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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 me

- Principal Investigator- UAntwerpen & imec
- Co-lead of Programmable and Intelligent Networks team
- Ph.D. in Computer Engineering – University of Girona
- Ph.D in Computer Sciences - UAntwerpen
- SCATTER – DARPA competition.

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Integrating Network Digital Twinning into Future AI-based 6G Systems

Project Factsheet



- **6G-TWIN vision:**

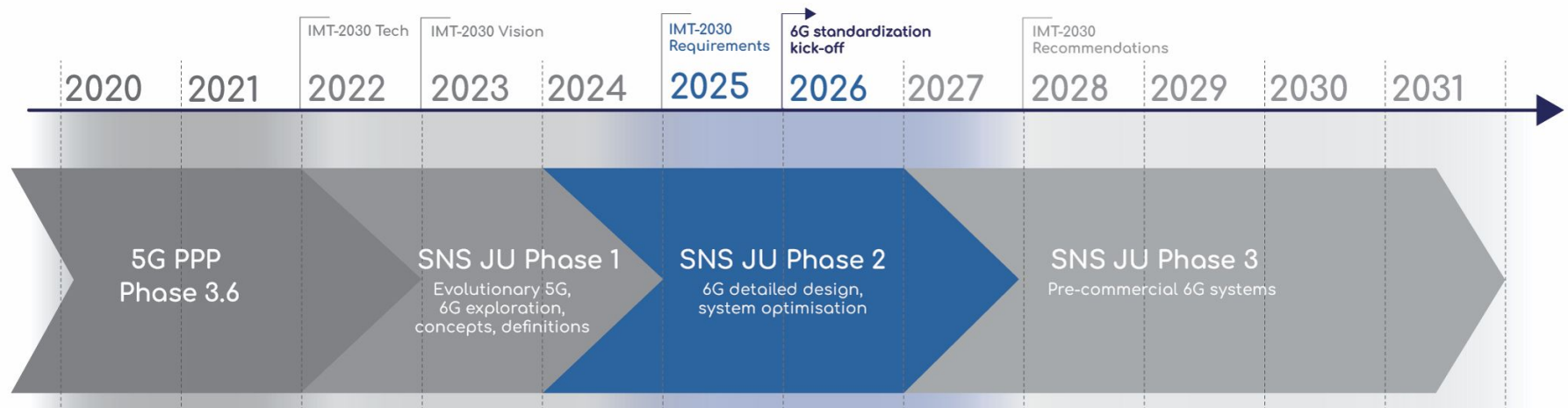
“To propose new methods, simulation and modelling tools around the concept of network digital twin and demonstrate their interest in tangible use cases”

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



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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



