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Perspective

End-to-end automated telco cloud workflows are critical for driving 5G value

February 2024

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1. Executive summary

1.1 Telco cloud automation is critical to realizing the full value of 5G networks

Operators need to achieve a return on the substantial capital investments that they are making in their 5G networks. Mobile consumer broadband revenue is only part of the 5G ROI; to justify their outlay, operators are also pinning their hopes of new revenue on the enterprise market. The promise of the 5G network is that it will spur an explosion of connectivity-enabled, innovative enterprise use cases that will drive a new Industry 4.0 era[1] with high levels of industrial productivity. Cloud-based 5G networks that can be customized for specific enterprise use case requirements are critical to achieving the Industry 4.0 vision.

The cloud's built-in automation capabilities enable mobile network functionality to be onboarded, deployed and scaled in flexible and agile ways to support new Industry 4.0 services. The cloud-driven automation of the 5G network is the principal key to unlocking the value of a 5G network. Cloud automation reduces the cost of managing virtualized and cloudified mobile networks and ensures that operators can cost-effectively provide and monetize thousands of individual enterprise network slices.

However, operators face the following five challenges (see Figure 1.1) in building cloud-native network automation for 5G networks.

- 5G telco cloud components are multi-layered and diverse because the telco cloud is a multi-vendor environment. Each telco cloud component brings with it its own automation building blocks, which operators must integrate into seamless, end-to-end automation flows so that the entire environment can be deployed, configured and operated as a single network entity.

- Such automation flows need to be created for, and managed, in high-scale, highly distributed telco cloud environments, such as the virtualized RAN.

- Most operators' 5G telco clouds will co-exist alongside 4G telco clouds for some time to come: operators of 4G telco clouds have their own automation approaches that must be integrated into new 5G workflows.

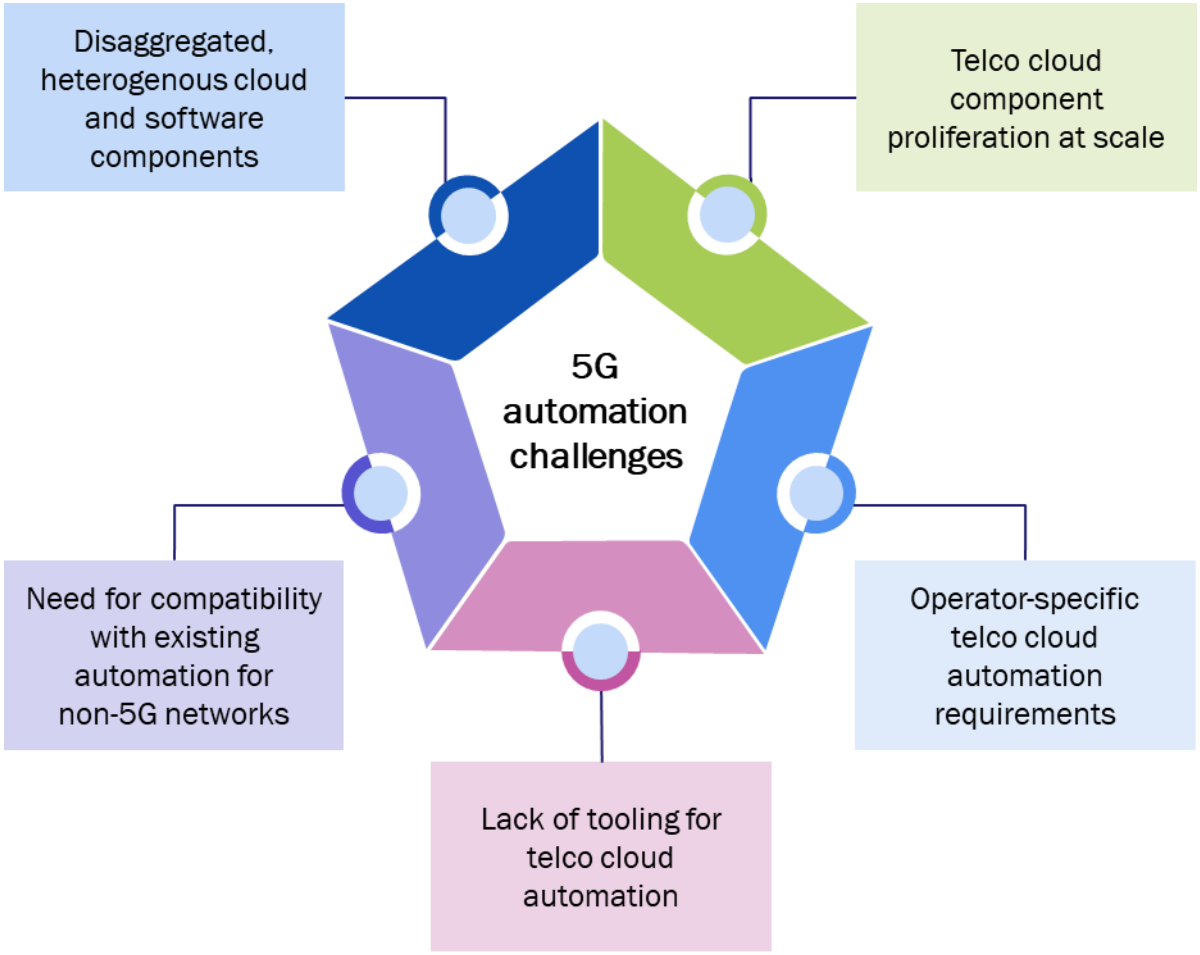
- 5G network automation is not available out of the box. Operator 5G telco cloud components will vary, as will the set of automations associated with those components. Operators will need to manipulate their set of automation components to execute the differentiated operational processes that they have defined and to respond to new customer/service demands over time.

