

TELECOM TRANSFORMATION: THE NEED FOR INTELLIGENT OPERATIONS

Managing Complexity in the Age of 5G





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EXECUTIVE SUMMARY

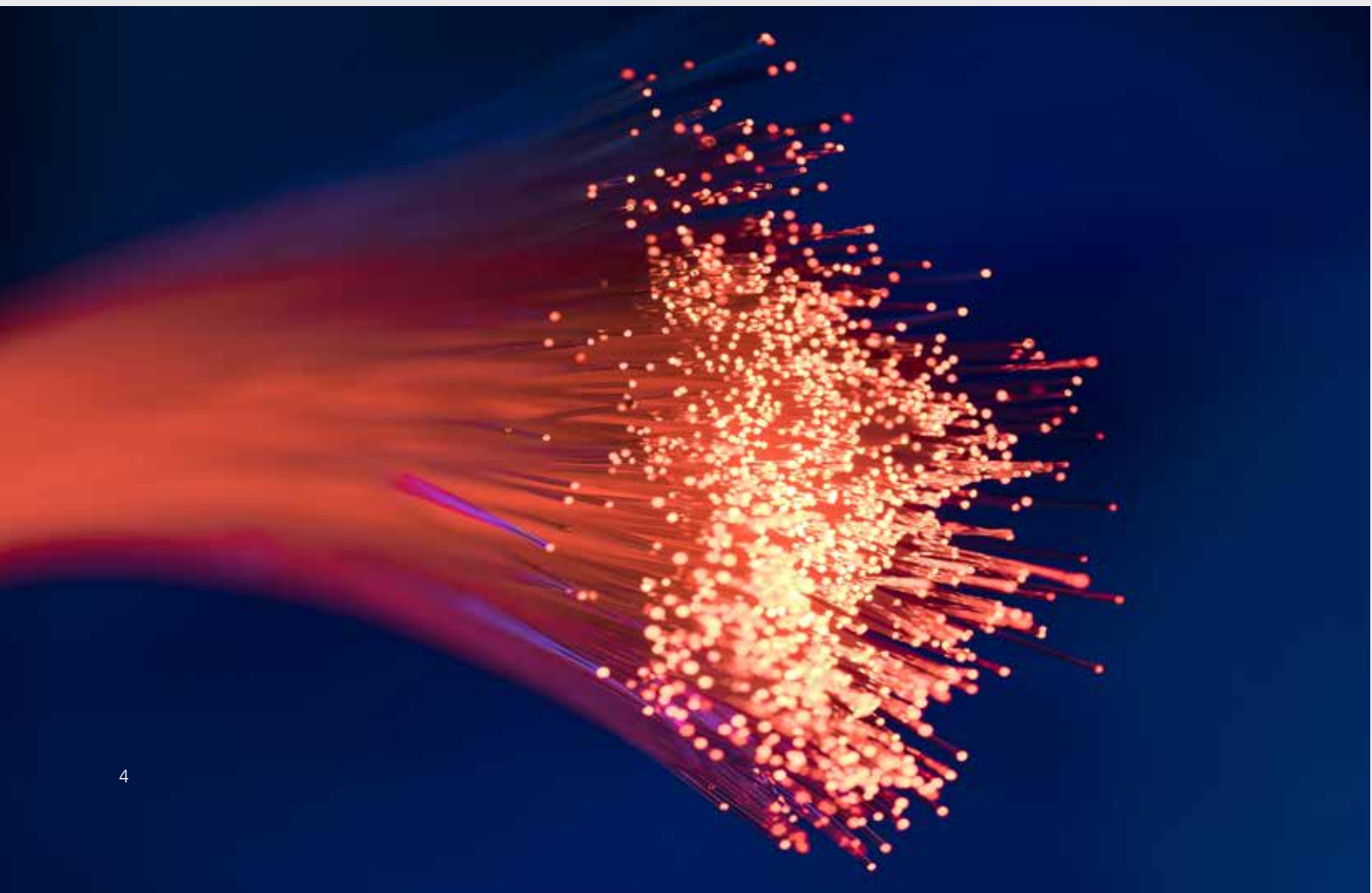
Intelligent operational support systems are a growth mandate

The fifth-generation technology standard for cellular networks – 5G – is a revolution with the potential to transform mobile network operators (MNOs), catalyze the digital transformation of entire industries and enterprises, and fundamentally change our societies forever.

