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Industry must address the management complexities and fragmentation challenges of Telco Cloud

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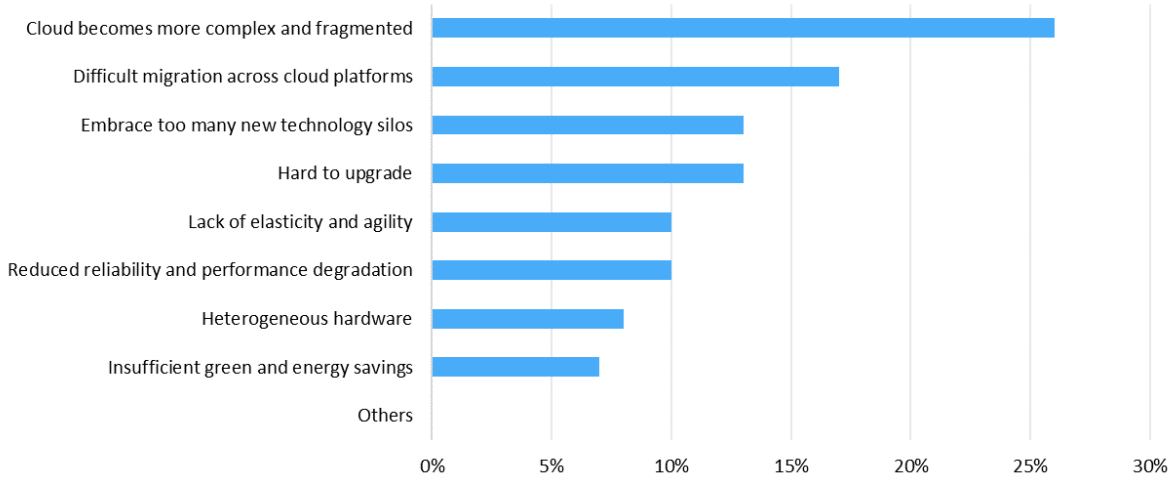
Introduction

Telecom operators globally have progressed well with network functions virtualization (NFV). Service providers' transformation to virtualized network infrastructure began by moving physical network functions (appliances) to virtualized network functions (VNFs). Omdia estimates that large operators across multiple geographies have reached over 80% virtualization in their core networks.

The industry is progressing towards cloud-native networks with 5G core (5GC). Operators are shifting their data and voice traffic to 5GC, deployed on container-as-a-service (CaaS) platforms, as they launch 5G standalone (SA) services. They would like these cloud-native platforms to host 4G EPC as well as 5GC.

This shift to cloud-native platforms brings multiple challenges for the telcos and vendors, as discussed at the recent Telco Cloud-native TechTalk at the Mobile Broadband Forum (MBBF) in Dubai. Industry participants attending the session agreed that their cloud infrastructure is fragmented, and its management and operations are complex. The industry also recognizes difficulties in migrating network workloads across cloud platforms. The move to the cloud has not removed long-standing vendor lock-in. F**igure 1** shows the survey results highlighting the top three pain points in telcos' cloud journey.

Figure 1: Top 3 telco cloud pain points



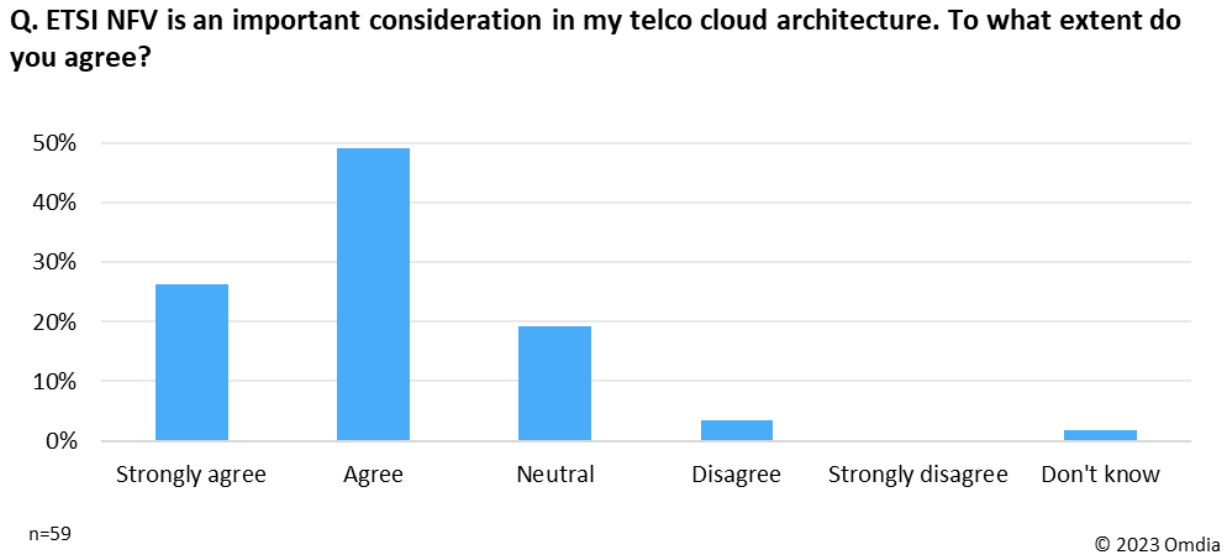
Source: Survey conducted by Huawei of participants at MBBF Dubai 2023

