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Budget

€ 5.3 Million

€ 5.1 Million EU-funded



Consortium

9 Partners

5 countries



Duration

42 Months

01/2023 - 06/2026



6GTandem

Unlock new potential of wireless network

A dual-frequency distributed MIMO approach for future 6G applications

Project progress and main achievements

We performed the synthesis and completed a comprehensive literature study on relevant 6G use cases, leveraging on EU project results, published papers, and open reports. We defined and analysed the 6GTandem enabled use cases based on this input, what 6GTandem can offer, and the deployment environments.

All partners have identified the models that are needed to perform simulation-based assessments of the 6G system.

A dedicated measurement campaign has been carried out, hosted by KU Leuven, to characterise the mobility of users in different AR/VR applications.

Further, we drafted several link-budget scenarios and have assessed the different architecture of the radio unit that can be realized in Infineon's proprietary eWLB packaging technology. We

have designed the required components for the radio unit such as the antenna, power amplifiers, low noise amplifiers, phase shifters, switches, and the coupler (MMIC to plastic microwave fiber transition). We have also designed the layout of the antenna-in-package planned to be taped out in July 2024.

Currently, the measurements of the chips in B11 HFC (130nm SiGe-BiCMOS) and B12 HFC (90nm SiGe-BiCMOS) (from the last year tape outs) are ongoing.

The work focusing on the communication system has started with high-level link budget calculations, which has led to a revisiting of the initial networking system ideas. Furthermore, the development of models has started targeting a comprehensive catalogue responding to the model requirements inventory that was established.

The main results of the project so far include analyses of use cases, link budgets and model requirements. The main impact of these results is that they are essential to progress the knowledge and steer the research and development in the project.

Furthermore, initial designs for sub-THz hardware components and antennas have been developed and circuits are measured with

impressive results. Some of these designs have been modified for eWLB packaging and are already fabricated, and are awaiting the upcoming packaging tape out.

Additionally, high-level transmission concepts have been explored. Further R&D will be needed before substantial impact can be anticipated.

Updates on the current status of the work packages

WP2: Use cases, system requirements

Parisa Aghdam (Ericsson AB)

In the first period of the project, we identified the use cases and the relevant deployment scenarios which were summarized in the Deliverable 2.1. We have then assessed the needs for models, resulting in requirements for 21 different models, identified as necessary in the design and evaluation of a 6GTandem system, spanning from high-level system models/simulation chain to models of system individual components, user mobility, data traffic and wireless propagation.

We are now focusing on the architecture, key parameters, and development plans of all the components that constitute the 6GTandem final hardware demonstrator. The parameters of these components will be compiled into a link budget. We are considering two scenarios: 1) the current status of the components in the demonstrator, and 2) a future outlook for what we can expect to see in a few years' time.

WP3: Models, medium-aware waveforms, and algorithms for energy-efficient, robust, and new 6GTandem services

Liesbet Van der Perre (KU Leuven)

The work has first focused on the creation of a comprehensive catalogue of models that are vital to progress the R&D on the wireless communication system, addressing the requirements identified in WP2. The models include equations for losses on the fiber and over-the-air links and expressions to account for non-ideal behavior of the HW and in particular the sub-THz components. Preliminary studies have shown that these will have a main impact on what can and cannot be achieved on the transmission. These models are crucial to progress the system and HW R&D in parallel. Actual parameters of models will be updated in the course of the project and upon measurements of HW components

The dual-frequency operation at the heart of 6GTandem, complementing the sub-THz high-throughput pipes with lower frequency channels providing consistent coverage, to ultimately provide reliable high-capacity, has been at the core of discussions in WP3. Dedicated conceptual approaches to support the challenging application requirements are explored.

The study of candidate waveforms for the sub-THz has progressed based on the findings of the initial link budget calculations and expected distortions introduced by the high-frequency hardware components. Candidates considered originate from the assessment of the relevant state-of-the-art.

WP4: D-MIMO Sub-THz radiostripe

Zulaicha Parastuty (IFAT)

During the past few months, the primary focus was on finalizing the packaging for the first eWLB tapeout. The activities during this period encompassed several key tasks. Firstly, there was a deliberate effort to select various SiGe RFICs, including highly integrated receiver and transmitter options for D-band fiber enabled communication. Additionally, the team embarked on designing multiple versions of the antenna and isolation structures for different packages, encompassing configurations with transmitters, receivers, single- or four-element antennas, fiber couplers with power amplifiers, and even packages with antenna plus dummy chips for direct antenna measurement. Furthermore, optimiza-

tion of the PMF coupler to reduce insertion loss and the selection of a stack-up and the schematic and layout of the PCB were pivotal activities. Notably, the design of a holder for the PMF that aligns with the assembly of the PCB and the eWLB was also part of the focus. Regarding the PMF design, the simulation of the PMF on different bending and twisting scenarios and the development of new fiber material, specifically quartz-doped polymer were performed. On the design of the materials, there have been second round of iteration to improve the PMF material to achieve the targeted performance.



