



White paper

Etisalat underpins its digital transformation with SAHAB, a state-of-the-art telco cloud

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1. Executive summary

1.1 Telco cloud is central to Etisalat's digital transformation vision

This paper describes Etisalat's journey to build a telco cloud – a carrier-grade cloud infrastructure - that will support any virtualized network functions (VNFs) and therefore any digital service that the operator cares to launch in future. It documents the drivers for, and benefits of, Etisalat's multi-vendor approach to telco cloud and the lessons that the operator has learned in the 5 years since its journey began. The paper describes how an open-source-based telco cloud is critical to Etisalat's ambitions to become a leading provider of digital services because it offers the ability to bring new services to market faster than competitors, with the right level of customer service and excellent operational efficiency. Etisalat's cloud journey is led by Esmaael Al-Hammadi, Senior Vice President, Network Development.

Etisalat wants to take advantage of the pace of innovation being set by the market in general, and open-source communities in particular, to shape its own destiny as a service provider. In parallel with its telco cloud technology transformation, Etisalat is introducing a DevOps way of working, which ensures that employees have appropriate skillsets and that the company as a whole adopts a 'digital' organisational culture that can leverage the cloud. Etisalat's telco cloud forms the foundation of the operator's business goal, which is summed up in its mission statement: 'driving the digital future to empower societies.' In other words, it is critical to the company's evolution from communications service provider (CSP) to digital service provider (DSP).

1.2 Etisalat has acquired valuable experience from two generations of telco cloud

Etisalat's second-generation telco cloud architecture, SAHAB, has been developed using the lessons from the operator's first cloud iteration. Etisalat established key principles for its network functions virtualization (NFV) transformation early in its journey, favouring a horizontal telco cloud over vertically integrated NFV stacks and prioritizing a multi-vendor, open-source-based approach to its telco cloud stack. However, its first cloud taught Etisalat about the integration points with its wider networking environment, the importance of automation using NFV management and orchestration (MANO) components and software-defined networking (SDN) and the need to transform skillsets and mindsets to support cloud operations.

Critically, Etisalat's SAHAB is establishing a fully automated VNF migration service, 'Digital Marketplace', which provides network function owners with an easy-to-use onramp to the telco cloud for their virtual network functions (VNFs). Although the telco cloud development team has the support of Etisalat senior management when it comes to encouraging VNF owners to use the telco cloud, Digital Marketplace is designed to make the process of doing so a highly attractive one and Etisalat expects that success will breed further success as VNF owners come to appreciate the speed to market and other agility benefits of telco cloud.

1.3 Etisalat's future-proof approach to telco cloud prepares it for 5G and edge

Etisalat is already planning its edge data center strategy and architecture so that it can connect edge clouds into its edge network and run them as remote extensions to its regional telco cloud. Etisalat is also anticipating the next phase of NFV, where VNFs will be developed from the ground up as cloud-native applications. The telco cloud team has shortlisted several cloud-native functions (CNFs) for testing in a platform-as-a-service extension to Etisalat's NFV infrastructure.

SAHAB is critical to Etisalat's 5G implementation plans. It intends its 5G mobile network to be virtualized end-to-end and its ambitious goal is to have this ready in the Abu Dhabi region in early 2020 (more than 500 radio sites). Deployment of Non-Standalone (NSA) 5G is underway and the telco cloud team is timing its support for CNFs to be ready when 5G Standalone (SA) standards are finalized.

1.4 Etisalat's telco cloud enables competitive differentiation

Etisalat's twin business goals of driving revenue from new services and being operationally efficient are underpinned by a robust telco cloud that will give the operator maximum flexibility through its ability to add or remove vendors depending on its business needs. This capability will enable the operator to maintain a 'best of breed' vendor environment, thereby enabling it to differentiate its network, customer experience and service portfolio through rapid innovation and will also help it to stay ahead of competitors.

