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Perspective

Creating the next-generation telecoms operations platform

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RESEARCH

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1. Executive summary

Next-generation operations systems need to address the multi-domain and dynamic infrastructure on which increasingly complex services are being offered. Without a significant change in the level of automation being applied to operations systems, innovation on 5G and other services will be greatly reduced because they will be too complex to deliver.

Next-generation operations systems must be built on widely understood established technology but should be integrated and applied to the specific needs of telecoms operations functions. There is common agreement on six areas that next-generation operations systems and staff need to MASTER.

- The platform must have data at its core to enable **Modelling**, analytics and other AI capabilities to be delivered around a comprehensive telecoms-focused data model.
- The systems need to support hyper-**Automations** using process automation tools applied with insights and cross functional and multi-domain integrations.
- **Service** assurance is needed for the new deterministic connectivity that is required to support new 5G enterprise services and hyperscale enterprise services.
- **Telecoms** knowledge must be applied at each stage along with data to guide automations.
- An open platform needs to be created, around which an **Ecosystem** of partners can work using open standards.
- The platform needs a **Reliable**, trusted DevOps development environment where the vendor, their customers and ultimately their partners in the ecosystem can create applications.

Mastering each of these areas requires not only technology and development capabilities of vendors, but also the active participation of operators and their willingness to implement radical changes to their processes.

2. Recommendations

For operators to make a success of 5G, they will need to upgrade consumer services from 4G, and migrate current and new enterprise services to the new 5G network. For the latter phase to succeed, operators will need a platform on which to design, deliver and manage complex deterministic services.

- **Operators must create an integrated operations system to support enterprise services.** Enterprises need simplicity for their networks, like that which hyperscalers provide with their IaaS, SaaS, and PaaS solutions. Operators' operations systems should be automated, and automations should be built using data-driven insights.

- **Vendors should use open standards when designing next-generation operations systems to enable an ecosystem of partners and customers to collaborate.** To ensure that enterprises' requirements can be met, systems should be built using open standards and a software development kit (SDK) should be available to allow for customisations and the creation of new capabilities.
- **A new platform is needed to support the operations requirements.** A new more integrated approach is required to support operations processes. The platform needs to be telecoms-aware; it should be built on a reliable telecoms data model; automations should support telecoms processes and operators should provide development tools for use by customers and partners.

3. Introduction

5G roll-out is acting as a driver for change in related operations systems. The need to change operations systems was less apparent before mobile networks services were deterministic and the quality of services was defined in service-level agreements (SLAs).

Operations processes will need to become more automated, without which the goal of winning new enterprise business will be lost because it will be too costly to manage, and operator response times will be too slow to support customer requirements. The development of a more integrated, wholistic platform that is service- and resource-aware and able to design, orchestrate, operate and manage services in a timely way will be critical in delivering the full capability of 5G enterprise services to market. This report outlines the challenges and elements of solutions that are needed to support the operations processes that are associated with these complex enterprise services.

4. Landscape and challenges

Today's operations systems and processes in all but a few operators have been established over many years and are highly complex. New operations systems have been incrementally added to support new technologies and subscriber requirements, often without retiring incumbent systems. The result is a complex mixture of systems, which is unique to each operator and reduces their ability to innovate and changes cannot be implemented quickly.

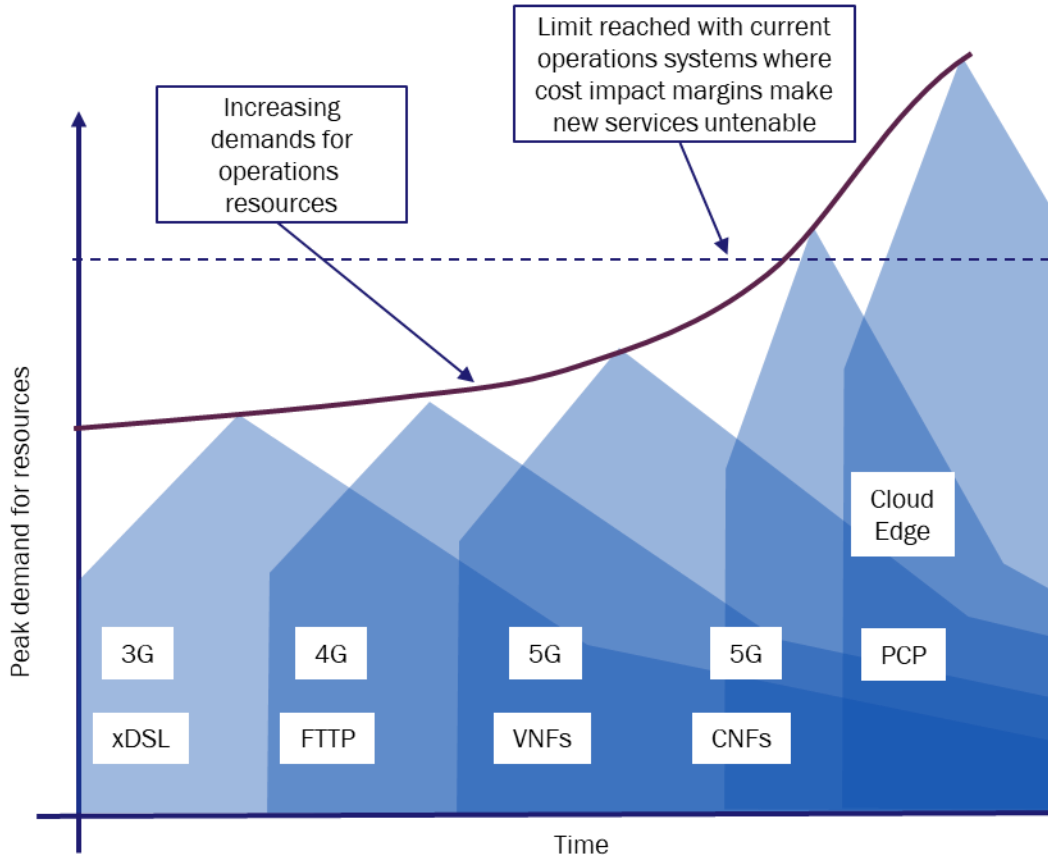
Additional pressure is being added to the mix of operations systems and processes as 5G networks and associated services are rolled out. 5G is not just another wireless generation, it has significant complexities, and it is being implemented at the same time as other 'waves' of IT and network architectural changes that are occurring in the market (see Figure 4.1). These changes include the following.

