

**The Age of Telecom Network Automation**

Automating Engineering and  
Network Operation RAN Processes

Telecom Engineering Centre of Excellence (TEE)

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# Introduction

We are in the dawn of a new era in what regards telecommunications networks' reality. This reality extends to multiple domains: network services provisioning, network services architecture, and network engineering and operations, while being driven by disparate requirements ranging from service flexibility and increased service quality, to the need to lower Operational Expenditure (OPEX) and Capital Expenditure (CAPEX).

From a foundational perspective, in a world moving to 5G, this is not an incremental step. The new standalone architecture (SA) and distributed vRAN (Virtual Radio Access Network) that 5G will bring is being defined as cloud native, and not merely Network Function Virtualization (NFV) oriented, meaning a huge disruption compared to today's reality.

In fact, as of today, the network roles are either provided by monolithic solutions, or by software components running on top of virtual machines, but rare are the vendors that have embraced the cloud native Virtualized Network Functions (VNF) challenge.

Ultimately, the goal of communication services providers (CSP) is to become digital services providers (DSP), exposing their network into on-demand consumable services: flexible, fast to provision and manage, with tailored quality of service and service level agreements that need to cope with the promise of the three main pillars of 5G (enhanced mobile broadband, ultra reliable low latency and massive machine type communications).

In such a world, automation is not an option but mandatory, as it will need to dynamically manage and orchestrate all the above services at such a volume and complexity whilst at the same time coordinating a multitude of data and technical domains, that it would never be feasible based only on manual human operations.

Furthermore, the new paradigm will be about managing end-to-end (E2E) customer service and not about managing networks, meaning that orchestration and automation need to be service focused and not merely network focused. This requires quite a disruptive approach to aspects such as organizational structure, data governance, company culture, and technical skills, as organizations move out of the traditional NetOps model.

We are in the dawn of a new reality in Telecom networks, not another incremental step or evolution.



E2E service orchestration is still far from mass adoption, but which building blocks of automation in 5G are already appearing in the market?

And which are the lessons learned we are already seeing as CSP start to really automate their engineering and operations activities?

Even more relevant: How to define the journey to automation as we move to 5G?

**While both software defined network (SDN) and NFV domains have been maturing for some time and are not**

**yet delivering fully on their promise, with the advent of 5G a cloud native approach using automation is unavoidable.**

This paper provides a view on the above topics, with a focus on Radio Access Network, as well as presenting Deloitte's Telecom Engineering Centre of Excellence EMEA (TEE CoE) proposed methodology to address the challenges that arise from this new Telecom Era. Following this document, our team will publish subsequent points of view for different automation domains.

In this new era, automation is not an option but mandatory. Defining the automation building blocks, learning from the early adopters and having a solid approach is paramount.



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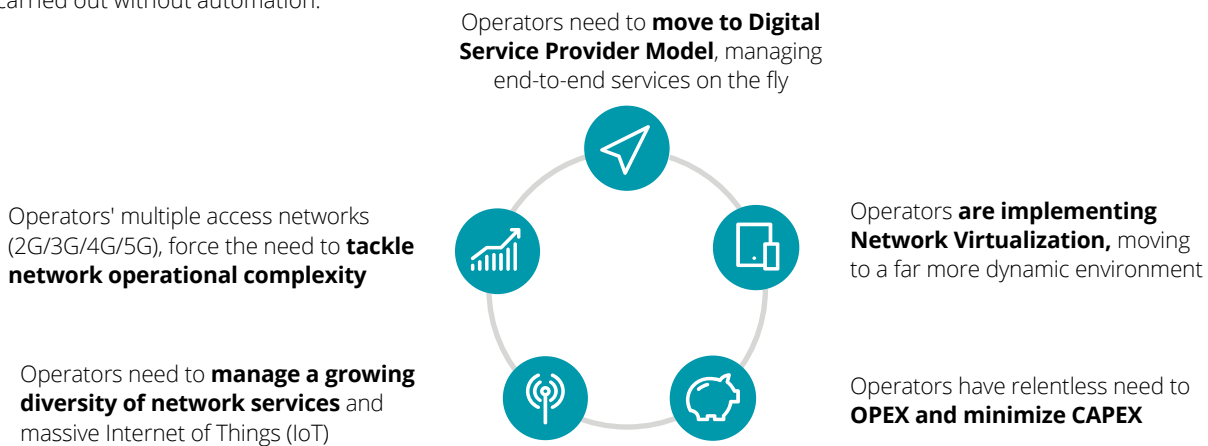
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# Operating networks in 5G: A brave new world

5G is the first mobile telecommunications generation that was thought from its inception to be based on virtualization, implementing concepts like network slicing, relying on open features such as API (Application Programming Interface), and a service based architecture to deliver the promise of tailored connectivity for a vast universe of use cases. New concepts like network slicing and its provisioning requirements, as well as the exponential increase of both connected devices and data traffic on the network, will make engineering and operations tasks, such as network optimization, provisioning, supervision and maintenance, impossible to be carried out without automation.

5G Standalone architecture (SA) is natively thought to be as flexible and automated as possible, not being another overlaid radio technology with some core network adaptations. 5G is therefore the mobile generation that will support the migration of a business model from CSP to DSP, where the latter intends to expose their assets via API to provision and monetize innovative services with a flexible and reduced time-to-market, that are completely new and far more similar to the ones of over-the-top players and hyperscalers than traditional telecom connectivity services of the old days.

The above topics, coupled with the fact that 4G, 3G and 2G still subsist and will still need to coexist with 5G for a significant amount of time together with other factors as illustrated in Picture 1, lead to a simple conclusion: **the current model of operation of telecommunications networks in a world that changes to 5G is doomed.** Automation will therefore be a vital step for the new operating model of DSP, and the application of automation in operation and network management will be a major step of the transformation of CSP to DSP.

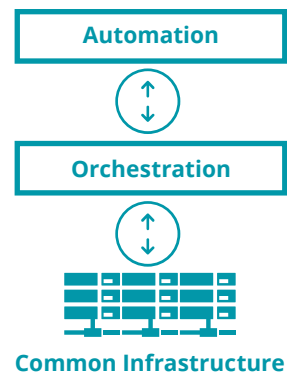


Picture 1 – Reasons for the change of the telecommunications network operating model in a world that moves to 5G

CSPs' approach to network management automation and overall business digitalization depends on several factors, the most important of which include strategic priorities, competitive pressures, region of operation, and the state of existing infrastructure.

Some of the biggest bottlenecks in a CSP's digital transformation journey are the existing systems and architectural structures. Most CSPs are overwhelmed

by legacy infrastructure and proprietary hardware systems, severely restricting their ability to extract value from the deployment of new software applications, and ultimately slowing down innovation. **However, by automating operations, implementing both E2E service orchestration and a domain Mediation/Abstraction/Orchestration layer, and using Artificial Intelligence/Machine Learning engines, CSPs enable their digital transformation journey towards DSP.**



Picture 2 – Future High-Level Network Architecture

# Leap ahead through automation

To tackle the challenges laid out previously, automation will act as the foundation pillar to manage the E2E user experience. Those who do not want to be left trailing are heavily investing in leaping towards the benefits of automation and its underlying technologies such as service orchestration, automation solutions such as (in the radio access) self organizing networks (SON) and Machine Learning (ML), as well as network virtualization, as can be easily inferred from market study reports regarding the sector.

**Early investors in automation are already envisioning secure long-term returns** and acknowledging the ability that automation applied to networking is demonstrating. This can be seen in relevant indicators such as cost reduction, increased group efficiency, consistent service delivery, swift time-to-market and customer experience.