2. Etisalat's digital transformation vision

2.1 Business goals for digital transformation

Etisalat Group is a highly successful operator across the Middle East and North Africa (MENA), headquartered in Abu Dhabi, United Arab Emirates (UAE). The Group has the most-valuable brand portfolio in MENA and was the first company in the Middle East to surpass USD10 billion in terms of wider portfolio value. In 2018, Etisalat Group had aggregate growth in subscriber numbers to a new base of 141 million, and revenue also grew to AED52.4 billion.

Etisalat is determined to be a leading digital player in the region. Its mission statement¹ is clear: Etisalat wants to be 'driving the digital future to empower societies'. The company has the following two goals in its quest to reshape the lives of consumers, accelerate the economic growth of businesses and enhance the competitiveness of the company's territories in a digital era.

1. **Develop new revenue from digital sources by building a portfolio of digital services.** Etisalat is especially targeting growth in the enterprise and public sectors where organizations need help with their digital transformations and the adoption of new technologies (such as IoT) and cloud-based platforms to support smart-city and Fourth Industrial Revolution initiatives. Etisalat believes that 5G will play a central role in supporting and enhancing the new digital services that it wishes to offer to its customers as a digital service provider (DSP).
2. **Maximize the value of its core business by being as operationally efficient as possible.** This will be especially important while the operator continues to increase the capacity and coverage of its mobile network across its footprint to meet high growth in consumer and enterprise demand for voice and data services.

These two goals are interlinked through Etisalat's own digital transformation, for which the company is acquiring the cutting-edge technology platforms, organizational culture and skills to enable it to become an agile and innovative digital service provider. Etisalat's digital transformation strategy will reinforce the operator's

¹ Etisalat Annual Report 2018, available at <https://www.etisalat.com/en/system/docs/2019/Etisalat-Group-Annual-Report-2018-English.pdf>.

market-leading position by giving customers a seamless, digital experience when interacting with the company and an enlarged and differentiated choice of services.

2.2 Business drivers for a telco cloud

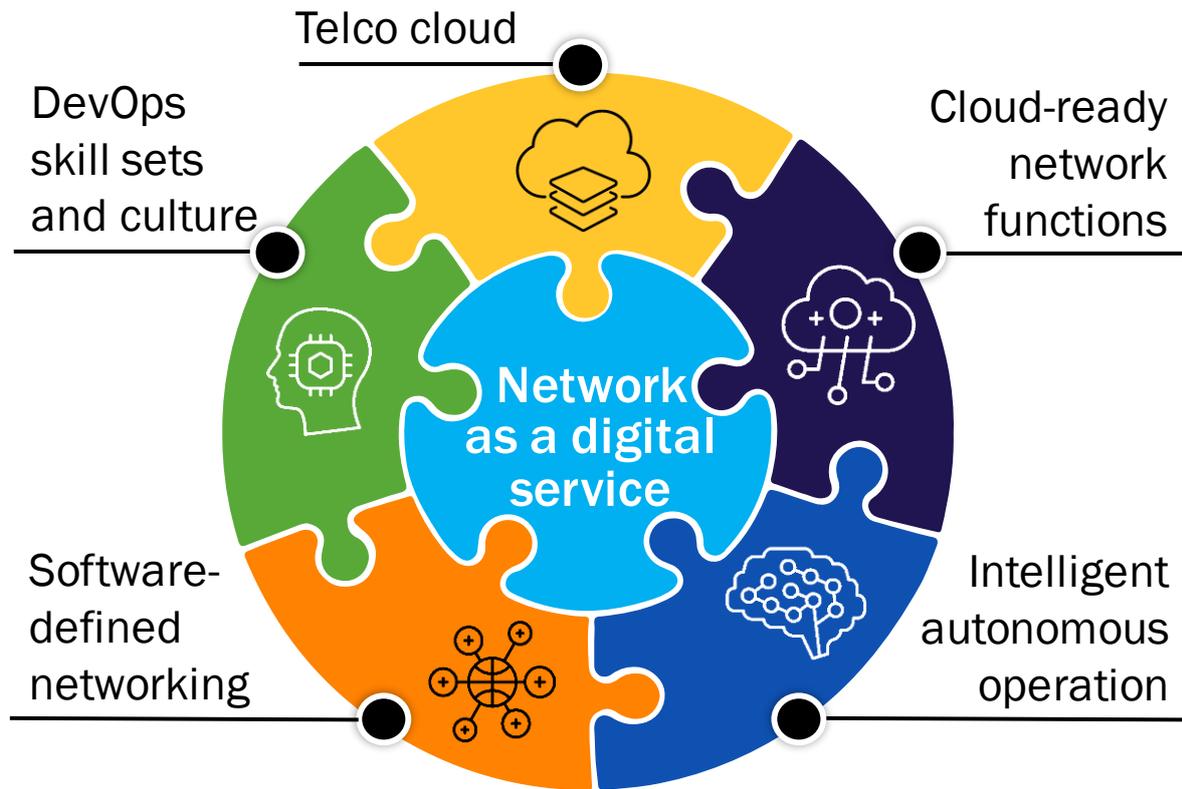
Etisalat's ability to deliver new digital services with high growth potential to consumer and business customers depends on the Group undertaking a major, long-term network transformation. The network needs to become a flexible, digital infrastructure that harnesses the power of cloud and automation to support new customer expectations of service delivery.

