

NANCY

An Artificial Intelligent Aided Unified Network for Secure Beyond 5G Long Term Evolution

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ITHACA

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Co-funded by
the European Union

6G SNS

NANCY project has received funding from the Smart Networks and Services Joint Undertaking (SNS JU) under the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101096456.



Consortium



8 Research Institutes



MINDS



UBITECH
ubiquitous solutions



5 Industry Organizations



DRAXIS
ENVIRONMENTAL TECHNOLOGIES



Virtual Open Systems

9 SMEs



GROUP OF COMPANIES



InnoCube



ERICSSON

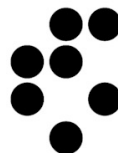
netcompany

intrasoft

UNIVERSIDAD DE
MURCIA



22 Partners



Independent Research & Consultancy

iti
Information
Technologies
Institute

8 Countries



THALES



Sant'Anna
School of Advanced Studies – Pisa

NEC

tecnal:a
MEMBER OF BASQUE RESEARCH
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NANCY Aim



The aim of NANCY is to introduce a secure and intelligent architecture for B5G networks. By leveraging AI and blockchain, NANCY enables secure and intelligent resource management and flexible network orchestration. In this direction, novel architectures, namely point-to-point (P2P) connectivity for device-to-device connectivity, mesh networking, and relay-based communications, as well as protocols for medium access, mobility management, and resource allocation are designed. These architectures and protocols will achieve the most by jointly optimizing the midhaul and fronthaul. This is expected to enable truly distributed intelligence and transform the network into a low-power computing unit. Finally, a new experimentally verified network information-theoretic framework will be presented to address the particularities of the new RAN arising from the use of novel building blocks such as blockchain, multi-access edge computing, and AI.

NANCY Concept

Key performance Indicators



>20% improvement



High security & privacy



Low latency (<1 ms)



