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

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Co-funded by the European Union

6GSNS

Project Factsheet

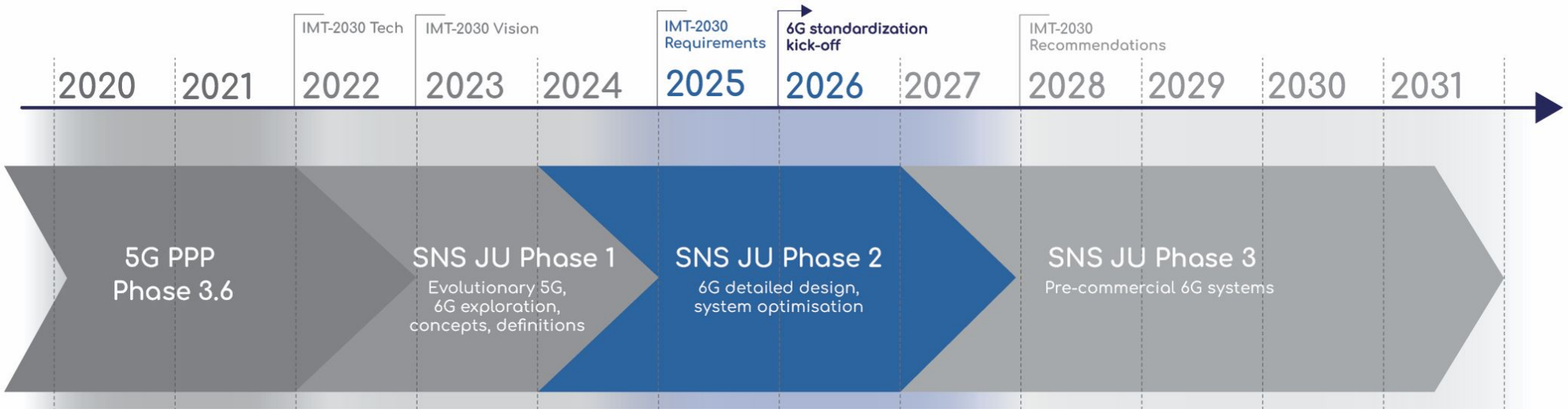
- **6G-TWIN vision**:

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

- **Duration**: 1 January 2024 – 31 December 2026
- **Budget**: 4.19 millions euros

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)



The consortium

11 partners from 8 Member States or associated Member States

LUXEMBOURG INSTITUTE OF SCIENCE AND TECHNOLOGY | LIST

Politecnico di Bari

imec

uB UNIVERSITÉ DE BOURGOGNE

TECHNISCHE UNIVERSITÄT DRESDEN

ubiwhere

Aelleran

R2M RESEARCH TO MARKET SOLUTION

ERICSSON

proximus NXT

VIAVI

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**.