- There is a lack of unified tooling to develop and keep track of end-to-end automated telco cloud workflows and their constituent automation fragments such as scripts and templates.

Without appropriate tooling to address these five challenges, operators will find it difficult to create customized enterprise services in a timely, cost-effective way. This will affect the value that they can generate to fully realize a return on their 5G investment.

[1] Industry 4.0 is a new phase of industrial change brought about by the application of digital technologies to industrial systems.

Figure 1.1: Five automation challenges for the 5G telco cloud



Source: Analysys Mason

1.2 Workflow management is a key facilitator of telco cloud automation

Operators urgently need a workflow management tool that can harness the automation fragments associated with the myriad components in a telco cloud environment and which can integrate them into end-to-end workflows and continuous integration/continuous deployment (CI/CD) pipelines at scale. Such a tool will allow operators to automate complex network deployments in a zero-touch manner and fulfil enterprises' customized service requirements quickly and cost-effectively. It will therefore enable operators to accelerate the time to value and to reduce operational costs.

Operators should look for a workflow management tool that allows telco cloud automation fragments to be stored and manipulated as 'building blocks' that can be orchestrated into process flows through open APIs and reused in multiple flows to save time and costs. Since operators have multi-vendor networks and each network component will come with its own automation fragment, the tool should not distinguish between automation building blocks that have been created by the workflow management tool vendor and those that have been supplied by third-party network component vendors or open-source projects. However, the tool vendor should prepopulate its catalog of automation building blocks with common process flows that are ready to use. Finally, a workflow management tool will need an easy-to-use, developer-friendly, low/no-code user interface for the visual assembly of workflows for Day 0 and Day 1 deployments, testing activities and Day 2 operations, as well

as a dashboard for monitoring and troubleshooting end-to-end process automation flows to understand how they are performing and where bottlenecks or fallouts may be occurring.

There are numerous benefits to a telco cloud workflow management tool. These include the ability to rapidly provision and deploy network cloud-based components and services through customizable, operator-specific workflow process templates, the means of automating operational sequences in a repeatable manner, which eliminates the need for manual intervention across multiple clouds and multiple network function domains. Telco cloud tools are also needed to generate insights into how processes can become more efficient and where manual intervention can be replaced with further automation.

