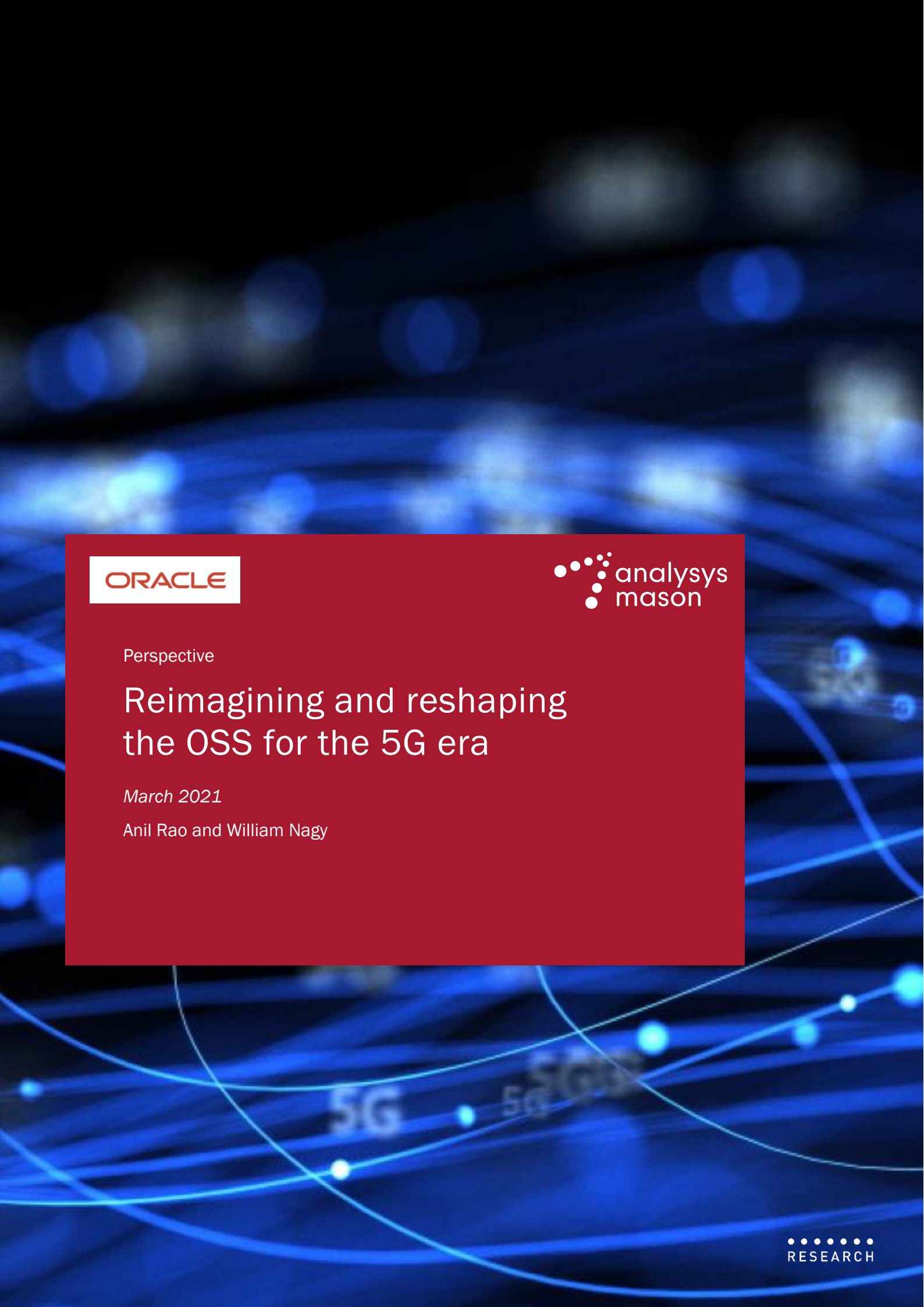

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Perspective

Reimagining and reshaping the OSS for the 5G era

March 2021

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RESEARCH

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1. Executive summary

Communications service providers (CSPs) are undergoing multi-faceted digital transformations with key initiatives such as digitising the front office, reducing opex and improving operational efficiencies, disaggregating and cloudifying the network and launching new 5G services. These initiatives are leading to major changes in the way in which customers interact with CSPs, how IT systems and networks are built and deployed and how services are designed and launched. Back-office operations must be themselves transformed to enable these initiatives.

CSPs must take a three-pronged approach to transforming the back office and making it fit for purpose for the 5G era. The pillars of this strategy are as follows.

- **Rationalise and modernise the OSS by adopting a lean approach to operations with technology based on cloud-native principles.** CSPs need to assess which capabilities they require as they modernise their systems and must define the approach that they will take towards systems consolidation and vendor rationalisation. They can take a best-of-suite or best-of-breed approach to building their OSS, and can increase the level of automation by adopting CI/CD processes supported by DevOps methodologies.

- **Standardise OSS interfaces based on open APIs and abstract the underlying network complexity from the higher-layer management functions.** Standardisation is needed to increase interoperability and the ease of integration between different vendors' solutions. This is particularly imperative for CSPs that are adopting a best-of-breed approach. TMF ODA is a standardisation initiative that has been championed by several Tier-1 CSPs; it is envisioned as a way to simplify, standardise and, most importantly, automate the lifecycle management of the OSS and BSS using software-defined standards.

