Network and service automation is key to operationalise 5G multi-cloud networks and digital services at scale

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Anil Rao

Executive summary

Communication service providers (CSPs) are accelerating 5G commercialisation; 69 CSPs are either already live or in the process of deploying 5G Non standalone, with many of those CSPs already preparing to upgrade to 5G Standalone (SA). 5G SA offers advanced capabilities to deliver network slicing and low latency-based digital services. To enable these capabilities, CSPs are building the 5G networks using cloud and programmable digital infrastructure which provide the basis for increased service agility and service enablement but also introduce a significantly high levels of network and operational complexity.

Consequently, CSPs need a new operational approach to manage the new complexities of the underlying digital infrastructures. CSPs should transform their operations to a new digital operations model that abstracts these complexities and automates the network and service lifecycle management as well as provide open API-based northbound capabilities to accelerate digital service innovation. A new hierarchical network and service automation platform is at the heart of this new digital operations model.

There is already strong evidence that network automation is critical to operationalise 5G. In an Analysys Mason survey of 52 CSPs, close to 75% said network automation is a top 5 strategic initiative; about 46% of the CSPs said they are using network automation to reduce time to provision and launch new services, and about 72% said they are implementing network automation to reduce opex.

This report explains the broader market context for network automation, and look at how VMware's recently launched Telco Cloud Platform addressses the key CSP requirements of evolving to a cloud-first digital architecture with integrated lifecycle management automation to operationalise 5G and edge.

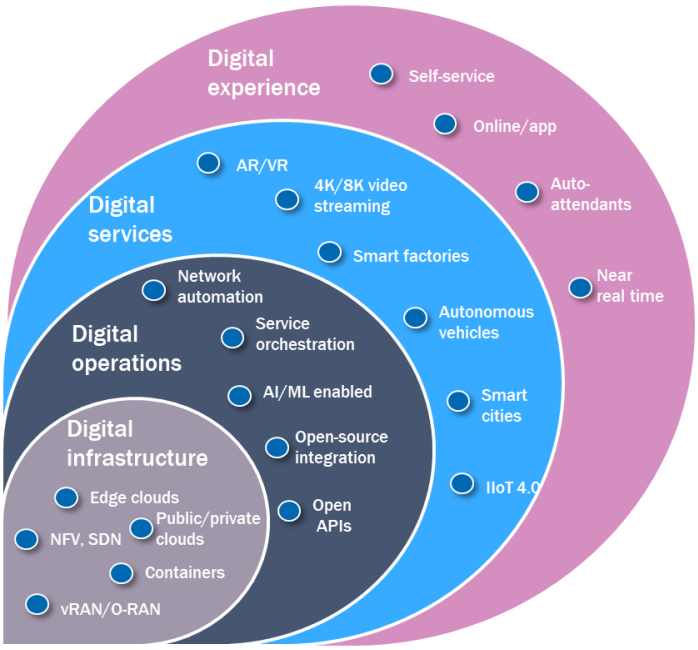
CSPs are in the midst of a multi-pronged digital transformation journey

Many CSPs are undergoing a multi-pronged digital transformations to achieve the following goals: increase business and service agility, dramatically reduce operational costs, enable service innovation and launch new services, and defend existing revenue by delivering superior customer experiences to consumers and enterprises. These goals directly translate to four key digital transformation pillars, depicted in Figure 1.

- Digital infrastructure**:** deploying software-driven, virtualized and cloud-native networks using network function virtualisation, software defined networking and container technologies, across a multi-cloud environment.
- Digital operations: implementing network and service automation technologies to manage network and operational complexity, aided by ML/AI and other technology innovations to lower opex economics and increase service agility.

- Digital services: enabling service innovation by the broader ecosystem as well as offering differentiated services that can be instantiated and consumed on-demand.
- Digital experience: delivering superior, real-time experiences to consumers and enterprises across all channels.

Figure 1: Four key pillars of CSP digital transformation



Digital operations is critical to the success of CSP digital transformation strategy

The introduction of digital infrastructure technologies such as NFV, SDN and cloud native computing is enabling CSPs to deploy their networks as a platform, upon which new services will be created. The 'network platform' paradigm takes a horizontal approach to the way networks are built by bringing together all the network domains including the RAN, edge clouds, programmable transport and the cloud-native core, and providing consistent API-based northbound interfaces for creating and delivering use cases with different performance characterises, to enterprises and consumers.

