Networks with *intelligence*

Why and how the telecom sector should accelerate its autonomous networks journey

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What are autonomous networks?

Autonomous telco networks are networks that, under most conditions, can self-configure, self-monitor, self-optimize, and self-heal. As there are varied definitions and terminologies in use, this report takes TM Forum's autonomous network maturity model as the industry benchmark. This model defines six levels of autonomous networks:

L0 – Manual management: The system delivers assisted monitoring capabilities, which means all dynamic tasks must be executed manually.

L1 – Assisted management: The system executes a certain prefigured repetitive sub-task to increase efficiency.

L2 – Partial autonomous network: The system enables closed-loop operations and maintenance (O&M) based on an artificial intelligence (AI) model for certain units in certain environments.

L3 – Conditional autonomous network: Building on L2 capabilities, the system can sense real-time environmental changes, and, in certain network domains, optimize and adjust its operation to the external environment to enable intent-based closed-loop management.

L4 – Highly autonomous network: Building on L3 capabilities, in a more complicated cross-domain environment, conducts analysis and makes decisions based on predictive or active closed-loop management of service- and customer-experience-driven networks.

L5 – Fully autonomous network: The goal for telco network evolution. The system possesses closed-loop automation capabilities across multiple services, multiple domains, and the entire life cycle.

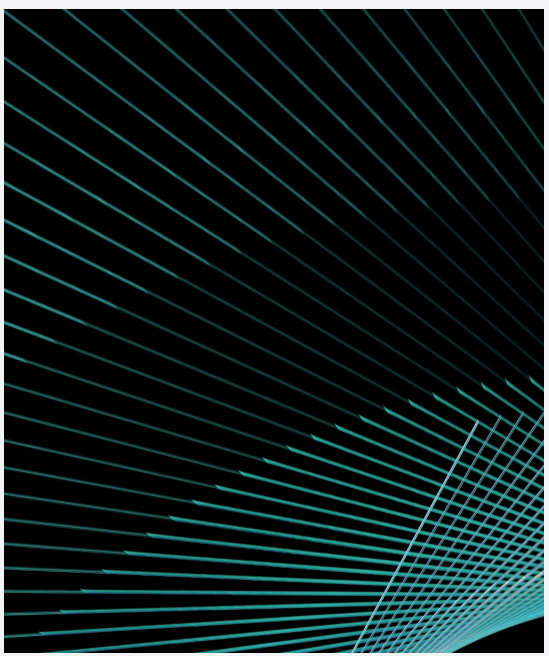


FIGURE 1.

TM Forum Autonomous Networks Levels and Vision

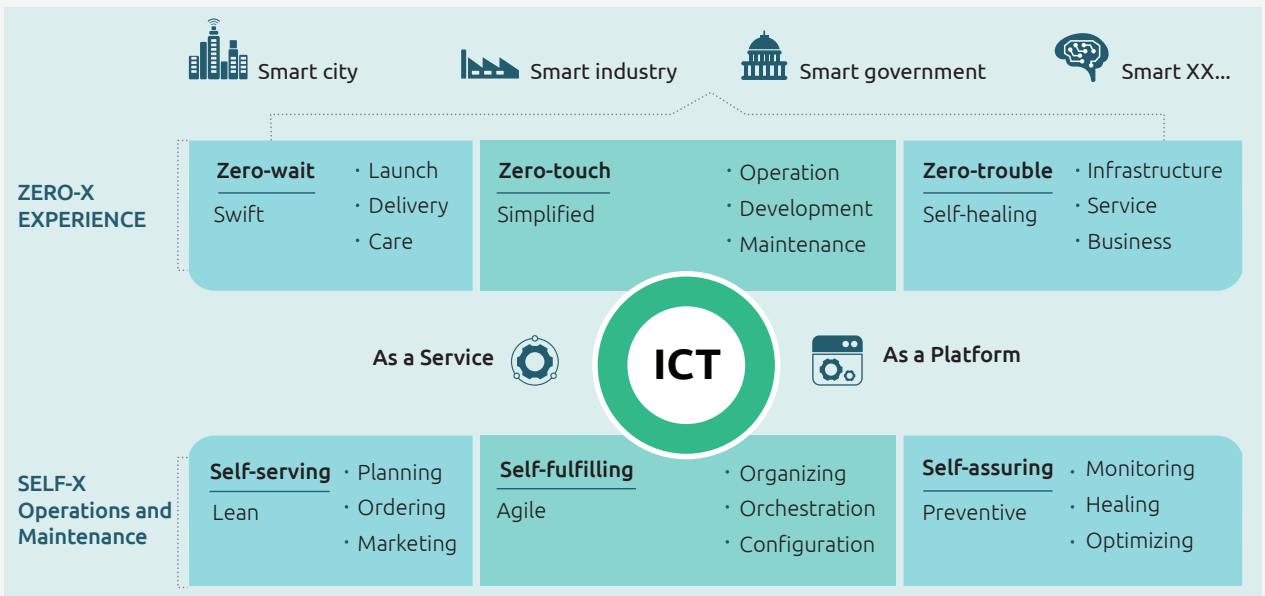
AUTONOMOUS NETWORKS LEVELS

LEVEL DEFINITION	L0: Manual Operation and Maintenance	L1: Assisted Operation and Maintenance	L2: Partial Autonomous Network	L3: Conditional Autonomous Network	L4: Highly Autonomous Network	L5: Fully Autonomous Network
Execution	P	P/S	S	S	S	S
Awareness	P	P	P/S	S	S	S
Analysis	P	P	P	P/S	S	S
Decision	P	P	P	P/S	S	S
Intent/Experience	P	P	P	P	P/S	S
Applicability	N/A	Select scenarios				All scenarios

P: Personnel, **S**: Systems

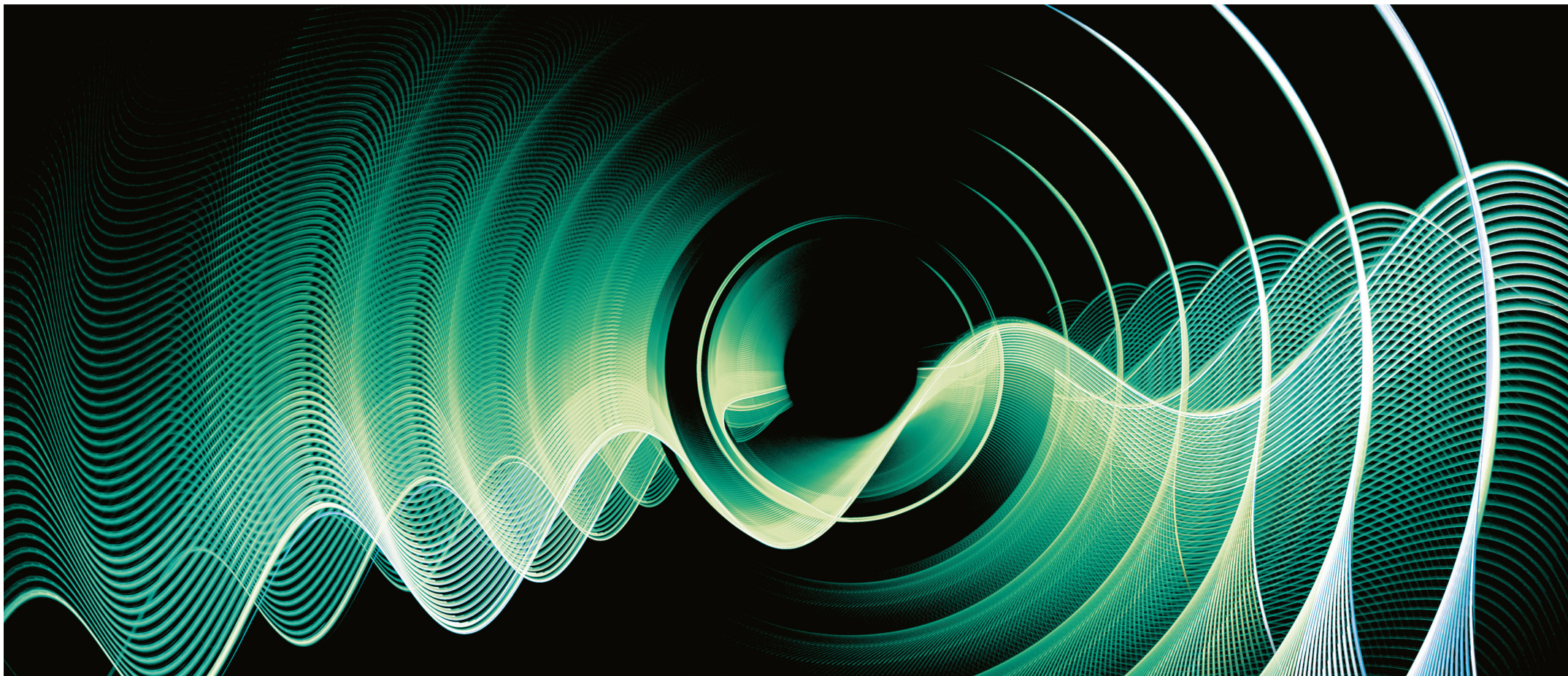
Source: TM Forum, "Autonomous Networks: Empowering Digital Transformation For The Telecoms Industry," May 2019.

AUTONOMOUS NETWORKS VISION



Source: TM Forum, "Autonomous Networks: Empowering digital transformation – evolving from Level 2/3 towards Level 4," September 2023.

In this report, the term 'telco' is used synonymously with telecom operators or communication service providers, including, but not limited to, full-service operators (fixed, mobile, and broadband), mobile operators, broadband providers, cable broadband, and mobile service providers.



Executive Summary

Here are the key findings from our research on autonomous networks comprising a primary survey of 435 telco industry professionals, and in-depth discussions with 22 senior executives overseeing their organizations' autonomous network initiatives (more details on research methodology are in the Appendix):

1. The telecom sector has just begun its autonomous networks journey, with a majority of telcos aiming to attain Level 3 autonomy or above by 2028.

- **Today, a large majority of telcos (84%) are either at Level 1 or Level 2 autonomy** for their overall networks

TM Forum's autonomous network levels – current and future (2028)

Percent of telcos in the category	L0: Manual operation and maintenance	L1: Assisted operation and maintenance	L2: Partial autonomous networks	L3: Conditional autonomous networks	L4: Highly autonomous networks	L5: Fully autonomous networks
End-2023	9%	42%	42%	6%	1%	0%
End-2028 (projected)	0%	8%	31%	44%	16%	1%

Source: Capgemini Research Institute, Autonomous Telco Networks Survey, December 2023–January 2024, N = 113 large CSPs.

Executive Summary

(including operations), as defined by TM Forum Autonomous Network levels (see table above).

- **The majority of telcos (61%) aspire to reach at least Level 3 autonomy by 2028.** The journey will be long and complex, however, as only 1% expect to attain Level 5 and 16% to attain Level 4 overall (including operations).
- **Use cases:** Most of the autonomous networks use cases are at the proof of concept (POC) or pilot stage, and about one in ten telcos is deploying these use cases at partial or full scale.

2. Several organizational and technological challenges threaten progress on autonomy.

- **Key challenges:** Telcos cite employee mindset, integration issues, and data sovereignty concerns as top challenges hindering adoption.
- **Strategy:** Only about one in five telcos (17%) has a comprehensive autonomous networks transformation strategy with well-defined goals and target timelines.
- **Leadership:** Fewer than one in five organizations (15%) has appointed a dedicated leader for autonomous networks, and 31% are in the process of finding one.
- **Roadmap:** 50% of telcos have a roadmap that covers only the next 1-2 years.

3. Telcos that are moving faster on their autonomous networks journey are reaping significant benefits.

- The benefits from autonomous networks are clear:
  - Telcos have realized a **20% improvement in operational efficiency and 18% network operational expenditure (OpEx) savings**, on average, through autonomous networks initiatives undertaken in the past two years.
  - 71% of telcos have reduced energy consumption in this period, and telcos expect to reduce emissions by 32% on average in the next five years.
- The financial benefits of autonomous networks are expected to reward investment.

Executive Summary

  - Telcos expect to invest **$87 million** on average in autonomous networks over the next five years.
  - Our analysis suggests that OpEx savings from autonomous networks would be **$150 million–$300 million** per organization over the coming five-year period.
  - Estimated return on investment (ROI) **of 1.7x–3.4x and a payback period of 2.9 to 1.5 years** in conservative and optimistic scenarios, respectively.

- Telcos with a comprehensive strategy and advanced implementation of autonomous networks are seeing larger benefits than organizations without.
  - We classified surveyed organizations into leaders, fast-followers, and beginners based on the maturity of their autonomous networks strategy and roadmap, planned investments, current level of network autonomy, and implementation of various use cases.
    * Over the past couple of years, telco leaders achieved a cumulative **19% reduction in network OpEx**, outpacing beginners who managed a 13% reduction.
    * Leaders have also demonstrated a **22% improvement in time-to-market for new services** – double that of beginners (11%).

4. Telcos accelerate and sustain their autonomous networks journeys by:

- devising a strategy and roadmap for the autonomous networks journey;
- formulating the right talent strategy to support the scale-up of network autonomy;
- investing in key technology and data/AI initiatives;
- setting the pace of their transformation in line with networks' maturity; and
- innovating continuously to remain at the cutting edge of autonomous networks development.

Who should read this report and why?

This report provides insights into the autonomous networks transformation to leaders in the telecom sector working in various fields of specialization including network, operations, engineering, data and IT, finance, and strategy. Among network leaders, chief technology officers, chief network officers, and heads of autonomous network and digital networks, and their teams will find it useful. Leaders from finance and strategy and top management at telcos will find it useful. Additionally, given the central role of data and artificial intelligence (AI) in autonomous networks, this report will inform, chief data officers, chief AI officers, heads of analytics/AI/data, and chief information officers. Finally, considering the potential of autonomous networks to drive energy efficiency and carbon footprint reduction, sustainability leaders will also find it useful.

This report is based on the findings of an industry survey of 435 senior executives (director level and above) from telcos, network equipment providers (NEPs), and hyperscalers. All organizations had annual revenue above $1 billion. About 51% of executives were from network; 24% from data/AI and IT; 15% from top management; and 10% from engineering. See the Research Methodology at the end of the report for more details.

Introduction

The telecom sector eagerly anticipates the emergence of the era of autonomous networks, with self-sufficiency to configure, monitor, and "heal" themselves. However, its arrival will not be straightforward.

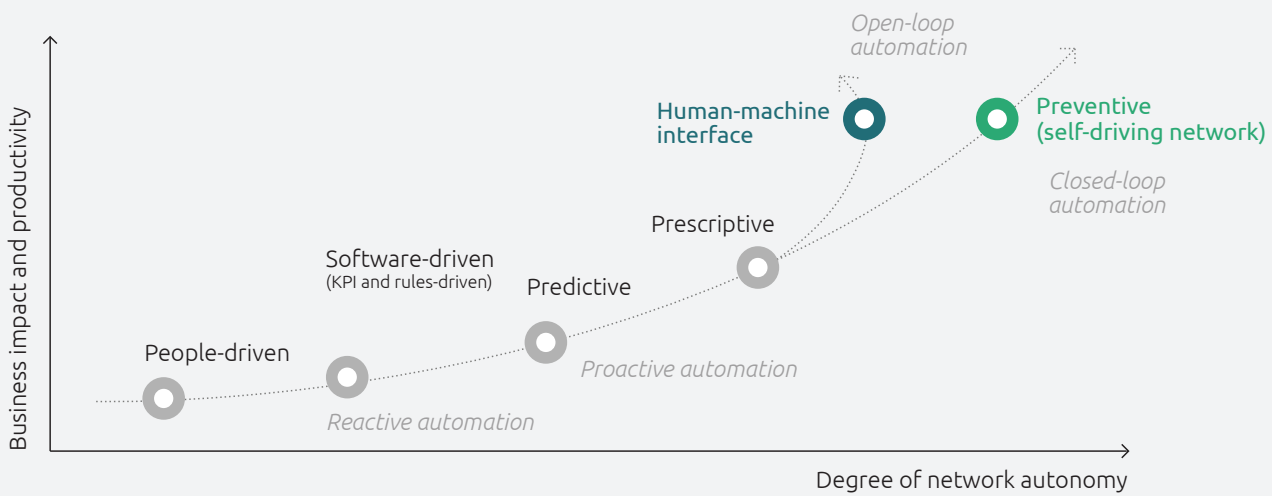
When telecom networks started out, they were largely reliant on manual systems and processes. They gradually built in software-driven rules and automation, although these were mostly reactive in nature (see figure 2). Today, the increasing use of data analytics and machine learning (ML) allows the network to take certain low-risk actions proactively or prescribe a series of actions to a human operator. Given recent advances in the field of AI, this is expected to change. The promise of a 'self-serving', 'self-fulfilling', and 'self-assuring' network, that is able to react autonomously to changing conditions to maintain or enhance the customer experience, seems closer than ever.

Demand for superior customer experience is putting increasing pressure on network resources. On one hand, over the past five years or so, the newer generation of technologies, such as 5G and superfast fiber broadband, have improved the reach and quality of network services. On the other hand, the increasing number of mobile phones and devices connecting to the network and exchanging ever-increasing volumes of data have deepened the complexity of the telco network. This has rendered some network-management activities beyond the reach of manual operations, necessitating software-based automated operations. Autonomous networks can help manage this complexity while also chipping away at rising network-operations costs.

This convergence of rising connectivity levels, AI, and high-performance computing among other factors, goes beyond simply building and deploying telco networks in a new way but has implications across dimensions such as network operations and maintenance, network management systems, planning, and observability of networks. From a telco business perspective, this evolution of network technology has a profound effect on an operators' strategy and operating model, skill acquisition, and build vs. buy decisions.

Introduction

FIGURE 2.
Evolution of autonomous networks



Source: Capgemini Research Institute analysis.

The potential of autonomous networks isn't limited to achieving business goals. Reducing energy consumption, intelligent workload management, and better resource utilization are already delivering sustainability benefits, particularly in relation to climate.

Are these benefits sufficient to justify the investment? If so, which use cases are most widely applicable and what value can they drive? Are telcos that are ahead of others on the journey achieving greater benefits? And, if yes, how can fast-followers and beginners accelerate their transformation? This research report attempts to answer these questions.

01 The telecom sector is just starting its autonomous networks journey

The majority of telcos aim to have Level 3 or above autonomy by 2028

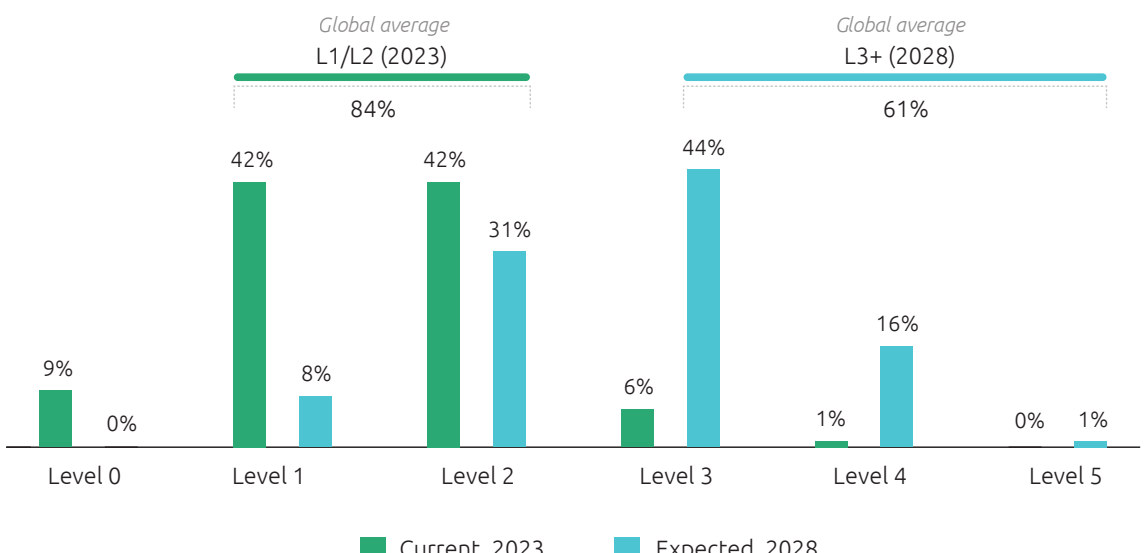
Today, the majority of telcos (84%) have either Level 1 or Level 2 autonomy, as per TM Forum's taxonomy of autonomous networks (see figure 3).

In the next five years, the majority of telcos (61%) aim to attain at least Level 3 autonomy. Beyond this, only 16% of telcos expect to reach Level 4 autonomy in the next five years, and only 1% expect to reach Level 5 overall (including operations). Telcos aiming to reach Level 4 and 5 believe technology will mature in the next five years, as more autonomous network use cases are implemented across network domains.

Paul Kells, director of network strategy and engineering at the British media and telecom company Virgin Media O2 (VMO2), tells us: ***"We have a three-year and a five-year network-transformation plan to have an intelligent network that's intent-based, using AI/ML. The design aims to minimize build and run cost per bit to mitigate traffic growth and the rise in input costs, in particular labor and energy. We aim to reach Level 4 in five years."***

FIGURE 3.
The majority of telcos (84%) have attained Level 1 or Level 2 autonomy

STATE OF OVERALL NETWORK AUTONOMY, CURRENT VS. EXPECTED



Percentages represent share of organizations by overall level of network autonomy (according to TM Forum's levels of autonomous networks).
Source: Capgemini Research Institute, Autonomous Telco Networks Survey, December 2023–January 2024, N = 113 large CSPs.