Cloud is becoming more complex and fragmented

In an ideal situation, telcos would build their cloud infrastructure horizontally (i.e., resource pools would be shared by multiple applications across networking and IT). However, most telcos today have a complex and fragmented cloud infrastructure. Operators at MBBF highlighted a lack of standardization as one of the reasons for this fragmentation.

An Omdia survey of telco technology leaders (see **Figure 2**) found that industry specification group ETSI NFV is still important for telco's cloud architectures. Nonetheless, while standards continue to evolve, operators cannot delay their network and technology upgrade decisions.

Figure 2: ETSI NFV is important for telco cloud



Source: Omdia Telco Cloud Adoption and Vendor Perception Survey, Aug 2023

Telcos continue to work closely with their suppliers to implement vertical clouds (i.e., for a specific network function or group of functions). The vendor delivers the network function as an integrated stack consisting of a proprietary virtualization infrastructure management platform (often based on OpenStack) and software packages for the network function running as monolithic applications.

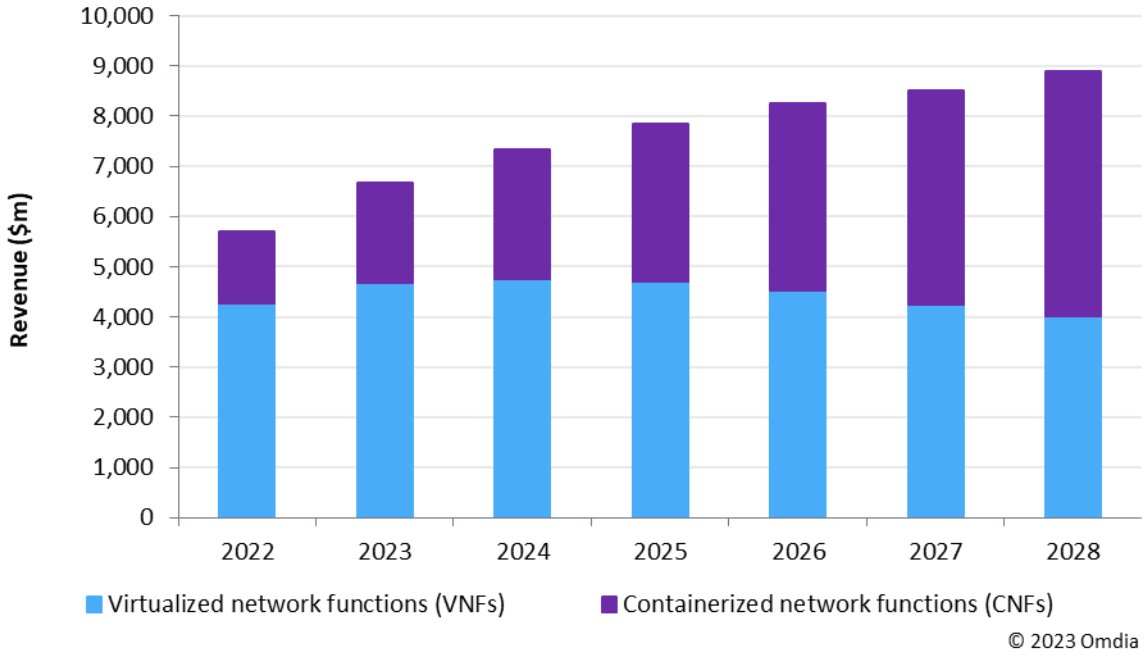
Telcos are also making progress in harmonizing their cloud infrastructure. With a horizontal approach to network cloud, the operator defines a common cloud infrastructure (often based on OpenStack or Kubernetes [K8s]) that all network function providers align to. At present, telecom operators are spending a lot of time on the validation and certification of network functions from different vendors on the cloud infrastructure. Doing so also brings additional complexities through extensive integration. Telcos need more resources to manage this. The industry agrees that reducing these complexities is important. Cloud stacks are standardized on OpenStack and K8s, but harmonizing vendor APIs can reduce the complexities seen with the current telco cloud deployments.