NFV uses the ability to create and modify network resources to reflect the changing service requirements and enable the allocation of these network resources precisely when and where they are needed. SDN introduces dynamicity in the transport network by enabling the programmatic control of the traffic management processes, so service delivery can be optimized, and network costs can be reduced. And finally, designing the network functions using cloud-native technologies such as containers prepares the network to be deployed natively on cloud platforms.

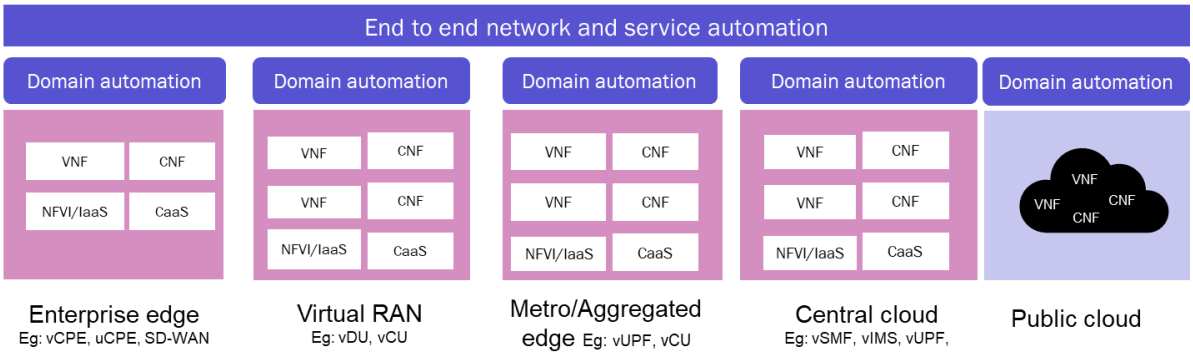
Consequently, as these networks scale up, become more dynamic and highly distributed to support complex services, they will introduce significantly high levels of network and operational complexity. Traditional operational approaches, which were built for managing physical networks and were highly labour intensive and manual, cannot be used to lifecycle manage the highly complex 5G networks and end to end services spanning a multi-cloud environment.

The digital operations pillar is aimed precisely at solving this problem. It introduces a new way to manage the network and operational complexity inherent in multi-cloud networks and provides the necessary abstractions and tool chains to automate the 5G network. Network automation is at the heart of this new digital operations paradigm.

A hierarchical cross-domain network automation solution is required to manage the multi-cloud network

The network is not only becoming software-based but is increasingly becoming distributed and being built using cloud technologies such as Kubernetes (K8s), especially in the 5G core (for the 5G Standalone deployment) and the edge clouds. The evolution to a virtualised core (4G) is already underway but this has been mostly in central datacentre locations (much like the centralised cloud locations).

The next stage in this evolution is the horizontal disaggregation, where the network functions are going to be deployed in a distributed architecture (eg: CUPS - control and user plane separation). This is driven by the CSP own needs to place VNF/CNF closer to the user to deliver 5G based low latency use cases. CSPs also plan to offer the edge computing locations by hosting edge clouds in their own real estate (such as cell sites and metro sites) and offer the platform to IT application developers1[1]. Thirdly, CSPs also intend to offer enterprise edge use cases such as virtual private 5G, virtual/universal CPE and SD-WAN based services. (Figure 2)



In each of these scenarios, CSPs will need to abstract complexity and embrace network automation, to achieve the necessary economies of scale for supporting many use cases (eg: network slicing), provide consistent customer experiences and deliver guaranteed SLAs to enterprises.

The network automation solution needs to cater for both vertical and horizontal disaggregation, and needs to be implemented at 3 different levels, with necessary abstractions and APIs provided at each level:

- starting from the bottom, the network resource layer automation will perform the lifecycle automation of the network resources using a common management layer that can manage both the VNFs and CNFs by abstracting the underlay management functions, i.e., ETSI's VNFM for VNF management and K8s CaaS for CNF management.
- at the next level up, the network domain automation will perform the lifecycle automation of the domain level services comprising of a combination of VNFs and CNFs (specified as NFVO by ETSI), potentially deployed in a multi-cloud environment, which would consume the resource layer automation as a service.

