Nokia Autonomous Network Fabric: evolve to full autonomy for scalable business success

Knowledge-driven autonomous network operations boosts customer experiences, catalyzes innovation and supports scalable business

NOKIA

Overwhelming complexity risks underwhelming customer experiences

Telco networks have grown rapidly in complexity as they become increasingly disaggregated and as distributed multi-cloud models are deployed. It's a trend that shows no signs of slowing. Managing this complexity efficiently to deliver always-on, personalized services is a major issue facing Communications Service Providers (CSPs).

Today's network operations are highly dependent on manual intervention with teams often running their own data acquisition and processing routines via a patchwork of legacy OSS systems. Such compartmentalization can prevent a complete understanding of network performance and customer experience. Even with the current roll out of automation, rising complexity risks a decline in network operational efficiency and poorer customer experiences. CSPs can also be distracted from creating the innovation needed to generate new business models that can monetize their networks beyond traditional connectivity.

While network complexity isn't going away, it can be managed more effectively by autonomous networks powered by telco-specific knowledge graphs, advanced artificial intelligence (AI) and automation. They are self-managing, self-healing and self-optimizing, with minimal human intervention.

Building on TM Forum's work, Nokia's autonomous network vision combines intelligence and automation for speed, simplicity and security. The Nokia approach is summed up in three key actions: Sense, Think, Act. Sense with observability, Think with AI/machine learning, Act with closed-loop automation for a Zero-Touch, Zero-Wait, Zero-Trust experience.

> "Autonomous networks are the neural pathways that power today's economy and society as the world moves increasingly toward touchless transactions and data-driven, intelligent processes. Higher levels of autonomy will soon become critical, and not optional, to retain a competitive edge in this scenario."
>
> TM Forum "Accelerating the adoption of autonomous networks: It is not optional anymore," May 2024

Autonomous networks: shifting to AI-driven total process orchestration

CSP investments in AI and automation are rising. A recent report reveals that AI, automation and machine learning (ML) are top priority telco investment areas for 2025, with about 30 percent of CSPs already implementing and using AI solutions.[1]

While these investments can improve network operations, they won't bring the business transformation that autonomous networks promise. That's because autonomous networks shift from automation that merely mechanizes simple rules-based tasks to the total orchestration of complex, cross-domain processes through AI-driven decision-making, self-learning and adaptability, with little human involvement needed.

Autonomous networks have the potential to ensure services never fail by anticipating and resolving otherwise unforeseen network problems.