- **Orchestrate and automate the network to enable localised and multi-domain automation.** Orchestration and automation across network layers and domains is key to achieving a modern and predominantly zero-touch back office that supports physical, cloud-native and SDN-enabled networks. Both resource-layer orchestration and network-domain-layer orchestration will need to have its own level of closed-loop automation, and the end-to-end network and service orchestration layer will unify all the domains and orchestrate based on service intent.

A highly automated back office powered by a digitally transformed OSS will empower the front office, thereby enabling true end-to-end automation from the point of customer contact through to service instantiation, lifecycle management and eventual service termination. This enables CSPs to provide a one-click digital experience to enterprises and consumers. CSPs will be able to increase their focus on service innovation and business growth without the operational limitations engendered by a traditional OSS. Innovative new services such as network slicing will enable CSPs to offer differentiated SLA-based services to enterprises with unique parameters that are specific to the use case. CSPs will also be able to embrace the network-as-a-service (NaaS) business model and will treat the 5G network as a 'networking platform' with API-driven service exposure to support new-generation 5G services, cloud services, security and content delivery services.

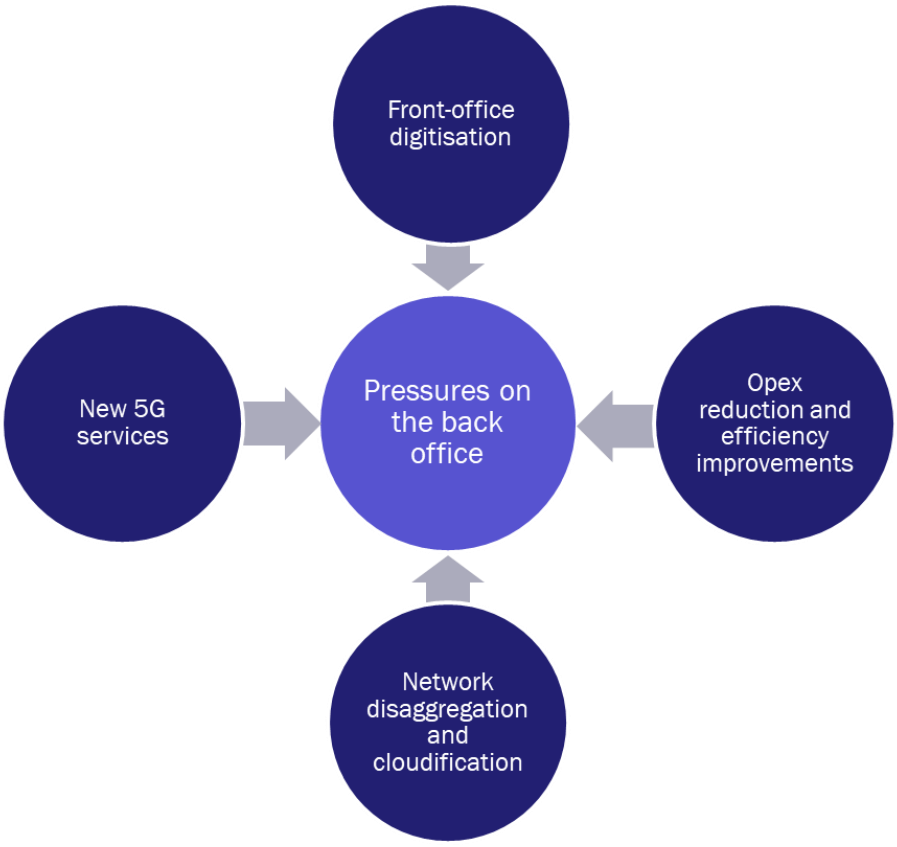
This new OSS paradigm will provide the basis upon which CSPs can work to achieve fully autonomous networks. However, achieving the highest level of network autonomy will entail a multi-year journey that requires a stepwise approach. The key automated OSS functions (automated service design and orchestration,

automated network orchestration and automated assurance combined with ML/AI) will be foundational in CSPs' journeys towards autonomous networks.

2. CSPs must address the key pressure points facing the back office as they prepare for 5G

CSPs are taking a multi-pronged digital transformation journey with the aim of achieving a broad range of goals such as delivering superior customer experiences, increasing service agility, reducing opex and increasing revenue. These initiatives are leading to major changes in the way in which customers interact with CSPs, as well as how IT systems and networks are deployed and how services are conceived and launched. Together, these changes are creating significant pressures on back-office operations (Figure 2.1). We discuss these issues in detail in the following sub-sections.

Figure 2.1: Four key pressure points on the back office



Source: Analysys Mason, 2021

2.1 Front-office digitisation

Traditional customer engagement systems have been plagued by a variety of issues, which have led to very poor customer experience. Many CSPs (and the telecoms industry in general) often perform poorly in customer experience and Net Promoter Score (NPS) surveys. Siloed and disparate information systems, poor user understanding, inconsistent interaction channels and swivel-chair customer service operations have all contributed to this. CSPs have therefore made front-office digitisation and providing a digital experience a top business priority.

A pivot towards digital customer engagement and automated channels that can deliver superior omni-channel experiences are at the heart of this transformation. CSPs aim to provide real-time, consistent experiences across online portals, mobile apps, chat bots and automated attendants that are enabled by conversational AI. These channels must have 24/7 availability and on-demand responsiveness to new service orders, modifications and customer complaints.

