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REPUBLIC OF TÜRKİYE
MINISTRY OF INDUSTRY
AND TECHNOLOGY | #NATIONAL TECHNOLOGY INITIATIVE

COMPETITIVE SECTORS PROGRAMME

TÜBİTAK

TÜBİTAK
BİLGEM

TÜBİTAK BİLGEM
(Informatics and Information Security Research Center)

REPUBLIC OF TÜRKİYE
MINISTRY OF INDUSTRY
AND TECHNOLOGY

#NATIONAL TECHNOLOGY INITIATIVE

TÜBİTAK
BİLGEM

TÜBİTAK BİLGEM is an institution of the Scientific and Technological Research Council of Türkiye [TÜBİTAK] and TÜBİTAK is affiliated council of the T.R. Ministry of Industry and Technology.

TÜBİTAK BİLGEM is the **largest research center** in Türkiye and focusing fundamentally on ICT and digital transformation.

TÜBİTAK BİLGEM contributes to Türkiye's technological independence and enhances both the Türkiye's and European technology ecosystems by conducting research in advanced technologies such as cybersecurity, artificial intelligence, digital transformation, blockchain, cloud computing technologies, chip technologies, and cryptology.

With 6 institutes, 8 testing laboratories, over 200 products, 230+ ongoing projects, and a portfolio exceeding 1 billion dollars, BİLGEM operates in 15 critical research areas. With over 2,000 employees, 14% of whom hold PhDs and 25% hold Master's degrees, BİLGEM continues to strengthen its capabilities.

TÜBİTAK BİLGEM actively participates in EU calls with over 19 completed and 14 ongoing projects.

TUBITAK Bilgem HİSAR LAB. Expertise

- Non-Terrestirial Networks
- mmWave and Terahertz communication for 6G and new generation communication systems
- UAV-based communication systems
- Massive MIMO
- AI/ML-based communication solutions/applications
- Reconfigurable Intelligient Surfaces
- Open RAN
- Integrated Sensing and Communication Systems/Techniques
- Physical Layer Security
- Distrubuted MIMO
- Spectrum sensing and signal classification
- Signal processing for large/distributed/multi-user antenna systems
- Signal processing and coding for future wireless networks

We aim to solve the challenges faced by society and industry with the research and development studies we carry out in the field of communications. By focusing on new technologies, we aim to meet advanced technological infrastructure and new performance criterias with secure and efficient communication systems.

We specialize in signal processing and end-to-end communication systems. In cooperation with other institutes and units within TÜBİTAK, HİSAR carries out multidisciplinary projects on communication, signal processing and radio frequency.
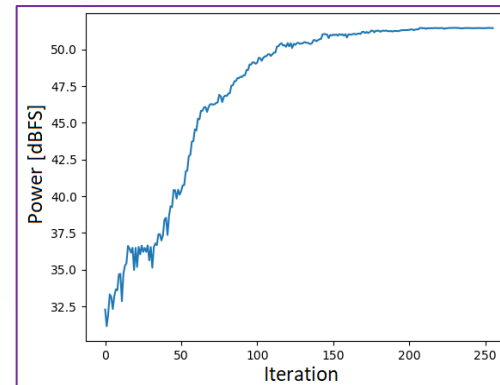
Research Fields & Expertise

- Open RAN
- Massive MIMO
- AI/ML-based Communication and Spectrum Sensing Applications
- Non-Terrestial Communication Systems and UAV Based Communication/Sensing Applications
- Reconfigurable Intelligent Surfaces
- mmWave and Terahertz Communication Applications for 6G and Channel Measurements