"We have a three-year and a five-year network-transformation plan to have an intelligent network that's intent-based, using AI/ML. The design aims to minimize build and run cost per bit to mitigate traffic growth and the rise in input costs, in particular labor and energy. We aim to reach Level 4 in five years."

PAUL KELLS
Director, Network strategy and Engineering at Virgin Media O2 (VMO2)

Globally, European telcos lead progress in autonomous networks journeys (see figure 4A and 4B). For instance, Orange has targeted Level 4 autonomy for some processes by 2025.[1] The group chief technology officer at a large French multinational telecom company says: ***"Our ambition to reach Level 4 network autonomy by 2025 plays a crucial role in the group's strategic plan. Through enhanced use of data and AI at Level 4 autonomy, our network will be more effective, more resilient, and higher performing."***

Nearly two-thirds of telcos in Sweden, Spain, Italy, and France have attained Level 2 autonomy. In 2021, Telefónica launched a program called Autonomous Network Journey (ANJ), encompassing all its operations in Europe and the Americas. As well as network autonomy, ANJ's goal considers the required management of data, architecture and enablers, security, sustainability, plus an organizational structure and reskilling staff to support the network.[2]

The head of telco analytics at a large US-based cloud platform provider says: ***"European communication service providers (CSPs) are leading in autonomous network levels, possibly driven by the need to reduce O&M costs as average revenue per user is lower in Europe than in North America."***

One-third of telcos (33%) in the US have moved to either Level 2 or Level 3 autonomy. US telco Verizon aims to build autonomous networks with monitoring and analytics capabilities. Verizon aims to use AI/ML to optimize network resources; detect network anomalies before service disruption; and automatically resolve issues within a continuous automated framework.[3]

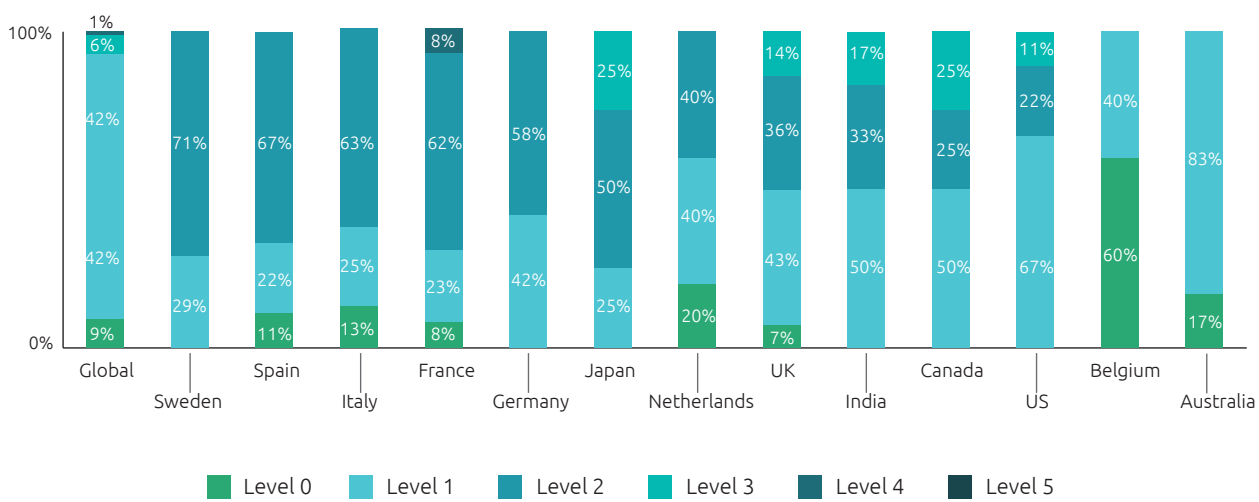
33%

of telcos in the US have moved to either Level 2 or Level 3 autonomy

FIGURE 4A.

Nearly two in three telcos in Sweden, Spain, France and Italy operate at network autonomy Level 2 – the highest level across all countries

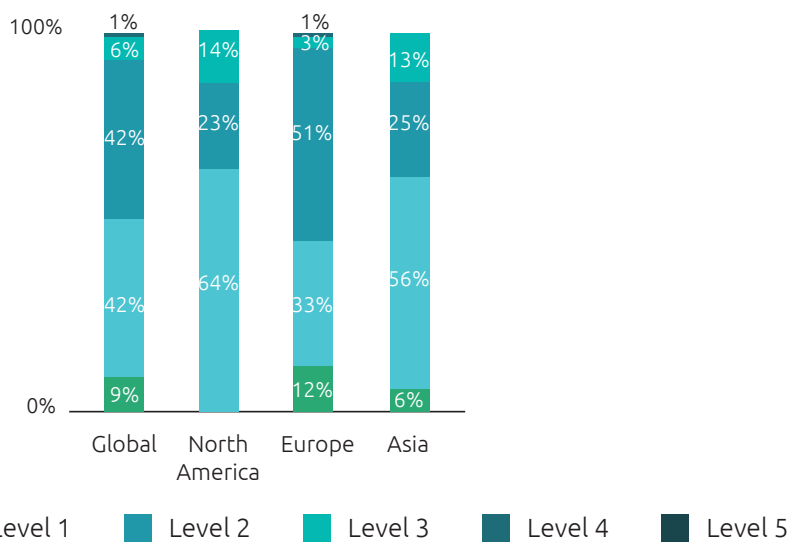
CURRENT STATE OF OVERALL NETWORK MATURITY, BY COUNTRY



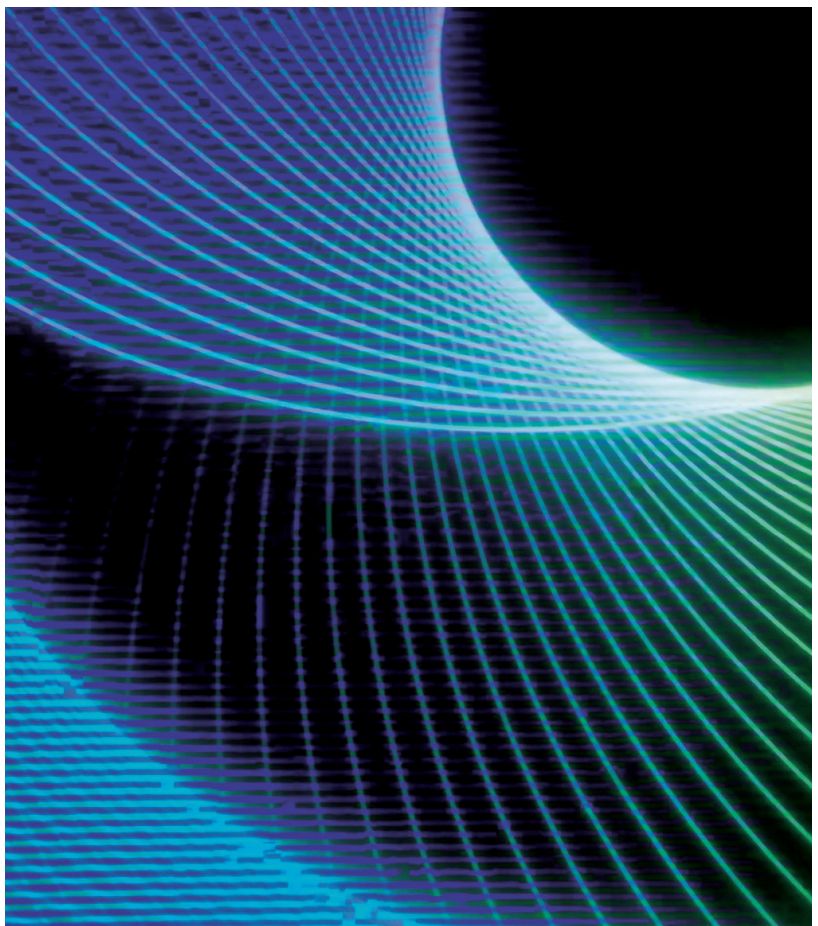
Percentages represent the share of organizations at specified levels of network autonomy for each country.
Source: Capgemini Research Institute, Autonomous Telco Networks Survey, December 2023–January 2024, N = 111 large CSPs.

FIGURE 4B.
Globally, European telcos lead progress in autonomous networks journeys

CURRENT STATE OF OVERALL NETWORK MATURITY, BY REGION



Percentages represent the share of organizations at specified levels of network autonomy for each country.
Source: Capgemini Research Institute, Autonomous Telco Networks Survey, December 2023–January 2024, N = 113 large CSPs. Asia, excluding China = Australia, Japan, India; Europe = Belgium, France, Germany, Italy, Norway, Netherlands, Spain, Sweden, UK; North America = Canada, US.



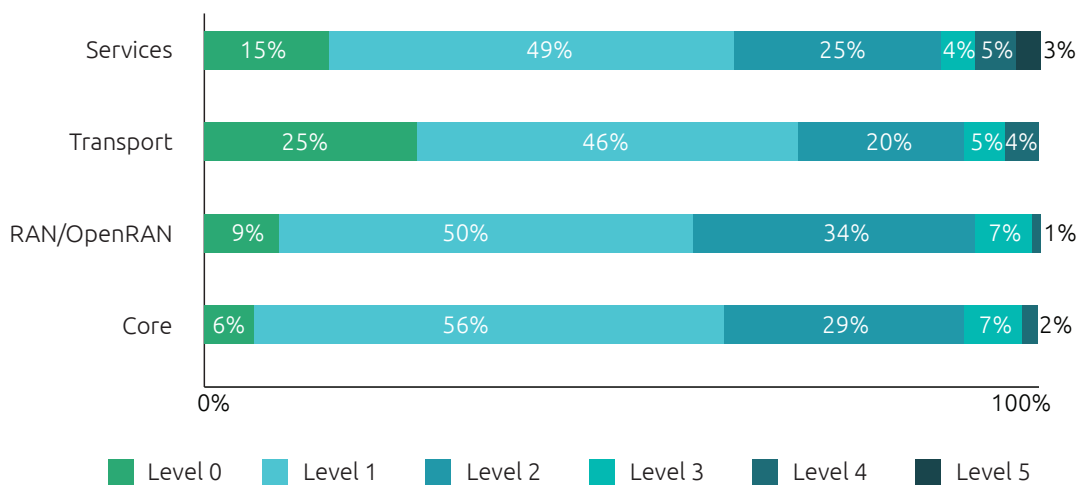
By domain, the picture looks similar, with a majority of telcos having all network domains at Levels 0–2 (see figure 5). A challenge CSPs face in deploying higher levels of autonomy in network domain is how to monetize their investments.

Going by the figures, telcos are taking a fragmented approach to upgrading network autonomy. A European telco told us that they are fairly advanced in the transport domain, followed by RAN, and core in that order.

FIGURE 5.

For nearly 90% of telcos, network autonomy by domain is at Level 0–2

LEVEL OF NETWORK AUTONOMY BY MAJOR NETWORK DOMAINS, 2023

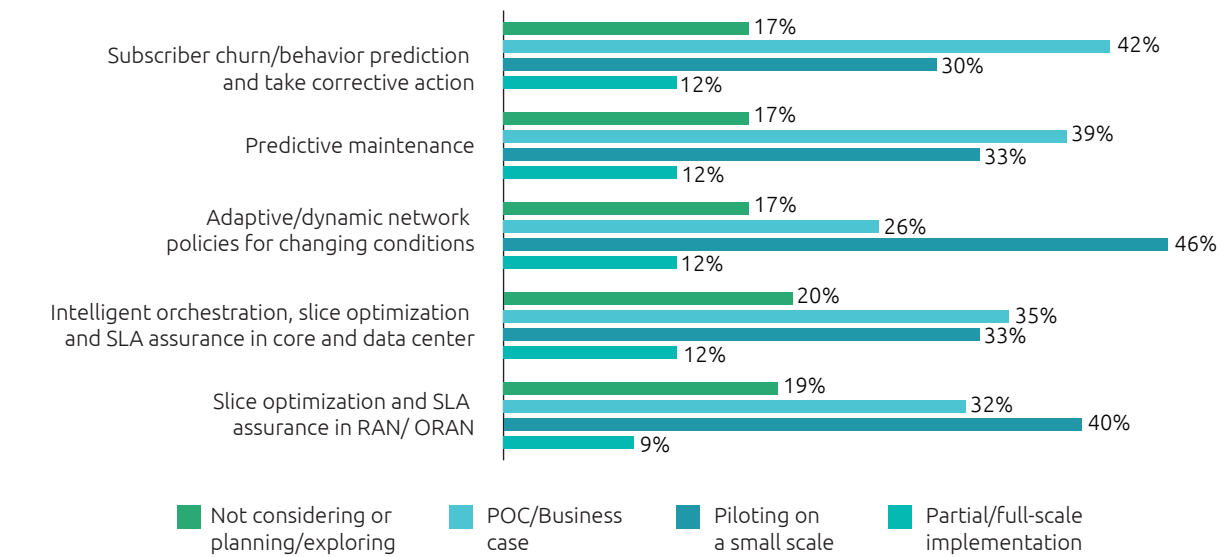


Percentages represent share of organizations at specified levels of network autonomy for each network domain.
Source: Capgemini Research Institute, Autonomous Telco Networks Survey, December 2023–January 2024, N = 113 large CSPs.

Most of the autonomous networks use cases remain in the initial stages of development

We analyzed 18 autonomous network use cases across network domains to understand current level of implementation. We found most to be at the POC or pilot stage (see figure 6).

FIGURE 6.
Most autonomous networks use cases are at proof of concept/pilot stage



Percentages represent share of organizations at each stage of autonomous networks use case implementation.
Source: Capgemini Research Institute, Autonomous Telco Networks Survey, December 2023–January 2024, N = 113 large CSPs.

Top autonomous network use cases across domains

Network Domain	Top use cases under experimentatio (POC/pilots) per our survey	Description
Radio Access Network (RAN)	Slice optimization and service-level agreement (SLA) assurance	Optimization of network slicing. Network slicing allows multiple virtual networks over a shared network domain
	Traffic steering and quality of experience (QoE)/quality of service (QoS) optimization	Defining an optimal path for network traffic to maintain or improve customers' QoE/QoS
Core and data centers	Intelligent orchestration	Intelligent orchestration is automating interactions across multiple types of device, domain, and related systems
	Dynamic capacity planning	Assessing network utilization, traffic volume, and traffic type to identify problems on a real-time basis
Transport	xHaul network predictive analytics	Analyzing network problems and providing solutions using AI/ML
	Network failure prediction in multi-layer software-defined networking (SDN)	Using AI/ML to predict failure of controllers in SDN networks under certain conditions
Operations and maintenance	Predictive maintenance	Predicting faults in network components by collecting data from multiple network sources
	Adaptive/dynamic network policies for changing conditions	Changing network policies to adapt to changing conditions
	Network design optimization and resource allocation	Measuring metrics such as latency and throughput, and optimally allocating resources
Customer-facing use cases	Subscriber churn/behavior prediction and take corrective action	Understanding subscriber behavior and taking corrective action to retain customers
	Prediction of level of user satisfaction	Analyzing data to understand customer's satisfaction level with telecom services

Source: Capgemini Research Institute, Autonomous Telco Networks Survey, December 2023–January 2024, N = 113 large CSPs.

Use cases

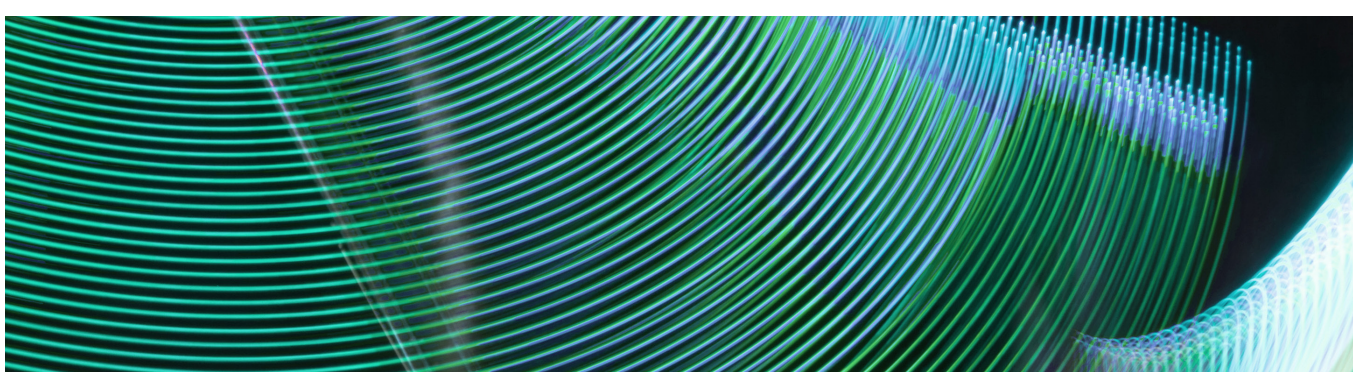
Verizon demonstrated the ability to sustain performance levels for mission-critical functions while passing video data over a network slice in a completely commercial 5G environment through Axon Fleet 3 and Axon Respond services. It is built on Verizon's cloud-native, standalone 5G core, offering service flexibility, and automated scalability, among other benefits. Consumers of the service have enhanced customer experience as they can access live maps, live streaming of mobile videos, and real-time situational awareness.[4]

The network director at a UK-based telco reveals: ***"Over 70-80% of the tickets, events, or incidents in the network are more or less similar or the same. These incidents occur frequently, demanding a considerable amount of human effort for activities that are not particularly complex to resolve. Automating these can save significant time and resources."***

Orange uses AI and advanced data-management platforms to detect abnormal network behavior or degradations in call quality or data flows. These trigger actions within intelligent automation and service-orchestration systems to ensure a consistent service level across distributed IT environments.[5]

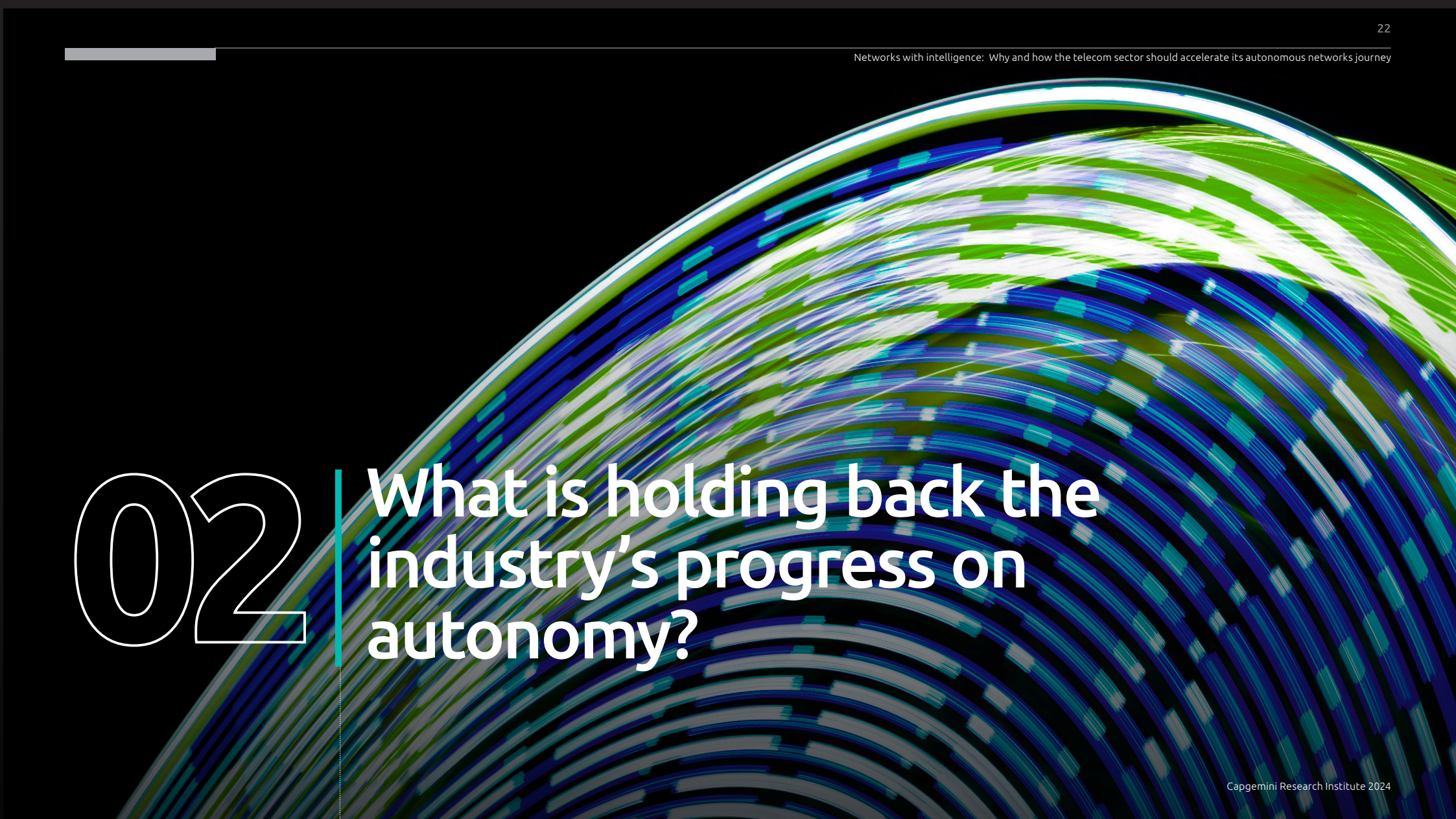
Emmanuel Lugagne-Delpon, director of technical networks, outlined examples of how Orange has improved its network operations using AI tools: ***"AI can enable Orange to build smarter networks, improve operational efficiency, and transform customer interaction and experience, all while following AI guidelines."***

Simon Norton, head of digital networks and OSS (Europe and international networks) at Vodafone, says: ***"We have introduced autonomous networks use cases in anomaly detection and predictive maintenance, we aim to replace more than 30% of our reactive tickets with predictive tickets. This enables us to fix issues before they ever impact a customer and at a lower cost relative to a classic 'reactive' intervention."***



"AI can enable Orange to build smarter networks, improve operational efficiency, and transform customer interaction and experience, all while following AI guidelines."

