White Paper

Next-generation OSS is critical to delivering service agility in new virtualized networks

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1 Executive summary

This white paper assesses the impact of the emerging network virtualization technologies of network function virtualization (NFV) and software-defined networking (SDN) on the operational processes and support systems of communication service providers (CSPs). It outlines the key role the OSS will play in enabling CSPs to deploy and realize anticipated benefits from service agility, operational flexibility and cost optimization.

In developing this white paper, Analysys Mason interviewed eight advanced CSPs that are actively exploring network virtualization technologies, to identify their present state of play (activities, concerns and considerations), and the future roadmap of their OSS to manage virtualized networks.

Service agility is the crucial driving force with cost optimization from NFV in the short term

Figure 1.1 illustrates the major forces driving virtualized next-generation networks (vNGNs[1]) to meet the needs of the evolving telecom sector for network and IT convergence and innovation. In the future telecom landscape, CSPs and suppliers will differentiate from their competitors on the basis of network software intelligence, not hardware.

Figure 1.1: Main drivers network virtualization [Source: Analysys Mason, 2014]

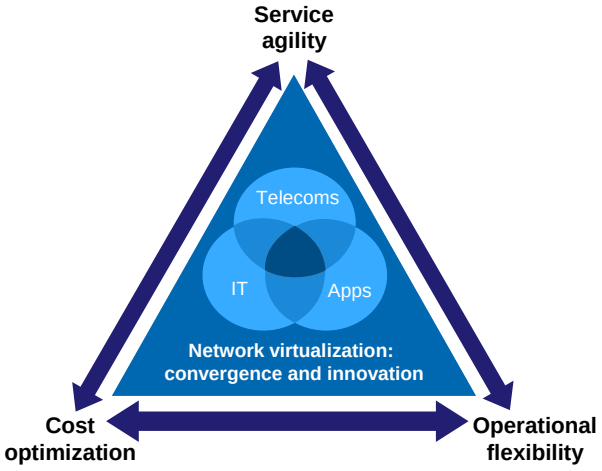


Figure 1.2: CSPs' weighting of drivers of network virtualization in the short and longer term [Source: Analysys Mason, 2014]

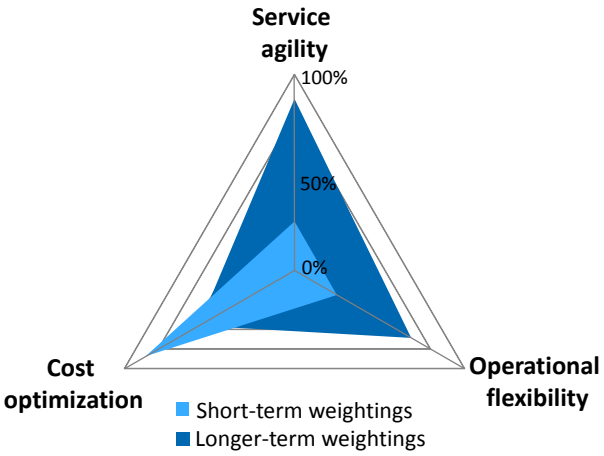


Figure 1.2 shows the weighting that the CSPs we interviewed gave to the drivers for network virtualization. The general consensus is that NFV is more real than SDN, and can bring shorter-term capex savings in the network. In terms of maturity, SDN is lagging NFV in CSPs' networks compared to data centers. However, CSPs see the key strategic benefit of network virtualization as increased OSS automation, enabling service agility.[2] Capex and opex savings are regarded as beneficial by-products.

1 vNGNs are a mixture of virtualised and traditional physical network assets where most of the core – namely the service layer – is virtualised.

2 Service agility refers both to faster development of internal systems and new services, and to reduced time-to-market for launching error-free services, both with owned network resources and together with third parties.