- The disaggregation of networks using virtual network functions (VNFs) or containerised network functions (CNFs) with cloud-native architecture. This includes the use of standard IT hardware in support of the network functions in the core and at the edge of the network.

- The rise of public cloud offerings and the preparedness for operators to run not only IT functions but network functions on them.
- The shift to DevOps-based approaches for IT applications development to support network and service roll-out using cloud-native technologies.
- New services, particularly those for enterprises based on SD-WAN, 5G network slices, complex partnerships, IoT and cloud edge functions.

The need to support current systems combined with the demands of other technology and service changes is threatening to overwhelm operators' resources that are tasked with operating and maintaining networks and services.

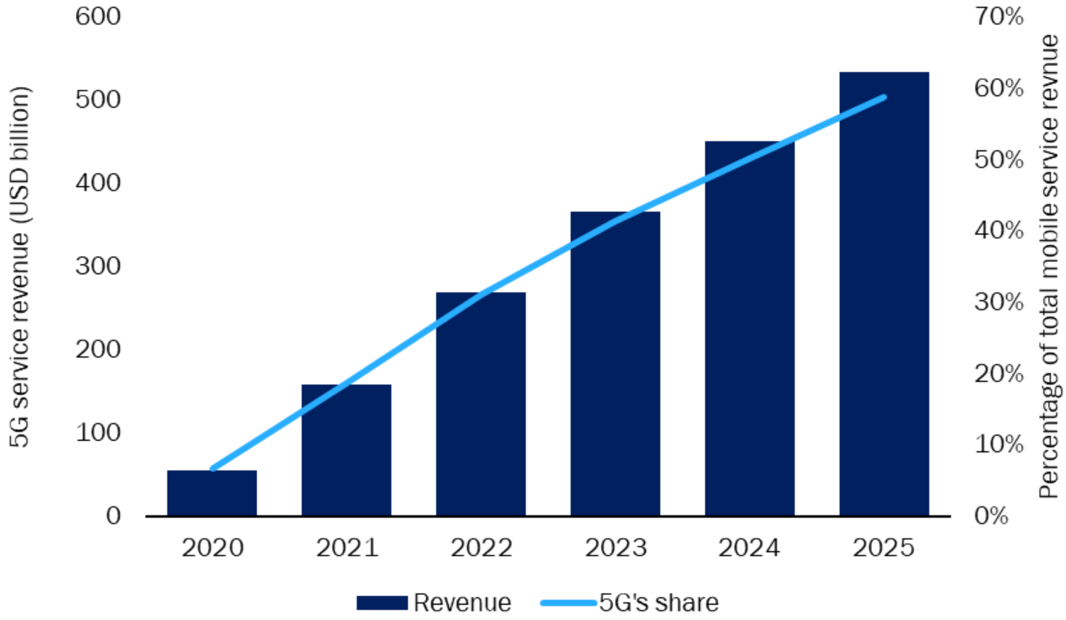
Figure 4.1: Technology waves that are overwhelming operators' IT resources



Source: Analysys Mason

The urgency for change is clear; the number of 5G connections is forecast to grow rapidly and will account for over 35% of mobile connections and 60% of total mobile service revenue worldwide in 2025 (Figure 4.2).

Figure 4.2: 5G service revenue and its share of mobile service revenue, worldwide, 2020–2025



Source: Analysys Mason

5G deterministic networks should be able to support communication service types such as ultra-low latency, mass M2M, narrow bandwidth or enhanced mobile broadband. These service types can then be configured for each customer, which will add considerable complexity to operations requirements.

Each application class can potentially be supported through different network services. In addition, different service types can be offered within network slices enabling enhanced security and reliability for individual enterprise customers. Therefore, network configuration will become driven by the applications and customer requirements that use them, and applications will start to drive the network requirements. Moreover, these services will need to operate dynamically to support the self-service and machine-driven requirements that customers have. The associated service management and orchestration needed to deliver against these goals is estimated to be a hundred times more complex than for today's services that have historically relied on manual processes. The plethora of new service options that 5G has the capability to support, coupled with the desire of customers to configure, operate and monitor through self-service portals will put enormous pressure on these manual processes and will inhibit the ability of operators to recover their 5G investments,

It is widely recognised within the industry that today's manual processes will not be sufficient to support the operational needs for 5G and specifically for 5G standalone in conjunction with network slicing. The common practice of supporting new technologies by adding additional systems without retiring older systems needs to be addressed. 5G is far more complex than previous network generations. The key challenges for future operations systems are therefore that they will need to:

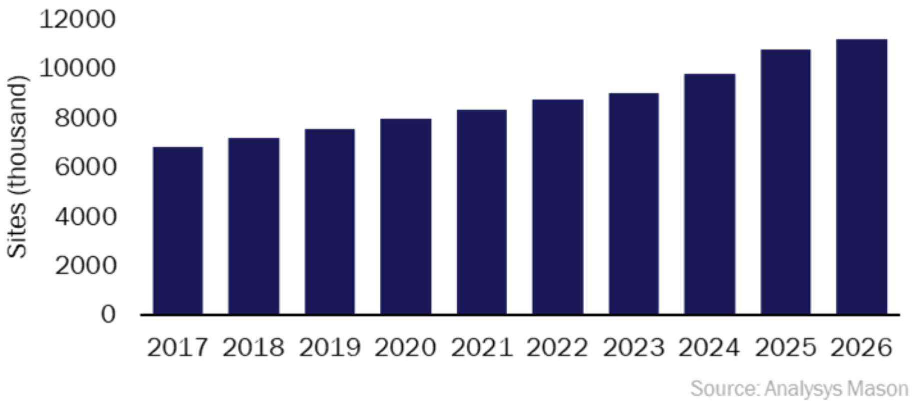
- support 5G network roll-out (physical network, new spectrum)
- support deterministic 5G services and complex service offerings
- be delivered on cloud-native technologies
- use open standards.