EMMANUEL LUGAGNE-DELPON
Director of technical networks, Orange



02 What is holding back the industry's progress on autonomy?

Telcos point to cultural issues, integration, and lack of technological maturity as top challenges to transformation

As figure 7 shows, half of telcos cite cultural challenges (e.g., inappropriate employee mindsets and behavior) and technology integration issues as the top barriers to the transformation of autonomous networks.

Business culture develops and is reinforced longitudinally. Managing cultural transition can be more difficult than deploying the technology itself. As the director of product management at a US-based network equipment provider says, ***"It's culture/traditional operations vs. a mindset change. The way you operate networks, or the kind of upskilling required now has tremendously changed compared to a few decades ago. For instance, do I choose the traditional ITIL functions, or the advanced NetDevOps?"***

"We need to continue the transformation of telecoms culture, to make it more inclusive, more customer-focused, and more innovative," says Kate Johnson, chief executive officer at Lumen Technologies, a global US-based telecom company, ***"There are enormous opportunities for the industry to solve technology challenges across sectors including retail, healthcare, manufacturing, and government agencies. We need to focus on understanding the human element and our customers first."***[6]

Moreover, employees are not usually enthusiastic about change. A recent Harvard study found that, ***"Willingness to support enterprise change collapsed to just 43% in 2022, compared with 74% in 2016. In 2022, the average employee experienced 10 planned enterprise changes – such as a restructure to achieve efficiencies, a culture transformation to unlock new ways of working, or the replacement of a legacy tech system – up from two in 2016."***[7]

"We focus on the entire life cycle of networks as part of our operational strategy. Instead of solely concentrating on the operational side, there is value in considering the design, build, and operation phases and how they interconnect. [...] Our intent is to integrate technologies from the beginning of network development to ensure a seamless and autonomous network operation."

MABEL POUS-FENOLLAR
Global head of digital and zero-touch operations at Vodafone

Autonomous network implementation is a complex, systematic transformation involving many ecosystem partners. Implementing solutions across different layers is challenging.

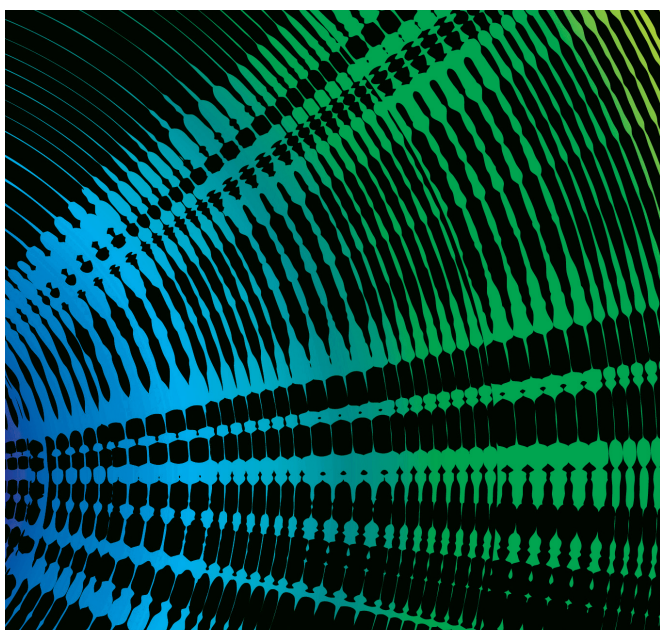
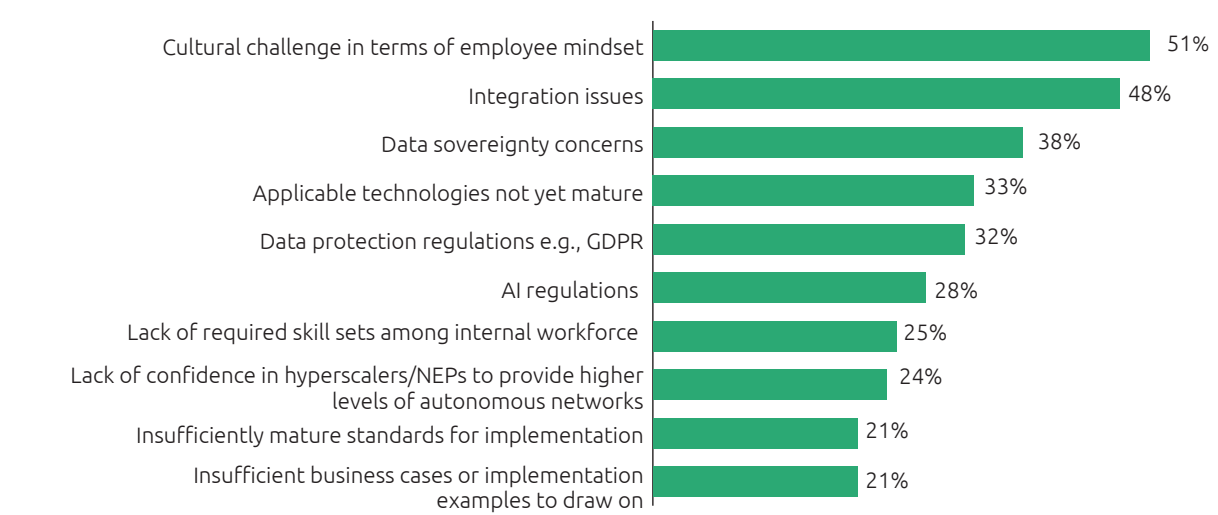


FIGURE 7.

Telcos encounter several obstacles to their transition towards higher network autonomy

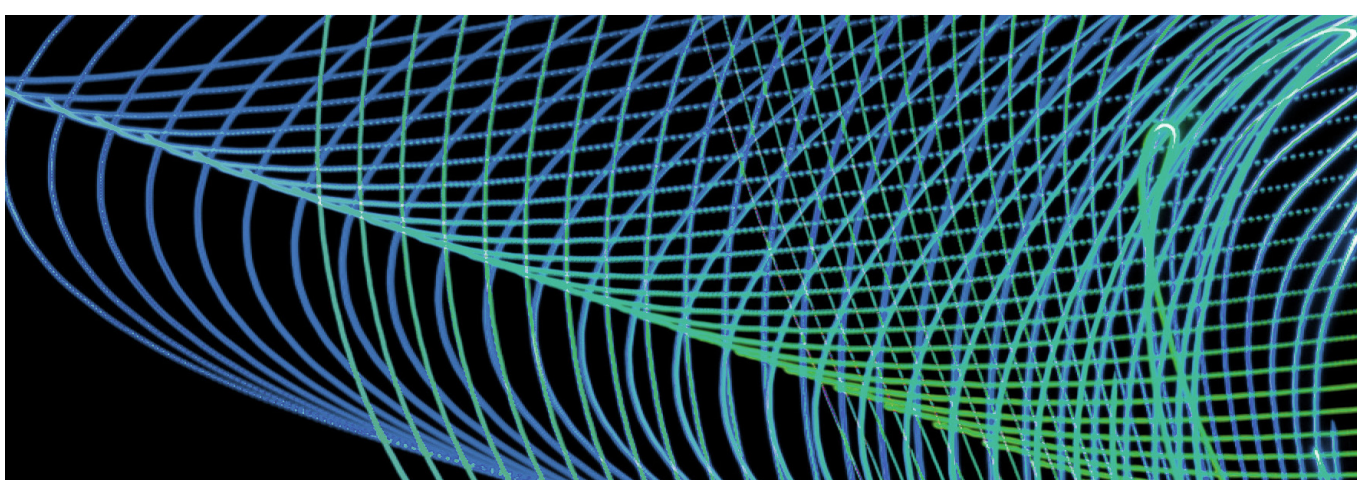


Percentages represent the share of organizations.
Source: Capgemini Research Institute, Autonomous Telco Networks Survey, December 2023–January 2024, N = 113 large CSPs.

51%

of telcos cite employee mindset as a top barrier to the adoption of autonomous networks

Highlighting the importance of acknowledging technology integration issues, Juan Luis Mulas, head of telco cloud, OSS and automation at Orange Spain, says: ***"To transform to Level 4 network autonomy, it's not only us who have to change. Our ecosystem, including vendors, system integrators, hyperscalers, and software providers, will have to reskill or upskill people to drive this change forward."***



Several regulatory challenges around data sovereignty, data protection, and AI, also appear among top ten challenges perceived to be hindering telcos' autonomous networks journeys. We will see in the later sections that leading telcos are bothered much less about these as compared to telcos that are at initial stages of their transformation.

Moreover, large organizations must also grapple with their legacy systems. Significant capital investment and employee training are required to switch over to new autonomous infrastructure. Hence, we also see CSPs initially focusing on automating their existing procedures, rather than overhauling entire operations.

As we will see further, telcos are inadequately prepared to tackle these challenges and advance on their journey as there are several gaps in strategy and implementation.

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JUAN LUIS MULAS
Head of global telco cloud, OSS and automation at Orange Spain

Only about one in five telcos has a comprehensive strategy for autonomous networks

As figure 8 shows of the surveyed telcos, only 17% have a well-defined autonomous networks transformation strategy, while nearly seven in ten are working on implementing autonomous networks without a structured strategy.

Mabel Pous-Fenollar, global head of digital and zero-touch operations at Vodafone, comments: ***"We focus on the entire life cycle of networks as part of our operational strategy. Instead of solely concentrating on the operational side, there is value in considering the design, build, and operation phases and how they interconnect. By leveraging technologies such as SDN (software-defined networking) and OpenRAN, we aim to automate and close the loop across various phases. Our intent is to integrate these technologies from the beginning of network development to ensure a seamless and autonomous network operation."***

Juan Manuel Caro, director of autonomous networks at Telefónica, explains: ***"We look at our autonomous networks strategy as a set of five drivers: agility – faster processes; efficiency – conducting operations in a better way; sustainability – reducing energy consumption and emissions; quality – improving customer satisfaction; and perception and intelligence – making our networks self-reliant and optimizable."***

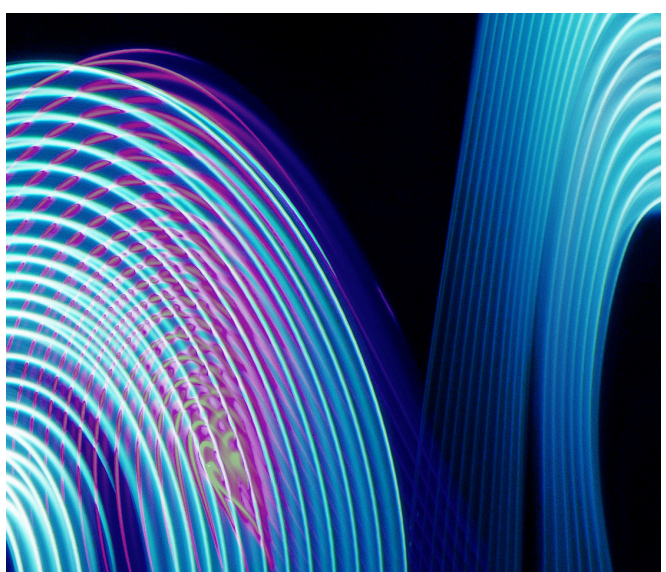
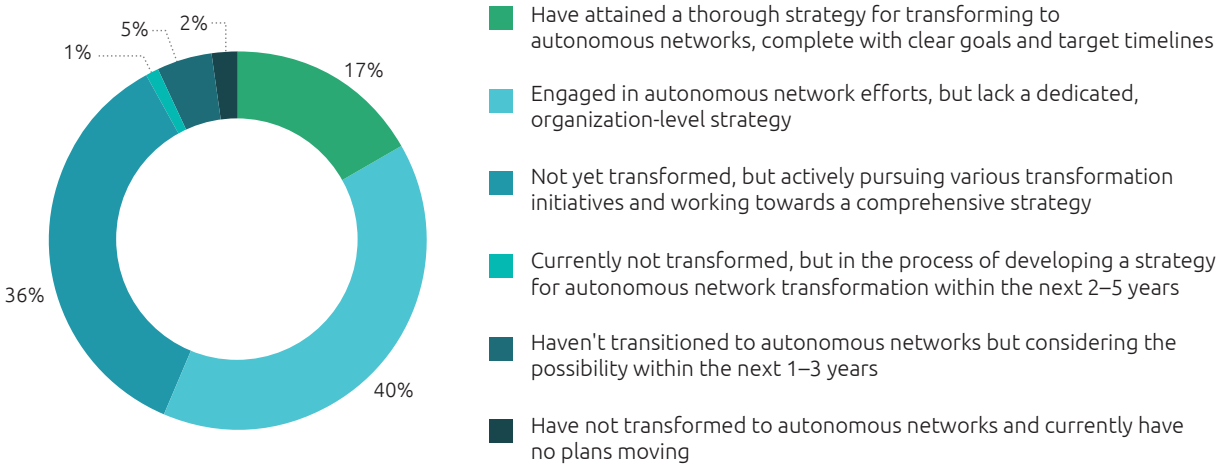


FIGURE 8.

The large majority of organizations are working without a dedicated strategy for autonomous networks

MATURITY OF AUTONOMOUS NETWORKS' TRANSFORMATION STRATEGIES



Source: Capgemini Research Institute, Autonomous Telco Networks Survey, December 2023–January 2024, N = 121 large CSPs.

Fewer than one in five organizations has appointed a dedicated leader for autonomous networks, and 31% are in the process of finding one

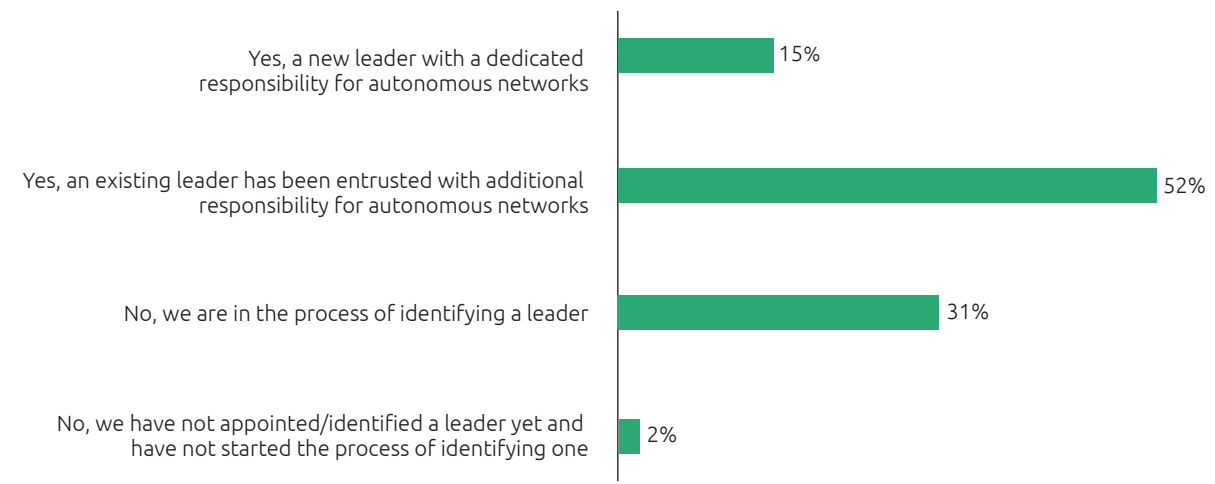
By appointing a dedicated autonomous networks leader, organizations can signal the priority they are assigning to autonomy initiatives. Yet fewer than one in five telcos has done so to date (see figure 9).

- About half have added advancing autonomous networks to the responsibilities of an existing leader
- About one-third (31%) have yet to identify a leader who will further their organization's autonomous networks agenda

For its leading its ANJ program, Telefónica appointed Juan Manuel Caro Bernat as head of autonomous networks by giving him a dedicated responsibility of this strategic initiative.

FIGURE 9.
Nearly one-third of organizations are yet to appoint an autonomous networks leader

ORGANIZATIONS THAT HAVE APPOINTED CLEAR LEADERSHIP FOR LEADING AUTONOMOUS NETWORKS INITIATIVES



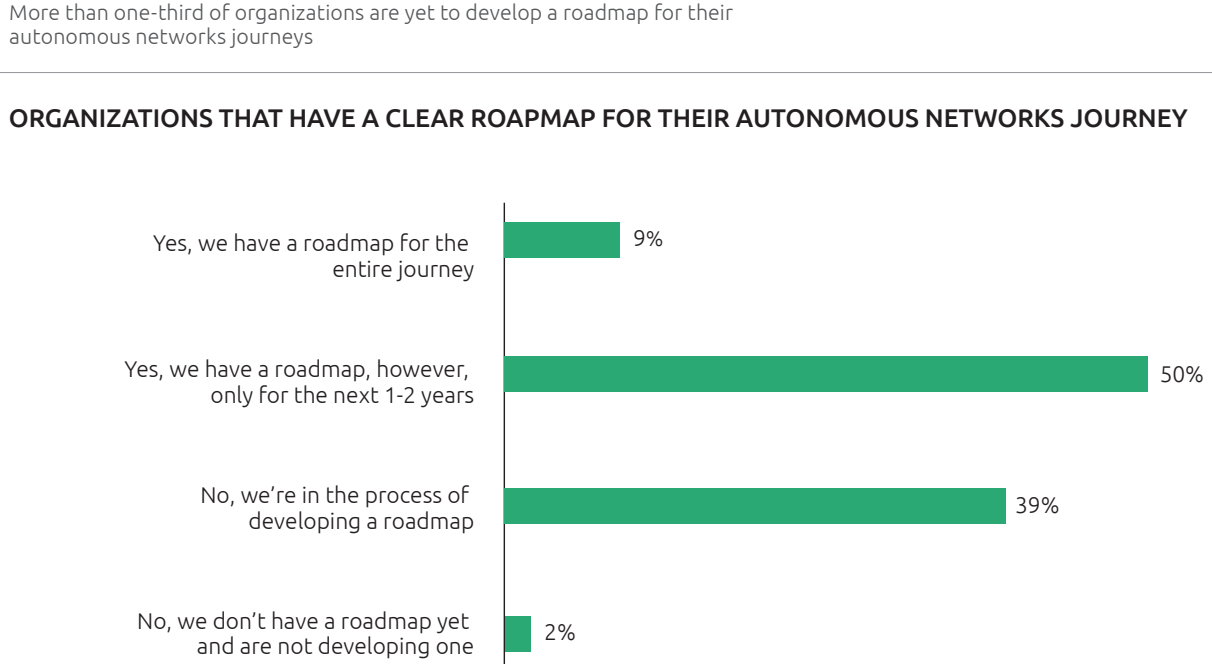
Source: Capgemini Research Institute, Autonomous Telco Networks Survey, December 2023–January 2024, N = 113 large CSPs.

Nearly half of the telcos have a roadmap for only the next 1-2 years

It is clear that a transformation of this size and scale will entail a multi-year journey. However, few telcos recognize the degree of planning required. Our survey found that only half have a roadmap for the next couple of years and just about one in ten have one for the entire journey (see figure 10).

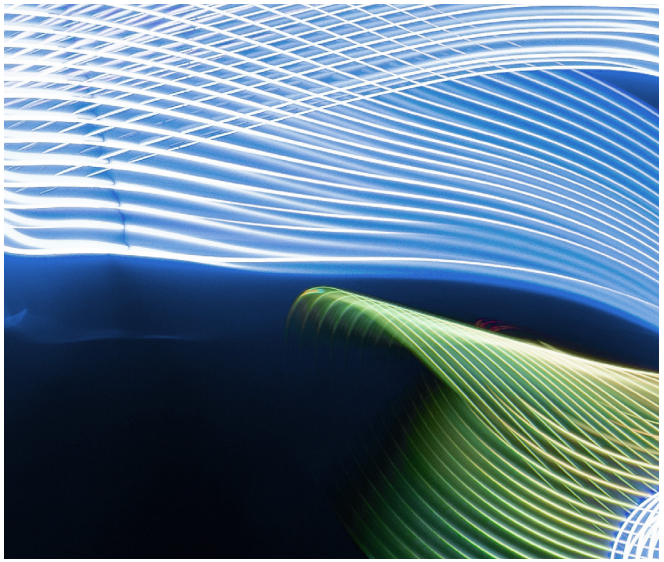
The global head of autonomous networks at a large, multinational telecom operator based in Spain comments: ***"We have set targets for 2026 and 2030. Our focus is to manage networks comprehensively, efficiently, and 'zero-touch,' all while warranting plausible bandwidth. The goal is to have intelligent and automated networks, with effective traffic management."***

FIGURE 10.
More than one-third of organizations are yet to develop a roadmap for their autonomous networks journeys



Source: Capgemini Research Institute, Autonomous Telco Networks Survey, December 2023–January 2024, N = 113 large CSPs.