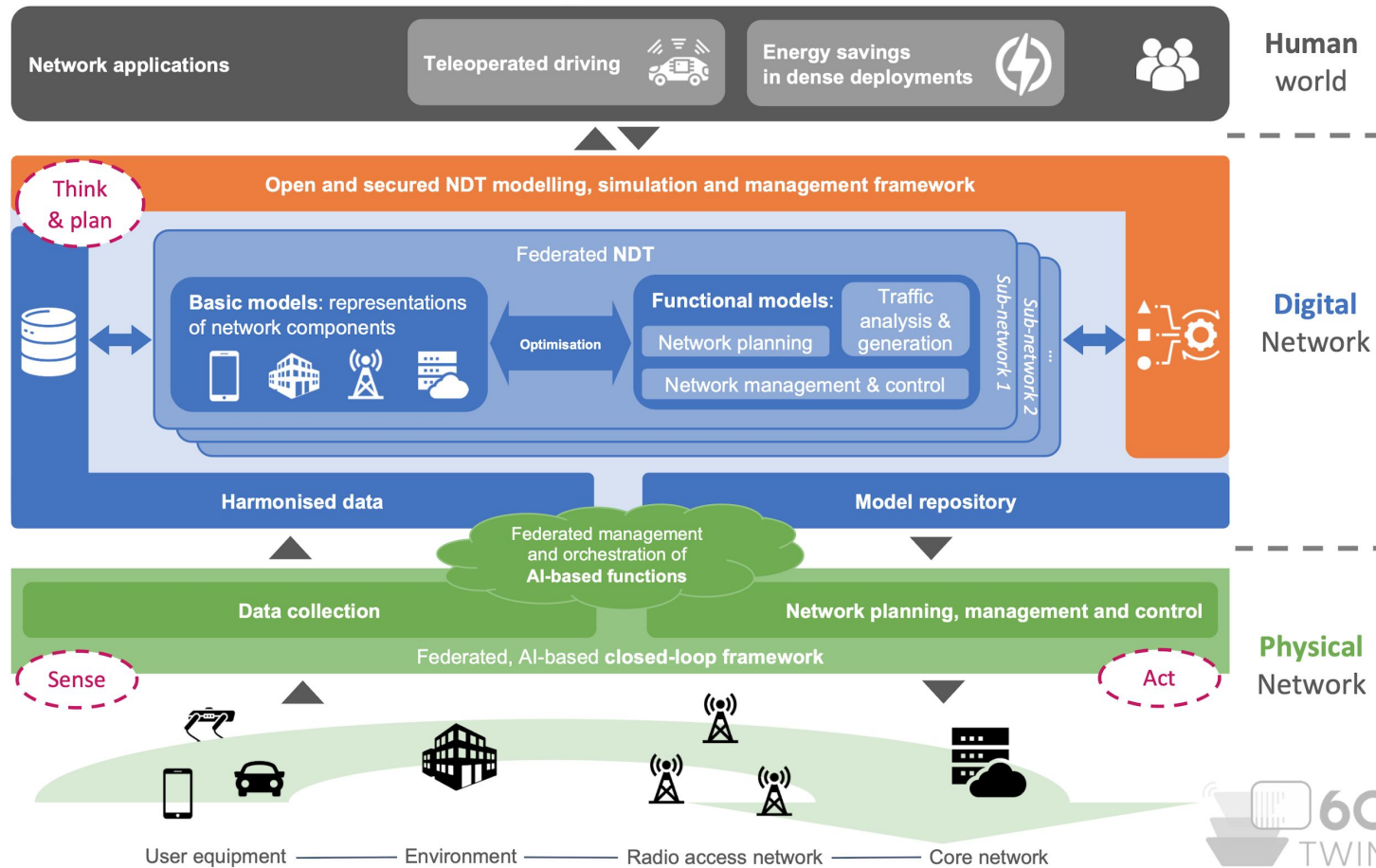
- The rapid integration of digital technology across industries like transportation and manufacturing has boosted the **need for efficient communication and computing services**.
- Networks are becoming increasingly complex and distributed, requiring a large variety of technologies to operate. With **6G**, 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

