



**imec**

Building Network Digital Twins for Next-Generation WLANs using  
Graph Neural Networks

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# Agenda

- **Part 0 – Network Digital Twins – 6G-TWIN vision**
  - Motivation
  - Technology enablers
  - Architectural concept
- **Part I - Introduction to Wireless Networking Management**
  - Background in Wi-Fi and its medium access mechanisms.
  - Background in Channel Bonding
  - Challenges in Channel Bonding
  - Necessity for digital twins
- **Part II – Hands-on: Building an NDT for Next-Generation WLANs with traditional AI/ML/DL**
  - Introduction to dataset
  - Introduction to AI/ML/DL techniques
  - Hands-on: Building an NDT with traditional AI/ML/DL
- **Part III – Hands-on: Building an NDT for Next-Generation WLANs using Graph Neural Networks**
  - Motivation for using Graph Neural Networks (GNNs) in topology-based problems
  - Introduction to GNNs
  - Hands-on: Building an NDT for Next-Generation WLANs using GNNs
- **Part IV – What is next?**

# About us



- Principal Investigator - UAntwerpen & imec
- Ph.D. in Computer Engineering – UdG
- Ph.D in Computer Sciences - Uantwerp
- Co-lead the team of Programmable and Intelligent Networks
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- Ph.D. student – UAntwerpen & imec
- M. Sc. in Telecommunications Engineering – UdeA
- Current research: developing network management strategies using artificial intelligence and machine learning.
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# Integrating Network Digital Twinning into Future AI-based 6G Systems

# Project Factsheet



- **6G-TWIN vision:**

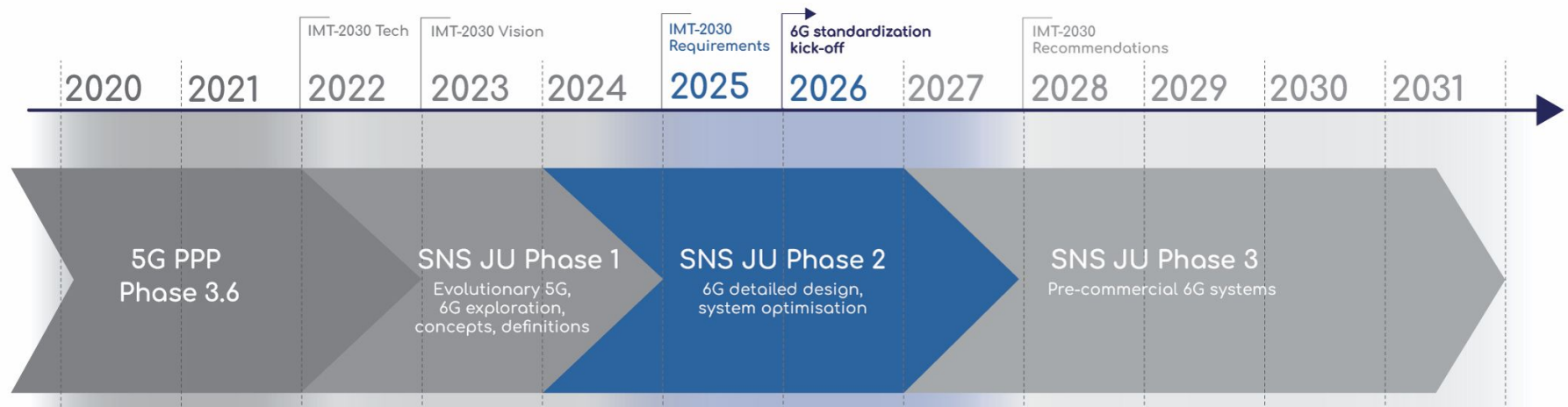
“To propose new methods, simulation and modelling tools around the concept of network digital twin and demonstrate their interest in tangible use cases”

# SNS JU: Advance 6G research in Europe



- SNS JU enables the pooling of EU and industry resources into Smart Networks and Services.
- 6G-TWIN is part of the SNS JU project portfolio, Phase 2, STREAM-B-01-01: **System Architecture** (5 projects selected, in total)

# 6G SNS



# The consortium



11 partners from 8 Member States or associated Member States



LUXEMBOURG  
INSTITUTE OF SCIENCE  
AND TECHNOLOGY



Politecnico  
di Bari



ubiwhere



## The consortium



- 2 leading research organizations, 3 universities, 3 SMEs and 3 LEs.
- Half of the consortium is member of the 6G-IA association.