The group chief technology officer at a large French multinational telecom company, talking about the company's roadmap, comments: ***"To improve monitoring and anomaly detection, our plan is to focus on regions where it matters the most and where the need to be agile is felt the most. We need to improve the time to market, the time it takes to bring new features to the network, and we need to do it in a safe and agile way."***



"We look at our autonomous networks strategy as a set of five drivers: agility – faster processes; efficiency – conducting operations in a better way; sustainability – reducing energy consumption and emissions; quality – improving customer satisfaction; and perception and intelligence – making our networks self-reliant and optimizable."

JUAN MANUEL CARO
Director of autonomous networks at Telefónica

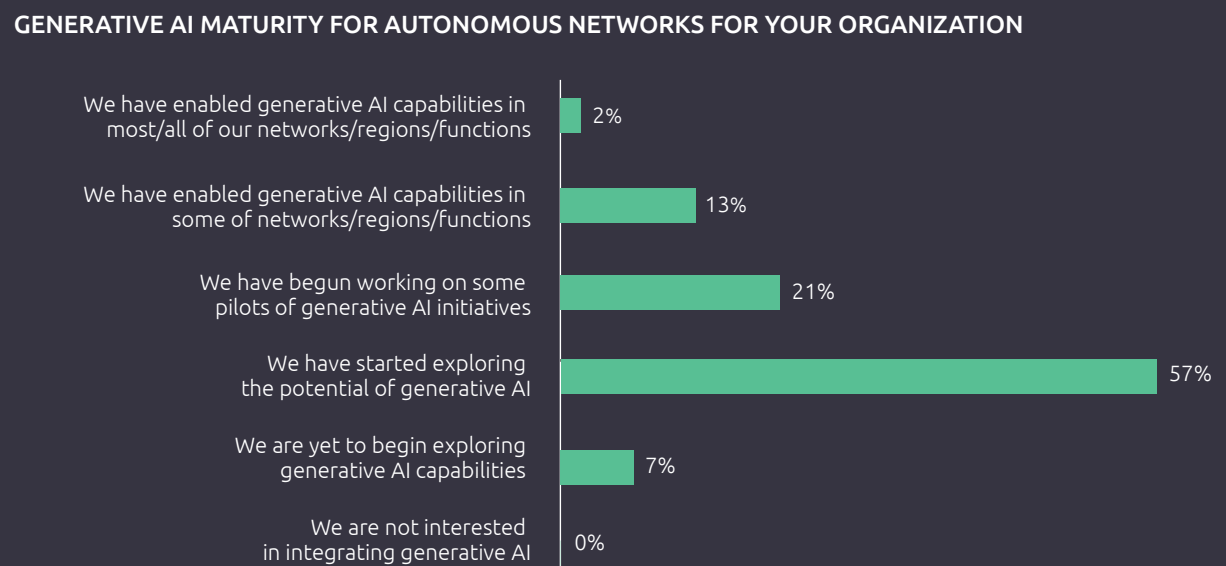
The potential of AI/ML and generative AI for autonomous networks

Three out of five telcos are exploring the potential of generative AI (Gen AI) for autonomous networks

AI and ML, along with generative AI, will help CSPs to achieve Level 3 and above autonomy over the next 2–5 years. AI/ML-based methodologies and generative AI have the potential to help CSPs in use cases such as:

- complex event processing;
- dynamic bandwidth selection and path selection;
- network capacity planning; and
- network provisioning and optimization.

FIGURE 11.
One in ten telcos has implemented generative AI for networks at a partial scale



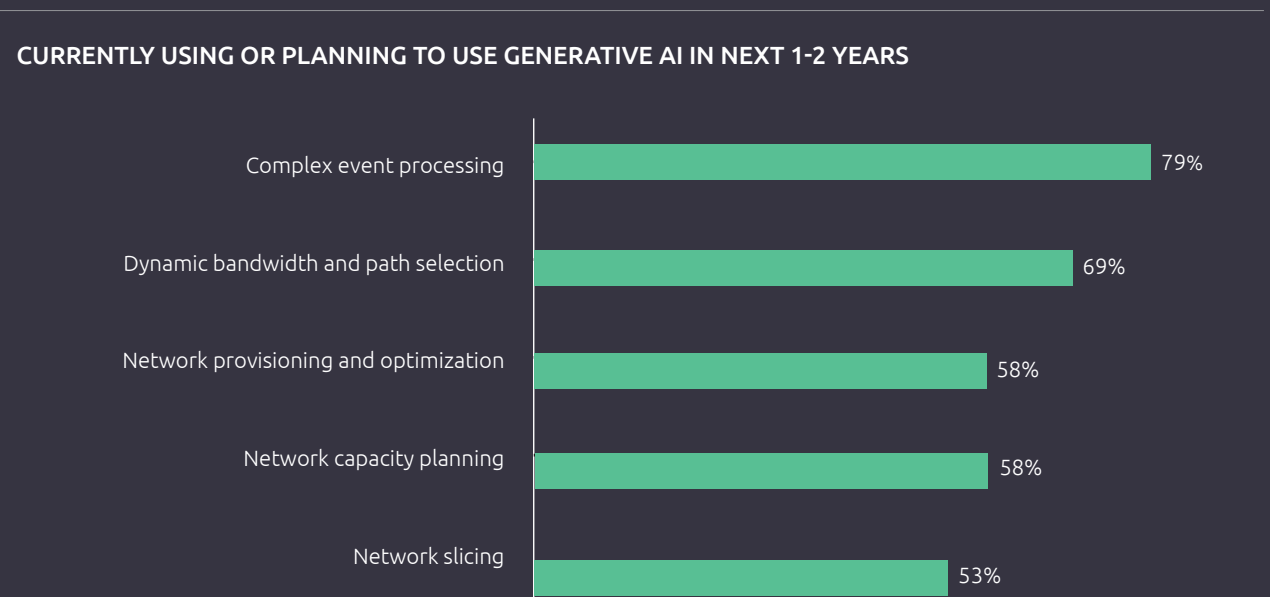
Source: Capgemini Research Institute, Autonomous Telco Networks Survey, December 2023–January 2024, N = 284 telco tech executives, 113 large CSPs.

"Gen AI cannot be disassociated from automation anymore. While automation was mostly heuristic in the beginning, operators now constantly deploy telemetry, network function data among others and build ML algorithms," says head of telco analytics at a large US-based cloud platform provider.

Eight out of 10 telcos are either currently using or plan to use generative AI in 'complex event processing.' Seven out of 10 respondents are either currently using or plan to use generative AI in 'dynamic bandwidth and path selection.' Next in terms of use-case implementation are 'network provisioning and optimization,' 'network capacity planning,' and 'network slicing' (half of respondents).

FIGURE 12.

More than half of telcos are currently using or planning to use generative AI in several use case in the next 1–2 years



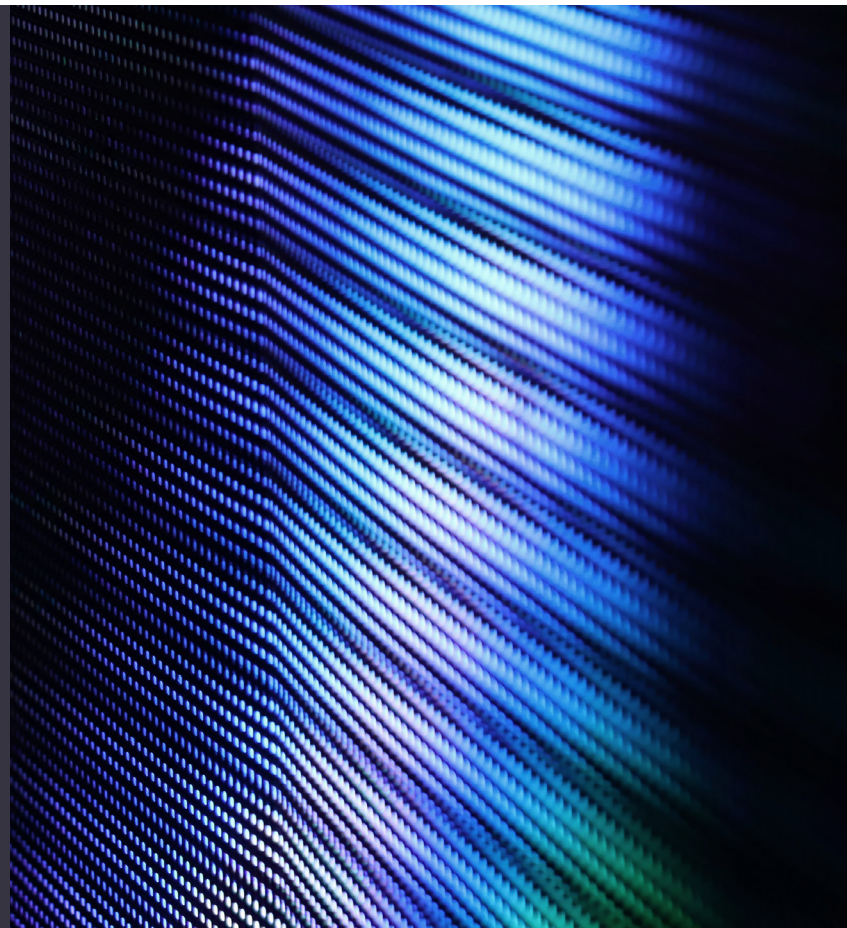
Source: Capgemini Research Institute, Autonomous Telco Networks Survey, December 2023–January 2024, N = 284 telco tech executives, 113 large CSPs.

Complex event processing

Complex event processing aggregates data and analyzes cause-and-effect relationships between events on a real-time or near-real-time basis. It finds patterns in event relationships and draws insights from analysis of those patterns, upon which users can then act. It also makes it possible to spot anomalies in the data sooner, with lower latency. Developments in both closed and open-source large language models (LLM) have improved generative AI's ability to understand natural language. The use of LLMs has the potential to help field engineers to ask questions of data and correlate problems with their possible causes more efficiently than before.

Dynamic bandwidth and path selection

Generative AI and AI/ML algorithms can be used by CSPs' networks to optimize resource usage and manage changes in network traffic in real time, by identifying bottlenecks and optimizing traffic routes. The algorithms analyze large amounts of traffic data to allocate bandwidth dynamically, enhancing network efficiency, and reducing energy costs and carbon emissions. It also ensures important and critical applications receive greater bandwidth during peak usage periods. The algorithm can also predict network congestion by analyzing historical and real-time data, allowing CSPs to act to prevent network congestion. Generative AI can help generate synthetic data to help train AI models for a variety of scenarios and make them more robust to handle problems in future.



"By harnessing synthetic data to train new network models and enable self-evolution of networks, telco systems can become adept at navigating unforeseen scenarios."

YVONNE KUIMBA
Head of AI and data at TM Forum

More granular and specific generative AI use cases to improve efficiency and effectiveness across network operations include:

1. **Translation:** Engineers within network operations centers (NOCs) are tasked with scrutinizing network data and deriving insights to inform decision-making. Generative AI can swiftly translate this data into plain language text, enhancing operator efficiency and effectiveness.
2. **Fraud resolution:** Traditional methods of fraud detection and resolution often suffer from delays, typically requiring 2–4 weeks for operators to identify and issue legal notices to perpetrators. This timeframe affords the fraudster time to abscond, leaving the network vulnerable. Integration of generative AI can speed up drafting and dispatching fraud-related documentation, allowing more expeditious legal intervention.

3. **Model training:** Generative AI demonstrates efficacy in model training through the generation of synthetic data. This synthetic data, in turn, facilitates the training and refinement of novel network models, contributing to advancements in network evolution and performance. Yvonne Kuimba, head of AI and data at TM Forum shares: ***"By harnessing synthetic data to train new network models and enable self-evolution of networks, telco systems can become adept at navigating unforeseen scenarios."***

Paul Kells at VMO2 says: ***"We plan to use Gen AI in network configuration and fault analysis, correlating and analyzing customer complaints with actual metrics on the network in the locality and providing more informed insight into where reactive and proactive maintenance is necessary."***

03 Telcos that are moving faster on autonomy are reaping clear benefits

Autonomous networks offer clear, significant benefits

Telcos with higher autonomy receive more business and operational benefits, make greater technological advancements, offer better end-customer experiences, and enjoy greater sustainability (see figure 13).

In the past two years, telcos have, on average, achieved a 20% improvement in operational efficiency and an 18% reduction in network OpEx through autonomous networks initiatives. More than half have witnessed a marked improvement in fault detection, network scalability, and flexibility, along with a notable decrease in network downtime and outages.

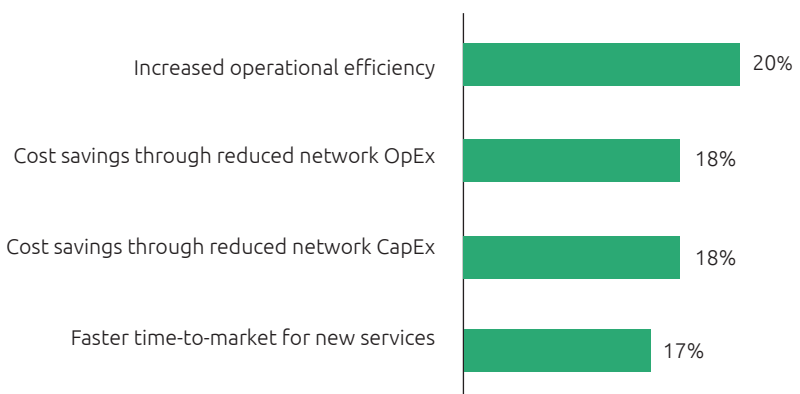
Yvonne Kuimba at TM Forum, says: ***"Better resource allocation, increased operational efficiencies, and enhanced scalability are compelling benefits of autonomous networks. Telcos are proactively rolling out new services, optimizing network resources, and prioritizing customer experience by minimizing downtime and enhancing satisfaction. Their focus is on achieving predictability and efficiency in network management, and autonomous networks play a pivotal role in realizing these objectives."*** Julia Martinez Arenas, customer experience manager at Telefónica, underscores end-customer benefits: ***"Having a personalized and real-time customer satisfaction index is key to fine-tuning some new services in 5G, such as network slicing and allows zero-touch automation to solve or mitigate any issues that may impact our customers' experience."***[8]

Highlighting the qualitative benefits, Simon Norton of Vodafone notes: ***"There are a lot of operational excellence benefits we get from automation. The mean time to resolve has decreased from many hours to just minutes. We've observed a 95% improvement in the time required, from incident detection and work order generation to dispatching the field engineer."***

Furthermore, 71% of telcos have been able to reduce significantly the energy consumption of their networks in the past two years through autonomous network initiatives. We explore this in more detail in the upcoming section on sustainability.

FIGURE 13.
Autonomous networks have yielded significant benefits

EXTENT OF BUSINESS AND OPERATIONAL BENEFITS REALIZED THROUGH AUTONOMOUS NETWORKS INITIATIVES IN THE LAST 1-2 YEARS



Type of benefit	Percent of CSPs that have realized significant improvements in these areas
Technological benefits	55% Improved scalability and flexibility in network management
	51% Improved fault detection
	48% Reduced network downtime and outages
	47% Optimized resource allocation and utilization
End-customer benefits	58% Enhanced network coverage and connectivity
	58% Improved reliability
Sustainability benefits	71% Improved energy savings

Source: Capgemini Research Institute, Autonomous Telco Networks Survey, December 2023–January 2024, N = 113 large CSPs.

The benefits of autonomous networks are expected to outweigh investment

According to our survey results, telcos expect to invest **$87 million** per organization in autonomous networks over the next five years. Our analysis suggests that network OpEx savings from autonomous networks alone amount to **$150 million–$300 million** for an average telco in our survey over this period (see table below).

For mid-sized telcos (typically with annual revenue of $11billion–$29 billion), potential OpEx savings are estimated at $300 million, and $500 million for large-sized telcos (typically over $30 billion in annual revenue). More details on these calculations are available in the appendix.

"There are a lot of operational excellence benefits we get from automation. The mean time to resolve has decreased from many hours to just minutes. We've observed a 95% improvement in the time required, from incident detection and work order generation to dispatching the field engineer."

SIMON NORTON
Head of digital networks and OSS (Europe and international networks) at Vodafone

Table 1. Analysis of OpEx savings from autonomous network use cases

A	Average investment dedicated to autonomous networks over the next five years* (survey data)	$87 million
B	Average revenue per operator *(survey data)*	$10.2 billion
C	Total telco OpEx as a share of total revenue[9]	~68.5%
D	Total telco OpEx per operator in our survey (estimated) = B * C	$7 billion
E	Network operations OpEx as a share of total OpEx[10]	17%
F	Network operations OpEx *(estimated) = D * E*	$1.2 billion
G	Total network OpEx over the next five years *(estimated)* = Sum of projected network OpEx in 2024–28	$6.7 billion
H	Telco network OpEx reduction enabled by autonomous networks in the last 1-2 years (survey data)	9%
I	Telco network OpEx reduction enabled by autonomous networks per year (optimistic scenario)	4.5%
J	Telco network OpEx reduction enabled by autonomous networks per year (conservative scenario)	2.2%
K	Corresponding network OpEx savings from autonomous network use cases over the next five years = G * I and G * J	$299 million (optimistic scenario) $150 million (conservative scenario)
L	Return on Investment *(estimated) = K/ A*	3.4x (optimistic) 1.7x (conservative)
M	Payback period *(estimated) = A / L / 5*	1.5 years (optimistic) 2.9 years (conservative)

**Investments in autonomous networks include hardware, software, services, talent, among other elements.*
Source: Capgemini Research Institute, Autonomous Telco Networks Survey, December 2023–January 2024, N = 113 large CSPs. Capgemini Research Institute analysis. OpEx growth between 2022–28 is assumed to be same as GDP growth estimates from IMF at 3% annually.

Leading telcos are significantly outperforming their peers

To gain a sense of how telcos progressing faster on their autonomous networks journey are achieving better outcomes, we classified surveyed organizations into leaders, fast-followers, and beginners, based on the following dimensions:

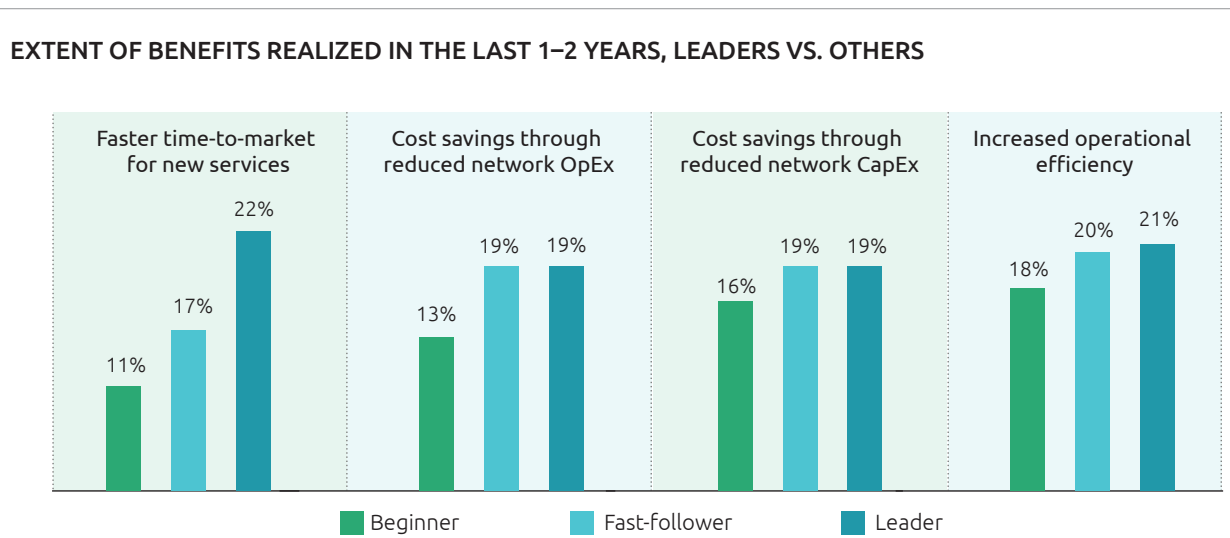
- Maturity of autonomous networks transformation strategy and roadmap
- Investments dedicated to autonomous networks transformation
- Current level of network maturity
- Stage of implementation of various autonomous networks use cases across domains

A telco that has made significant progress across all four dimensions is designated a leader. Additional information regarding this analysis can be found in the appendix.

Based on this analysis, leaders acquire significant benefits currently unavailable to beginners (see figure 14). Over the past 1–2 years, telco leaders achieved a 19% cumulative reduction in network OpEx, outpacing beginners, who managed a 13% reduction. Leaders have also demonstrated a notable improvement in time-to-market for new services, achieving a 22% cumulative enhancement – twice that of beginners, while fast-followers achieved a 17% improvement.

This outperformance could be attributed to the presence of a structured strategy, a clear roadmap for the entire journey, higher levels of network autonomy and experimentation, and scaled implementation of several use cases across network domains.

FIGURE 14.
Leaders outperform beginners in substantial benefits



Source: Capgemini Research Institute, Autonomous Telco Networks Survey, December 2023–January 2024, N = 113 large CSPs, N = 19 Leaders, N = 74 Fast-followers, and N = 20 Beginners. Capgemini Research Institute analysis.