One of the front-running banners carried by the automation wave is efficiency increase across the whole chain that comprises the implementation and provisioning of modern networks. Automation gradually voids numerous costly and time-consuming legacy practices regarding manual equipment configuration, troubleshooting, and maintenance, greatly reducing OPEX. Reducing the risk of human error also improves network performance, taking to a self-learning, self-improving automated network.



**Telco** investments in **AI** will reach around **US\$11,2B** by 2025<sup>1</sup>



**SON** is estimated to represent a **US\$5,5B** market until the end of 2022<sup>2</sup>



**Orchestration and NFV market** is projected to surpass **US\$70B** by 2024<sup>3</sup>

Sources: Tractica, Research and Markets, and Market Study Report



**Improved ROI**

Tier 3-5 CSP clients in Automation and Orchestration have experienced roughly **400% ROI** over the past 5 years<sup>4</sup>

Sources: Cisco



**Improved Consistency**

**70% to 90% of repetitive network maintenance work** can be automated via machine learning, improving consistency and efficiency<sup>5</sup>

Sources: Deloitte, Tupl



**Team efficiency**

Team effort reduction of around **37% in RAN engineering management by deploying SON algorithms**<sup>5</sup>

Sources: Deloitte, Cellwize



**Time to Market**

**80%** less engineering effort and **1-3 hours** to get a site ready for air<sup>5</sup>

Sources: Cellwize



**Customer Experience**

**100%** consistent, **100x** faster response to customer<sup>5</sup>

Sources: Tupl

Frequent upgrades inherent to an automated network will require a shift from networking engineering staff into new skills typical of IT staff, as automation will take care of networking oversight leaving the application, software-based layer to human input. Moreover, the seamless implementation of these upgrades in the system will be executed quickly and in a distributed manner, as opposite to complex upgrade projects of today, coupled with a new-found network resilience that makes use of its dynamic

configuration and cloud based auto-scaling features to flexibly adapt in real-time to any unexpected disruptions.

Furthermore, automation enables stress-free network maintenance as most repetitive and time-consuming tasks are taken care of by specialized engines blending Rule Base, Closed Loop and ML operations. In the future RAN (Radio Access Network) ecosystem, these engines run over an abstraction/orchestration layer that enables seamless

network automation implementation avoiding the hassle of complex configurations, specific to each RAN vendor deployed in the network.

**Network optimisation and configuration is done at a much higher level as the network layer becomes abstracted, orchestrated and open via provisioning gateways, parameter policies engines and API that automatically translate abstracted decisions into networking orders that the underlying network elements OSS understand and execute.**

# Key components of RAN automation

RAN automation steps until today have mostly been focused on Distributed-SON and Centralized-SON, reaping benefits that can be boosted by far more disruptive RAN automation approaches which can be implemented based on open platforms as we will see. While temporarily coexisting with legacy technologies, we see **several new components** and key building blocks for a new telecom operating model reality, delivering the DSP reality promised by 5G. This reality includes two major realms:



**The automation of engineering and operations tasks**, aiming at increased consistency, efficiency and accuracy, ultimately leading to cost reduction and improved customer experience via network and specially service performance.



**The automation of E2E service provisioning**, therefore leading to improved network agility, faster and simpler (self-)provisioning, shorter service deployment times and optimized resource usage, ultimately leading to business agility and improved customer experience via service management performance.

## Automation of engineering and operations tasks

For the automation of engineering and operations tasks on 5G, we see as key components Open RAN platforms that enable the northbound deployment of automation use cases. These can enable algorithmic based applications, such as SON, or ML based applications which can work together to deliver complex engineering use cases not possible before in a far more efficient way. The key fundamental concept is the fact that

these open platforms expose data from the 5G network (and obviously, legacy 4G/3G/2G) in an abstracted way, enabling the algorithms to decide on optimization actions without needing to care about the specificities of each hardware vendor, **meaning that a network Orchestration layer is paramount.**

Looking northbound, these platforms therefore expose the network Information

(configuration management and performance management data) in an abstracted way. Looking southbound, these platforms include a provisioning gateway that implements the provisioning for all RAN vendors also abstracting the specific vendor details as much as possible, hiding the implementation specificities. Conclusion is that **a network provisioning gateway or module is a central piece of open automation.**

Typically another key component is configuration management automation tools that manage all the configuration management templates and policies (rule based, which may be dynamic), therefore enforcing the CSP parameter policies and strategies, abstracting these from the need to know specific parameters for every RAN equipment vendor, and removing the hassle of having to change all templates and policies in case of a RAN software upgrade. **Full abstraction and automation potential can only happen if the platforms include a parameter policies management module.**

**56%** of Mobile Network Operators globally have little or no automation in their networks<sup>6</sup>.

Sources: GSMA

This field is the domain of expert companies that have the expertise and market reach that enables them to be on the cutting edge of OSS provisioning for traditional architectures and ORAN (Open RAN) or ONAP (Open Network Application Platform).

**ML platforms dedicated to telecoms are another crucial component in RAN automation**, being typically northbound to the Open RAN platforms, as the former consumes data from the latter, and also use the latter to enforce and provision the decisions taken by ML algorithms.

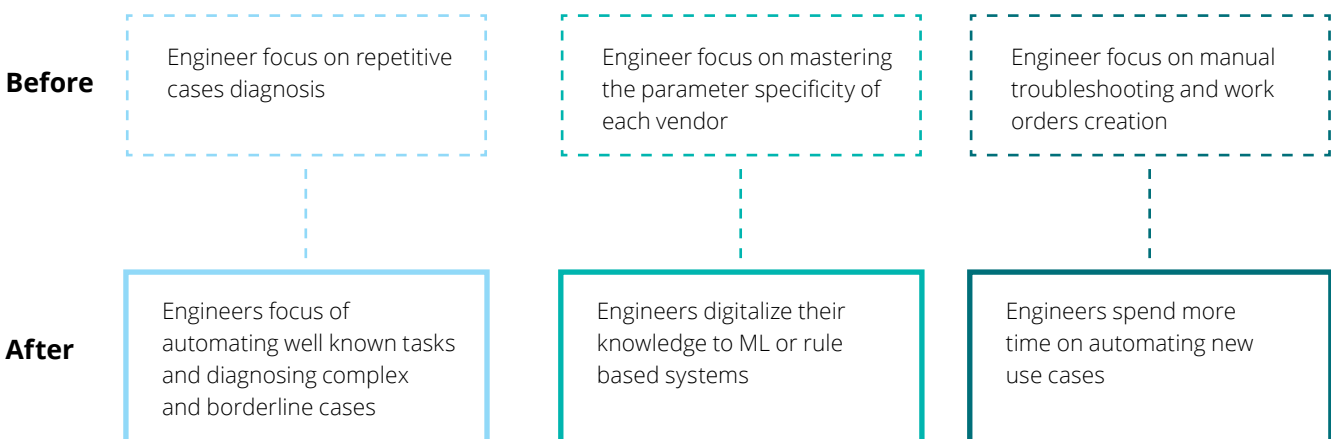
**Such platforms show traits of low code and should be designed to be used by engineers with basic knowledge of data science and analytics, as opposed to generic ML frameworks which are designed for data scientists.** ML

platforms tailored for telecoms engineering and operations use network data, including Performance, Configuration, and Fault

Management, but should also be open to integration of Customer Data, traces and geo-located data, ticketing systems and other data sources or systems that allow the full digitalization of use cases. On top of that, these platforms should adopt big data frameworks that are scalable, robust and easy to integrate with any kind of data source and actuation engines that can use API to trigger network actions via southbound entities like OSS or RAN abstraction/orchestration platforms.