Early 5G use cases based on non-standalone (NSA) deployment have the potential to deliver multi-gigabit enhanced mobile broadband (eMBB) services to consumers, but, it is the new business and economic opportunities offered by standalone (SA) 5G in the form of ultra-reliable low latency communications (URLLC) and massive machine-type communications (mMTC) use cases for other industry verticals that are exciting the stakeholders and partners across the board including industries such as manufacturing, automotive, utilities, and healthcare and emergency public services.

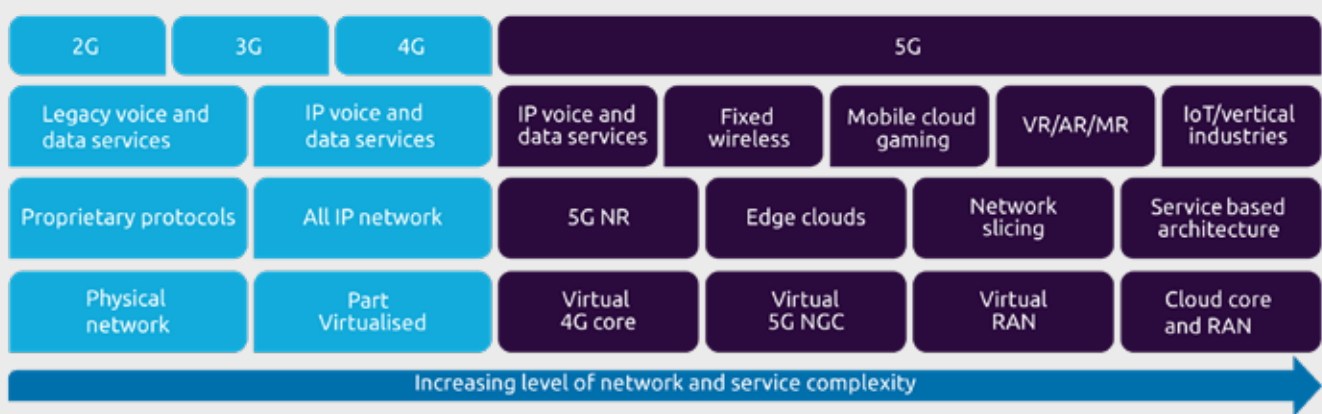
To support such diverse industries with a broad array of use cases and varying demands such as service dynamicity, quality of service (QoS) and latency requirements, the industry is building the 5G network based on different technological innovations such as service-based architecture (SBA), network functions virtualization (NFV), Cloud-native computing (CNC) and software-defined networking (SDN). However, these technological innovations introduce significant network and operational complexities that need to be managed to deliver on the promise of 5G.

The result? Traditional service management and operational approaches – built to support physical networks delivering mass market communication services – are not fit for purpose. The operational support systems' (OSS) solutions for operating such networks need to be intelligent enough to self-heal and auto-repair in real time to address complex use cases and dynamic network behavior.



WHAT IS DRIVING COMPLEX OPERATIONS IN 5G & WHY ARE INTELLIGENT NETWORK OPERATIONS REQUIRED?

The evolution to 5G and the enabling technologies



Source: Analysys Mason

The scope of 5G is much broader than that of consumer voice and data services. Previous generations of mobile networks (2G, 3G, and 4G) were built for consumer voice and data services, but 5G networks are being built to support a variety of use cases that in turn support the digital transformation of different industries. To operationalize new generation networks and services at scale, 5G is leading to network and infrastructure innovations that will increase complexity.