Infrastructure and Capabilities: Reconfigurable Intelligent Surface
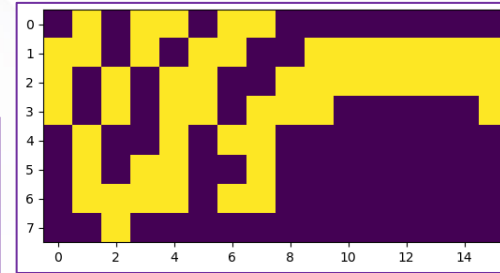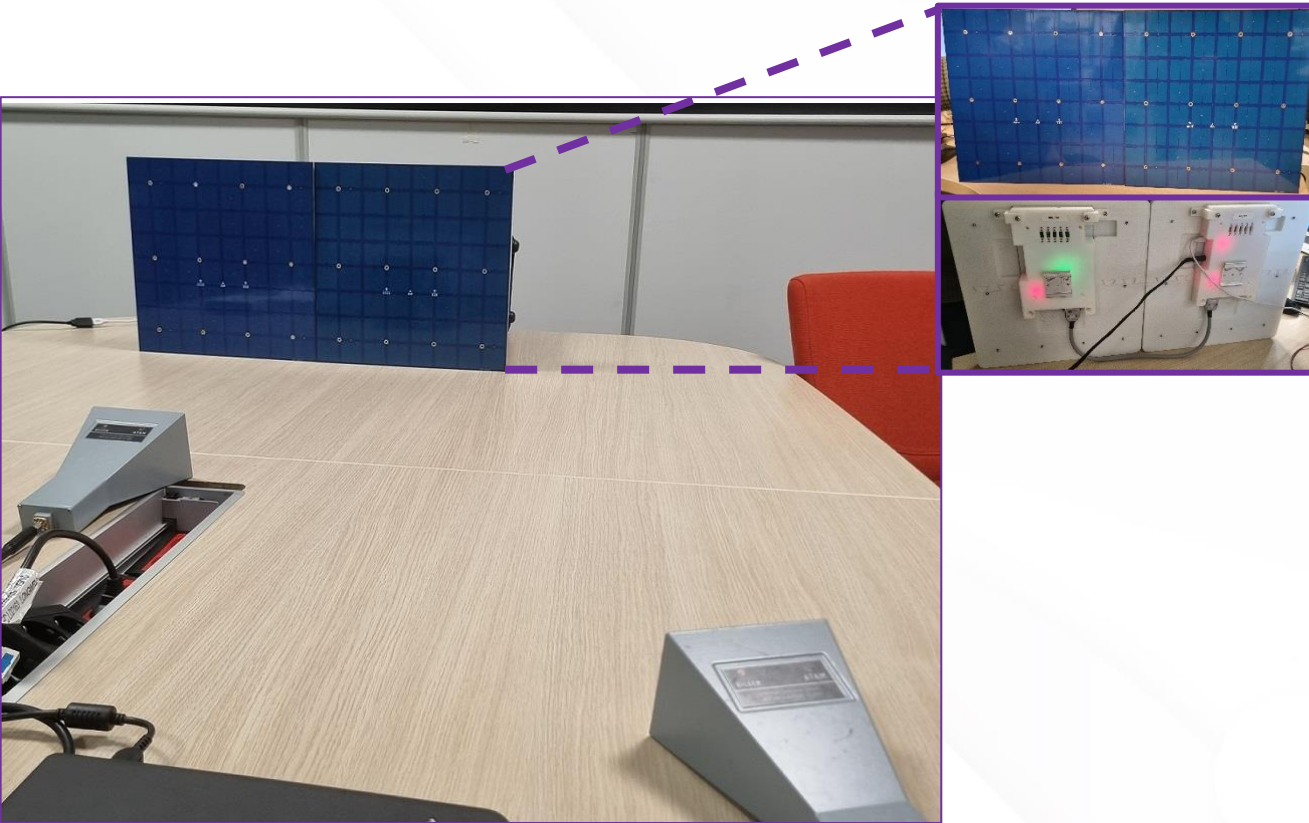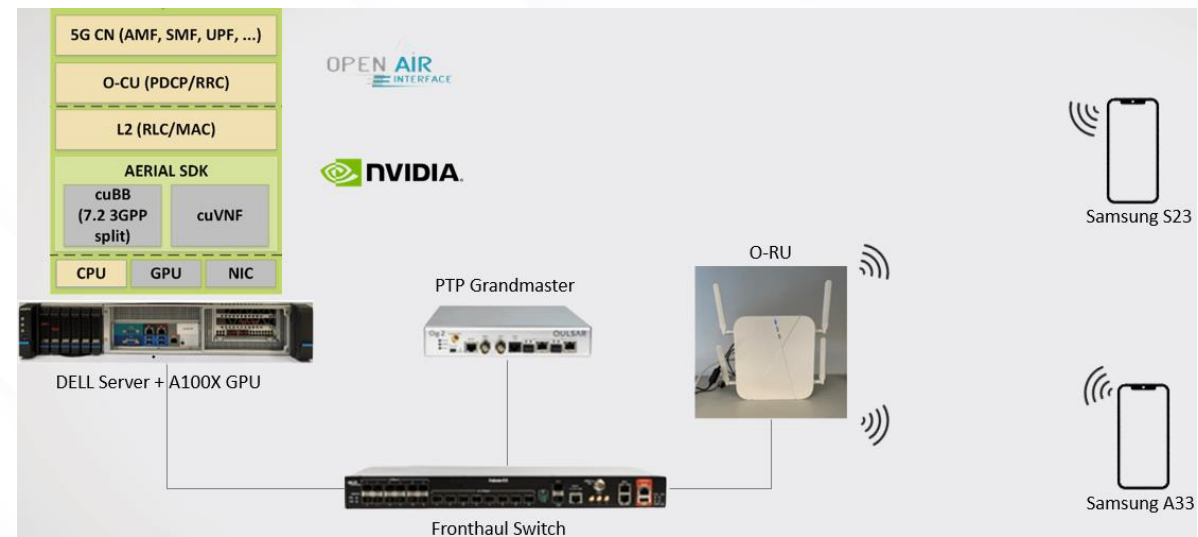

RIS element configuration

Received power with element configuration

- Joint RIS development activities with **TÜBİTAK MAM**.

