6GTandem

Unlock new potential of wireless network

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

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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 Use Case Analysis and Characterization

To identify future societal and industrial needs in health, entertainment, and industrial processes, the 6G Tandem project has analysed potential use cases that would benefit from its dual-frequency, highly reliable, and high-capacity network architecture. The following deployment environments were characterized during this analysis:

- **Large venues:** Ideal for sport events and entertainment, ensuring high-quality, high-capacity connectivity
- **Industrial manufacturing sites:** Enhances connectivity in factories and warehouses, improving industrial processes
- **Public transportation stations:** Provides robust and reliable coverage in busy transit areas
- **Healthcare settings:** Improves communication and operation precision in care facilities. Including hospitals and surgery rooms
- **Educational Institutions:** supports advanced learning environments in classrooms and seminar settings

By considering these driver environments and the specific common characteristics or similar technical challenges of the individual use cases, 6GTandem's use cases were classified into the following four groups:

Augmented Reality (AR) / Virtual Reality (VR) / Extended Reality (XR)

Immersive technologies have undergone significant evolution over the past decade, driven by

advancements in hardware and software. These technologies have transitioned from niche applications to mainstream use in areas such as gaming, education, and healthcare. In this context, the 6GTandem project proposes use cases spanning industrial, medical, and recreational domains, showcasing the potential benefits of a 6GTandem-like deployment. In the industrial sector, Mixed Reality (MR) is highlighted for its X-ray-like capabilities, alongside Virtual Reality (VR) applications for professional training. In the medical field, the focus shifts to remote surgery enabled by VR telepresence and MR-assisted surgical procedures. The project also explores opportunities for social interaction in Extended Reality (XR), such as interactive classroom environments and everyday XR applications, including Augmented Reality (AR) solutions for events or public transport stations.

Positioning/tracking

Logistics and supply chains are often managed manually, resulting in inefficiencies and bottlenecks. These challenges can be significantly mitigated with the adoption of advanced wireless access technologies. Enhanced positioning accuracy and reliable connectivity across numerous devices enable real-time tracking of items throughout the supply chain. This capability improves inventory management by providing precise location and identification details, facilitating real-time decision-making as users or robots interact with goods. The 6GTandem project leverages dual connectivity and sub-THz frequency bands to achieve superior location accuracy. Beyond logistics, this system can monitor crowd density in specific areas, supporting effective crowd management. Additional applications include visitor profiling and search-and-navigate functions. However, ensuring individual privacy is paramount, as not everyone may want to be tracked. To address privacy concerns, low-cost passive tags offer a practical solution, allowing for advanced tracking capabilities while respecting user preferences.

Ultra-Reliable Low-Latency Communications (URLLC)

The future of manufacturing increasingly depends on the capabilities of 5G and, eventually, 6G connectivity. These advanced networks enable real-time data exchange, supporting transformative technologies such as the Internet of Things (IoT), artificial intelligence (AI), and digital twins. By leveraging these capabilities, manufacturing can achieve greater operational efficiency through predictive maintenance, quality control, and optimized supply chains. Remote monitoring and control further enhance flexibility and agility in production processes. Additionally, 5G and 6G are poised to drive innovation and competitiveness by supporting AR and VR applications for training, design, and troubleshooting in manufacturing. As future production environments integrate even more IoT devices and robots, ultra-reliable and low-latency communications (URLLC) will become essential.

High Throughput (not latency critical – federated learning)

Large venues like stadiums, airports, and shopping malls face significant challenges in maintaining public safety and security. Detecting and tracking individuals, such as suspects, during sudden changes in lighting or high-density crowd movement during rush hours is particularly critical. Traditional video surveillance systems, however, often raise privacy concerns due to the real-time collection and analysis of sensitive data. Federated learning offers a promising solution by enabling the use of intelligent video surveillance while keeping data decentralized. This approach is especially valuable in privacy-sensitive scenarios, as it ensures that sensitive data remains local rather than being centralized for processing. The 6GTandem project's dual-frequency bands further enhance the implementation of federated learning tasks, providing the high bandwidth and reliable connectivity necessary for efficient, secure, and privacy-conscious surveillance in large-scale environments.

Furthermore, we are excited to share a video of the 6GTandem use cases, showcasing the innovative solutions and real-world applications. This video provides a glimpse into how 6GTandem is set to revolutionize industries, enhance everyday life, and push the boundaries of what's possible with 6GTechnology.

Discover the Future with 6GTandem: Watch our latest use case video.

Link:
6GTandem Use Case video

Technical meeting

The 6GTandem team has met on the 19th and 20th of September 2024 in Munich for a technical meeting, hosted by Infineon Technologies Germany. The team discussed the status and progress of all work packages and upcoming deliverables. Besides that, new video interviews were recorded and uploaded to the project website. After these two days there is still a lot to be discussed which happens within our regular online meetings.

Dissemination activities

The paper "**High perfromance Polymer Microwave Fiber Coupler in eWLB Package for Sub-THz Communication**" was presented at the 74th Electronic Components and Technology Conference. The authors are Vasileios Liakonis, Yannis Papananos, Maciej Wojnowski, Walter Hartner.

The paper "**Propagation distance estimation for radio over fibre with cascaded structure**" was presented at SPAWC2024. The authors are Dexin Kong, Diana P. Osorio and Erik G. Larsson.

Communication activities

To continue providing insights from our experts, we have published three further video interviews. We have spoken to project partners from Infineon, Linköping University and Chalmers 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.

- **Walter Hartner**
- **Oksana Moryakova**
- **Gregor Lasser**

Interviews:

Results

The paper "**Channel Performance Metrics and Evaluation for XR Head-Mounted Displays with mmWave Arrays**" was published in IEEE Transactions on Communications. The authors are Alexander Marinsek, Xuesong Ca, Lieven De Strycker, Fredrik Tufvesson and Liesbet Van der Perre.

The paper "**MmWave for Extended Reality: Open User Mobility Dataset, Characterisation, and Impact on Link Quality**" was published in IEEE Communications Magazine. The authors are Alexander Marinsek, Sam De Kunst, Gilles Callebaut, Lieven De Strycker, Liesbet Van der Perre.

The paper "**Toward Energy-Efficient Massive MIMO: Graph Neural Network Precoding for Mitigating Non-Linear PA Distortion**" was published in IEEE Transactions on Cognitive Communications and Networking. The authors are Thomas Feys, Liesbet Van der Perre, François Rottenberg.

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 semiconductors to small SMEs. The team comprises a diversified competence 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

1. Technikon Forschungs- und Planungsgesellschaft mbH, AUSTRIA [Villach]
2. Ericsson AB, SWEDEN [Gothenburg]
3. KU Leuven, BELGIUM [Ghent]
4. Infineon Technologies Austria AG, AUSTRIA [Villach]
5. Chalmers University of Technology AB, SWEDEN [Gothenburg]
6. Linköping University, SWEDEN [Linköping]
7. Lund University, SWEDEN [Lund]
8. Infineon Technologies AG, GERMANY [Munich]
9. Huber + Suhner AG, SWITZERLAND [Herisau]

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