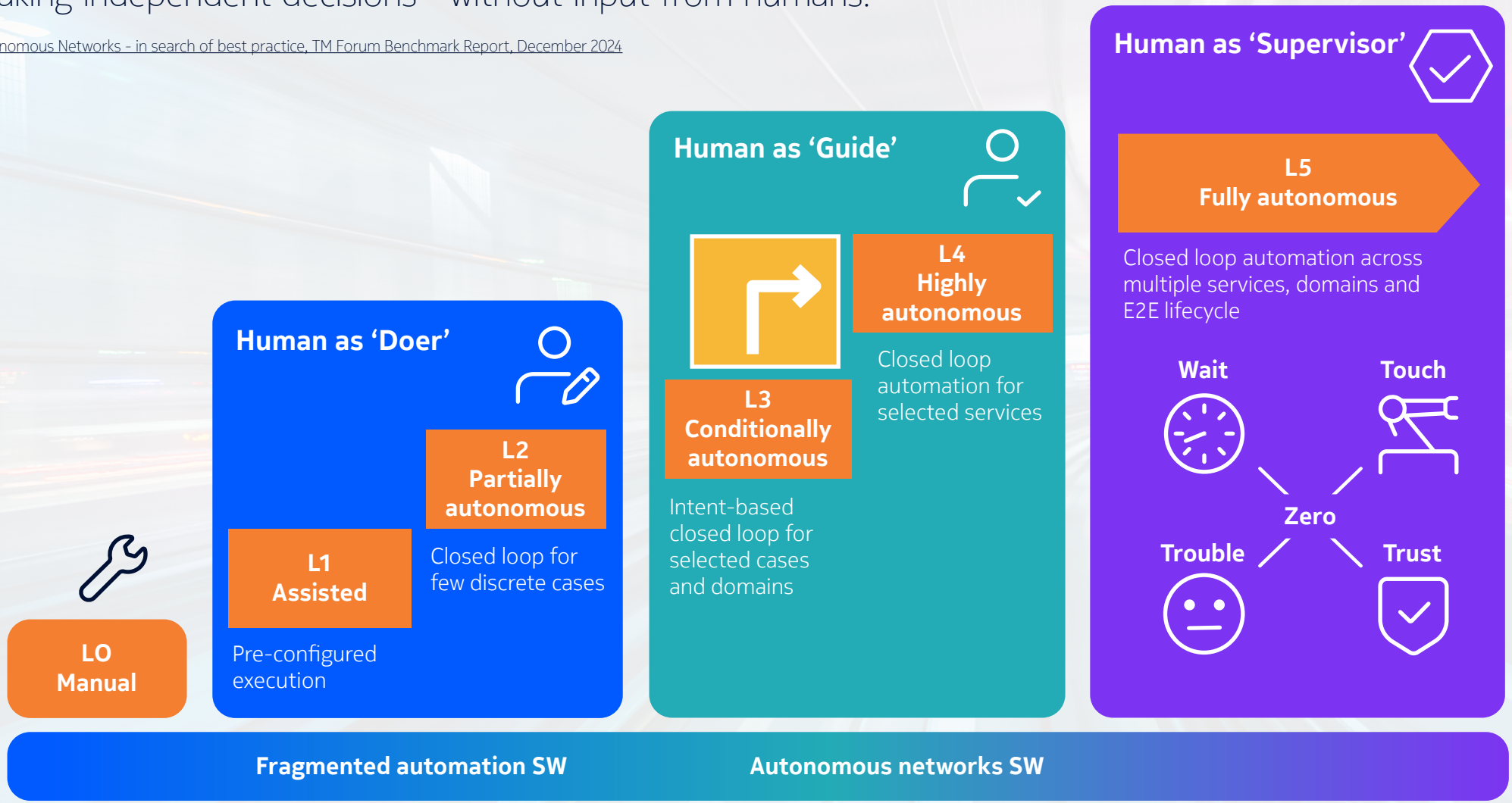
Reducing the dependency on humans to operate networks frees up resources to enable CSPs to focus on developing more state-of-the-art services.

Yet, the TM Forum reckons that as many as 83 percent of CSPs are currently only at level 1 or level 2 of its six-level autonomous network maturity model. The journey to autonomous networks is clearly not a smooth linear progression. Instead, a new approach is needed to help CSPs 'cross the chasm' to reach level 4 or even level 5 autonomy.[2]

1. Telecoms survey reveals AI as top investment priority for 2025, November 2024
2. Accelerating the adoption of autonomous networks: It is not optional anymore, May 2024

"Autonomous networks are not simply a technical evolution; they represent a transformative change in how networks operate, adapt and serve CSPs and their customers. Whereas automation relies on predefined rules, network autonomy involves intelligent systems making independent decisions – without input from humans."

Autonomous Networks - in search of best practice, TM Forum Benchmark Report, December 2024



Crossing the chasm to level 4 and level 5 autonomous networks as defined by the TM Forum

What is an autonomous network?

An autonomous network is a system of interconnected networks and software platforms that can sense its surroundings and adjust its behavior with minimal or no human intervention. The interaction between domains is driven by intent, which sets and communicates business expectations that the network must achieve through automated processes that can reason and derive decisions and actions.