4.1 5G roll-out challenges

5G roll-out is a significant investment for the telecoms industry, which will increase to more than USD100 billion in 2022. This reflects the following.

- The increased number of sites required (Figure 4.3), which is expected to be more than 30% more than with 4G, and the addition of New Radio (NR) technology. The number of sites is expected to increase to over 10 million from around 7 million to deliver 5G services over 10 frequency bands, an increase from three main bands.

Figure 4.3: Number of new or upgraded outdoor sites, worldwide, 2017–2027



- The resulting large-scale heterogeneous network is a much more complex environment than with previous generations of network technology.

- 5G frequency bands are aligned to applications classes and to support the characteristics of 5G. These include indoor coverage, high bandwidth requirements and more reliable network coverage, which result in more antennas on 5G NR.

4.2 Support for deterministic 5G services for business

A key characteristic of 5G is its ability to provide deterministic services. It can provide a deterministic and differentiated experience for different applications, vertical industries and customers that are implementing various types of use cases or applications. 5G networks will be able to support the mobile services that are available today but will also be able to deliver virtual private networks with defined characteristics supported by SLAs to enable customers to adopt 5G where previously only fixed-line applications were reliable enough. This will require each 5G service instance to be orchestrated and managed to provide the desired characteristics. As a result, telecoms operators are facing the new challenges of scheduling and orchestration, network slicing within the core network, transport network or the RAN, and monitoring each new service. Deterministic network services may also rely on the use of cloud-native mobile edge compute (MEC) technology, which can flex to meet increased demands from new service types and can be delivered using virtualised cloud infrastructure.

The SLA assurance requirements for deterministic networks will increase as the number of services grows and services become more complex. Each service is likely to need specific SLAs to support and encourage enterprises to move to 5G. Monitoring is key in the success of 5G services if they are to overcome established perceptions that mobile networks are less reliable than fixed for enterprise services. Monitoring enables operators that offer stringent SLAs to present the results, via portals, to their customers. Monitoring systems are also valuable tools and sources of data that can be used to automate actions to address service issues, potentially before any SLA has been violated. Telecoms network monitoring is facing the following key challenges.

- The number of alarms and events may grow too large to manage. SLA-based alarms are often handled by different teams to support different accounts, so the same faults may be handled multiple times.
- Many traditional root-cause analyses rely on manual and static rules, which will become too cumbersome and slow when the network services are set up rapidly by customers using self-service interfaces.
- Manual set rules can be unreliable, and engineers may spend time verifying the alarm accuracy, when there is not a fault.
- Lack of efficiency for engineers because they use many tools, offline operations and multiple steps.
- Wireless engineers demarcate, diagnose and make decisions based on expert experience of a specific network technology, whereas SLAs are for complete services and the diagnosis accuracy is low. As a result, problems cannot be handled in a timely manner, causing more SLA breaches.

The introduction of new deterministic services using the DevOps-based approach, means there are many more changes possible within a network or to the services that are being provided over it. The high frequency of changes needs to be supported with an orchestration layer that can run at the same pace. Older systems that rely on manual processes are not able to provide a high degree of automation and are unable to scale to meet anticipated demand from services.

4.3 Implemented on cloud-native technologies.

Many operators are shifting to cloud-native technologies for their IT systems and network functions. This significant shift enables containerised cloud-native workloads to be run on cloud infrastructure, both public and private. Moreover, the DevOps frameworks and use of CI/CD based technologies enables the amalgamation of development and operational teams to support customers and develop new services more rapidly. Current monolithic systems that are built using legacy development techniques may need considerable re-platforming effort to support new cloud-native technologies and infrastructure. Legacy software that is still using older development environments is grounded in a commercial model that limits the operator’s ability to innovate. Older systems do not support low-code or no-code options that enable operator staff to configure their own services.

Cloud-native technologies enable workloads to be shifted to public, private or hybrid cloud environments within their containers to ensure the most suitable processing of each workload. This allows what were once dedicated network appliances to be disaggregated into VNFs or CNFs and to be run on cloud infrastructure and general-purpose IT hardware. Cloud-native technology therefore gives much greater flexibility for operators that are deploying and building new IT and network functions. However, beyond the initial re-platforming of established applications there are operational challenges to support the CI/CD development processes and the management of the containerization of the functions, which adds operational costs in terms of setting up new tooling, changing development processes and managing the containerised assets. The CI/CD DevOps approach also needs additional governance and testing.

4.4 Use of open standards

The use of open standards to guide the development of next-generation operations systems would enable vendors to collaborate and implement automations using capabilities from installed software solutions.

