

# REALIZING THE FULL BENEFITS OF NETWORK FUNCTIONS VIRTUALIZATION AND SOFTWARE-DEFINED NETWORKING

STRATEGIC WHITE PAPER

This paper explores how recent technological innovations make this an opportune time to simplify Operations Support Systems (OSSs) to automate and improve the introduction of new services while better supporting the near real-time customer experience. Virtualization and other cloud-software technologies inside network functions are providing an opportunity to enrich and align network operations with agile IT operations practices. At the same time, the paper shows that reaping the full benefits of Network Functions Virtualization and Software-Defined Networking for greater OSS simplicity requires an evolutionary strategy with a dynamic operations approach. The Alcatel-Lucent Motive Dynamics Operation (MDO) portfolio is presented as key to enabling this evolution.

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## THE OSS SIMPLIFICATION OPPORTUNITY

Ever since the rise of Internet-based competition, service providers have been faced with the need to innovate and simplify their operations support systems (OSSs). They need solutions that will further reduce operational expenditures (OpEx), allow them to be more competitive through agile introduction and delivery of new services, and to meet the growing demand to manage customer experiences in near real-time. These objectives have been hard to achieve so far, but new technology trends such as Network Functions Virtualization (NFV) and Software-Defined Networking (SDN) are opening new perspectives and opportunities to meet these challenges.

Today, a real opportunity exists for service providers to simplify their OSS by introducing a highly automated and dynamic approach to service operations. Why has this opportunity become available?

First, the use of virtualization and other cloud software technologies inside network functions and their deployment as applications on IT infrastructure provide the opportunity to enrich and align network operations with agile IT operations practices. Dynamic application lifecycle management principles can be leveraged from the IT world and directly applied to network functions. This enables simplification by moving from dedicated to IT standardized processes, including DevOps automation processes.

Second, new flexibility has been introduced by linking the OSS processes to the features of NFV orchestrators and SDN controllers as programmable networking technologies exposed using open APIs. OSS systems that are able to leverage the capabilities of these dynamic resource managers can also achieve the dynamic operations processes that are required to take full advantage of NFV and SDN.

Previous approaches to automation and rapid new service introduction, such as low-level management interface standardization or the use of service delivery platforms (SDPs), have mostly failed to deliver on their promise. However, the far-reaching technology changes just described present service providers and the industry as a whole with a real game-changing opportunity. If well planned, these changes can increase service operations automation and make flexible new service introduction possible. In addition, they can dramatically simplify the OSS while meeting the needs of an end-to-end NFV- and SDN-based dynamic operations environment.

## ESTABLISHING AN ENHANCED OSS STRATEGY

How can service providers address the evolutionary requirements for optimal, end-to-end operations supporting cloud, NFV-based and SDN-based services? How can they achieve further automation and optimization of traditional service operations? Assuming that the introduction of new technologies will take some time, an effective evolution strategy must also consider service operations across hybrid networks consisting of both current and new technologies. In particular, the following two aspects of OSS evolution need to be addressed, sequentially or in parallel:

## NFV readiness

The current OSS needs to be assessed with respect to its capability to move up the value chain from current to dynamic operations. This includes cleaning up current OSS service fulfillment, inventory and assurance stacks. This can be done by consolidating and automating where possible, and by ensuring OSS readiness for dynamic process support. These steps are required in order to play a part in the target OSS for NFV and SDN and to be ready for dynamic operations.

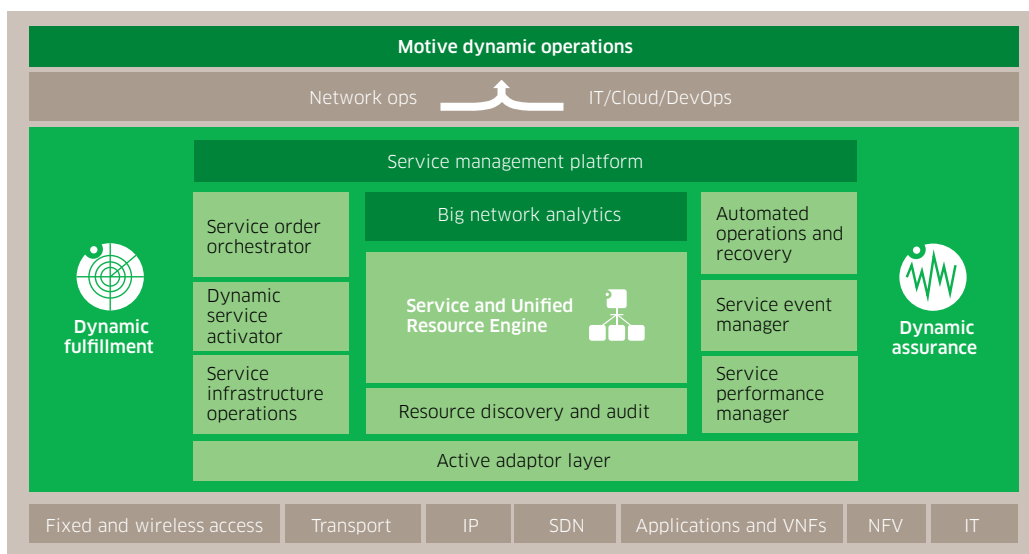
## Introduction of new operations solutions linked to NFV and SDN technologies