The combined operational cost and time-to-revenue benefits of a workflow tool enable operators to create a compelling business case for 5G network investment. Such a tool is key to fully realizing the returns that operators are seeking from a cloud-based network that can support enterprise customers with unprecedented levels of service customization.

2. Cloud-based automation is essential for driving value from 5G networks

2.1 Mobile networks are central to value creation beyond broadband connectivity

Operators are investing in 5G networks to create new sources of revenue and to drive down operational costs. Operators expect 5G networks to yield significant additional revenue because they can support enterprise use cases beyond business-as-usual revenue from consumer mobile broadband. A growing number of enterprises are choosing to use 4G and 5G mobile networks to replace their patchwork of fixed, Wi-Fi and proprietary radio network technologies in operational environments such as factories, ports, retail stores, stadia and other campus locations.

As the 5G network becomes increasingly capable of supporting ultra-low latency and massive numbers of connected devices, operators anticipate its widespread adoption as a key enabler of enterprise operational transformation. Enterprises are already evaluating and using 5G networks to implement use cases such as automated guided vehicles (AGVs) across campuses, drones for inspection, delivery and public safety purposes, extended reality (XR) in maintenance environments and AI-enabled digital twins. However, most enterprises are still at the beginning of their Industry 4.0 journeys. This means that although the revenue that operators are deriving from 5G enterprise use cases is small today, the potential for growth of enterprise 5G connectivity services (including network slicing) is vast, as industrial transformation becomes a mainstream activity.

Operators will be able to create further value from 5G networks because its capabilities are designed to be exposed to developers through APIs. This will drive a wealth of new applications (both for enterprises and consumers) that can tap into the quality-of-service, enhanced data rates and other 5G features through APIs to transform customer experience and meet individual customers' and application needs.

5G promises to usher in a new era in which networks can be massively customized, but operators will not be able to drive value from such customization unless they can control their operating costs. Network customization today is prohibitively expensive due to the lack of appropriate tools and a shortage of developer expertise with which to build the reusable automation needed to manipulate network APIs and spin up

individual network slices. Operators are under severe pressure to reduce operational spending and they urgently need to see a return on their investment in 5G networks in the form of opex reduction.

Figure 2.1: 5G revenue opportunities for operators

Source: Analysys Mason

2.2 Telco cloud and cloud-based automation are critical enablers of new revenue and cost reduction

The 5G network is the world's first cloud-native network specifically designed to run on a cloud platform. The cloud underpins the programmability of a 5G network, which in turn is key to operators' ability to drive new enterprise value through customized network slices and network APIs.

The cloud is also key to the flexibility and agility with which network functionality can be onboarded, deployed and scaled to support new services. In the cloud, infrastructure and network function lifecycle management processes are inherently automated, which means that the 5G network can be operated in a highly efficient way. Cloud automation reduces the cost of managing virtualised and cloudified mobile networks compared to the cost

of manual operations in physical networks. In the latter, proprietary, hardware-based nature of functions makes automation more difficult and expensive to achieve. Cloud automation also ensures that operators can cost-effectively deal with the rising complexity of software-based networks and their potential to support thousands of individual enterprise network slices.

3. Simplifying the automation of a telco cloud environment is a key operator concern

3.1 The fragmentation of telco cloud automation poses challenges for operators

The cloud provides the automation tools that operators need to maximize the revenue-generating and cost-reduction potential of 4G and 5G networks. However, the selection of the right automation tools is a prerequisite for the full realization of a return on operators' 5G investments.

Creating seamless automation across all the components in a 5G network cloud environment is challenging. Network cloud components are numerous and diverse and include virtualized and bare metal compute, storage and networking infrastructure, virtualization technologies (hypervisors, Kubernetes and their associated management environments), network functions and network services such as user-specific 'slices' of infrastructure/functions. These components are made by different vendors, since the network cloud is a multi-vendor environment, and each component vendor brings its own automation building blocks. The risk to operators is that they end up with many siloed automation fragments that they then need to integrate into a functioning whole.

