



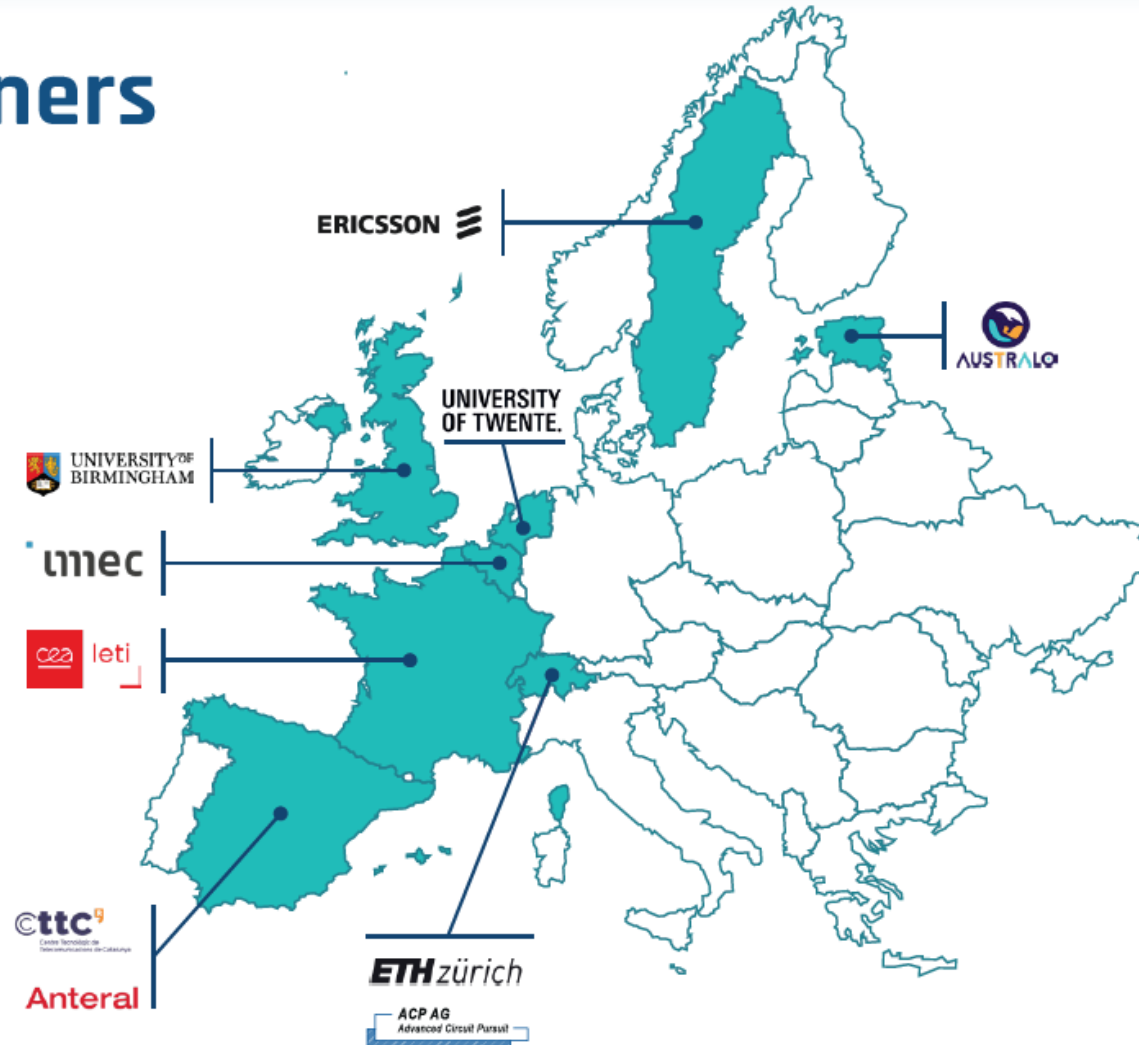
6G Hardware Enablers for Cell Free Coherent
Communications and Sensing
&
ISMD Laboratory at CTTC