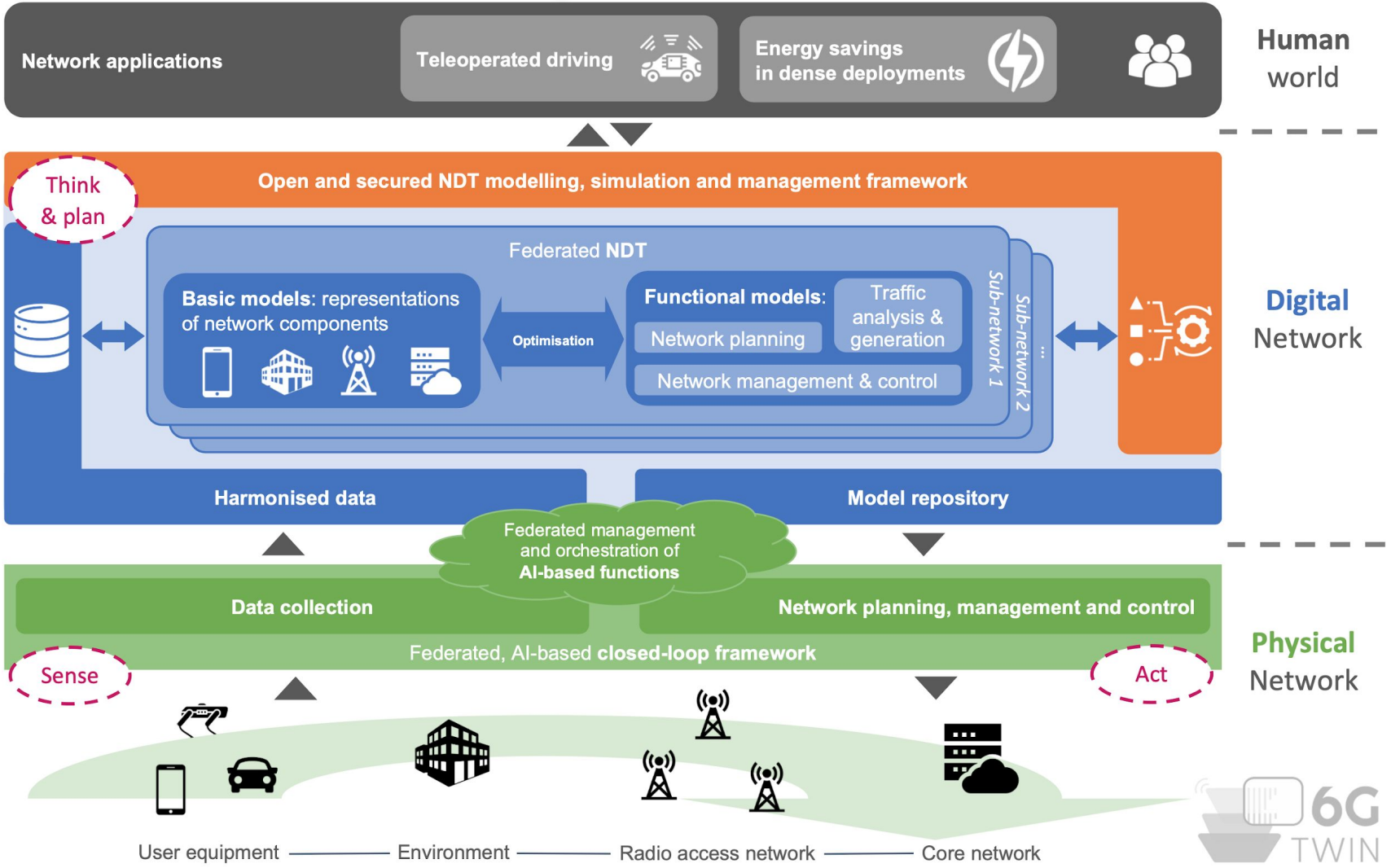
- European 6G roadmaps prioritize an **AI-native management** system for complex networks. These networks need to be sustainable, energy-efficient, and adaptable to various services and business models. Establishing a consistent **unified communication and computing architecture** requires unconventional methods, along with collaboration among standardization groups and industry leaders for practical market integration.

