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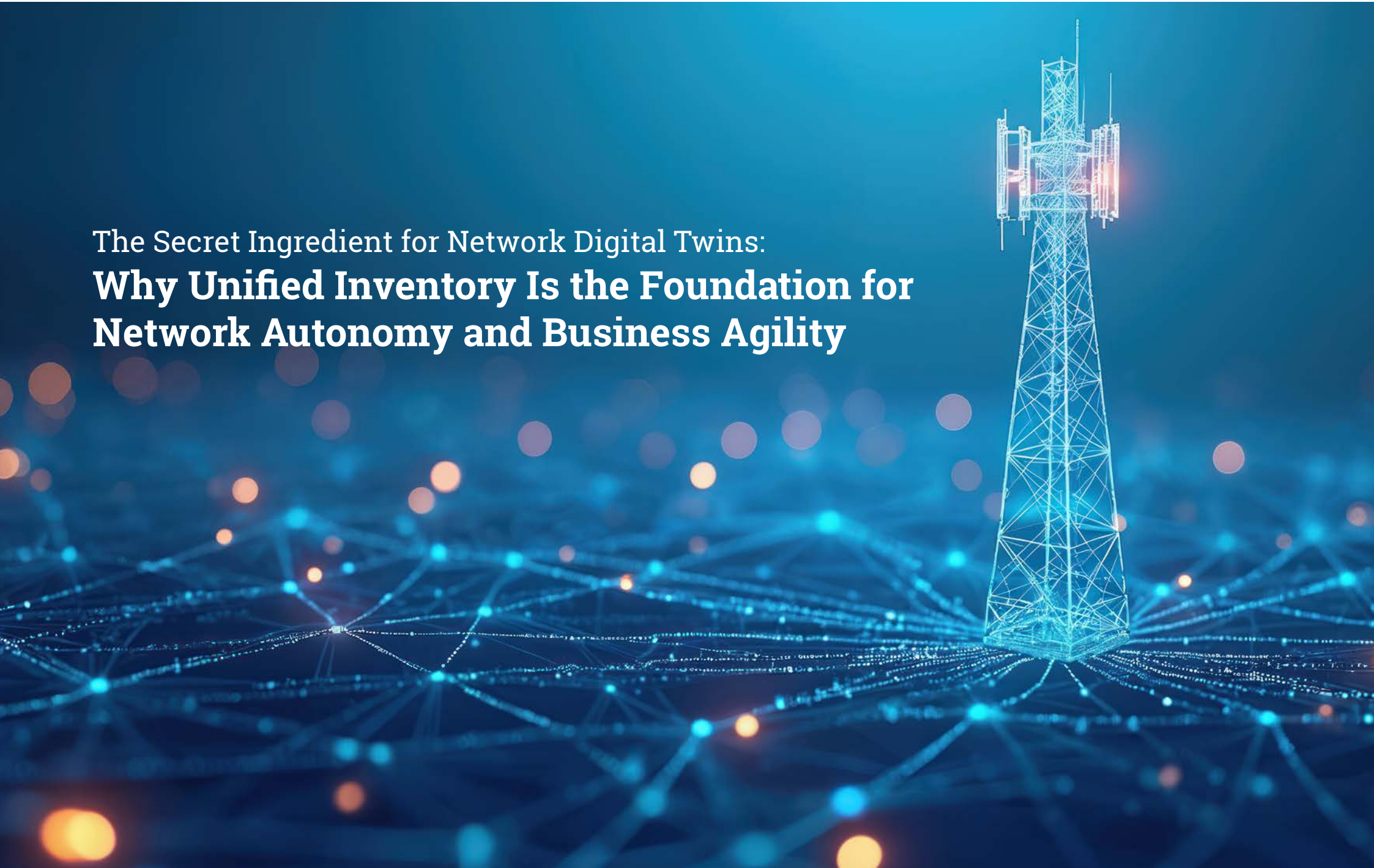
FNT
// simplify complexity



The Secret Ingredient for Network Digital Twins:

Why Unified Inventory Is the Foundation for Network Autonomy and Business Agility