I. Llamas-Garro, Z. Brito-Brito
CTTC



Funded by
the European Union

Our Partners



6G ✦ REFERENCE

Low latency
Communication

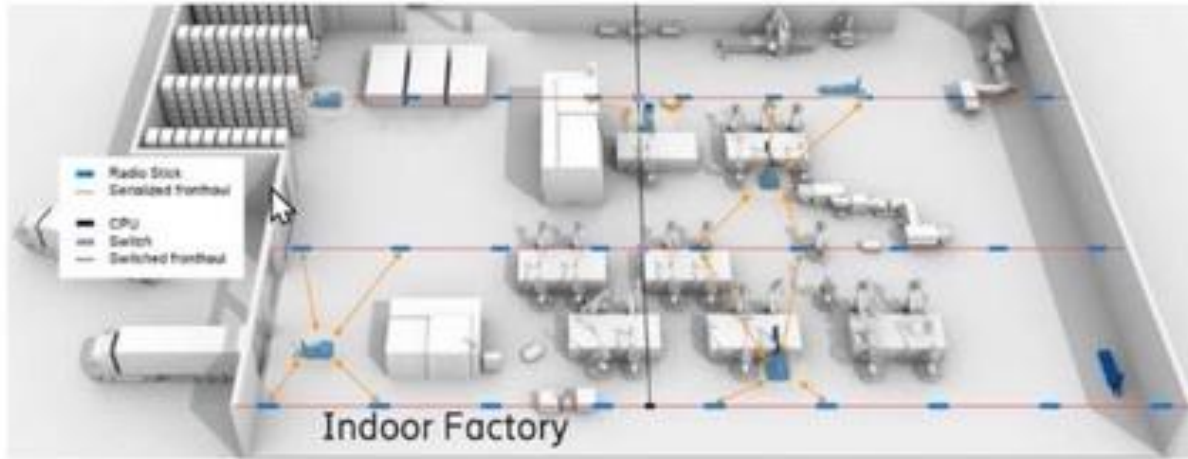
ISAC

Over-the-Air
Synchronization



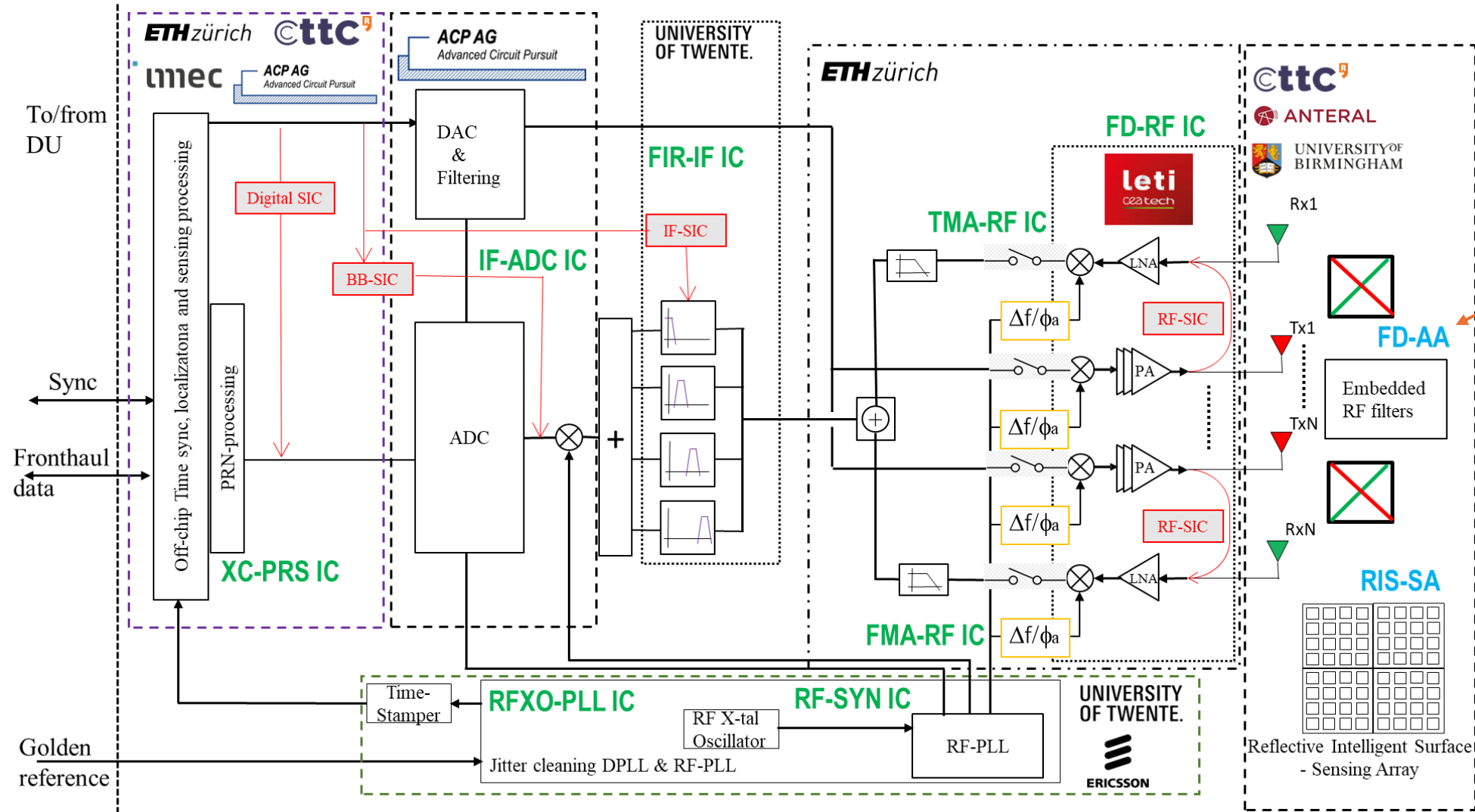
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6G-REFERENCE Radio unit concept