The diversity of a network cloud environment is compounded by the fact that operators may need to maintain existing automations of 4G network functions and infrastructure while adding automation for new 5G components such as the 5G standalone (SA) core and virtualized RAN functions. At the same time, network components and cloud locations are proliferating as a result of 5G network expansion. Edge cloud locations in a virtualized RAN are highly distributed and the complexity of virtualized RAN deployments must be managed in an automated way to keep costs down.

The heterogeneity of operator network clouds is inevitable since no two operators will have the same set of components and component automations and their cloud maturity can vary, even across opcos belonging to the same operator. Each operator will want to create and manipulate automation in a way that differentiates it in the market by reflecting its specific security policies, testing regimes and high availability requirements. Operators therefore cannot buy end-to-end automation for their network clouds 'out of the box' or from a managed cloud provider. They want the control and flexibility to pull the right automation components together in the right way at the right time to execute operational processes that they have defined, and which may change over time in response to new customer/service demands.

Few operators have formal, cross-domain ways of sequencing their siloed automation components. They must spend large amounts of time keeping track of the custom scripts associated with each component and stitching these together into larger process automations in hand-built ways. The manual nature of such workflow development has a severe impact on the speed at which operators can bring services to market. Operators are unable to rapidly realize service revenue for three key reasons.

- They find it difficult to replicate and scale script-based automation across network functions in a timely manner.
- Automations designed for specific circumstances rather than for reuse are more unreliable and inflexible.
- Script proliferation creates higher maintenance overheads and inconsistent policy implementation.

The viability of key enterprise 5G use cases such as network slicing hinges on the seamless implementation of end-to-end automation and replicable process workflows, so the lack of such a capability will affect an operator's ability to generate new revenue. Fragmented automation components are also a barrier to operator goals to control the costs and complexity of a network cloud environment.

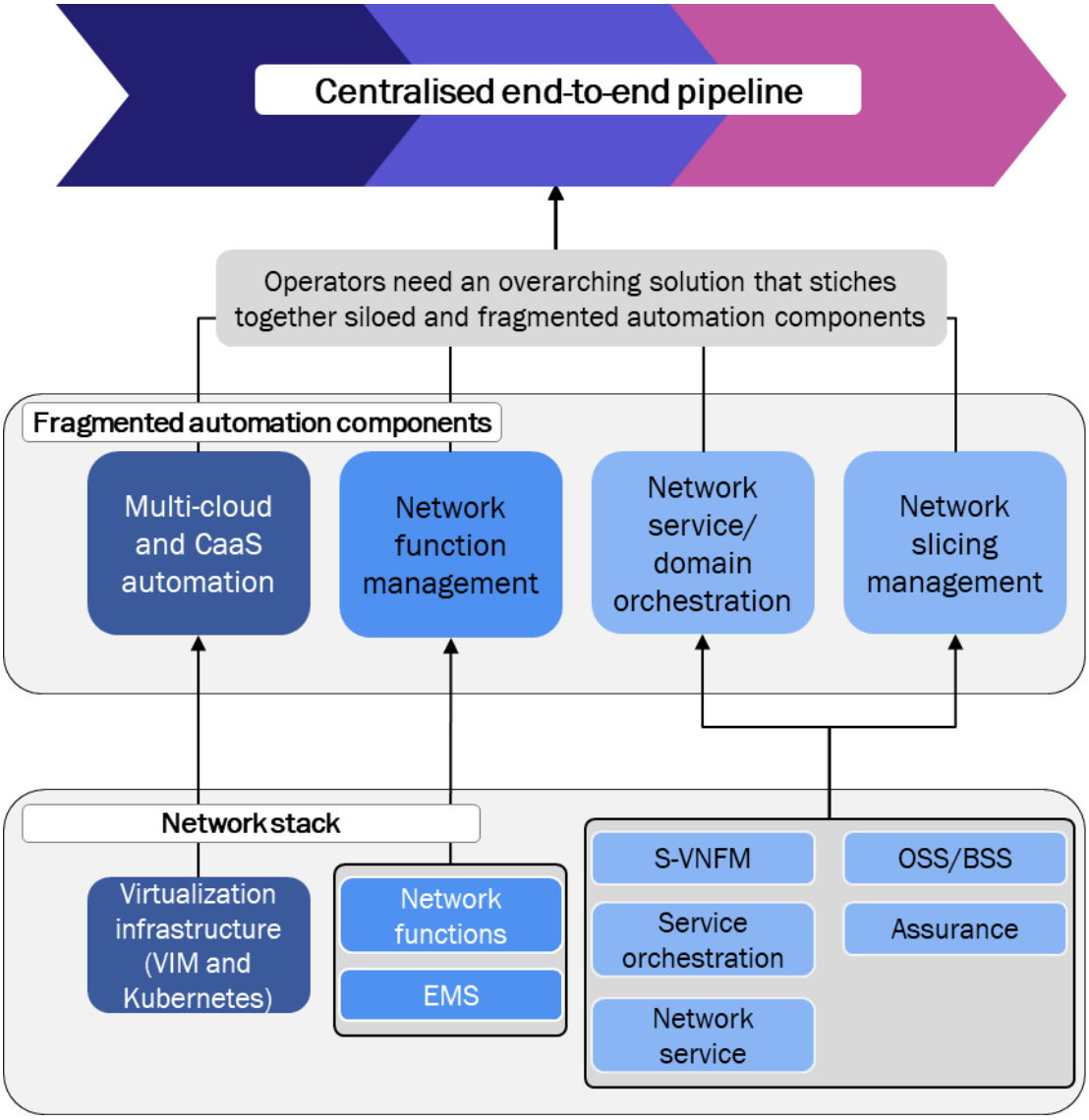
3.2 Operators need a way to streamline telco cloud automation end-to-end