4.5 Beyond systems and technology

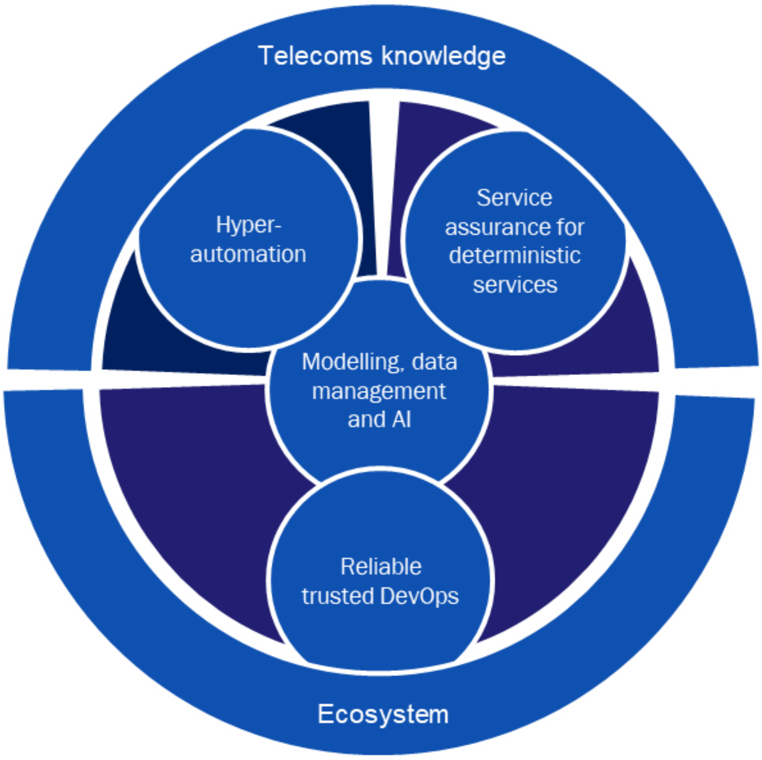
Digital transformation is not just a technology change, but also a re-engineering of an organisation, its processes, people and platforms. These factors are challenging for many organisations that are not used to changing. Proposals to automate or retire older systems are often met with resistance from the incumbent workforce who may be concerned about how these changes will affect them.

5. A new solution and approach are needed

The challenges outlined in the previous chapter have driven advanced operators and vendors to transform their operations systems. Their approach has been to combine mature and tested capabilities together in a highly integrated open platform that addresses the needs of all services and their maintenance. These new systems can support multiple technologies from different vendors in a single platform and key functions ‘out-of-the box’ and offer an environment that enables rapid and trusted development to address each operator’s specific requirements based on their system, network and service needs.

The service orchestration and management platform is a single integrated cloud-based platform that can support deterministic network services. It is able to apply a high degree of automation by using machine learning-informed insights coupled to automation tools. The platform is open, which enables developers to build new functionality flexibly.

Figure 5.1: Key elements of a next-generation service orchestration and management platform



Source: Analysys Mason

5.1 Delivering operations from a single platform

For operators to fully support their customers, it is essential for them to have a single service orchestration and management platform. A standardised approach will enable operators to support an ever-increasing number of new services.

Having a single platform will rationalise technology-specific systems and simplify the management and orchestration between them. In addition, an ability to support the full lifecycle of each service from design, operation, monitoring, and retirement gives continuity that can support the delivery of business intent at scale.

The goal of breaking down traditional operations processes, functions, data and knowledge silos requires operators to adopt a cross-domain, open system that can then apply the data analytics and machine learning to the end-to-end service requirements. This is essential in the delivery of the service experience that customers are now demanding to support their businesses.

The new service orchestration and management platform needs to MASTER the following six key areas:

- Modelling of data and developing insights to support operations functions
- Automations at scale for operational processes using hyperautomation approaches, AI and robotic process automation (RPA)
- Service assurance for new deterministic network services
- Telecoms knowledge of process, integrations and systems
- Ecosystem to support customer and partner developments

- Reliable and trusted DevOps development platform.

These six areas must be addressed when building next-generation operations platforms.

5.2 Modelling of data and developing insights to support operations functions

Advanced operators have accepted that analytics in the form or ML or AI is crucial to supporting their operations requirements. The complexity of service components and configurations, the speed at which they need to change, and the personalisation required means that insights built from ML and AI are needed to monitor, run and predict potential issues. This allows processes that were once only possible to do with highly skilled staff to be delivered using either a fully automated process or by providing support to humans to enable them to be more productive. In general, more predictable, repetitive data orientated tasks are more suitable for use with ML technologies as they can learn the decisioning form historical data, but over time only a few processes will not be suitable for ML-based technologies.

For ML and AI to be implemented effectively in a timely manner requires access to data and skills to develop insights and data models. High-quality trusted data, potentially in large volumes, is needed to ensure that the correct insights can be built. In addition, the data should be complete to ensure that all aspects of potentially impacting insights are considered – these insights may include additional data sources and may include weather information or other information from partners or network suppliers.

The development of insights is done using offline data, but once deployed the use of streaming data for timely inferences is required. Therefore, the management of data pipelines is a critical function of the service orchestration and management platform. It is essential to define the data model into which data can be stored and accessed. Data management includes deriving KPI data sets from raw data to help to reduce the amount of data that needs to be stored and provides business-based metrics that ML tools and humans can more readily understand and consume.

As AI technologies mature and play an increasingly important role, operations systems can move from the traditional heavily manual processes to being data-led and automated.

5.3 Automation at scale

Hyperautomation approaches support dynamic and complex network management functions and processes within an operator or between an operator and its customers or suppliers. Technologies used include the following.

