Network automation is key to delivering significant opex reduction and increasing agility in the 5G era
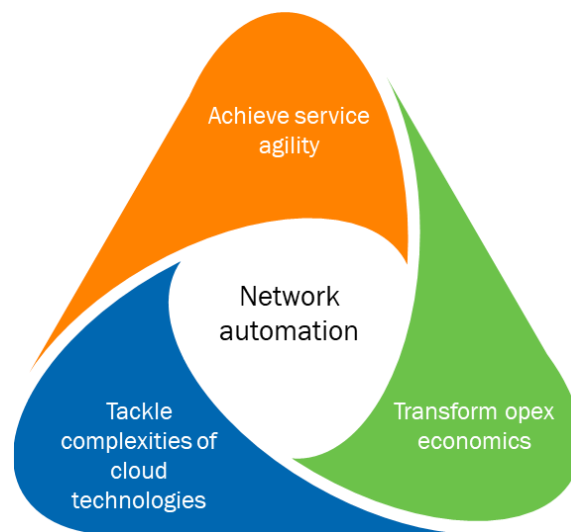
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Communications service providers' (CSPs') success in the 5G era will be defined by their ability to launch and operationalise new digital services for a fraction of their operating cost and to enable the digital transformation of enterprises. However, the existing telecoms operational model is not fit for purpose for the 5G era; business processes such as network design and planning, network roll-out and provisioning, assurance, operations and maintenance are highly disjointed and often require manual interventions and manual inter-departmental handovers, resulting in high opex and limited service agility.

The new operational model must deliver service agility, significantly reduce opex and tackle the complexities of new foundational technologies such as virtualisation and the cloud (Figure 1). Network automation is the key to achieving these goals and provides the foundation for autonomous operations.

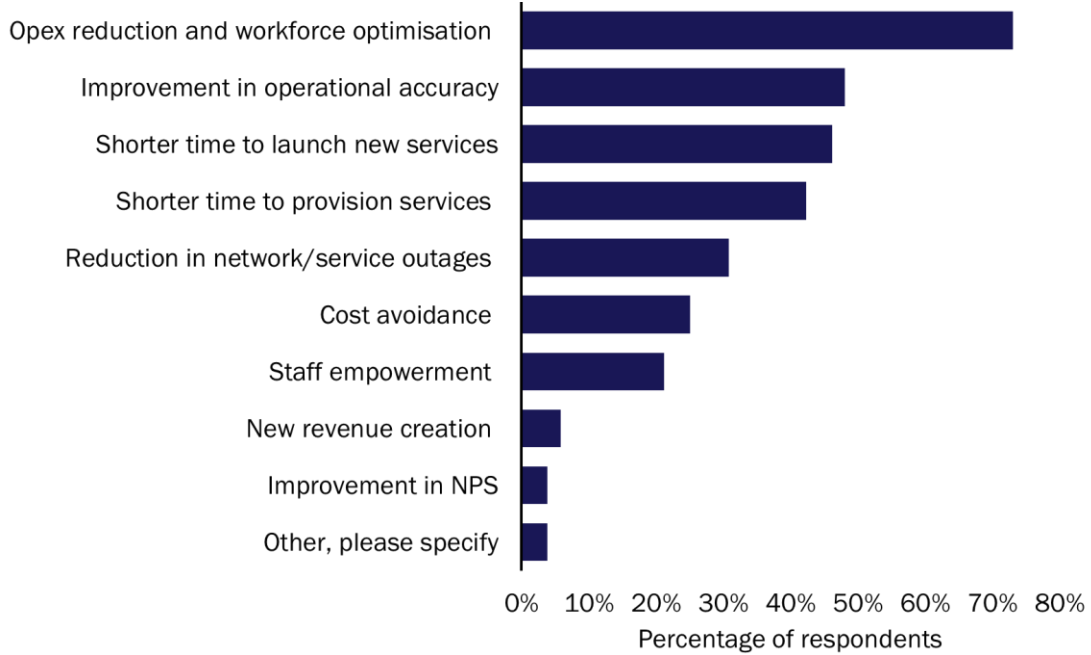*Figure 1: Illustration of the goals that can be achieved using network automation[1]*

Source: Analysys Mason, 2020

More than 50% of the participants of a CSP survey conducted by Analysys Mason in 2019 said that network automation was a top-three strategic initiative, and about 73% stated that reducing opex was their main driver for automating the network (Figure 2). Approximately 45% of the surveyed CSPs chose service agility as their key driver for automating the network (46% selected "reducing the time to launch new services" and 42% selected "reducing the time to provision services").

