

Madrid, Spain, November 11, 2019

MINTS: The potential of mmWave technology

Millimeter-wave Networking and Sensing for Beyond 5G, with Joerg Widmer as Principal Investigator, is the base of this project funded by European Union (H2020-MSCA-ITN-2019 / Marie Skłodowska-Curie Innovative Training Networks), from November, 2019 to October, 2023 (Madrid Time)

Europe has been at the very forefront of telecommunication technology since the Global System for Mobile communications (GSM) standard. However, maintaining this position in today's market has become a tremendous challenge. The growth of the EU's telecommunication market is decelerating, new international players (e.g., Huawei) are aggressively expanding their global market share at the expense of traditional European equipment vendors... EU's telecommunication industry is at risk. Communication for industry 4.0 applications and autonomous driving are some of the examples for such highly promising new use cases, with the specific purpose of significantly improving network throughput performance and enabling new applications.

Therefore, the overall aim of the European Training Network MINTS provides a concerted effort to overcome this three challenges: building up a highly skilled labour force in the mmWave technology sector; mitigating the impact of network dynamics and density on the performance and resilience of mmWave networks; and advancing mmWave technology in order to leverage it in emerging EU and international markets.

Challenges into oportunities

In the case of MmWave frequencies (the value of the mmWave technology market is expected to reach EUR 7.63 billion by 2025), their potential (30 GHz to 300 GHz, but usually also frequencies above 10 GHz are included) for future mobile networks led to a significant investment in research in the form of H2020 projects and specifically several large 5G Public-Private Partnership (PPP) projects. Products focusing on such relatively static scenarios as fixed wireless access, WLAN 802.11ad, are already available on the market. However, these products are not designed for mobile environments and may suffer from frequent connection outages due to the inefficiency of their beamforming and interference control techniques.

MINTS proposes, in any case, turning the challenges into new oportunities. Although high directionality and penetration loss pose challenges, they are outweighed by the potential gains in data rate and reduction in latency because of the extremely small transmission delay. In addition, the range limitations and directional communication also bring important advantages, including low interference and high spatial reuse for extremely dense deployments. And mmWave and conventional low frequency communications have highly complementary characteristics and integrating both allows to simultaneously provide high performance as well as reliability and resilience. These architecture and protocol design choices at the physical layer, the network layer, and the application itself are highly interdependent and need to be considered jointly.

The primary goal of this European Training Networks (ETN) is to train Early Stage Researchers

(ESRs) to co-create the required mmWave algorithms and protocols together with the novel use cases mmWave technology is supposed to enable. Specifically, providing continuous and reliable connectivity in extremely dense and highly mobile scenarios is an open challenge, and understanding how to tune a mmWave network towards a specific future application with its particular mix of throughput, latency and resilience requirements is still in its infancy. This is not only important for ubiquitous mobile broadband services, but is a key requirement for the forthcoming industry 4.0, vehicle-to-everything (V2X), augmented reality (AR) and similar new applications, adding new important network capabilities and calling for adaptive and tailored network solutions.

To be at the forefront of these markets, a new generation of highly skilled labour is needed: cross-disciplinary knowledge in electrical/communication engineering and computer science... not yet available in Europe. So, MINTS offers the first training program on mmWave networking that covers the full stack from the physical layer to the application, together with a specific focus on the complex inter-layer interactions. With beneficiaries and partner organisations as leading members of large EU initiatives (5G PPP), EU projects (H2020), and comprise major telecommunication manufacturers (e.g., Nokia, NEC, Sony) and operators (e.g., Italtel, Proximus). Architecture and network components that jointly address both the fundamental challenges of mmWave systems and the highly important application-specific problems.

Source(s): IMDEA Networks Institute

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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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