The fundamental platform for Etisalat's digital business is the telco cloud, which will support all future digital services, including the network itself as a digital service. Etisalat wants to take advantage of NFV, an industry trend in which key network functionality is transformed into software applications that can run on a telco cloud. NFV is the foundation for future business agility and customer delight, since it will support Etisalat in the timely development and delivery of connectivity-enabled digital services at scale.

Not only will the telco cloud be the scalable and agile platform for running all of Etisalat's network functions and capabilities, it is also a low-cost infrastructure that uses commoditized IT technologies, a very high degree of operational automation and IT innovation economics to drive down capex and opex. This is particularly important to operators such as Etisalat that must expand network capacity to meet growing user demand but need to control their costs in a competitive market.

Etisalat is addressing its comprehensive network transformation through multiple initiatives. As Figure 2.1 shows, telco cloud is a foundational component of Etisalat's overall vision for a digital network. Now it is in place, Etisalat can migrate and launch VNFs (such as the mobile core network and future 5G radio access network functions) on the telco cloud. The operator is building out the new orchestration stack for the digital network, which will eventually manage the entire digital network end-to-end in a zero-touch, autonomous manner using intelligent (machine learning/AI-driven) operations. Etisalat is implementing programmable connectivity using SDN to automate networking between VNFs across the telco cloud. Etisalat also recognizes that technology change at the network level needs to be accompanied by organizational and culture change, including the acquisition of new talent and skillsets to support a cloud-driven way of operating, evolving and innovating in the network.

Figure 2.1: Key building blocks for the digital network



Source: Analysys Mason

3. Etisalat's journey to the telco cloud

3.1 Etisalat's starting point for telco cloud

Etisalat started its journey towards network virtualization – and becoming a DSP - in 2015, by building an early horizontal cloud to gain NFV experience. The first VNF that it chose to onboard to its new telco cloud infrastructure was the Evolved Packet Core (EPC). Etisalat recognized that a virtualized EPC would help it to support growth in its LTE network, create competition for traditional EPC vendors and, it hoped, enable the operator to realize operational efficiencies.

Etisalat learned many important lessons from its early experience of NFV. For example, it gained an understanding of cloud concepts, as well as where the challenges and gaps are between the cloud and a telecoms-grade environment. However, the operator was hampered by the lack of operational tools for configuration, performance and security for the cloud infrastructure, which meant that it had to integrate the infrastructure with internal OSS for management purposes, an additional effort. Etisalat also experienced issues with cloud technology vendors' support and upgrade capabilities. In its first iteration of telco cloud, Etisalat did not automate the management of VNFs and their connectivity through an NFV Orchestrator (NFVO), a generic VNF Manager or SDN in order to automate service chaining. Etisalat nevertheless gained experience of onboarding several VNFs to its first-generation telco cloud. These VNFs included the vEPC, virtual probes and

NB-IoT. The company was able to define key integration points between the telco cloud and several different Etisalat domains, including core and aggregation networks, security infrastructure and service edge.