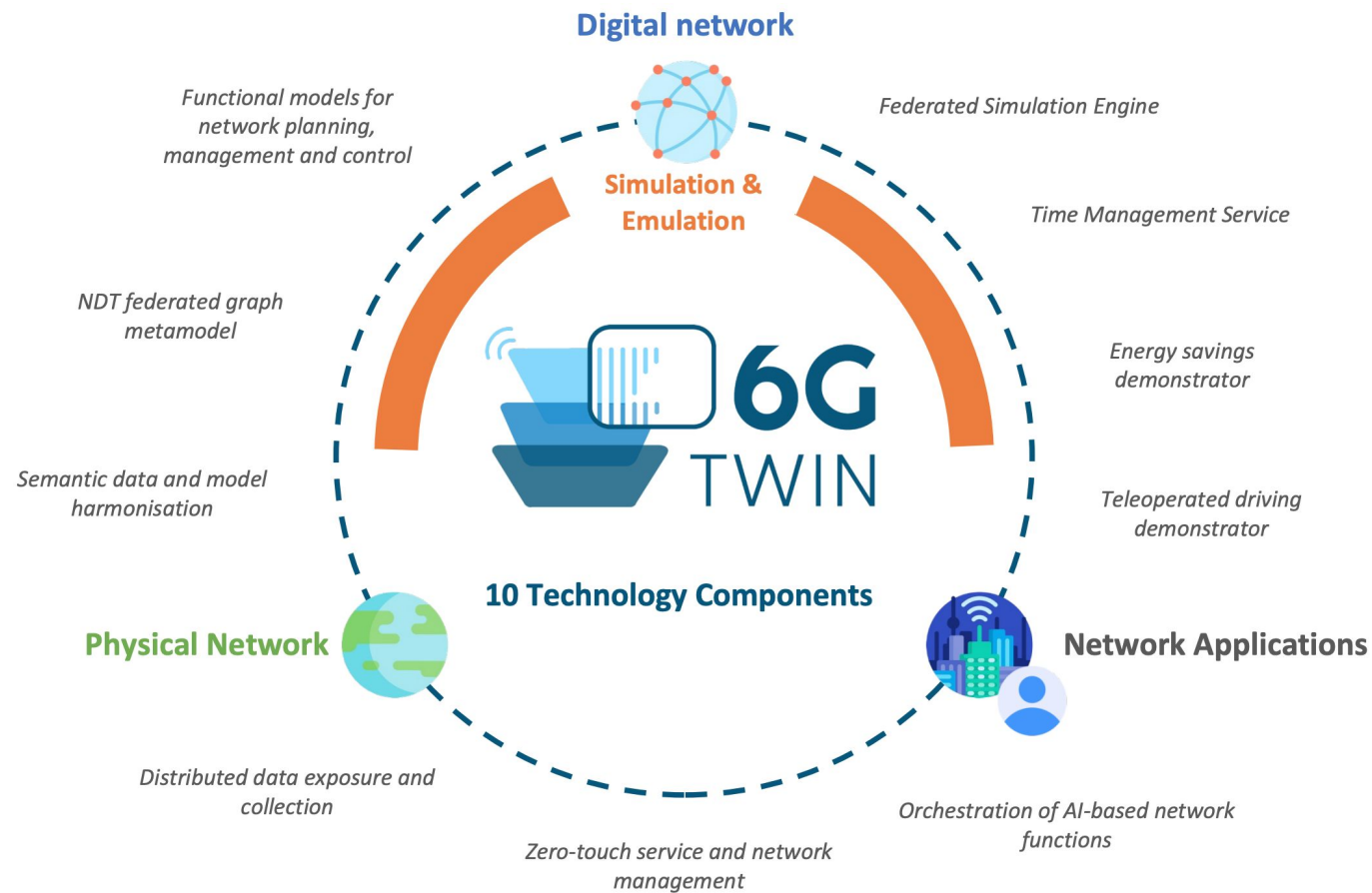


- To provide the foundation for the design, implementation and validation of an **AI-native reference architecture** for 6G systems that incorporates **Network Digital Twins (NDT)** as a core mechanism for the end-to-end, real-time optimisation, management and control of highly dynamic and complex network 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



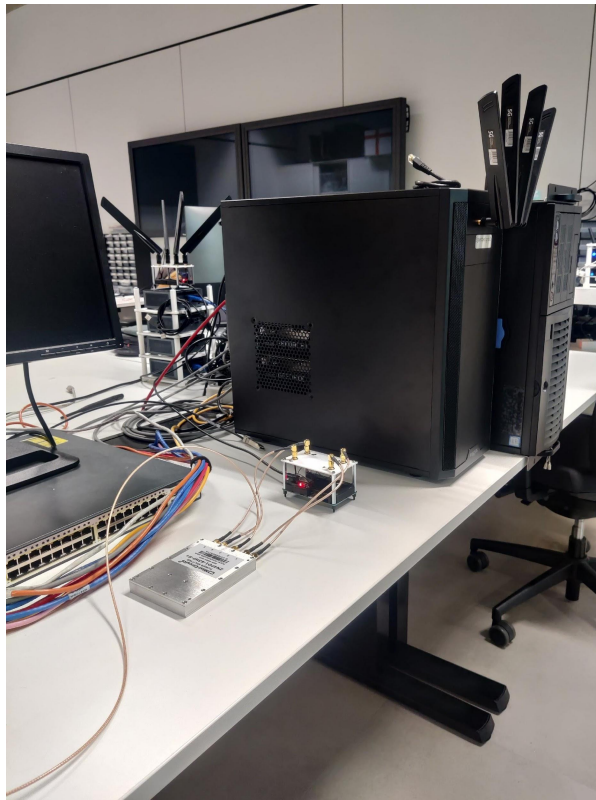
Technology solutions





Labs hosting the demonstrations

• **mec**





Thank you for your attention !



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