CSPs are speculating about the total cost of ownership without thorough analysis

Uncertainty of the benefits of network virtualization in terms of the total cost of ownership was expressed by all CSPs interviewed: they were concerned whether the expected 33% capex savings (as seen in data center environments) would be lost to increased virtualization software opex in the longer term. Section 2.3 of this white paper explores the costs and benefits of network virtualization, and highlights the added costs that CSPs will incur if they do not employ a holistic service agility framework when moving towards network virtualization. A critical success factor is the evolution of the OSS layer to orchestrate the design, creation and management of services. CSPs are seeking guidance on how to evolve their OSS environment to support vNGNs.

Near-term benefits of service agility can fuel the longer-term 10-year transformation journey

CSPs expect that, with the help of vendors, OSS for vNGNs will be developed within two or three years that can support the coexistence of traditional physical and virtualized networks for the next five years. However, a CSP may need up to 10 years to transform to a new OSS architecture which is cheaper, more agile and automated – matching the flexibility and elasticity of a virtualized network, while still capable of managing a traditional network. In this white paper, we term a next-generation OSS of this type a vNGN-OSS.

The development of vNGN-OSS with increased OSS automation functions is expected from existing as well as new vendors. CSPs anticipate that vendors will innovate and develop commercial off-the-shelf solutions to meet the vNGN-OSS requirements for vNGNs. This approach provides a win-win outcome for CSPs and vendors alike, by:

- allowing CSPs to continue to use or extend their existing OSS processes and systems, thus maximizing the return on their investment while ensuring minimal disruption to operations and customer services
- limiting changes to CSPs' operating and organization structures by allowing them to continue to buy and operate multivendor OSS solutions for which the various vendors bear the costs of R&D, development and maintenance
- accelerating vendors' software skills and assets, as they will continue to be vital suppliers to CSPs
- self-regulating the industry – vendors will be able to continue to differentiate themselves on their products, while CSPs differentiate themselves on service agility and innovation using vendors' solutions.

Oracle will continue to be an important vendor as CSPs move to vNGNs and vNGN-OSS

Oracle was the second largest service fulfillment vendor by revenue in 2012.[3] It has dedicated itself to providing multivendor service solutions that are interoperable with its own and third-party BSS/OSS, using industry standards to help CSPs accelerate the design, creation, delivery and management of services. Section 3 provides an overview of the readiness of Oracle's OSS to increase service agility in traditional physical and virtualized networks.

> "Over the next five years, you will see a virtualization of the network"
>
> *Randall Stephenson, AT&T chairman and CEO, at the 2013 Goldman Sachs Communacopia*

[3] Source: Mark Mortensen: *Service Fulfilment Systems: Worldwide Market Shares 2012*, Analysys Mason, 2012

2 The challenges of vNGNs will be met by OSS evolution, not revolution

ETSI's NFV industry group has purposely omitted the OSS/BSS layer from its scope of work, which is expected to be completed in January 2015. However, this omission has not removed the issue from the industry. NFV orchestrators (NFVOs) and SDN controllers are being developed in parallel and with some level of isolation by members of the ETSI NFV and Open Network Foundation (ONF) groups, respectively. NFVO development is following an OSS development path because it is driven primarily by CSPs and telecom vendors. To increase service agility, service-fulfillment OSS functions are being focused on first, i.e. order management, inventory management, activation/provisioning, and planning and optimization. SDN trials and use cases generally target traffic control and management, with increased emphasis on service-assurance OSS functions.

Presently, NFV and SDN trials are being conducted by CSPs to deliver existing services via traditional physical networks. Existing OSS can support network virtualization by abstracting control of the virtual infrastructure through virtual network function (VNF) managers, NFVOs and SDN controllers, while preserving existing OSS processes and operations with the current OSS and user interfaces. Figure 2.1 depicts the ability of a multivendor OSS that provides multiple levels of API abstractions to manage physical and virtual infrastructure. It also shows (in green) the new OSS functions and features, and APIs, needed to support vNGNs.