For simple applications, ML algorithms based on ML programming may suffice, but to **reach maximum automation maturity, ML-enabling platforms with the right mix of rules or algorithms based automation, northbound to abstraction, provisioning and policy layers are mandatory.**

It is really important to understand that in such an ecosystem, the role of engineers suffers significant changes as:



Picture 3 – Evolution of engineering work with the new automation paradigm



# The automation of E2E service provisioning

By 2025, **80%** of MNOs expect to have automated **40%** of their network operations<sup>6</sup>.

Sources: GSMA

Becoming a DSP implies evolving from the CSP traditional approach of the manual management and provisioning of E2E service solutions. Instead, DSPs reach flexible service chaining architectures where instead of individually managing each service with a E2E approach, independent, self-managing domains are used. Additionally, these domains must be prepared to be orchestrated by a coordination entity or an external system. Empowering services disaggregation acknowledges the implementation of new technological services, ability to operate within a variety of vendors, and facilitate the integration of possible technological partners. Rather than operating within an old-fashioned highly detailed view of the network, organizations enhance orchestration with a dynamic attitude.

E2E service provisioning therefore relies on E2E service orchestrators that assure that the service chain is properly configured E2E. In a universe of 5G where the network resources are virtualized and the concept of slicing is introduced, the goal is for a fast service provisioning, preferably subscribed and managed by the customers themselves, delivering tailor-made quality of service on the fly.

Needless to say that domain orchestrators need to cascade below E2E service orchestrators, therefore assuring the coherence of all domains, such as RAN, IP backhaul, IP and DWDM transport, the core VNFs, potentially multi-access edge computing resources, and all the underlying virtual resources, managed via Management and Network Orchestration (MANO).

**In such an operating model, new services are mapped to technical requirements which are then translated to E2E network functions service chains, which in their turn deliver a tailored fit connectivity slice to each individual customer/subscriber.**

In the journey evolution from CSP to DSP, many network operators today have orchestrated network and IT domains, but few have the capability to orchestrate E2E services given the fact that physical network functions still coexist with VNFs (non cloud native, but running over virtual machines) and with cloud native VNF. On top of this mixed ecosystem, 5G non-standalone architectures are the norm for the next couple of years, meaning that the full promise of network slicing and tailor fit connectivity is yet in its early days.

**Full automation will also not happen without an E2E service orchestration.**

As a quick summary, the components where key decisions are going to be needed for an automated ecosystem in a 5G world are the following:



Machine Learning and APP driven operations, automating tasks and enabling **the move from reactive to proactive/predictive event** detection and solving

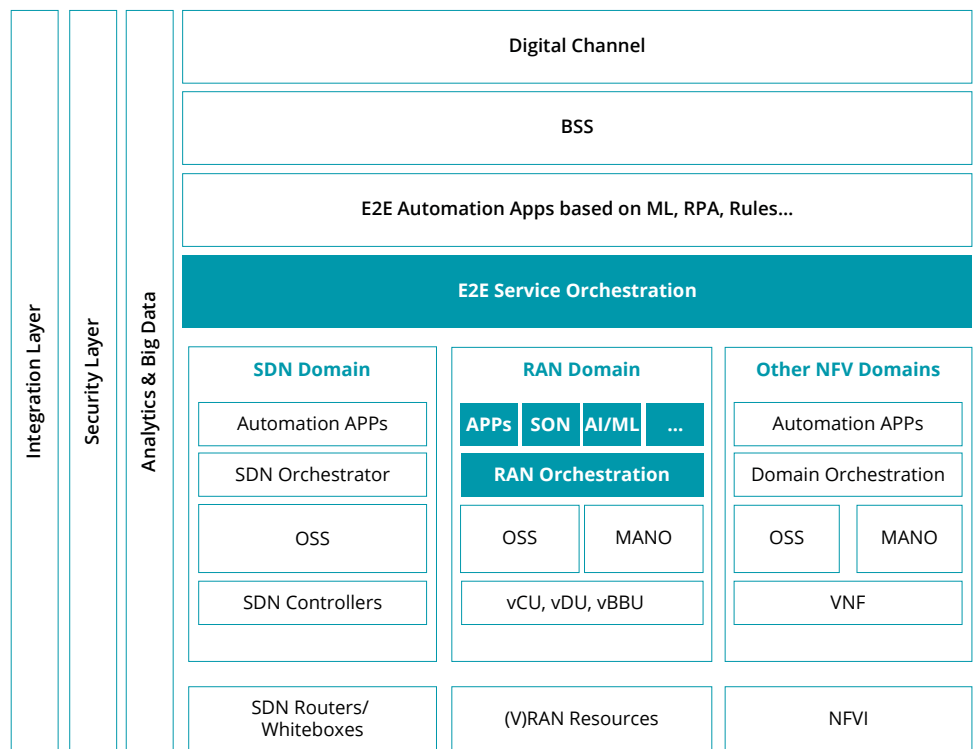


Open Abstraction/Orchestration platforms and SON, enabling **the implementation & provisioning of automation use cases** across all RAN types and vendors, including vRAN and traditional RAN



E2E Orchestration, **automatically provisioning the network slices** across all involved domains and orchestrating the necessary quality of experience

The subsequent pictures illustrates in a very simple schematic the multiple domains to be considered in an E2E mobile network and highlights particularly the RAN Domain automation components, as well as the E2E key automation components. Key concepts are per domain orchestration and automation, as well as E2E orchestration and automation to provide E2E service chaining, assurance and automation.



Picture 4 – Overall Network Architecture with highlight RAN and E2E automation key components

# Is automation only about technology?

Although it may seem counter-intuitive, automation is definitely not mainly about technology.

The automation and virtualization journey has a clear impact on various dimensions of the operating model and we have collected valuable lessons from interacting with customers and partners while delivering projects. Namely, we collected 6

key lessons learned that, if not addressed, will impair the overall success of the automation journey and subsequently the larger journey of CSP to DSP.

## Focus on use cases

As any manager experienced in change management knows, organizational change requires incremental successes that can show the delivered value so that the organization can adhere and gain momentum. **There is no other way in automation implementation but to implement a use case focused approach, preferably in agile mode.**

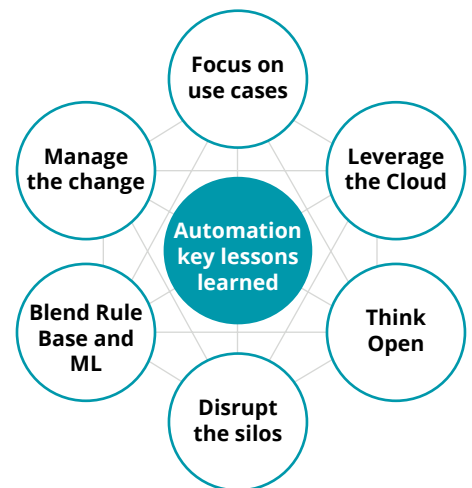
Other approaches such as starting by defining a one-size-fits-all technology stack or launch huge waterfall initiatives will imply such large timeframes that benefits will not be delivered until a time where the organization no longer believes in the vision of the program anyway.

Opposite to these approaches, focusing on making the data available and manageable for exploitation, based on incremental use cases and delivered via an agile approach by an empowered and skilled organization,

is the way to deliver business value fast, gain supporters across the organization up to executive suit, and test concepts quickly.