***Sprint** (now T-Mobile) transformed its customer experience by modernising its care and commerce platforms. It had been under pressure to evolve its engagement channels because delayed orders and limited self-service capabilities had resulted in poor customer satisfaction. It used microservices and DevOps processes to integrate a modernised engagement platform, thereby increasing its architectural agility and reducing support costs. It was able to decrease the time to market for new offerings, reduce order fall-out rates and regain control of its systems to be able to lead its own customisations in the future.*

The front office and back office still remain operationally siloed, thereby creating a bottleneck in delivering digital experiences due to the inherent dependence on an often unprepared back office. Customer order and service order management systems typically function in an offline mode and lack the functionality to support the digital front office. Continuous availability of the back office, fully automated processing that is responsive to online channels and the ability to support initiatives such as social-media-driven sales campaigns are key success factors that enable CSPs to provide a truly end-to-end digital experience to customers.

2.2 Network disaggregation and cloudification

Cloud technologies and software-defined networking (SDN) are foundational to the next-generation digital infrastructure that can support the dynamic and high-performance services that are required to enable 5G. However, they also introduce unprecedented network and service complexity that must be addressed. Network virtualisation and cloud technologies enable agile resource allocation, which is required to dynamically optimise services. It provides the flexibility that CSPs need to configure network resources in order to create services that are specific to customers' requirements. Network cloudification through the migration to container-based network architecture is necessary to support this agility at the infrastructure level. CSP spending on network cloud infrastructure will grow rapidly and will reach USD31.8 billion worldwide by 2025.[1] Virtualised, cloud-native networks will support lower operational costs and open, multi-vendor architecture, as well as CSPs' transformation to digital service providers. Indeed, Rakuten is already benefitting from a cloud-native network.

1 For more information, see Analysys Mason's Network cloud infrastructure: worldwide forecast 2020–2025.

***Rakuten** is building its cloud-native network with the intent of keeping the total cost of ownership low and enabling the flexibility to deploy new services quickly. It is building its telco cloud network from scratch on container-based architecture, including an edge cloud with 4000 NFVi nodes. Its end-to-end open and disaggregated approach has allowed it to include more than 20 different vendors in the network. These factors let Rakuten pursue targets such as running its network at a fraction of the cost of its competitors' networks and launching twice as many services per year as its peers.*

SDN, on the other hand, gives CSPs programmatic control over network traffic management in the optical and IP/MPLS networks. This programmability is a key enabler of automation and optimisation and means that the network can be more dynamic. CSPs such as Telefónica are eager to capitalise on the benefits of SDN.

*The aim of **Telefónica**'s FUSION strategy is to make the transport network cost-efficient when supporting current and future traffic demands and 5G services (such as network slicing). Telefónica is aiming to abstract the physical network from the management and control layer using standardised REST interfaces. It is taking a hierarchical approach and is using domain-specific SDN controllers to replace traditional NMS. These are aggregated by a cross-domain SDN controller, which in turn integrates with the OSS layer. This approach enables Telefónica to simplify the management of its programmable, multi-vendor transport network through a 'single pane of glass' interface.*

CSPs must have virtualised, software-defined, cloud-native networks if they wish to compete in the 5G era, but they must move away from a traditional OSS, many of which were built for static, monolithic networks, if they wish to succeed. CSPs will struggle to reconcile the agility of the network with the rigid and cumbersome OSS that was built to support legacy voice and data services. The new-generation OSS must provide a host of capabilities to operationalise these networks, such as managing the virtual network functions (VNFs) and containerised network functions (CNFs), supporting the automated lifecycle management of the network services and orchestrating the many different pieces of the network to construct the end-customer service.

2.3 Opex reduction and efficiency improvements

Opex reduction is another key business initiative that CSPs are engaged in to increase profit margins in the face of stagnating revenue. The existing operating model relies on highly manual processes and siloed organisational structures, thereby creating major hurdles to achieving the requisite opex savings. This is mostly because a large number of back-office applications use a variety of commercial products and in-house tools. Furthermore, a lack of common standards means that CSPs have used proprietary interfaces to tightly integrate the applications with each other and with the underlying network.

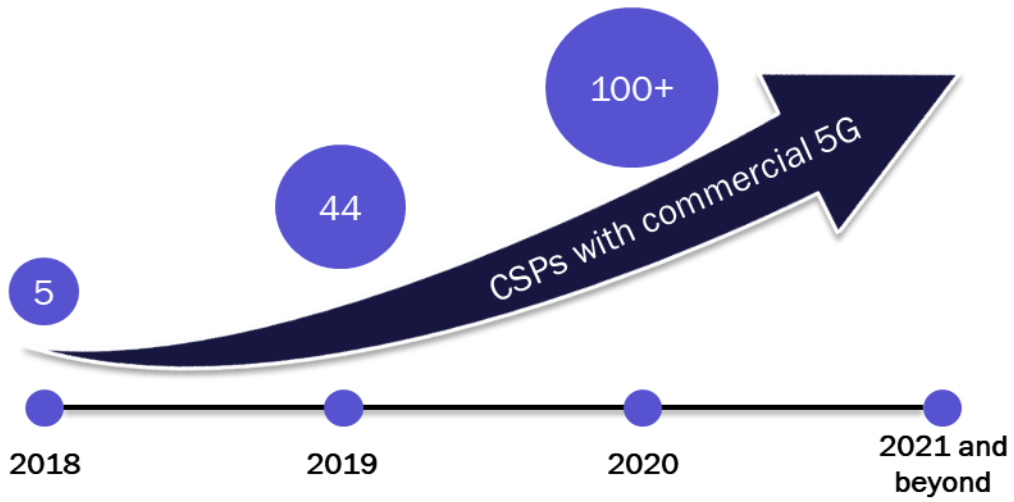
This approach has provided short-term benefits such as the ability to quickly get new products to the market, but it has also created some serious and expensive long-term problems. CSPs need an army of internal and external staff to manage the massive sprawl of diverse systems and integrations, leading to ever-increasing software integration and maintenance costs. Another side effect of this approach is the over-reliance on inefficient manual intervention for routine service fulfilment, activation and assurance activities. Each integration effort is tactical and product-focused, and even when automation is part of the solution, it is inherently limited and, in many cases, impractical to implement. Network engineering and operations departments develop manual processes to work around these limitations, which ultimately become standard operating procedures, and tribal knowledge makes changes very challenging. The introduction of new generations of technologies and network expansions over the years have resulted in further growth in these systems, causing a sustained trend of increasing opex.

