Network virtualization drives the need for service lifecycle orchestration.

White paper
The advent of virtualization in the telecoms industry

The telecommunications industry is known for its fast-paced, dynamic nature, as it has experienced constant change at an accelerating rate for many years. The advent of virtualization cannot be considered as simply a new technology domain, but instead as the pillar for a significant paradigm shift for the industry: when the physical and human components are minimized in the process, this results in an unprecedented opportunity for agility through automation, centralization and economy of scale.

Although generally interpreted as one and the same, there exist two separate currents in the virtual domain. One, known as Software Defined Networks (SDN) is related to the centralized control and programmability of network elements, i.e., the intelligence is removed from the physical devices, which can then be replaced with generic white boxes and managed from a central, programmatical entity known as the SDN controller. The other refers to Network Function Virtualization (NFV), which although started a few years after the SDN movement, quickly took central stage. This current relates to the migration of network functions from their proprietary hardware into the cloud (e.g. virtual machines and / or containers). Both technologies tend to be grouped together as they complement each other.

The technology and expertise in this space are still maturing as many CSPs have carried out trials, consulted with vendors and published their planned architectures. However, there is a clear sign that virtualization will fulfill its promise: the IT industry in general and perhaps more specifically large cloud providers have not only solved some of the problems that the telecommunications sector is confronting, they have been actively participating in supporting public communities to increase the pace of adoption.

In this new cultural landscape, CSPs are responding accordingly by either merging CTO and CIO groups or requesting them to cooperate more closely together. Their customers have become accustomed to consuming digital services that are enabled instantly and for which only what has been used needs to be paid for. CSPs must adapt to these new trends and require a new generation of orchestration tools to meet these goals. Figure 1 summarizes described evolution on high-level.

Figure 1. Evolution of BSS, OSS and underlying infrastructure
End-to-End orchestration as a strategic asset

There are several standard bodies currently producing guidelines in this domain (e.g. ETSI NFV MANO, MEF’s LSO, TMF Zoom project, etc.). Most of the efforts were initially focused on managing virtual domain itself with the assumption that this could be later attached to traditional OSS platforms. However, there is growing acknowledgment that if virtualization is to reach its full potential, this domain cannot be simply stacked next to its legacy counterparts (e.g. transmission, access, IP, etc.) and managed in a similar fashion.

Traditional OSS platforms were designed and built to support a business model where the constraints of the physical world and human factor dictated the highest degree of agility that could be supported to deliver services and manage them. To meet the full potential of the virtual infrastructure, an orchestration suite must not only be able to exploit the benefits of virtualization, but also manage appropriately the requirements to handle the physical components from legacy platforms. For the foreseeable future virtual and physical resources will need to be drawn together to deliver end-to-end services that customers can consume. This is illustrated in Figure 2 below.

The FlowOne Service Lifecycle Orchestrator is a vendor agnostic, end-to-end, cross-domain orchestration platform that enables creation of complex services, which can be extended to include resources onboarded from multiple third-party domains such as NFVO domain (Network Function Virtualization Orchestrator), SDN domain (SDN controllers) and Public cloud domain (IT applications). These domains in the service design space would allow service designers to create complex cross-domain service specifications, which can be published to northbound platforms to comprise commercial products (e.g. self-care portals, CRMs, CPQs, etc.).

Figure 2. Physical and Virtual domains under the E2E Orchestrator
FlowOne SLO - Multi-domain E2E service orchestration

FlowOne SLO supports the full range of traditional service orchestration and fulfillment functionalities, but extends it further to account for the need to orchestrate and fulfill orders across multiple domains (both physical and virtual). From a general high-level perspective, FlowOne Service Lifecycle Orchestrator is positioned between the Customer and the Resource domain layers as shown in Figure 3 below.

At the northbound platform layer, options are not restricted to a single CRM/CPQ platform but can support any combination of independent entities (e.g. omni-channel support) that can reference published service specifications and package them into bundles to target specific market segments. Service orders originate also from Customer domain layer and contain references to the service specifications published by FlowOne SLO. The persistence layer of the FlowOne Service Lifecycle Orchestrator is completely Oracle database free.

Multiple domains shown at the bottom part in Figure 3 represent resources and where applicable, platforms responsible for managing them. For instance, SLO may be extended to directly interact with an Element Manager (EM) to enable service provisioning. On the other hand, SLO can be extended to interface directly toward any Network Function Virtualization Orchestrator (NFVO) or an IT application management platform for service orchestration.

A key feature of FlowOne Service Lifecycle Orchestrator is supporting design of service specifications that can be validated and published directly for consumption.

Figure 3. FlowOne Service Lifecycle Orchestrator positioning in general architecture
Figure 4 shows the general flow of tasks that typically take place in service specification design activity. FlowOne SLO is meant to be able to on-board resource specifications from the underlying registered resource managing platforms. Because on-boarded components can be represented in different formats/standards originating from an array of technology domains, they are converted into a set of common features and terminology in a process referred to as unification. This allows for components belonging to different sources to be seamlessly used in service specification design.