Overarching objective

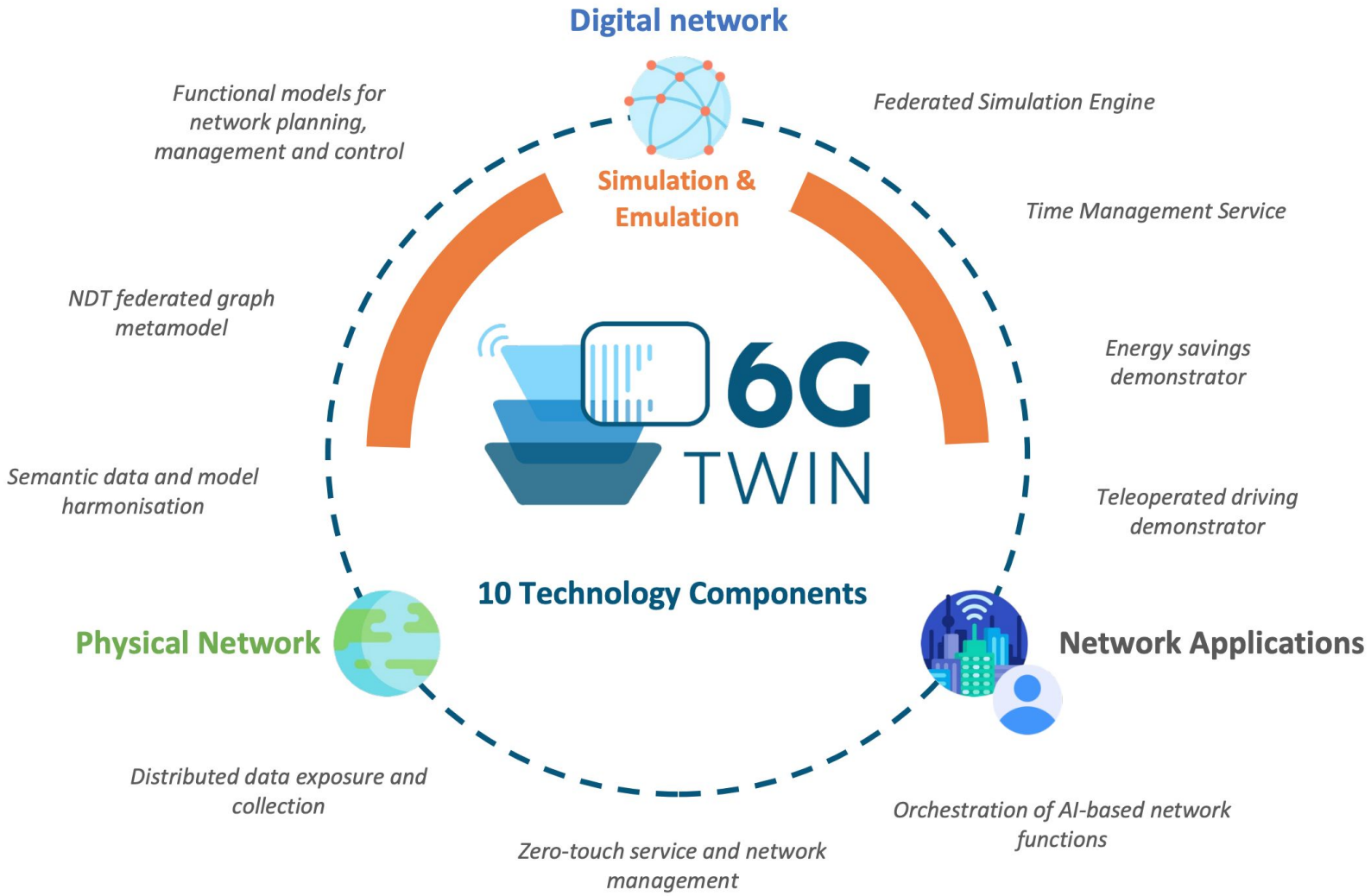
- To provide the foundation for the design, implementation and validation of an **AI-native reference architecture** for 6G systems that incorporates **Network Digital Twins (NDT)** as a core mechanism for the end-to-end, real-time optimisation, management and control of highly dynamic and complex network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


Network applications
Teleoperated driving
Energy savings in dense deployments
Human world
Think & plan
Open and secured NDT modelling, simulation and management framework
Federated NDT
Basic models: representations of network components
Optimisation
Functional models:
Traffic analysis & generation
Network planning
Network management & control
Sub-network 1
Sub-network 2
...
Digital Network
Harmonised data
Model repository
Federated management and orchestration of AI-based functions
Data collection
Network planning, management and control
Federated, AI-based closed-loop framework
Sense
Act
Physical Network
User equipment
Environment
Radio access network
Core network

Technology solutions



6G-TWIN specific objectives

Area 1: advance the state of the art

SO1: To design and develop an **open, federated and AI-native network architecture** for future 6G systems that integrates NDT to enable intelligent data analytics and decision-making in real-time.