In fact, stating problems (in the current document scope, technical or service problems), putting a value to their resolution (either expressed as a monetary or service quality impact value ), making a quick business case and delivering a minimum viable product (MVP) that addresses such problems is a way to deliver value early and test the use case quickly. In case of success, the value is realized, further improvements are potentially achievable, and the organization moves ahead to new use cases.

As we will see, use cases need to be prioritized and change management is necessary, but without a use case mindset, the organization will not start its journey in the right way.



Picture 5 – Key lessons learned around telco automation

# Disrupt the silos

One of the key lessons that we see customers learning the hard way is that **it is paramount to disrupt the data and operational silos associated with the traditional CSP operational model.**

In fact, telecom networks engineering and operations are converging with IT, given the fact that networks are becoming virtualized and hosted in IT infrastructure.

Adding to this domain convergence, the boundaries of engineering and operations are becoming blurred, given the fact that telecom equipment software versions will be managed as workloads in a DevOps environment, as opposite to the very long deployment cycles of the past.

A third vector is the fact that the ultimate goal is now to manage digital services that run on top of the networks, and not just to manage the networks themselves. This implies a much richer set of data to be analysed by network engineers, which ultimately needs to be embedded into a service management culture. Silo disruption is therefore needed because in order to have an holistic approach to automation and use case implementation, engineers will need access to data that used to be owned and managed by teams that existed in an operating model that no longer makes sense. Use case must drive data sharing, usage and the automation platforms. On top, customer impacting use case centricity must drive the engineers mind-set.

In fact, without this structural change, automation will only increase the complexity of network operations instead of reducing them. Among the biggest challenges is finding qualified people to work on new and existing structures, due to the coexistence of the legacy network and the new automated processes. Many CSPs are actively hiring new employees with skills to work with virtualization and automation.

# Manage the change

All the previous topics lead to an immediate conclusion: **change management is paramount.**

We are not alone in this conclusion as even technology delivery focused companies like Ericsson state that "60% of the effort is change management - new processes, ways of working, cross-functional collaboration, skills and competences".

Change in this context is holistic as automation management encompasses processes, tools, IT systems, data

management blueprints, orchestration, organization changes, workforce skills changes among others.

It is obvious that new automated use cases impact the old processes and tasks delivered by the engineering and operations teams, which lead to process management, toolchain changes and most likely to new IT integrations.

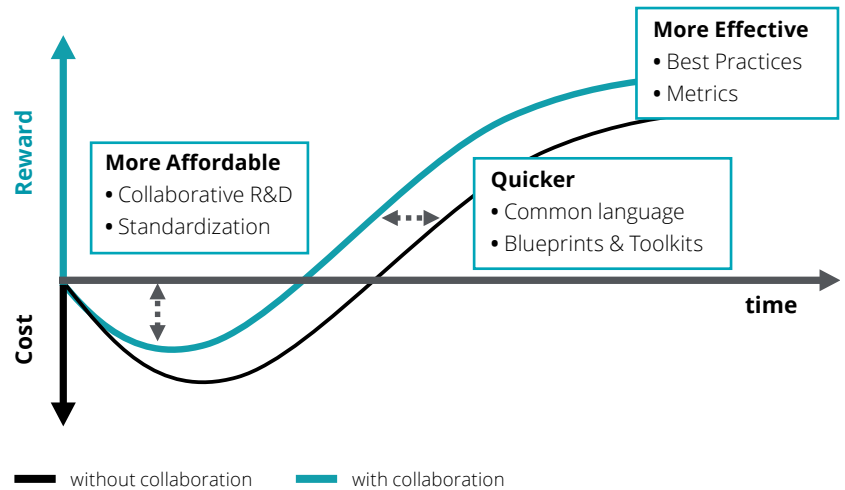
However, given that automation requires tools based on ML, SON, mediation, orchestration and others, using agile software development methods and

DevOps delivery approaches, new skills need to be introduced. This means that in addition to hiring new employees, there is an aspect that we identified as important, which is the right training and identification of talents in the current staff that can be used to catalyse the change.

Change management is ultimately about value realization and culture change, being the other components to be managed, means to reach the ultimate ends of supporting the journey of moving from CSP to DSP.

# Think Open

**Having an open-minded way of networking is what is propelling the main spearheading leaders in the sector.** It is not an architecture, but rather a perspective. Developing an open ecosystem where different vendor generated data is both abstracted into accessible mediums as well as not locked inside organizational clusters, empowers the whole operation by removing communication hurdles and streamlining access to useful information for everyone, by everyone, besides allowing the organization to embrace self empowerment via agile use cases development. Thinking open is therefore a technical extension of silo disruption.



Sources: adapted from 'Open Digital Architecture', tmforum<sup>8</sup>

Picture 6 - How collaboration helps transformation in the communications industry

The smartest players know that efficiency comes from shared knowledge, promoting open platforms where useful data and API can be accessed to generate value for everyone. **This "think open" philosophy is commanding the abstraction and orchestration revolution.** Providing ways for different vendors to intertwine their solutions to the management and automation layers, leaving provisioning to automated processes that enable these different equipments to be accessed via provisioning gateways that implement network orchestration and automation

orders from higher level abstraction enabled interfaces.

Furthermore, this open-thinking perspective should be implemented locally by piercing broad communication channels and disrupting internal silos in organizations, employing an open data philosophy. Enforcing a systematic sync between the BSS (Business Support System) and OSS components is key to achieve an hive-mind operation, where group efficiency is the end-goal.

The common language of the modern digital world – APIs – is the main foundation behind the current surge of big data-based services, a standardized way companies use to share useful data in order to maximize data usage and monetization. Don't get comfortable in looking at what is possible today in a post-API world, adopt a future-proof way of thinking and plan to make all your current and future tools API accessible – empower others by empowering you. APIs are the key engine behind abstraction, providing a common input/output language for all vendors.

## Blend Rule Base and ML


So the saying goes: "When you have a hammer, everything looks like a nail." No one denies the ground-breaking power of ML applications in many use-cases, reaping the benefits brought by a self-learning digital tool which is going to completely revolutionize some sectors as well as generate completely new ones. However, not all use-cases are suited for/need ML to create automation benefits.

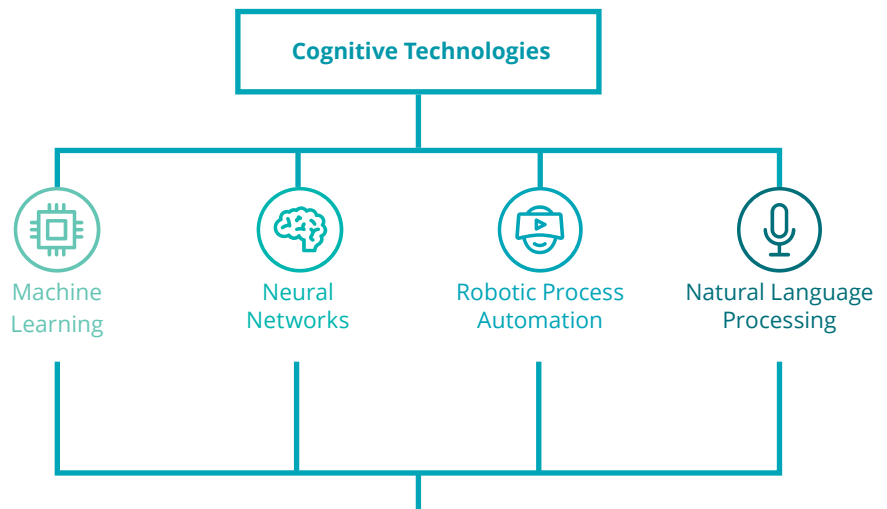
Knowing when to employ simpler rule-based techniques or more complex closed loop differential algorithms such as SON to specific use-cases where high efficiency is already attainable, as opposed to employing potentially even more complex to model ML-based ones, is what can differentiate the ROI (Return on Investment). Additionally, most CSPs already have access to rule-based

automation skills internally and accessing data scientists is becoming increasingly harder. ML can be left to applications where it can really make a difference, while organizations can leverage what they already have with rule-based techniques. **This dynamic blend enforces efficiency – it uses the best of multiple worlds.**



Don't use a one-size-fits-all approach. CSPs moving to DSP need to look at their available arsenal and gauge which initiatives and use cases really benefit from each ground-breaking technology.