- Goal: Radio Units WITHOUT Fiber Access.
- Cell-free distributed MIMO envisioned 6G system (urban areas and factory)

6G REFERENCE Simplified Radio Unit Concept

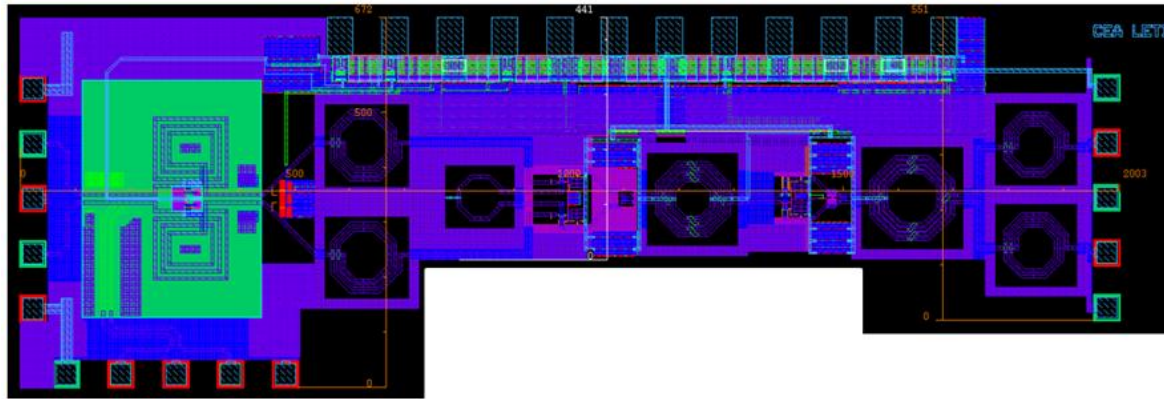


On Exhibition At the MWC 2026

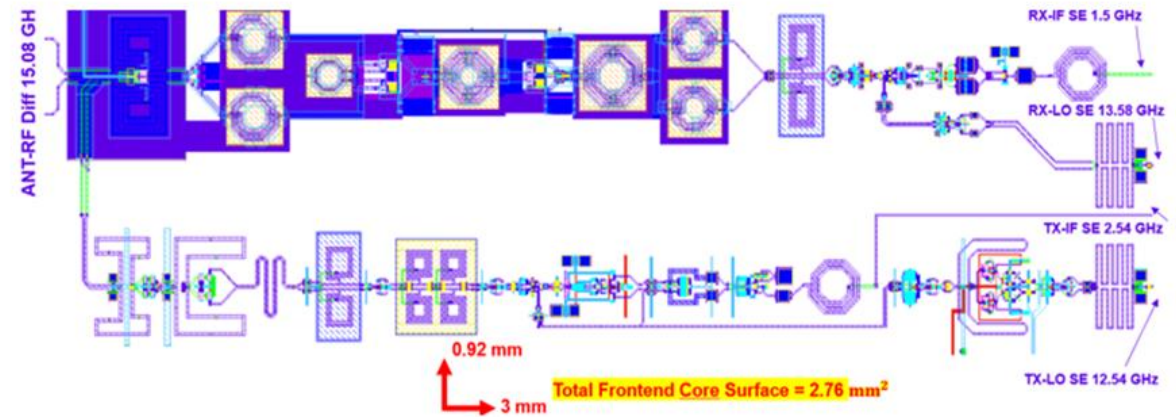