The digitisation of customer engagement channels, network cloudification and 5G will only exacerbate the operational efficiency and opex pressures. CSPs must urgently look at ways to increase operations efficiency and achieve sustainable opex levels by transforming the back office. Organisational inertia will act as resistance to such transformations, but the resulting business structure and culture will prove beneficial in the long term. The new modes of operation will require new and different skill sets due to the accelerating convergence of networks and IT. This will provide CSPs with options to redeploy key personnel to more value-adding and strategic positions. CSPs will also be able to use a rewarding career path to attract and retain staff and create a more valuable business as a whole.

2.4 New 5G services

More than 100 CSPs worldwide had launched commercial 5G services using non-standalone specifications by December 2020 (Figure 2.2). Many CSPs have also already started to deploy the 5G next-generation core based on the standalone specifications, which provides brand new capabilities that were not available before. CSPs can use the 5G standalone core to provide a new class of services based on ultra-low latency reliable communication (uRLLC) and massive machine type communication (mMTC) technologies, which will be critical to offering new dynamic digital services to enterprises across many industry verticals.

Figure 2.2: The number of CSPs worldwide with commercial 5G services



Source: Analysys Mason, 2021

Network slicing is seen as a key technology enabler that will allow CSPs to offer differentiated SLA-based services to enterprises. Network slicing enables CSPs to partition the network into logically isolated, separate network slices with unique parameters that are specific to the service supported. Each slice will have differentiated network performance and quality of service parameters that are dependent on the service requirements. 5G networks will be required to support and optimise many diverse slices; each will have to maintain stringent SLAs to guarantee high-quality service.

The combination of 5G network slicing and SDN-enabled transport networks allows CSPs to truly embrace the NaaS business model. These capabilities allow the 5G network to be treated as a ‘networking platform’ that

provides on-demand services and is enabled by API-driven service exposure to support new-generation 5G services, cloud services, security and content delivery services. The on-demand nature of the platform will require specific OSS capabilities such as auto-scaling to support dynamic service creation and security and assurance to provide performance guarantees. Full visibility and analytics can be sent back to the customer to provide additional differentiated service offerings. Ultimately, the NaaS business model enables CSPs to create a network service marketplace for enterprises, and its success will depend on a highly modernised back office.

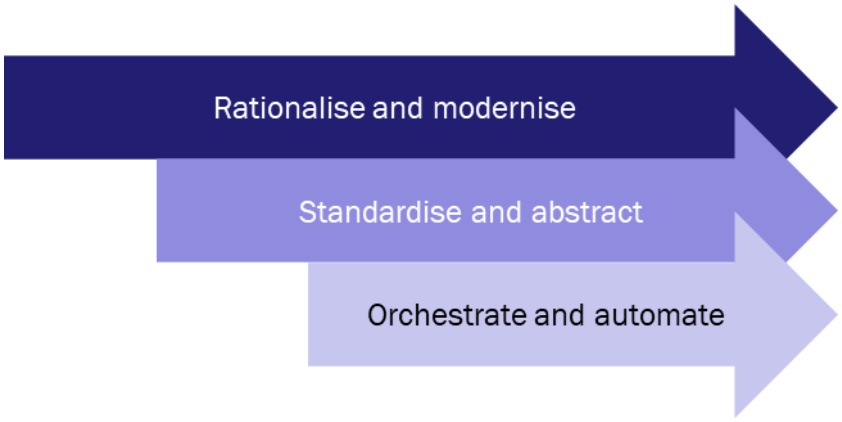
3. A modern and automated OSS will reshape the back office

CSPs may need to re-evaluate their current approach to back-office operations to address the pressure points discussed above. CSPs should look to loosely couple, but tightly integrate, the front and back office in order to simplify and automate the OSS estate and deliver superior customer experiences, achieve sustainable opex, manage the complexity of the new digital infrastructure and enable new 5G services.

3.1 A three-pronged approach is required to achieve an automated OSS

CSPs need to take a multi-pronged approach to transform the back office and make it fit for purpose for the 5G era. Figure 3.1 depicts the three cornerstones of this strategy. The journey to an automated back office will be gradual, and each of the three proposed streams will potentially progress in parallel, but the transformation path and the pace of transformation will depend on the current state of the CSP's OSS estate, the level of automation and the overall digital transformation strategy.

Figure 3.1: Three-pronged strategy to automating the back office



Source: Analysys Mason, 2021

Rationalise and modernise

Most large CSPs have a plethora of OSSs to perform a variety of functions such as customer order management, service order management, service provisioning and activation and configuration. These systems have been procured from a combination of equipment vendors and independent software suppliers, as well as through mergers and acquisitions and internal ad-hoc development to support unique requirements. Consequently, large

CSPs such as Tier-1 group operators with multi-country operations have to manage hundreds, if not thousands, of legacy OSS components in their operations, which is cumbersome and expensive. Therefore, OSS rationalisation and modernisation should be a key priority for CSPs.

