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Grant Thornton

Digital Twin of 5G Network Infrastructure

STUDY 07 · 5G & VHCN ECOSYSTEM

Concept, architecture and use of the Network Digital Twin — and the road to 5G Advanced and 6G.

AT A GLANCE

A digital twin is a live virtual replica of a physical entity or process. This study explains the concept across verticals — from manufacturing and energy to telecoms and smart cities — and then focuses on the Network Digital Twin (NDT): a continuously updated virtual model of a physical 5G network that lets operators evaluate performance, optimise resources and resolve faults in a controlled environment. It maps the technology, benefits, architecture and the evolution toward 5G Advanced and 6G.

What the study covers

Three attributes separate a true digital twin from an ordinary model: real-time data synchronisation, bidirectional communication, and the ability to run “what-if” simulations. The study sets out 5G’s dual role — as the enabling connectivity for digital twins across virtually all verticals (including the RedCap, NB-IoT and Cat-M IoT variants), and as the subject of its own twin, the NDT, used to design, test and optimise the network itself.

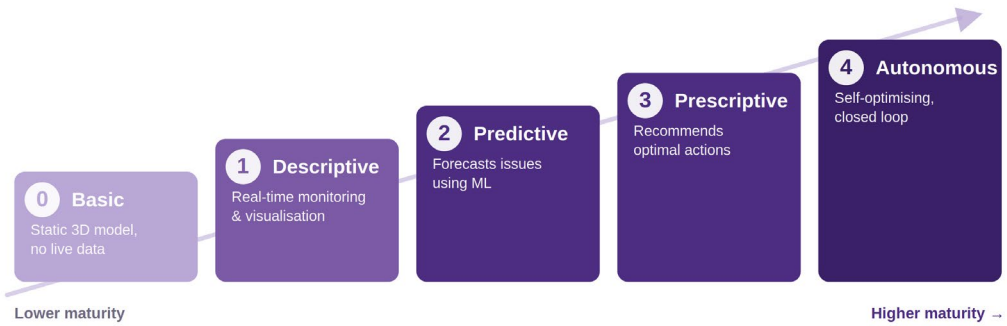
Why it matters

Data and its real-time transfer are the lifeblood of any digital twin, which makes 5G the ideal foundation. Adoption is accelerating fast — yet most twins deployed today remain at a low maturity level, limited to monitoring rather than recommending or acting.

10×	**$6 bn+**	**5G + IoT**
projected market growth, 2020–2025	manufacturing digital-twin market alone	ideal enabler for real-time twins

From a static model to an autonomous system

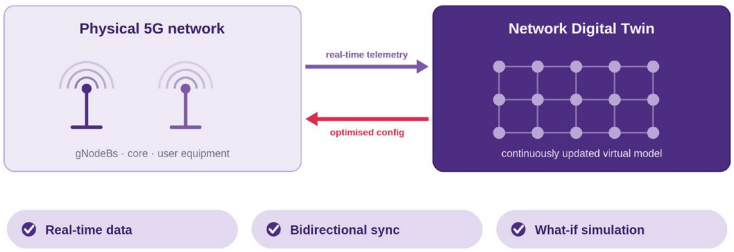
Maturity rises across five levels — each adding capability on top of the last, toward twins that can decide and act on the physical network on their own.



Five maturity levels of a digital twin, from a static representation (0) to a self-optimising closed loop (4).

The Network Digital Twin (NDT)

5G's benefits — throughput, low latency, slicing, MEC, private networks — bring far greater architectural complexity. The NDT answers this: a virtual model kept continuously in sync with the live network, with a bidirectional link so telemetry flows in and optimised configurations flow back out.



More than inventory, monitoring or a testbed

Network inventory

A static digital record. The NDT adds real-time adaptation and predictive insight.

Monitoring tools

Track isolated metrics. The NDT fuses data sources into one holistic, interactive model.

Testbeds

Isolated and offline. The NDT stays continuously synchronised with the live network.

Where the NDT delivers

C-V2X vehicle testing

Virtual trials of connected and autonomous vehicles, cutting physical test mileage.

QoS planning for operators

CSPs and MNOs validate configurations and protect service quality under changing load.

Private 5G for Industry 4.0

Model and optimise factory networks needing ultra-low latency and high reliability.

Cyber range

Safely simulate attacks and test resilience of the network and its security teams.

In practice

Urban digital twins were a recurring theme Smart Cities Meetup, Central Europe's leading smart-city platform — illustrating the study's "connected twins" outlook for cities.

Prague (IPR) — a semantic 3D city model plus a photorealistic mesh twin of the whole city, used for planning, environmental and traffic modelling, accessibility mapping and municipal asset management.

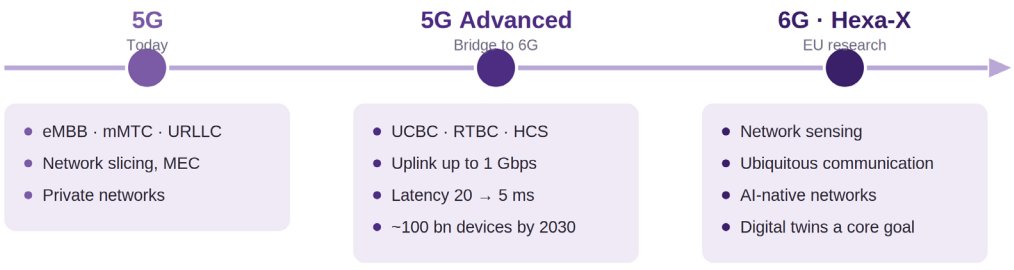
Plzeň (DUET project) — an EU-supported 3D city twin that simulates traffic and environmental scenarios before decisions are taken.

City asset twins — exhibitors such as MDP GEO build twins from laser scanning and multi-source data — one live system for infrastructure management and decision-making.

Source: URBIS Smart Cities Meetup, Brno; IPR Praha; DUET project / City of Plzeň.

The road ahead: 5G Advanced → 6G

5G Advanced bridges toward 6G with better uplink and latency for richer twins. In the EU, the Hexa-X initiative is shaping 6G with digital twins as a core goal — backing Europe's technological sovereignty and digital transformation.



KEY TAKEAWAY

The Network Digital Twin turns 5G's complexity into an asset — a live, bidirectional model that lets operators design, optimise and secure networks before touching the physical infrastructure, and a cornerstone of the connected, AI-driven systems of 5G Advanced and 6G.