This includes extending or elaborating new operational processes that work across network/SDN and cloud/NFV platforms, as well as analyzing their impacts on current processes and organizations. The following areas are of particular concern:

- Operational process integration with NFV resource management solutions that handle required complexity and functions at the lowest level.
- Operational process connection to near real-time SDN management and control solutions that initially address the data center LAN, but are moving into the WAN as well.
- Exploitation of big data analytics solutions that provide high-volume information gathering and storage, used as the foundation for intelligent processing applications that provide near real-time insights, which can then help steer the dynamic operations processes. See Analytics Engine block in Figure 1.
- Organization impacts, for example, on network operations and IT departments—organizations will need to interconnect their systems, processes and teams in new and automated ways, and additional technology skills will be required on both sides. Additional impacts, such as on procurement processes, will bring further operations challenges.

As illustrated in Figure 1, an OSS solution architecture ready for NFV and SDN dynamic operations requires broad technology coverage, new efficient software modules and a unified service and resources view.

Figure 1. Motive Dynamic Operations - Solution Overview



## THE ESSENTIAL ROLE OF ABSTRACTIONS

Abstractions are particularly useful for OSS service operation in an NFV and SDN world where highly dynamic resource management may take place in order to avoid service impacts. Abstraction between the resource and service layers is key for end-to-end dynamic operations and OSS simplification. Abstractions are needed to shield the service operations OSS from resource-focused details. Abstraction can be repeated as often as needed to enable simplified end-to-end service operations. The availability of a simple information model to represent service instances with minimum information at each level of abstraction is essential to this approach. This model allows the implementation of the required object hierarchy, where instances are created dynamically through service fulfillment or auto-discovery, and which can also be used by dynamic service assurance processes, closing the loop between fulfillment and assurance.

For example, to achieve dynamic operations, a divide-and-conquer strategy with an abstraction approach, keeps as much domain-specific knowledge as possible inside the relevant domain managers. Such domain managers might include near real-time applications, such as cloud resource managers (for example, the Alcatel-Lucent CloudBand Management System or the Nuage Networks Virtual Services Platform) that manage on-demand resources in near real-time. By connecting to such resource managers, highly dynamic and automated operational processes can be achieved to manage services inside the domain. Abstraction from resource-specific details is vital to ensure that the OSS can eventually be simplified. Abstraction is applied in many places, for example:

- Resource managers provide configuration, orchestration, fault and performance management functions for their domain. They abstract resource specifics northbound and expose service-focused views to upper service operations systems.
- Service operations systems provide the dynamic fulfillment/orchestration and associated dynamic assurance functions, on a per domain, area or other scope basis.
- End-to-end service fulfillment/orchestration and service assurance, which is as independent as possible of the underlying technologies, supporting the end-to-end service operations dashboards. It also exposes business information to business support systems (BSSs) and to customer self-service portals and tools.

## IMPLEMENTING THE EVOLUTION STRATEGY WITH A DYNAMIC OPERATIONS APPROACH

Rather than introduce a new technology stack or bolt onto a 15 year-old software platform, one strategy is to use NFV and/or SDN as a compelling event to rejuvenate the operations approach. The proposed dynamic operations approach targets both current networks and NFV- and/or SDN-enabled networks and is able to have those co-exist in a hybrid way for the foreseeable future. This approach progressively improves all aspects of network and service operations by introducing automated and dynamic processes, and it increasingly integrates relevant aspects of IT management. This approach also simplifies today's operations by evolving the current OSS into a state-of-the-art, flexible OSS. As a result, it fosters operational excellence, high degrees of automation for both fulfillment and assurance and adjoining business functions, as well as lower operating costs as a percent of revenue. Moreover, the approach must prepare operations, IT and network

teams for NFV and SDN gradually or abruptly, depending upon the decided business targets. Whatever the starting point, all OSS evolution approaches should contribute to achieving the same common target OSS architecture for dynamic operations across current and SDN-enabled networks, IT and cloud/NFV platforms, as well as current VNFs and applications.

## **Service models**

Service models define the abstracted view that the OSS has of network services, IT, and application resources. This view enables the OSS to shift focus from resource management to dynamic services operations. The service modeling needs to become the heart of this new approach to operations. Alcatel-Lucent has long-standing experience in defining service models for current network services end-to-end, and is extending its portfolio with service models covering both NFV- and SDN-based services, as well as hybrid services across current and new networks.