Adopting a lean approach to operations facilitates agility and provides more clarity to the operational architecture. The traditional, monolithic solutions that have supported legacy services have introduced redundancies in capabilities across different tools. CSPs need to assess which capabilities they require as they modernise their systems and define the approach that they will take to systems consolidation and vendor rationalisation. CSPs can take one of two approaches to vendor rationalisation, as described in Figure 3.2.

Figure 3.2: Approaches to vendor rationalisation

Approach	Description	Benefits
Best of suite	CSP uses a single vendor to provide a fully integrated OSS software stack	• Single point of contact • Simple integration • Unified user experience
Best of breed	CSP uses multiple vendors to construct the OSS layer and chooses the best product for each function individually	• Highly flexible • Choice of vendors • Reduces vendor dependency • Best component for each function

Source: Analysys Mason, 2021

Modern OSS technology must be built using cloud-native principles, that is, it must be based on containers and microservices. This will enable the software to be designed as well-defined, service-oriented functional blocks that serve specific purposes and scale independently of other microservices. This new architecture facilitates the 'only consume what you need' approach, akin to the cloud and 'as-a-service' models. Furthermore, the use of containers (such as Dockers and Kubernetes) with microservices architecture makes the OSS compatible with any cloud and sets CSPs up to migrate their OSS applications to a cloud environment when they are ready.

The adoption of CI/CD processes supported by DevOps methodologies is another key route to increasing automation. DevOps enables CSPs and their vendor partners to co-develop tailored solutions to address CSPs' specific needs. The move to containerised solution architecture ties in with this development model because containers provide a standardised environment for applications, thereby enabling rapid software development. The use of DevOps requires close collaboration between CSPs and vendors, and highly skilled software engineers are needed on both sides. The decreased time to deployment for applications will be critical to enable CSPs to quickly adapt to changing business, service and network demands.

Standardise and abstract

Standardisation is needed to increase interoperability and the ease of integration between different vendors' solutions. This is particularly imperative for CSPs that are adopting a best-of-breed approach. A blueprint operational architecture will help with standardisation efforts. This could be internally developed or based on an industry blueprint such as those from the TM Forum (TMF), MEF Forum or the European Telecommunication Standards Institute (ETSI).

***Vodafone** has applied TMF's Open APIs programme to automate its DevOps and is working to develop integration standards to simplify, automate and standardise OSS/BSS integration. Vodafone strives to go beyond TMF's current blueprint: the TMF Application Framework (TAM). TAM provides a standardised language for software integration, but lacks the specificity required for simplified integration and interoperability. Vodafone intends to use TMF Open Digital Architecture (ODA) to move away from RFPs and towards PoCs to rapidly test different software to find what is best for its network. Vodafone, Orange and BT are leading the TMF ODA project.*

The TMF ODA project is an initiative that aims to provide a platform to help CSPs to adopt the software collaboration and development models of cloud-native companies. It is envisioned as a way to simplify, standardise and, most importantly, automate the lifecycle management of OSS and BSS components using machine-readable, software-defined standards. TMF ODA also enables CSPs and vendors to develop open APIs for OSS/BSS that are interoperable and consistent across users. It delivers standardisation through an architecture framework, common language and design principles with common data architecture and modularity. The ODA component accelerator project is taking this initiative forward with a platform that provides a code-based reference implementation and test environment for collaborators to develop, experiment and share software developments.[2]

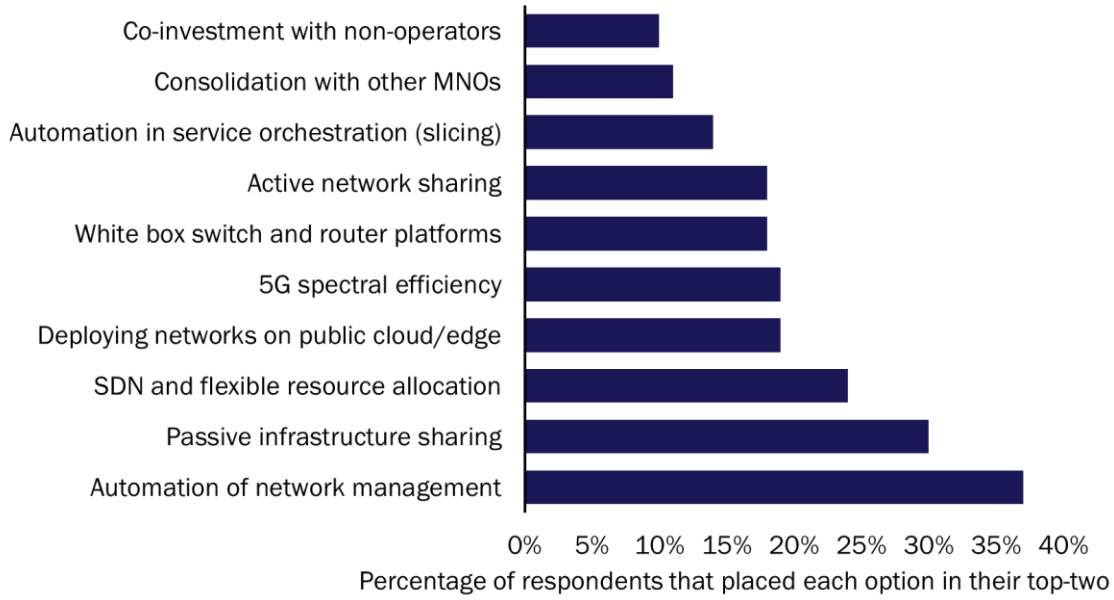
Open APIs are also valuable because they alleviate the risks involved in 5G network transformation initiatives such as network cloudification and SDN. They enable CSPs to treat the network as a platform by abstracting the network complexity of existing legacy networks, the cloud and SDN technology. Network abstraction allows CSPs to control and manage the network through clean and simplified northbound and southbound interfaces rather than having to deal with multiple interfaces for different parts of the network.