Integrated circuit/Antenna technology

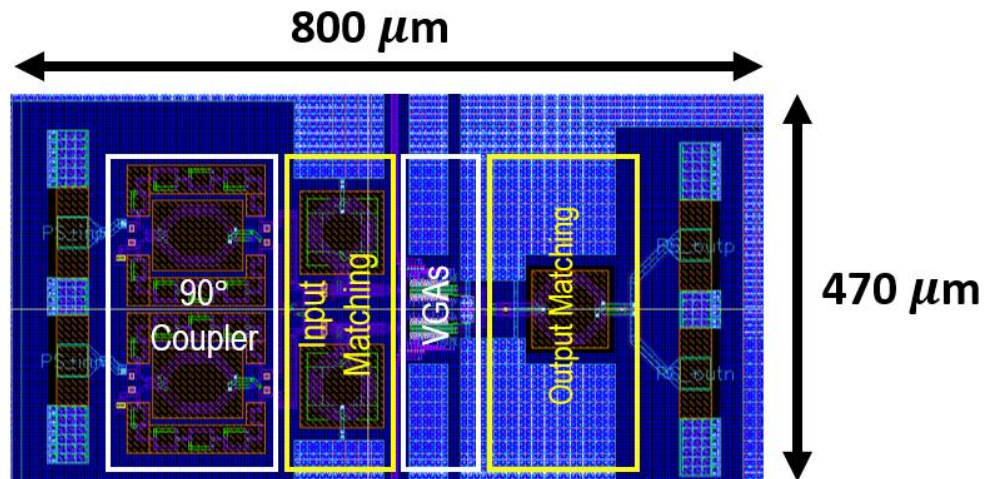
Hardware Integrated Circuit Designs



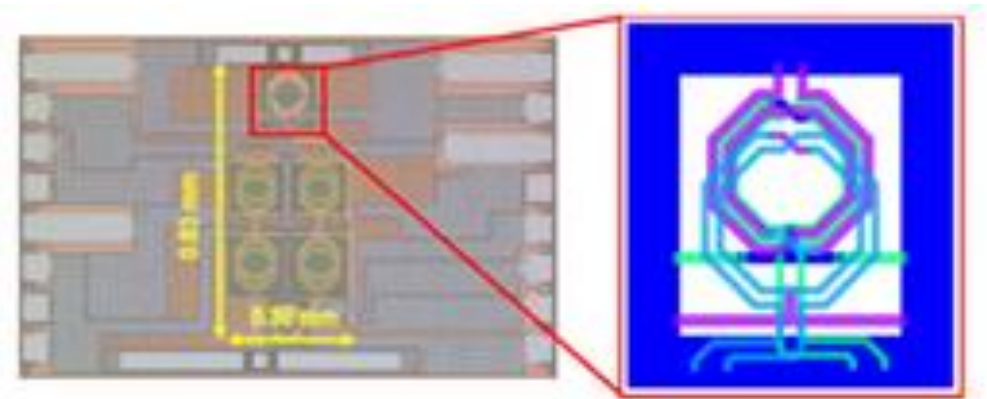
LNA design + duplexer



Preliminary layout of the transceiver core

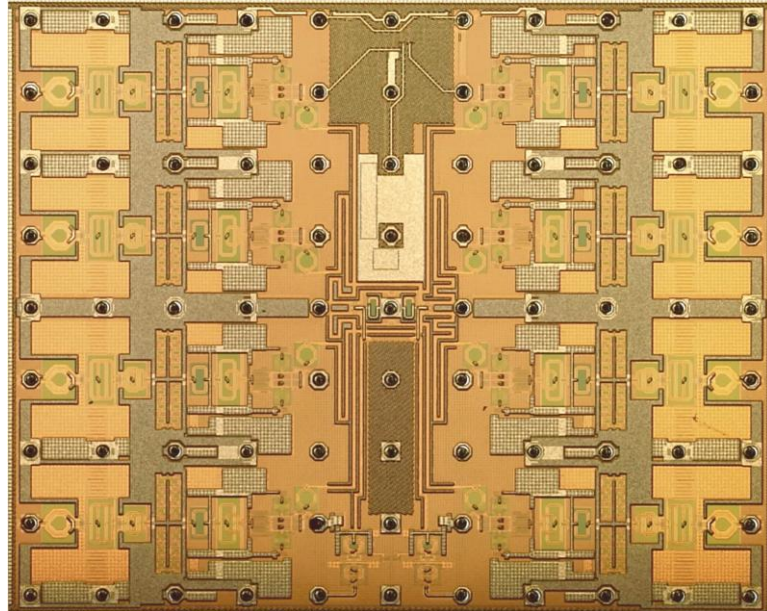