Since automation is so critical to the operation of a 5G network cloud and for reducing the cost and complexity in this environment, it is important that operators have a strong workflow management capability. They need to be able to integrate automation fragments associated with any component into an end-to-end process automation flow that supports new network builds, the roll-out of new services and day-to-day, cost-efficient operations.

In the core, an end-to-end workflow capability is needed, for example, to set up temporary test environments automatically and on-demand for network functions without testers having to custom-configure the network cloud infrastructure underneath. This can accelerate the release of a new version of a running network function, which has to be integrated and tested with multiple network applications and the cloud environment, as well as support the testing of mobile core slices for different enterprise use cases and needs.

The 5G virtualized RAN is another candidate for building end-to-end automated workflows in a disciplined, repeatable way. This is because operators want to carry out zero-touch deployment, provisioning and lifecycle management of thousands of distributed network clouds in new, far-edge cloud locations: at their cell sites. Operators need a means of bringing together automation fragments from the many layers of components that compose a virtualized RAN so that Day 0 and Day 1 activities involved in setting up the function and its supporting infrastructure at a specific cell site can be executed as a single workflow. Day 2 lifecycle management operations across the virtualized RAN functions and cloud infrastructure also need to be defined as a coherent set of workflows that call on automation fragments associated with each network cloud component as they are needed.

Figure 3.1: An end-to-end solution for automating network cloud process flows



Source: Analysys Mason

4. Requirements for a telco cloud end-to-end process automation solution

4.1 Operators need a centralized platform to create and manage automated telco cloud workflows

Operators urgently need a way to harness automation fragments and to parse them into end-to-end workflows quickly and easily if they are to achieve the full value from a network cloud. Such workflows will allow operators to automate complex network deployments, network service fulfilment and network cloud operations at scale, following zero-touch principles that accelerate the time to value and reduce operational costs.

Operators should assess the capabilities of workflow building tools against the following set of criteria.

- The tool should treat automation fragments associated with each component type in a network cloud as 'building blocks' that it can orchestrate into process automation flows through open APIs. These APIs should conform as closely as possible to widely supported network cloud standards, such as ETSI SOL interfaces.