- According to initial performance tests, an improvement of nearly **20 dB** was observed.
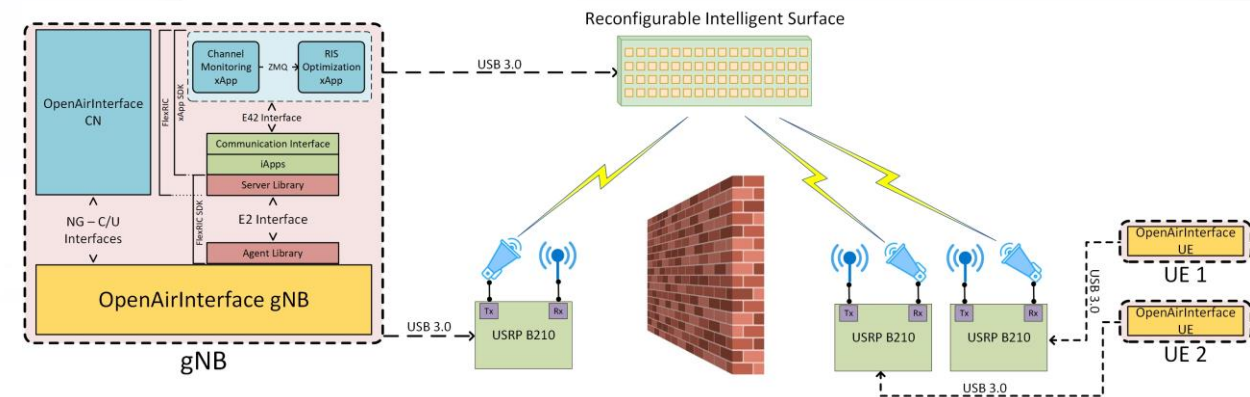