 **IDC forecasts show spending on this segment to reach USD 77.6 billion in 2022**



“Personalize and contextualize the human-technology interaction, allowing businesses to provide tailored language and image-based information and services, with minimal or no human involvement<sup>9</sup>.”

Sources: Deloitte Tech Trends 2020

Picture 7 – Overview of ML Technologies

## Leverage the Cloud

Avoid the storm and choose the cloud. Changing an organization's network architecture into a cloud-based one is a way to leverage the benefits of decentralized computing for modern network delivery and oversight. It makes it so that organizations can deallocate the time and investments previously put in costly legacy processing power and shift it to service development and optimization – directly steering those resources into value-generating operations instead of value consuming ones, whilst at the same time localizing the delivery of their services closer to the end-user as needed.

In a path to a world ruled by data collection and analysis on an unfathomable level, and where a new breed of networking is on the way to being virtualized, open, self-organizing and abstracted, enabling flexible and easy to provision slices of 5G

communication, **CSPs not venturing into cloud-supported architectures are going to be left behind in a legacy-ridden, complex, and inefficient ecosystem in the long term.** This makes no sense, even because very relevant moves from the hyperscalers already enable their full stack on-premises, therefore bringing the scale benefits into distributed datacentre architectures, blending the advantages of public and private cloud.

**No CSP-to-DSP transformation is achievable without the cloud.** It is a mandatory requirement for a connected world where data based automation of cloud native VNF is second-nature and 5G represents networking as whole and where software reigns above a self-adapting, decentralized, hardware infrastructure. The focus is on the end-user and an

edge-focused quality of experience (QoE) philosophy.

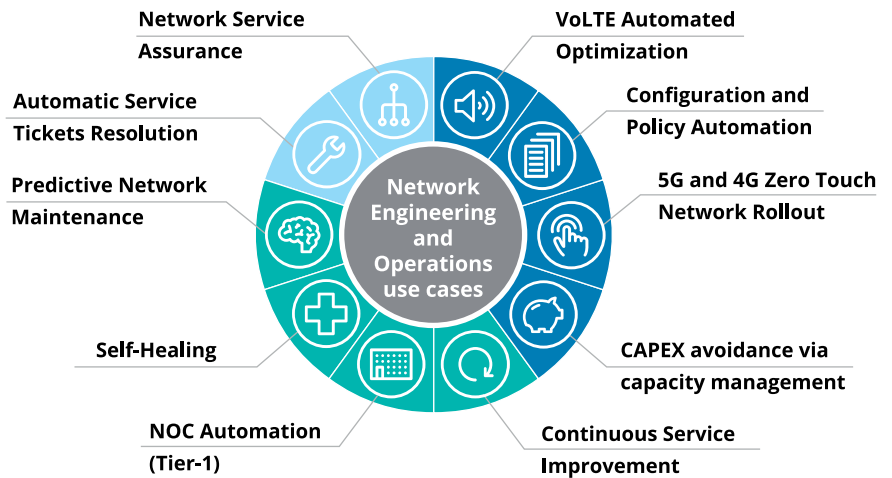
Again there is no one-size-fits-all for any case. Telcos wanting to course-correct into cloud-automation should analyse their use-cases and see first, which can benefit from a cloud adaptation, and second, which cloud provider best suits those applications, as well as where each network function and platform will reside, from core to edge.

By 2025, one third of MNOs will have automated **80%** of their network operations<sup>6</sup>.

Sources: GSMA

# Which RAN use cases are we seeing on the market?

Among our experiences with clients and market research, we have assembled a set of powerful use cases, which have shown great results where implemented. The automation use cases that we have explored mainly can be separated into three families or large domains, namely: **Network Planning and Engineering**, **Network & Service Operations** and **Customer or Service care**:



Picture 8 – RAN high priority use cases

## Network Planning and Engineering

### VoLTE Automated Optimization

Contrary to data, IP voice services have significant less tolerance to drops or delays in communication packets when compared to streaming applications or internet traffic. Therefore, CSPs providing IP voice services over LTE (VoLTE) need to differentiate and automate parameter optimization in order to maintain or gain competitive advantage in the market. Automating dynamic link quality management and automating mobility management will greatly improve the call setup and drop rates, packet loss and voice quality, having a direct impact on consumer quality of experience (QoE).

### Configuration and Policy Automation

Controlling and managing networks across a landscape of vendors and proprietary technologies endures a daunting task for organizations. Managing the engineering knowledge base expressed in parameter templates, and fighting parameter inconsistencies is another key challenge. Networks are in need of solutions that manage policy and configuration

interactions regardless of operating layer or vendor to ensure compatibility and coherence between the different services. Automation of the aforementioned tasks, allows the maintenance of consistency between OSS, design workbooks and the live sites across design to implementation process, ending on optimization.

### 5G and 4G Zero Touch Network Rollout

Network densification will be a crucial activity to address continuous increase on capacity demands on mobile networks. By fully automating the mass rollout of new sites, not only customer experience but also engineering efficiency will increase. Being able to create an abstraction layer between network providers and rollout management and operations will empower faster adaptability to specific requirements such as massive capacity, infinitesimal latency, supreme reliability, personalized customer experience, etc.

It is imperial for organizations to adopt zero touch technology, by employing

automation techniques enabling the power to engineer or operate networks. As a consequence, engineering human resources can be redirected to more important and meaningful tasks and organizations can benefit from time savings and decreasing complexity.

### CAPEX Avoidance Via Capacity Management

Implementing measures to ensure the optimization of the utilization of available resources is of utmost importance in a CAPEX constrained reality. Automation allows the understanding of traffic trends within the network, overused and underused neighbour sites and recommend actions to attend the dynamics of continuous yet dynamic traffic growth. Machine learning enables the detection of both the traffic trends, as well as the correlation of such trends with sites usage and forecasting of the impact of traffic management, allowing to an improved asset usage.