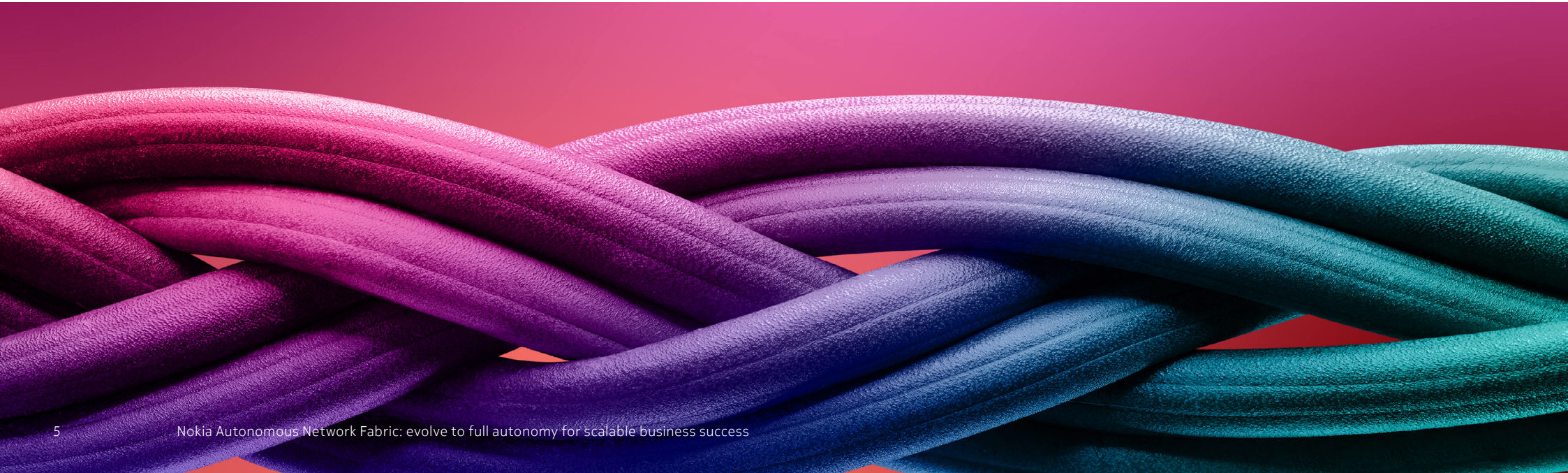
An autonomous network:

Can operate independently, make its own decisions and manage itself according to business intent without any external humans or machines controlling it.

Is built with a simplified network structure, virtual components, automated agents and smart decision-making engines.

Offers flexible capabilities to create intelligent business and network operations.

Can configure itself, monitor its performance, fix issues (self-heal), protect itself and analyze data. This makes the network cheaper to run, while also boosting its agility, security and resilience.



Navigating complexity requires a holistic approach

To make the leap beyond level 3 automation, CSPs must evolve from deploying and running automation workflows or processes within isolated functions such as security, network operations and customer experience. Automation must run across network domains (access, transport and core networks) supported by advanced intelligence to translate business intent and handle negotiations between service and resource layers.

The complex integration demands of such cross-domain automation are cited as the biggest obstacle to implementing autonomous networks.[3]

Two primary factors contribute to the difficulty: the extensive number of siloed tools and legacy systems that most CSPs have across all network domains. These make it impossible for CSPs to share real-time insights across departments, hindering collaboration between teams working on cyber-security, network operations, and customer experience.

Nokia Autonomous Network Fabric (ANF) enables CSPs to evolve their existing technology stack to effectively bridge those silos using level 4/5 autonomy that can assure interoperability across multi-vendor, multi-technology and multi-domain environments.