3.2 Telco cloud requirements

After the successful implementation of the vEPC, Etisalat's senior management took the strategic decision to virtualize the operator's network more aggressively to support the transition from CSP to DSP. Etisalat set up a telco cloud team to take responsibility for all aspects of telco cloud development, from planning to operations. The team is part of the network development department, the head of which reports to the CTO. The team has adopted a DevOps methodology and members have different backgrounds; architects, cloud engineers, planners, operational engineers and software engineers have all been brought together.

The telco cloud team knew from Etisalat's previous experience with NFV that it would need a new cloud that could be scaled to support multiple VNFs and with less operational complexity. The company also wanted to future-proof its telco cloud by selecting 'best of breed' technologies and vendors for each component. Etisalat was looking for vendors that could become partners in its transformational journey towards telco cloud, not just technology providers. Financial efficiency was also an important criterion.

Etisalat was particularly keen to base its telco cloud on open-source technologies that are rapidly becoming standards in the telecoms industry. The operator did not want to incur the cost of trying to build its own telco cloud from proprietary or 'forked' technologies. Open-source components bring agility and modularity to its telco cloud at low cost so that Etisalat can invest in developing differentiated services on top.

Another important consideration in the vendor selection process was the level of support that each vendor is able to provide. Local presence was a key selection criteria, given the business-critical nature of a telco cloud. Etisalat wanted to ensure that suppliers could respond immediately with the right technical support should it have any issues with their components. The operator wants to be able to assemble the right vendor/operator team on the ground to resolve problems as quickly as possible.

3.3 Etisalat's telco cloud architecture

Etisalat selected the vendors that it considers the most technically mature for its second iteration of telco cloud, named SAHAB, including for the components that were missing the first time around, such as the NFVO and SDN. Its suppliers of digital infrastructure include Dell, which provides servers for compute and storage, and Juniper, for the telco cloud switching fabric and SDN controller. Etisalat sees SDN as a key requirement for its telco cloud because it automates the connectivity of VNFs within and across multiple data centers, and in the latter case, using data center interconnect (DCI) capabilities. Contrail was selected as the data center SDN, automating the IP switching fabric that supports the telco cloud and the overlay connectivity between VNFs, from the virtual machines themselves to the data center gateways. The telco cloud team has successfully carried out service chaining trials using Contrail and NFV orchestration and expects service chaining to become an important capability when it needs to deploy and manage 5G use cases.

Etisalat has selected Red Hat to supply the NFVI virtualisation layer and OpenStack virtual infrastructure manager (VIM) for its second-generation telco cloud.

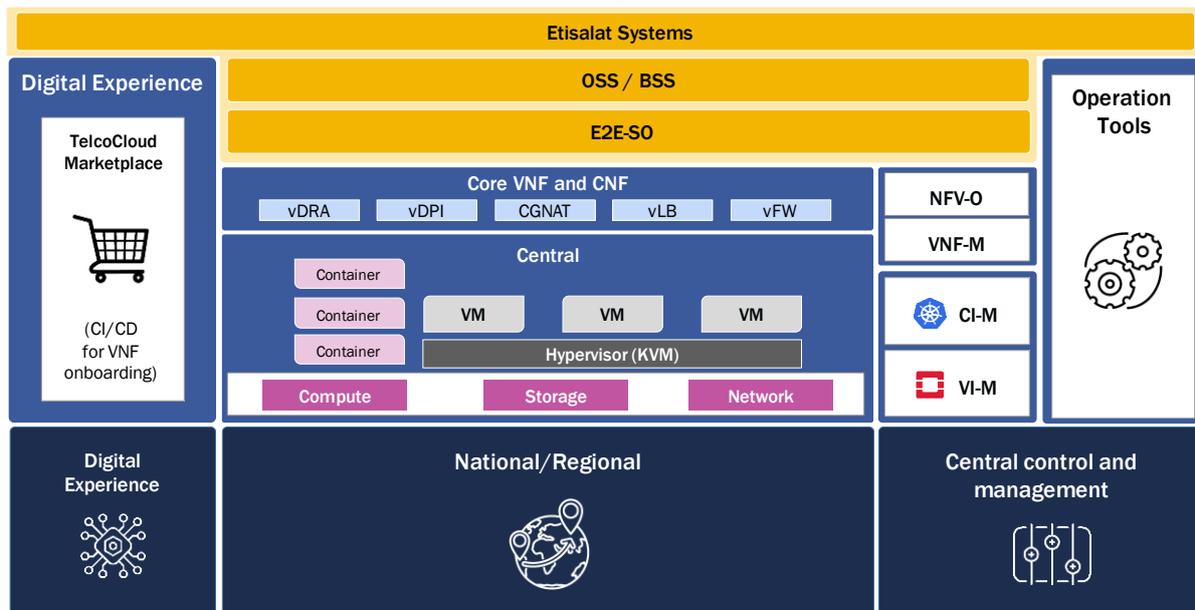
To manage the digital network environment, Etisalat selected Netcracker Technology's NFV Management and Orchestration (MANO) products: a generic VNF manager and an NFVO. Netcracker is also the supplier of Etisalat's End-to-End Service Orchestrator (E2ESO), which supports the fulfilment of network services across networking domains, both virtualized and physical. The Telco Cloud NFVO is the domain orchestrator for the