Active phase shifter

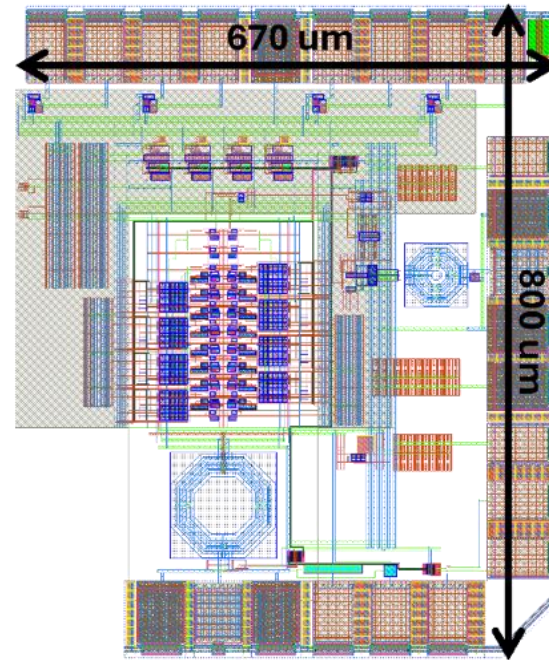


Power amplifier

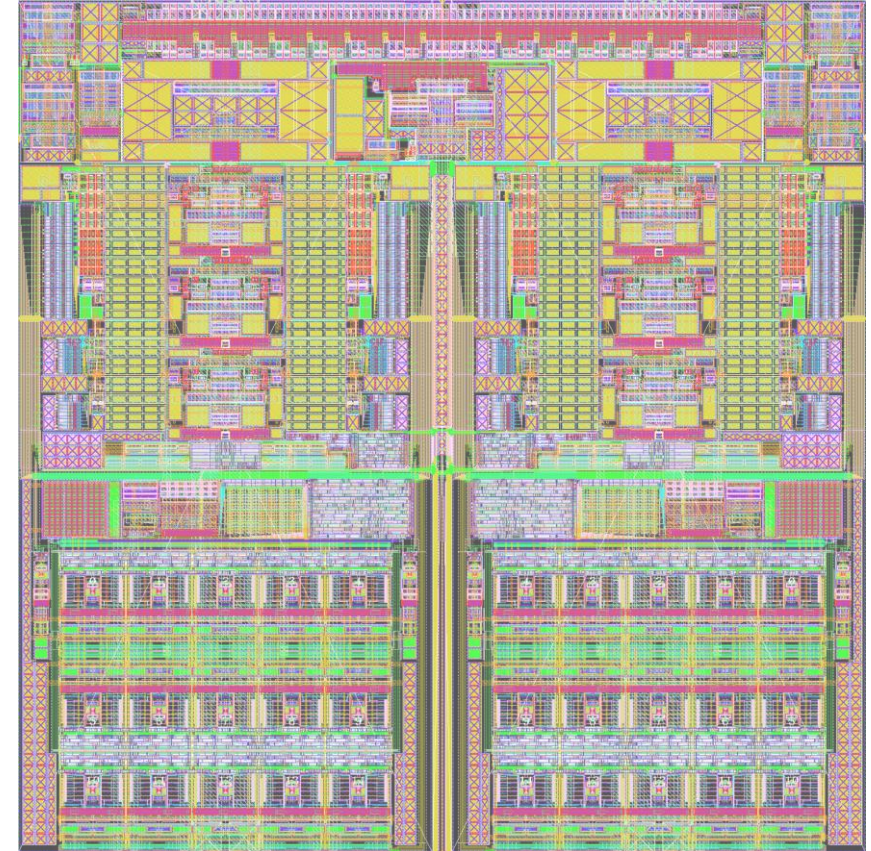
Hardware Integrated Circuit Designs



8 channel FMA system

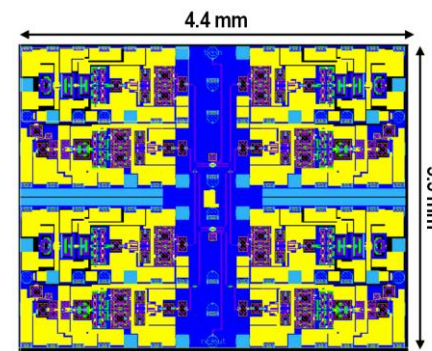
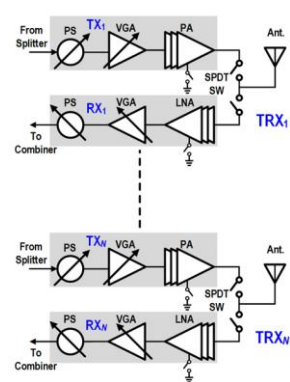