Use Case	Typical Data	Main Outputs	Key Benefits
VoLTE Automated Optimization	VoLTE and Mobile Broadband Configuration (CM) and Performance Management (PM) data	Configuration regarding handovers, codes, antennae tilts, uplink parameters, neighbouring cells	<ul style="list-style-type: none"> <li>• Enhance E2E call execution</li> <li>• Improve drop call rate</li> <li>• Better QoE</li> </ul>
Configuration and Policy Automation	Configuration Management Data, potentially from different vendors and technologies	Seamless configuration of multiple RAN platforms	<ul style="list-style-type: none"> <li>• Parameters consistency</li> <li>• Policies control and enforcement</li> <li>• Personalization of practices</li> <li>• Know how sharing</li> </ul>
5G and 4G Zero Touch Network Rollout	CM and PM data, as well as physical sites data	Pre-optimized configuration scripts for automated network integration	<ul style="list-style-type: none"> <li>• Increased efficiency</li> <li>• Rollout capacity increase</li> <li>• Time savings</li> </ul>
CAPEX Avoidance via Capacity Management	Performance management data, physical data information and configuration management data	Optimized offloading to accessible assets	<ul style="list-style-type: none"> <li>• Increase CAPEX efficiency</li> <li>• Reduce network costs</li> <li>• Improved quality of service in case of network overload</li> </ul>

Table 1: Network Engineering

## Network & Service Operations

### NOC Automation (Tier-1)

Each day Network Operation Centres (NOC) are challenged with enormous amounts of alarms and warnings. With the increasing network complexity and customer demand for uninterrupted services, expectations are sky-high. The pace at which organizations are able to respond will determine their future success. By leveraging ML to correlate alarms and selecting meaningful insights, automating activities of Tier-1 is possible. The automatic root cause analysis and action recommendation result in troubleshooting accuracy, proactive responses and significant time savings due to faster, systematic and consistent processes at this level of the NOC. On top of these benefits, Tier-2 tickets are reduced and team efficiency is dramatically increased.

### Continuous Service Improvement

Networks today produce an overwhelming amount of data. However only few

CSPs can harness the transformation of data into insights. By being able to uninterruptedly gather information from service, configuration and performance data it is possible to detect, diagnose and forecast events and trends to act instantly on involved network elements that are not malfunctioning. These diagnostics can be real-time triggers of optimization actions implemented by the RAN orchestrators and can enable increasingly fast and adaptable networks along with minimization of errors originated by human behaviour.

### Self-Healing

Having a network capable of regenerating itself after a failure in a world of highly dense networks is a mandatory requirement. Automating the process of executing handoff and compensation techniques to seamlessly offload workloads to healthy surrounding nodes before initiating troubleshooting procedures can have massive impact

on the perceived user experience. Additionally, cost reduction will also be a product of the automation of these tasks, as these are technically challenging activities and often cause long localized service shutdowns.

### Predictive Network Maintenance

Improper reactive approach maintenance practices of the physical layer of the network results in serious networking issues that can be hard to track down in complex networks. Automating the maintenance process and moving from a reactive to predictive practice, is a relevant step in the right direction towards ensuring a consistent operation of the network by minimizing the risk of sudden equipment malfunction and potentially reducing expensive truck roll costs by minimizing their urgency or even avoiding them, while maximizing customer experience via outage avoidance.

Use Case	Typical Data	Main Outputs	Key Benefits
NOC Automation (Tier-1)	Fault management (FM) and network elements status data	Automated root cause analysis and tickets closure and automated action recommendations	<ul style="list-style-type: none"> <li>• Troubleshoot accuracy</li> <li>• Time to resolve</li> <li>• Team efficiency</li> <li>• Escalations reduction</li> </ul>
Continuous Service Improvement	CM, FM and PM data, service data, geolocation, physical sites data and others	Automated diagnostics to be used as triggers for engineering, operations or orchestration actions	<ul style="list-style-type: none"> <li>• Faster issue resolution</li> <li>• Higher efficiency</li> <li>• Human error minimization</li> <li>• Maximized QoE</li> </ul>
Self-Healing	PM, FM and CM data as well as network elements status data	Actions that handoff the traffic to non affected nodes	<ul style="list-style-type: none"> <li>• Autonomous corrections</li> <li>• Constant fix of network impairments</li> <li>• Improved QoE</li> </ul>
Predictive Network Maintenance	Fault management and network elements status data	Pre-emptive Maintenance Instructions	<ul style="list-style-type: none"> <li>• Operations consistency</li> <li>• Minimize malfunctioning risk</li> </ul>

Table 2: Network & Services Operation

**Customer Care**

**Automatic Service Tickets Resolution**

Handling customer complaint tickets is both an inevitable and resource-heavy undertaking for any CSP. Employing an ML-based Automatic Service Tickets Resolution system is paramount to greatly improve complaints resolution efficiency by having specialized algorithms learn and detect patterns across the information gathered from complaints over time and automatically act upon them, minimizing human interaction and time wasted by engineering and operations teams

in handling repetitive tasks as well as improving response times to costumers, while moving the organization to a service centric approach.

**Network Service Assurance**

Connectivity Services relies on the orchestration of distributed capabilities across networks domains and even operators to enable end-to-end management. Orchestration via policy-based management capabilities provide rules-based coordination and automation

of management processes supporting effective configuration, assurance, and control of services and their supporting resources. An orchestrated environment allows the definition of end-to-end SLA enforcement / assurance / resolution policies associated with the Product Offering (which contains QoS/QoE KPIs to be enforced). Going further the policy based rules can be further adjusted automatically by applying ML-based capabilities.

Use Case	Typical Data	Main Outputs	Key Benefits
Automatic Service Tickets Resolution	Customer complaint tickets, PM, FM, CM and customer service data	Automatic troubleshooting recommendation	<ul style="list-style-type: none"> <li>• Minimize human interaction</li> <li>• Improve response times</li> <li>• Time savings</li> <li>• QoE</li> </ul>
Network Service Assurance	PM, FM, CM and customer service data	Service orchestration rules enforced end-to-end in multiple OSS	<ul style="list-style-type: none"> <li>• Improved service provisioning</li> <li>• Faster time to market</li> <li>• Consistent network experience</li> <li>• High Efficiency</li> </ul>

Table 3: Customer and Service Care

# How are we succeeding with our customers?

At the Deloitte Telecoms Engineering Centre of Expertise, we believe striving in the automation journey requires three very different sets of skills. First, both engineering and business perspectives need to work together to avoid the “build and they will come” trap. With both lenses defining the strategy, the implementation requires automation skills but also an ecosystem of partnerships that allow getting the best of breed in each specific situation, without allowing customizations and adaptations to hinder future changes in the business. And as we have explored in a previous chapter, this journey is much more than technology, so a transformational focus needs to be in place.

Our three pillars of automation are based upon a functional narrative of the whole transformative process from a non-automated starting point, into a more mature automation states via Business Transformation Process (BTP):

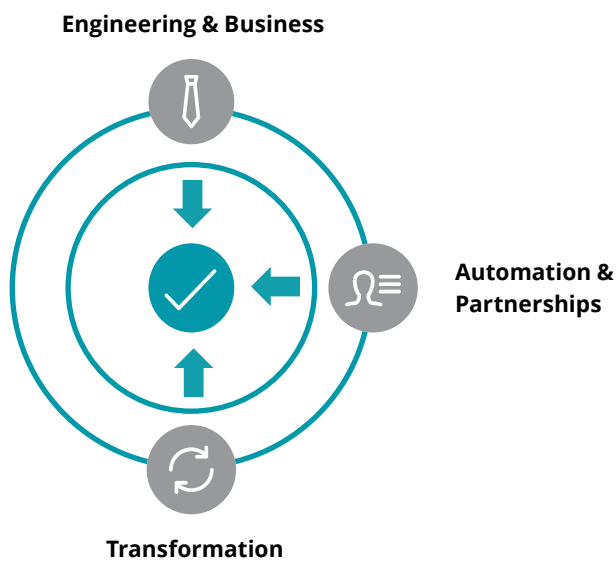
**Engineering & Business** - We use specialized network engineering resources and the business know-how. Having a deep understanding of both engineering and of how telecom business is run enables us to optimize our solutions from a use case based perspective.