network services that use VNFs running on the telco cloud and it has several integration points with the E2ESO. Other domain orchestrators in Etisalat's physical network are connected to the E2ESO.

Netcracker's sister company, NEC, is the systems integrator for the telco cloud.

Figure 3.1: Etisalat's telco cloud architecture

Etisalat Telco Cloud building blocks: **Today**



Source: Etisalat, 2020

3.4 Etisalat's telco cloud implementation

Etisalat officially began its SAHAB project in January 2018. The project was divided into two phases. The first phase concluded on August 2018 with the implementation of a first iteration of SAHAB across six sites. The telco cloud team continues to enhance the platform and fill in functional gaps to achieve the agility and stability that it wants. In a second phase, which has not yet been scheduled, SAHAB will be introduced to a further six sites.

As internal demand increases for SAHAB from Etisalat's network function owners, the telco cloud team will expand. However, its telco cloud development and implementation role will not change. 24x7 management and monitoring of the telco cloud is the responsibility of a separate team with the remit to monitor all IP-related services in Etisalat.

3.5 Automating the telco cloud: a Digital Marketplace approach

Etisalat's next DSP milestone will be the onboarding of VNFs to SAHAB. The telco cloud team has completed the planning phase for VNF migration and is currently in the process of specifying the design aspects of the migration so that its VNF migration service provides a seamless experience to network function/network service owners. Etisalat calls its migration service a 'Digital Marketplace' because it encompasses the journey that service owners will take from the start of a project to virtualize a network service/function to launching it on the telco cloud. At present, the team is incrementally building the Digital Marketplace, following public cloud provider best practices, to ensure that it 'digitalizes' every step of the onboarding process. For example, it

expects that a network function owner will raise an onboarding request through a web portal and be guided interactively through the planning and design phases until the VNF/network service is onboarded. The web portal is being connected to SAHAB's capacity planning tool and the NFVO through APIs, so that these tools can push appropriate configurations into the telco cloud infrastructure to support the VNF as it is onboarded. Once the VNF is ready for instantiation in SAHAB, the team expects to run simple sanity/health checks on it to verify the onboarding process and will then hand over access to VNF owners so that they can proceed with service testing. The Digital Marketplace portal is also connected to Etisalat's Jira project management system, which tracks the end-to-end onboarding process and flags up any problems.

An early version of the Digital Marketplace onboarding service is live but the telco cloud team retains a couple of temporary workarounds that nevertheless make onboarding a new VNF relatively straightforward until the full set of functionality is in place. If the VNF is mature, its owner provides the team with a VNF Descriptor (VNFD) based on ETSI standards. This can take advantage of the automated integration between the VNF and NFVO, which is itself based on the industry standard, TOSCA. Providing the VNFD specifies requirements such as IP allocations and self-healing scripts, it can be automatically uploaded to the NFVO so that it is ready for use at VNF runtime. It takes the Telco Cloud team, from start to finish, a day to onboard a medium-sized VNF using the NFVO. If the VNF does not yet have a VNFD, the Telco Cloud team onboards the VNF manually by defining its requirements directly in its Virtual Infrastructure Manager (VIM) – Red Hat OpenStack. The Telco Cloud team will then work with the VNF owner to develop a VNFD. This process takes around 2 days, depending on the size of the VNF.