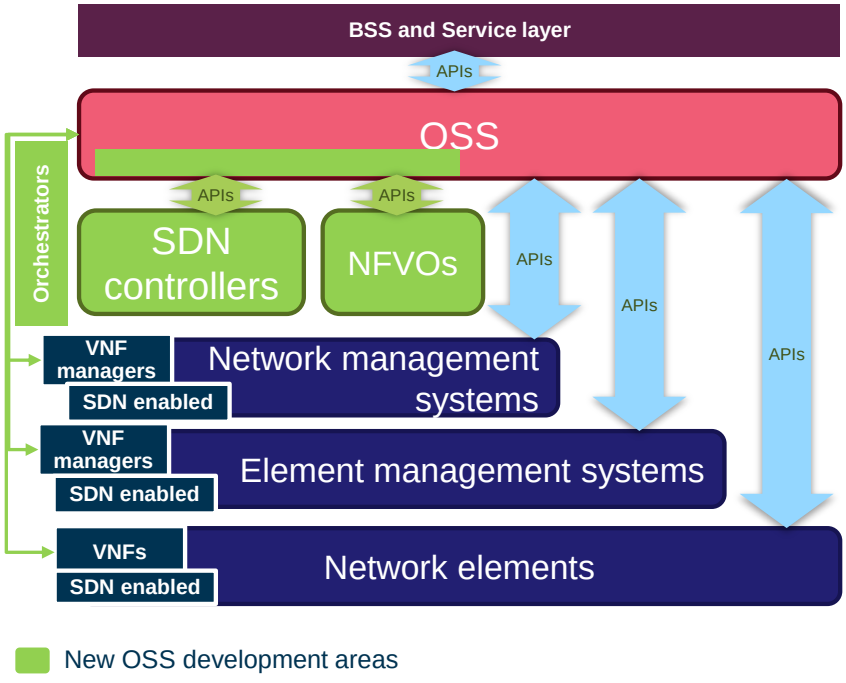


Figure 2.1: OSS providing multiple levels of abstraction to manage existing and new virtual infrastructure [Source: Analysys Mason, 2014]

"We will build our business case on customer engagements, and see service fulfilment OSS abstraction as a critical first step, then assurance"

Diego Lopez, Head of Technology Exploration in the Global CTO Unit at Telefónica

CSPs accept that OSS abstraction provides a default migration path for them. Initially, OSS abstraction will deliver service fulfillment and assurance control for existing services, through new software control layers of VNF managers, NFVOs and SDN controllers. This will be achieved in a streamlined way, with the minimum disruption. However, for maximum benefit, CSPs expect that vendors will develop new, mature vNGN-OSS that will:

- orchestrate and manage physical and virtual network resources for both existing and new services
- continually reduce the complexity, development and maintenance costs of CSPs' OSS
- reduce the time and cost of integration through open interfaces, and hardware and software interoperability standards
- provide near-real-time view and control of operations, with policy-controlled automation and analytics
- encompass delivery and lifecycle management of services, where resource management is implicit
- potentially modernize operations to converge network and IT planning, build, operations and maintenance.

2.1 Three key milestones of OSS maturity with network virtualization

Today, discussions of OSS by CSPs and vendors are in their early stages. Exploration of multiple OpenStack projects is ongoing, but OpenStack's management of virtualized infrastructure is seen as the most applicable at present. This exemplifies the immaturity of network virtualization technologies.

Figure 2.2 provides three key milestones that CSPs see in evolving their OSS with network virtualization.

- Over the next three years CSPs and vendors will continue to identify network functions that can and should be virtualized because this will bring business benefit. Network functions will be virtualized at different times, and may progress through these milestones at differing rates.[4] CSPs have identified that greater cost reductions could be achieved in the access network than the core network – exemplified by Telefónica, which is conducting trials of virtual CPEs.
- In the following three years, CSPs anticipate that vendors' OSS will be advanced to allow coexistence of physical and virtualized networks through OSS abstraction as explained in Section 2, above.
- Over the subsequent five years, CSPs expect to continue to gradually progress their development, implementation and rationalization of their OSS, in preparation for transforming to a consolidated, slimmer vNGN-OSS architecture that addresses OSS challenges and gaps to orchestrate the management of vNGNs. As a result, towards the end of the next decade we can expect CSPs to be completing their migration to vNGN-OSS which will manage the vNGNs and technologies that have emerged during the decade.

