Driving autonomous networks: 7 practical steps to building a digital twin

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Executive Summary

Communication service providers (CSPs) are at a crossroads, grappling with profitability challenges in an ever-evolving digital landscape. As they seek innovative solutions, one strategy stands out: enhancing network autonomy to boost efficiency, elevate service quality and reduce operational costs.

The industry's vision? A paradigm shift from traditional human-led automation to cutting-edge autonomous networks where systems operate independently. Artificial intelligence (AI), machine learning (ML) and Generative AI (GenAI) are propelling CSPs forward on this transformative journey. Yet to truly ascend to higher levels of autonomy, CSPs are increasingly recognizing the potential of digital twins – virtual replicas that can significantly enhance decision-making capabilities.

While recent technological advancements have paved the way for telecom-specific digital twins, embarking on this path can seem overwhelming. This paper presents a roadmap of seven practical steps to construct your digital twin, describing key building blocks along the way.

Introduction

A digital twin is a digital representation of a real-world entity or system, aiming to mirror a physical entity, process, organization or other abstraction accurately. The goal is to help make more reliable decisions by managing the impact of potential changes to a product or service without risking the entity itself.

The digitalization of our world, driven by recent technological progress, has accelerated the adoption of digital twins across various industries and domains.

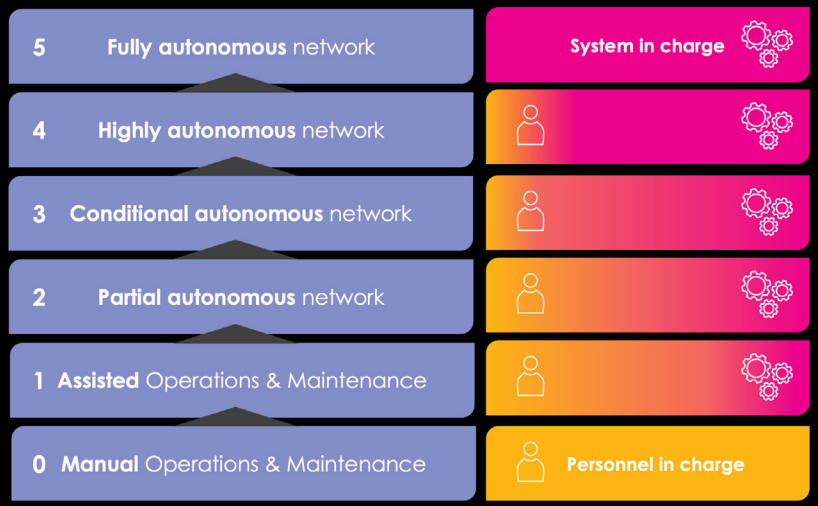
Key enablers include:

- Ubiquitous connectivity
- Available compute power and storage
- Data processing capabilities, volumes and speed
- AI, ML and GenAI
- Internet of Things (IoT)
- Security

For example, in manufacturing, digital twins are used to create digital replicas of production lines and equipment. Models integrate real-time data from sensors on physical machines, process monitoring and quality control systems. By simulating different production scenarios, manufacturers can optimize processes, predict maintenance needs and improve overall efficiency without disrupting actual operations. This approach enables proactive decision-making, reduces downtime, and ultimately, increases productivity and cost savings.

Digital twins in the communications & media industry

The communications and media industry, like other sectors, is gradually embracing digital twins as part of its digital transformation journey. Recognized by TM Forum as a key enabler for the evolution towards autonomous networks, digital twins are becoming essential in achieving higher levels of network autonomy – specifically levels 4 (highly autonomous) and 5 (fully autonomous). These advanced levels of autonomy rely on closed-loop and intent-driven automation, where accurate and reliable decision-making is critical – something digital twins can provide.