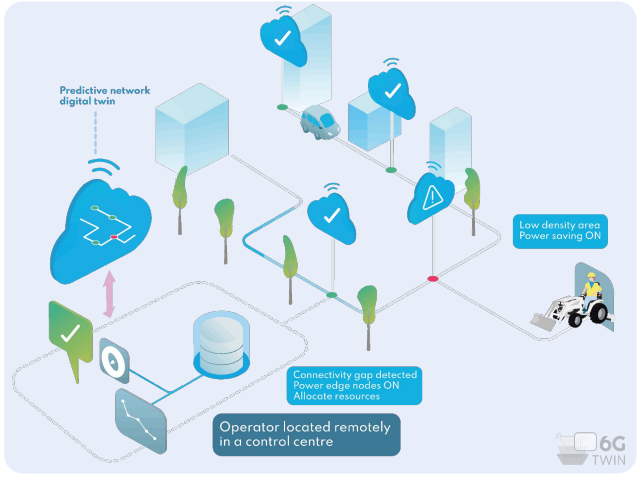
SO2: To design a **federated, graph-based NDT** that accurately represents highly dynamic and complex network scenarios and serves as a sandbox for optimising network planning, management and control applications.

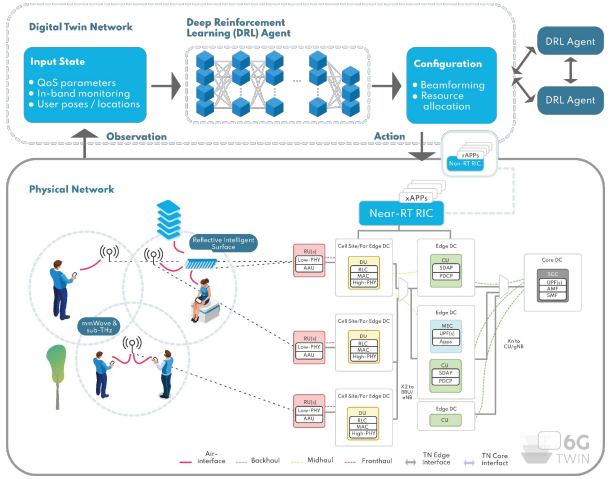
SO3: To implement an **accurate, reliable, open and secured modelling and simulation framework** to represent a networked environment and test the functionalities of the proposed 6G architecture.

6G-TWIN specific objectives

Area 2: demonstration

SO4: To test, validate and facilitate the transferability of the solutions developed in 6G-TWIN through the development of two demonstrators supporting highly dynamic use cases, with two key focus areas: **teledriving** and **energy efficiency**.