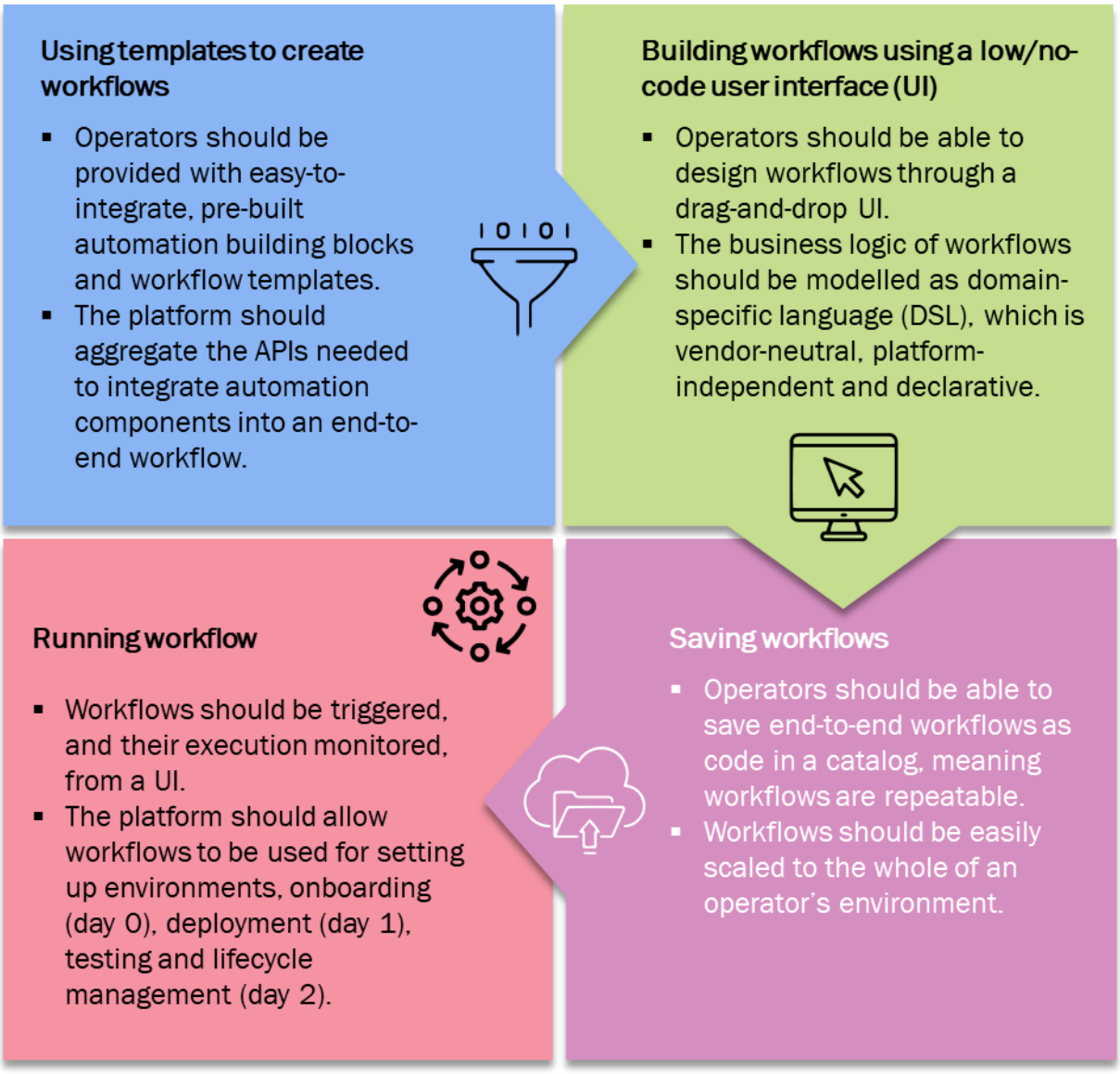
- The tool should be open enough to integrate building block automations associated with each component type in the network cloud regardless of whether these have been developed to support a 4G or 5G network and regardless of building block provider. Building block automations may be built by an operator (for example, by using common ~~open~~ and open-source automation tools such as Ansible, GitHub and Jenkins) or by third-party vendors. Products that support the lifecycle management of network cloud components, including network functions, such as service assurance systems, zero-touch provisioning tools and bare metal automation, should also be able to be encapsulated as automation building blocks that the workflow tool can orchestrate into process flows.