What is a Digital Twin

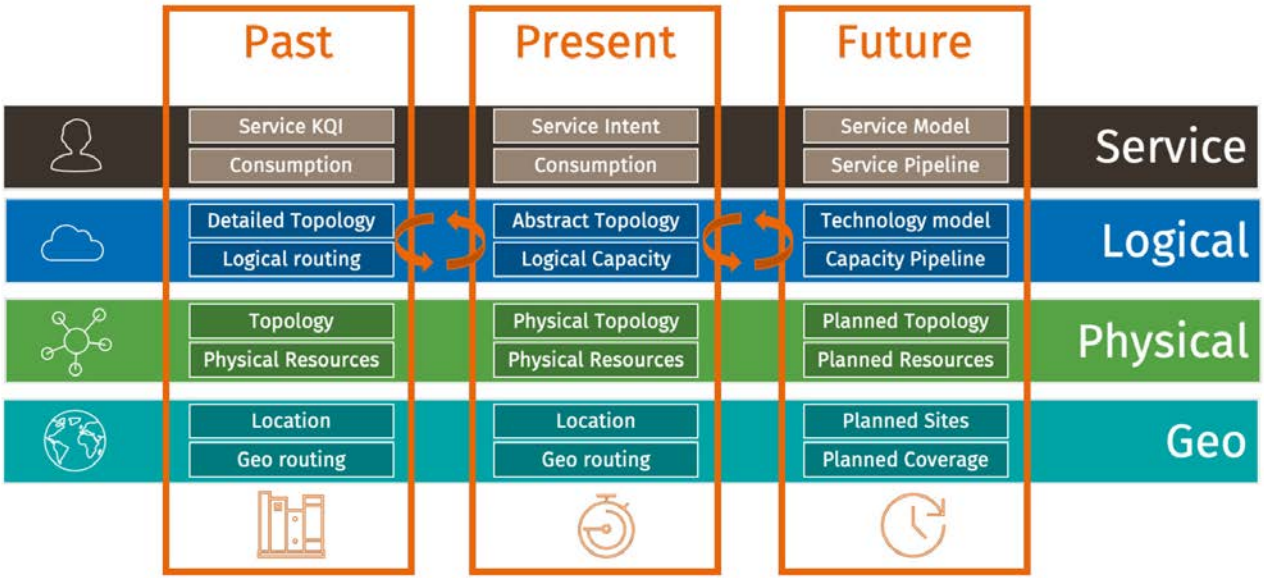
A Digital Twin is a digital replica of a real-world system. This digital copy can be used to optimise and manage the original system, often in near real-time. Digital Twins are not a new concept in telecoms networks, but the potential widespread adoption of Generative AI and AI-based agents in telco has spurred a renewed interest in them. Similarly, the requirement for greater automation and autonomy in networks requires a more holistic and integrated view of the network. An automation process requires complete observability of the component it is monitoring and changing, but it also requires a model against which the behaviour of a component can be assessed, as well as the context for the component's role in the wider end-to-end network. Digital Twins are the model context that enables operational agility and efficiency, using automation and AI agentic decision making.

Inventory: the foundation for a new generation of Digital Twins

At the centre of this new network-wide Digital Twin is the network inventory, which provides the glue between the physical and geographical placement of the network, all the way up to the connectivity services delivered on that network. Providing the linkage between the past status of the network, the present configuration of the network and the future intent of the network – all driving improved, agile and potentially agentic decision making. Like Scrooge in Dickens' Christmas Carol, an agent cannot make truly informed decisions without a view of the past, present, and future; knowing the present real-time state is not sufficient. Network inventory also provides the foundation on which other network processes, such as supply chain, security threat intelligence, and software development/integration, can be aligned, and wider network insight and decision-making can be achieved.

Inventory is already a powerful example of a Digital Twin of a network, with the data building blocks of Digital Twins (containment, connectivity, collections, and network lifecycle twins - see Appledore Building Digital Twins). It is the natural starting point for the aggregate Digital Twins that are required to support agile, autonomous networks.