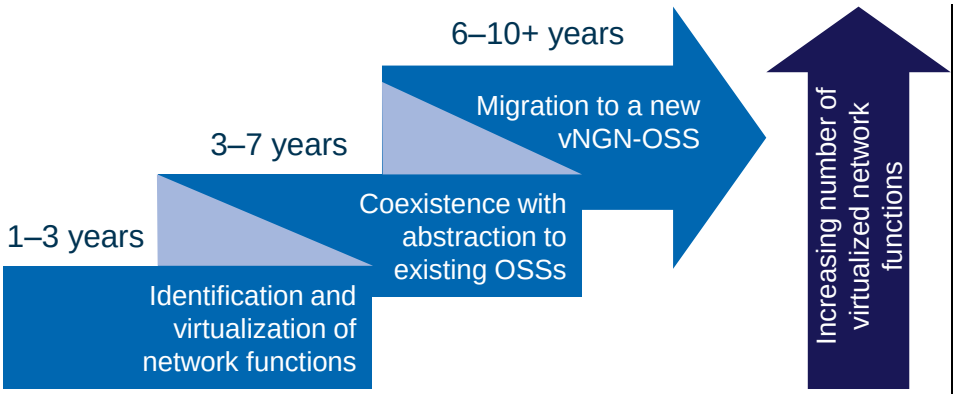


Figure 2.2: Three key milestones for OSS maturity with network virtualization, with an indicative timeline [Source: Analysys Mason, 2014]

[4] Analysys Mason forecasts NFV and SDN use cases and adoption of network functions in its report *SDN and NFV at a Crossroads: Vendors Innovating And Positioning For The Future Of CSPs' Network Virtualisation*

However, a ten-year maturity roadmap is not acceptable for CSPs' typical five-year business plans. They need some way to progress more quickly through these milestones, while still attaining some business benefit and not inhibiting the overall vNGN-OSS transformation roadmap. Possibilities include:

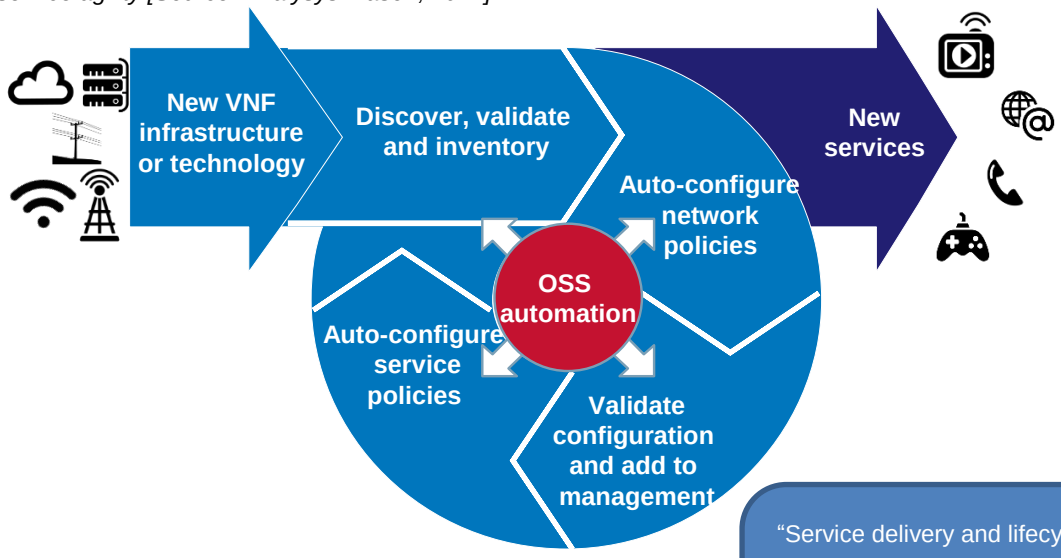
- investing based on customer engagements, so that customers part-fund the vNGN-OSS development for particular services, while other customer OSS functions could be migrated to the vNGN-OSS
- progressing when sufficient VNFs are available for end-to-end delivery of one or more services
- overlapping self-organizing networks (SON) automation with vNGN-OSS requirements
- developing a holistic service agility vNGN-OSS framework and requirements for moving towards automation, and include these requirements in all OSS procurement documents henceforth (see Section 2.2 below).