- Radio Access Network (RAN) is transforming towards open, intelligent, virtualized and fully interoperable RAN (O-RAN) to make deployment of 5G and other cellular networks less expensive and thereby result in faster innovation of features and services.
- Transport Network is changing to support new 5G capabilities. Capacity requirement will be increased using the same spectrum with MIMO for microwave and using Microwave multi-band booster on existing and new sites. Also, long haul microwave will provide high capacity in rural or remote areas where no optical fiber is available.
- The core network is being built using container technology and a service-based architecture to deploy and operate the networks in Cloud environments and to support just-in-time scalability, software reusability, and extreme network automation.
- Edge computing brings compute power closer to the edge for localized processing and application hosting to reduce network congestion and service latency. Edge computing also allows the data to remain at the Edge for security/confidentiality purposes.
- Network slicing enables the creation of end-to-end cross-domain virtual logical network slices, and each slice delivers differentiated QoS and SLAs to match service-specific KPIs such as network capacity, latency, and reliability.

Together, these wide-ranging technology enablers (such as NFV, SDN, Cloud-native computing, network slicing, and Edge computing) provide the basis for new 5G-based digital services but at the same time, they magnify the complexity of the networks and services to unprecedented levels. This also significantly increases the operational complexity, rendering the traditional methods of operations obsolete.

In summary, the 5G and beyond networks should be capable of handling the complex array of

operations. Current operations methods were designed for 2G/3G/4G networks – for static physical networks that supported basic voice and data services. These methods cannot meet the needs of 5G networks, let alone the technologies that follow. MNOs should instead embrace a new operational approach that is designed for the 5G and beyond networks which support new digital services. Maintaining the status quo is not an option.



HOW SHOULD MNOs TRANSFORM NETWORK OPERATIONS INTO INTELLIGENT OPERATIONS?

A good transformation strategy is required to address the opportunities and challenges that the 5G network brings. Transforming network operations into intelligent operations rests on **four pillars**.

1. Processes: to manage, automate and orchestrate a 5G network

MNOs will require new end-to-end (E2E) operational processes to leverage automation capabilities, minimize manual interventions, and achieve overall network visibility. Process transformation will be enabled by the below-mentioned three principles.

Automation: This provides maximum efficiency and effectiveness; It enables self-healing and proactive improvements for assurance; and it requires assessment of effort, impact, cost, risks, and time savings.

Policy: This provides a framework of rules which are used for automation; It helps in closed-loop operations and serves as a platform for AI and ML capabilities; and it requires a dedicated cross-functional team of experts.

Analytics: This provides near-real-time data for automation and insights; it helps improve customer experience and provides deep-dive E2E analysis; and requires computer science, networks, and business skills to collect, store, and process data.

2. Organization: to adopt a cross-domain model by focusing on competencies

MNOs need to transform their model from a typical domain (vertical) to cross-domain (horizontal) to enable the necessary E2E competencies for leveraging the capabilities of a Cloudified world. This will require new competencies and skills to be developed and organizational borders reviewed to match the needs of the new processes. Most importantly, this transformation will only be possible with full C-level commitment and support.

The organizational transformation mainly affects:

- Roles and skills – to operate the new Cloud-native network paradigm
- Governance – setting a service-oriented governance both internally and with suppliers and partners
- Service-oriented layered organization – associated processes for each layer of the organization, with services, not silos, in mind
- Organizational matrix model – to scope horizontal capabilities while providing a vertical view
- Reusable infrastructure services – to accommodate the demands from network and IT operations with OpEx efficiency

3. Technology: to embrace capabilities to achieve high 5G operational efficiency

Networks are transforming and their architecture, services, and infrastructure are evolving to service different customer needs. Some key technology capabilities to achieve the high operational efficiency expected from 5G networks are:

Microservices-based architecture: In legacy, data is typically trapped in siloed applications, making it difficult for MNOs to gain cross-module insights and move quickly to act on events occurring in the network in real-time. A microservices-based approach will enable the Cloud-native platform to support multiple operational capabilities that are today realized as separate and non-data sharing systems.

