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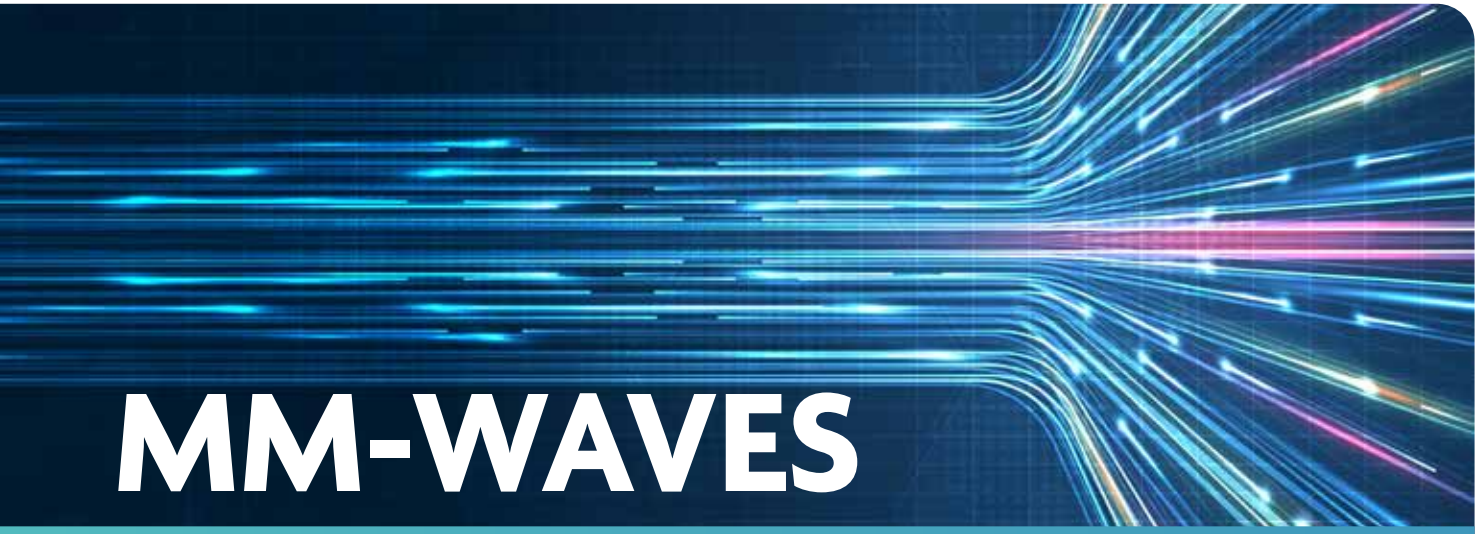
SMART INDUSTRIES



MM-WAVES

Last mile broadband wireless connectivity through the unlicensed 60 GHz frequency band

The telecom industry faces a massive, worldwide challenge. Soon, the existing technologies will no longer be able to deliver the required capacity for broadband connectivity. To bridge the last mile between the main telecommunication network and the end user's home or business, Fiber-To-The-Home is a promising solution. However, the roll-out of this technology quickly becomes prohibitively expensive. Also connecting customers that are far away from the existing fiber network may take a long time.

An alternative is FWA (Fixed Wireless Access), which is about to start a massive growth. Its total cost of ownership is expected to be much lower than that of fiber deployments, while still providing end users with high-speed wireless connection. The imec.icon MM-WAVES project built upon a state-of-the-art radio module to implement FWA through millimeter wave technology, more specifically in the 60 GHz frequency band that supports high-rate, low-latency, unlicensed wireless communication.

To realize FWA, the project's objective was to optimize the phased array configuration of the radio module. Moreover, the consortium planned to design a mechanical enclosure suited for outdoor usage without impacting the signal.

A further requirement was a thorough characterization of the wireless radio channel and the induced electromagnetic field exposure, as well as defining approaches for enhanced mesh networking for mm-wave communication. Both are required to ensure a reliable and compliant operation and to demonstrate the capability of network-grade connectivity.