2.2 Network virtualization facilitates OSS automation, which in turn will drive service agility

CSPs are far more convinced of the benefits that network virtualization can bring in terms of service agility and operational flexibility, compared to any cost savings that may be achieved. OSS automation is a cornerstone if CSPs' strategies to increase service agility. OSS automation requires new OSS functions and features that can do auto-additions of new network elements, functions and technologies, and can deliver services using a combination of network and service policies. These OSS functions and features would effectively optimize CSPs' end-to-end plan-to-provision OSS processes, consequently increasing their service agility with an OSS that has "automated services readiness".

Figure 2.3 illustrates new enhanced operations opportunities that OSS automation can provide to CSPs. While OSS automation does not exist yet, CSPs view it as crucial to increase their service agility and allow them to differentiate themselves from other CSPs as well as IT-centric competitors such as OTT and data center providers.

Figure 2.3: OSS automation of new network elements and functions, assimilation and service creation to increase service agility [Source: Analysys Mason, 2014]



"Service delivery and lifecycle management require a new generation of orchestration systems to be integrated with the existing OSS estate"

Andy Reid, Chief Network Services Architect, British Telecom

Figure 2.4 describes three OSS automation use cases that can increase CSPs' service agility in vNGNs.

Figure 2.4: Use cases for OSS automation in vNGNs [Source: Analysys Mason, 2014]

Use cases	Description
Network augmentation	• If there is increased market demand for existing services, network capacity monitoring can alert the CSP of the need for new VNFs or NFV infrastructure (NFVI) because all existing virtual machine capacity has been exhausted. • New NFVI could be automatically discovered and sent configurations from the control plane, based on the network configuration policy. New VNFs could be pre-configured from a pre-defined network architecture in the control layer, to automatically configure the new VNF when it is implemented in the network. New NVI and VNFs would be made available to the OSS inventory to support network readiness, service fulfillment and assurance processes.
Addition of new NFVI, VNFs and/or technologies	• Addition of new network functions (UDC/UDR, PCRF, DRA, ANDSF), technologies (LTE, SON) and NFVI (server, storage, network I/O (400G optical)) can be achieved in a similar way to the above scenario. However, it will deliver a new service which was not possible without the new technology or VNF, such as 300Mbit/s mobile broadband with QoS using LTE-A and service policy rules. • New resources and service specifications would be modelled in the service catalog and, when discovered, the new network capabilities would be instantiated and made available in the OSS inventory to support network readiness, service fulfillment and assurance processes.
Create services from existing resources	• Launching new services ensures CSPs stay competitive. With network virtualization, VNFs can be created from existing, dormant NFVI to deliver new services without additional capex. • Existing capacity will be queried. If available, VNFs can enter the creation, inventory, configuration and management cycle (Figure 2.3). If not, either network augmentation or new addition (above) will be needed to create, deliver and manage the new service being requested.

Arguably, OSS automation does exist today, but it is not as plug-and-play as in IT environments because of the lack of standardization. For true OSS automation to be realized, the following are some of the vNGN-OSS requirements that are needed, in addition to open interfaces and more standardization:

- VNFs must provide a minimum number of parameters to the OSS or orchestrator for seamless auto- discovery and configuration
- a master policy database in the OSS layer that can configure the VNFs based on pre-determined and approved network and service designs and configurations
- new simulators and emulators of OSS features to pre-test the results of implementing the changes
- improved security administration, hierarchy and auditing functions
- off-the-shelf, plug-and-play infrastructure for new vNGN service delivery and management
- single end-to-end view and operation of service delivery and lifecycle management.