## Beyond 5G



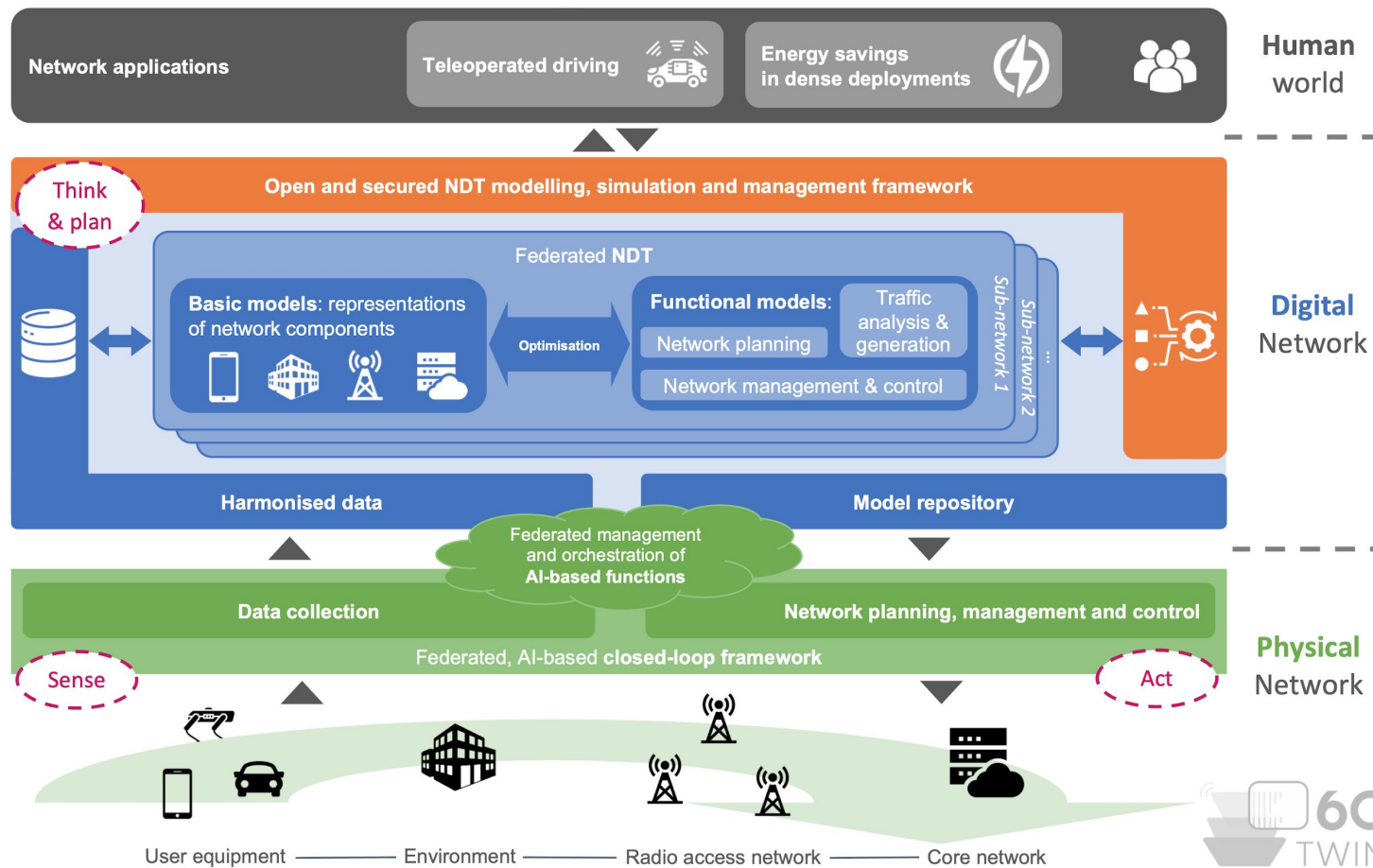
- The rapid integration of digital technology across industries like transportation and manufacturing has boosted the **need for efficient communication and computing services**.
- Networks are becoming increasingly complex and distributed, requiring a large variety of technologies to operate. With **6G**, which is now on the horizon for around 2030, it is essential to design, experiment and standardize **new network architectures with more intelligence and automation**.
- European 6G roadmaps prioritize an **AI-native management** system for complex networks. These networks need to be sustainable, energy-efficient, and adaptable to various services and business models. Establishing a consistent **unified communication and computing architecture** requires unconventional methods, along with collaboration among standardization groups and industry leaders for practical market integration.