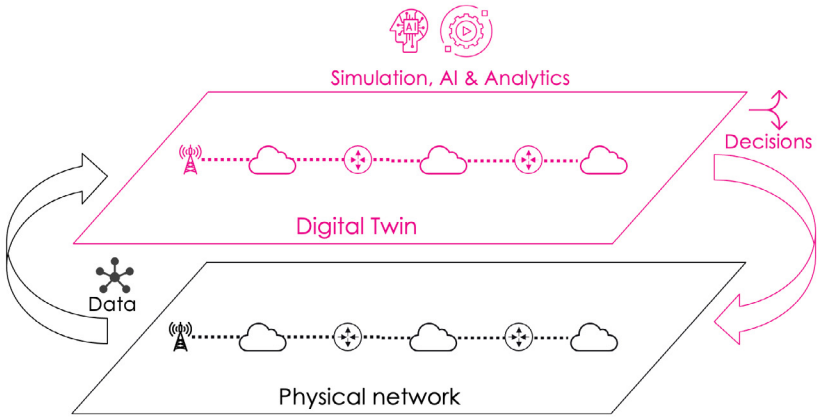


TM Forum Autonomous Levels

For CSPs, digital twins provide digital replicas that offer a comprehensive view of the network by integrating data from multiple sources, such as:

- Equipment data
- Topology data
- Configuration data
- Fault and performance data
- Environmental data

By combining historical and real-time data, digital twins support simulations, AI and analytics to predict failures and recommend corrective actions, thereby strengthening autonomous networks and enabling CSPs to make more reliable decisions and operate efficiently.



Business benefits

Digital twins deliver value in multiple business areas. By enabling data and AI-driven decision-making, they increase the reliability of decisions and the actions they trigger.

Benefits include:

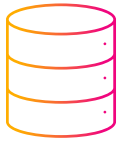
- Improved network planning and optimization through network scenario simulations
- Enhanced operational efficiency through data and AI-driven decision making
- Improved customer experience by predicting and preventing service impacting issues
- Reduced cost by enabling remote inspection and reducing the need for on-site visits
- Accelerated innovation by simulating and testing new services and technologies

Building a network digital twin: Practical steps

Building a comprehensive digital twin is a challenging task, requiring careful planning and execution. Here are seven practical steps to guide you through the process.

1. Define your goals

Building a digital twin that addresses all potential use cases from the outset is unrealistic. It's therefore essential to clearly outline the initial goals. Such goals might align with business objectives (e.g., improving customer experience), operational processes (e.g., accelerating network rollout), or network domains (e.g., enhancing RAN coverage). Once defined, these goals and their associated use cases can be prioritized based on factors like urgency, feasibility or return on investment.



2. Identify the relevant data sources

After identifying and prioritizing your goals, involve key stakeholders from various departments, such as customer service and network operations, to identify relevant data sources. Since data is the lifeblood of the digital twin, its quality will determine the effectiveness of the decisions derived from it. For these reasons, establishing data quality and governance practices will be critical for ensuring data reliability.

The required data typically spans various formats and characteristics, including structured and unstructured, static and real-time, as well as historical and planned data. Importantly, the data should also align with the goals identified in step 1. For example, if the goal is to improve customer experience, include customer service data and network performance data, but network planning data might not be necessary.

3. Select the right tools, aim for reuse

The digital twin is not a single application but an architecture that integrates various tools and technologies. These include data collection and integration, modeling and inventory, simulation, real-time analytics and more. When selecting tools, whether existing or new, consider the following factors:

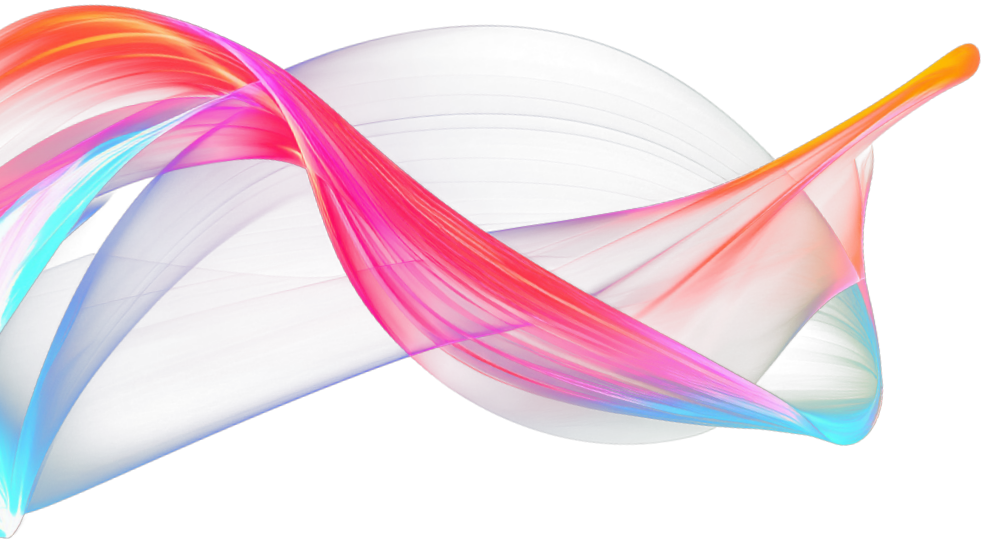
- Flexibility and scalability to enable management of diverse data types and models, and to scale as the digital twin evolves
- Data management to ensure data integrity, quality and accessibility throughout the digital twin's lifecycle
- Ease of integration for connecting with relevant data sources and other digital twin architecture components
- Security features to protect sensitive data and comply with regulatory requirements, even when data is decentralized

4. Define the model and implement it

With the goals defined, data sources identified and tools selected, the next step is to implement the digital twin, ensuring it accurately represents the network.

First, to determine how data is stored, define the model using the selected design tools. Depending on the use cases, the model will vary in complexity and level of detail. For example, if the goal is to improve customer experience, the model should track both the SLA contracted and the SLA delivered.

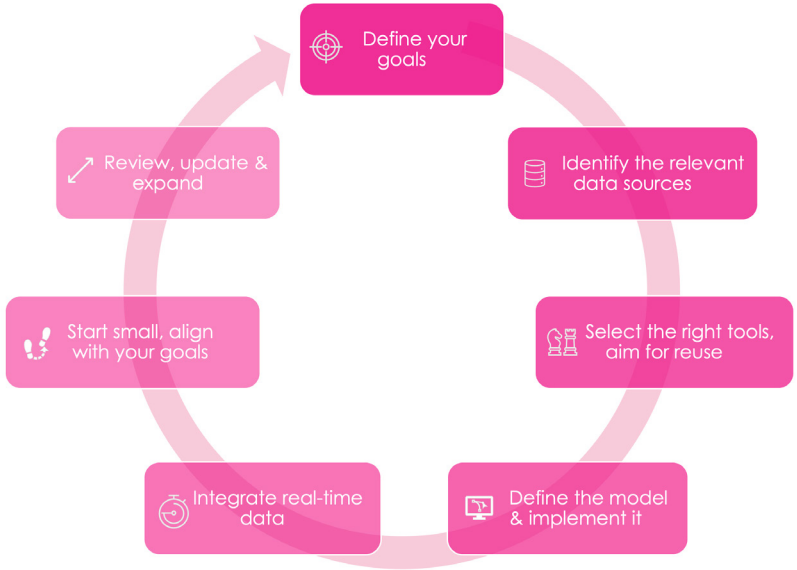
Once the model is defined, the next step is to populate the digital twin with data. The selected tool or set of tools, such as inventory systems, will supply the necessary data to the simulation, AI and analytics tools that will support the identified use cases. The digital twin's data management approach must be flexible, supporting both data replication and data federation techniques for efficient data retrieval.



5. Integrate real-time data

The digital twin must continuously represent the network in real-time. For this reason, supporting real-time data integration is crucial to ensuring the digital twin reflects the network's current state. Data management techniques, such as federation and augmentation, can help retrieve the necessary data in real time.

The integration capabilities of the digital twin are critical to ensuring that real-time data can be efficiently retrieved from multiple data sources, such as service assurance systems. Aligning with industry standards like TM Forum Open APIs can also reduce the total cost of ownership (TCO) of the digital twin.



7 practical steps

6. Start small, align with your goals

Once the required data is accessible from the digital twin, use it to fulfill the identified goals, such as improving customer experience, accelerating network rollout or validating network changes. To build confidence and identify any oversights in the previous steps, start small with incremental steps in monitoring, simulation and optimization of your selected use cases. For example, if the goal is to improve customer experience, begin with high-value customers and services. Then, apply simulation, AI and analytics to ensure the network consistently delivers the committed SLA, anticipating and avoiding potential impacts from maintenance or predicting and preventing service issues.