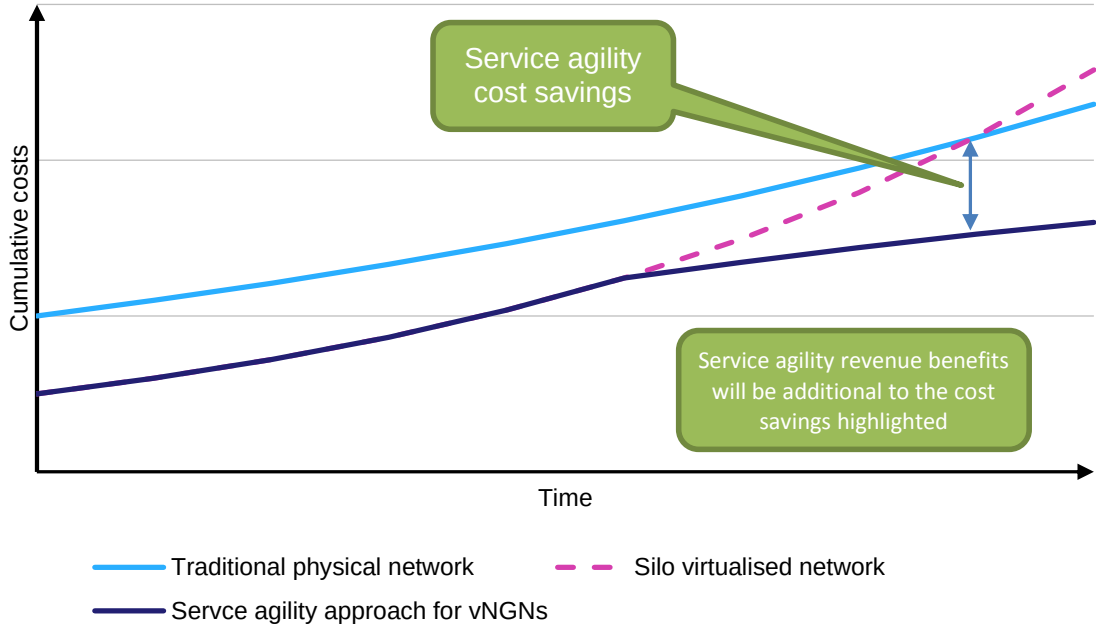
2.3 OSS is important to realizing benefits from network virtualization

The CSPs interviewed expressed uncertainty about the benefits of network virtualization in terms of total cost of ownership, and in particular whether the expected 33% capex savings would be lost in the longer term due to the greater opex of virtualization software. CSPs believe that, potentially, the cumulative cost of a traditional physical

network hardware and software with lower O&M costs could be less than the total cost of ownership of a virtualized network, which offers an initial capex saving but incurs higher O&M costs.

To date, little in-depth analysis of the costs and benefits of network virtualization has been done by the industry. Our high-level analysis, illustrated in Figure 2.5 below, suggests that retaining the existing physical network and systems while also investing in "silo" network virtualization could lead to overspending. In contrast, using a holistic service agility approach to migrating to a vNGN can realize the maximum benefits of network virtualization.

Figure 2.5: Illustrative comparison of cumulative costs of various approaches to network virtualization [Source: Analysys Mason, 2014]



"It is critical that AT&T has one framework that the suppliers can build their products on and allow focused innovation to occur much more rapidly,"

Margaret Chiosi, Technical Strategist at AT&T, at 2013 SDN Central interview

A critical success factor is the evolution of the OSS layer to orchestrate the design, creation and management of services. All the CSPs interviewed see this service agility as the real benefit, increasing revenues from the new services, accelerating the time to market, and also – as by-products – providing capex and opex savings. The capex and opex saving arising from service agility were seen by CSPs as sufficient to outweigh the higher software opex needed for network virtualization, that may negate initial capex savings over time. Figure 2.5 highlights the increasing divergence in costs thanks to OSS automation to enable service agility, which is as a result of achieving the cost savings identified in Figure 2.6. Figure 2.5 excludes the revenue benefits to CSPs from service agility, thus reinforcing its positive impacts.

Service agility is the linchpin for maximizing the benefits of network virtualization

Following the service agility approach shown in Figure 2.5, CSPs can sustain lower costs with a virtualized network, and there is an inflection point where CSPs can further curb costs. At best, Analysys Mason forecasts this inflection point can be achieved in five to seven years. For success, CSPs must have an overarching service agility framework for augmenting their existing networks with VNFs, and increasing OSS automation. Figure 2.6 summaries the critical success factors needed for CSPs to maximize the benefits of network virtualization.