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[1] For more information, see Analysys Mason's Network automation: a solution framework for service agility and cost economics in cloud-enabled 5G networks.

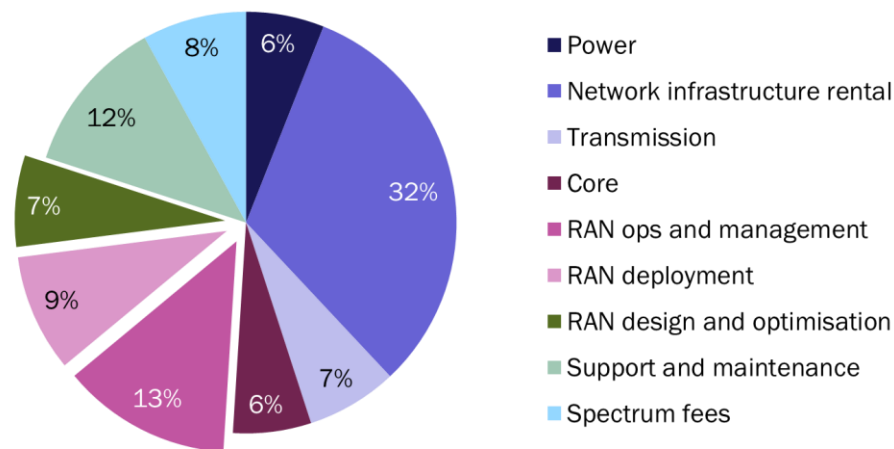*Figure 2: The drivers of CSP network automation according to our survey, worldwide, 2019[2]*

Automating network deployments and operations can deliver significant opex reductions and service agility

Processes related to radio access network (RAN) planning, design, deployment and validation account for about 16% of the total network opex. RAN operations and management (O&M) accounts for a further 13% of the total network opex, meaning that overall, the RAN is responsible for 29% of all network opex (Figure 3).

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[2] For more information, see Analysys Mason's Network automation survey: CSPs' automation initiatives; n = 52.

Figure 3: Typical breakdown of network opex[3]

Legend:
- Power — 6%
- Network infrastructure rental — 32%
- Transmission — 7%
- Core — 6%
- RAN ops and management — 13%
- RAN deployment — 9%
- RAN design and optimisation — 7%
- Support and maintenance — 12%
- Spectrum fees — 8%

Source: Analysys Mason, 2020

Some of the key RAN challenges are as follows.

- 5G New Radio (NR) introduces a large number of parameters (multiple thousands). These are time-consuming to manage manually and any mistakes in doing so could result in costly errors. It is essential to configure and optimise RAN parameters in real time in order to achieve the cost economics and agility required to roll out new sites and rapidly provision new services at these sites.

- Next-generation RAN architecture is based on complex hardware and software designs that enable various scenarios such as a single RAN for 2G/3G/4G/5G technologies and a virtual RAN with disaggregated radio units, distributed units and centralised units. CSPs will struggle to support this new architecture at scale while not compromising on cost and time to market without using automation.

- Site roll-out and validation processes are often manual. These require repeated field visits and are prone to human errors. Some processes will continue to require manual intervention (for example, civil engineering and truck rolls for site visits and deployment) but others can be automated and moved to the NOC. In addition, field engineers can be empowered with advanced visualisation technology to improve their effectiveness during site visits. This approach will enable CSPs to rapidly roll out new sites at a lower cost and to remotely provision new services in a fraction of the time that is currently required.