RX chip



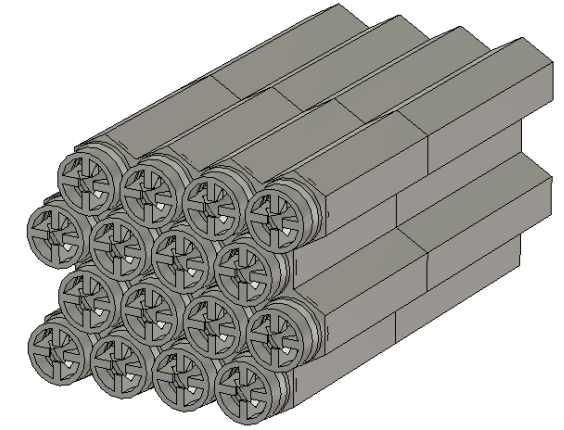
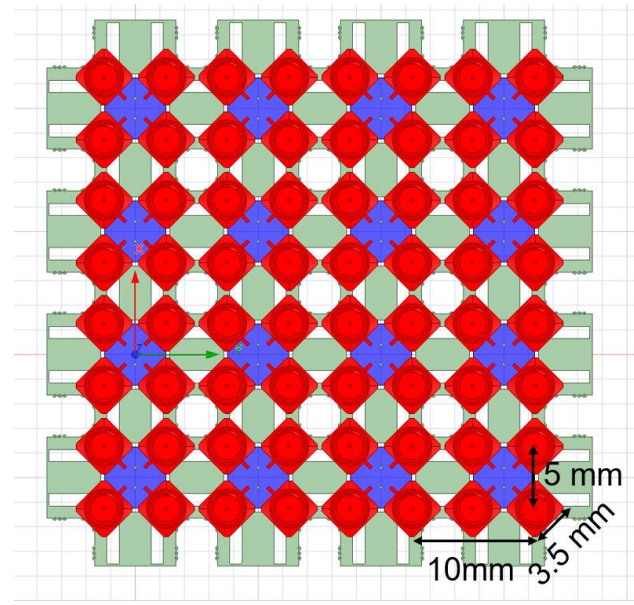
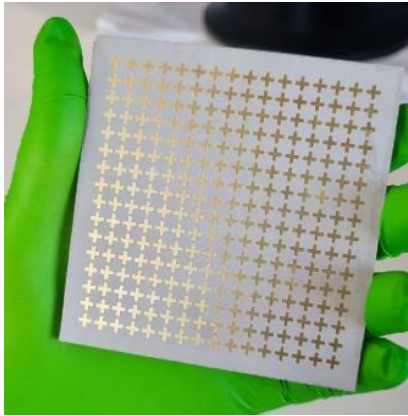
ADC layout