## Overarching objective

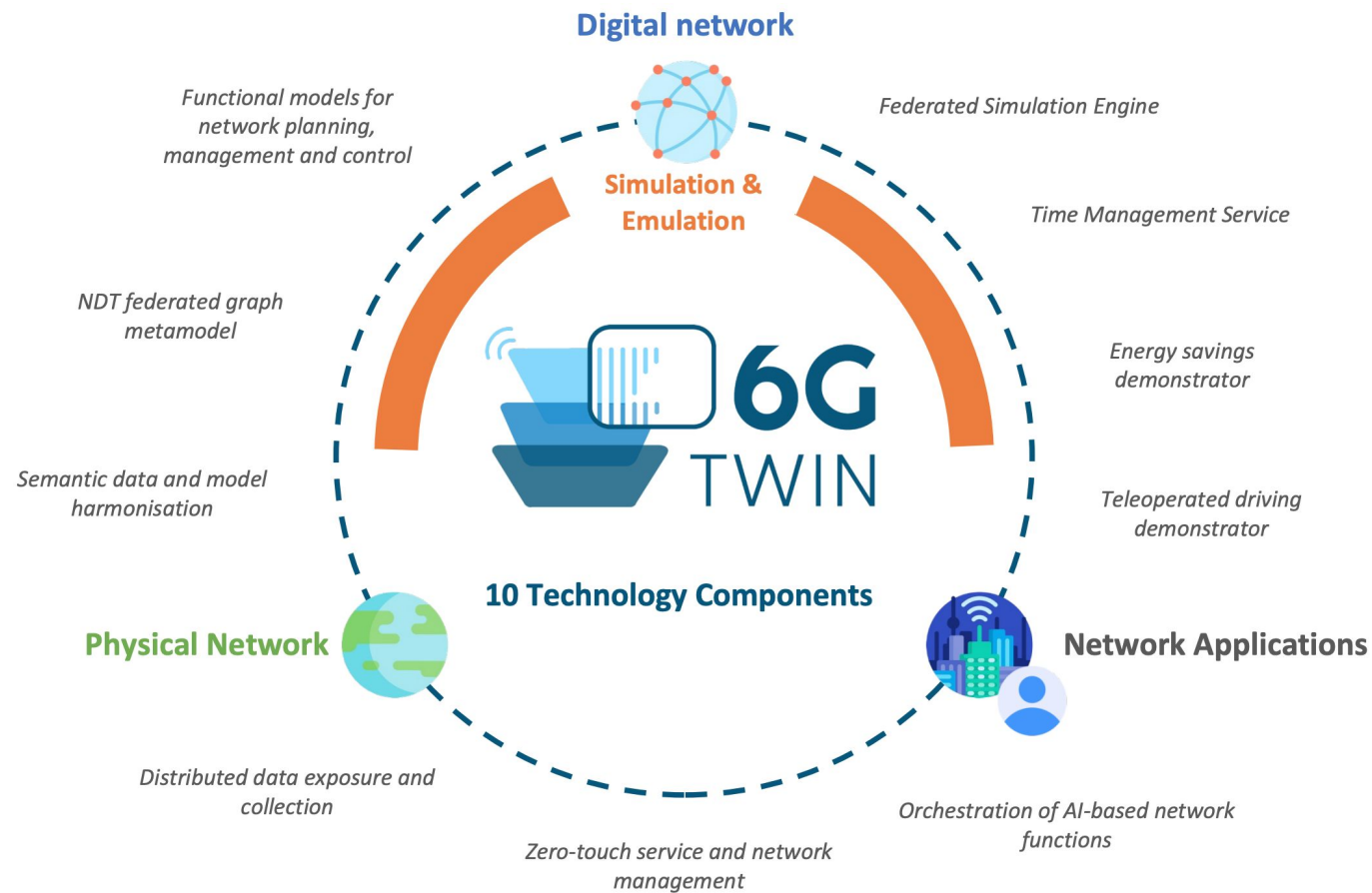


- To provide the foundation for the design, implementation and validation of an **AI-native reference architecture** for 6G systems that incorporates **Network Digital Twins (NDT)** as a core mechanism for the end-to-end, real-time optimisation, management and control of highly dynamic and complex network scenarios.
- Creating a real-time digital replica of the physical network infrastructure (i.e., NDTs) means creating a **sandbox** in which it is possible to train models and test different scenarios before deploying them on physical network controllers.

# Concept



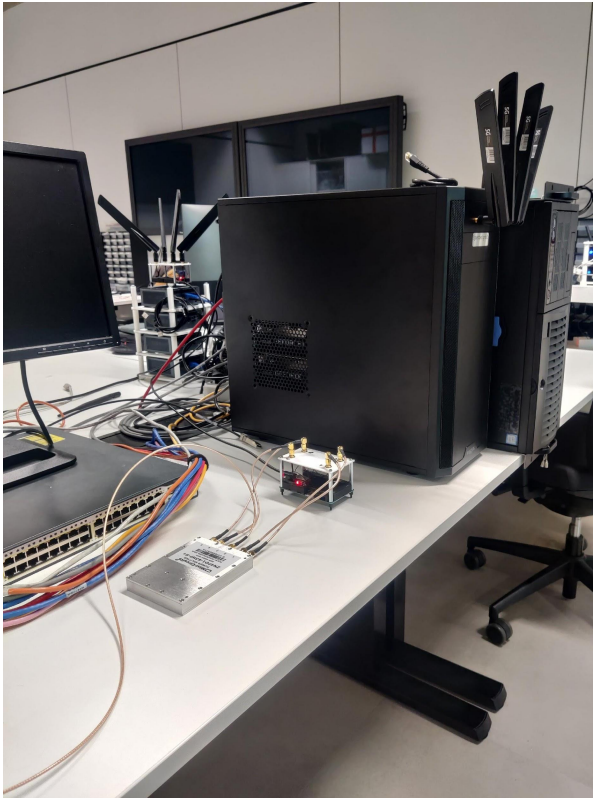
# Technology solutions





# Labs hosting the demonstrations

• **mec**





Thank you for your attention !



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