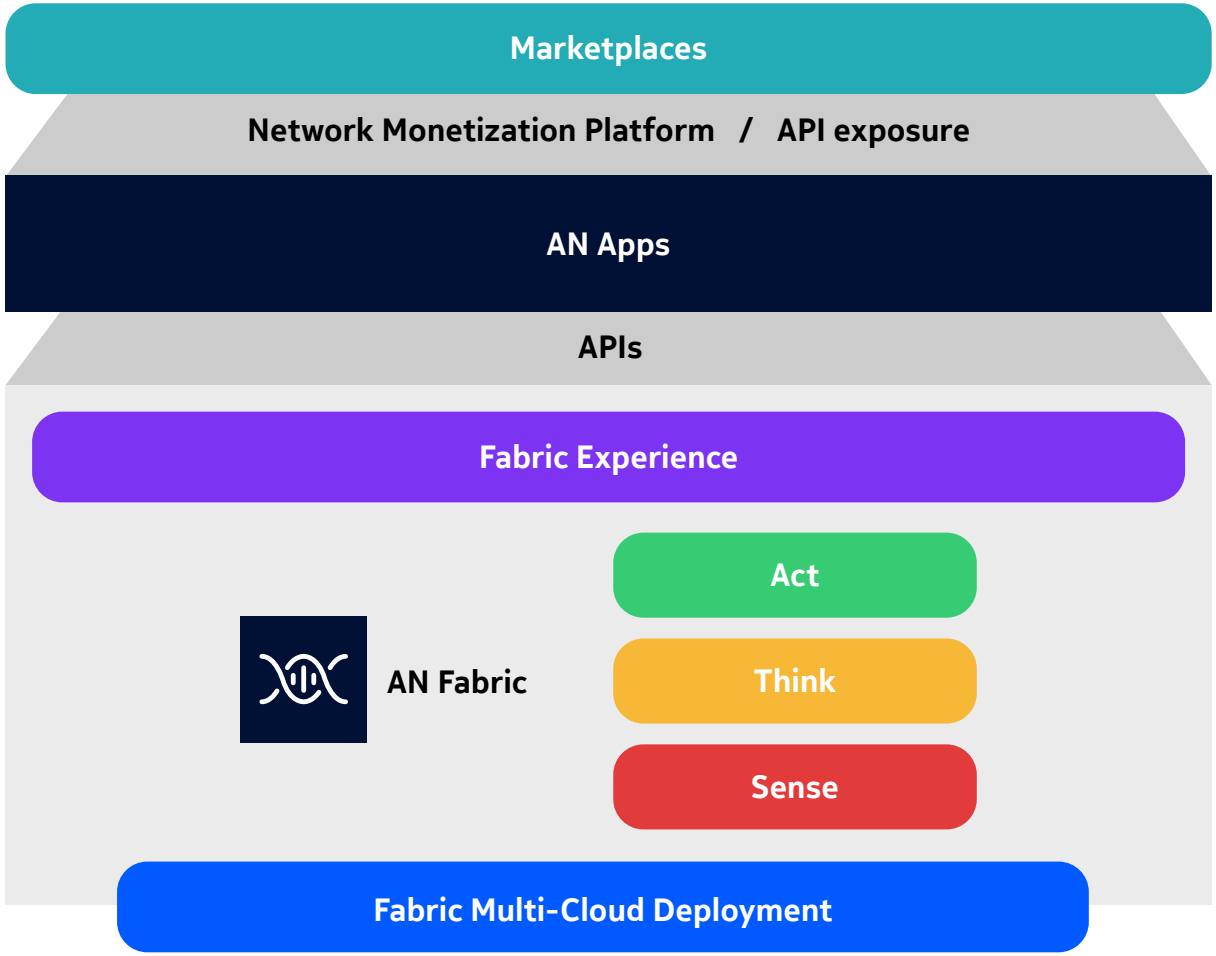
3. Autonomous Networks - in search of best practice, TM Forum Benchmark Report, December 2024

Nokia pushes ahead with data-driven operations

The Nokia ANF uses a modern data and knowledge framework to meet the needs of complex telecoms networks at risk of being deluged with data.

The solution stores and curates data once for use by all applications, offers 360-degree observability and explainable AI, while also generating new automation patterns that can be stored and applied as required. Its unified architecture not only enables more effective team decisions based on a single source of truth, but it offers real-time capabilities to support various data sources and advanced AI, helping to accelerate the implementation of new autonomy levels.