The telco cloud team is using best practice open-source tools to build the seamless automation required for its Digital Marketplace service, for example, Gitlab for code and version control, Ansible for automation, Jira for ticketing, an artefact repository system (JFrog), and cucumber.io as the automated testing solution. It uses Ansible scripts to automate its change management process, ensuring that it is highly efficient across an extensive and complex digital infrastructure, and one that is consistent and less prone to human error.

The telco cloud team understands the importance both of making the onboarding process as easy as possible to use and of promoting this ease of use to network function owners across the company. In this way, it will encourage early use of the telco cloud, which will yield more learnings and opportunities for improvement.

4. Telco cloud: next steps

4.1 Preparing for 5G and edge computing

As part of its commitment to provide leading capabilities to its telecoms markets, Etisalat is continually investigating new technologies, evaluating how they can help its business and becoming an early adopter to maintain its competitive advantage.

For example, Etisalat is already planning its edge data center strategy and architecture so that it can connect edge clouds into its edge network and run them as remote extensions to its regional telco cloud. These edge clouds (see Figure 4.1) will support Etisalat's plans to virtualize access infrastructure (including vRAN and SD-OLT) and converge this network function in edge cloud locations, such as central offices. Etisalat has already implemented data center interconnect and successfully run multiple VNFs across multiple telco cloud sites in different regions, so it is in a good position to extend these capabilities to potential data center locations closer to the network edge.

Etisalat is also anticipating the next phase of NFV, where VNFs will be developed from the ground up as cloud-native applications. To ensure that it is ready to take advantage of CNFs as they appear on the market, and particularly 5G cloud-native functions such as the 5G next-generation SA mobile core, the telco team is already experimenting with Red Hat's OpenShift platform, on which a number of VNF vendors are building next-generation, cloud-native versions of their products. The telco cloud team has shortlisted several CNFs for testing in the OpenShift environment, which will happen once it has completed its validation of the platform. OpenShift is a natural extension of Etisalat's Red Hat-based NFV infrastructure and curates many cloud-native, open-source development and deployment tools, including Kubernetes.

Etisalat plans to have the first commercialized CNF in its network by early 2020 but expects SAHAB to support heterogeneous VNFs/CNFs for the foreseeable future. Many of the VNFs in its onboarding pipeline are not yet available as CNFs and their conversion to a cloud-native architecture may take years. The telco cloud team expects that in 5 years' time, there will still be VNF vendors playing catchup with the CNF concept. Etisalat recognizes that cloud-native technologies are still maturing, so it and vendors need to have their technical and security concerns resolved before making them the cornerstone of a digital network.