Infrastructure and Capabilities: ORAN Private Network and Applications
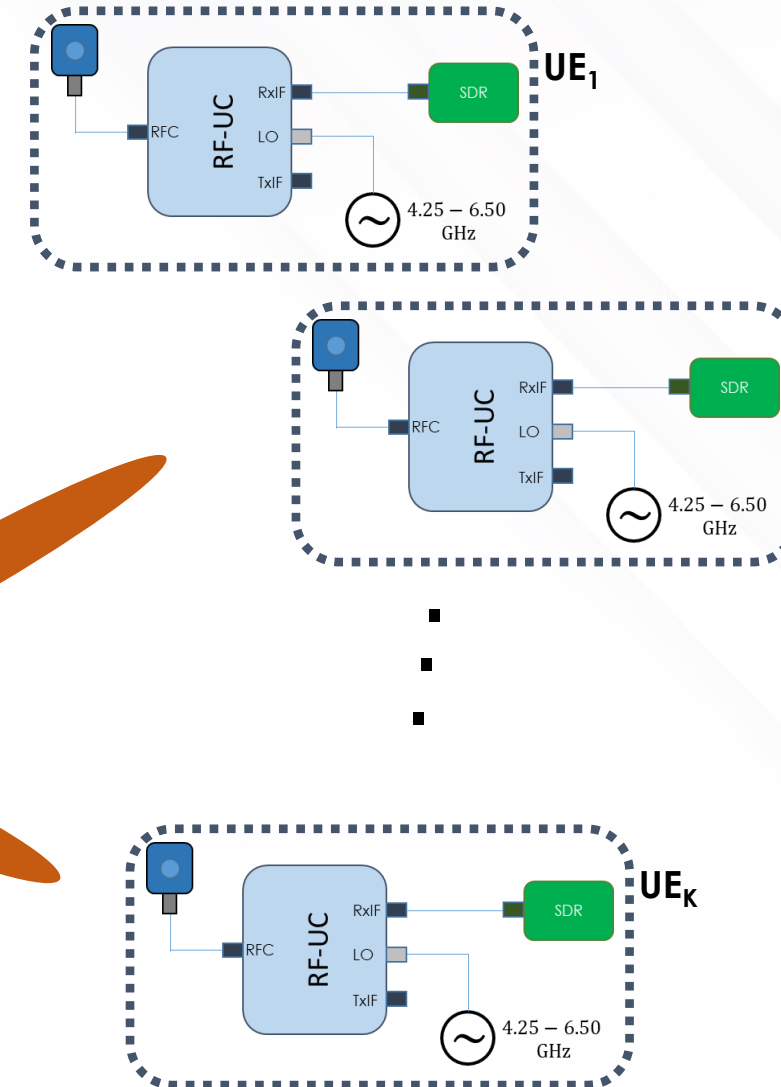
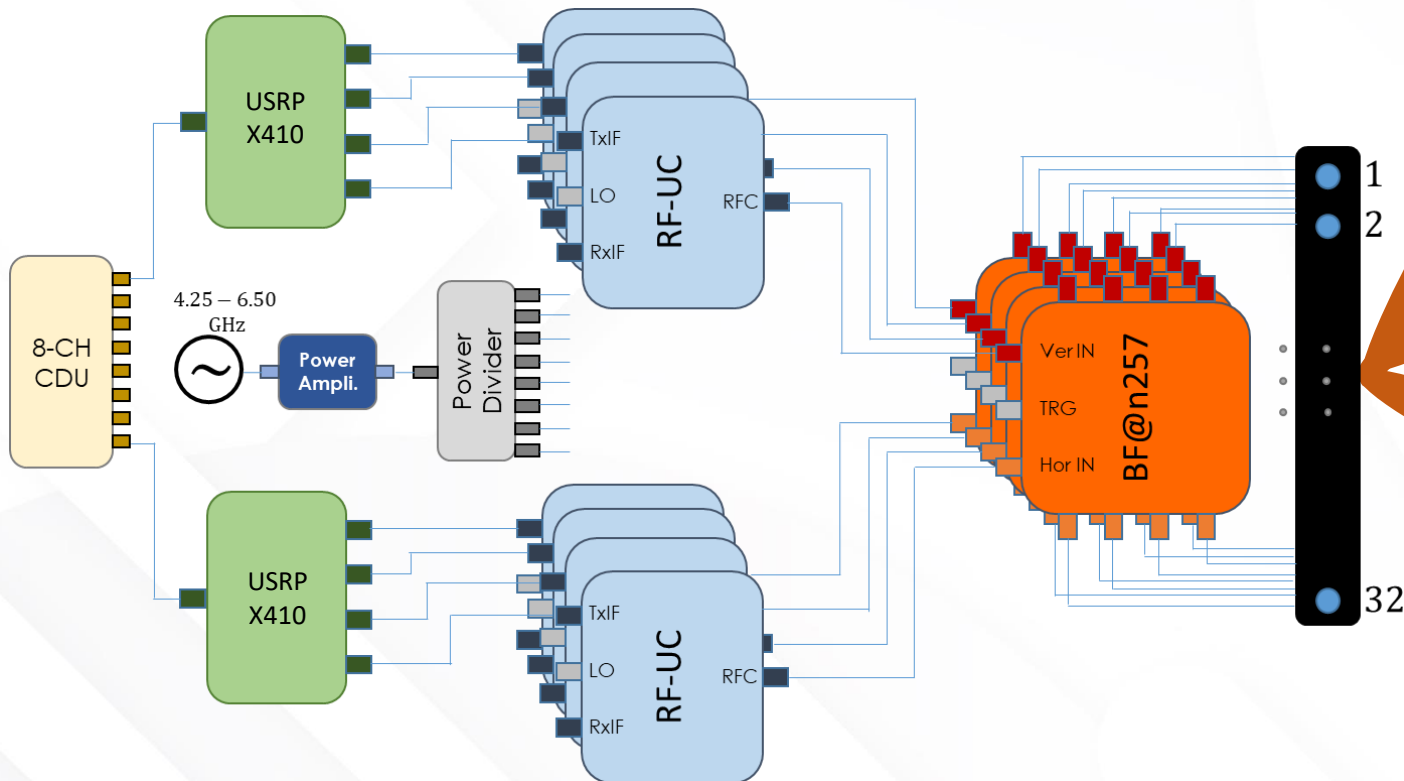*Use Case 1 : DRL-Based Network Slicing*