Ultra-high reliability

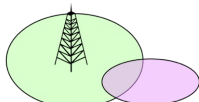


Ultra-high availability



AI reusability rate > 90%

Flexible scalability

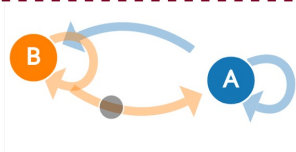


100m e2e range

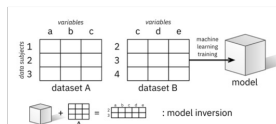


> 20% ownership cost reduction

Fundamental characteristics



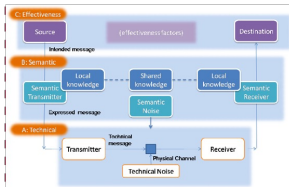
Blockchain modeling



Attacks modeling



Cell/grant free access



Semantic Communications



Smart pricing

Technology enablers



Multi-access edge computing



Blockchain



Post-quantum cryptography



Caching/offloading policies

Key technology module



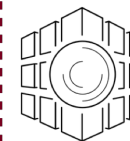
Artificial intelligence



Orchestration

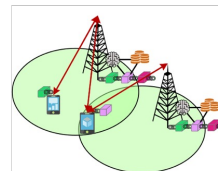


NG-SDN/NFV

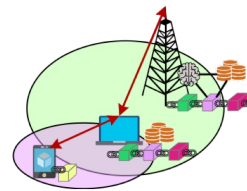


AI virtualisation

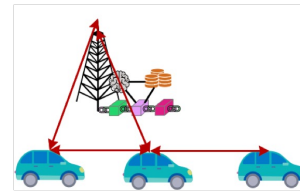
Usage scenarios



Fronthaul network of fixed topology

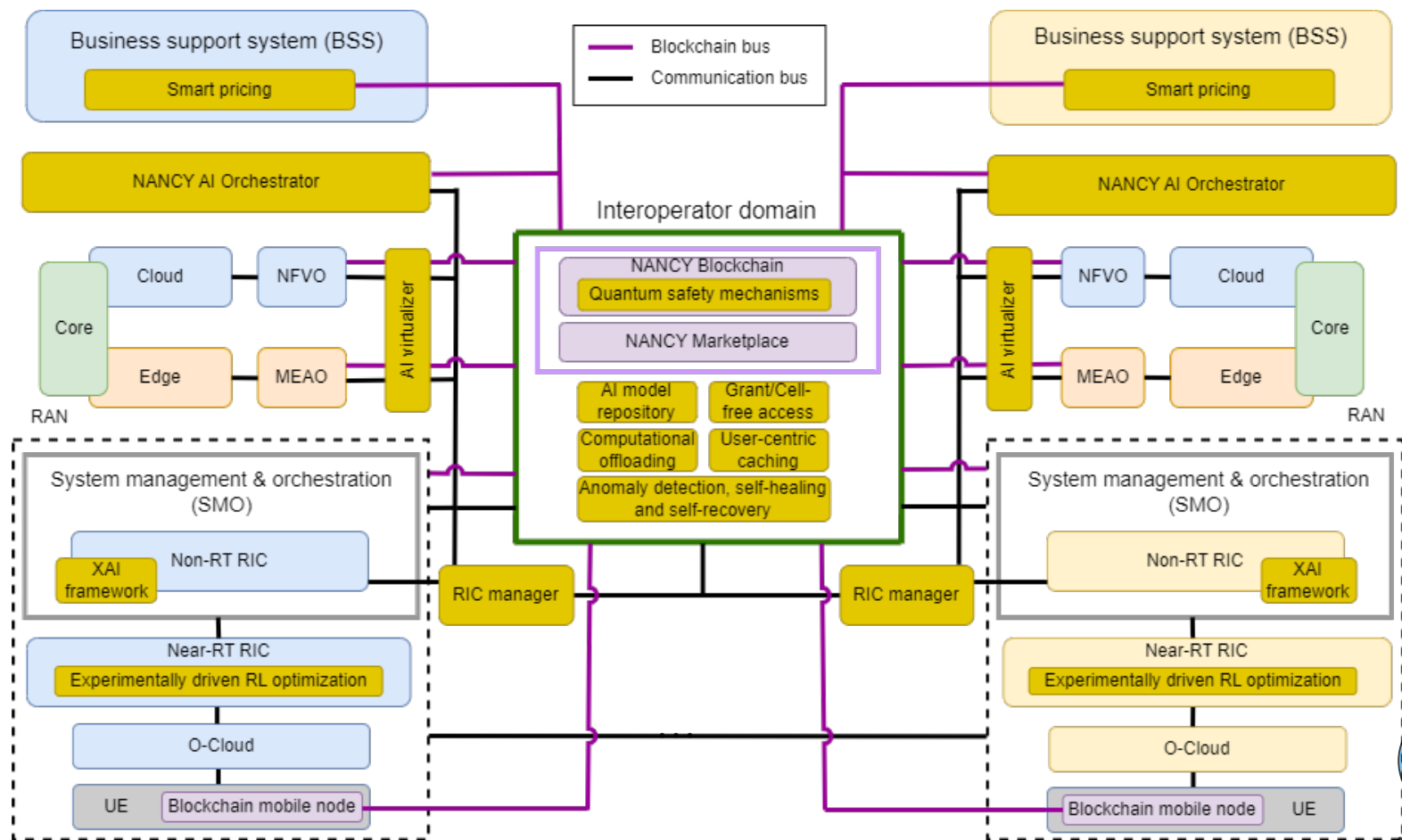


Advanced coverage expansion



Advanced connectivity of mobile nodes

High-level Architecture



Demonstration and Validation

3 Large-scale Demonstrators

Massive IoT (Italy)

High-mobility Vehicles (Spain)

Advanced Service Provisioning (Greece)

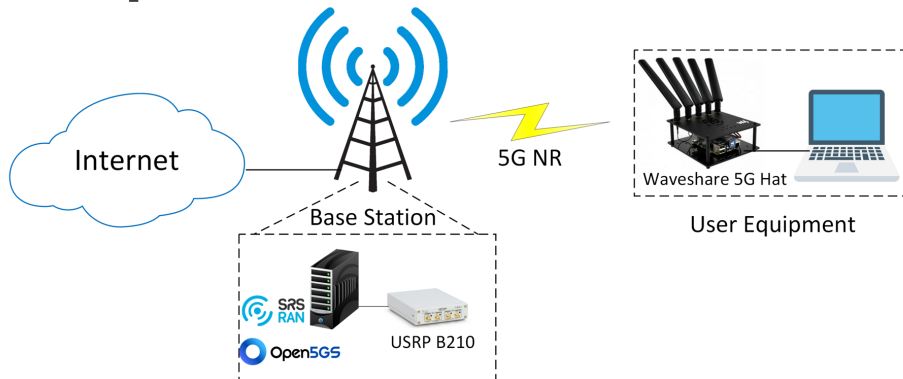
2 Laboratory Testbeds

University of Western Macedonia (Greece)

