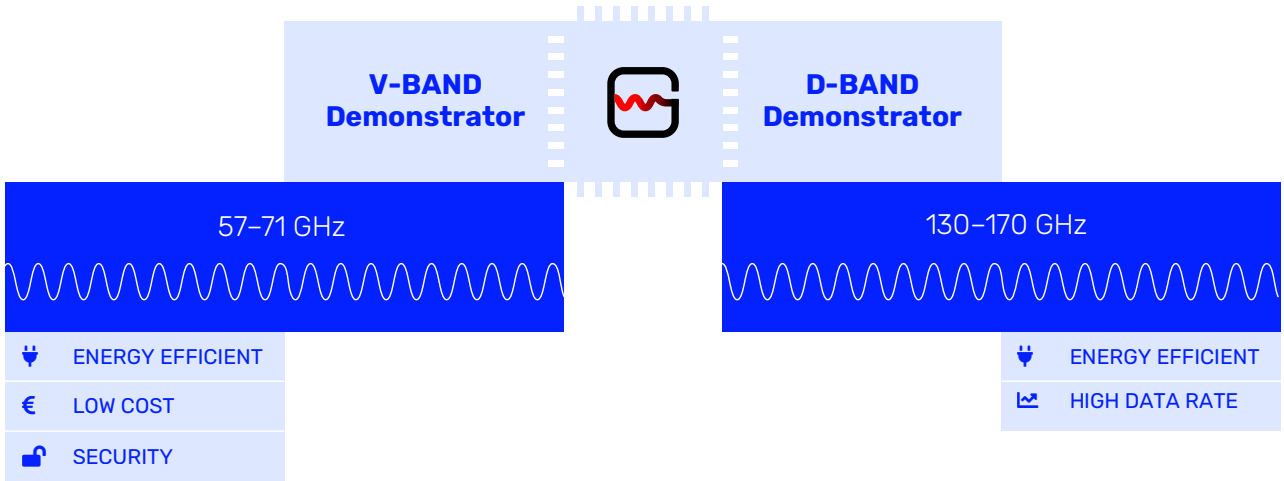
FirstTo6G publishable summary

Context and overall objectives

FirstTo6G is developing the world's first 6G transceiver microchip technology, comprising data converters and corresponding millimetre-wave front-ends that meet the stringent requirements necessary for the widespread adoption of 6G. The project is focused on developing energy-efficient data converters capable of achieving up to 16GHz instantaneous bandwidth and integrating state-of-the-art frontend technology. These converters will be integrated into two complete millimetre-wave transceiver chipsets.

The project's architecture involves integrating groundbreaking Fourier Domain Digital-to-Analog and Analog-to-Digital Converters (FDDACs/FDADCs) with novel frontend technologies. FirstTo6G will develop two demonstrators, as depicted in the figure. The proposed V-band solution aims to integrate the complete transceiver into a single 22nm-FDSOI-based chip, resulting in a total instantaneous bandwidth of 8GHz. The proposed D-band solution proposes a two-chip solution, with data converters in 22nm FDSOI and the frontend in silicon-based and III-V semiconductor technologies, achieving an instantaneous bandwidth of 16GHz.

Through this project, FirstTo6G addresses critical technological challenges associated with the global introduction of 6G by 2030, including high instantaneous bandwidth, energy efficiency, cost-effectiveness, and scalability. The project's outcomes will contribute to 6G standardisation, and the demonstrators can be utilised in experimental radio devices for 6G trials. A successful adaptation of the technology developed in this project will facilitate the widespread adoption of 6G, thereby ensuring the availability of ultrahigh-speed wireless connectivity globally. Smart cities will be equipped with the capability to optimise traffic flow through continuous data exchange between vehicles, roads, pedestrians, and traffic lights. Smart energy grids will be able to distribute energy based on demand, and autonomous drones will monitor infrastructure. AR/VR applications will attain unprecedented levels of resolution and realism, benefiting from enhanced sensing capabilities and becoming an integral part of our daily lives, providing immersive mixed-reality experiences wherever we are.



Work performed and main achievements

During the reporting period, significant progress has been made across all work packages towards achieving the project objectives. WP1 defined system requirements and architectural specifications for the V-band and D-band solutions, completing system-level modelling and performance trade-off analysis. WP2 advanced the development of high-performance data converters, finalizing the design of 8 GHz and 16 GHz DAC/ADC architectures and validating their performance. WP3 and WP4 focused on the design and characterization of the analogue frontends for sub-100 GHz and above-100 GHz systems, optimizing key RF components and conducting circuit simulations. In WP5, the demonstrator architecture was finalized, with PCB layouts and antenna configurations prepared for integration and testing. The next phase will focus on refining circuit designs, integrating components, and validating system performance.

Results beyond the state of the art

Project participant InCirT has invented a novel and disruptive approach to data conversion known as the Fourier-Domain DAC and the Fourier-Domain ADC. The primary innovation lies in the data converter architecture, which enables the complete elimination of oversampling and digital filtering. Consequently, performance enhancements are no longer reliant on the availability of more advanced semiconductor technology. Notably, this new approach facilitates the attainment of up to 100x higher instantaneous bandwidth compared to state-of-the-art, while simultaneously achieving a 10x higher energy efficiency.

The 8-GHz DAC/ADC developed for the V-band solution will surpass current state-of-the-art performance by a factor of over 4. Simultaneously, it will exhibit significantly lower energy consumption and cost. This cost reduction will be realised by integrating the chip into the mature and cost-effective 22FDX technology. The 16-GHz DAC/ADC developed for the D-band will further double this performance.

FirstTo6G

www.FirsTto6G.eu
FirstTo6G

FirstTo6G has received funding from the Smart Networks and Services Joint Undertaking (SNS JU) and its members under the European Union's Horizon Europe programme and by the Swiss State Secretariat for Education, Research and Innovation (SERI).

Co-funded by the European Union

6GSNS

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

INCIRT

sivers SEMICONDUCTORS

RWTH AACHEN UNIVERSITY

YEDİTEPE UNIVERSITY

SCIPROM Science, Management & Communication

ARGO SEMI