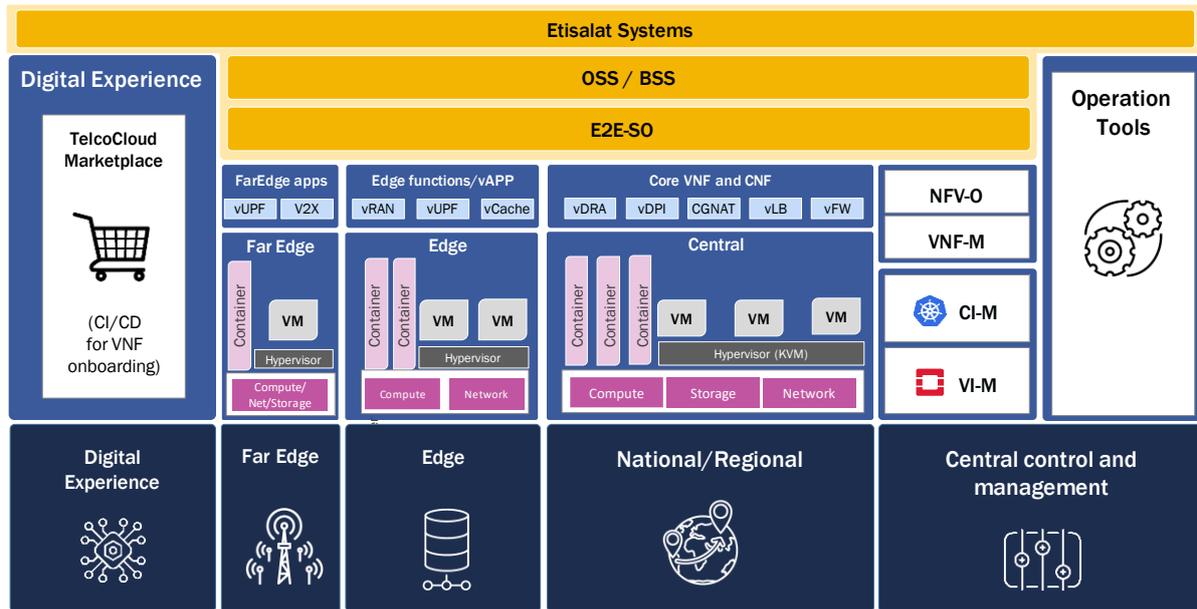
SAHAB is critical to Etisalat's 5G implementation plans. As a DSP, Etisalat intends for its 5G mobile network to be virtualized end-to-end and its ambitious goal is to have this ready in the Abu Dhabi region in early 2020 (more than 500 radio sites). Deployment of NSA 5G is underway and the telco cloud team is timing its support for CNFs to be ready when 5G SA standards are finalized.

4.2 Expanding Etisalat's telco cloud deployment

Etisalat's intention is to prove out its telco cloud concepts, architecture and implementation in the UAE first before promoting them to other operators within the Group. There are ongoing discussions with these operators, and Etisalat UAE is acting as a guiding entity for them. Like many Group operators, each Etisalat opco has built its own networks based on local market conditions and requirements, so there is a concern that the UAE's version of telco cloud may not be right for other countries. This is an active area of investigation and Etisalat UAE is working closely with other opcos on the application of cloud concepts to their networks and on disseminating the lessons that other countries can learn from UAE's best practice telco cloud implementation.

Figure 4.1: Etisalat’s 5-year plan for its telco cloud architecture, including edge cloud

Etisalat Telco Cloud building blocks: Target



5. Benefits and best practices

5.1 Business benefits from telco cloud

Etisalat has seen further benefits from the second iteration of its telco cloud. Although the architecture of this cloud is more complex than its first horizontal cloud, it has managed to simplify the management and operation through the way that the telco cloud team has set up the MANO and cloud tools. The team cites operational efficiencies resulting from orchestration-enabled simplification and automation as the main benefits that they are experiencing with their current telco cloud implementation. Etisalat sees the mastery of automation as a critical to its ambition to become a DSP.

Internally, ‘Etisalat VNF owners can focus on the application layer rather than on infrastructure deployment and operational issues,’ says Esmael AlHammedi, Senior Vice President of Etisalat’s Network Development department. This translates into faster service delivery, which leads to greater customer satisfaction. AlHammedi explained that ‘Thanks to SAHAB, we now have a programmable network with standards-based APIs for ease of integration with the rest of the business. As a result, Etisalat can accelerate the launch of new services and customers can self-manage them. As a digital service provider, we can give customers full visibility of their service consumption and the ability to turn services up and down on-demand.’

Etisalat foresees further benefits with the onboarding of CNFs to SAHAB. CNFs are built from very small software components known as microservices, which Etisalat anticipates being able to mix and match from different providers/vendors to build new and innovative services for customers. Another benefit arises from the architecture of CNFs: microservices are stateless and run in lightweight virtualization technology called

containers: they can be replicated and distributed for high levels of service availability and resiliency. They also consume fewer compute resources, which saves capex.