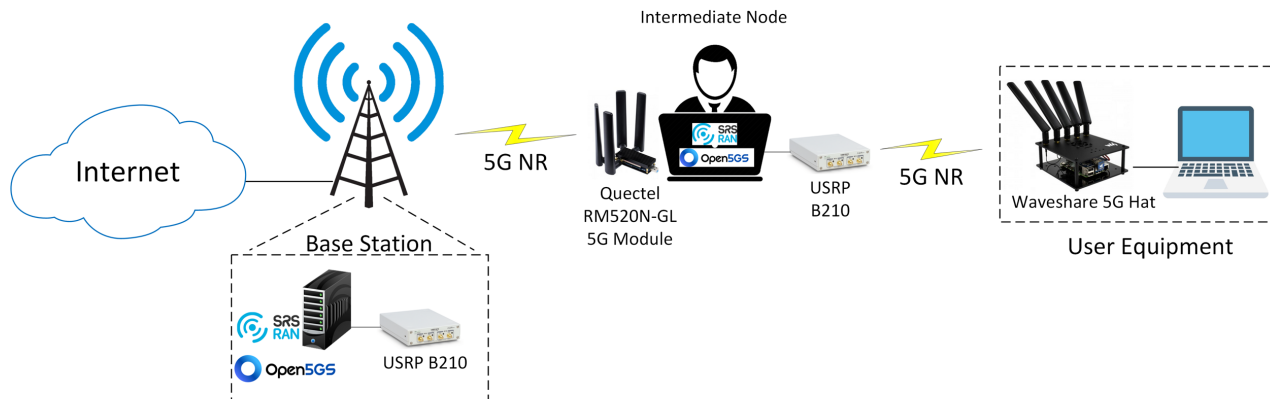
Italtel (Italy)

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Coverage Expansion Scenario



Topology A



Topology B

Hardware Equipment

A. 2x Ettus Research USRP B210

- 70 MHz – 6 GHz Radio Frequencies
- Up to 2x2 Multiple Input Multiple Output
- 56 MHz Real-time Bandwidth