7. Review, update and expand

Like the network, the digital twin is a living system with its own lifecycle, requiring continuous refinement and updates. For example, the need for additional data might lead to including new data sources, updating the digital twin model and building new integrations.

As you build trust in the digital twin, new use cases will be incorporated, requiring new iterations of the steps listed above. However, as your model expands, these iterations will likely require less effort and the digital twin will become a more accurate representation of your network, ultimately becoming an integral part of your operations.

Key components of a digital twin

A digital twin isn't a single application. Rather it's an architecture comprising multiple layers and components that work together to generate reliable decisions.

Key components include:

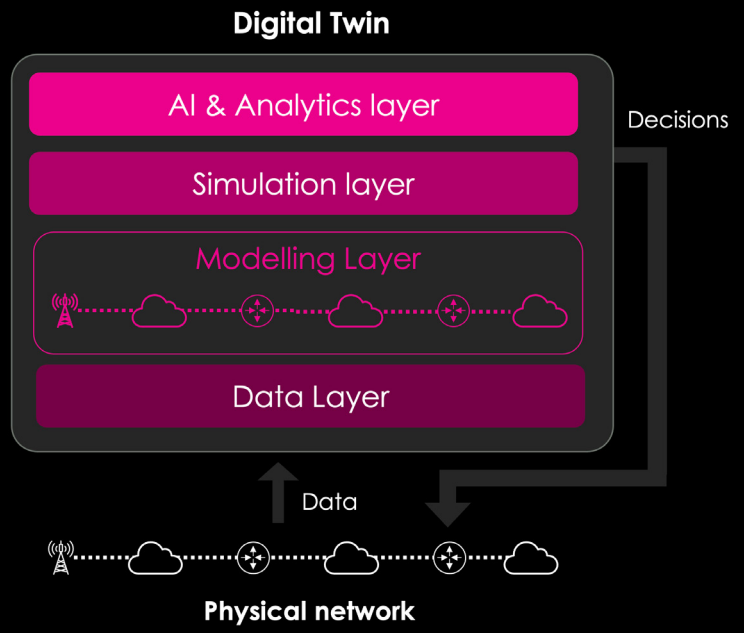
1. Data layer

Data is the core of your digital twin. CSPs therefore need a robust data layer to efficiently manage the retrieval of data from various sources. It must address challenges such as real-time data retrieval, data harmonization, quality, consistency and security. Simultaneously, it must ensure data availability across the organization to support different use cases.

2. Modelling layer

The modelling layer supports the creation of detailed and accurate digital models of the network, including equipment, connections, topologies, configuration and more. These models capture and represent the network's characteristics and behaviors comprehensively.

The layer includes both the digital models and the actual data instances that form the digital representation of the network. To populate and maintain these models, the modeling layer integrates with the data layer, retrieving and updating the required data to support various digital twin use cases. This ensures close alignment between the digital models and the real-world network, enabling accurate simulations and analysis.



Key components of a digital twin

3. Simulation layer

The simulation layer leverages the digital representation from the modeling layer to simulate network behavior under various conditions and support "what-if" scenarios. These simulations help CSPs apply learnings to the physical network and determine the best courses of action.

To provide accurate results, this layer requires access to comprehensive data, which, depending on the use case, might include real-time data retrieved through synchronization between the digital twin and the physical network. The generated data layer can also be used to support AI model training.

4. AI & Analytics layer

The AI and analytics layer encompasses applications that enhance CSPs' decision-making capabilities, supporting their transformation into data- and AI-driven organizations. It does this by extracting insights, identifying patterns, and predicting network changes.

The layer supports digital twin use cases by deriving actions from analyzing historical, current and real-time data. Furthermore, AI applications within this layer help model complex network behaviors, such as spectrum propagation, which are difficult to simulate using traditional rule-based methods.

5. Generative AI

GenAI plays an important role in CSPs' deployment of digital twins. On one hand, it streamlines digital twin development by accelerating software development and generating synthetic data to support simulations. On the other hand, it enables CSPs to interact with digital twins in new ways through natural language, thereby simplifying operations – for example, requesting a simulation with simple, conversational commands.