Etisalat's successful implementation of a telco cloud has built confidence in this approach at senior management level. Whenever the Telco Cloud team receives a new requirement for a VNF, it has an executive mandate to support the process of implementing the VNF, from its procurement to its onboarding to its launch into the production network. Senior management now support a plan to unify Etisalat's disparate cloud verticals onto the telco cloud to pave the way for future 5G and IoT-related services that will produce new revenue streams. The Telco Cloud team is leading the way in changing organizational culture and skillsets within Etisalat.

5.2 Lessons learned from Etisalat's telco cloud journey

Etisalat has learned several lessons from working on both iterations of its telco cloud as well as with vendor-specific, vertically integrated technology stacks supporting individual VNFs.

Multi-vendor integration is not easy but there are ways to address it. The telco cloud team is constantly facing issues over multi-vendor integration from certain vendors that insist on specific hardware and software customization, although others are more amenable and helpful in this respect. The team challenges the former set of vendors in technical discussions to understand specifically why they need this customization and requires vendors to justify it. Most of the time, the team discovers that vendors lack technical resources to prepare their VNFs adequately for the cloud. Etisalat believes that further industry standardization will help overcome these issues, although this will take time, and in the meantime, the operator will have to ensure that it can deal with vendor shortcomings itself, for example by acquiring the right skillsets and setting up integration labs.

Create rules and guidelines for infrastructure integration early on in the project. Integrating SAHAB with Etisalat's network and services has been a major endeavour, particularly given the scope and complexity of the second telco cloud, which encompasses orchestration (MANO) and SDN. Etisalat was fortunate to have its experience with its first-generation cloud to draw on. The operator ensured that it had discussions with all relevant teams so that they could jointly establish rules and guidelines to govern the integration from both an infrastructure and service perspective. Putting these rules and guidelines in place was a major milestone that has set a future-proof standard for SAHAB and any subsequent iterations, such as a future cloud-native infrastructure and edge clouds. The process of establishing rules and guidelines for integration uncovered gaps in cloud automation, for example, around the orchestrated onboarding of VNFs, which Etisalat has addressed through its Digital Marketplace initiative.

Establish a common, continuous integration/continuous deployment (CI/CD) pipeline for all VNFs with the right experience for VNF owners. Etisalat was determined to give VNF owners a best-practice cloud experience to support them when they are onboarding and operating their VNFs. Not only does such an automated VNF lifecycle management process encourage VNF owners to make the telco cloud their execution environment of choice but it also meets Etisalat's business goal of accelerating time to market for new services. Etisalat regards its Digital Marketplace project (which implements CI/CD) as a strategic investment. Etisalat is modelling its Digital Marketplace platform on public cloud providers' user interfaces, which are easy to use, and offer intuitive dashboards and a richness of experience.

6. Conclusion

Etisalat's twin goals of driving revenue from new services and being operationally efficient are underpinned by a robust telco cloud, SAHAB, that will give the operator maximum flexibility through its ability to add or remove vendors depending on its business needs. This capability will enable the operator to maintain a 'best of breed' vendor environment and to differentiate its network, customer experience and service portfolio from those of its competitors. Etisalat regards its vendor-agnostic telco cloud, built with open-source components, as a critical foundation for market-led innovation. Etisalat believes that such innovation is likely to be faster than – and superior to – innovation from any single telecoms vendor.

Etisalat recognizes that while its telco cloud technologies are important, the company also needs to change the skills and culture of its employees so that they can develop and work with the highly automated operations a telco cloud environment needs. Etisalat is therefore in the process of transforming its organization, establishing DevOps teams and practices and retraining staff. The cloud transformation journey is long and complex, involving change to people's mindsets, processes and technologies, but Etisalat believes that it is the right step to take if the company is to become a leading provider of digital services.

7. About the author



Caroline Chappell (Research Director) co-ordinates Analysys Mason’s digital transformation research and contributes to the Digital Infrastructure Strategies research programme. Her research focuses on service provider adoption of cloud, and the application of cloud technologies to fixed and mobile networks. She is a leading exponent of SDN and NFV and the potential that these technologies have to enhance business agility and enable new revenue opportunities for service providers. Caroline investigates key cloud and network virtualisation challenges and helps telecoms customers to devise strategies that mitigate the disruptive effects of cloud and support a smooth transition to the era of software-controlled networks.

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