B. Quectel RM520N-GL 5G Module

- Mounted in a USB adaptor



C. SIMCom SIM8200EA-M2 5G Module

- Mounted in Waveshare 5G Hat

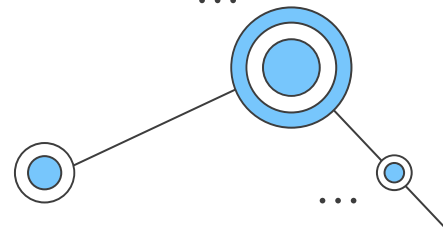


D. sysmocom Programmable SIMs

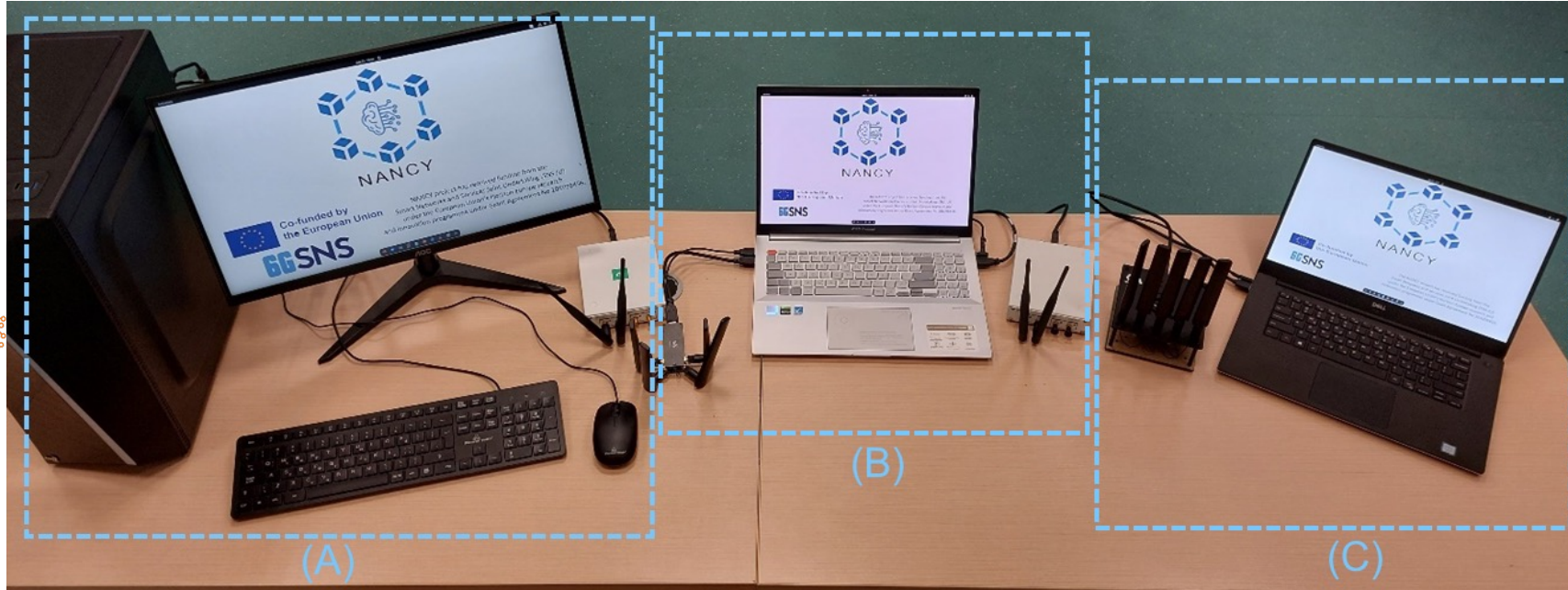


Software

- **srsRAN** (<https://www.srsran.com/>)
 - Deploys a 5G Base Station using the Ettus Research USRPs
 - Supports 5G Non-Standalone (NSA) and 5G Standalone (SA)
- **Open5GS** (<https://open5gs.org/>)
 - Provides 5G Core Network Functionalities
- **FlexRIC** (<https://gitlab.eurecom.fr/mosaic5g/flexric>)
 - Serves as Radio Access Network Intelligent Controller



Laboratory Deployment



(A) Main Base Station

(B) Intermediate Node

(C) User Equipment

5G Coverage Expansion Dataset 1



MINDS



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[<https://ithaca.ece.uowm.gr/>]

² MetaMind Innovations P.C. [<https://metamind.gr/>]

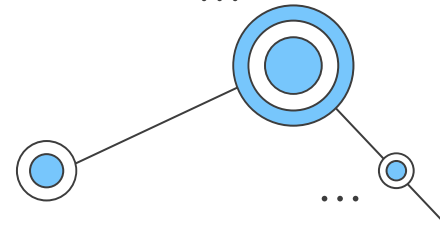
³ Sidroco Holdings Ltd. [<https://sidroco.com/>]

IEEE DataPort: <http://ieee-dataport.org/12120>

Zenodo: <https://zenodo.org/records/10442969>

DOI: <https://dx.doi.org/10.21227/vm3z-ww28>

Configuration Parameters



Parameter	Main Base Station	Intermediate Node
Device	Ettus Research USRP B210	Ettus Research USRP B210
5G NR Band	n78	n77
Frequency	3489.39 MHz	4050 MHz
Duplexing	Time Division Duplexing (TDD)	
Bandwidth	40 MHz	
Subcarrier Spacing	30 kHz	
Modulation	256 Quadrature Amplitude Modulation (256-QAM)	
Antenna Configuration	Single Input Single Output (SISO)	



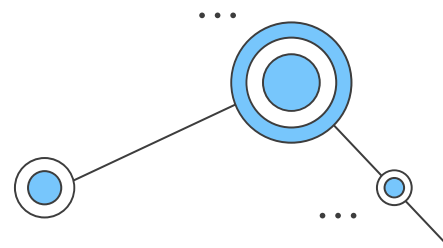
Evaluation Scenarios

➤ iPerf3

- TCP and UDP Modes

➤ VLC Media Player Streaming

- 720p - High definition (HD) with a resolution of 1280x720
- 1080p - Full high definition (FHD) with a resolution of 1920x1080
- 1440p - 2K resolution of 2560x1440
- 2160p - 4K resolution of 3840x2160