Migrating workloads across clouds is difficult

Telcos also face challenges when migrating workloads or network functions from one cloud environment to another. Different vendors, both CaaS and network function providers, have their own optimization tools and modeling languages. For a telco desiring a disaggregated stack, this requires customizations where a neutral cloud platform hosts network functions from various vendors. Sometimes, there are tight dependencies between the application layer and the services provided by the infrastructure layer, such as storage services. These dependencies make it difficult to move workloads from one cloud environment to the other.

There are challenges in migrating VNFs, designed to run over VMs, to containers. Omdia notes that an increasing number of telcos are investing in CaaS platforms as they launch 5G SA services. As shown in **Figure 3**, we estimate over 55% of network functions will be deployed on Kubernetes-based CaaS platforms by 2028.

Figure 3: Global telco network functions – VNFs versus CNFs



Source: Omdia Telco Network Cloud Tracker – 2023 Annual Forecast Report, Jun 2023

With this transition, telcos are building cloud infrastructure to support both VNFs and containerized network functions (CNFs). Vendors are investing in migration products that can host VM-based workloads over CaaS. Kubevirt is an example that can transition VMs to container platforms built using open-source technologies such as Kubernetes. Meanwhile, operators have the additional challenge of managing and operating the VM and container infrastructure in a unified manner.

Managing upgrades to a disaggregated cloud is hard

Continuously tracking and monitoring the flow of changes in a multi-vendor and dis-aggregated environment becomes challenging. Streamlining infrastructure upgrades with VNF lifecycle management operations is critical for the smooth functioning of the network functions. This is particularly difficult in the case of virtual machines as OpenStack does not support the life cycle management of network functions. Therefore, while OpenStack serves as the virtual infrastructure manager (VIM), telcos rely on additional orchestration solutions from network function vendors.

Consequently, networks lack automation capabilities

Telcos believe a lack of unified cloud infrastructure and management systems impacts their ability to implement end-to-end network automation. The two business requirements for telcos that were heard across the board during MBBF were agility and efficiency in operations. This means having an agile infrastructure and application environment that can reduce the overall time and cost to serve customers. Telcos attending the session agreed that improving end-to-end service automation levels will enable them to become more competitive and resilient. The recent research Omdia Telco Network

Automation Survey (Sept 2023) showed that a significant proportion of the telco industry is in the early stages of the automation journey. **Figure 4** below shows that most operators have reached Level 2 of automation. This signifies partially autonomous networks where systems enable some automated operations and management (O&M) for certain domains based on predefined rules and policies.

Figure 4: Which best describes the level of automation in the following network domains within your organization?

	Level 0	Level 1	Level 2	Level 3	Level 4	Level 5	Weighted average
IP backbone/MPLS network	6%	23%	36%	26%	17%	4%	2.6
Optical transport network	8%	26%	32%	18%	14%	8%	2.4
Converged core	12%	28%	24%	10%	22%	4%	2.1
FAN	9%	23%	36%	13%	13%	0%	1.9
RAN	9%	32%	23%	11%	9%	4%	1.7
Average	9%	26%	30%	16%	15%	4%	