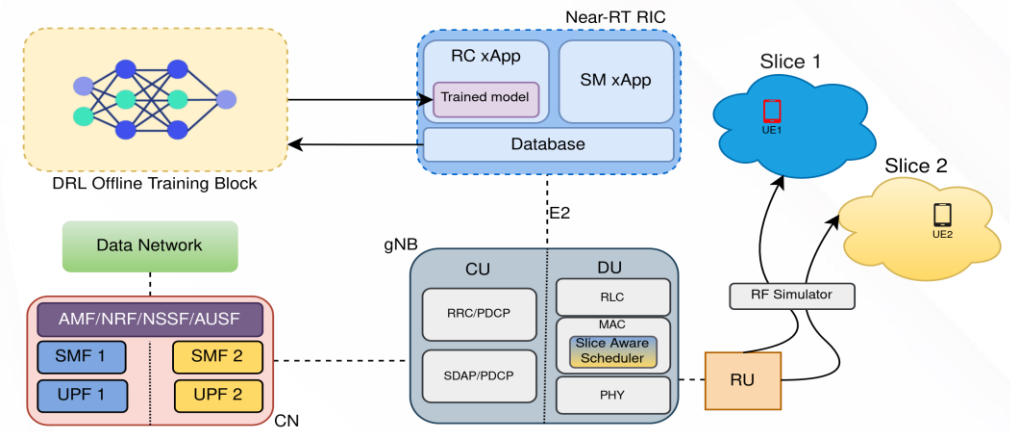
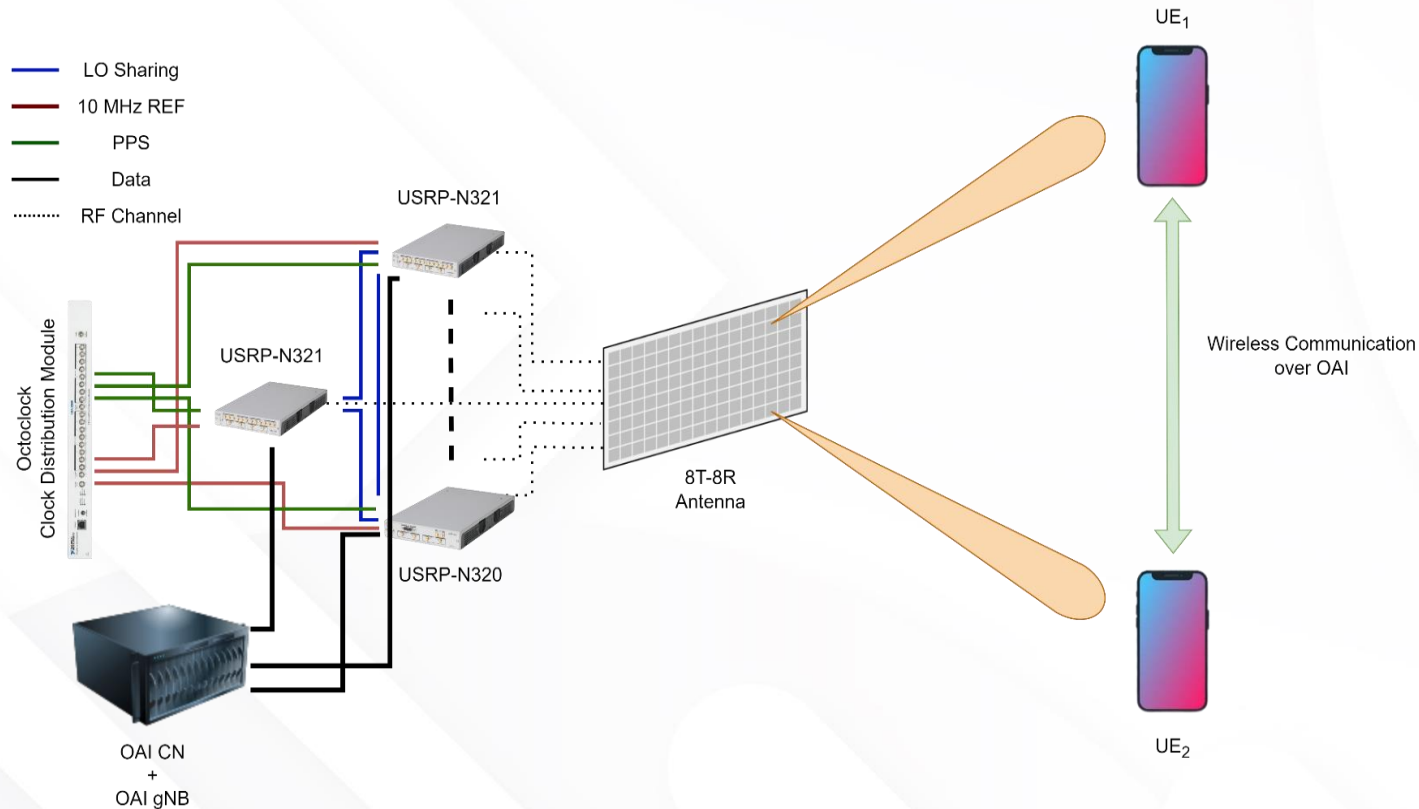*Use Case 2 : End-to-end ORAN based RIS Demonstration*