Figure 1: Inventory across the network lifecycle



Source: Appledore Research Inventory Management

Drivers for change

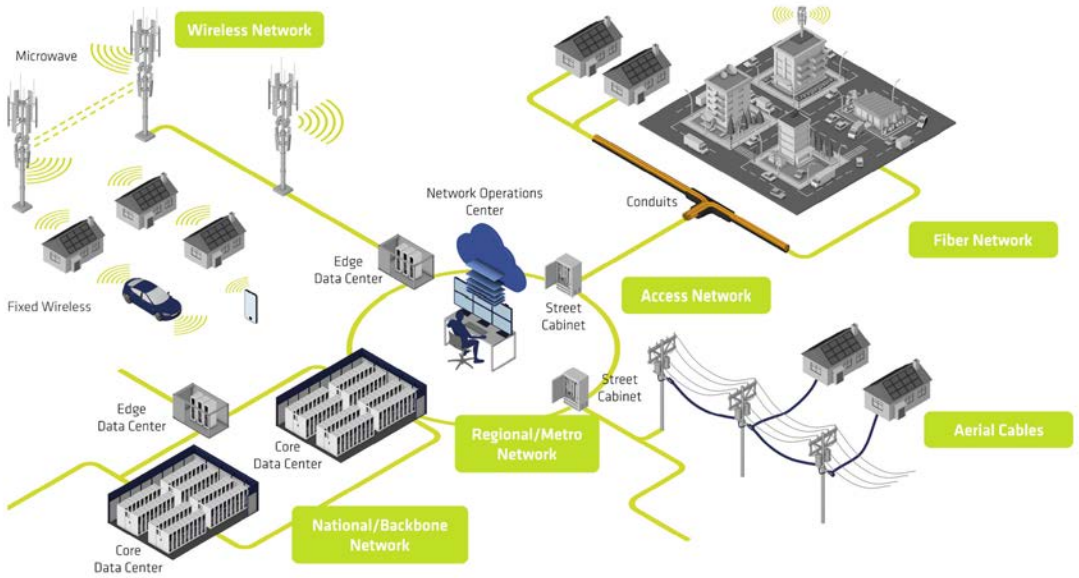
Operator networks and customer services are becoming increasingly complex, interconnected, and dynamic. Systems built for semi-static networks and services cannot support these new services and network technology, or they act as a barrier to their implementation. Telco has a long history of automating static processes; however, these processes are brittle to any change; change that is now hard-wired into the network.

The hope has been that new approaches, like service orchestration and now AI-based agents, would enable operators to effectively manage these increasingly complex networks and services. However, effective orchestration or AI agents require a reference for their decision-making. Orchestration offers the promise of agile delivery and assurance of networks and services across technology domains. Agentic AI promises scalable, network decision-making. But both require an underlying reference, the network Digital Twin, to truly deliver this.

The Digital Twin is not one single system, but at its heart, the inventory provides a centralised reference point that can be shared throughout the organisation with other systems and applications. Cross-department teams can easily coordinate efforts and improve teamwork. The Digital Twin brings (or requires) several critical capabilities to support the new orchestrated, agentic, dynamic network:

- An end-to-end view supporting cross-network collaboration, and importantly, conflict
- A business-wide view supporting cross-organisation collaboration, and importantly, conflict
- Consistency across the network, allowing multi-domain expertise and ultimately agentic decision making
- Abstracting, where necessary, network complexity to end-to-end network orchestration and autonomy processes
- Providing, where necessary, detailed configuration and topology to support domain-specific orchestration and autonomy processes
- Supporting processes across business boundaries
- Data accuracy

Figure 2: All resources and hierarchical dependencies across heterogeneous technologies - ranging from wireline and wireless access through transport networks to core and data center sites - are unified in a digital twin of the hybrid infrastructure, integrating assets from multiple suppliers.



Source: FNT

Supporting cross-network collaboration and conflict: Trade-offs and choices between multiple intents and network technologies exist all over telecom networks. Operators need to choose between cost, performance, reliability, and customer experience. Inventory Digital Twins can support this decision-making with domain detail and a cross-domain view.

Supporting business policy and intent conflict: Trade-offs and choices between multiple business requirements and policies exist all over telecom networks. Inventory based Digital Twins can be used to support the trade-offs between the requirements of different operator departments or process agents. The inventory is the missing link between technology systems, like NMS, and business systems, like ERP and EAM. For example, telecom networks are often overbuilt with utilisation rarely above 70–80%. Effectively, operators improve network performance by throwing more hardware at the problem. A Digital Twin can support the derivation of the "efficient frontier" for network utilisation - the best balance between extra capacity cost, the realm of planning and finance, and latency, throughput, availability performance, the realm of network operations and marketing. It can allow operators to decide whether to optimise for lower cost vs higher headroom. The twin helps to make these trade-offs explicit, rather than hidden across the organisation.

Consistency: A Digital Twin provides a common view of the network, enabling consistent processes and multi-skilled people across the network. It enables change to be implemented once, consistently across the network, rather than requiring multiple changes in multiple places.