**Automation & Partnerships** - Using an healthy synergy between our own engineering and project management skills and our open philosophy to work closely through partnerships with best of breed companies specialising in key components for automation implementation we use the right solutions to the required use cases, avoiding a one-size-fits-all approach.

**Transformation** - It is obvious, although many times neglected, that if we implement automation, the old processes, metrics, tools, functions and even people skills are impacted, meaning that process transformation and measuring the benefits is a key factor for success and for providing the visibility that will catalyse further change via automation. Transformation management is key.

Studies confirm that the time-to-market factor for organizations using agile approaches improves on average by 18 to 20 percent. Agile helps organizations of all sizes to respond faster to market demands and deliver customers what they really want faster than ever before<sup>10</sup>.

Sources: adapted from Atlassian



Picture 9 – The Big Three in Automation



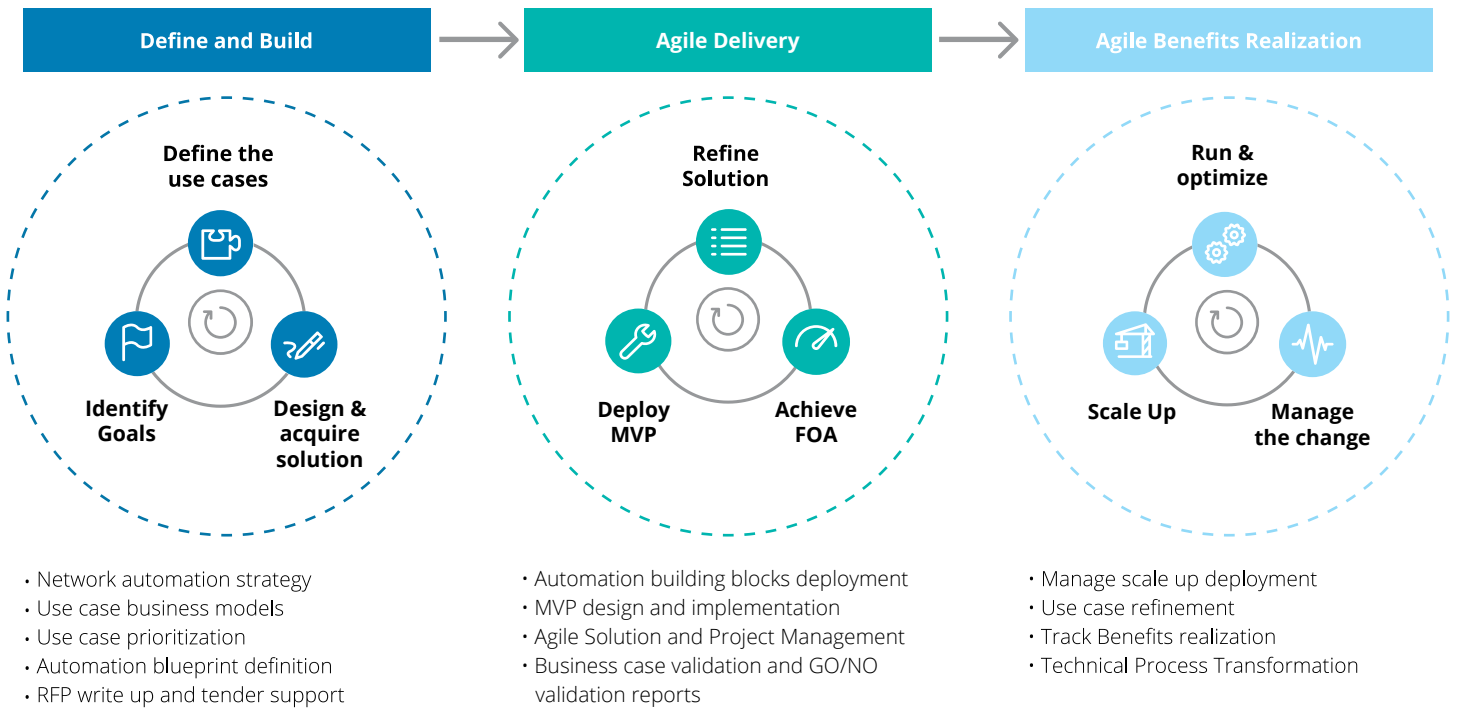
With the three pillars in place, a succeed or fail fast methodology needs to be used. Therefore, our agile-based approach for Network automation is structured in three typical phases: **Define and Build**, **Agile Delivery** and **Agile Benefits Realization**, where we apply our engineering and business capabilities, automation skills and partnerships and our transformation best practices. We use this arsenal of diverse tools to be prepared for various environments and client necessities – it makes our solution versatile without compromising on its robustness for a large spectrum of applications.

**Define and Build:** The strategic phase. An holistic assessment is done to understand client’s needs and draw a roadmap for the journey. Use cases and respective business cases are defined and given different priorities to aid in laying out the most suitable rollout plan. If/ when needed, RFPs are drawn up to find the best partnerships for the journey. Alternatively we can deploy our partners to deliver joint value.

**Agile Delivery:** Delivery and execution through an agile approach. We focus on implementing the planned solution in a controlled scenario to guarantee harm-free testing and securing a final, functional result. A MVP is established, ensuring

a functioning solution. From there, an iterative refinement process is carried out in order to shape the solution to cater directly to the client’s target use case and business benefit. The business case validation process is carried out to see if First Office Application (FOA) is possible.

**Agile Benefits Realization:** Smooth delivery. With client’s approval, the functioning automation model is scaled up for real-world deployment, its performance analysed by tracking the benefits manifested by the implementation, and optimized by refining it for the use cases. On top, transformation management is carried out via BTP.



Picture 10 – Methodology and standard deliverables

# Conclusions

The fifth generation of mobile telecommunication systems will provide a disruptive leap forward in the telecom industry, but unlike previous generations, it won't be mostly about more bandwidth. CAPEX, OPEX and revenue constrained CSPs will have to revolutionize themselves and evolve to DSPs, exposing their assets via API to provision and monetize innovative services with a flexibility and reduced time to market that are totally new and far more similar to over-the-top players and hyperscalers than before. And all this will happen while investments in densifying the network will increase to cope with the raging quality of service and bandwidth that customers demand.

In this context, Deloitte Telecoms Engineering Centre of Expertise believes automation is the foundational pillar to tackle the challenge of increased complexity, changing business models and easing investment constraints. Sharing this vision, some players have moved ahead and are already reaping benefits.

In this paper we focused on RAN automation and in the role the key automation blocks in a 5G world, from a high-level perspective:

- **The RAN orchestration/mediation/abstraction layer**, which being northbound to the OSS abstracts and orchestrates diverse (v)RAN resources in the system,

consolidating them into a single point of data integration, including performance management and configuration management data (or any other network or service performance related data sources).

- Northbound to the RAN orchestration lies **the automation applications layer** using machine learning and APP driven operations. These can include SON engines, rule based algorithms, the ML engines, a blend of the two, and so on.
- Even more northbound is **the end-to-end service orchestration**, which coordinates the RAN orchestration with other domains therefore orchestrating end-to-end service assurance.

However, this challenge goes beyond technology. Companies will have to transform internally, creating and maintaining an open mentality, sharing responsibilities between IT and Networks teams or thinking in organisation-wide automation use cases. Externally, getting the benefit of a greater and dynamic ecosystem, leveraging a new open, API based, data driven and cloud-native architecture.