Infrastructure and Capabilities: Hybrid Beamforming Testbed

@Baseband&RF w/ 8 RF-Chains (32T32R, 26.5-27.5 GHz (FR2))

Infrastructure and Capabilities: Massive MIMO Test Environment

- Testbed consisting of **8 wideband SDRs** and a **powerful server** system for a **new generation software defined radio (SDR) based massive MIMO** infrastructure with open architecture and open source software.
- Integrated with **open source 5G emulator**.
- Can be used for waveform development and testing purposes.

Infrastructure and Capabilities: Telco Cloud Integration with TUBITAK B3LAB

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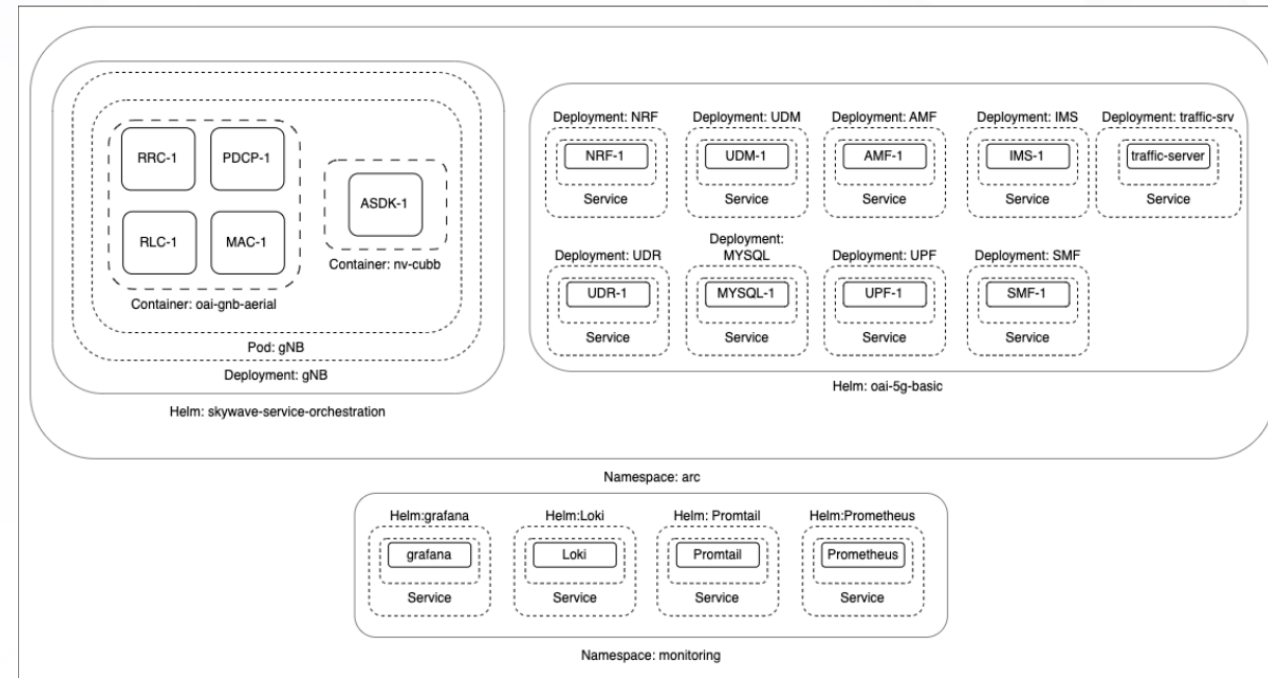
Infrastructure and Capabilities: NTN Test Setup & Channel Emulator
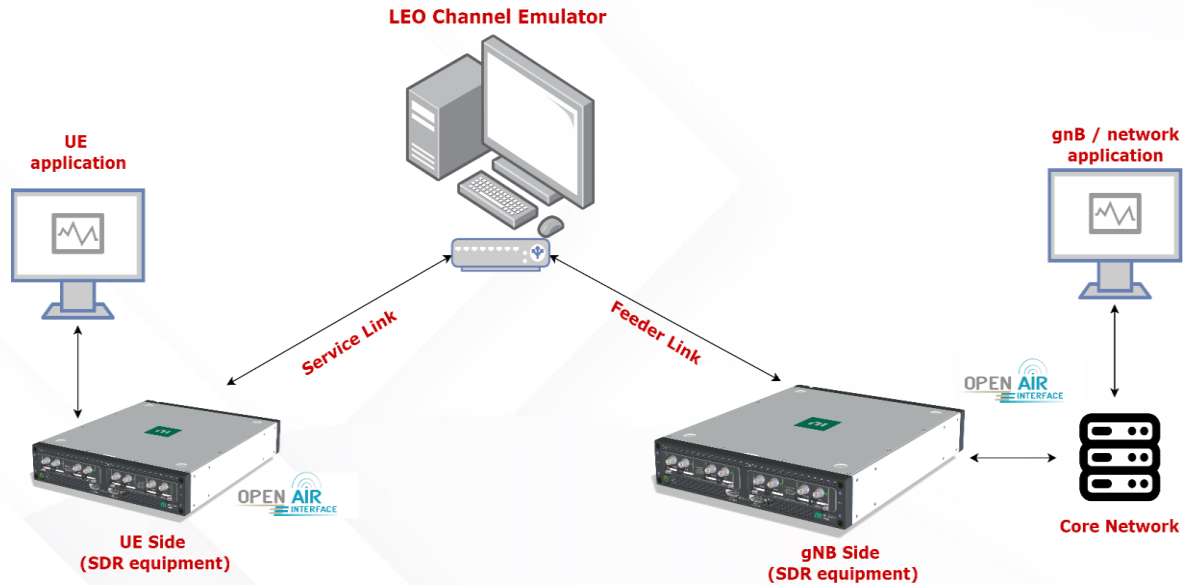
Example scenario