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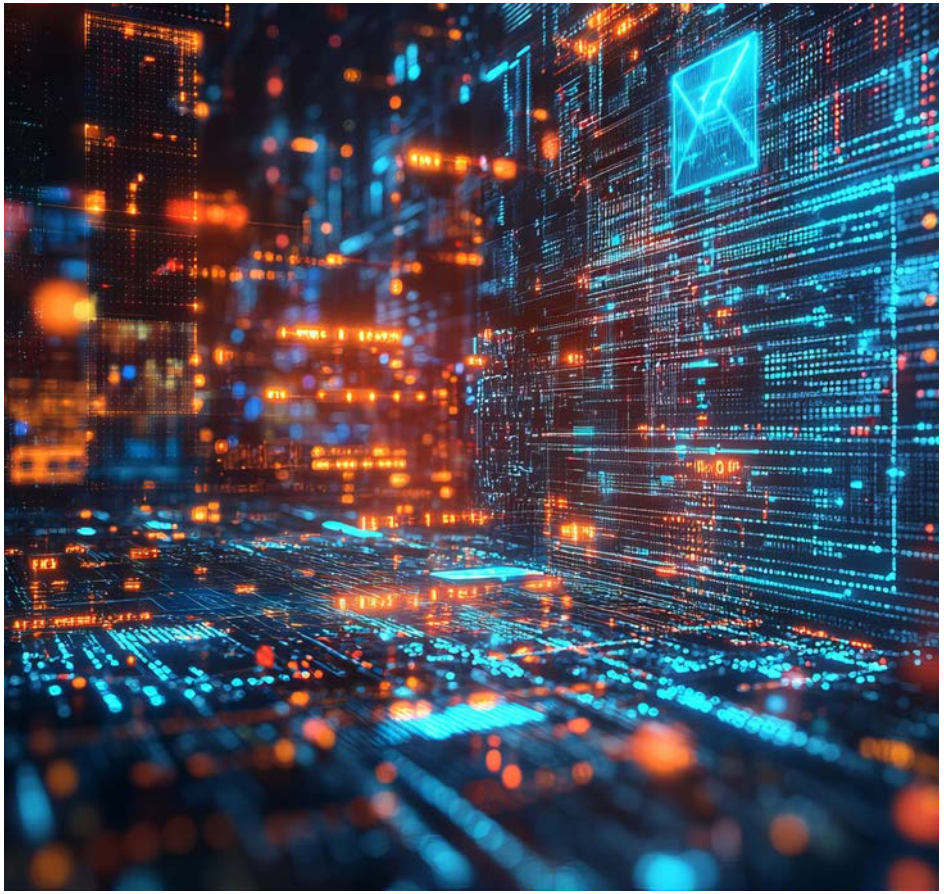

Abstraction: A Digital Twin has a critical role in taming the complexity of network technology, enabling technology-independent, end-to-end network decision-making and automation.

Providing a detailed view: Noting the opportunity for consistency and abstraction above, the Digital Twin still needs to be capable of specific modelling and detail of specific technologies and services. The Digital Twin supports detailed and technology/service-specific decision-making where necessary.

Business boundaries: Process integration may have to span business boundaries. Each of these business boundaries acts both as a barrier to understanding but also offers examples of where a Digital Twin, based on inventory, can provide opportunities for competitive advantage and/or cost savings. For example, a telco cloud may consume external public clouds, with the Digital Twin, allowing the telco to compare offers from different public cloud providers to meet its projected needs. A telco consumes hardware parts, software and systems with limited or manual interaction between part design in a supplier and the operational usage of the part in a network. Digital Twin integration can allow suppliers to see how components are used by the telco. It also allows an operator to better understand what its supplier understands about a component's performance

Data accuracy: Decision-making is only as good as the data on which it is based, agentic or human. The Digital Twin must provide high levels of alignment with the actual network, supported by processes to correct data where data accuracy is in doubt.

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Ontology importance

It is tempting to see the recent advances in Generative AI offering a radical new approach to managing and automating network operations based on raw data, enabling operations to leapfrog years of failed operation transformation. However, a generative model is an exceptional prediction engine; it cannot provide context or understanding. We have become used to the term "hallucinations", which more accurately would be termed "false conclusions". Without an understanding of how networks fit together, both structurally and operationally, the insights that GenAI can discover could be potentially revolutionary, but also just plain wrong. It is the network model, the Digital Twin, that can sort insight from hallucination. At the heart of the Digital Twin is how data in networks relate, the network ontology.