Orchestrate and automate

Orchestration and automation across network layers and domains is key to achieving a modern and predominantly zero-touch back office that supports physical, cloud-native and SDN-enabled networks. The automation of network management is a top priority for CSPs worldwide in order to reduce operating costs in the 5G era, as illustrated by the results of an Analysys Mason survey (Figure 3.3). CSPs will require multi-layer orchestration that can provide automation and synchronisation across the resource, network and services layers of the network to achieve opex reduction in an increasingly complex network.

2 TM Forum (2020), *Leading Telecoms Companies Collaborating to Build Market for Plug-and-Play Software*. Available at: https://www.tmforum.org/press-and-news/leading-telecoms-companies-collaborating-to-build-market-for-plug-and-play-software/.

Figure 3.3: Key contributors to reducing operating costs in the 5G era[3]



Source: Analysys Mason, 2021

Resource-layer orchestration will automate network resources using a common abstraction and management layer for the VNFs and CNFs in the case of the network cloud, and SDN-enabled network management systems in the case of the transport network. Integrating assurance functions such as monitoring and analytics at this level will enable resource management functions to perform localised or tactical closed-loop orchestration to maintain optimal resource health. The management layer can resolve issues without escalating the actions to domain-level orchestration, thereby creating additional computing efficiencies.

Network-domain-layer orchestration or a domain-level SDN controller will perform the lifecycle automation of the domain-level services that are formed of a combination of VNFs and CNFs (specified as NFVO by ETSI). This will consume the resource-layer automation as a service. Each domain will require domain-level intent as well as specific policies and governance to optimise resources and enable local automation as per the services it supports. A domain-level assurance platform with domain-specific intent will allow the monitoring techniques and analytics applied at this level to be highly targeted towards the parameters and directives of the domain in question, thereby enabling closed-loop automation of the domain.

Finally, the end-to-end network and service orchestration layer will perform multi-domain automation and configuration of the services across the network domains (network cloud and SDN domains), potentially in a multi-cloud environment. It will also monitor the health of the end-to-end service. The network and service orchestration will govern the service intent for network slices and NaaS-based services, which in turn will dictate the network intent for each domain. The end-to-end layer will be responsible for monitoring and maintaining SLAs and aggregating service analytics to drive service-level (or strategic) closed-loop assurance and orchestration.

3 Survey of Tier-1 and 2 MNOs, worldwide, carried out in 4Q 2020. Question: "What are the two most significant contributors to reducing opex?"; *n*=79.

Telefónica, Deutsche Telekom, Orange and Vodafone have joined forces to develop standardisation for the transport SDN architecture. These CSPs are working under the Telecom Infra Project's Open Optical and Packet Transport group to develop standard technical specifications for northbound and southbound interfaces in the transport domain. Northbound interfaces in the optical domain will use ONF T-API 2.1/2.2 and those in the IP domain will use RESTCONF/YANG and OpenConfig from the IETF.

3.2 CSPs can deliver a truly end-to-end customer experience where the automated back office works in harmony with the digital front office

A highly automated back office will empower the front office, thereby enabling truly end-to-end intent-driven automation. As discussed above, the automation of the back office provides the necessary service agility, dynamic control, low-cost economics and rapid fulfilment and orchestration capabilities that are needed to support the real-time interactions provided by the digital front office described in section 2.

This end-to-end automation from the point of customer contact through to the service instantiation, lifecycle management and eventual service termination enables CSPs to provide a one-click experience to enterprises and consumers. Such digital user experiences provide the customer with increased flexibility and control and will go a long way in enabling CSP differentiation, thereby improving customer perception and loyalty.

3.3 A modern, automated back office will give control back to the CSP

The move to a modern and automated back office enables CSPs to focus on service innovation and business growth without the operational limitations engendered by a traditional OSS. Automation will greatly transform CSPs' opex economics. The highly manual, labour-intensive processes can be codified into reusable software modules with decision trees and manual overrides for operations engineers. CSPs can gradually move from guided automation to zero-touch automation as the operational trust in automations increases.

Additionally, the adoption of cloud-native software development processes signals a significant paradigm shift for CSPs and enhances their ability to attract highly skilled IT talent. The competition to acquire and retain high-quality software engineers has increased dramatically thanks to hyperscalers and digital-native tech firms. These companies have almost had a monopoly on top-tier software development personnel over the last decade due to the opportunities for new challenges and rapid innovation that they provide. CSPs that are pursuing transformation initiatives will be able to swing the balance back to a more even playing ground and accelerate their journey to become digital service providers themselves.