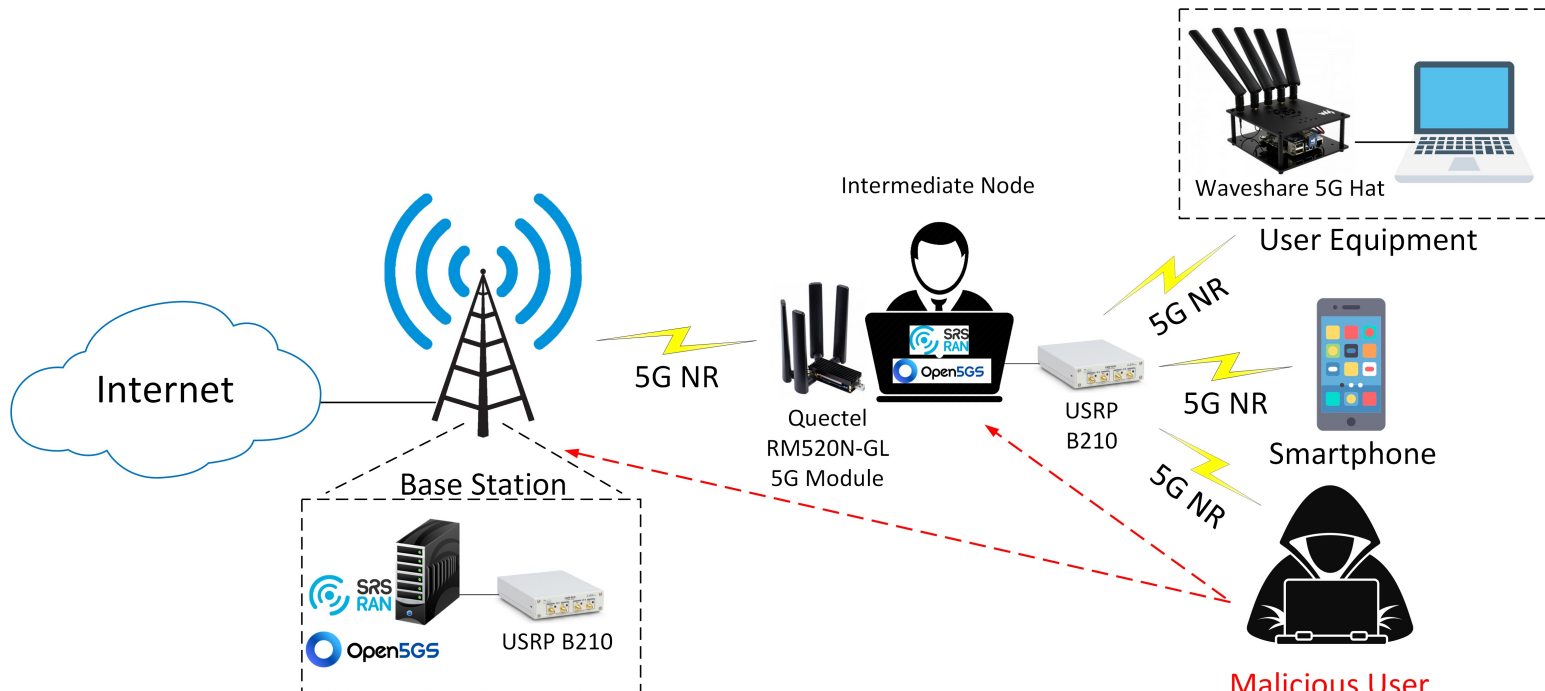
Highlights & Results

- **Prototyping using Software Defined Radio technologies**
- **All software used is open source**
- **Network traffic can be captured from three locations**
 - Main base station
 - Intermediate node
 - User equipment
- **Over 16 GB of data included in the first dataset release**
 - Network traffic
 - System resource utilization statistics
 - Streaming statistics from VLC media player



Threat Detection using Artificial Intelligence

ETSI AI Conference



MINDS



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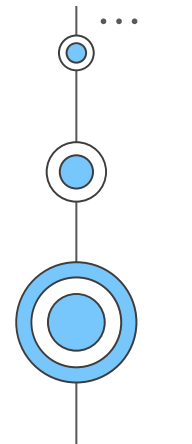
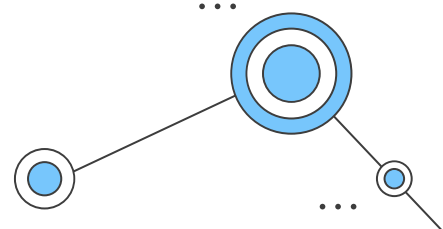
Next Steps

➤ **Integration of eXplainable AI (XAI)**

- XAI will provide insights about the impact of the network variables on the decisions taken by the AI model

➤ **Adding offloading capabilities**

- Devices with constrained resources will be able to offload their processing tasks to the intermediate node in order to reduce processing time



Thank you for your attention!



<https://nancy-project.eu/>



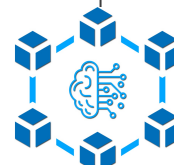
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