With open application programming interfaces (APIs), microservices, and service platform virtualization, the Cloud enables MNOs to decouple their services functionally and technically. For example, alarms, incidents, inventory, and topology can all be implemented as microservices that run on the same platform and can be called upon by multiple platform-based tools/systems as and when required. Also, MNOs will require more interoperability and openness with third parties. Microservices-based OSS will allow other OSS to integrate smoothly with third-party systems. This approach will allow for the rapid integration of new operational capabilities. In summary, microservices and open APIs will allow MNOs to act on network events in near real time and with lower investments in software and infrastructure.

From batch to real-time processing: Most legacy systems in network operations still rely on batch processing of data, which is slow and doesn't always provide the most current view of the network events. The Cloud integrates both Cloud-based solutions and legacy systems to support real-time data streaming, which is a prerequisite for generating recommendations for decision-makers and building predictive models that identify near real-time network events.

Unified cross-domain assurance: The current approach to service assurance is based on siloed systems and processes with rigid architecture and custom integrations. This has resulted in a highly disconnected assurance estate deployed for specific operational domains. MNOs should opt for the idea

of E2E cross-domain assurance for 5G, that spans across the network, from the Cloud core to the subscriber or Edge device, including the backhaul, Edge Clouds, the front haul, and the 5G New Radio. MNOs should consider a unified monitoring solution based on a combination of active and passive probes, in software, virtual and Cloud-native formats to achieve maximum coverage and impact.

Dynamic monitoring: Assurance in today's static networks is often considered only at the last stage in the investment cycle before handover to operations. This approach is not fit for the 5G and beyond era where the virtual network functions (VNFs) or Cloud-native network functions and service instances can be created and altered on demand including dynamic traffic flow changes based on SDN policies. Assurance systems should adapt and, if required, scale in line with the changing network, to monitor the portable VNFs and the modified service chains. This would be particularly important in the case of 5G standalone access (SA) deployments where MNOs will offer network slice-based differentiated services requiring highly dynamic monitoring and assurance for slice-level service quality parameters.

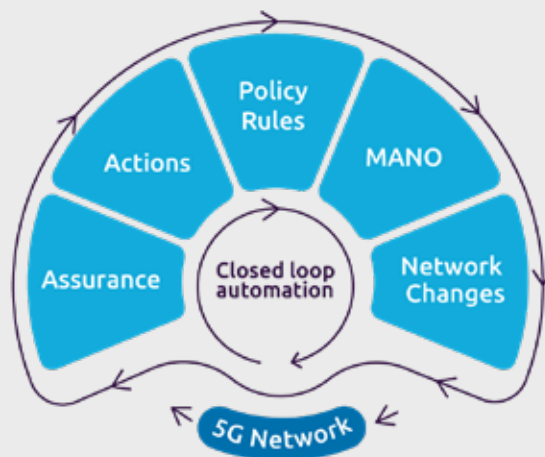
AI/ML for predictive assurance: AI/ML will enable real-time and predictive assurance. ML algorithms can be applied to identify network issues and anomalies by monitoring network data. As MNOs' application of ML improves, the technology will become capable of identifying the network events that may eventually lead to service degradation. This will enable predictive assurance capabilities, where the MNO can identify an emerging anomaly and then plan and deploy remedy days or weeks in advance of any impact on the customer experience. As trust continues to develop, predictive AI- and ML-based assurance will become capable of initiating proactive remedies automatically as soon as an anomaly, or an emerging anomaly, is detected and specific KPIs are breached. AI and ML technologies will enable MNOs to not only do a much better job but also to prepare for emerging use cases around 5G video/AR/VR and ultra-low latency IoT.

Closed-loop automation: A link between virtualized networks and operations is essential if MNOs plan to take advantage of AI/ML driven real-time and predictive assurance capabilities. ML algorithms can detect and propose resolutions for network issues that affect customer experience, and these resolutions should be implemented back into the network via orchestration and configuration management systems. Automated operations may then close the loop by feeding data relating to the proposed remedy and the results back into the algorithms, thereby further improving their accuracy. To achieve this, the assurance functions

should be joined with the network orchestration systems to drive meaningful changes in the network that will improve the customer experience.