Top 10 SNS-JU
Key
Achievements

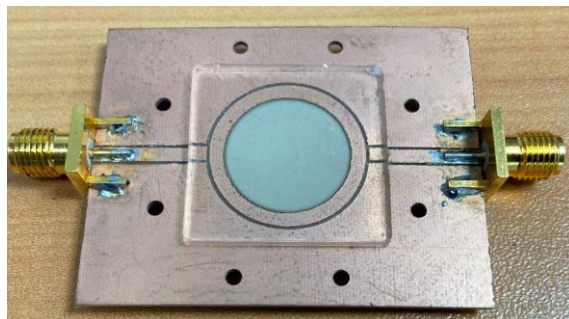


TMA system architecture and chip layout

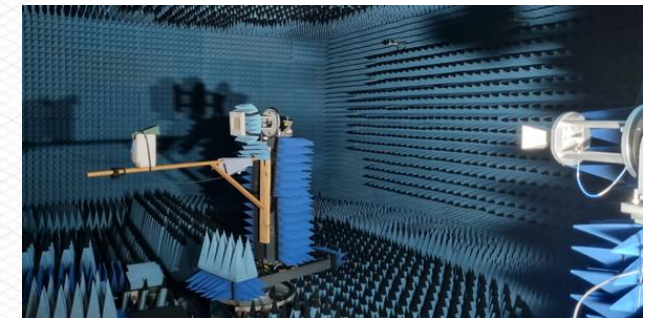
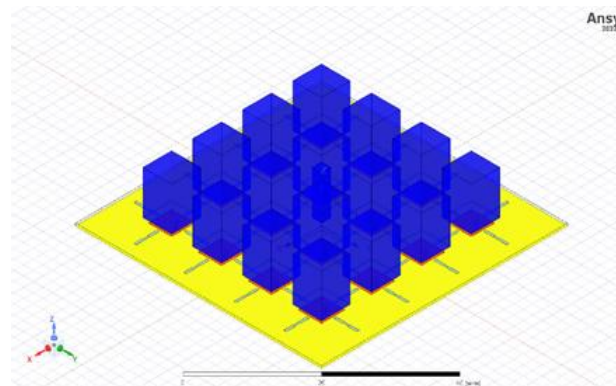
Hardware Antenna and RIS Designs



Liquid metal based RIS



3/19/2026 Environmental sensors
(temperature/volatile organic compounds)



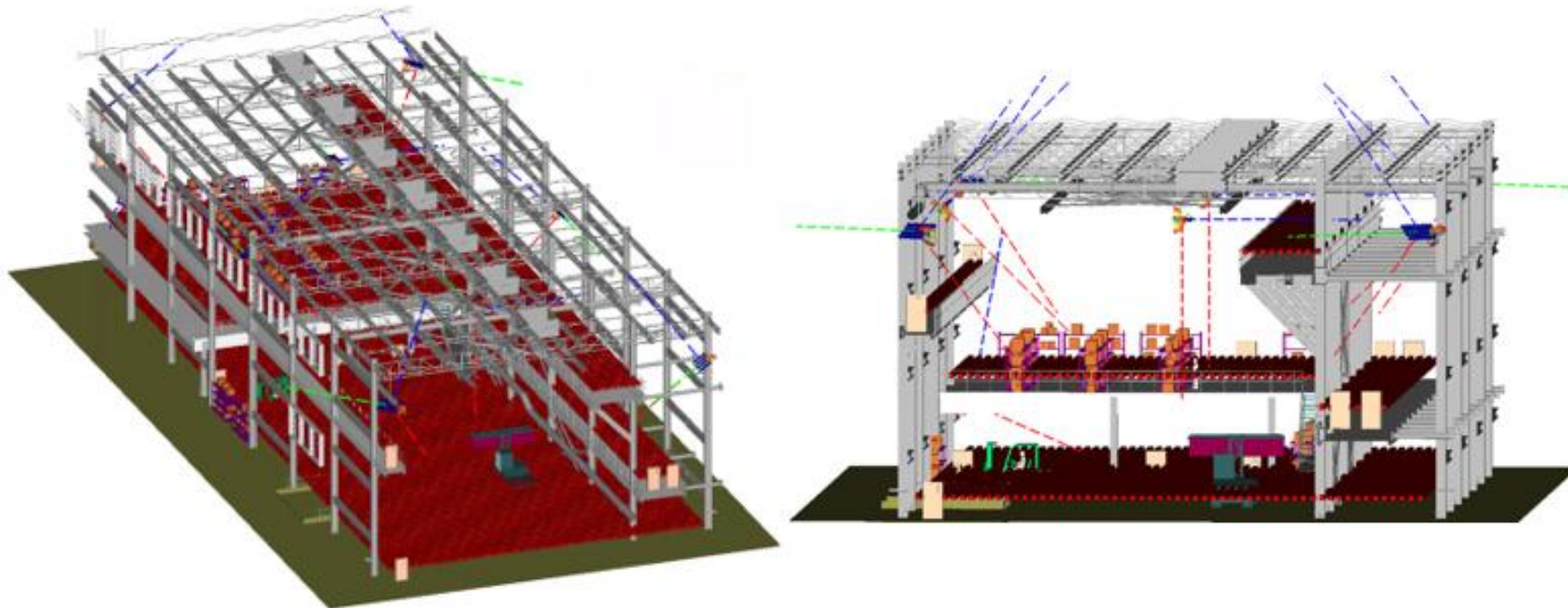
Planar and 3D antenna arrays

Factory Hall Scenario



- Factory Hall with fiber-less RUs
- 25m grid with 4x4 antennas
- Channel Impulse Response

D-MIMO Factory Hall CIR Dataset
Tx: 9 RUs at ceiling 45° tilted 8x4 arrays
Rx: 13506 UE-nods 1.2m above floor (1 antenna)
(<https://zenodo.org/records/17566853>).