Telcos at Level 2/3 have realized significantly larger benefits than those at Level 0/1

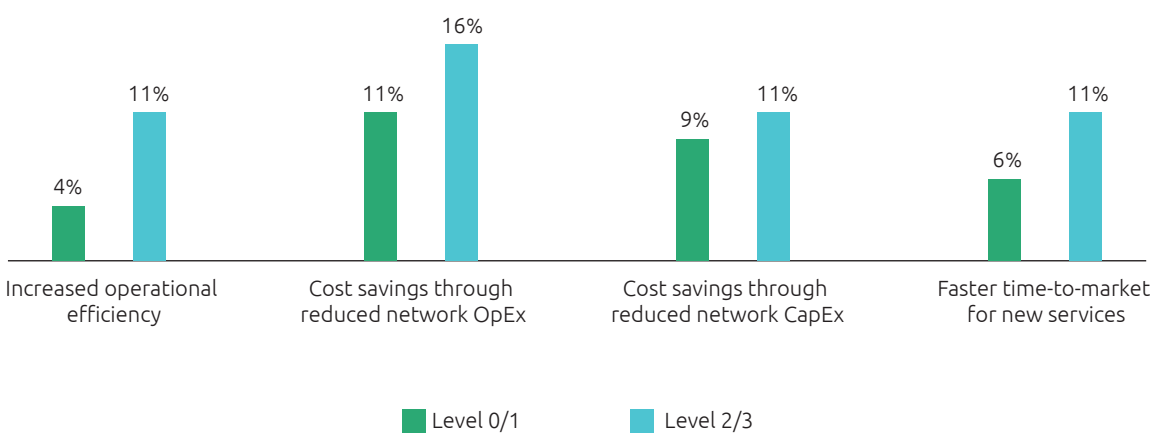
Telcos operating at Levels 2–3 have reported notable reductions in operational costs, faster time-to-market for new services, and increased overall efficiency (see figure 15). Telcos with partial or conditional autonomy (Level 2–3), utilizing data, AI capabilities, and real-time insights to enable intent-based closed-loop management in certain network domains, have achieved an 11% improvement on average in operational efficiency. Conversely, those with no or minimal autonomy (Level 0–1) have realized a modest 4% improvement on average in operational efficiency. Likewise, telcos with higher network autonomy are also saving more, with 16% reduction on average in network OpEx.

Orange's Juan Luis Mulas sums it up: ***"Implementing fully autonomous use cases has reduced the mean time to repair from hours to minutes, delivering enormous benefits to our customers."***

FIGURE 15.

Telcos at higher levels of network autonomy have realized greater cost savings and faster time-to-market for new services

EXTENT OF BENEFITS REALIZED IN THE LAST 1–2 YEARS, TELCOS AT L0/L1 VS. L2/L3



Source: Capgemini Research Institute, Autonomous Telco Networks Survey, December 2023–January 2024, N = 112 large CSPs, N = 58 at Level 0/1 overall network autonomy, N = 54 at Level 2/3 overall network autonomy. Capgemini Research Institute analysis.

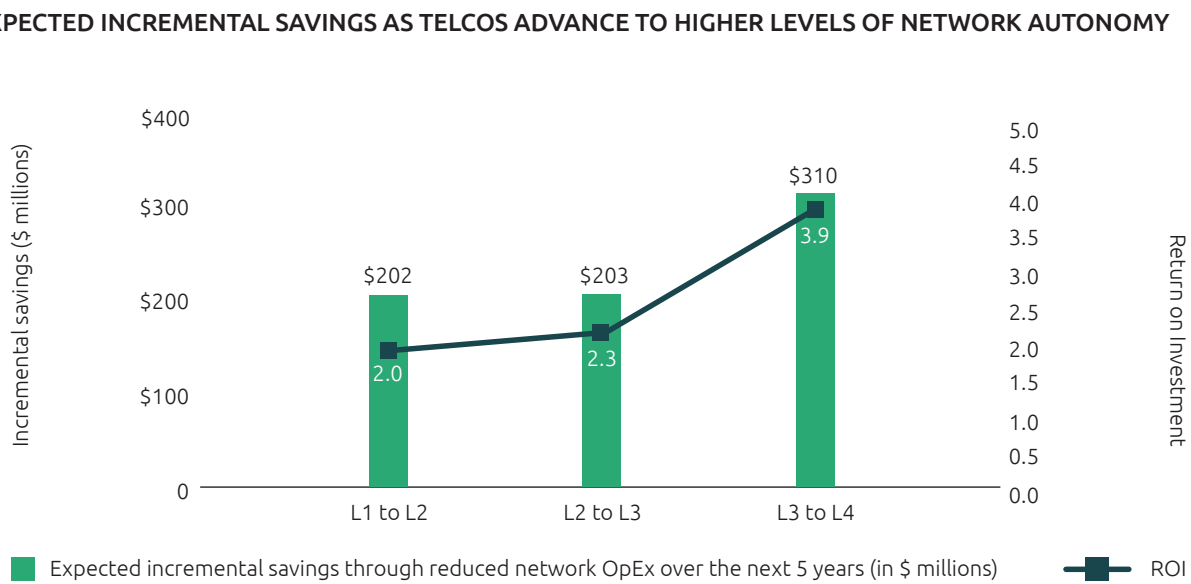
We also analyzed the potential savings from reduced network OpEx for telcos over the next 5 years as they progress each level of network autonomy. With each advancement, significant savings are anticipated at high ROI (see figure 16). Telcos planning to move from Level 1 to Level 2 within the next five years expect an average savings of about $202 million at an ROI of 2x, while those transitioning to Level 3 anticipate an additional $203 million in savings. Further progression to Level 4 is estimated to bring an additional $300 million in total savings at an ROI of 4x, revealing that gains gather speed as telcos move to Level 4.

20%

improvement on average in operational efficiency

FIGURE 16.

Telcos anticipate significant OpEx savings and ROI of 2–4x as they advance through each level



Investments in autonomous networks include hardware, software, services, talent, among other elements.
Source: Capgemini Research Institute, Autonomous Telco Networks Survey, December 2023–January 2024, N = 108 large CSPs.
Capgemini Research Institute analysis.

The sustainability benefits of autonomous networks

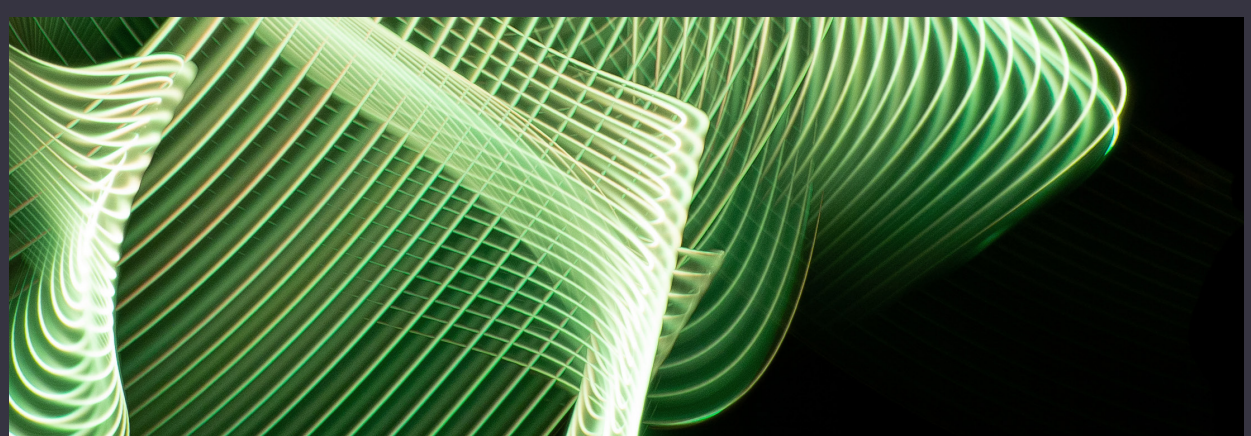
The network accounts for 90% of energy use for an operator on average and the radio access network (RAN) represents more than 80% of this.[11] Consequently, energy efficiency has become a core strategic priority across the telecom ecosystem, offering both financial and environmental advantages.

Nearly all (97%) of executives in our survey believe that embracing higher levels of autonomous networks will optimize energy usage, concurrently reducing carbon emissions within their organizations.

Telefónica Group has reduced its energy consumption by 7.2% between 2015 and 2022 even as the traffic managed by its networks increased more than seven-fold in the same period.[12] The company has reduced its overall emissions by 51% in seven years. A recent trial conducted by China Mobile yielded a saving of 475 million kWh of electricity and a reduction of 373,000 tons in carbon emissions over a 12-month period.[13]

97%

of executives believe that embracing higher levels of autonomous networks will optimize energy usage, concurrently reducing carbon emissions within their organizations



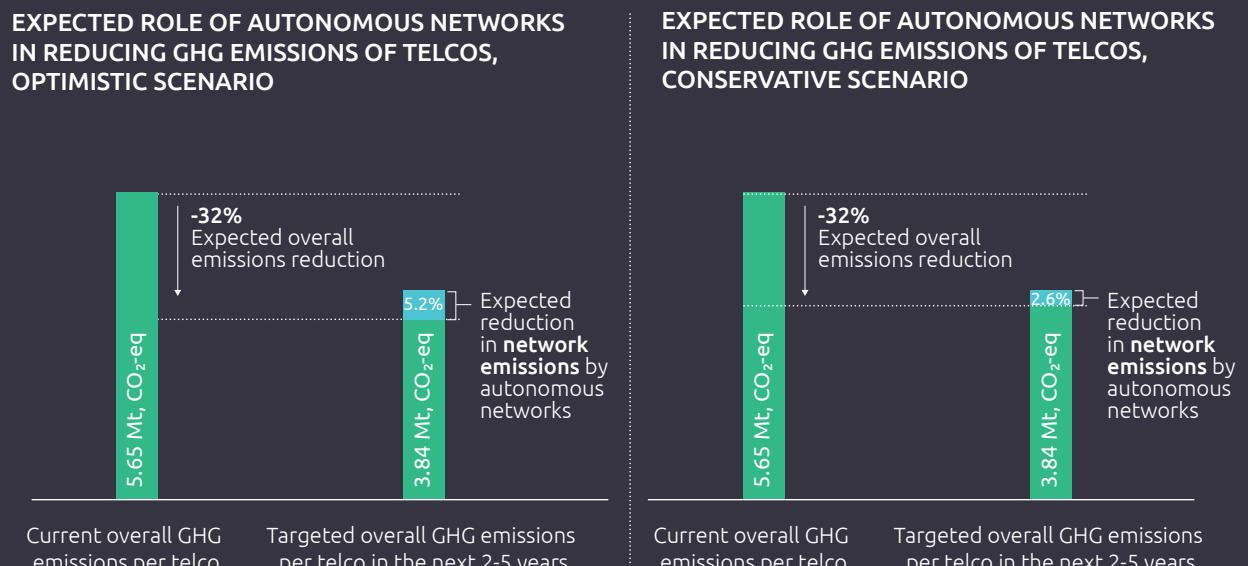
Our telco cloud study last year found that telco networks presently account for 42% of greenhouse gas (GHG) emissions of a telco's overall emissions. The telcos surveyed for this study aim to reduce their overall emissions by 32% overall within the next 5 years. Telcos project a 7.5–15% reduction in their networks' carbon emissions as they transition to higher levels of autonomous networks in conservative and optimistic scenarios respectively. Our analysis projects that autonomous networks have the potential to cut down telcos' overall emissions by 2.6–5.2% in conservative and optimistic scenarios, respectively (see figure 17).

2.6–5.2%

expected reduction in telcos' overall emissions enabled by autonomous networks

FIGURE 17.

Telcos expect up to 5% reduction in their GHG emissions through autonomous networks within the next five years



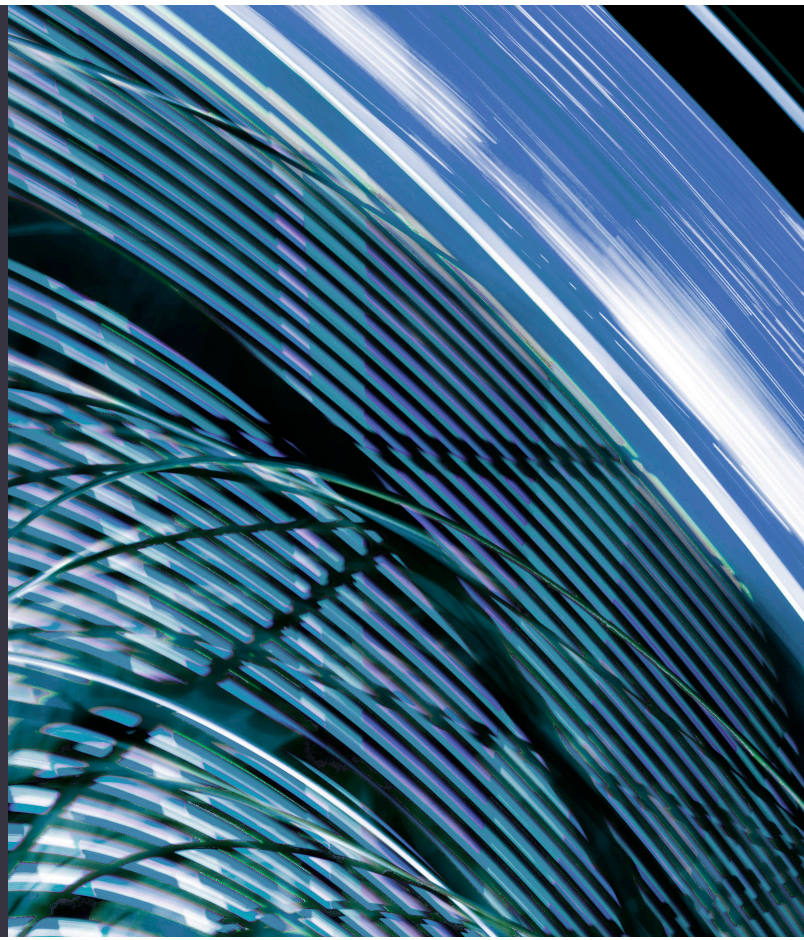
Source: Capgemini Research Institute, Autonomous Telco Networks Survey, December 2023–January 2024, N = 113 large CSPs.
Capgemini Research Institute analysis.
Refer to appendix for more details on the analysis.

Several autonomous networks use cases have the potential to improve network energy efficiency and reduce telcos' overall carbon footprint, without compromising customer experience, such as:

- AI-enabled energy savings in RAN, core, and data centers
- Predictive analytics and maintenance for network devices and infrastructure
- Helping enterprise customers cut down Scope 1 carbon emissions

Simon Norton of Vodafone adds: ***"With AI/ML and automation, we can dynamically optimize energy usage during low-traffic hours without compromising customer satisfaction. By analyzing performance data and considering geographical factors, we can precisely adjust energy-saving features on our sites, potentially doubling energy savings."***

Mabel Pous-Fenollar of Vodafone further emphasizes: ***"Automation plays a pivotal role in our sustainability efforts. Our focus extends beyond energy to support customers worldwide. Autonomous networks are crucial for advancing sustainability, addressing both industry and global challenges, particularly in the face of climate change. The frequency of incidents, such as floods and fires, has significantly increased***

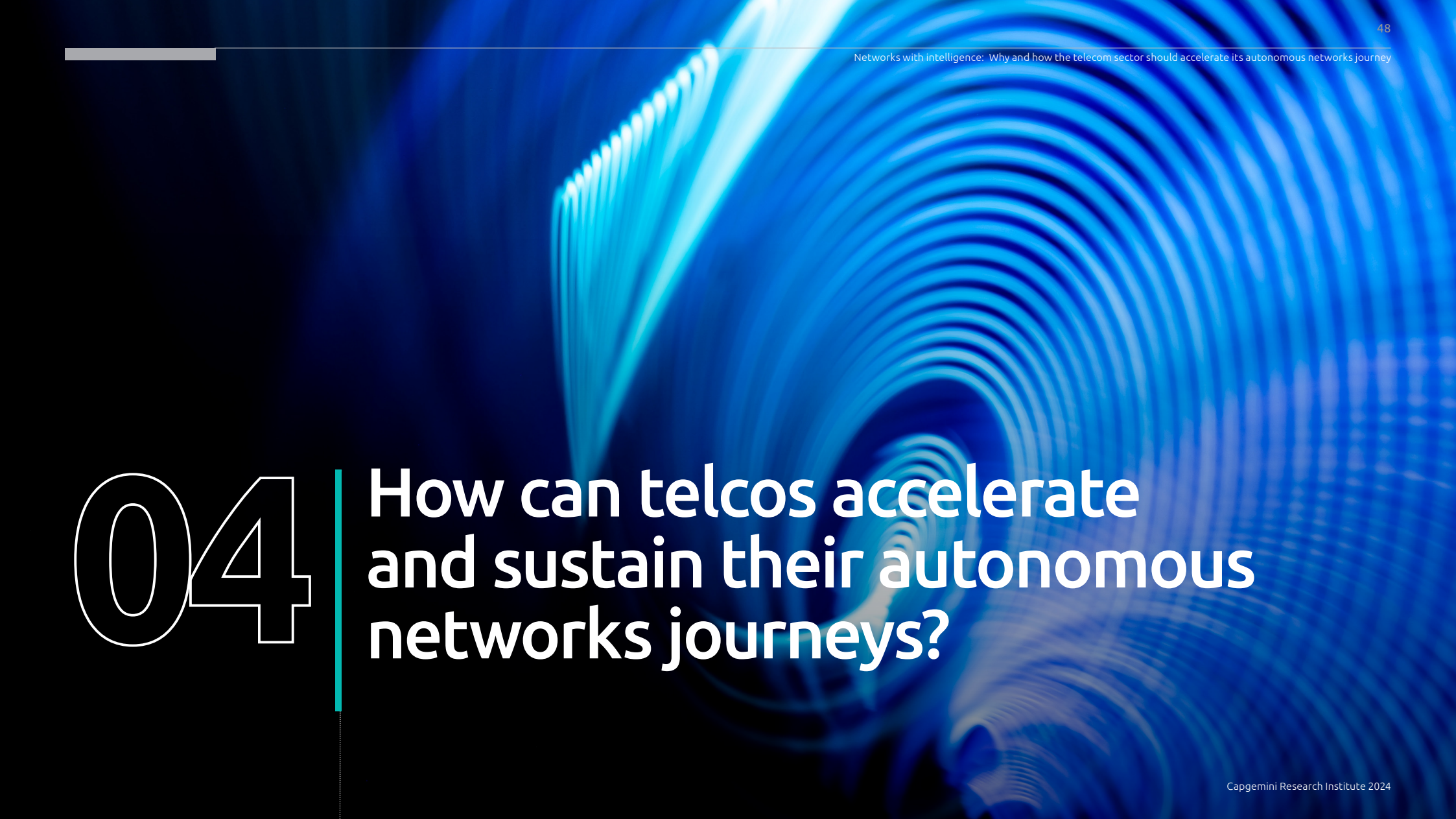


due to climate change. Our vision for autonomous networks, combined with weather data, positively impacts not only energy but also on a broader scale concerning the planet."

Only 5% of organizations currently involve sustainability experts in teams committed to advancing their autonomous networks, while about 15% recognize a gap in expertise. Bridging this talent gap would also be essential for realizing the full potential of autonomous networks in terms of fast-tracking telcos' environmental sustainability.

"With AI/ML and automation, we can dynamically optimize energy usage during low-traffic hours without compromising customer satisfaction. By analyzing performance data and considering geographical factors, we can precisely adjust energy-saving features on our sites, potentially doubling energy savings."

SIMON NORTON
Head of digital networks & OSS (Europe & international networks) at Vodafone



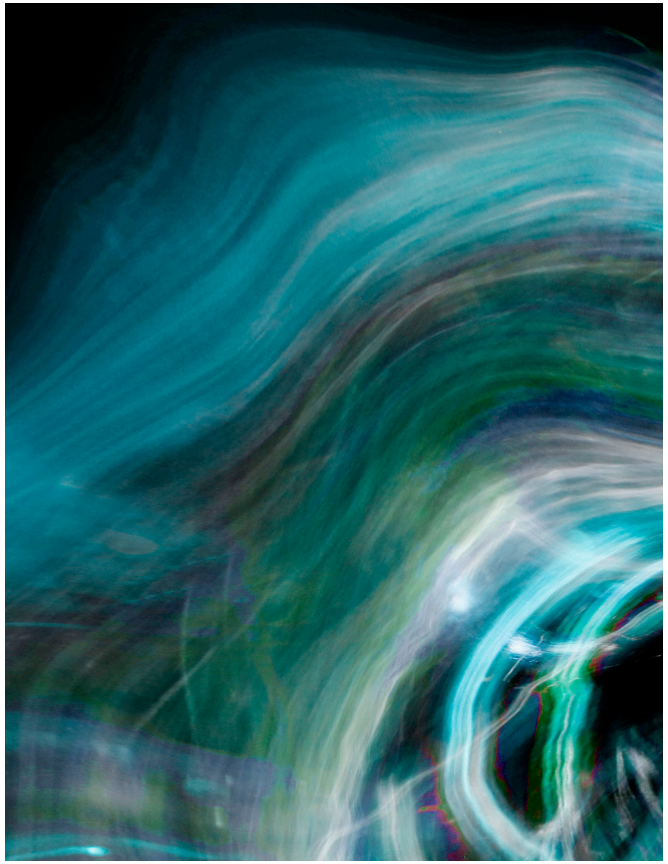
04 How can telcos accelerate and sustain their autonomous networks journeys?

Devising a strategy and roadmap for the autonomous networks journey

As we saw previously, only about one in five organizations (17%) has a comprehensive autonomous networks strategy in place. We also find that having a robust strategy and roadmap is a key differentiator, allowing those in possession to reap the highest rewards of this transformation. It can also serve as a key enabler to scale and sustain the transformation through its entire journey.