- The RAN's wide range of deployment architecture types and large number of possible combinations of parameter configurations means that there is a high chance of faults and alarms scenarios. Using traditional monitoring approaches without alarm deduplication and suppression will lead to thousands of tickets for network operations engineers to process, which is not sustainable. CSPs need to take an automated approach to significantly reduce the number of tickets and keep NOC costs at sustainable levels, with the aim of building a zero-touch autonomous NOC.

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[3] For more information, see Analysys Mason's The impact of 5G and next-generation networks on mobile opex spending.

Network automation can address some of these challenges, thereby resulting in significantly lower RAN opex and increased service agility.

Network automation enables service automation and digital transformation in industries other than just telecoms

Key stakeholders in the telecoms industry agree that 5G enterprise use cases will have a much higher economic impact than the traditional consumer use cases. Indeed, the general consensus is that 4G was for humans and 5G is for machines. This has important implications for CSPs and a range of stakeholders in various industries, as well as regulatory bodies, public service providers and government agencies. In addition to using 5G to offer multi-gigabit enhanced mobile broadband (eMBB) mobility services, CSPs are also launching new consumer use cases such as fixed-wireless access (FWA) for home broadband, which uses 5G NR for the last mile instead of fibre or copper.

FWA is an evolution in the use of mobile technology for humans, but 5G will inspire and enable a new generation of industrial use cases and business models for enterprises. Capabilities such as massive machine-type communications (mMTC) and ultra-reliable, low-latency communication (uRLLC) services promise to transform industries such as manufacturing, automotive, utilities, healthcare and emergency public services by enabling industrial IoT, autonomous vehicles, smart grids, telemedicine and disaster response, respectively.

The diverse nature of the use cases, the requirements for service dynamicity and low latency and the need to support new business models is forcing the telecoms industry to consider new architectural and operational approaches for 5G networks. The introduction of virtualisation to support network slicing and edge clouds will make 5G networks significantly more complex than those of previous generations.

Network automation not only allows CSPs to tackle these complexities at the network resource level, but also enables service automation (that is, the automation of the creation, provisioning and O&M of new enterprise services). The ability to automate both the network and services will enable CSPs to rapidly launch and support next-generation use cases at scale, thereby providing the foundation for the digital transformation of enterprises and whole industries.

ML/AI technology is the key to achieving 5G network automation at scale

Established automation approaches such as business process automation and workflow automation, as well as more-recent techniques such as robotic process automation, are limited in how they can be applied to network automation. Most of these approaches rely on predefined policies and rules that cannot be scaled for highly complex 5G networks that have a diverse use case scope with stringent latency and reliability requirements. Instead, ML/AI-based automations are the key to automating 5G networks.

By applying a more joined-up approach to the RAN design, deployment and O&M processes, and by empowering these processes with ML/AI-based automation techniques, CSPs can significantly reduce opex, increase service agility and enable vertical industry use cases. Figure 4 highlights some of the 5G use cases in which ML/AI-based automations will play a significant role.