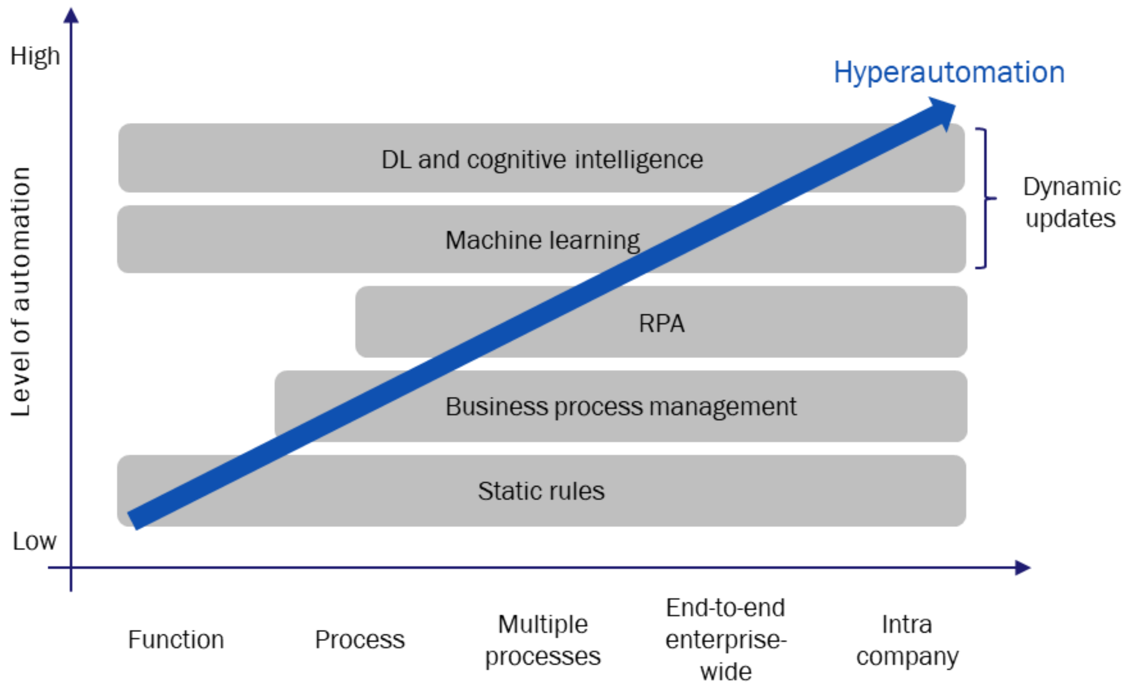
- AI and analytics to create smart data-driven decisions for key processes and the use of ML enables processes to adapt to changes in underlying data and process outcomes to automatically update and adjust processes without necessarily needing manual intervention or re-programming. The technology enables the possibility of applying data-driven automations to many more processes or to provide a much greater degree of accuracy or precision to current processes.

- Cognitive analytics and algorithms can enable real-world data such as natural language or images to be digitalised and understood to enable manual processes to be digitalised and automate, for example using digital imaging and recognition solutions to replace manual data entry by technicians.

- Robotics process automation (RPA) tools to automate manual processes using software robots. The application of RPA robots within telecoms operations and maintenance systems includes their use in repetitive tasks for incident logging, event management, diagnostics management, runbook automation, and field engineering management.

- Event-driven architecture (EDA) that enables complex event patterns to be used to trigger automated processes can improve or replace manual tasks such as anomaly detection in HetNets based on event patterns that signal optimization needs for improved beamforming in 5G cells.
- Intelligent Business Process Management Software (iBPMS) tools that use data-driven insights can be implemented with process automation tools to orchestrate humans, machines, and things in a specified business process. This enables operations teams to automate tasks and activities without heavy coding. iBPMS tools might be supplemented by low-code and no-code tools.
- An integration platform that is delivered using a cloud service, enabling the integration of the application assets to support different automation technologies across different network domains.

Figure 5.2: The combination of technologies that provides hyperautomation



Source: Analysys Mason

Hyperautomation is a key area of service assurance for deterministic network services. It is used to ensure closed-loop automation across different automated tasks, such as detection of service faults, performance analysis, and root-cause analysis. By embracing powerful processes like anomaly management, hyperautomation can detect anomalous events and effectively foster end-to-end management. Closed-loop automation is a critical approach that helps to reduce operational effort, provide holistic automated assurance and complete actions to mitigate or resolve service issues.

5.4 Service assurance for new deterministic network services

5G networks address potentially millions of businesses that were originally served by 'best effort' mobile networks but can now be transformed if they are served using determinate mobile networks. The traditional passive fault handling that relies on manual analysis, decision-making and general network assessment, needs to be transformed with use of AI to shape determinative SLA assurance on a per instance basis to provide a known and planned experience for different business applications carried over a 5G network, potentially for the same business customer.

Deterministic networks offer certainty for applications and users, particularly in B2B engagement models, by ensuring that 'what is signed is what is served'. This means that the key measures that underpin the characteristics required by the end user can be delivered for the specific service. Deterministic networks are achieved through definition, modelling and evaluation of network system reliability based on reliability engineering of network systems, reliability metrics and the operations objectives of the service provider. The definition of the target characteristics is based on multiple perspectives, such as the network equipment, network topology and impacts on subscriber needs. In addition, service management, accurate scheduling, network control, network slicing as well as monitoring each SLA come into play. 5G from 3GPP release 16 onwards can provide deterministic services through network slicing. The network slices can be implemented on the core network (CN), transport network (TN) and the RAN, using network slice management functions (NSMF), with the network slice subnet management functions (NSSMF) on each of the three network portions.

SLA management becomes significantly more complicated as KPIs (typically based on availability, packet loss, jitter, latency and bandwidth) for each network slice instance need to be determined, set up and managed. Network slices are delivered over the CN and TN, but when slices are delivered over the RAN, they are the most subject to change. This is because the RAN is more likely to be vulnerable to challenges associated with interference and usage limitations against radio capability and therefore need careful management.

The operations platform will enable multi-dimensional monitoring of the devices and services. Traditional approaches use only single data sources, thereby limiting the ability to associate a fault or event in a wider context. By including data enrichment to network events, a comprehensive view can be gained on the implications of a specific event, which services and customers are affected and what is the root cause of the problem. The increased accuracy will act as a guide to which actions need to be taken and what priority they need to be given.