17%

of telcos have a comprehensive autonomous networks strategy in place



Elaborating on their autonomous networks strategy and its origins, Juan Manuel Caro, director of autonomous networks at Telefónica said, ***"Though our strategy for autonomous networks started with operations a few years ago, we soon realized that the opportunity and challenges are much bigger than operations and span the entire technical organization. That's when we decided to make it a company-wide slogan to give it a broader reach than pure automation in operations."***

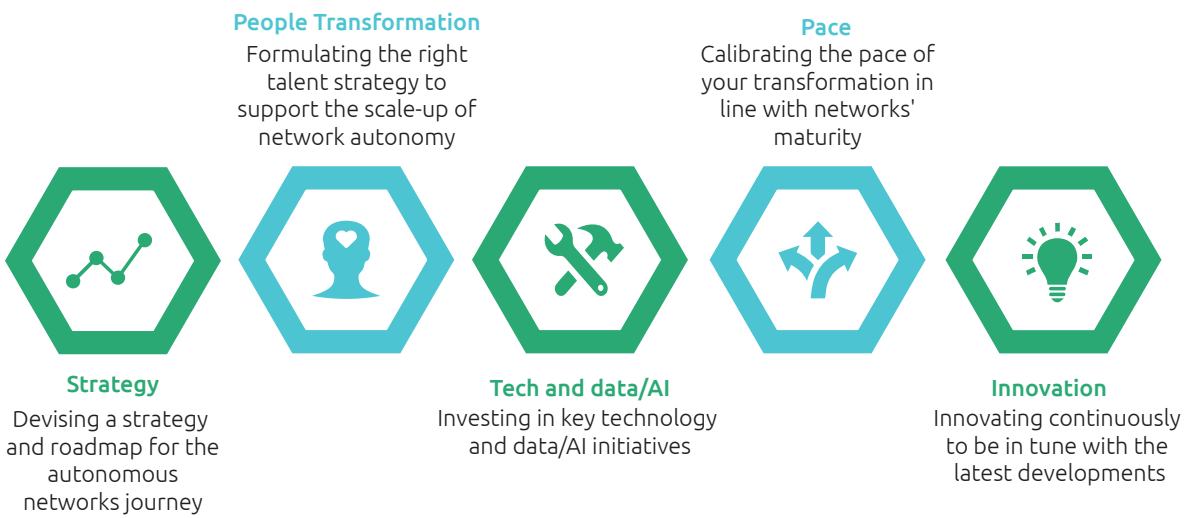
Leading telcos prioritize a comprehensive strategy involving most or all of the following elements (see figure 18):

- **Strategy and roadmap:** A comprehensive strategy backed by business case, and internal as well as external collaboration.
- **People:** Reskilling and upskilling the workforce to adapt their ways of working with a higher degree of automation, sometimes in closed-loop environments. Also deals with changing mindset and culture to be more open to delegating control of networks to software and cloud.
- **Technology:** Including virtualization and cloudification of networks and having the infrastructure for data collection, analysis, and AI.

- **Pace of transformation:** Including identifying and selecting use cases that make the most sense from a network-maturity perspective.
- **Innovation:** Embracing continuous innovation, including the latest technologies, such as generative AI and OpenRAN.

We will explore each of these areas in greater details after we delve into how telco leaders develop a robust autonomous networks strategy.

FIGURE 18.
Key elements of a robust autonomous networks strategy



Source: Capgemini Research Institute analysis.

Establishing the business case backing the investment

Securing financing for an initiative such as autonomous networks is a key part of a robust strategy. Some organizations make a global/group-level financial commitment. However, to sustain such a transformation, it is critical that telcos identify areas that can deliver value in the short as well as the longer term. It not only justifies the initial investment but pays for itself over the journey, while also generating associated business benefits.

Juan Manuel Caro explains how Telefónica justifies investment in autonomous networks: ***"Fundamentally, we're investing in upgrading our network with next-generation technologies and preparing it for new customers and services. It's a key enabler for our business and customer experience and does not require a short-term pay back. Nevertheless, we are getting efficiencies from automation and autonomy that allow us to deliver our services faster, better, and cheaper. And, going forward, it will enable the monetization of new services and the massification of network APIs (application programming interfaces)."***

It is also a tendency in the sector to tie in investments like these with large technology refresh cycles that happen every five years or so. However, it need not be done this way. As we saw in section 3, the level of investment necessary for autonomous networks is not very high (~1% of annual revenue over five years on average per organization). The high ROI from autonomous networks initiatives (1.4–2.7x) is likely to be recouped within five years. The group chief technology officer at a large French multinational telecom company shares how low CapEx requirement of this transformation helps them move faster: ***"The CapEx required for autonomous networks is very small compared with overall network CapEx. This is why we encourage all our countries to make those investments."***

"A program like this demands investment from a strategic perspective. Once that's done, a few use cases can provide cost savings that can be ploughed back in as investments. For instance, in use cases that we're executing, there are significant CapEx savings."

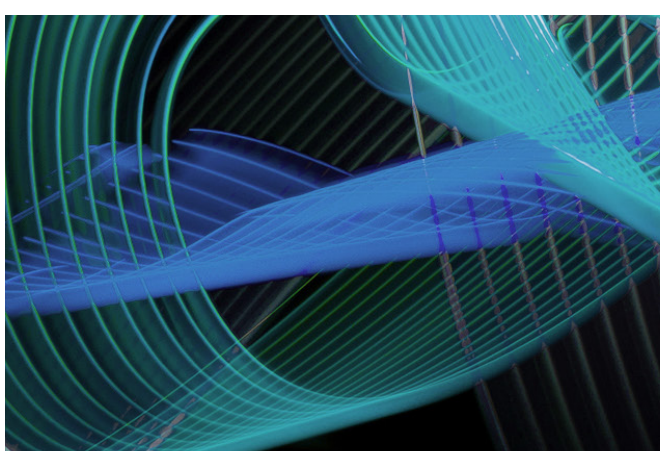
JUAN LUIS MULAS
Head of telco cloud, OSS & automation engineering at Orange Spain

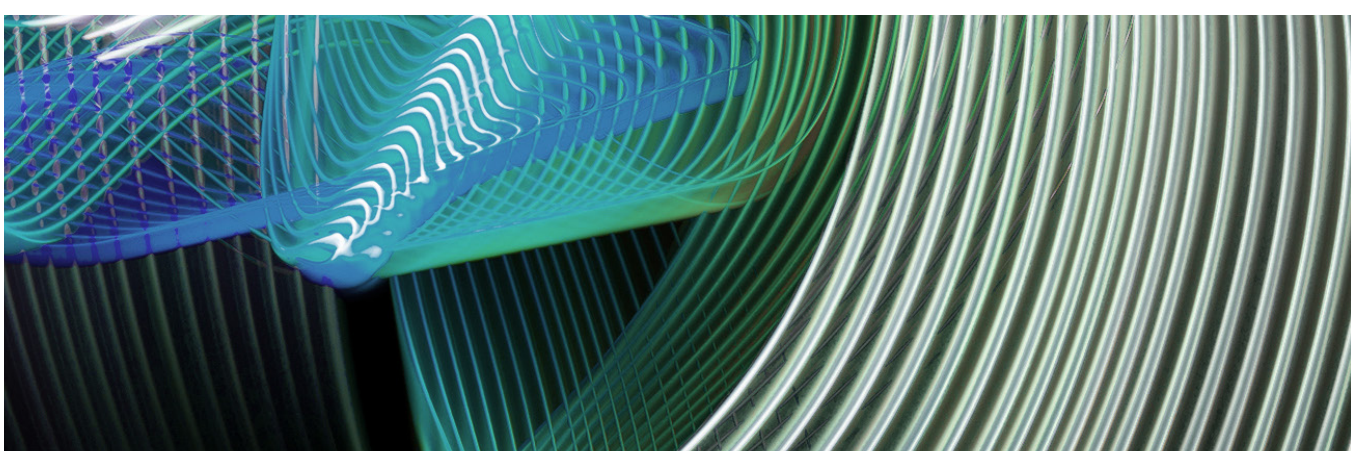
Often, the business case stems from selected use cases. Some telcos find it better to execute proof-of-value experiments on a set of use cases, derive benefits, and use those findings to make a case for further investment in autonomous networks. Juan Luis Mulas at Orange Spain explains such an approach: ***"A program like this demands investment from a strategic perspective. Once that's done, a few use cases can provide cost savings that can be ploughed back in as investments. For instance, in use cases that we're executing, there are significant CapEx savings."***

Growing and collaborating as an ecosystem

All players in telecoms ecosystems recognize the need for sectorial transformation. Orange, for instance, engages with TM Forum and open-source initiatives such as CAMARA from GSMA and the Linux Foundation. Apart from Orange, 24 other major operators are also part of the GSMA global initiative. Through open network APIs, operators enable an ecosystem of developers to contribute to building network capabilities, share learnings, and progress faster together.[14]

The need for greater reliability and faster time-to-market for services are the top technological and business drivers, respectively, for transitioning to autonomous networks. To deliver on these objectives while accommodating the rising complexity of the network and the burden of legacy equipment, telcos will need the support of ecosystem players. As figure 19 shows, the majority of telcos (60%) prefer to lead the transformation of the network core themselves, but are much more open to their partners' leading the transformation of other domains – hyperscalers in transport (53%) and hyperscalers (43%), and software vendors (49%) in services.





Our survey found that 38% of telcos consider data sovereignty concerns and 32% consider data protection regulations such as GDPR to be a barrier for their organization in moving to higher levels of autonomous networks. However, leaders seem to have already found ways to make progress in compliance with regulations as much fewer of them perceive these challenges (16% and 26%) vis-à-vis beginners (40% and 55%, respectively).

As such, it becomes all the more important for telcos and their partners in the industry to closely work with government, policy institutions, and standards development organizations to ensure that regulation serves as a catalyst for the growth of the industry, not as a hurdle.

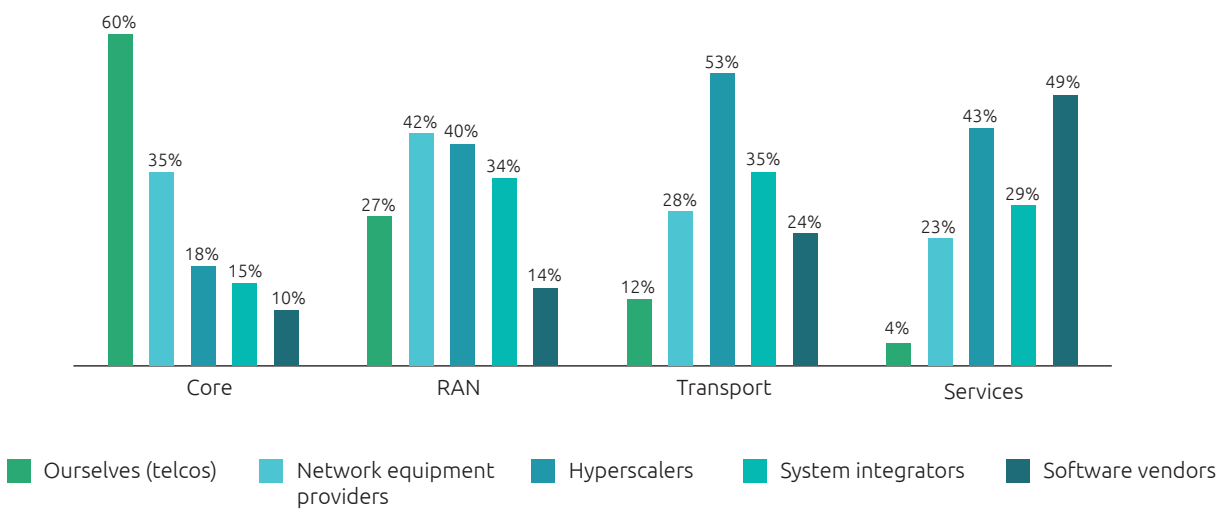
53%

of telcos are open to hyperscalers' leading the transformation of transport network

FIGURE 19.

Telcos' preferences for leading partners for autonomous networks transformation

% OF TELCOS THAT PREFER A PLAYER AS A LEAD PARTNER FOR AUTONOMOUS NETWORKS TRANSFORMATION



Source: Capgemini Research Institute, Autonomous Telco Networks Survey, December 2023–January 2024, N = 113 large CSPs.

"Telcos and CSPs are evolving their legacy equipment and closed systems towards an open, disaggregated system. Network providers need to bridge the fiber optic network to other layers while enabling simple plug and play capability. This allows CSPs to get alarm correlation, even from equipment that comes from different vendors. It helps them maintain the status quo for the next-generation tech cycle and save precious CapEx."

AARON CHASE
Senior director, network architecture strategy at Infinera

Aaron Chase, senior director, network architecture strategy at Infinera, speaks about helping telcos overcome the interoperability challenge: ***"Telcos and CSPs are evolving their legacy equipment and closed systems towards an open, disaggregated system. Additionally, separate domain controllers for each layer of networks that have never talked to each other before now need to. Network providers need to bridge the fiber optic network to other layers while enabling simple plug and play capability. This allows CSPs to get alarm correlation, even from equipment that comes from different vendors. It helps them maintain the status quo for the next-generation tech cycle and save precious CapEx."***

Building a global/group-level strategy with strong governance at global and local levels

For global telcos, a key challenge to overcome is connecting global/group-level strategy with local strategies and initiatives at operating companies (OpCos) or country-level operators. Juan Manuel Caro told us about the strong governance model Telefónica has set up: ***"For each operating business, we have a program structure with a local leader and a group-level sponsor. The program comprises nine projects across all major areas and countries covered in the autonomous networks program. Every year, in Q1, we sync KPIs at both levels and commit our objectives to the Executive Committee together. Thereafter, we report our progress every three months for each of the projects."*** He adds, ***"This robust governance has taken some time to establish, but it has been worth it, as it has created a common language and a shared sense of purpose across various internal teams."***

Formulating the right talent strategy to support the scale-up of network autonomy

Bridging the skills gap in areas such as AI and multi-disciplinary skills

A recent European Commission study showed that information and communication technologies (ICT) is one of the top three sectors in terms of new job vacancies, seeing a sharp rise of 4.1% in 2022.[15] The transformation to autonomous networks requires a step change in terms of how telco workforces manipulate and use data. This

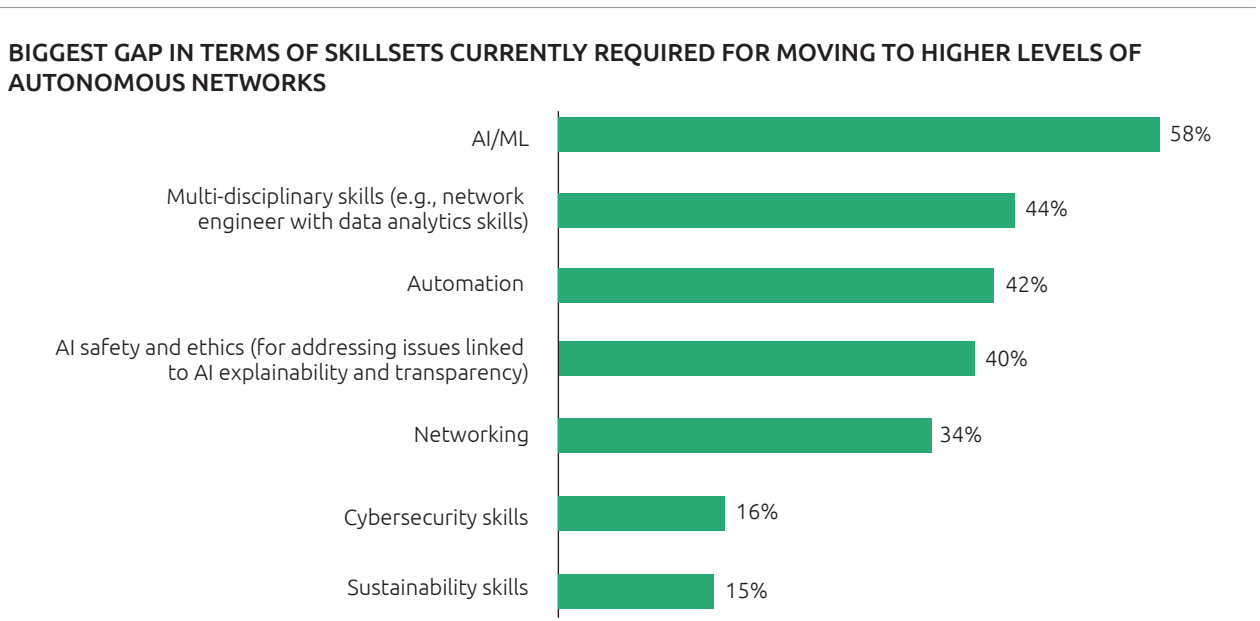
change will require AI, ML, and data analytics skills at an unprecedented level. Nearly 3 in 5 telcos see the greatest skills shortage lying in AI and ML (58%). Telcos will require new strategies to acquire and retain data and AI experts.

The second-largest skills gap is in multi-disciplinary or cross-domain/transversal skills. This area requires individuals to possess a combination of skills to a high level, for instance, a network engineer with data analytics skills or a data expert with network domain knowledge. This is a tough ask, as these skills have historically been developed in specialized silos.

During the implementation of autonomous networks, planners should consider both future and current demand. During the initial phases of the journey, more data/AI and automation-related skills are required, whereas, during the advanced, more extensively automated stages of the journey, monitoring, problem-solving, and decision-making skills will be more heavily in demand.

FIGURE 20.

AI/ML and multi-disciplinary skills show the biggest gaps for autonomous networks transformation



Source: Capgemini Research Institute, Autonomous Telco Networks Survey, December 2023–January 2024, N = 335 telco executives.

Upskilling and reskilling of the workforce

Telcos are faced with the dual challenge of retaining the knowledge and experience of resigning or retiring staff, while also attracting and retaining new workers.

Moving internal systems and processes to higher levels of network autonomy allows manual tasks (and those beyond manual capabilities) to be automated. Survey data shows that there is potential to automate an estimated one-third (30%) of work traditionally done by in-house network engineers/ architects and administrators. Our survey also finds that over one-quarter of these workers (27%) must be reskilled to allow them to work with newer technologies and processes and undertake more value-adding jobs. AT&T invests more than $200 million annually in its internal training organization, branded as AT&T University. In addition, the company also teams up with universities and online-learning platforms.[16]

Preparing your organization for a mindset and culture change

Transformation calls for steadily relinquishing a level of control over the network to software and decision-making systems, such as AI and ML models. As a result, it involves reorganization and reimagining of systems, processes, and tools, from manual or semi-autonomous ways of working to software-led or fully autonomous processes. To be fully effective, an upheaval of deep-rooted practices and processes requires a mindset change among the workforce.

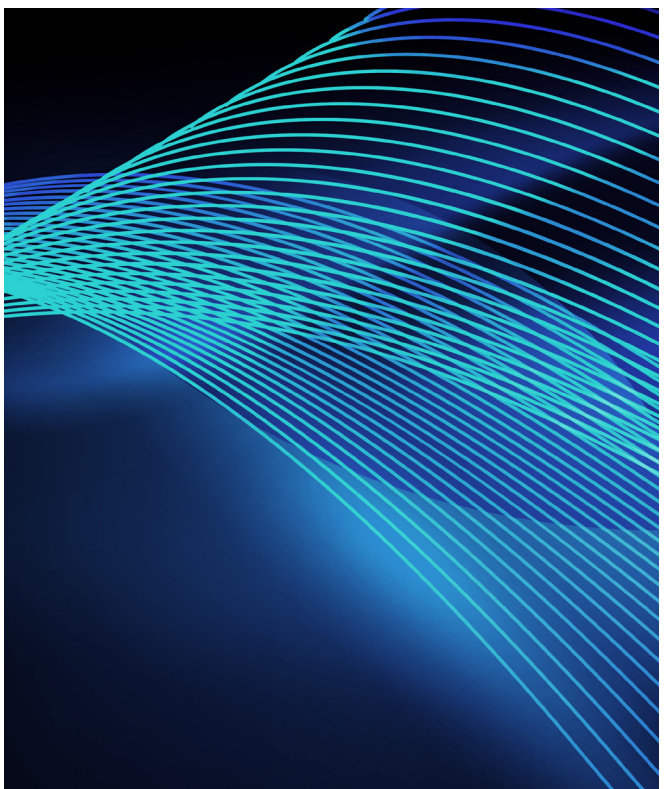
As we saw in section 2, our survey found that the cultural challenge (i.e., changing the employee mindset) stands as the single biggest barrier (51%) to telcos' moving to higher levels of autonomy. Further analysis shows that fewer organizations who have advanced on their journeys and developed a roadmap consider this a challenge (43%) compared with those who are yet to build a roadmap for their transformation (63%).

Juan Luis Mulas of Orange Spain concurs: ***"Changing people's mindset has been the most challenging aspect of this journey so far. Having a strong leadership and vision has helped rally people around this program. Identifying appropriate trainings and customizing learning journeys depending on individual needs have helped as well."***

A cultural divide also exists between operations teams, whose key priority is to optimize network operations and customer experience, and the data and AI team, and innovation professionals entrusted with implementing autonomous functionalities. Mabel Pous-Fenollar of Vodafone shares her strategy for overcoming this challenge: ***"It is critical that we bring all stakeholders along on this journey. We need supporters, but we also need everyone who is impacted by the transformation, whether they support it or not. A way to gain detractors' support is to demonstrate the benefits to them on a smaller scale, winning their trust, and allowing them to test and ask questions. There's no better way to organizational change than to win over detractors."***

Investing in key technology and data/AI initiatives

Technology integration issues (48%), lack of maturity of AI and ML for networks (32%), and lack of standards (21%) are the top three technological barriers to moving to higher levels of autonomy. To ensure that there are no roadblocks from a technological perspective, telcos will need to



make strategic investments in key technology and data/AI initiatives, such as:

Taking stock of current and future data landscapes

Often telcos lack an end-to-end view of their data landscape. Large organizations typically prioritize data-related investments in customer-facing domains, leaving operations and back-end technology on the back burner. This obstructs the required extraction and distribution of data. For instance, lack of availability of a real-time data-collection, analysis, and feedback loop severely limits use cases such as outage and threat detection, and dynamic policy management.

