team is engaged in cutting-edge fundamental science and technology. As a growing, English-speaking institute located in Madrid, Spain, IMDEA Networks offers a unique opportunity for pioneering scientists to develop their ideas. IMDEA Networks has established itself internationally at the forefront in the **development of future network principles and technologies**. Our **team** of highly-reputed researchers is designing and creating today the networks of tomorrow.

***Some keywords that define us:** 5G, Big Data, blockchains and distributed ledgers, cloud computing, content-delivery networks, data analytics, energy-efficient networks, fog and edge computing, indoor positioning, Internet of Things (IoT), machine learning, millimeter-wave communication, mobile computing, network economics, network measurements, network security, networked systems, network protocols and algorithms, network virtualization (software defined networks – SDN and network function virtualization – NFV), privacy, social networks, underwater networks, vehicular networks, wireless networks and more...*

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