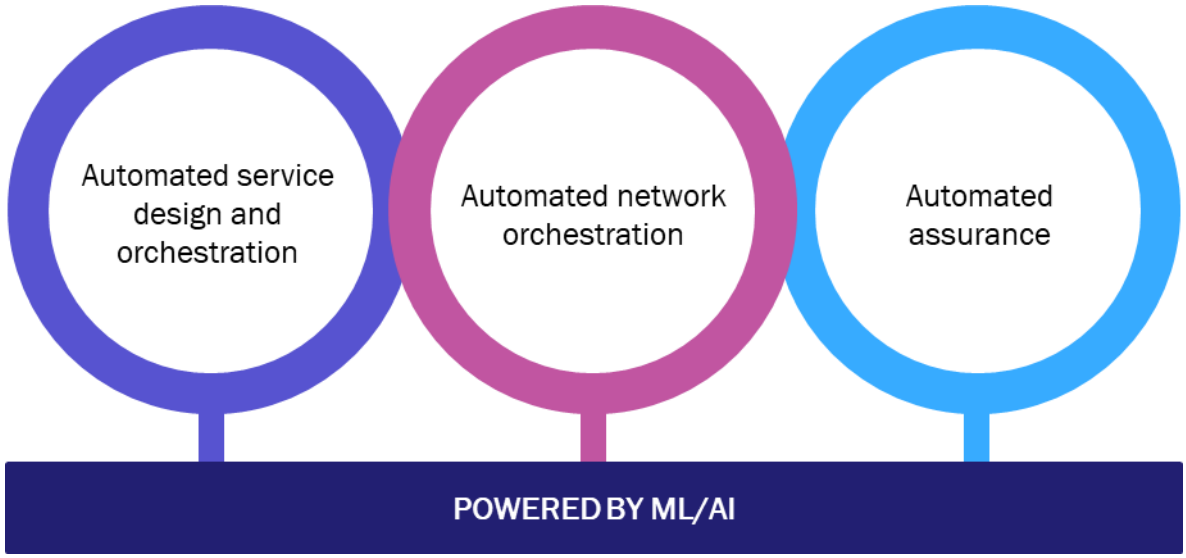
4. A modernised OSS will enable the journey to autonomous networks

The new OSS paradigm outlined above will also provide the foundation upon which CSPs can work to achieve fully autonomous networks. Different levels of autonomous networks are possible, defined by the level of human intervention required. A fully autonomous network possesses closed-loop automation of the full service lifecycle across all domains, as explained above.

However, achieving the highest level of network autonomy will entail a multi-year journey that requires a stepwise approach. Various industry initiatives are developing high-level frameworks for autonomous networks.[4] Analysys Mason believes that CSPs will need four key, highly interworking OSS pillars to achieve the goal of autonomous networks (Figure 4.1). These are:

- automated service design and orchestration
- automated network orchestration
- automated assurance
- ML/AI to power the above three.

Figure 4.1: The four key pillars of autonomous networks



Source: Analysys Mason, 2021

Service design and orchestration systems enable the automated network planning, design, roll-out and service design functions that are supported by automated customer and service order orchestration. These systems manage and automate the critical functions for turning business intent into service intent. They also design services by decomposing the customer request (business intent) into network service requirements. Network orchestration systems translate service intent into network intent. They also manage and dictate the network resource lifecycles within and across domains, as well as those in distributed edge clouds and central clouds, and ensure that they are activated when and where required, and are reconfigured as needed.

A robust assurance platform is essential to support automation at every layer and domain of the network. The assurance platform monitors network and service performance and integrates with higher-level orchestrators. Predefined, intent-driven policy rules and governance that are based on the service intent will be used to assess service performance and trigger automated actions in the network orchestrators. The assurance applications are powered by ML/AI and will predict and pre-empt service degradations by raising alerts when the network falls out of optimal operating parameters and triggering self-healing routines. Tight integration of the assurance and network orchestration systems will be critical to enable the various closed-loop mechanisms discussed above.

[4] TM Forum (2020), *Autonomous Networks: Empowering Digital Transformation for The Telecoms Industry*. Available at: https://www.tmforum.org/resources/whitepapers/autonomous-networks-empowering-digital-transformation-for-smart-societies-and-industries/.

ML/AI will provide key insights to strengthen the three other OSS pillars and enable the delivery of digital transformation goals with minimal human intervention. Embedding ML/AI in all layers of the operational stack will ensure that the execution of ML/AI and the subsequent actions is done close to the point of need.

Networks will become more autonomous as the levels of trust in ML/AI increase. Network engineers can constantly evaluate the accuracy of predictions in the early stages of implementation, and can retain control of the actions to perform automation. Trust will increase as the prediction accuracy increases, and engineers can switch on full ML/AI-based closed-loop automations once they gain full confidence in the system. This is achieved through re-enforced feedback loops in which operations engineers rate the predictions and suggested courses of action, thereby refining the model over time.

5. Conclusion

CSPs are in the midst of a multi-year digital transformation journey with the goals of delivering superior customer experiences through digital front-office systems, deploying new digital infrastructure for 5G while constantly trying to reduce opex and launching new revenue-generating services. These initiatives are putting significant pressure on the traditional back office, and are rendering it inefficient and unfit for purpose. CSPs need to adopt a modern and automated OSS for the 5G era.

CSPs need to execute a three-pronged strategy for their OSS transformation. They must:

- rationalise their OSS estate and migrate to cloud-native architecture
- standardise and abstract OSS integrations using open APIs to simplify systems integration
- orchestrate and automate the network to manage complexity and automate the network and service lifecycle.

The actual path and speed of the CSP transformation journey will depend on the starting point, that is, the current state of the CSP's OSS estate and associated operational processes, the current level of automation and the overall aims of their digital transformation strategy. CSPs will need to finalise a blueprint OSS architecture for the desired state and execute a best-of-breed or best-of-suite deployment strategy.