Figure 2.6: Summary of critical success factors needed for CSPs to maximize the benefits of network virtualization [Source: Analysys Mason, 2014]

Benefits	Quantifiable benefits	Critical success factors for CSPs to maximize benefits
Service agility	• Reduced time to market for traditional and new services • Reduced service development times • Reduced management overheads over the service lifecycle • Increased service innovation and flexibility	• Have an overarching service agility framework for augmenting existing network with VNFs and increasing OSS automation • Develop and include service agility vNGN-OSS requirements in all OSS procurement documents henceforth • Commit to retraining the organization to be more software-oriented • Foster and reward service innovation • Move to closed-loop service lifecycle processes, where possible
Revenues	• Earlier revenues from faster time to market • New services revenues from service innovation not previously possible without virtual network resources	• Be open to new business models and opportunities to enter new industry verticals • Revenues from new services that require virtual network resources such as private, public or hybrid network cloud services • Explore service innovation with third parties to compete more strongly in the customer ecosystem and add new potential revenues streams
Opex reduction	• Headcount reduction • Reduced OSS development, integration and maintenance costs • Reduced time and costs for operational processes	• Ensure process automation is intrinsic to all OSS implementation • Commit to headcount reduction, when needed • Consolidate/rationalize OSS, with better integration for simpler architectures • Minimize parallel running of systems and processes • Commit to legacy replacement and/or retirement, where applicable • Standardize on certified hardware and software that have open interfaces and interoperability • Modernize operations to converge the planning, build, and O&M of network and IT
Hardware savings	• Deferred hardware spending • Lower hardware cost for virtualized infrastructure	• Virtualize as many network functions as possible to attain economies of scale on the costs of the added virtualization software layer • Standardize on hardware to drive down costs – the principle of NFV • Invest in software to automate and maximize sharing of network resources

There are three phases for the successful migration to an agile CSP with a vNGN-OSS:

- **Deployment of vNGN**: vNGN investments should be used primarily to augment or replace the network infrastructure that is delivering existing services. The vNGN should not be implemented in a silo environment, which would lead to dual spending on two networks and operations.
- **Co-existence with vNGN**: In this phase, the benefits gradually begin to match the costs. These will largely come from deferred and reduced hardware costs, and the application of existing OSS to provision, manage and assure physical and virtual network resources for existing and new services using OSS abstraction.
- **Transformation to vNGN and vNGN-OSS**: CSPs clearly identify legacy systems and infrastructure, and either replace or retire them newer, lower-cost virtualized alternatives which are more readily integrated into the new vNGN and vNGN-OSS architecture. The faster this transformation is completed, the sharper the inflection point can be in the service agility trend shown in Figure 2.5 above.

Historical trends indicate that if CSPs continue their "as-is" operations, costs will increase gradually but continually over the next 10 years. As a result, a holistic service agility framework for migrating to vNGNs with vNGN-OSS could curb CSPs' climbing costs whilst increasing competitiveness.