The data model or **Ontology** is one of the quiet, yet crucial, foundations that enable Digital Twins to function effectively. Ontology creates a **Common Language** for data across systems and vendors, and between twins that enables wider insight. The ontology defines the **schema and rules** for how knowledge is structured between twins and across twins. The Ontology defines how network entities, their attributes, and relationships are consistently managed across twins and in aggregate, so all systems interpret these concepts consistently. Ontologies enable Digital Twins to exchange and interpret data consistently, which is essential when creating a twin that spans lifecycle, organisation, technologies and vendors.

The ontology is something that can be created and derived, given time and expertise. Existing inventory solutions are the shortcut to this meta-model knowledge, both in terms of networks generally, but also in terms of the subtle, but important, differences between how CSPs implement and manage networks. The advantage of leveraging existing inventory product solutions is the existing ontology knowledge "out of the box" about how networks generally, and CSPs specifically, behave.

Transformation: not just systems

Digital Twins are an important route to transformation and autonomous decision-making, but they are not a magic wand. Leveraging the full business benefits of a Digital Twin platform requires a corresponding change in people and processes. Digital Twin/inventory technology on its own does not change anything. In a similar way to ontology, often the key ingredient that an inventory provider delivers is knowledge about what the best network operational practice is, and the route to achieving this, providing context that goes beyond generic IT data solutions.

Level 4+ autonomy using Digital Twins for agentic operations

Digital Twins that support agentic decision making, particularly supporting high levels of network operations autonomy, are not simply about a reboot of existing inventory solutions. Successful Digital Twins need an inventory that can be easily integrated with new sources of information to deliver new decision-making insights. The right Digital Twin foundation must provide an easy integration of new network data and orthogonal system data (like trouble ticketing).

At the same time, it is not much use if that complexity cannot be abstracted away from the agentic decision-making. Agents should be able to make decisions, not have to replicate existing network decision-making complexity.

In a recent TMF catalyst, a RAG (Retrieval-Augmented Generation) based agent is using inventory, combined with insight from PM and FM, to improve the accuracy and usefulness of LLM based insight; generating decisions and insight grounded in facts from the network and avoiding hallucinations.

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From inventory platform to modern Digital Twin

FNT is already delivering new Digital Twins, built on its underlying inventory foundation, that enable autonomous and agentic decision making, with business agility.

FNT has a strong **Ontology** at the heart of its inventory, with a metadata and model-driven approach from day one. Importantly, FNT delivers a library of components with detailed metadata that give a detailed view of the network, as well as providing abstraction. FNT provides deep knowledge of the relationships present in a telco network model, going beyond IT and data centre models and delivering the critical understanding of what makes a network different.