Deloitte Tee CoE has been working with multiple telecom operators across the world and, together with an ecosystem of partners, developing use cases to bring important and tangible benefits for

the network: from network engineering planning to network & service operations. Prioritizing investments according to the potential benefits, helping to unlock the highest possible value from the journey where three foundational competencies are key: business and engineering perspectives, transformational capabilities and technical automation skills.

It is important to reiterate: there is no attainable way of migrating from CSP to DSP without modularly automating the RAN network from the end-to-end orchestration layer down to the abstraction point.

Network complexity in a post-5G world is beyond the control of legacy networking practices. Deloitte Telecom Engineering Centre of Expertise structured approach to automation takes care of this by employing a fluid agile-based, intelligently phased implementation with the technical backing necessary to comfortably work on a broad spectrum of environments with different needs. Ensure your place in the future of flexible digital providers by starting your journey now.

# An ecosystem of automation specialist partners

Deloitte Tee CoE is a telecom network specialized group, focused in enabling a smooth transition into the automated 5G networks of the future as CSP move to DSP.

In this multi-domain 5G world, which relies on a federation architecture that includes multiple technologies, orchestration at

different levels (network and service) and a diverse potential of automation, there is no organization who masters the whole multitude of skills necessary to cover all the required fields that maximize the automation benefits.

Being specialized in engineering and in the transformation brought by automation,

we recognize the value of specialized automation companies in order to jointly deliver end-to-end use cases and reap the full benefits of engineering and operations automation and our partnerships with TUPL and Cellwize are living examples of this.



## TELCO AUTOMATION EXPERTS

to design, deploy and implement specific use cases



### Who TUPL is

- ✓ Experts in Networks, Software and AI
- ✓ Backgrounds from multiple Mobile Operators, Big OEMs and other start-ups



### What TUPL Does

- ✓ System for complex task automation. Abstracts network complexity automatically for minimum human supervision, leveraging AI
- ✓ Builds digital super engineers via SW and ML to address the top three problems for CSPs: efficiency, CSAT, and performance
- ✓ All of this is achieved via Intelligent Process Automation



### Field-proven value

- ✓ Make use of existing Big Data and AI tech with TuplOS
- ✓ Respond to customers 10x faster
- ✓ Improve operations and engineering team efficiency by offloading repetitive tasks to automation
- ✓ Access network data instantly via centralized interface



## A NETWORK AUTOMATION AND ORCHESTRATION PLATFORM, based on an open architecture



### What Cellwize Does

- ✓ Chime, a cloudified RAN automation and orchestration platform, can accelerate deployment of 5G networks with ease and face the future with confidence
- ✓ Chime eliminates complexity and introduces smart automation and management, enabling next generation networks
- ✓ Chime allows to code in any language, and enabling the creation of any needed application
- ✓ Cellwize Operates globally, has a rich partnership catalogue, with dozens of projects running today, enabling leading service providers worldwide with a unique RAN automation experience



### Field-proven value

- ✓ An open architecture for handling all types of RAN vendor data, abstracting it, and connecting to any application via open APIs
- ✓ Agile & scalable for handling the multiple complexities of rolling out and managing 5G networks
- ✓ Full automation of complex heterogeneous networks, including both traditional network kit players as well as new vRAN players

# Who we are

Our focus is on making an impact that matters.

The Telecom Engineering Centre of Excellence (TEE) has a footprint spanning 4 continents and has delivered projects in over 50 countries being currently supported by 1 headquarters and 5 branches with circa 80 telecom engineers.

We deliver professional telecommunications engineering consulting services globally supporting our customers via a global network of offices from Europe to Australia, having delivered over 200 projects globally in over 50 telecom operators.

Working together with other Deloitte practices when needed, our integrated business ecosystem provides a differentiated set of core foundations beyond telecoms engineering which, when combined, enable a portfolio that assures end-to-end business impact beyond the deployment of technical solutions.



# Glossary

APP – Application  
API – Application Programming Interface  
AI – Artificial Intelligence  
BSS – Business Support System  
BTP – Business Process Transformation  
CAPEX – Capital Expenditure  
CoE – Centre of Excellence  
CSP – Communication Service Provider  
DWDM – Dense Wavelength Division Multiplexing  
DSP – Digital Service Provider  
E2E – End-to-End  
FOA – First Office Application  
IT – Information Technology  
IoT – Internet of Things  
IP – Internet Protocol  
KPI – Key Performance Indicator  
LTE – Long Term Evolution  
ML – Machine Learning  
MANO – Management and Network Orchestration  
MVP – Minimum Viable Product  
MNO – Mobile Network Operator  
NOC – Network Operations Centre  
NFV – Network Functions Virtualization  
ORAN – Open Radio Access Network  
OPEX – Operational Expenditure  
OSS – Operations Support System  
QoE – Quality of Experience  
QoS – Quality of Service  
RAN – Radio Access Network  
RFP – Request for Proposal  
ROI – Return on Investment  
SON – Self Organizing Network  
SDN – Software Defined Network  
SA – Standalone Architecture  
VNF – Virtual Network Function  
vRAN – Virtual Radio Access Network  
VoLTE – Voice over Long Term Evolution



# References

## Endnotes

- <sup>1</sup> <https://tractica.omdia.com/research/artificial-intelligence-for-telecommunications-applications/>  
"Artificial Intelligence for Telecommunications Applications" Report
- <sup>2</sup> <https://www.researchandmarkets.com/reports/4621704/son-self-organizing-networks-in-the-5g-era>  
"SON (Self-Organizing Networks) in the 5G Era: 2019 - 2030 - Opportunities, Challenges, Strategies & Forecasts" Report
- <sup>3</sup> <https://www.marketstudyreport.com/reports/network-function-virtualization-nfv-market>  
"Global CSP NFV Management and Orchestration Solutions Market Size, Status and Forecast 2019-2025" Report
- <sup>4</sup> <https://www.cisco.com/c/en/us/products/collateral/cloud-systems-management/network-services-orchestrator/white-paper-c11-738289.html>  
"The Business Benefits of Automation and Orchestration White Paper" White Paper
- <sup>5</sup> Deloitte Internal Research
- <sup>6</sup> <https://www.gsma.com/futurenetworks/wiki/ai-automation-an-overview/>  
"AI & Automation: An Overview" Online Document
- <sup>7</sup> <https://www.ericsson.com/en/managed-services/supercharging-customer-experience-through-ai-and-automation>  
"Supercharging customer experience through AI and automation" Report
- <sup>8</sup> <https://www.tmforum.org/resources/whitepapers/open-digital-architecture/>  
"Open Digital Architecture" Report
- <sup>9</sup> [https://www2.deloitte.com/content/dam/insights/us/articles/tech-trends-2020/DI\\_TechTrends2020.pdf](https://www2.deloitte.com/content/dam/insights/us/articles/tech-trends-2020/DI_TechTrends2020.pdf)  
"DEloitte Tech Trends 2020" Report
- <sup>10</sup> [https://www.atlassian.com/dam/jcr:d9ce12ec-c1a1-4495-b7dc-16c38d6b594e/Atlassian\\_Harvard\\_Business\\_Review\\_Agile\\_Report.pdf](https://www.atlassian.com/dam/jcr:d9ce12ec-c1a1-4495-b7dc-16c38d6b594e/Atlassian_Harvard_Business_Review_Agile_Report.pdf)  
"AGILE PRACTICE: THE COMPETITIVE ADVANTAGE FOR A DIGITAL AGE" Report

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