[1] Refer to Operator opportunities and threats in the public edge cloud computing market: https://www.analysysmason.com/research/content/reports/public-edge-cloud-rma16/

- at the highest level, the end to end network and service automation layer will perform the cross-domain lifecycle automation and configuration of the digital services that span multi-cloud environments across multiple networking domains.

The network automation solution must demonstrate some key traits

The network automation solution itself must be developed as a modular microservices-based platform using containers to make it easy to compose features and enable seamless introduction of new capabilities with minimal disruption to the run-time environment. The platform needs to support open and standardised, northbound APIs at each of the layers discussed above for 'plug and play' in a multi-vendor, multi-cloud environment that can consist of both VNFs and CNFs. This is particularly important as each of the layers may be at a different level of maturity, so an API driven architecture enforces clean abstraction for the higher layers.

CSPs also place high level of importance on the ability of the network automation platform to support a multi-vendor environment. It needs provide multi-vendor support at each of the layers; i.e., the end to end network and service orchestration should integrate with any domain-level network orchestrators, which in turn should support multi-vendor VNFs and CNFs; additionally, the platform should also support a mult-vendor hyperscale cloud environment such as Google Cloud Platform, Amazon Web Services, and Microsoft Azure.

There are two additional capabilities that the overall network automation solution is expected to support; firstly, it should be intent (model or policy) driven; an intent captures the service model required to deliver the contracted customer SLAs. The network automation platform consumes the high-level service intent, and converts it into network level intent, which dictates the network policies such as the number of VNFs/CNFs required for the service, the placement of the VNFs/CNFs etc. Secondly, the network automation platform should be supported by fit for purpose automated assurance technology to perform continuous monitoring of the resource health, domain level service health and end to end service health. So, the network automation platform together with the automated assurance systems will enable the self-healing of the network and service through closed loop automation, which is the ultimate end state of digital operations.

VMware Telco Cloud Platform

The VMware Telco Cloud Platform includes VMware Telco Cloud Infrastructure and VMware Telco Cloud Automation. VMwareTelco Cloud Infrastructure provides the digital infrastructure foundation (Figure 2) and supports a multi-cloud environment using VMware Cloud Director and VMware Integrated OpenStack for VNFs, and Tanzu Standard for Telco for CNFs. VMware Telco Cloud Automation provides the new generation digital operations capability, supporting IaaS and CaaS management automation to streamline workload placement and deliver optimal infrastructure resource allocation and intelligently automate the end-to-end lifecycle management of network functions.

Conclusion

CSPs need a new digital operations model powered by a network and service automation platform, to abstract complexity and automate the lifecycle of multi-cloud networks and digital services in the 5G era. The VMware Telco Cloud Platform solution is positioned to take advantage of this fast-growing market. According to

Analysys Mason, the software market associated with the network automation solutions discussed in this paper is expected to grow at a CAGR of 45% to reach USD 8 billion by 2023.[2]

[2] Refer to Network automation and orchestration: worldwide forecast 2019–2023: https://www.analysysmason.com/research/content/reports/nao-forecast-2019-2023-rma07/

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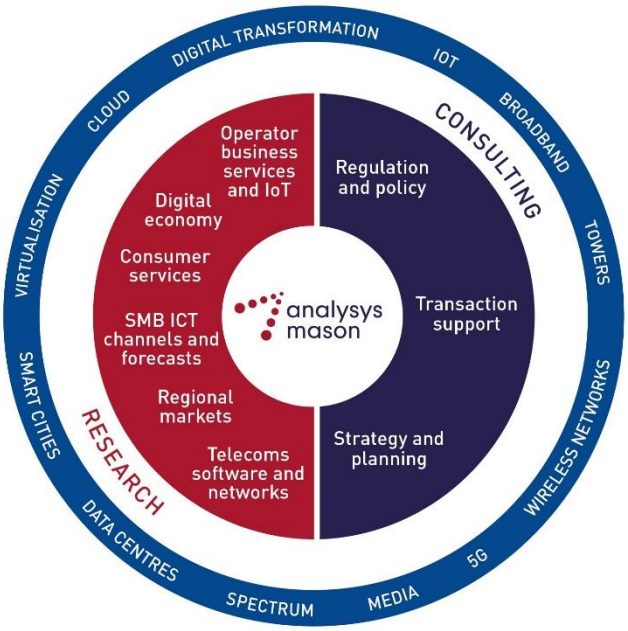

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