Closed-loop automation can seamlessly integrate the two sets of processes (as shown in the figure below). This level of network automation can be achieved by gaining the highest level of trust in automated root-cause analysis and by establishing clear policy rules as network and service preconditions to trigger the configuration changes back into the network. The changes themselves can be executed through the management and orchestration (MANO) system.

Closed-loop assurance through MANO



Source: Analysys Mason

4. Data-centric architecture: turn complexity from a liability into an innovation driver

5G and beyond networks enable revenue growth, alongside opportunities and use cases connected to Industry 4.0, smart city, smart port/airports, autonomous mobility, and more. These opportunities bring such technological complexity that human beings alone are not capable of handling the amount of incoming data that is needed to run networks efficiently and effectively. For telecom operators, the ability to mine the vast amount of data traversing the network can unlock value and opportunities to optimize the network, improve network operational efficiency, and improve the customer experience. However, collection of huge amounts of data (or 'big data') needs to be accompanied by advanced analytics running alongside it to provide network operations teams the actionable insights they need to respond to network-related issues in a more proactive and predictive manner. By processing massive data sets using AI and machine learning (ML), MNOs can gain a real-time picture and some

insights into the network. A logical, data-centric architecture provides your AI / ML solutions with essential context, without which their ability to draw conclusions is limited.

Also, operational data is highly siloed among teams, different OSS/NMS are associated with different layers of the network and network domains. MNOs need to create complex processes to stitch this data and make it accessible to the stakeholders who need it. For instance, inventory data is frequently spread across multiple silo systems and excel spreadsheets. Operating with fragmented information and systems results in higher OpEx and negatively impacts revenues. In a data-centric network operations architecture, all the data from distributed systems – the network – can be collected in one place. The data then can be made available in real time to any stakeholder/task that needs it, with different teams and network operations sharing the same source of truth.

REAL WORLD INSIGHTS – HOW MNOs ARE ADOPTING THE CONCEPTS

In the previous section, we looked at key pillars in the transformation of network operations into intelligent operations. Now, let's look at the real-life examples of how MNOs around the world are adopting these concepts.

- **Data:** Cox Communications is using Capgemini's Network Monitoring and Real-time Correlation Engine that provides a service-level health view of a network by dynamically ingesting, correlating, aggregating, and calculating points of interest (POI) based on telemetry readings and call

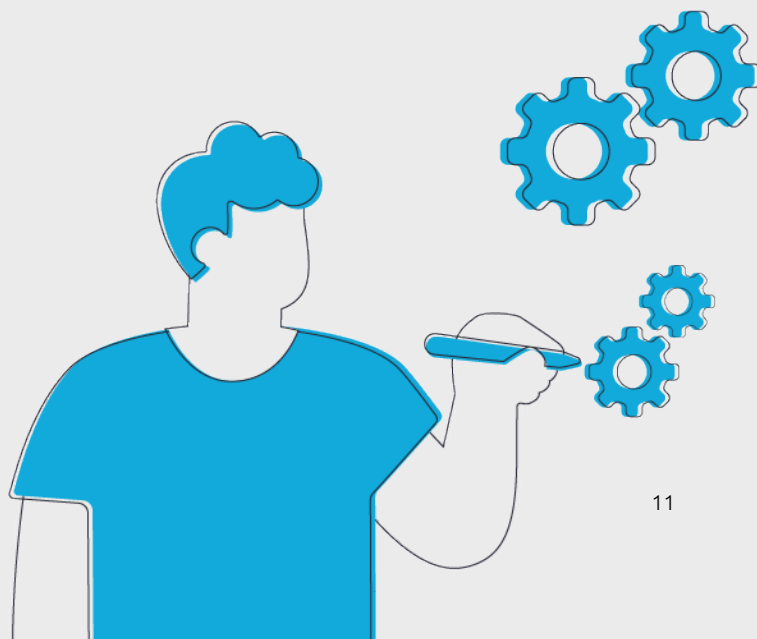
volumes. It has resulted in reduction of MTTR by 25-30% and reduction in avoidable truck rolls by 30 to 40%.