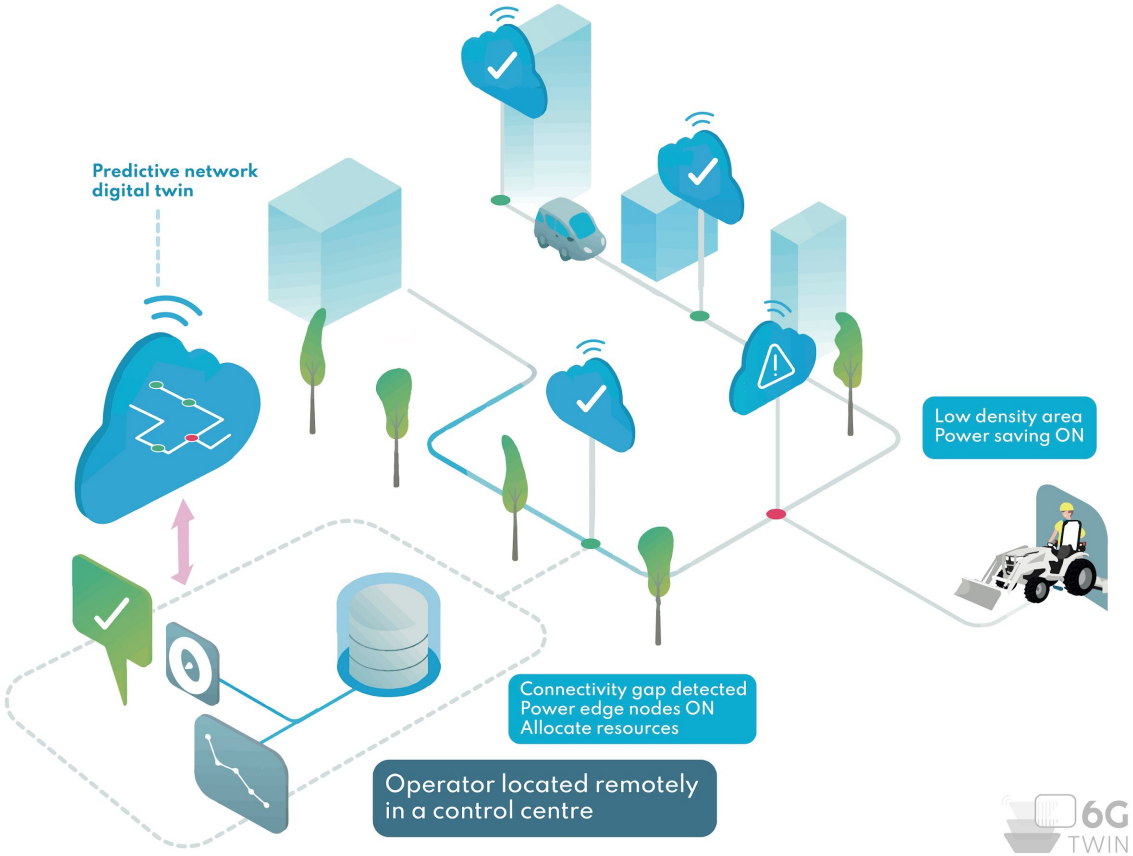




Demonstrator #1

Teleoperated driving demonstrator

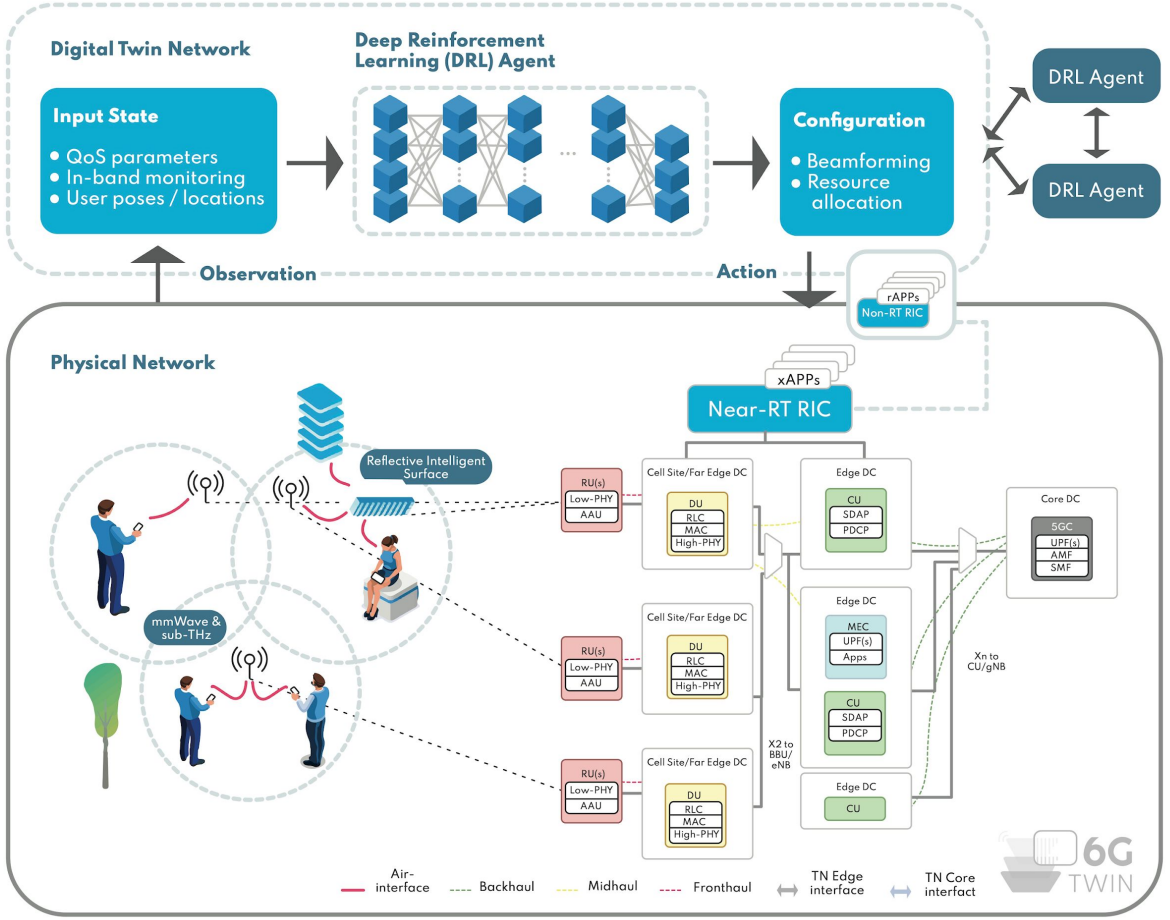
NDT solutions allow to anticipate (predictive DT) the network behaviour that could face a teleoperated vehicle prior to its departure, to ensure an extreme quality of service and availability of the network resources all along its journey.