GenAI also augments traditional AI/ML, helping CSPs gain deeper insights and improve decision-making, initially assisting humans and gradually evolving towards full autonomy through reinforcement learning.

How Amdocs supports CSPs in building digital twins

Amdocs provides key foundational components of the digital twin architecture.

Amdocs Network Inventory

Amdocs Network Inventory is a comprehensive solution for managing the coexistence of physical, virtual and cloud network functions, providing end-to-end visibility. The inventory includes key capabilities required by digital twins, such as:

- A flexible yet comprehensive data model that tracks all aspects of network capacity
- Synchronization with external data sources
- Planning sandboxes that support "what-if" analysis
- Real-time data federation

For more information, visit Amdocs Network Inventory.

Amdocs Helix Service Assurance

The AI-powered Amdocs Helix Service Assurance Suite (SAS) integrates all aspects of assurance, fault, performance and service quality management, uniquely combining a 360° view of the network and service status, which is critical for a network digital twin.

Its patented AI/ML algorithms are deployed worldwide to analyze large volumes of real-time and historical data. This enables teams to uncover deep insights to address network issues that could impact performance and customer experience.

For more information, visit Amdocs Helix Service Assurance.

Amdocs Network Optimization Suite

Amdocs Network Optimization Suite is an analytics-driven, scalable platform providing a unified workspace for all network analytics and optimization operations for mobile networks from GSM to 5G. Leveraging data from drive tests, indoor testing, configuration management, performance management and subscriber trace sources, the suite acts as a Radio Access Network (RAN) digital twin, enabling analysis and benchmarking across the network. It also supports loading, processing and analyzing large data volumes using both centralized and distributed deployment models.

For more information, visit Amdocs Network Optimization Suite.

Amdocs Drone-Aided Site Audits

Amdocs Drone-Aided Site Audits provides an end-to-end service for maintaining communication towers, focusing on safety and efficiency. Powered by partner software, the service employs autonomous drone flights with standardized flight paths and image capture, standardizing data capture and creating a digital inventory of assets while eliminating the need for human involvement.

The service creates network digital twins using autonomous drones to capture information about tower assets, enabling more efficient network analysis and decision-making for optimizing network performance, RF tuning and more.

For more information, visit
Amdocs Drone-Aided Site Audits.

Amdocs amAIz

The Amdocs amAIz platform is a unique, telco-grade and trusted GenAI platform that enables CSPs to drive innovation, automate processes and optimize decision-making, helping to accelerate the adoption of digital twins across the industry.

Integrated with Amdocs products and services, amAIz provides copilot capabilities to increase the efficiency and productivity of CSPs' operations personnel. Not limited to Amdocs data sources, the solution can operate across silos using efficient data management, providing value throughout the CSP's ecosystem with its GenAI-powered agents.

For more information, please visit
Amdocs amAIz.

Conclusion

Digital twins represent a transformative leap for the communications & media industry, enabling CSPs to make more reliable decisions that drive both business performance and operational effectiveness. While implementing the technology presents challenges, the potential for cost reduction and improved customer experiences makes it a crucial investment.

Achieving success requires a balanced approach: CSPs should start small with high-impact use cases, scale gradually and carefully select the components of their digital twin architecture. In parallel, prioritizing the reuse of existing capabilities – such as inventory, assurance and discovery – will help streamline the process and ensure alignment with business goals.

By partnering with Amdocs, CSPs can navigate this complex terrain, leveraging a unique combination of telco-specific products and services to build their digital twin at their own pace while focusing on delivering tangible business results along the way.

Amdocs helps those who build the future to make it amazing. With our market-leading portfolio of software products and services, we unlock our customers' innovative potential, empowering them to provide next-generation communication and media experiences for both the individual end user and large enterprise customers. Our approximately 29,000 employees around the globe are here to accelerate service providers' migration to the cloud, enable them to differentiate in the 5G era, and digitalize and automate their operations.

Listed on the NASDAQ Global Select Market, Amdocs had revenue of $4.89 billion in fiscal 2023.

For more information, visit Amdocs at www.amdocs.com.

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