Event management that is based on extensive data assets use AIOps approaches to incorporate, monitor, and discover anomalous signs and patterns in day-to-day activities that humans may miss. Based on these anomalies, predictions can be made about impending faults, and actions can be recommended to resolve them. Closed-loop processes and iterative changes to the networks can contribute to the knowledge of the network and only when actions are unclear or further guidance is needed would issues be passed to expert staff.

5.5 Telecoms knowledge of processes, integrations and systems

Operations staff are looking for a rapid resolution to their current challenges and will be expecting a new system to provide some functions swiftly 'out of the box'. The platform needs to be aware of systems and have integrations to network elements, data sources and operational systems. These need to be supported by APIs that conform to industry standards where they are available. In addition, the treatment of data for diagnostics should be provided for common processes with a deep understanding of the specific context in which telecoms companies use them.

Where ML technology is used, appropriate libraries and algorithms that are developed to support specific sets of use cases should be available so that time is not wasted with model training from first principles and examples of data are needed to train models.

For operations personnel that are in urgent need of transformation, the platform provides application orchestration capabilities through platform and service decoupling. The platform provides out-of-the-box assets, including system integration, APIs, operations event awareness, diagnosis, decision-making rules/policies, and an open platform and DevOps mode. This needs to be supported by staff who understand telecoms networks, services, systems and data.

5.6 Ecosystem

Traditional telecoms equipment generally uses dedicated hardware, which leads to low utilisation of network equipment, resulting in high costs. In addition, hardware devices are independent of each other, resulting in poor scalability of telecoms networks, numerous isolated systems and insufficient network openness, which is difficult to adapt to in the 5G era. The rapid development of service requirements is hindered because the network is not agile and efficient, the service roll-out period is long, and collaboration and automation possibilities are lacking.

5.7 Reliable and trusted DevOps development platform

DevOps

Operations processes are unique to every operator, given the complexity of systems, infrastructure and organisational set-up, and will therefore need to be configured, changed and developed to support each operator’s requirements. DevOps approaches are now becoming widely used but their success is based on the trust that the operations and development teams have in the system. Key to building this trust in designing and delivering deterministic network services is ensuring that the underlying data is precise. An integrated next-generation operations platform is a centralised resource and a common development environment that gives a single view of associated data.

The DevOps approach should also use low-code and no-code interfaces to reduce barriers for less-technical staff that will use the system. The ability to manage code and build functionality using modular components enables new functions to be built while quality assurance will be performed on only changed elements, to speed up releases and implement changes swiftly without reducing the quality of the software.

The development environment is a critical element not only for customers, but also for potential partners using the platform. It is important that vendors operators and their partners take a consistent approach to development and testing.

Cloud

The use of cloud-native technology is widely accepted as a key element of every new development. The openness of the platform and its ability to be executed seamlessly running on different environments is important for operators and vendors. This includes running on-premises technology within a private cloud or being executed with a public cloud provider or hybrid architecture. The use of cloud-native technology also enables standard open-source components to be used to develop code, provide data streaming, data storage, monitoring of code and many other functions.

Depending on the region, operators have different approaches to migrating their operational and business systems to the cloud. Some operators in North America are running their core network on public cloud, for example. SaaS-based delivery models have enabled operators to move BSS systems to the cloud, that has helped fuel the growth in CRM systems in recent years, whereas OSS systems have not been migrated to the public cloud until recently. Reducing the total cost of ownership is often the main driver for operators to migrate their systems to the public cloud but using cloud as part of a transformation is another incentive because it saves on the costs of setting up parallel systems. Most operators have some elements of their OSS/BSS running in the cloud, none are likely to run everything in the cloud and some will ultimately only run as little as 10% of their IT on public cloud. The elastic nature of the cloud combined with containerisation of the applications enables flexibility in terms of where workloads can be run, and the resources required to run them.

6. Expected benefits

The introduction of an integrated operations platform is multi-fold; however, the most significant benefit is the ability for operators to recover their investment by launching innovative services that can take advantage of the estimated USD509 billion market that the retail services opportunity is estimated to represent in 2025. Next-generation operations systems have the following benefits.

6.1 Operations efficiency improvement

The operations platform approach enables three primary maintenance improvements as follows:

- It can enable operators to spot potential issues before they become critical and thereby dramatically reduce performance issues with services or the need for active treatment of faults.
- It can enable operators to actively maintain devices before they are likely to fail, which optimises the time to maximise their effective life without causing service issues.
- It uses AI to accumulate and learn from experts and historical data in order to achieve more precise predictions of multi-domain and inter-related failures even for specific network domains, network locations and specific services.

Predictability improves the proactive maintenance capability of the network, reduces the MTTR, and improves the automation of digital operations.

6.2 Resource efficiency improvement

Workforce efficiency

It has been found that even when staff costs are relatively low and staff members are well trained, it may not be possible for staff to meet a dramatic increase in the demand for operations functions. The introduction of an intelligent operations platform provides a level of automation that could enable operational staff to support many more customers. Automation ensures that processes are executed more accurately and can scale with person–machine collaboration to ensure that the cost of running new enterprise services does not rise linearly with their take-up. Even with simpler services that do not include network slicing improvements to operations functions, efficiency is still a significant factor.

Infrastructure efficiency

Intelligent operations systems enable a better use of software, services and hardware that are purchased with more precision. Automated processes help to ensure that resources are used more efficiently because usage predictions are improved, assets can be used nearer to their maximum capacities, stranded assets are tracked and reduced, inventory levels are optimised, and service utilisation and capacity can be appropriately managed.