Technical meeting

The 6GTandem team has met on 12th and 13th of March 2024 in Linköping for a technical and general assembly meeting, hosted by the Linköping University. The team discussed the status and progress of all work packages and preparation for the first review meeting that would take place in the following month. Furthermore, the upcoming deliverables were prepared and critical inter-

dependencies were discussed. Besides that, new video interviews were recorded, which are available on our project website. Even after two days of discussions, there is still much left to be deliberated, which will be addressed in our upcoming regular online meetings. We are already looking forward to our next face-to-face meeting planned in fall 2024.

Dissemination activities

Parisa Aghdam at Wireless Future podcast

Our technical lead Parisa Aghdam has been interviewed by Prof. Erik Larsson (from LIU) and Prof. Emil Björnson (KTH) in their Podcast Wireless future. Have a glimpse into it and find out more about the Wireless future! Ep 39. Radio Stripes at Terahertz (With Parisa Aghdam) – [YouTube](#)



Presentation at EuCAP 2024

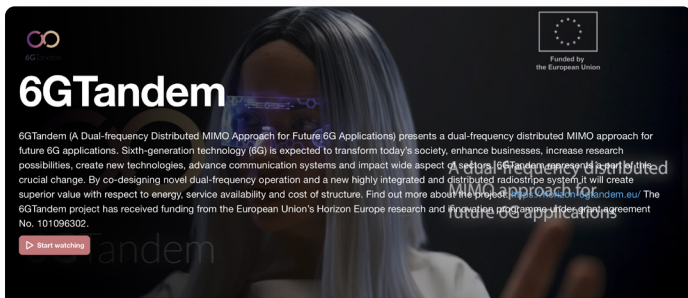
Our project members from ULUND have been present at **EuCAP2024** from 17th to 22nd of March in Glasgow, Scotland. The 18th edition of the European Conference on Antennas and Propagation took place at the SEC Centre (Scottish Event Campus). Yuyan Cao presented the findings of the paper “**Circularly Polarized Sub-THz Antenna Design for Distributed Deployment**” that has been authored together with Buon Kiong Lau and Maciej Wojnowski. The presentation was very well received by the audience, and it attracted good questions and discussions both after the talk and after the session. Congratulations to the European Association on Antennas and Propagation for such a successful event!



Video interviews

To continue providing insights from our experts, we have published three further video interviews. We have spoken to project partners from Linköping University, elaborating on their role in the project, where they see the main challenges and how they are planning to address them, by providing some examples.



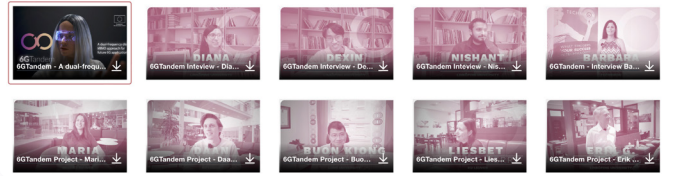


Video Showcase

Check out the new video showcase, where we've collected all the videos created for the 6GTandem project in one place!

Link:

[6GTandem video showcase](#)



Scientific publications

The paper “Circularly Polarized Sub-THz Antenna Design for Distributed Deployment” was presented at **EuCAP 2024**. The authors are Yuyan Cao, Maciej Wojnowski and Buon Kiong Lau.

The paper “Channel Performance Metrics and Evaluation for XR Head-Mounted Displays with mmWave Arrays” was published in IEEE Transactions on Communications.

The 6GTandem Consortium

The 6GTandem consortium consists of 9 partners from 5 different countries (Austria, Sweden, Belgium, Germany and Switzerland). It consists of a well-balanced mixture between academic and industrial players, from large semiconductor to small SMEs. The team comprises a diversified competencies pool with the knowledge and capability to tackle and resolve upcoming challenges.


 All past and upcoming events can be found on the 6GTandem official webpage:
horizon-6gtandem.eu/events

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| <p>① TECHNIKON
Technikon Forschungs- und Planungsgesellschaft mbH
AUSTRIA [Villach]</p> | <p>② ERICSSON
Ericsson AB
SWEDEN [Gothenburg]</p> | <p>③ KU LEUVEN
KU Leuven
BELGIUM [Ghent]</p> |
| <p>④ infineon
Infineon Technologies Austria AG
AUSTRIA [Villach]</p> | <p>⑤ CHALMERS
UNIVERSITY OF TECHNOLOGY
Chalmers University of Technology AB
SWEDEN [Gothenburg]</p> | <p>⑥ li.u LINKÖPING UNIVERSITY
Linköping University
SWEDEN [Linköping]</p> |
| <p>⑦ LUND
UNIVERSITY
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Huber + Suhner AG,
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