Demonstrator #2

Energy savings demonstrator

NDT solutions are used to adapt its behaviour in near real time with the objective to optimise the overall, end-to-end energy efficiency of the network (reactive DT).



Labs hosting the demonstrations

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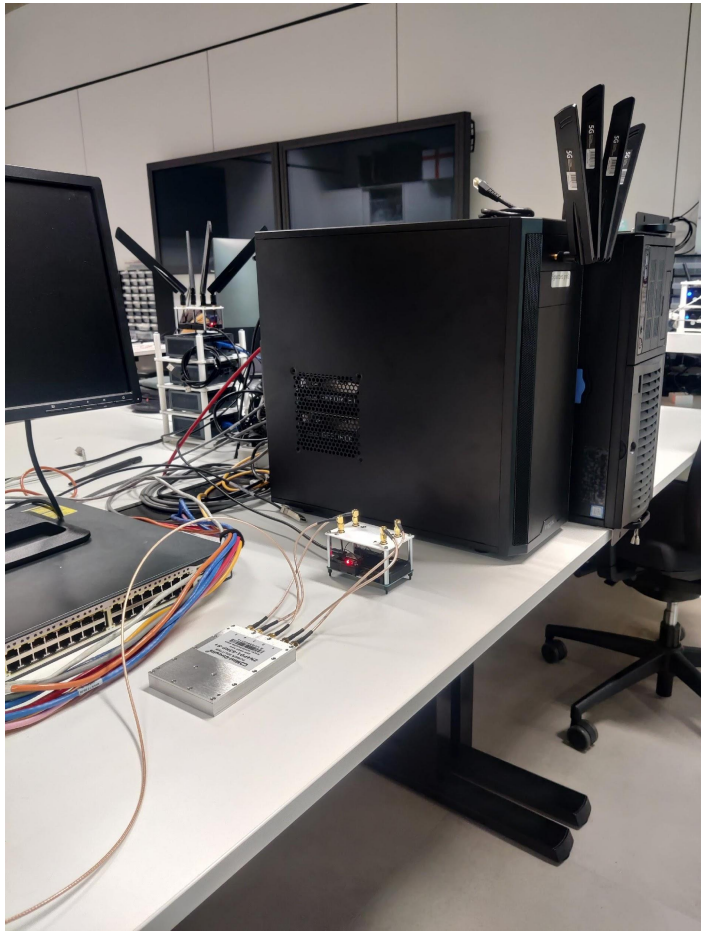


6G-TWIN specific objectives

Area 3: adoption

SO5: To support the **standardisation** of the 6G-TWIN operation system to ensure the interoperability, platform openness and operation harmonisation of future 6G-TWIN Solutions.

SO6: To provide industry with insights on **innovative business models** based on 6G-TWIN solutions and visions.

Expected results

- Integration of the TCs in **one federated and AI-native network reference architecture that integrates multiple NDTs** for real-time data analytics and decision-making across at least two network domain
- **New on-the-fly AI approaches** to orchestrating network functions and services.
- At least **3 AI-based NF/NS for data analytics or/and decision-making to optimise network performance**.
- Accurate, reliable, **open and secured modelling and simulation framework for representing a networked environment and testing the functionalities of the 6G architecture**.
- Monitored KPIs & KVIs for each demonstrator, including **at least 30% end-to-end improvement in energy efficiency**.