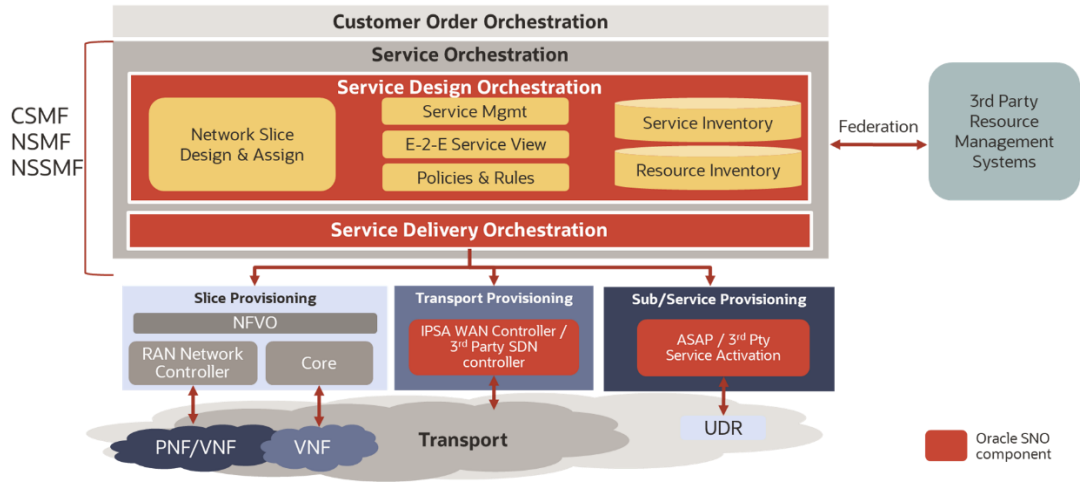
CSPs must embrace cloud-native and microservices-based architecture to make the OSS flexible and composable, with the ability to be deployed on any cloud. A modern OSS that is built on these modern software design and engineering paradigms, combined with DevOps and CI/CD principles, hands the control back to CSPs because it enables them to significantly increase the pace at which they can roll out new features and updates, thereby accelerating the pace of service innovation and time to revenue for new services. Furthermore, it bolsters CSPs' position in the ongoing competition for software talent with hyperscalers and other companies born in the cloud.

The digitally transformed OSS, together with the digital front office, enables a truly end-to-end digital experience for consumers and enterprises. The key automated OSS functions (automated service design and orchestration, automated network orchestration and automated assurance), combined with ML/AI, will be foundational in CSPs' journeys towards autonomous networks.

6. Oracle solution description

Oracle's Service and Network Orchestration solution (Figure 6.1) provides the multi-service, multi-domain orchestration of consumer and enterprise services delivered over virtual, software-defined, cloud and traditional networks.[5] It decouples commercial offerings, services and resources from their technical implementation using a 'product–service–resource' model that drives the behaviour for each domain using a coherent set of modular configurations.

Figure 6.1: Overview of Oracle's Service and Network Orchestration solution for 5G services



Source: Oracle, 2021

Oracle's Service and Network Orchestration solution rapidly supports the introduction of net new services and technologies. It also enables CSPs to transform brownfield environments due to its open, modular nature. It focuses on the immediate areas of need and allows for gradual systems consolidation and retirement. Its cloud-native nature means that it supports fast deployments, upgrades and auto-scaling, as well as reduced/eliminated maintenance downtimes. It can be deployed and controlled on public clouds or on-premises. It supports DevOps practices with CI/CD pipelines and contemporary cloud-native tools for the rapid launch of differentiating services.

Oracle's Service and Network Orchestration solution supports key industry standards including TM Forum's open APIs and standards from bodies such as ETSI, 3GPP and MEF Forum. These standards and the openness of Oracle's solution empower CSPs and/or their systems integrators to fully control and manage the end solution. They are also instrumental in supporting new services and technologies such as 5G[6] thanks to the:

- rapid design, deployment and lifecycle management of 5G network slices and end-customer 5G services
- configurable order orchestration of 5G network slices by geography, bandwidth and quality of service
- support for eMBB, URLLC, mMTC slices and variants
- end-customer order orchestration on pre-defined 5G slices
- service orchestration through intelligent, 5G-aware service design

5 *Oracle Communications Service and Network Orchestration*. Available at: https://www.oracle.com/industries/communications/service-providers-applications/products/service-network-orchestration/.

6 Oracle (2020), *Delivering 5G Services with Oracle's Service and Network Orchestration*. Available at: https://www.oracle.com/a/ocom/docs/industries/communications/comms-deliver-5g-now-network-wp.pdf.

- technical order orchestration with 5G service activation
- network orchestration of virtual and physical 5G network functions.

In summary, Oracle's Service and Network Orchestration solution is proven, deployed worldwide and referenceable at scale for current and next-generation services and technologies. It currently orchestrates over 10 million orders per day across some of the largest CSPs in the world.

7. About the authors

Anil Rao (Principal Analyst) is the lead analyst on network and service automation research that includes the *Network Automation and Orchestration*, *Automated Assurance* and *Service Design and Orchestration* research programmes, covering a broad range of topics on the existing and new-age operational systems that will power operators' digital transformations. His main areas of focus include service creation, provisioning and service operations in NFV/SDN-based networks, 5G, IoT and edge clouds; the use of analytics, ML and AI to increase operations efficiency and agility; and the broader imperatives around operations automation and zero touch networks. In addition to producing both quantitative and qualitative research for both programmes, Anil also works with clients on a range of consulting engagements such as strategy assessment and advisory, market sizing, competitive analysis and market positioning, and marketing support through thought leadership collateral. Anil is also a frequent speaker and chair at industry events, and holds a BEng in Computer Science from the University of Mysore and an MBA from Lancaster University Management School, UK.

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