- The tool should come with a set of pre-defined automation building blocks that are stored in a catalog for easy access and reuse. The catalog should be extensible so that operators can add their own and new automation components as their network cloud environments evolve.

- The tool should provide an easy-to-use, developer-friendly, low/no-code user interface for the visual creation of workflows for Day 0 and Day 1 deployment, testing activities and Day 2 operations. This interface will draw on existing building blocks in the platform catalog, as well as help to modify and/or create new automation building blocks that can be added to the catalog.

- The tool will supply a dashboard for monitoring and troubleshooting end-to-end process automation flows to understand how they are performing and where bottlenecks or fallouts may be occurring.

Figure 4.1: Requirements for a network cloud workflow management platform



Source: Analysys Mason

4.2 The benefits of a centralized telco cloud workflow management platform

Operators will gain numerous benefits from a platform that can support the development of scalable and flexible workflows from pre-built and modifiable building blocks using a user-friendly interface.

For example, operators will be able to rapidly provision and deploy network cloud-based components and services through customizable, operator-specific workflow process templates. These templates will specify the individual automation building blocks that are needed to fulfil workflows that span network cloud infrastructure, virtualization environments, network functions and network services and integrate these into end-to-end processes that can be executed at speed and scale.

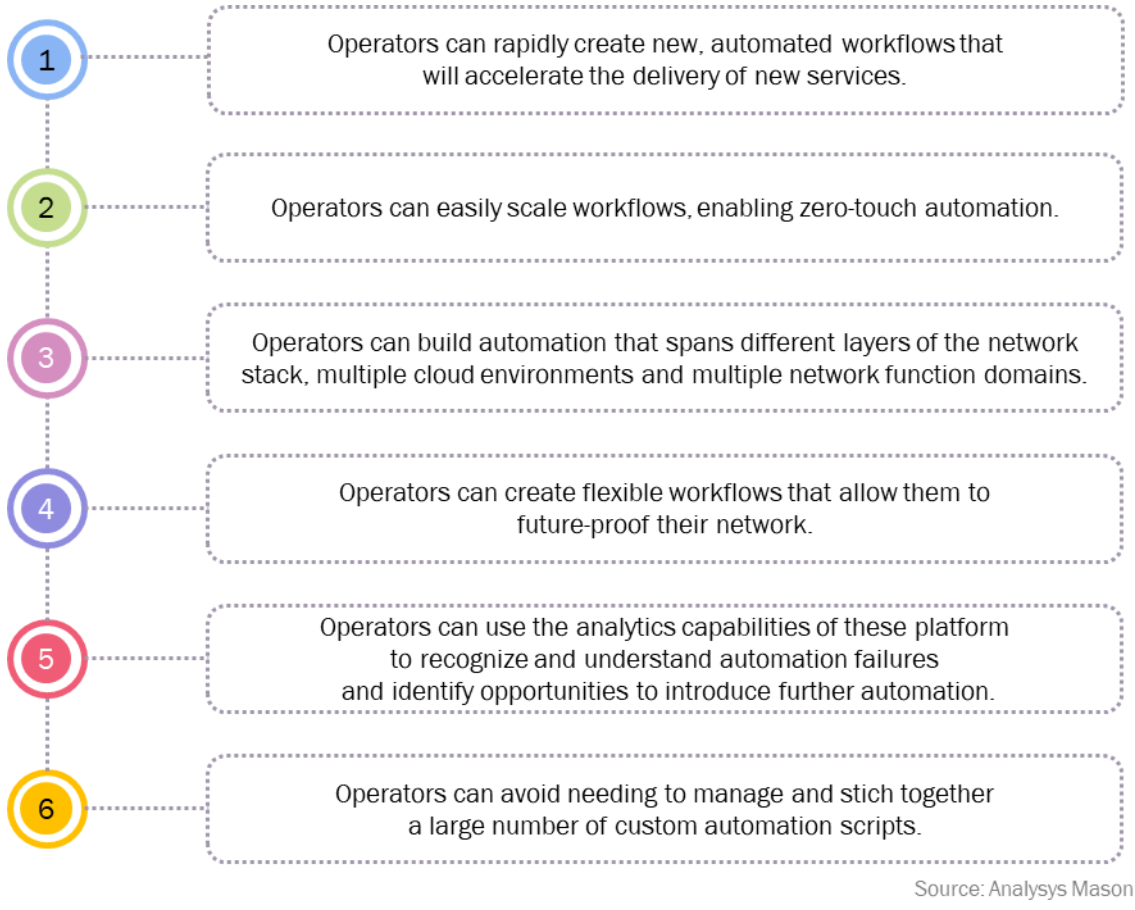
The ability to automate operational sequences with templates that eliminate the need for manual intervention will enable operators to accelerate service launches and create value faster. This financial benefit is deepened by the reduction in operational costs that the zero-touch execution of end-to-end processes can deliver. A workflow