6.3 User experience improvement

Network design, planning and configuration are automatically performed, and the service roll-out time can be shortened to one tenth of the original time. For enterprises, device and application data is used to achieve optimal user experience based on a closed-loop mechanism. This could enable enterprises to deploy complex global networks in minutes with cloud-network synergy enabled, and network-wide routes automatically advertised and learned, implementing scheduling and routing in ways that are invisible to users. Customers expect to be able to configure services in the same way as they do for other online capabilities, getting quick responses to configuration or service requests.

Deterministic network services must be delivered with SLA agreements. The operations platform will bring new measures to leverage extensive multi-dimensional data to effectively support SLA commitments. This is possible based on the feature programming, for example by location, customer and usage scenarios that apply to the network. By harnessing extensive data, operations platforms can reliably predict service metrics that are required to meet business SLAs.

6.4 Co-operating with partners in an ecosystem

As services are provisioned to customers, some of the components of those products or services are supplied by third parties. Using the same abstraction framework as contained within the operations platform, means that each supplier component can be included automatically in service design and delivery. This enables operators to improve value propositions and enables them to offer hyperscale-like services.

Partners can also take advantage of exposed capabilities of operations platform SDKs, which allow for easy integration and extension of services through APIs and virtualized application functions. This can lead to enhancements that help to bring richer automation of functions through integration on the platform.

7. Case study: CSP in China that uses Huawei’s operations platform

China Mobile, the world’s largest operator in terms of subscribers, has deployed more than 560 000 5G base stations in China, with the goal of covering all rural towns by the end of 2022. The company is targeting consumer services and 19 vertical business markets. As part of the roll-out, China Mobile updated its network and operations systems to better support 5G services. The architecture has been built to conform with TM Forum’s Open Digital Framework, which enables a multi-vendor-based 5G operations ecosystem. China Mobile has used its partnerships with ecosystem partners to build more than 100 use cases for 5G-powered connectivity business and applications in key industries.

5G B2B engagements require service-aware differentiation because enterprise customers that use 5G require stringent SLAs to ensure reliable running of business applications. While mobile networks to date have been run on 'best effort' basis, the ability to support deterministic services is a prime requirement for mobile operators to meet the needs of business-critical applications. An operator's success with 5G services directly correlates to the ability plan, design, maintain and operationalize deterministic network services. Network service instances need to be operated and maintained according to SLA targets.

The applications and enterprise use cases need to be understood in order to ensure that the requested network services are maintained to meet the enterprises' business needs. To accomplish this, China Mobile had to transform its operations culture, people and tools in order to support a fully integrated operations approach around a new single intelligent platform that automates operations activities. China Mobile has re-architected its network and operational systems to enable it to target enterprise verticals with trusted 5G services, without being overwhelmed by the operational requirements that include: assessing each service and the network capabilities required at each location; having the ability to set up network slices and deliver this over their new 5G network; and seamlessly integrating cloud and edge compute infrastructure. The platform uses a common data model and AI management that integrates data on customers, services and network resources. The data model and platform serve as an incubation platform that is also exposed network-as-a-service (NaaS) to industry partners for co-development, co-maintenance and co-value creation.

China Mobile recognises that enterprise customers expect self-service capabilities to enable them to order implement and operate services in a highly automated fashion using NaaS capabilities the same way that cloud and software services are consumed today in IaaS and SaaS offerings. The single operations platform capability is providing a high degree of automation for China Mobile's enterprise (B2B) customers, hiding the complexity of setting up, operating and maintaining services, and helping to manage the end-to-end lifecycle of 5G-connected business using standardized service templates for offers that require slicing, cloud and MEC network capabilities.

The new operations platform builds on software-defined networking (SDN) technologies, combined with IoT, cloud, MEC, data, security and AI to provide what is needed for a deterministic connectivity business capability. This assures high-quality B2B network services for customers in each vertical industry.

7.1 Use cases supported

Efficiency gains for legacy fault and performance management operations

Challenge. Fault management across multiple network domains (RAN, core, transmission etc) is complex and requires extensive skills and cross-domain knowledge by engineers using disparate operations systems. This results in problems that hard to understand, locate and demarcate across different network domains.

Solution. Graph-based technologies were used to represent the state of and interconnections between network nodes, and the operations data held on them. This representation is used to understand and trace how faults propagate through a network thus providing a means to accurately analyse the network and demarcate root causes of network problems. Advanced computer science techniques that rely on neutral networks are used to support this approach. These techniques improved fault-handling efficiency, reduced the workload of operations personnel and improved the experience of enterprise customers.

This use case scenario is based on Huawei's Automatic Alarm Behaviour Discovery (AABD) (Figure 7.1), which provides self-assuring capabilities using cognitive algorithms and expert experience to mine fault propagation relationships using three functions.