THREE MAIN OUTCOMES

1. A unique radio solution

In this project, Pharrowtech managed to realize the only radio solution to date capable of offering reliable, carrier-grade performance for the FWA market in high volume. In a package with a Renesas baseband processing chip, the technology offers a low-cost, easy-to-deploy alternative to fiber. It does so by leveraging technical innovations such as fast beamsteering.

In addition, Unitron designed a suitable enclosure, protecting the complete stack of hardware from all weather conditions. Special attention went to the design of the radome, of which Unitron was able to keep the impact on the signal as small as possible, with an attenuation of only 0.5 dB on the mainlobe and less than 2 dB on the sidelobes.

2. A thorough characterization of the channel

Successfully deploying an FWA network requires a robust and reliable wireless connection. To that end, the imec-WAVES lab has experimentally characterized the radio channel, accounting for the typical use case conditions for FWA such as rain or vegetation along the signal path. It was also observed that reflected signals can be used for signal transmission, with reflection attenuations measured to be below 15 dB. To evaluate the compliance with exposure guidelines, the researchers designed an FWA-specific procedure for exposure assessment.

Further, imec-IDLAB integrated a mesh routing protocol to provide end-to-end routing with specific QoS characteristics, supporting a 15ms local detection link failure time and a 150ms end-to-end path repair time. Furthermore, a centralized network controller was integrated into the routing and link management framework, offering visualization of the network state and topology as well as central control of link and routing protocol management.

3. Successful lab and field trials

The combination of (among others) the Pharrowtech RFIC and Renesas baseband into a plug-and-play, water-proof enclosure enabled the consortium to run successful lab and field trials to showcase a 60 GHz mesh typology in the real world, with a stable 210 m point-to-point link with a throughput of 1.3 Gbps. Within the field trial, interoperability with Telenet's backbone infrastructure was demonstrated.

Setting up and integrating the mesh onto various types of existing infrastructure (building façade, mobile site pylon...) has highlighted the technology's unique selling point of fast deployment. Despite these proven rollout advantages, the MM-WAVES FWA mesh solution as it is today, has not yet sufficiently proven its ability to stand out among other technologies such as coax, fiber and mobile technologies (4G/5G). Key to a telecom operator's (such as Telenet's) service agreement with its customers is the underlying reliability of its solution, typically set at a 99.999% reliability. The partners now work towards this level of reliability, especially through further work on the realization of a stable and optimal meshed typology.

NEXT STEPS

At the successful completion of the project, the partners have defined varying tracks for further commercialization. Pharrowtech will aggressively go to market with both the RFIC and RF module used in this project, ramping risk production in Q1 of 2023 and volume production in Q3. Unitron is using the knowledge from this research project to draw up a commercial feasibility plan of this technology, with a trade-off between product cost, speed of development of potential products, and the matching applications. Unitron pursues this early-stage business development partly in cooperation with Pharrowtech and partly with their existing customers. Telenet, as a leading Belgian ISP, retains a conservative point-of-view on the commercial viability of the solution and would need to see further developments before taking next steps. For imec-WAVES and imec-IDLAB, the expertise gained is very valuable in view of other research projects on next-generation wireless communication systems.

MM-WAVES project partners:

telenet PHARROWTECH UNITRON GROUP GHENT UNIVERSITY

AGENTSCHAP INNOVEREN & ONDERNEMEN Vlaanderen is ondernemen

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FACTS

NAME	**MM-WAVES**
OBJECTIVE	Last mile connectivity using the license-free 60 GHz band
TECHNOLOGIES USED	FWA, Fixed Wireless Access, meshing, mmWave
TYPE	imec.icon project
DURATION	01/10/2020 – 31/12/2022
PROJECT LEAD	Tim Senden, Telenet Group
RESEARCH LEAD	David Plets, imec – WAVES – UGent
BUDGET	2,244,934 euro
PROJECT PARTNERS	Telenet Group, Pharrowtech, Unitron
RESEARCH GROUPS	imec - WAVES - UGent, imec - IDLab - UGent

WHAT IS AN

IMEC.ICON PROJECT?

The imec.icon research program equals demand-driven, cooperative research. The driving force behind imec.icon projects are multidisciplinary teams of imec researchers, industry partners and/or social-profit organizations. Together, they lay the foundation of digital solutions which find their way into the product portfolios of the participating partners.

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