A wide set of available applications make use of the Nokia ANF via APIs



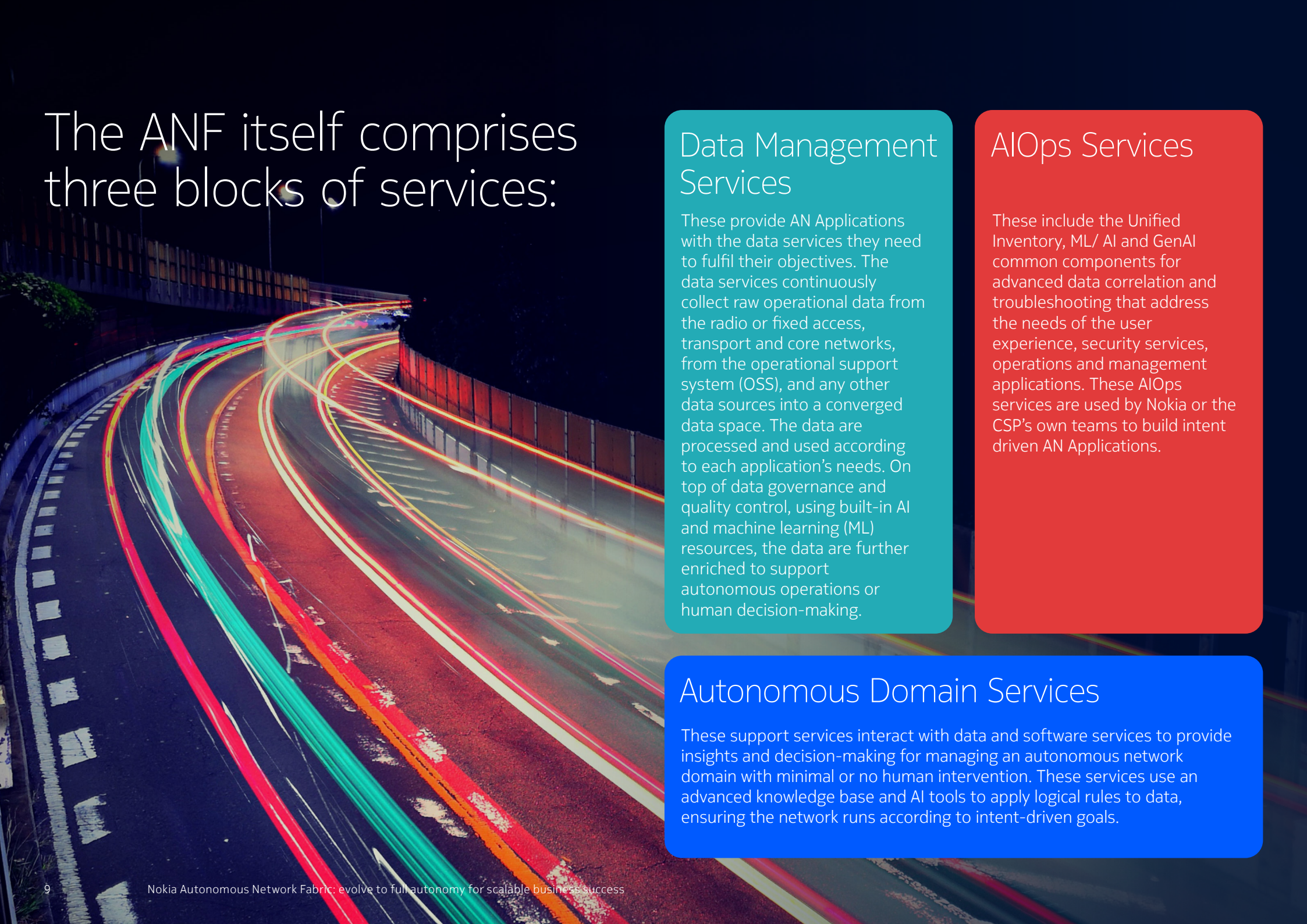
Nokia ANF is an evolutionary approach that comprises Data Management and AIOps Services, along with Domain Services to achieve autonomous networks. A catalog of AN Applications accesses the services of the ANF via internal Application Programming Interfaces (APIs).

Autonomous Network (AN) Applications help businesses optimize key objectives like service quality, revenue and security. They vary in autonomy, with humans “as doers” either executing pre-set and partially automated tasks; humans “as guides” automating certain intent-based operations; or humans “as supervisors” overseeing autonomous processes across multiple domains. AN Applications function in various network environments, including 4G RAN, 5G Core and VoLTE services.

Each autonomous domain is intent-driven with defined operational or business outcomes that a network should deliver, such as a network slice SLA, energy saving targets or customer group prioritization. Intents are set without specifying how to achieve or implement them. A domain has a defined scope of autonomous behavior and uses control loops to adapt its actions according to changes in user needs, business goals or environmental conditions.

The applications use northbound interfaces to allow Nokia’s Network Monetization Platform or other entities to tap into the autonomous network services via APIs.

The ANF itself comprises three blocks of services:



Data Management Services

These provide AN Applications with the data services they need to fulfil their objectives. The data services continuously collect raw operational data from the radio or fixed access, transport and core networks, from the operational support system (OSS), and any other data sources into a converged data space. The data are processed and used according to each application's needs. On top of data governance and quality control, using built-in AI and machine learning (ML) resources, the data are further enriched to support autonomous operations or human decision-making.