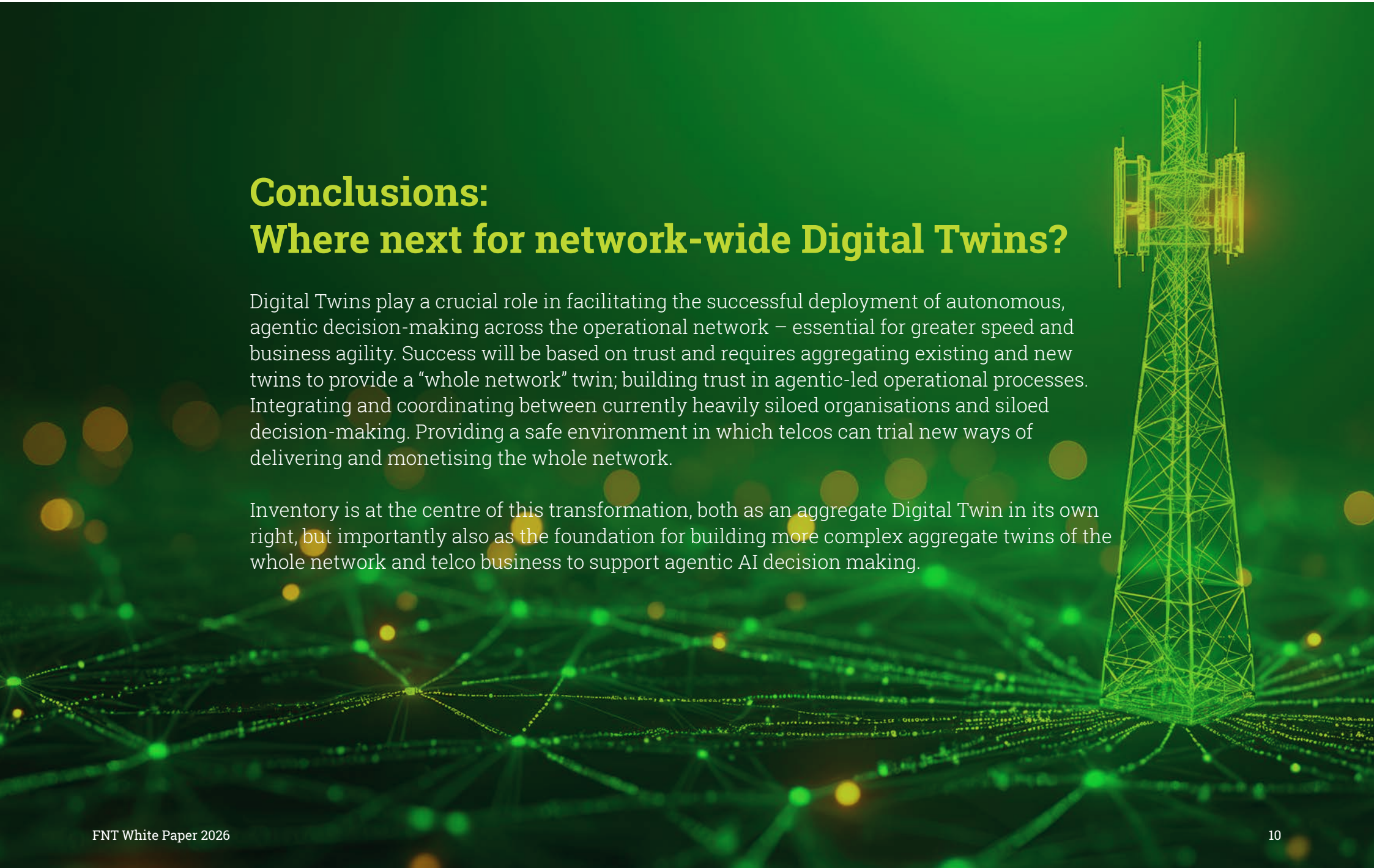
FNT's **open APIs**, in combination with the highly flexible integration and reconciliation framework, facilitates the sharing of data with other applications as well as the reconciliation with other data sources. This ensures that data stays current and accurate across the organisation. Protecting data integrity and accuracy and providing a detailed view and an abstract view of the network as needed.

FNT is supporting the Digital Twin of the end-to-end **network lifecycle**. Within FNT, it enables the modelling of planned changes to infrastructure and the simulation of what-if scenarios to be analysed before any real change in the network is implemented. However, it is looking to go further by **integrating** with other expert Digital Twin providers. FNT does not seek to duplicate or replicate deep technical expertise and processes. For example, in the IP and optical domains, Nokia NSP already provides strong simulation Digital Twins for packet flow. FNT's approach is to leverage integration with NSP with a two-way flow of information between NSP and FNT.

Similarly, in areas like asset history and CMDB, there are existing strong vendors with Digital Twins. FNT looks to integrate with these tools to create a wider aggregate Digital Twin. Similarly, in the future, they anticipate looking at integrating with radio planning solutions (Digital Twins in their own right), integrating with them to provide better network lifecycle decision-making.

In a 2025 TMF DTW catalyst, FNT took this further and delivered an open inventory foundation, integrated with Performance and Fault Management, providing a unified (non-siloed) data fabric (Digital Twin) that enables **AI-driven insight** - Predictive Intelligence for Optimized Networks & Enhanced Experience Resilience (PIONEER).

In The Power Of Network Inventory Solutions, FNT highlights the important role network inventory plays in managing today's complex network infrastructure, and navigating the challenges service providers face in keeping track of modern networks. It looks at the key components that should inform a CSP in choosing a modern inventory solution that can provide the foundation for the network Digital Twin.



Conclusions: Where next for network-wide Digital Twins?

Digital Twins play a crucial role in facilitating the successful deployment of autonomous, agentic decision-making across the operational network – essential for greater speed and business agility. Success will be based on trust and requires aggregating existing and new twins to provide a "whole network" twin; building trust in agentic-led operational processes. Integrating and coordinating between currently heavily siloed organisations and siloed decision-making. Providing a safe environment in which telcos can trial new ways of delivering and monetising the whole network.

Inventory is at the centre of this transformation, both as an aggregate Digital Twin in its own right, but importantly also as the foundation for building more complex aggregate twins of the whole network and telco business to support agentic AI decision making.