srsRAN interface
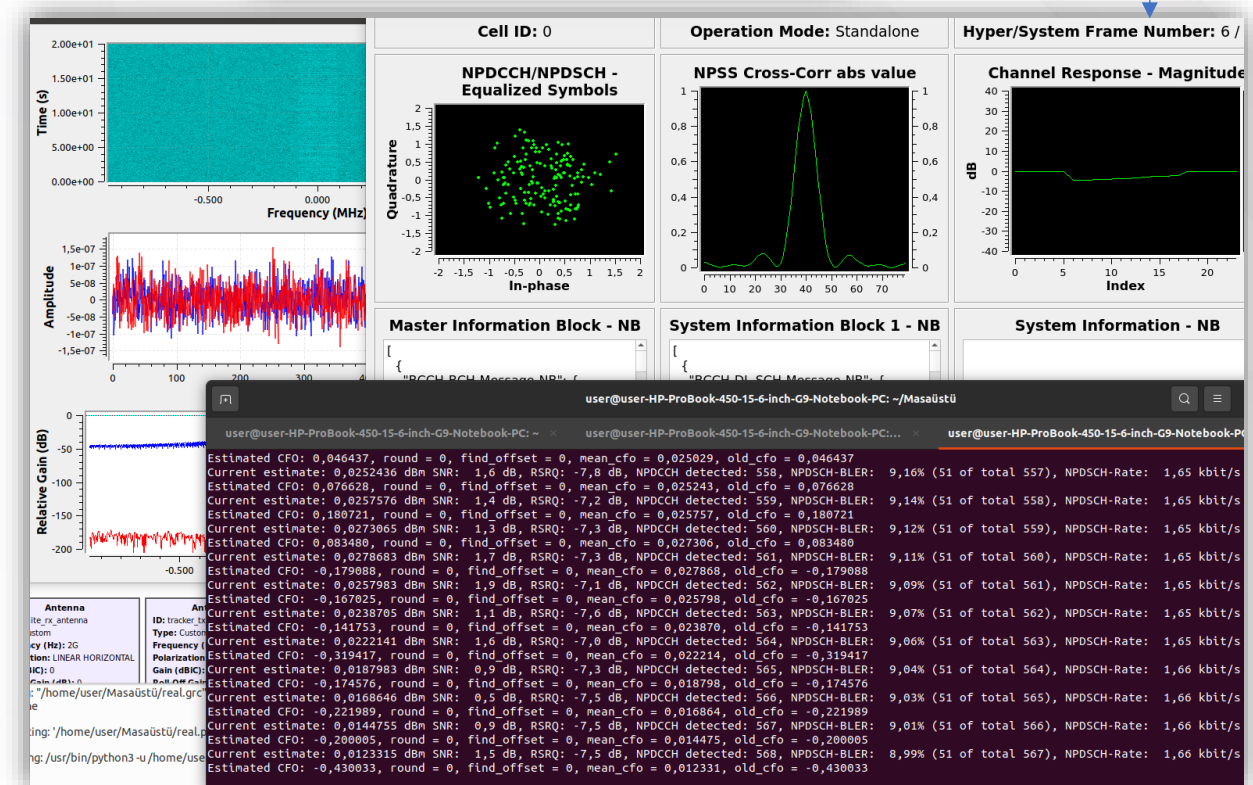
LEO Channel Emulator

UE application

gnB / network application

Service Link

Feeder Link

OPEN AIR INTERFACE

UE Side (SDR equipment)

gNB Side (SDR equipment)

Core Network

On-going Projects

On-going Projects

6G BRICKS

ORIX: Orchestration of Reconfigurable Intelligent Surfaces with xApps
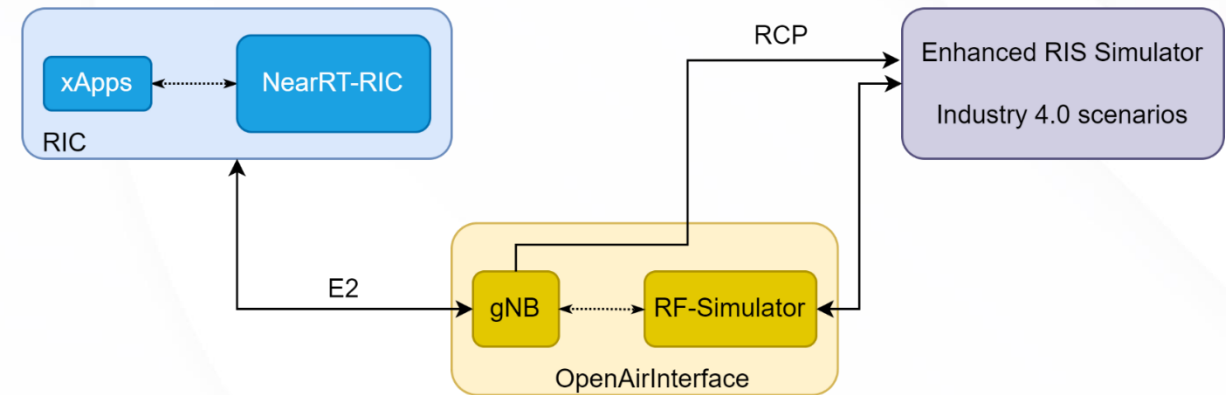
Project Idea: Massive/Distributed MIMO based sensing and communication technologies