AIOps Services

These include the Unified Inventory, ML/ AI and GenAI common components for advanced data correlation and troubleshooting that address the needs of the user experience, security services, operations and management applications. These AIOps services are used by Nokia or the CSP's own teams to build intent driven AN Applications.

Autonomous Domain Services

These support services interact with data and software services to provide insights and decision-making for managing an autonomous network domain with minimal or no human intervention. These services use an advanced knowledge base and AI tools to apply logical rules to data, ensuring the network runs according to intent-driven goals.

The ANF, applications and the network combine to comprise an autonomous network

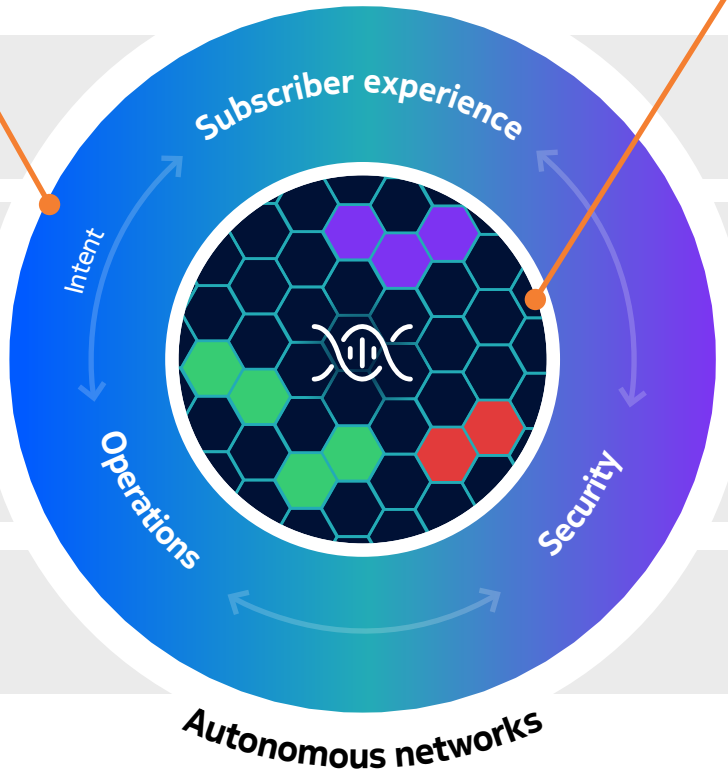
Application Suite

Intent driven
User asks “what” - system defines “How”

Comprehensive security
Holistic, integrated, proactive defence

Agile and on-demand
SaaS-first/multi-cloud for speed and flexibility

Monetization
API access to developer ecosystem



Autonomous NW Fabric

Shared data management
Collect, store and curate once - used by all apps

360º Observability
E2E full stack shared insights between functions

Explainable AI
Telco trained ML/LLM/LAM across functions

Automation Mining
Self-discover and apply new automation patterns

Nokia ANF provides a common data and AI layer. This unified architecture enables more effective team collaboration, with co-ordination of actions based on a single source of truth to feed into Nokia’s Autonomous Networks Applications suite which covers the areas of operations, security and subscriber experience.

Easier and more flexible to deploy

Nokia provides unrivalled flexibility in the way its autonomous network approach can be implemented to meet the needs of any CSP. Nokia ANF adapts to existing autonomous deployments to enable re-use of existing investments, while helping to transition towards level 5 Autonomy.

Nokia ANF empowers CSPs and their existing business and operational support systems (BSS/OSS) by introducing intent-based, automated operations, all with full transparency of autonomous decision making. ANF can also be deployed in multi-cloud environments spanning on-premises, private cloud and public cloud, according to CSP preferences.

CSPs can move towards autonomous networks at the pace that best suits them and their existing infrastructure environment. Deployment can be undertaken step-by-step, with efficiency gains accruing as the roll out progresses.

Lower costs, better experiences

Consolidating each application data stack into a modern AI-powered and common data fabric enables organizations to spend less time managing complex infrastructure and more time unlocking value from their data and network investments.

