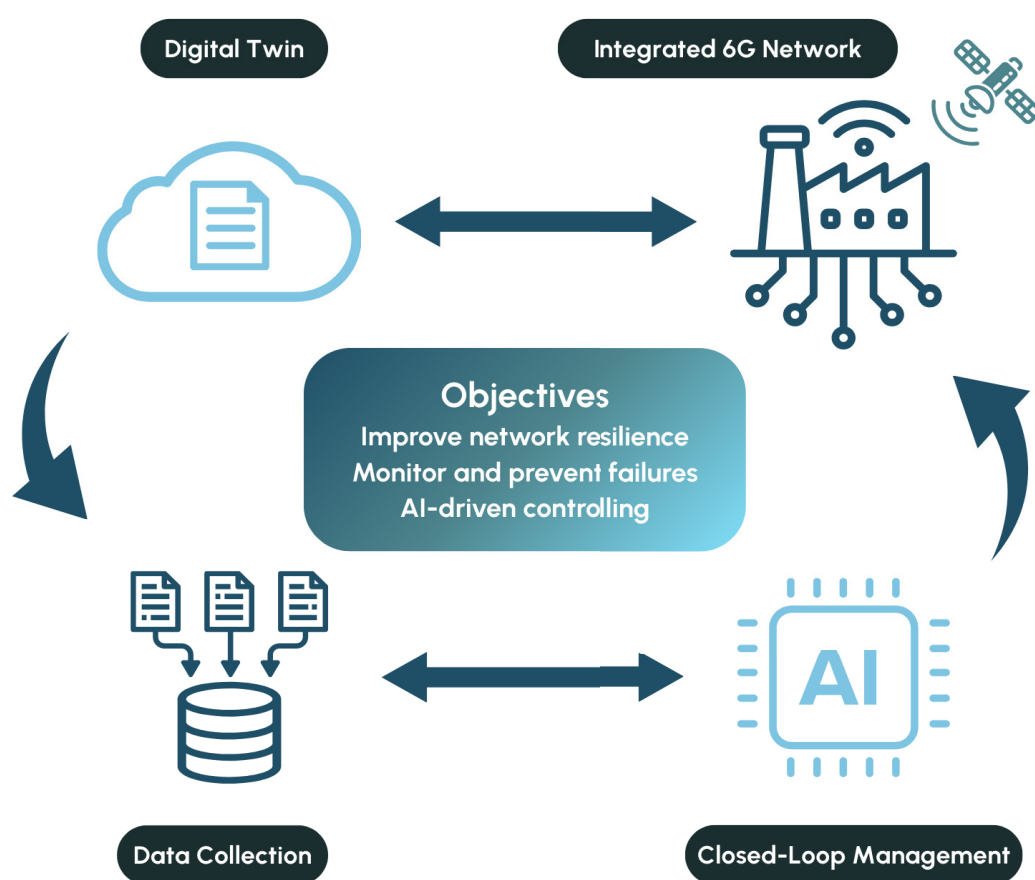# Digital Twin for integrated 6G network evaluation

Use Case 3

UNITY-6G's "Digital Twin for integrated 6G network evaluation" use case targets the core problem of operating a resilient, heterogeneous 6G infrastructure across terrestrial, transport, satellite, NPN, and edge-cloud domains. Instead of reacting to faults, the Digital Twin mirrors the end-to-end network—topology, functions, traffic, context, and policies—to enable proactive decision-making, predictive control, and AI-driven closed-loop management. Continuous

telemetry from real infrastructure feeds the Digital Twin while simulated actions and AI models feed back as recommendations or automated reconfigurations, preventing equipment failures and minimizing service disruption.

Motivation

Building and running multi-domain 6G systems is complex: resources are scattered, failure modes are opaque, and configuration space explodes. The Digital Twin addresses this by aggregating real-time and historical data, generating statistics, and learning patterns to forecast issues. It shortens the "sense–decide–act" loop for operators, accelerates site rollout and configuration, and improves orchestration across radio, transport, satellite, and edge resources—raising overall robustness and trustworthiness.

Objectives

- Train and validate AI/ML models (including online Deep Reinforcement Learning) on realistic, DT-backed environments close to production.

- Rapidly test and deploy novel 6G services and configurations; assess future "what-if" scenarios and function changes before touching the live network.

- Simplify and speed up site deployment configuration and end-to-end service provisioning.

- Enhance transport/xHaul, NPN, satellite, and radio resource management with DT-informed policies.

- Sustainably operate the edge–cloud continuum (scalable, energy-aware).

- Tackle trustworthiness, resiliency, and effective orchestration/management at scale.

Novelties

The use case unifies heterogeneous domain knowledge into a living, AI-empowered replica that closes the loop between observation, prediction, and actuation. Beyond mere transparency, it

delivers actionable intelligence: control knobs (e.g., scheduling, placement, parameter tuning) are exposed to real-time (dApps), near-real-time (xApps), and non-real-time (rApps) controllers. Historical replay, synthetic data generation, and preventive-maintenance insights become first-class capabilities. In short, this is not just a dashboard—it is an operational co-pilot for resilient 6G networks.

Outcome

A first-of-its-kind Digital Twin platform for integrated 6G networks that:

- Detects and mitigates failures before they propagate.

- Optimizes resources and QoS under tight latency/reliability constraints.

- Serves as a safe sandbox for innovation and rapid deployment.

- Elevates network planning, evaluation, and sustainability through continuous, data-driven intelligence.