tool that can support such automation across multiple clouds and multiple network function domains (including the automation of workload creation, placement, and lifecycle management in public cloud environments) will enable operators to flexibly deploy and future-proof their networks in case of expansion or changes in network cloud infrastructure strategies.

A workflow tool that can carry out root cause analysis of process failures and capture automation analytics will generate insights into how processes can become more efficient and where manual intervention can be replaced with further automation. This will enable operators to further reduce operational costs.

The combined operational benefits, in terms of costs and time to revenue, of a workflow tool enable operators to create a compelling business case for 5G network investment. Such a tool is key to fully realizing the returns that operators are seeking from a cloud-based network that can support enterprise customers with unprecedented levels of customization.

Figure 4.2: The benefits of a centralized network cloud workflow management platform



Source: Analysys Mason

5. Conclusion

Operators understand that end-to-end process automations for their cloud-based mobile networks can significantly reduce operational costs, minimize errors, and expedite time-to-market for new 5G services. A tool that helps operators build, maintain, and reuse such automations enables them to realize a faster return on their

5G core and RAN investments. Such a tool supports the roll-out at scale of complex new services that are key to 5G revenue generation, including customized network slices that support Industry 4.0 applications.

A workflow creation platform provides operational peace of mind because of the consistency and reliability of automated workflows compared with manual processes. This is particularly important in a cloud-based network, such as the mobile core or a virtualized RAN, which contains multiple components, each of which has its own automation script. A tool that can repeatedly and accurately co-ordinate and execute the many different automation fragments across the layers of a virtualized RAN, for example, is an advantage for an operator that will have to deploy and operate potentially tens of thousands of cell sites.

Operators should ensure that a workflow platform for the network cloud can treat automations as reusable building blocks to maximize operational productivity and minimize the costs associated with automation fragment creation. The tool should be open to ingesting automation building blocks from multiple sources and storing them in a catalog that is easy for process automation engineers to access through a low code/no-code interface. The platform should allow process owners to monitor and quickly troubleshoot their process automations to further drive down costs.

A workflow automation tool with such capabilities is an indispensable key to unlocking the value that operators can generate from their 5G networks.

6. About the author

Ameer Gaili (Analyst) is a member of the Cloud research practice, and mainly contributes to the Cloud Infrastructure Strategies and Edge and Media Platforms research programmes. Prior to joining Analysys Mason, Ameer was a strategy consultant at a boutique management consultancy. Ameer holds an MEng in chemical engineering from the University of Manchester.