- **Processes:** Rakuten Mobile has developed virtual network functions (VNF) lifecycle processes, addressed operations with service reliability engineering (SRE) and helped reimagine new ways to deliver change, incident, and release management.



- **Microservices-based architecture:** China Mobile has developed an IP Maintenance Platform, where autonomous network capabilities are implemented to significantly improve service provisioning efficiency in combination with containerized and micro-service architecture. The IP Maintenance Platform has enabled zero touch, and zero-wait to the end-to-end process from service subscription to service provisioning, reducing the total time of fulfilling cloud-networking services to only a few minutes. This has improved customer satisfaction.
- **Organization:** Rakuten Mobile has designed the new organization and operating model behind the world's first fully virtualized mobile network, including new roles, responsibilities and KPIs.
- **Zero touch reliability:** China Mobile has implemented zero-touch reliability 5G network business solution that uses single-domain autonomy and cross-domain collaboration as the core principle to build a fault management framework with comprehensive real-time sensing, automatic anomaly diagnosis, and intelligent decision-making. It has increased average processing efficiency by 40%. The number of invalid work orders have reduced by more than 20%. The fault handling efficiency of frontline maintenance personnel has improved by 80%, and that of second line maintenance personnel has improved by 25%.
- **AI/ML:** Vodafone Italia is making use of real-time AI solutions powered by Machine Learning algorithms that respond promptly and accurately to quickly provide customers with the requested quote for a new fiber connect order. This provides customers with more accurate quotes which increases the acceptance rate and reduces after-sales issues.
- **Chatbot:** Vodafone Idea (Vi) has launched a new AI-powered digital customer service and virtual assistant called VIC. It can deliver instant responses on a host of user queries like bill payments, recharges, VAS, plan activation, new connection, data balance, bill requests and more. Moreover, the service is live 24x7.
- **Service Assurance:** Rakuten Mobile has created a new network engineering capability, defining, and deploying engineering solutions to improve observability of the network, network performance, problem management, and architectural integrity. These are all complex undertakings in a network that combines cloud, software-defined networking, and pioneering hardware solutions. They have merged network and IT, infusing concepts such as DevSecOps and Agile into the organization. They have reimagined the traditional Network Operations Center (NOC), set up and operationalized Service Experience Center (SXC). This next generation concept is entirely focused on customer-experience on the network. They have enabled unparalleled network intelligence and automation that provides a true 360-degree view of the network and customer. The platform is Cloud-native, allowing near-real-time monitoring and control of the network, ingesting data and analyzing it with machine learning to enable proactive fault detection and prevention.

[Source: tmforum](#)



CONCLUSION AND RECOMMENDATIONS - THE WAY FORWARD

The telecommunications industry is undergoing a major evolution due to both technological innovations and changing consumer habits. In response, telecom operators have started a transformation program to increase the efficiency of network operations. The actual path and speed of the MNO transformation journey will depend on the starting point, that is, the current state of the MNO's OSS estate and associated operational processes, the current level of automation and the overall aims of their digital transformation strategy. MNOs that have already started on their journey towards intelligent network operations advise that other MNOs should take a plunge and start their own journey. Leading MNOs say that by embarking on an intelligent MNO strategy, they have experienced important lessons that they had not anticipated and have uncovered implications that they would not otherwise be aware of. This is a valuable exercise because every organization is different and needs to adapt to its own circumstances: it cannot simply apply an industry blueprint and expect success.

Following are recommendations MNOs should take to transform network operations. They can be used in each phase of transformation to help identify where there are gaps, establish key areas to focus on, and where to start.

- **Transform Organizations** – MNOs should transform their organizations for autonomous networks. MNOs should reskill their existing workforces alongside hiring new talent with the requisite DevOps and software engineering skills.
- **Think Cloud-native** – If MNOs adopt Cloud-native systems, they can use agile operational infrastructure to quickly pivot new service models to revenue in the 5G era whenever an opportunity arises.
- **Merge networks & IT** – Service and network operations should be combined, and this merger should be reinforced in process design and internal roles within the company to get the most from the shift to cloud native systems and software defined networking.