The head of AI at a large Australian telco says: ***"From a data landscape perspective, mobile networks are fairly software-driven and have a simpler path to value. Fixed networks, in contrast, carry a lot of legacy that makes it harder to pull data, clean it, and use it in models."*** He adds: ***"Due to the complexity of KPIs, devices, exchanges, and so on, one of the biggest learnings in recent years has been that, instead of deploying a use case in one of the domains (such as in mobile or fixed domains), it is better to break down the data landscape into logical segments, solve for a use case such as anomaly detection in individual segments, and then scale those up."***

AIS, one of Thailand's top mobile operators, uses AI-enabled network digital maps to increase the efficiency of its IP-RAN network planning.[17] It has automated collection and visualization of near-real-time data, including inventory, fault alarms, and linking KPIs, among others. It also highlights anomalies such as link outages and high latency, making network planning, as well as assurance, very effective. As a result, the fault-identification timeframe has reduced to less than one hour and the time-to-market for new services has reduced by 60%.

Mabel Pous-Fenollar of Vodafone shares an example of how better data visibility can lead to better outcomes: ***"The crucial nature of visibility and availability of good-quality anonymized, aggregated data cannot be overstated. In countries where we have a mature data landscape, for instance, for inventory data, it has allowed us to go beyond simple service automation to predicting and preventing equipment and service failures."***

Advancing network automation as part of telco cloud transformation

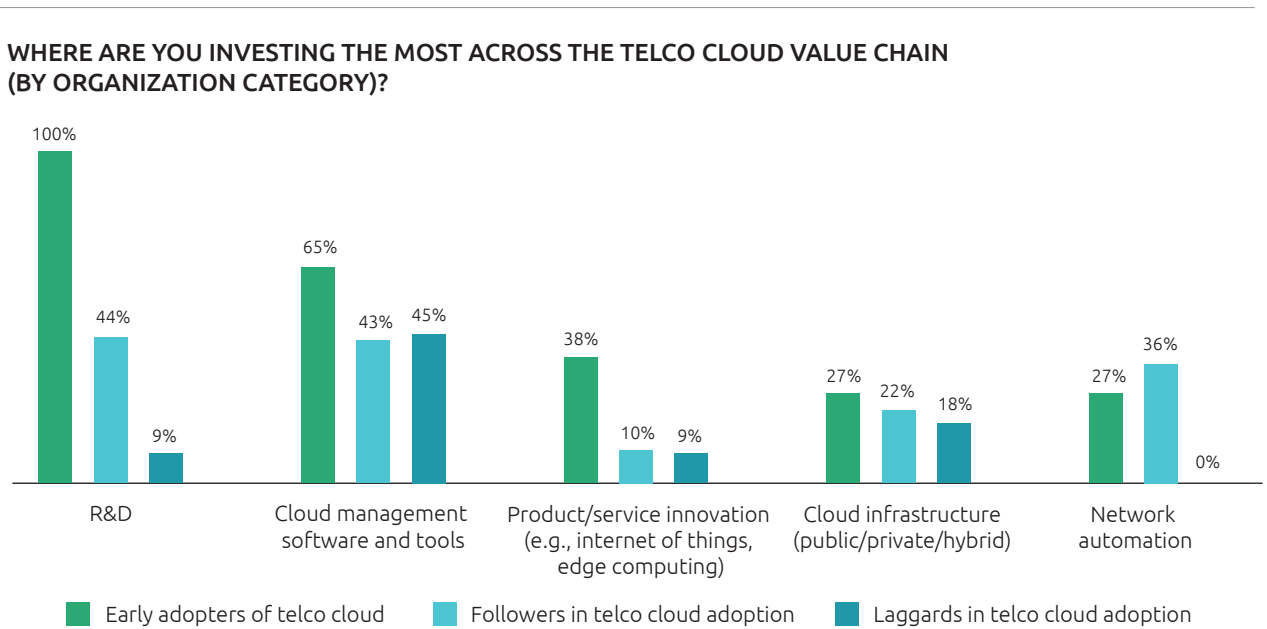
Telco cloud transformation is one of the key levers of autonomous networks. The virtualization and containerization of network functions enables faster rollout of network functions, automation, and services to end-customers. Our 2022 research on telco cloud transformation found that nearly half of telco network capacity will be cloud-native in the next 3–5 years. Yet, network automation is a low investment priority for telcos. As figure 21 shows, among top investment areas in the telco cloud value chain, network automation stands lowest, with only 27% of early adopters of telco cloud prioritizing it.

27%

of early adopters of telco cloud prioritize investment in network automation

FIGURE 21.

Network automation stands at the lower end of telco cloud investment priorities



Source: Capgemini Research Institute, Telco Cloud Executive Survey, November-December 2022, N=114 telco executives.
Percentages represent the share of executives selecting top three areas of investment across their telco cloud value chain.

Establishing robust data governance and data frameworks for effective data management and processing

A key pillar of the technology strategy for autonomous networks is the governance and management of data. Data governance sets standards and policies for how data is collected, stored, and analyzed in an organization. It is important that these policies observe the latest data security, privacy, and ethical guidelines before any data source is employed in an autonomous network use case.

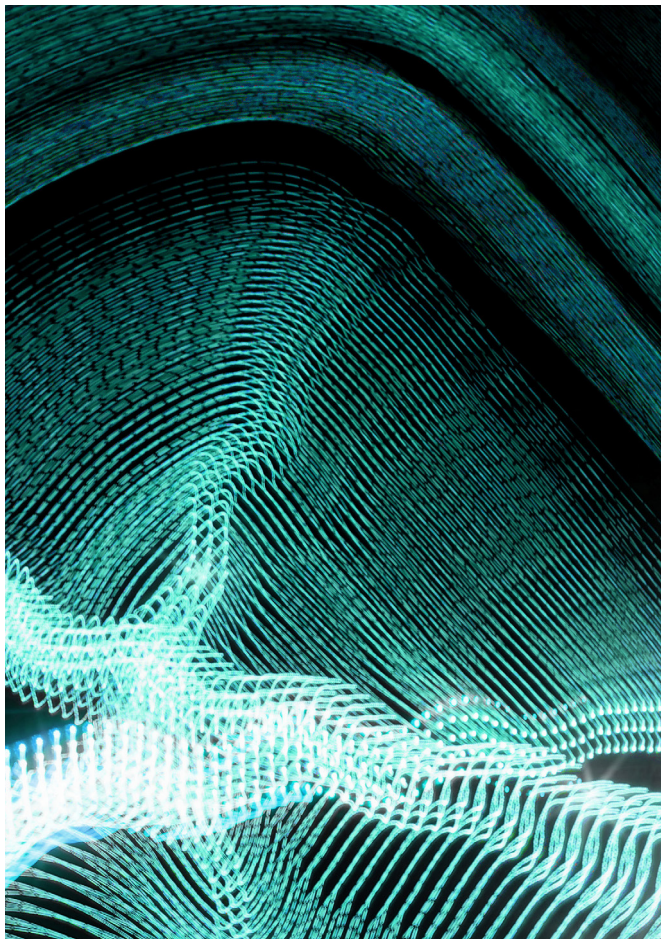
The ever-increasing complexity of telecom networks makes it a challenging endeavor to collect data generated from a variety of network equipment, often through different protocols and standards, and then using it effectively to derive insights. Due to the proprietary nature of network equipment, the applications and services that are bundled with them often produce data that is not interoperable and translatable across devices and domains. This leads to a highly fragmented and siloed data landscape that not only hinders use case implementation but also makes some autonomous networks use cases practically infeasible. The network transformation lead at a large, American multinational telecom company says: ***"Getting to Level 4 automation requires a solid foundation in real-time data analytics. Streaming analytics is a complex terrain, and it's not just about collecting data but also swiftly analyzing it, and taking remedial actions with strong decision support systems powered by AI. The challenge lies not just in technology but in ensuring interoperability across diverse devices and ecosystems."***

To overcome these challenges, telcos must put in place data frameworks that help with aggregating, normalizing, and correlating heterogeneous network data. A data framework like this makes network data more open, accessible, documented, and trusted, serving as the foundation of further processing. It opens doors to making this data available for ready consumption by services or machine learning and AI-based models that can be built on top of this framework. Further, MLOps/AIOps tools can be introduced to efficiently develop these models and manage their lifecycle.

Beatriz Ortega, telco business development manager at Red Hat, talks about the importance of an end-to-end view of data: ***"Telcos have a goldmine of data sitting across various systems. However, when it comes to having the data ready for one use case, it's almost always a challenge. Often,***

"Telcos have a goldmine of data sitting across various systems. Often, data is not interoperable, not of acceptable quality, or not available in real time for enabling real-time and near-real-time use cases. So, this is a key challenge that we try to solve by bringing in a network of partners that can bring together the right data, in the right place, at the right time."

BEATRIZ ORTEGA
Telco business development manager at Red Hat



data is not interoperable, not of acceptable quality, or not available in real time for enabling real-time and near-real-time use cases." She adds: ***"So, this is a key challenge that we try to solve by bringing in a network of partners that can bring together the right data, in the right place, at the right time."***

Telefónica Brazil streamlined the integration, configuration, and provisioning of its network transport and mobile access layers, saving close to 6,000 workdays, reducing network alarms by 25%, and reducing rework by 30%.[18] This was made possible by centralization of data from all key areas and customizing access to it.

Calibrate the pace of your transformation depending on the maturity of autonomous networks

To begin, telcos must select which network domain and use cases to prioritize for transformation

Telcos at the beginning of their autonomous networks journeys should prioritize one or two network domains among core, transport, access, or operations. Once the choice of domain is clear, several factors need to be considered:

- The level of risk that the organization is willing to take during experimentation and scaling (if selected use cases pose a risk to end-users/consumers, a network change going wrong can shut down connectivity, negatively impacting customer experience)
- The difficulty level of implementation
- The required level of investment
- The level of software-based network functions

- Availability of good-quality network data
- Availability of domain experts

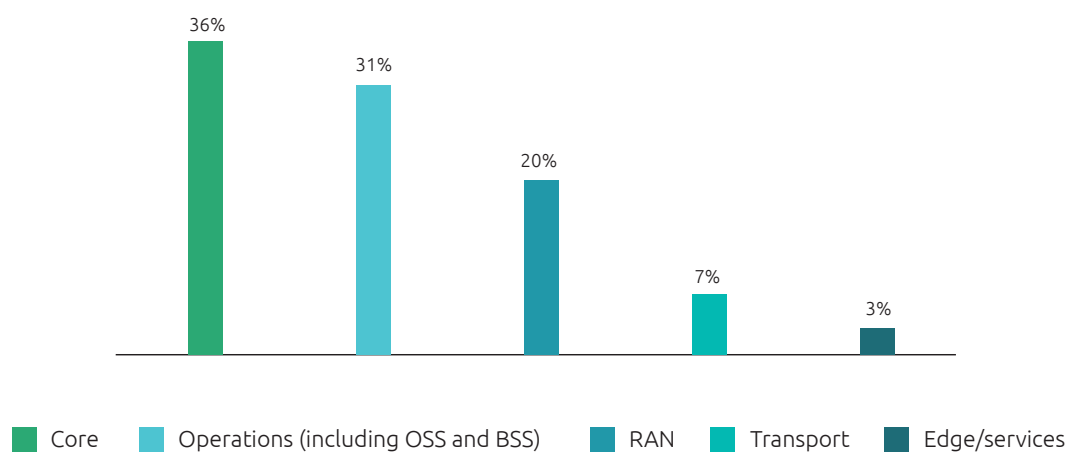
Figure 22 shows network domains that are the top priority for transitioning to autonomous networks. Juan Manuel Caro told us Telefónica's priorities for its transformation: ***"We're fairly advanced in terms of autonomous use cases for transport, followed by RAN. And Assurance is by far the process where we have advanced more until now. For Core, we have just implemented the first AI closed-loop use case, although we are being cautious with the level of autonomy there. It is important to gain trust before going farther due to the high impact of any potential problem of this domain."***

The network director at a UK-based telco echoes this sentiment: ***"RAN takes precedence due to frequent incidents. With numerous data centers and thousands of base stations, there's a significant opportunity for workload reduction. In critical areas like data and voice in the core, operators maintain a conservative approach due to higher risks. Mistakes in the core can impact a substantial portion of the network, a risk many avoid. This cautious approach is common among many European operators. The focus on RAN is driven by lower risk and greater automation opportunities, resulting in significant savings."***

FIGURE 22.

Operations and core are top-priority domains for autonomous networks

TOP PRIORITY FOR TRANSITIONING TO AUTONOMOUS NETWORKS, BY NETWORK DOMAIN



Source: Capgemini Research Institute, Autonomous Telco Networks Survey, December 2023–January 2024, N = 113 large CSPs.

The selection of use cases for beginner telcos can be low-hanging fruit: low-risk, high-benefit use cases to explore potential and prove value on a small scale. An agile test-and-learn strategy is crucial here, so that engineers can trial multiple approaches. Once there is sufficient confidence in technology and partners, the most successful can be scaled up to larger levels, across layers, domains, and cities/countries.

Telcos midway through their autonomous networks journeys must double down on their investment and focus on scaling

Telcos midway through their transformation journey have already proven value in some of the use cases and possibly partially scaled some of them. Given their relative success to date, it makes sense to redouble their investments and efforts on top use cases. They can do this by breaking silos across domains and optimizing resource allocation among them, scaling tech hardware and software, and making these available across regions and domains. Tools should be made available across the organization, and best practices identified and implemented across functions, among other such scaling initiatives.

"Our team invests in developing digital twins of physical networks. Creating a virtual replica of the network enables us to optimize network design, enhance diagnosis, and conduct simulation and what-if analysis. It also allows us to simulate and train AI/ML algorithms and explore optimization scenarios to validate network implementation without the risk of impacting end user experience. The network digital twins will play a crucial role in telcos' transition to more complex networks, with more sites/sectors, frequency and technology enabling the network to increase autonomy."

HAN CHEW
APAC head of network planning and optimization at Nokia

The group chief technology officer at a large French multinational telecom company told us about an initiative that's paying dividends for the company: ***"We have a 'Telco Cloud Factory' that is a platform on which to build and deliver telco cloud instances for different countries and then operate them. We have delivered 40 instances to date across the group and plan to scale this to 60."***

He adds: ***"On top of this layer, we have created a 'Network Integration Factory' and a tooling zone that oversees onboarding and testing of each network function before they are put into production. Once a country has successfully deployed network functions on cloud, an image of the environment and test plans are shared with other countries, which can customize and deploy functions in their specific environments. This reduces a significant amount of process and tech overhead, leading to efficiencies."***

Virgin Media O2 is working to advance its autonomous networks journey by progressively defining and implementing "one use case at a time," using data, analytics, and AI.[19] Reflecting on the development, Paul Kells at VMO2, remarks: ***"Most of the use cases are presently at Level 2, and we are scaling up. In the past six months, we've executed around 20 material use cases, each yielding material benefits. The key is strong governance coupled with robust change management. This ensures a smooth transition and guards against reverting to old operational methods after the initial disruptive phase."***

Embrace continuous innovation in network architecture and operations

Advance initiatives to adopt open, disaggregated, and software-driven networks

Pursuing open and disaggregated networks throws the door open to innovative use cases – some of them on autonomous networks have the potential to be big value drivers for telcos. It also paves the way for innovative services that are more in-tune with the network's behavior – called network-aware apps/services.

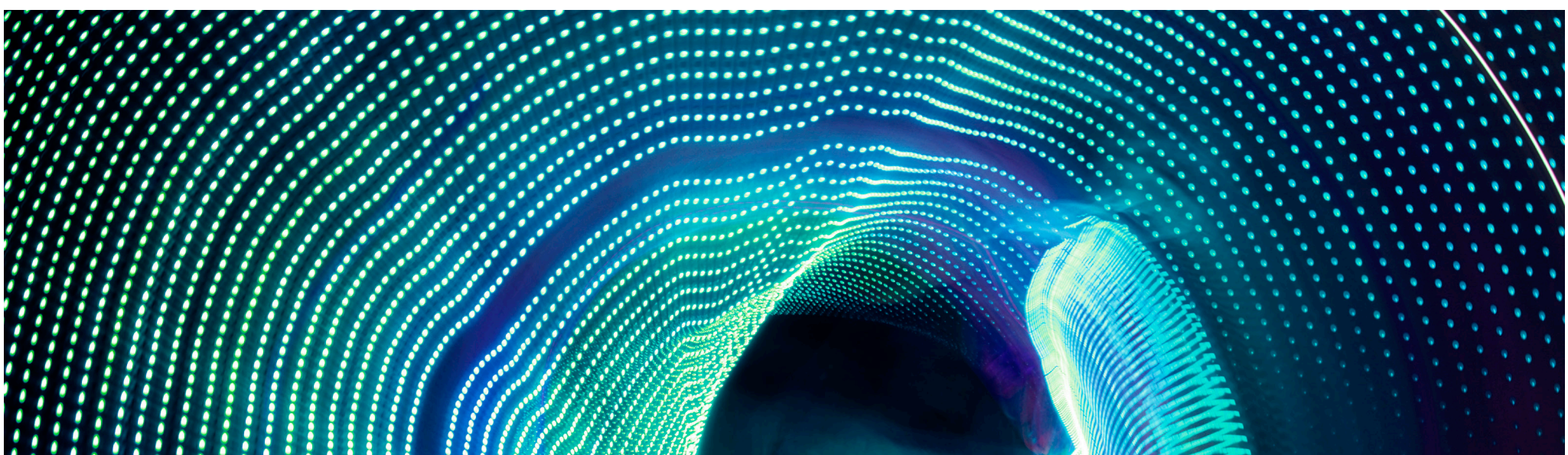
OpenRAN – technology that introduces a set of open standards for radio access network (RAN) hardware and software – is one of telco industry's key initiatives to decouple RAN hardware and software and reduce dependence on proprietary equipment. The disaggregation of network hardware and software that OpenRAN enables, removes the

need to procure them from a small set of suppliers, boosting vendor diversity, and supply chain resilience. OpenRAN has the potential to be a key catalyst for innovation as it opens doors to new and more effective solutions, and advanced network functionalities that accelerate autonomous workflows.

Recently, Vodafone started the rollout of OpenRAN at 2,500 mobile sites across Wales and the southwest of England.[20] Trials have demonstrated that this transformation allows Vodafone to replace legacy technology with network equipment that exceeds 4G and 5G call success rate, as well as download and upload speeds compared to that of the legacy tech.

CAMARA is a telco global API alliance that seeks to:

- simplify the complexity of telco networks for making user-friendly APIs;
- adhere to data-privacy and regulatory requirements; and
- facilitate the integration of applications to network.[21]



Telco APIs have the potential to make telco networks much more programmable by enabling the extraction of data/information from the network. They also allow configuring the network by means of programmed actions taken based on AI/ML model outputs. Exposing network APIs also makes it easier for developing network-aware apps and services – a top 2 technological driver for autonomous networks for a majority of telcos (65%).

Experiment with emerging technologies such as generative AI, metaverse, and digital twins to enhance network operators' efficiency

Our recent cross-industry research on generative AI revealed that generative AI is on the boardroom agenda for 96% of organizations.[22] While generative AI is in its infancy in terms of scaled adoption and implementation, nearly 60% of executives globally say their leadership is a strong advocate for generative AI and only 39% are taking a "wait-and-watch" approach to adoption. As discussed earlier (see "The potential of generative AI for autonomous networks"), generative AI has a significant potential for various network use cases, well beyond its potential for customer engagement uses. As such, more exploration and experimentation is needed to harness the full potential of generative AI for telecom networks. Some telcos are using generative AI to help field technicians with a summary of past incidents and their resolutions, helping reduce the mean time to resolve (MTTR) for their ongoing investigation significantly.[23]

With immersive interfaces and metaverse, network engineers working on complex networks or machinery can access support from experts situated elsewhere. Similarly, technicians can scan components of machines they are working on through their AR headsets or AR-enabled smartphones and read detailed information about these components. The network transformation lead at a large, American multinational telecom company remarks: ***"We recognize the potential of innovation in driving new value. Therefore, we focus on technology convergence and particularly invest in emerging technologies such as gen AI, 5G, edge computing, immersive technologies, etc. to drive autonomous networks."***

Digital twins act as digital replicas of physical networks allowing simulation of network behavior with real-time or historical data. The insights can be used to optimize network performance and predict future outcomes. Han Chew, APAC head of network planning and optimization at Nokia, asserts: ***"Our team invests in developing digital twins of physical networks. Creating a virtual replica of the network enables us to optimize network design, enhance diagnosis, and conduct simulation and what-if analysis. It also allows us to simulate and train AI/ML algorithms and explore optimization scenarios to validate network implementation without the risk of impacting end user experience. The network digital twins will play a crucial role in telcos' transition to more complex networks, with more sites/sectors, frequency and technology enabling the network to increase autonomy."***

By leveraging these emerging technologies, telcos can further boost their operations' efficiency and effectiveness.