Call Topic: HORIZON-JU-SNS-2025-STREAM-B-02: Wireless Communication Technologies and Signal Processing – Standardisation and Follow-up/PoCs

Deadline Dates: June-September 2025

❑ **Objectives:** Physical layer Technologies, MIMO technologies, this including advanced massive MIMO technologies and extremely large antenna arrays (XL-MIMO), AI/ML & semantic communications, Spectrum sharing and RAN co-existence, ORAN, enable 6G in 7-15 GHz band

❑ **Expected Results:** AI-native RAN framework, massive MIMO systems, Algorithms, software and hardware implementations for 6G

Project Idea: Open-Source 6G Telco Cloud Plug-and-Play Platform & Mobile Edge Cloud Applications

Call Topic: HORIZON-JU-SNS-2025-STREAM-C-01: 6G Telco Cloud and Service Provision Enablers

Deadline Dates: June-September 2025

❑ **Objectives:** Develop a standardized, open-source 6G telco cloud infrastructure that enables seamless, efficient, and secure service integration, fosters innovation through modular and scalable platforms, and reinforces cloud sovereignty under EU standards.

❑ **Expected Results:** Multi-provider, multi-tech system that hosts network functions, offers 6G deterministic networking, and provides additional services like **AI, Compute, Security,** and **ISAC** either within or independent of the telco system. Innovative 6G research across numerous technical areas including radio development for advanced networks including **6G Radio Access Network (RAN)** architectures, **network orchestration models, Massive MIMO**

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Project Idea: LEO satellite-based integrated communication and localization

Call Topic:HORIZON-JU-SNS-2025-STREAM-B-03-01: 6G NTN-TN Unification/Integration

Deadline Dates: June-September 2025

❑ **Objectives:** : NTN-TN unification, topology and traffic routing, dynamic spectrum access and sharing, resource slicing, GNSS free positioning

❑ **Expected Results:** TN-NTN communication continuum, security and resilience optimisation of NTN, compatibility, adaptability of the technologies, protocols and architecture (or a subset of those) to non-satellite scenarios such as drones or other flying 3D nodes

Project Idea: High-Frequency MIMO-Capable RU Front-End / Chip Development

Call Topic: HORIZON-JU-SNS-2025-STREAM-B-05: Microelectronic – Front-End Module (FEM)

Deadline Dates: June-September 2025

❑ **Objectives:** : FEM design that covers in priority **FR3** frequency range, a complete FEM including a Digital Front End, a Radio Front End including **antenna elements** with the needed conversion stages and capable of **handling at least 200 MHz channels and** enabling **SoC** implementations.

❑ **Expected Results:** FEMs (7 to 15 GHz range) with possible extension up to 24 GHz if required by some regional implementations, covers promising use cases with possibility to support both cellular (FR1 like) and FWA (FR2 like) scenarios, covers frequency sharing and co-existence with incumbent services, notably satellites at FR3 range, enables integration of secure sensing technologies and ISAC use-cases.

Project Idea: Energy Efficient IoT Devices and Applications for 6G

Call Topic: SNS-2025-STREAM-B-01-02: Advanced IoT and Device Technologies

Deadline Dates: June-September 2025

❑ **Objectives:**
- Energy-efficient devices using optimized sensing, connectivity, and battery-less components to operate effectively without traditional power sources over their full lifecycle.
- Architectures that leverage the unlicensed 6G spectrum for rapid deployment and robust connectivity in industrial, healthcare, and campus settings.
- Create and optimize IoT applications and novel device designs that utilize 6G's advanced features to deliver significantly improved performance compared to legacy 5G systems.

❑ **Expected Results:**
- Evaluate low-power IoT technologies for long-term, unattended operations with minimal network performance loss.
- Develop architectures for 6G IoT in unlicensed bands, especially for industrial scenarios.
- Design innovative IoT devices and operation modes that achieve enhanced KPIs/KVIs over legacy 5G systems.

Technology Enablers and Collaborators

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COUNTRY: Turkiye