When the design for a new service specification is finalized, it can be validated by deploying service instance based on the specification design to test environment or laboratory environment. After validation, the service specification is ready for publishing. Publishing service specification exposes it to one or more northbound platforms to be consumed directly or bundled together according to customer segment needs. When these bundles are purchased, northbound platform(s) will produce orders referencing one or many service designs and the specific transactions required of them. The general flow for this process is shown in Figure 5.

Orders received by FlowOne Service Lifecycle Orchestrator are matched against their corresponding specifications which will typically contain an ordered list of tasks that need to be executed to successfully complete the order transaction.

These may involve in turn, passing on requests to the resource layer referencing the components on-boarded earlier during the service specification design phase with all the corresponding parameters.
FlowOne SLO - Standards and references

There are four key organizations that are leading the standards for the SDN and NFV space. In most cases, there exists coordination among them:

- The Open Networking Foundation (ONF) has taken the lead on the standardization of SDN and originally supported one protocol (open flow) although there are now several of them. This organization was initially led by the large cloud suppliers (Google, Microsoft, etc.) who have deployed this technology into their production data centers and (SD) WAN network connections. This community targets mainly the lower SDN resource level specifications.

- ETSI NFV MANO probably presides the discussions on the NFV side. The first management architectures for the virtual domain in the telecommunications space were proposed by this standards body. More advanced E2E orchestrations discussions are making their way into the standards.

- TM Forum, and more specifically the ZOOM project1, carries out higher level E2E orchestration discussions. They denote a similar demarcation between the Resource and Service orchestrations as in the alternative ETSI NFV MANO architecture but it completely detaches the service role from the NFVO layer as can be seen in Figure 6 below. TMF’s data models for the representations of virtual resources has been adopted to a good measure by other standards bodies such as ETSI and MEF. FlowOne Service Lifecycle Orchestrator models are closely aligned to the TMF’s.
• MEF Lifecycle Service Orchestration (LSO) is an initiative from the Metro Ethernet Forum to also standardize E2E Service Orchestration across multiple domains which is in line with the FlowOne SLO goal and purpose. Figure 7 shows a sample reference architecture. The MEF raises a valuable point on the modularity expected from the LSO: E2E Orchestrators will be available in multiple different admin domains (e.g. enterprise, SP, etc.) and will need to collaborate with each other

1 Source: https://www.tmforum.org/zoom/
Key benefits

Key benefits of FlowOne Service Lifecycle Orchestrator include the following:

- FlowOne SLO provides a unique platform for binding together resources from multiple resource domains, both traditional physical resources and virtualized resources, and allows for modelling end-to-end physical, hybrid or virtual services with effective Catalogue Driven Fulfillment (CDFF) framework.
- Due to the unification process of resources from multiple domains, top level service modelling can take place seamlessly in a single design space making the process more efficient and reducing time-to-market.
- FlowOne SLO provides full functionality of extensively validated and widely used FlowOne Fulfillment and Provisioning and Activation engines to enable service orchestration and fulfillment capabilities - now also for hybrid services.

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• Bridges across multiple domains with agility at the center: FlowOne Service Lifecycle Orchestrator has been purposely built to maximize the inherent agility of virtualization and provide the tools that span across the physical domains that are necessary to deliver E2E services.

• FlowOne SLO is vendor agnostic - the suite can be extended to interface with any other software or hardware vendor or open source community project. It has many interfaces already pre-built and readily available but should this not be the case they can be easily created for new systems/platforms. Customers can decide whether to create their own interfaces or outsource the task to a third party of their choosing provided they follow certain guidelines. For example, FlowOne SLO comes with out-of-the-box integration to CloudBand Network Director (CBND) as NFVO.

• The product has strong emphasis on User Experience (UX), which enables seamless service specification design. This in turn simplifies the process of creating complex designs from natively built components and/or those that are on-boarded (imported) from registered domain controllers (e.g. NFVOs, SDN controllers etc.).
Abbreviations

API  Application Programmable Interface
CPQ  Configure Price Quote
CRM  Customer Relationship Management
CSP  Communication Service Provider
ECOMP  Enhanced Control, Orchestration, Management & Policy
ETSI  European Telecommunications Standards Institute
LSO  Lifecycle Service Orchestration (MEF)
MANO  Management and Orchestration (ETSI)
MEF  Metro Ethernet Forum
NFV  Network Function Virtualization
NS  Network Service
NSD  Network Service Descriptor
ONAP  Open Network Automation Platform
ONF  Open Networking Foundation
PNF  Physical Network Function
PNFD  Physical Network Function Descriptor
REST  Representational State Transfer
SDN  Software Defined Networking
VL  Virtual Link
VLD  Virtual Link Descriptor
VNF  Virtual Network Function
VNFD  Virtual Network Function Descriptor
VNFFG  Virtual Network Function Forwarding Graph
VNFFGD  Virtual Network Function Forwarding Graph Descriptor
WAN  Wide Area Network

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