Figure 4: The role of ML/AI-based automations in selected 5G use cases

Use case	Description	Role of ML/AI-based automation
Dynamic network slicing	5G networks can be used to set up multiple logical networks in order to support the varying network quality-of-service needs of different enterprise customers or edge devices.	Network slicing requires complex decision making. This calls for automated AI-built responses in near real time to enable the volume and revenue of 5G services to grow without adding considerable overheads to operations.
Multiple input, multiple output (MIMO)	MIMO systems transmit from tens to hundreds of antennas at once, thereby creating the best transmission route to a user.	The optimisation of 5G networks using smart massive MIMO (over 32 logical antenna ports per base station array) is significantly more complex than the optimisation of 4G networks. 200 network parameters were required for 4G, but over 10 000 are needed for 5G. Even more complexity is added when deploying a non-standalone network involving 4G-to-5G NR migration in order to ensure that customers' current performance does not degrade. The complexity of the task means that ML/AI algorithms are needed.
Beamforming	Beamforming is a traffic signalling system used in 5G networks that determines the most-efficient data delivery route for a subscriber. It reduces the interference of adjacent users and can use massive MIMO arrays and/or millimetre waves.	Beamforming has advanced through mobile network generations, but 5G has introduced larger massive MIMO arrays, thereby making the computation much more complex. 5G has also introduced millimetre waves. Highly complex transient beams need to be automatically created and optimised in an environment that potentially has fast-changing requirements. AI-based systems can generate and support this complex data set.
Pre-emptive support	It is vital to be able to predict faults in cases where 5G networks are used for industrial or mission-critical applications.	5G is being rolled out in private networks for industrial uses, which will not tolerate network failure or degradations. The ability to pre-empt any issue in order to prevent network outages in near-real time is needed to ensure that SLAs are met. It also reduces the number of outages and allows faster resolution times.
Network roll-out and operations automation	The design, planning, deployment, optimisation and O&M of the migration to 5G networks.	The use of millimetre waves means that cells are smaller and cannot penetrate walls, and therefore many more cells must be deployed for 5G networks (densification) and coverage must be planned in 3D. 5G still needs to work with previous generations of wireless technology (4G, Wi-Fi and NB-IoT) and other low-powered network alternatives, and planning has to take these previous network generations into account. 5G utilises heterogeneous network deployments (HetNet) and requires planning over multiple network technologies. 5G supports seven modes of MIMO, 3D MIMO, new services and other next-generation 5G wireless requirements, thereby adding greater complexity to the planning effort. ML/AI techniques will provide the intelligence to support these network planning, deployment and optimisation scenarios.

Source: Analysys Mason, 2020

An open hierarchical platform approach to network automation enables domain-level autonomy and accelerates innovation

CSPs' networks consist of many networking domains, such as the RAN, fixed transport for backhaul, edge cloud and the 5G core. The solution architecture must be carefully considered in order to deploy end-to-end network automation that spans all of these networking domains. A common architectural approach being considered by the industry has the following two key characteristics.

- **Hierarchical domain-based automation.** Each of the networking domains is automated through a domain-level orchestrator to enable domain-level abstraction, closed-loop automation, local decision making and autonomy. The domain orchestrators are then integrated into an end-to-end multi-domain service orchestrator in a higher layer for service automation.

- **Automation platform.** The domain orchestrators expose open northbound APIs in order to easily integrate with the service orchestrator and other adjunct systems within CSP operations. Furthermore, the service orchestrator also provides northbound open APIs that expose the automation platform for agile service instantiation.

Together, these two characteristics encourage seamless collaboration between CSP departments, partners and customers, and increase the pace of innovation so that services can be delivered more quickly. For CSPs and their suppliers, partner ecosystems will become an important adjunct capability that will be able to bolster operations and further accelerate innovation and service agility. A CSP can harness the power of a larger community of experts, 'crowdsource' innovations and quickly adopt the most relevant applications by opening up its network automation platform to its trusted network of business partners and vendors. Multinational group CSPs can explore opportunities to cascade their applications across their operating companies for rapid adoption. Where relevant, CSPs can also monetise their applications by selling them on to their enterprise customers or offering the applications for free to earn goodwill.

Conclusions

5G provides CSPs with a once in a generation opportunity to transform their business; it will also, enable the digital transformation of whole industries and enterprises and change our societies forever. The combination of low latency, high bandwidths and ultra-reliability enables changes in the way that businesses, devices and consumers operate. Compared to previous generations of mobile technologies, the scale and complexity of 5G networks is enormous, and they can support a greater number and diversity of uses case. However, CSPs cannot achieve the full benefits of 5G using the existing operational model that relies heavily on manual processes, especially for network roll-out and O&M, and results in high opex and limited service agility.

Network automation is the key to achieving sustainable opex economics and increased service agility in 5G networks, even while supporting increased network complexity. For example, the automation of network roll-outs and operations can deliver significant opex savings while preparing CSPs to rapidly launch and automatically provision new digital services for enterprise customers. CSPs must embrace ML/AI technologies to empower network automation processes and should move to an open network automation platform that enables innovation across an ecosystem of partners and vendors as well as internal CSP departments.

About the author

Anil Rao (Principal Analyst, Research) 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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