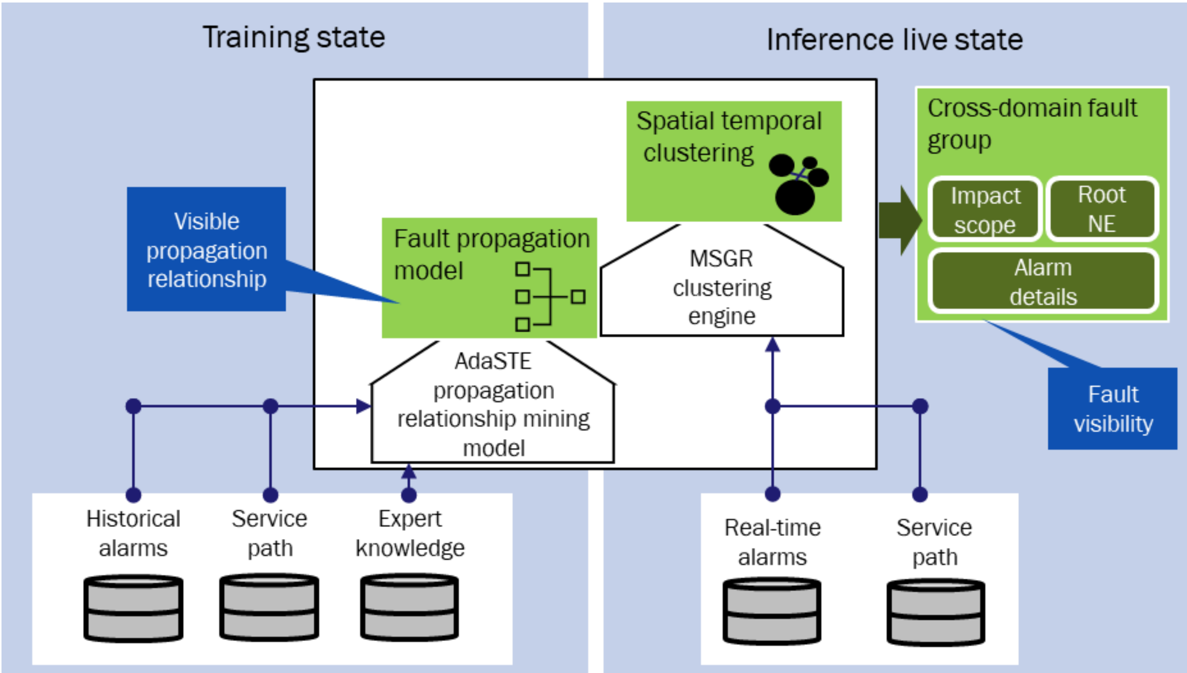
- Fault propagation diagram construction (mining algorithm), which uses AI mining of fault propagation relationships and clustering to build a fault propagation diagram.

- Spatiotemporal clustering, which clusters space-time dimensions with the fault propagation diagram using graph search technology to group faults.

- Root-cause inference is performed based on the fault propagation diagram and expert experience. The combination of the clustering and propagation diagrams is useful when identifying the root cause of alarms and faults that point to specific faults in network equipment.

Benefits. The implementation of this cross-domain service management coupled to multi-vendor wireless access and transport domains increased the fault clustering accuracy to 90% and improved the root-cause identification accuracy to 93%. The impact on the operator was to reduce the number of wireless trouble tickets by 7%.

Figure 7.1: Assurance architecture used by Huawei AABD



Service-aware 5G operations using an intelligent event management platform to detect and resolve service impacts in a timely and effective manner

Challenge. Operations staff have lacked the ability to focus on and prioritize anomaly events that may be having a negative impact on services, and staff were consistently unable to initiate timely corrective activities to mitigate potential service problems.

Solution. Huawei's operations transformation model implemented AUTIN's intelligent Event Management (iEM) solution, which leverages all six areas of the MASTER plan.[1] The solution, built on multi-source data streams from different network and IT domains, systems and devices, is able to provide a simplified visual map of a network service issue or fault. The iEM solution can identify issues and apply closed-loop automation to repair and resolve anomaly events without human intervention. The system analyses operations, runs scripts and

1 For more information, Huawei's AUTIN operations service solution, see https://carrier.huawei.com/en/products/service-and-software/AUTIN.

leverages annotations during each the anomaly event management processing lifecycle using AI/ML technologies and systematized telecoms operations knowledge models.

Knowledge models that underpin the platform are continuously updated to adapt to anomaly event processing changes to reduce repeat processing based on root-cause inferencing or resolution. The efficiency of anomaly event handling is dramatically improved over time as the knowledge models evolve. The increased efficiency reduces the need for human intervention or involvement in maintenance activities. In a complex 5G network, this translates into improved network operations efficiency, and it supports the transformation of the operations workforce.

Benefits. Faults can be identified 85% more accurately in the less than 5-minute window of an anomaly being detected. Faults are automatically demarcated based on expert experience rules with fault demarcation accuracy greater than 80%, and the average demarcation duration of typical faults reduced from 60 minutes to 15 minutes. Along with automatic fault demarcation, the mean time to repair (MTTR) typical faults is reduced by 35%, effectively reducing the impact of 5G network domain (especially core network data service) faults.

8. Summary

Next-generation operations systems must be built on the widely understood technology but need to integrate them and have them applied to the specific needs that telecoms operations functions require. Next-generation systems need to MASTER the following six areas.

- An open platform needs to be created, around which an ecosystem of partners can work using open standards.
- The platform needs a reliable, trusted DevOps development environment on which the vendor, their customers and ultimately their partners in the ecosystem can achieve co-create applications.
- The platform must have data at its core to enable modelling, analytics, and other AI capabilities to be delivered around a comprehensive telecoms-focused data model.
- The systems need to support hype-automations using process automation tools applied with insights and integrations.
- Service assurance is required for the new deterministic connectivity to support new 5G enterprise services.
- Telecoms knowledge must be applied in each stage along with data to guide automations.

Mastering each of these areas in an integrated system requires not only technology and development capabilities of vendors, but the active participation of operators that are willing to implement radical changes to their processes.

9. About the author

Justin van der Lande (Research Director) leads the Applications practice, which is part of Analysys Mason's Telecoms Software and Networks research stream. He specialises in business intelligence and analytics tools, which are used in all telecoms business processes and systems. In addition, Justin provides technical expertise for Analysys Mason in consultancy and bespoke large-scale custom research projects. He has more than 20 years of experience in the communications industry in software development, marketing and research. He has held senior positions at NCR/AT&T, Micromuse (IBM), Granite Systems (Telcordia) and at the TM Forum. Justin holds a BSc in Management Science and Computer Studies from the University of Wales

This perspective was commissioned by Huawei. Analysys Mason does not endorse any of the vendor's products or services.