This includes adopting DevOps practices, continuous integration, and delivery, and microservice architectures to provide agility in both the business and network.

- **Embrace automation** – Choose an assurance solution that incorporates ML/AI techniques to provide predictive assurance and automated root-cause analysis using real-time network and service topology, and network-slice topology. Use the insights and actions generated from the automated assurance systems to drive policy-driven closed-loop assurance in conjunction with their MANO systems.
- **Look for new suppliers** – Most spending on service assurance over the last decade has been with a relatively small number of vendors. Large deals with incumbent suppliers mean that assurance is often part of a larger bundle. This is changing as vendors from other areas of IT are showing that their knowledge of cloud, VM infrastructure, workflow management, database management, and AI and machine learning are absolutely relevant to modern MNO operations.
- **Focus on standards** – Digital operations are highly reliant on APIs in the network and OSS/BSS. MNOs rightly specify in requests for information and proposal that vendors should comply with industry standards including TM Forum's Open APIs. Standards are especially important in assuring services end to end across partners' boundaries.

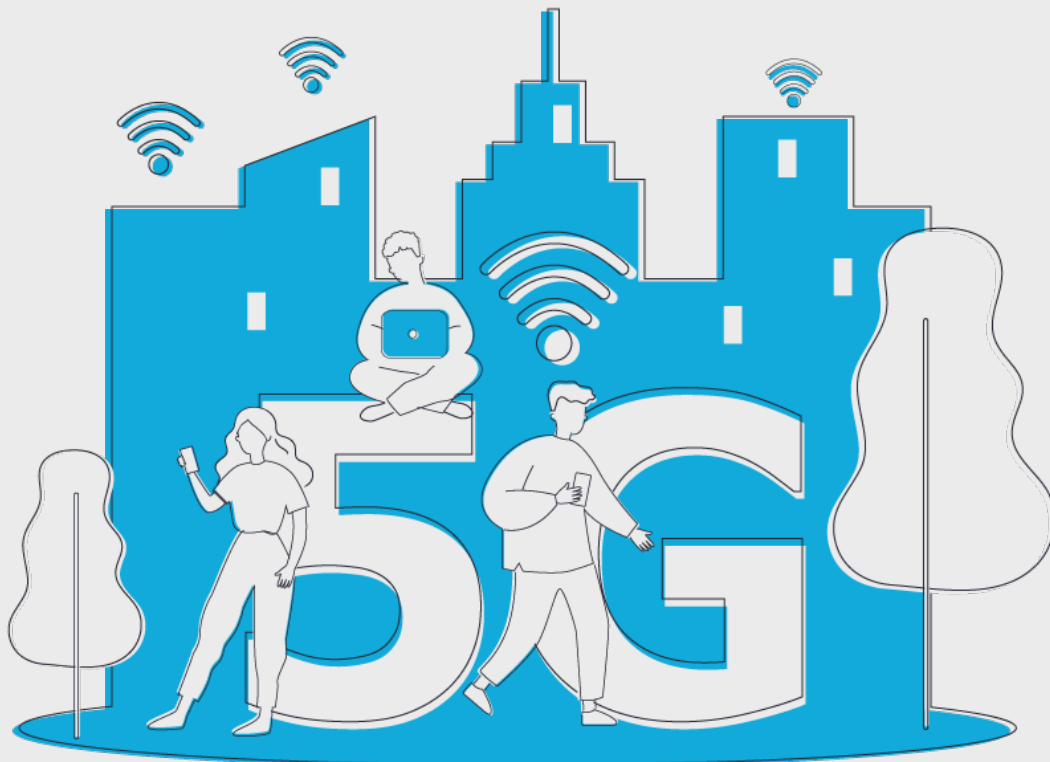


HOW CAN CAPGEMINI INVENT HELP?

Capgemini Invent is Capgemini Group's innovation, design, and transformation powerhouse. We combine technology expertise, with deep engineering skills, across IT and networks. And because we know the technology and how to apply it, we can support clients all the way through their 5G and Edge transformation. And we are delivering this through our key service offerings, that will help you strategize, build, transform, and deliver business value with 5G and Edge:

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- Strategic Service Platforms
- Use Cases & Applications
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- 5G End-to-end business & Operational services.