An autonomous network built on the Nokia ANF offers multiple benefits for CSPs. These principally include:

Enhanced user experience
Not only do services become more reliable, but the user experience can be enriched by using data from multiple applications to enhance and personalize the customer journey.

Increased operational efficiency
Autonomous systems manage complex network operations with minimal human input, reducing errors and speeding up processes. This leads to more efficient use of resources, faster problem resolution and significantly reduced network operational expenditure (OPEX).

Tighter security
Nokia ANF incorporates security from the start, employing strong encryption and authentication. Each network layer features real-time threat detection and response to prevent unauthorized access and thwart cyberattacks. Nokia's proactive security by design approach allows threats to be predicted and addressed rather than merely reacting to them.

Additional benefits include streamlining application footprints by eliminating redundant data collection and harmonizing data processing. Moreover, sharing data across multiple applications uncovers valuable insights previously concealed within data silos. This can enable CSPs to accelerate innovation and launch new services more quickly while also reducing energy consumption and lowering carbon emissions.

Use case

Scenario

Hackers have deployed harmful devices within the network, focusing on the AMF NF that manages user registration for accessing data services. This has resulted in increased strain on the NF, leading to registration issues for ordinary users and restricting their access to data services.

Value proposition

Detect the issue within minutes, determine the root cause and autonomously initiate corrective actions involving all relevant agents.

Signals observed by operations agents

- Ops agent: anomaly in registration events at AMF
- Ops agent: degradation in data service accessibility KQI for that AMF
- Customer exp agent: decline in CEI, increase in customer complaints
- Security agent: from security logs rogue IMSI, threat score raised at AMF
- Network controller scales AMF, unable to resolve issue
- Cross domain information exchange with unified LLM

Resolve the issue

- Ops agent uses orchestrator to blacklist rogue IMEI
- Migrate all critical devices and users to a new slice
- Customers notified that the issue is resolved
- New automation pattern added to library

Rogue device activated

Identify the problem

- AN engine correlates cross domain signals and confirms DOS attack
- All agents using LLM interface notified of this event
- Security ops agent triggers an intent towards assurance for remediation
- New automation pattern discovered

Nokia ANF: smart, fast, efficient networks for revenue growth

In today's complex telecommunications landscape, CSPs face unprecedented challenges in delivering exceptional, always-on customer experiences. Enter Nokia's Autonomous Network Fabric (ANF)—an innovative approach that transforms network operations with cutting-edge AI, telco-specific knowledge graphs and intelligent automation. ANF empowers CSPs to create self-managing networks that adapt effortlessly to demands with minimal human intervention.

Nokia ANF is available on any cloud platform. It seamlessly integrates with existing infrastructure, offering unrivalled flexibility and scalability, enabling CSPs to transition towards autonomy at their own pace. CSPs can rely on ANF's transparent, explainable AI decision-making and comprehensive protection based on Nokia's security-by-design approach. With this flexibility, Nokia's ANF is optimized to work together with Nokia's Autonomous Network Application suite, which allows for:

- Intent-based networking enables CSPs to define desired outcomes rather than technical configurations
- Persona-based user experiences for diverse user profiles
- Unified user experience ensuring consistency across touchpoints

ANF unlocks the full potential of a CSP's data, delivering groundbreaking insights, accelerating innovation and enabling faster service launches.

It's a powerful capability that can dramatically improve the ability of CSPs to monetize their networks and deliver business-to-business services at scale.

This state-of-the-art autonomous approach enables CSPs to manage extreme network complexity, unlock data-driven insights and build a stronger foundation for innovation and growth.

Learn more about Nokia ANF

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About Nokia

At Nokia, we create technology that helps the world act together.

As a B2B technology innovation leader, we are pioneering networks that sense, think and act by leveraging our work across mobile, fixed and cloud networks. In addition, we create value with intellectual property and long-term research, led by the award-winning Nokia Bell Labs, which is celebrating 100 years of innovation.

With truly open architectures that seamlessly integrate into any ecosystem, our high-performance networks create new opportunities for monetization and scale. Service providers, enterprises and partners worldwide trust Nokia to deliver secure, reliable and sustainable networks today – and work with us to create the digital services and applications of the future.