3D model of the factory hall scenario used in REMCOM's Wireless InSite software to simulate ray-traced wireless propagation channels.

Main Project Goals: "6G-REFERENCE" design for D-MIMO at 15GHz



Full Duplex RU-RU Communication (COM):

- Antenna Array & key functional ICs (22nm FDSOI)
- Filtering Antennas >25dB Tx-Rx Isolation (@ dual polarization!)
- Full-Duplex Self-Interference Rejection <80dB
- Also concurrent multi-beam (TMA)

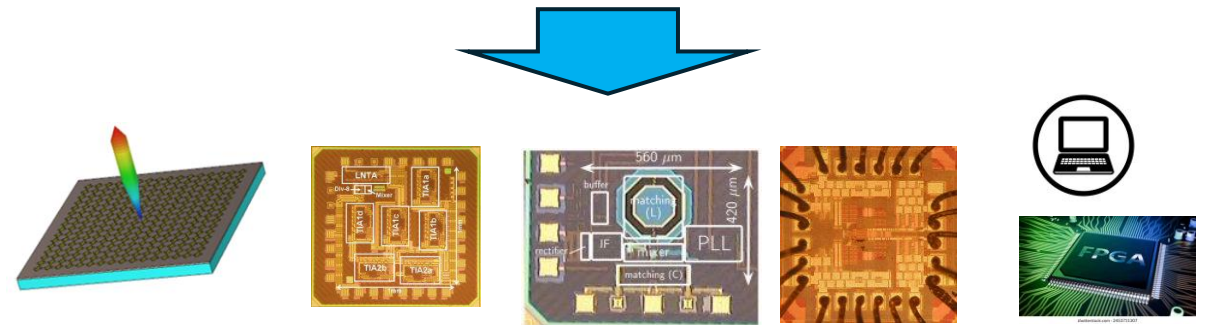
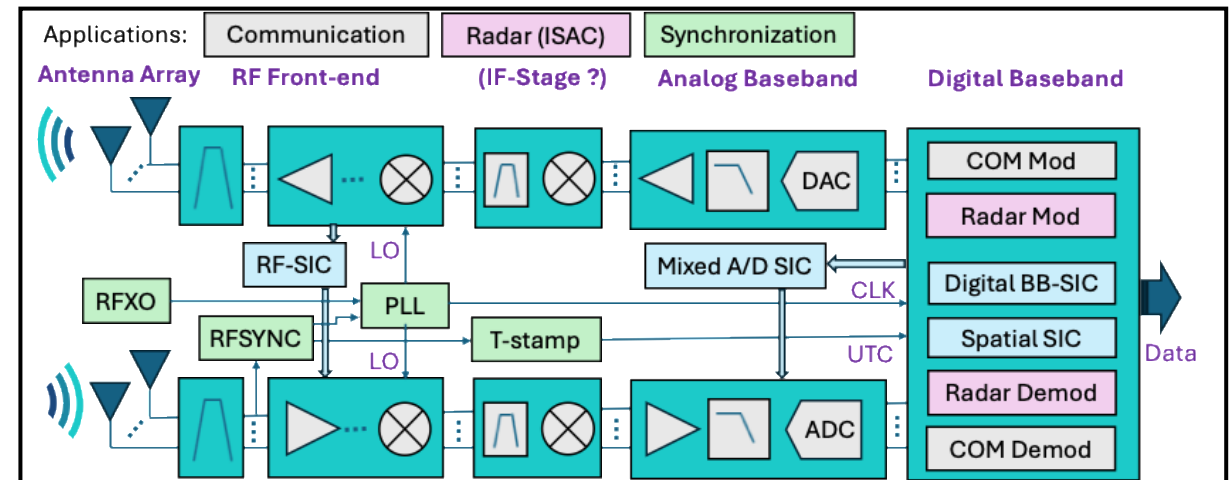
Integrated Sensing and Communication (ISAC):

- Range/doppler specifications: <0.5m & 0.5m/sec

Over-the-Air Synchronization (SYNC)

- Frequency-synchronization <1ppb
- Frequency Synthesizer Integrated Jitter <100 fsec
- UTC Time-stamping <100ns
- Holy grail: coherent cooperative D-MIMO

What can we achieve in practice??





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