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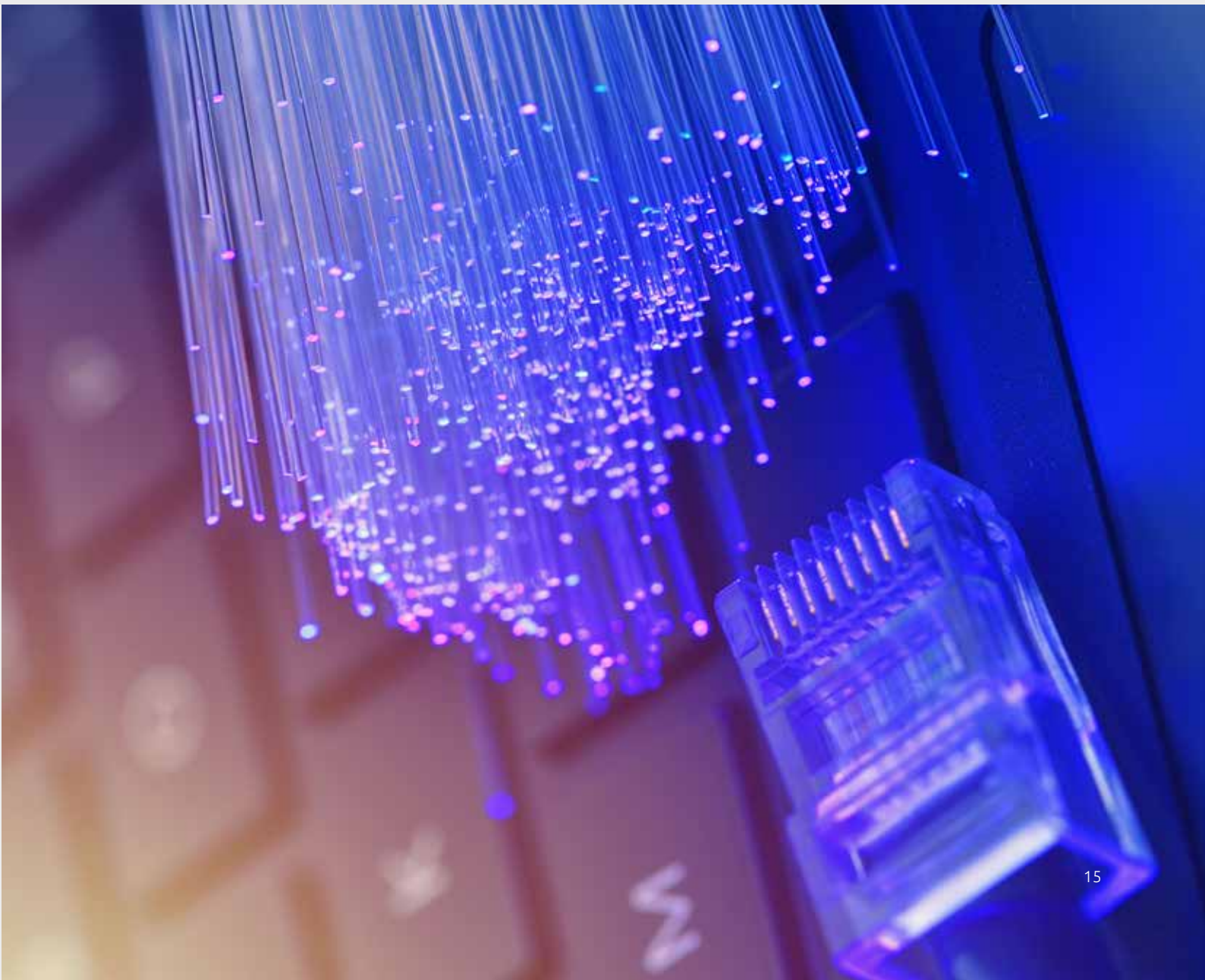
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