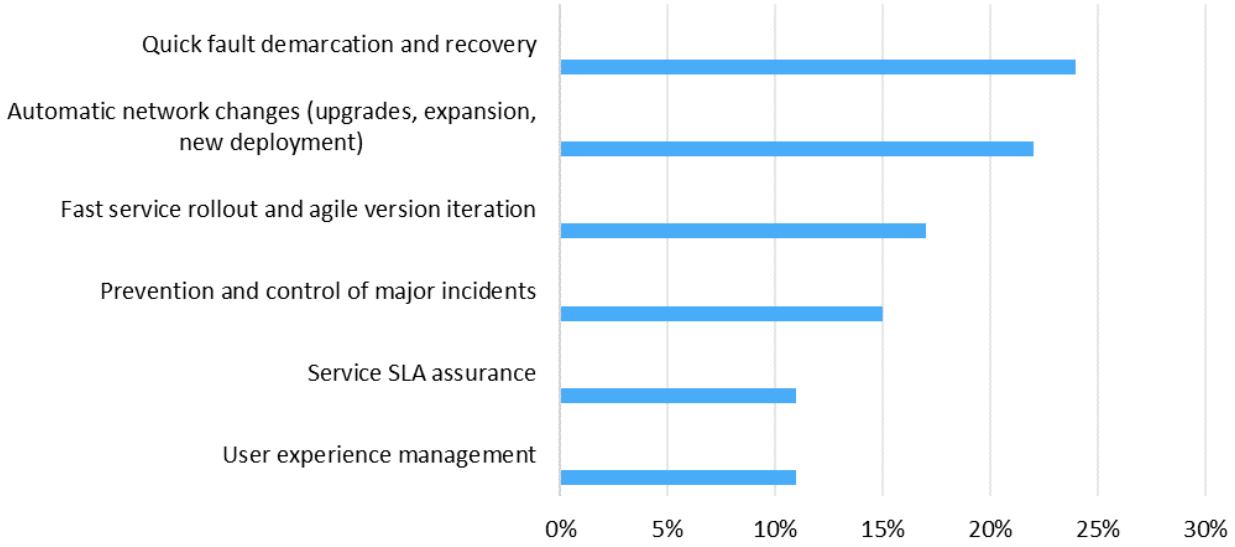
Notes: The color intensity increases with higher values and the number of respondents (n)=55

Note: levels are per TM Forum's AN definition
Source: Omdia Telco Network Automation Survey – 2023, Sept 2023

Automation can help telcos in optimizing network performance

Figure 5 shows the survey results highlighting the top three areas where telcos are building automation capabilities.

Figure 5: Top 3 network automation capabilities to be improved



Source: Survey conducted by Huawei of participants at MBBF Dubai 2023

Most operators expect to automate network operations and improve capabilities to identify and resolve network issues more quickly. Telcos and vendors have keen interest in Artificial Intelligence (AI) and Machine Leaning (ML) techniques as they automate various aspects of network and cloud operations. The term AIOps has started to penetrate the networking domain. Omdia suggests that operators have invested around $1.1bn in 2022 in AI Ops solutions for telecom networking. This is expected to grow at a CAGR of 11% to $2.1bn by 2028.

Network equipment vendors demonstrate strong capabilities in implementing multiple use cases where AI can help improve network operations. Telcos monitor and analyze network performance data in real time, identifying issues that impact network performance. AIOps can add to intelligent network monitoring by analyzing large data sets and filtering network alerts to identify the key ones that are likely to impact network performance.

Conclusions and recommendations

Standards are important for the telco cloud architecture encompassing data models, interface APIs, test procedures, and security requirements among others. They make telcos' cloud infrastructure more reliable, resilient, and stable than the general-purpose cloud. Having said that, the industry needs to work together to move away from the rigid (vendor-specific) implementation of the data models and interface APIs. Telcos can learn from the IT industry that leverages abstractions to hide the complexities of the implementation logic. One solution is building declarative systems (or interfaces) rather than expecting inputs in a format that conforms to a specific data model.

An after-effect of the cloudification of telecommunication networks is the creation of a convoluted network stack with multiple layers of solutions. Add to it the need for supporting multi-cloud and distributed cloud architectures. Telco Cloud should not only support the hosting of multiple workloads (such as IT and tools, network functions (VNFs and CNFs), and MEC applications) but also enable unified management of the cloud resources from core to edge sites. Operators and vendors should address this

complexity by adopting open-source technologies such as K8s. Container orchestration technologies, K8s, have matured to support a telco's carrier-grade requirements. K8s supports the declarative management of K8s objects with standard tools such as Kubectl and Cluster APIs (CAPI).

Building a unified cloud infrastructure must also aim at improving network automation. Overall, Omdia notes relatively low levels of end-to-end service automation in telco networks. Telcos are implementing different strategies or approaches for automation. A generic approach is to extend the existing management systems to automate or orchestrate cloud infrastructure. However, adopting a more cloud-native approach that applies a consistent framework across multiple layers or domains for infrastructure and applications automation is desirable. Telcos must also leverage AI to navigate the complexities in their cloudified networks. At the same time, the blurring boundaries between network and IT is driving telecom operators to embrace a holistic approach that unifies management practices and leverages shared technologies such as AIOps.

Appendix

Further reading

Project Sylva Addresses Key EU Telco CaaS Convergence Challenges, (April 2023)

Telco Cloud Adoption and Vendor Perception Survey, (Aug 2023)

Telco Network Cloud Tracker – 2023 Annual Forecast Report, (Jun 2023)

Telco Network Automation Survey – 2023, (Sept 2023)

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