Conclusion

The operating model of telecom networks is steadily changing from one managed by human operators to an autonomous one where software aided by data and AI increasingly makes the network smarter, faster, and more efficient. It's a fundamental shift in terms of how networks are designed, developed, and operated, since the shift from analog to digital networks a few decades earlier. As previous waves of similar transformations have shown, the transformation is imminent, and it is the pace of change that will define the difference between winners and also-rans.

Appendix

I. Classification of leaders, fast-followers, and beginners

Model inputs

Factors on which the analysis for leaders vs. fast-followers vs. beginners was based	
Strategy and roadmap	• Establishment of a comprehensive autonomous networks transformation strategy, with well-defined goals and target timelines • Establishment of a clear roadmap for the entire journey
Investments (including hardware, software, services, talent, among others)	Telcos investing more than the global average and those investing less than the global average
Current level of network autonomy	Telcos' state of network maturity – based on TM Forum's autonomous network levels.
Implementation of use cases	Current stage of implementation of various autonomous networks use cases across domains

We assessed the surveyed organizations using the aforementioned criteria. Organizations falling within the range of Mean + 1σ to Mean + 3σ were classified as 'Leaders;' those within Mean – 1σ to Mean + 1σ were categorized as 'Fast-followers;" while those below Mean – 1σ were categorized as 'Beginners.'

II. Autonomous networks business case calculations for mid-size and large-size telcos

	Benefit/KPI	Mid-size telco (typically $10-$29bn in annual revenue)	Large telco (typically over $30bn in annual revenue)
a.	Average investment dedicated to autonomous networks over the next five years* *(survey data)*	$118 million	$149 million
b.	Total telco OpEx *(estimated)* = Average annual revenue * Total telco OpEx as a share of total revenue[24] (~68.5%)	$11.9 billion	$24 billion
c.	Network operations OpEx *(estimated) (17% of total OpEx)*	$2.04 billion	$4.08 billion
d.	Total network OpEx over the next five years *(estimated)* = Sum of projected network OpEx in 2024–28	$11.5 billion	$23 billion
e.	Telco network OpEx reduction enabled by autonomous networks per year, conservative scenario	2.7%	2.2%
f.	Corresponding network OpEx savings from autonomous network use cases over the next five years *(estimated)* = d * e	$307 million	$502 million
g.	Return on Investment *(estimated)* = f / a	2.6x	3.4x
h.	Payback period *(estimated)* = a / f / 5	2 years	1.5 years

*Investments in autonomous networks include hardware, software, services, talent, among other elements.

III. Expected role of autonomous networks in reducing GHG emissions of telcos

			Remarks/references
I.	Telecom sector emissions (2022), Gt CO_2-eq	0.9684	• Telco companies are responsible for 1.6–2% of global carbon emissions[25] • Global GHG emissions in 2022 is 53.8 Gt CO_2-eq[26] (=1.8% * 53.8)
II.	Share of global market represented by telcos in our study	66%	
III.	Average emissions per telco, Mt CO_2-eq	5.65	*(III = I * II / Number of operators in the study (113))*
IV.	Current share of GHG emissions of telco networks in organizations' overall GHG emissions	42%	*(Survey data)*
V.	Current emissions from telco networks per telco on average, Mt CO_2-eq	1.97	*(V = III * IV)*
VI.	Projected reduction in network emissions enabled by higher levels of autonomous networks, Mt CO_2-eq	0.2955 0.1478	15% *(Survey data)*, optimistic scenario *(VI = V * 15%)* 7.5% *(Survey data)*, conservative scenario *(VI = V * 7.5%)*
VII.	Contribution of autonomous networks to target achievement	5.2% (optimistic scenario) 2.6% (conservative scenario)	*(VII = (VI/III)*

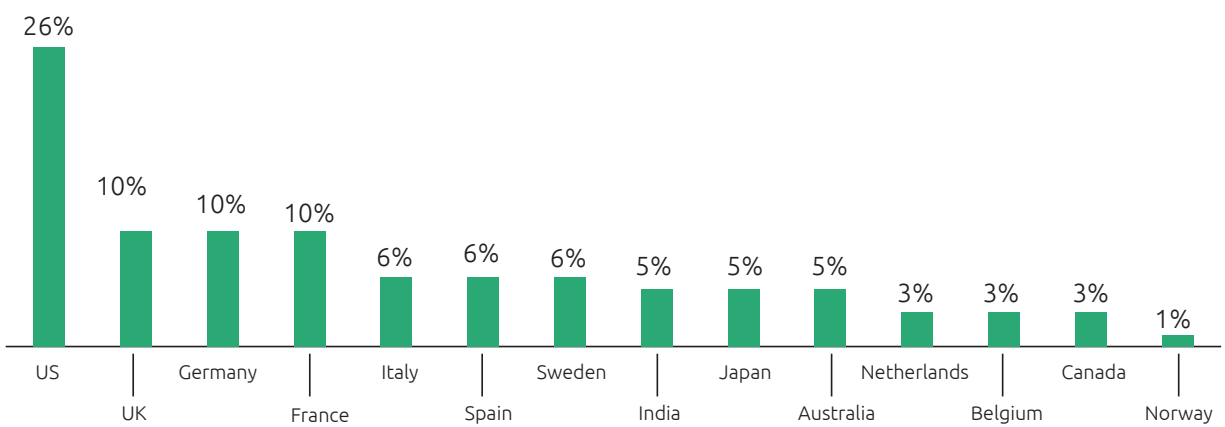
Source: Capgemini Research Institute, Autonomous Telco Networks Survey, December 2023–January 2024, N = 113 large CSPs.
The optimistic scenario assumes that a half of the total reported gains (30%) are ultimately realized at the organizational level, whereas the conservative scenario assumes a fourth of the gains are ultimately realized.

Research methodology

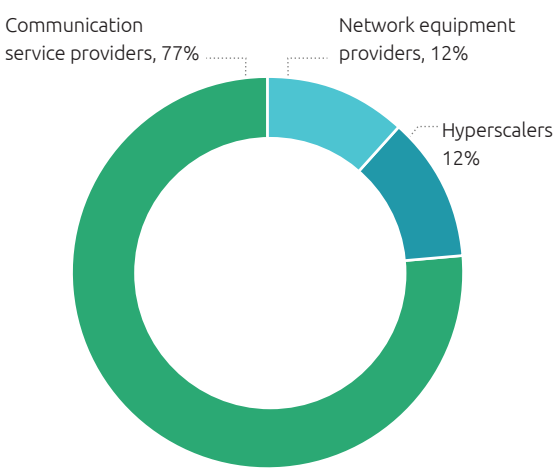
We surveyed 435 industry executives, from large CSPs, network equipment providers (NEPs), and hyperscalers. Of these, 335 executives belong to CSPs, 50 to NEPs, and 50 to hyperscalers. They are based in 14 countries across North America, Europe, and Asia-Pacific.

The distribution of respondents and their organizations is provided below.

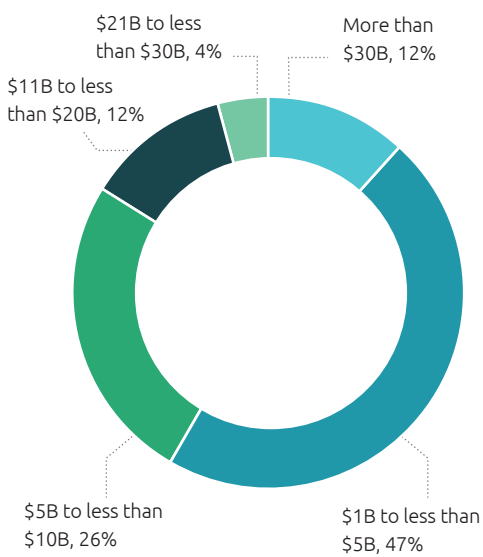
ORGANIZATIONS BY COUNTRY



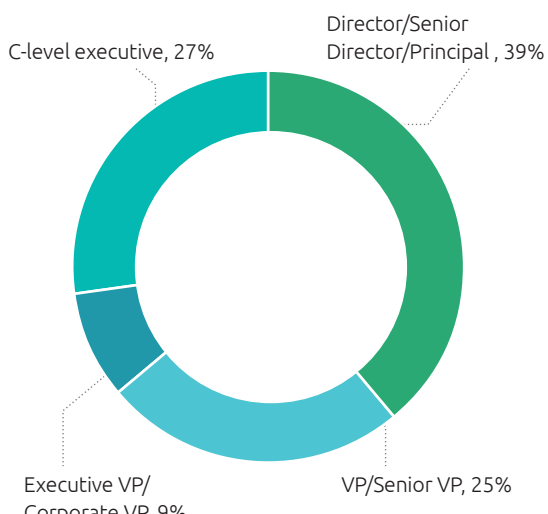
ORGANIZATIONS BY SECTOR



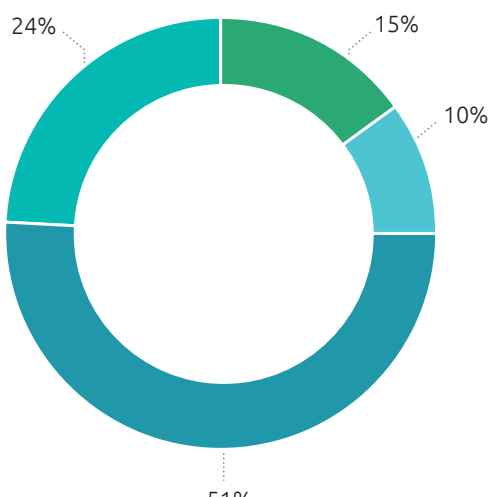
CSPS BY LATEST ANNUAL REVENUE



EXECUTIVES BY TITLE (N = 435)



CSPS BY FUNCTION (N = 335)



Top management: Chief executive officer, chief operating officer, head of strategy/chief strategy officer, chief finance officer, and other equivalent strategy roles

Engineering/R&D: Chief engineering/R&D officer, head of engineering and R&D, and other equivalent roles

Network/tech: Chief technology officer, chief network officer, head of network management/planning, head of network operations, head of autonomous networks, and other equivalent roles

Data/AI & IT: Chief data officer/head of data, head of AI, head of analytics, chief information officer, chief information security officer, and other equivalent roles

We also conducted in-depth discussions with 22 executives from the telcos, NEPs, and hyperscalers to complement the survey findings. We would like to extend our special thanks to executives from the following organizations who took part in the in-depth interviews for this research:

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- BT Group
- Cisco
- Dish
- Ericsson
- Google
- Infinera
- Juniper
- NEC
- Nokia
- NSW Telco Authority
- Orange
- Red Hat
- Telefónica
- Telstra
- Three UK
- TM Forum
- Verizon
- Vodafone
- Virgin Media O2

References

1. TM Forum, “Orange pursues service agility with Level 4 network autonomy,” June 2023.
2. TM Forum, “Empowering digital transformation - evolving from Level 2/3 towards Level 4,” September 2023.
3. Ibid.
4. Verizon, “Verizon accelerates network slicing technology with new public safety use case,” November 2023.
5. Orange website, “Data and artificial intelligence,” accessed February 2024.
6. The Mobile Century, "Leading culture change in telecoms,” February 2023.
7. Harvard Business Review,”Employees are losing patience with change initiatives,” May 2023.
8. TM Forum, “Intelligent customer experience profiles pave way for ‘perfect’ network operations and lower churn,” November 2023.
9. Omdia, “An analysis of telco OpEx: Minimizing costs and maximizing efficiency,” January 2024.
10. TM Forum Inform, “Telcos dial intelligent automation and cloud solutions as OpEx pressures build,” August 2023.
11. GSMA, “Mobile Net Zero: State of the industry on climate action 2023,” February 2023.
12. Telefónica, “Telefónica commits to a 90% reduction of its operational emissions by 2030,” November 2023.
13. TM Forum, “The role of autonomous networks,” accessed February 2024.
14. Orange website, “Orange Open Gateway: the new era of digital services and mobile apps”, accessed February 2024.
15. European Commission, “Employment and social developments in Europe,” July 2023.
16. AT&T, “Life at AT&T”, accessed February 2024.
17. TM Forum, “Empowering digital transformation – evolving from Level 2/3 towards Level 4,” September 2023.
18. Total Telecom, “Accelerating Telefónica network autonomy,” October 2023.
19. Virgin Media O2, “Virgin Media O2: First steps to an autonomous network,” Digital Report 2022.
20. Vodafone, “Vodafone begins volume deployment of OpenRAN for 2,500 sites across Wales and southwest England,” August 2023.
21. GSMA, “CAMARA: Telco Global API Alliance,” accessed February 2024.
22. Capgemini Research Institute, “Harnessing the value of generative AI: Top use cases across industries” July 2023.
23. Capgemini, “How gen AI will revolutionize telecom network operations,” February 2024.
24. Omdia, “An analysis of telco OpEx: Minimizing costs and maximizing efficiency,” January 2024.
25. IEEE Computer Society, “How to prioritize telecom sustainability and reduce carbon emissions,” October 2023.
26. European Commission, “GHG emissions of all world countries,” 2023.

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The Capgemini Research Institute is Capgemini's in-house think tank on all things digital. The Institute publishes research on the impact of digital technologies on large traditional businesses. The team draws on the worldwide network of Capgemini experts and works closely with academic and technology partners. The Institute has dedicated research centers in India, Singapore, the UK, and the US. It was recently ranked number one in the world by independent analysts for the quality of its research.

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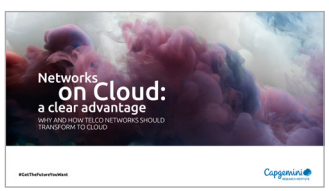

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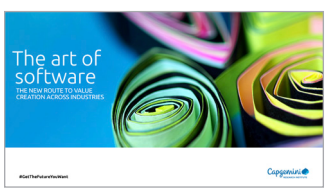

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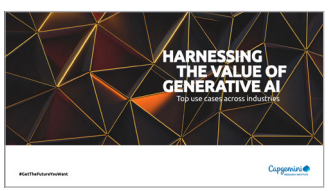

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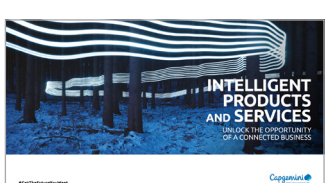

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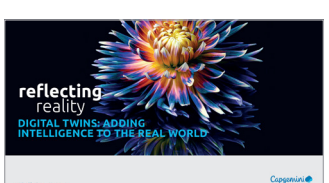

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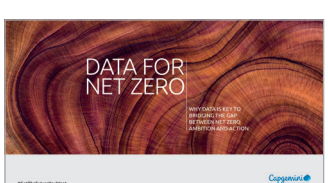

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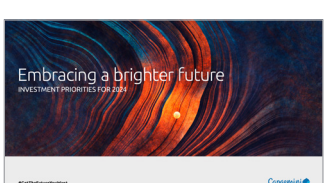


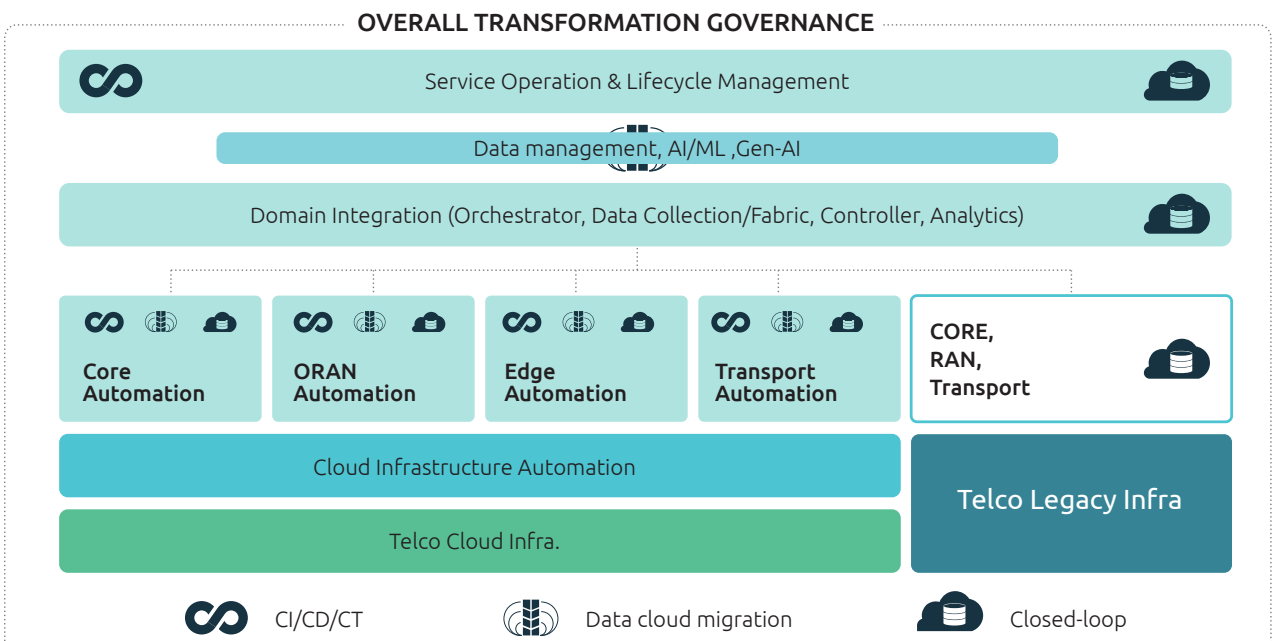
Embracing a brighter future: Investment priorities for 2024

Capgemini enables and accelerates the CSP journey from conventional network to autonomous network

Main challenges to accelerate autonomous networks journey include:

- Limited access to high-quality data due to legacy systems and proprietary interfaces;
- Lack of unified observability platform;
- Data Acquisition: multi-protocol normalization, correlation of these data with events in the network;
- Closed-loop use case definition and implementation (e.g., operation model, energy saving, network planning, customer services, and marketing);
- Addressing security and regulatory compliance.

Transforming current CSP's networks into an *Autonomous Network is a journey* where **strategy, data, automation and AI/ML** are the key levers to achieve it.



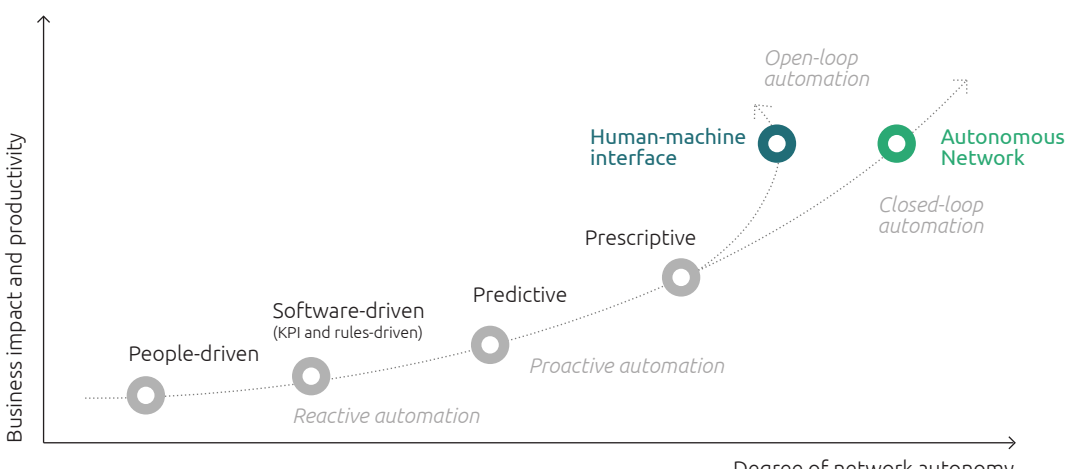
However, the lack of speed on this journey can be due to lack of a coherent strategy and technology implementation. In addition, CSPs require to reskill their teams in network and operational domains for additional digital capabilities such as:

- Data-driven technology
- ML, AI and Gen AI
- Telco Cloud

Capgemini brings E2E expertise and experience from strategy to deployment in all Autonomous Network Journey.

This will comprise an E2E transformation program that involves the execution of different subprograms and projects in the different areas and domains. Capgemini is working on all layers: network R&D, network management and network data, data management, real-time decision-making and orchestration; and all of this has been done with NEPs, OSS vendors and CSPs:

- Proven track record on strategical large transformation projects
- Hands-on delivery experience in real-time AI-driven decisioning systems and data quality / data management transformation
- Assets in Network AI and Network automation that enable our customers to accelerate and secure the transformation
- With a partner ecosystem including hyperscalers, platform vendors and NEPs, Capgemini brings the best tailor-made solution for its customers.



Capgemini Assets on the Autonomous Network Journey	
1	**Advanced Network Automation (ANA)** xNF set up, operations, deployment, validation, CI/CD/CT pipelines
2	**Data Management/ Data Governance** Shaping the data layer
3	**NetAnticipate** Autonomous Network Design Studio
4	**Autonomous Networks Use Cases** Customized Use Cases

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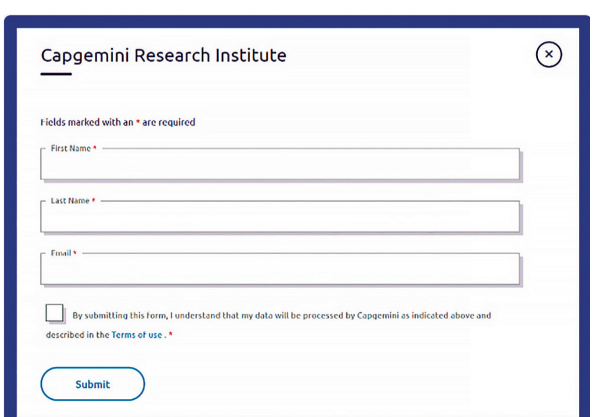

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