Expected outcomes (1/2)

- 6G-TWIN will provide an **AI-native IT architecture for 6G systems that integrate NDT as a core mechanism**: enhanced control, management and deployment in a highly dynamic and complex network environment is achieved.

- **Innovative protocols** for overcoming known Internet limitations are made available by 6G-TWIN as originating from new scenarios and vertical requirements (ultra-low latency, extreme mobility, ultra-high data rates, integration of end-terminals, controlled security, space applications).

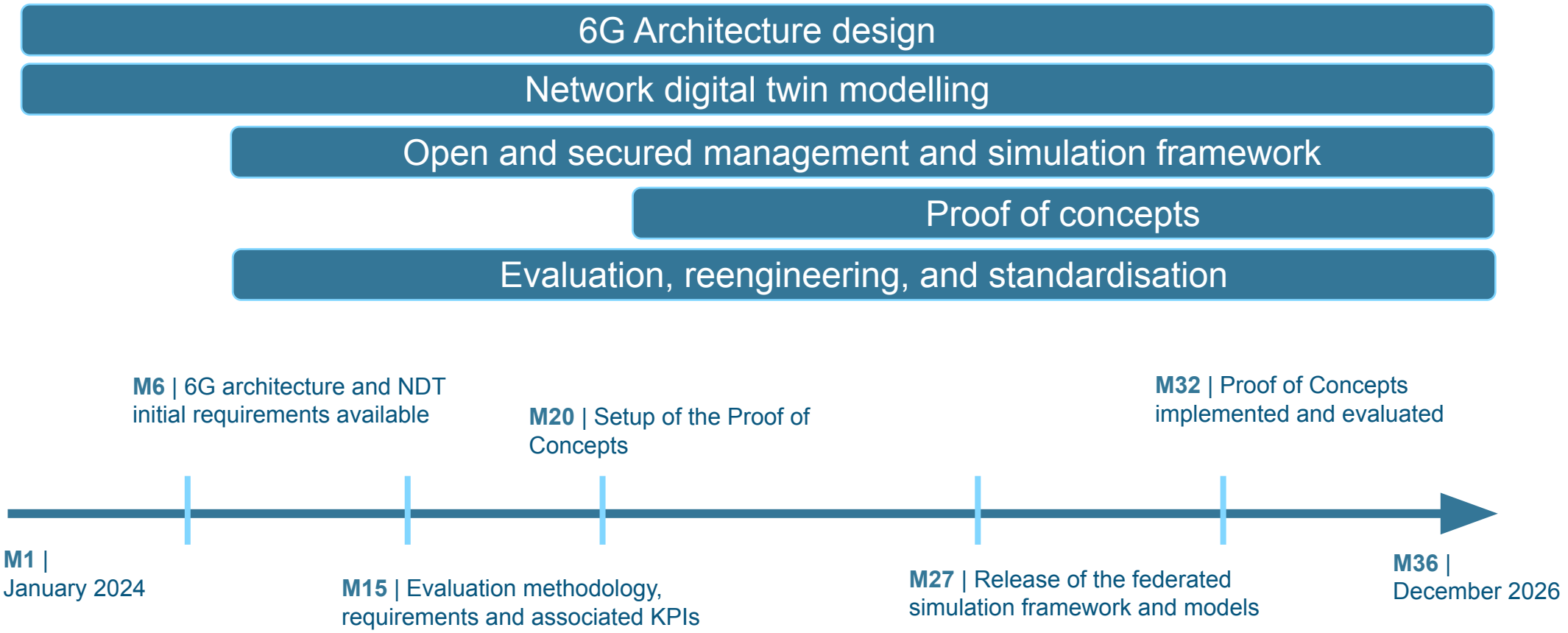
Expected outcomes (2/2)

- **Proven high reactivity to network changes** in line with high topology and load dynamics beyond what semi-rigid network architectures, thanks to AI driven on-the-fly optimisation of both communication and computation aspects of mobile networks based on DTs.

- **Single, unifying, and open controllability framework** providing a unified view of the network, allowing the connectivity and service infrastructure to be programmable.

- **Uptake of project results** by industrial partners (both large enterprises and SMEs), push toward standardisation and further replication.

Timeline and core activities



Follow us and get in touch

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