3 Network virtualization readiness of Oracle's OSS

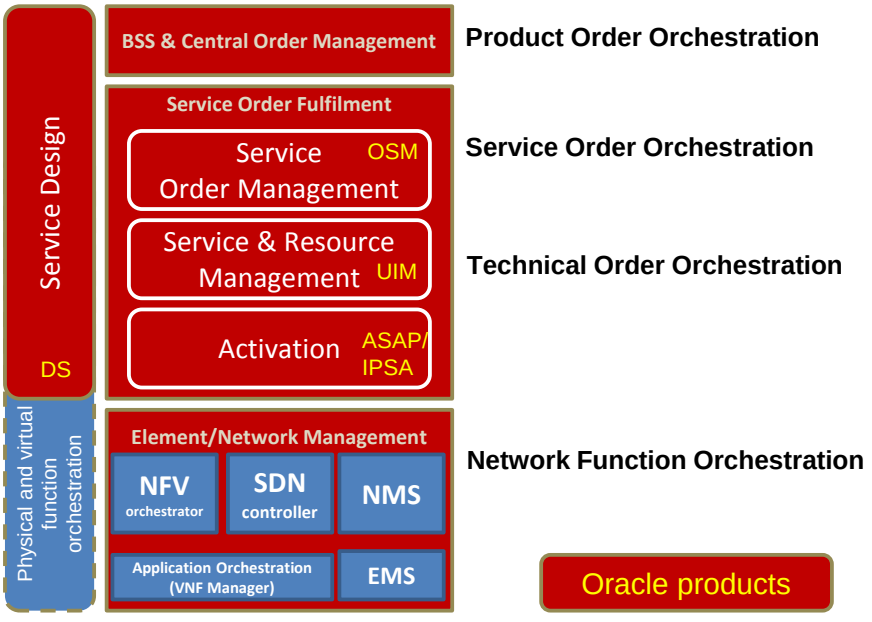


Figure 3.1: Conceptual Oracle BSS/OSS network architecture for NFV and SDN [Source: Analysys Mason and Oracle, 2014]

Oracle's BSS/OSS solution already works on the principle of abstraction, where network virtualization will basically augment a layer in the architecture. In Figure 3.1, the BSS and central order management layer at the top orchestrates the execution of customer orders containing one or more products, transforming each into potentially multiple service orders, but synchronized by the central order management function in Oracle's Rapid Offer Design and Order Delivery (RODOD) solution. Each service order is then dynamically orchestrated at the service order management layer in RSDOD, using a stateful service and resource inventory (Oracle's UIM). The solution designs the services and assigns the resources on each service order resulting in a number of fully assigned technical orders.

This results in the activation of the services and resources at the highest level of abstraction provided by the physical and virtual network with Oracle's ASAP/IPSA.

Interworking of these layers in the architecture provides flow-through automation whilst separating the service requirements from the technical requirements, thus providing service agility – by speeding up the implementation of both new services and network capabilities. This decoupling also allows the smooth transition of resources from physical, through hybrid to a fully virtual nature.

Enabling all of this is Oracle's Design Studio (DS), a unified design environment which supports the specification of products, services and resources together with the corresponding meta-data, including network and service policies that will control their run-time behavior (policy-controlled automation). DS also supports the configuration of automated network discovery and inventory updates, enabling the introduction of new technology and augmentation of the network.

Two new capabilities will be introduced that will be used by the upper layers of the Oracle architecture: VNFs on NFVI- and SDN-enabled infrastructure. Initially, Oracle can provide orchestration and control functions using multiple levels of OSS abstraction to EMS, NMS, VNF managers, NFVO and SDN controllers, as shown in Figure 2.1 and Figure 3.1. Oracle's RSDOD solution thus allows CSPs to retain existing OSS development and process flow-through.

As network virtualization becomes more mature and pervasive, Oracle has the opportunity to extend its service design function (in Design Studio and associated components in Figure 3.1) to support both network function and service orchestration capabilities, enabling CSPs to better manage the end-to-end service lifecycle of both physical and virtualized network functions, thereby increasing service agility.

4 Conclusion

The key findings on this white paper are:

- Service agility is the key strategic benefit of network virtualization, increasing revenues from new services, accelerating time to market and also providing capex and opex savings as by-products. As such, cost optimization is an implicit benefit from increased service agility.
- OSS will be a key enabler for achieving service agility, operational flexibility and optimization of costs.
- New vNGN-OSS must be cheaper and more agile – matching the flexibility and elasticity of virtualized networks, while still capable of managing traditional networks. vNGN-OSS will also need to orchestrate and manage physical and virtual network resources for both existing and new services.
- A holistic service agility framework is needed when moving towards vNGNs, a framework that increases the agility of the service delivery and lifecycle management, and uses increased OSS automation that can provide near-real-time views and control of operations, with policy-controlled automation and analytics.
- The benefits from service agility that are achievable within the next five years can fuel the longer-term 10-year transformation of processes, systems and processes.
- There is potentially an increasingly diverging cost if CSPs do not employ a holistic service agility framework (see Section 2.3).

About the authors

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