## **Solution design and deployment**

Service providers may wish to consider different lines of attack to address end-to-end, dynamic operations across current network and IT environments, as well as NFV and SDN. OSS solutions can be defined with the following objectives:

### **Initial standalone deployment of new OSS for NFV and SDN**

NFV and SDN are to introduce new, highly dynamic resource management functions that allow management of virtual resources to be separated from management of application resources. They can also provide common lifecycle management functions across all VNF and cloud applications. These new functions dynamically manage virtual resource requirements driven by applications on demand, high volumes of end users or administrative users, as well as by network-based applications. This dynamic management is achieved by a set of new systems that might include:

- Orchestration-based dynamic cloud resource management systems, such as the Alcatel-Lucent CloudBand Management System (CBMS).
- Policy engines for dynamic virtual network resource allocation and optimization, such as the Nuage Virtual Services Director (VSD) within the Nuage Networks SDN solution.
- A big data solution with continuous analytics applications, such as the Motive Big Network Analytics solution to support the high volumes and changing conditions.

### **Increase automation in and across current network and IT operations**

Selecting Alcatel-Lucent as a partner can quickstart automation programs on current operational domains. The company has been productizing years of automation experience in the design and implementation of OSS projects on current networks. The focus has been Operating Expense (OpEx) reduction and customer experience management (CEM) for service providers in the new Motive Dynamic Operations portfolio. This experience, combined with our company knowledge of the NVF platform, SDN technology and VNF applications, is used to develop innovative service models. These strengthen automation of service fulfillment and assurance on all types of current networks, including for advanced root cause analysis and auto-recovery orchestration. These new service models also allow the linking of dynamic fulfillment and assurance for innovative planning processes involving both the network and IT, and are designed to ensure readiness for the introduction of new NFV- and SDN-enabled networks and services.

### **Operational process integration across current and new OSSs**

In the near and mid-term, new NFV and SDN network and application functions will co-exist with current networks and applications, with services running across both. Therefore, end-to-end dynamic operations need to cross all such functions. By combining a software-driven, highly automated approach to network operations and IT management, and by introducing service models for abstraction from resource to service operations, real end-to-end service fulfillment and service assurance can be achieved. A service and resource abstraction engine can provide the right and practical data model that allows orchestration, correlation and analytical techniques to support dynamic service operations hierarchically across layers and horizontally across domains. This approach applies to both current networks and IT, as well as to the NFV and SDN arenas. In addition, service models provide a unique opportunity for further streamlining of existing OSSs. By introducing abstraction using the service models for current networks and IT in the current OSS, and linking resulting views with the abstract views obtained through the dynamic operations solution defined for NFV and SDN, integration across the current and new OSS can be achieved. Over time, this also enables the consolidation of service operations systems and simplification of the OSS in a phased way.

### **OSS transformation**

As of today, any OSS transformation project needs to account for NFV and SDN, which require increased OSS agility. Current OSSs are generally not well equipped to deal with the highly dynamic behavior offered by the NFV- and SDN-related resource management functions. Although more recent OSSs are mostly adaptable to NFV and SDN, viability of older OSSs will need to be assessed. To fully leverage NFV and SDN capabilities, the complete OSS will need to become much more dynamic than it is today. For example, policy-driven automation activities need to occur within seconds or minutes rather than in hours or days. This acceleration will enable service providers to realize the dynamic operation processes required to stay competitive in the cloud environment. In addition, integration of IT and network operations is essential. As a result, OSS transformation projects also need to address the new skills sets and organizational changes required. OSS transformational methods enable operators to achieve dynamic operations needed to realize the OpEx reductions promised by NFV and SDN.

## **ALCATEL-LUCENT MOTIVE DYNAMIC OPERATIONS PORTFOLIO**

Alcatel-Lucent has recently unveiled its new Motive Dynamic Operations (MDO) portfolio. This portfolio consists of a modular set of OSS applications designed to reap the full benefits of NFV and SDN as fast as possible. It is also designed to assist service providers in continuously increasing the level of automation in their operations environment. The MDO solution facilitates the definition of transformation projects; it takes service providers through a series of focused transitional steps, which are executed as self-contained projects. This process prepares for the introduction of NFV and SDN while simplifying the existing OSS along the way.

The MDO solution provides applications in essential operational areas, such as:

**Dynamic Fulfillment:** This solution allows for the rapid introduction of new and innovative services, including agile orchestration for end-to-end services activation. The MDO solution also enables service providers to create a simplified and open fulfillment architecture that works across the network and IT while isolating business operations from network management.

**Dynamic Assurance:** This solution addresses customer needs by bringing customer care and network operations closer together through intelligent root cause and service impact analysis tools. The solution includes analytics-driven automation of service assurance and also allows service providers to build in proactive, automated processes. These processes automatically identify and resolve service and network issues, thus avoiding them through proactive measures.

**Dynamic Operations for NFV and SDN:** This solution enables the operationalization of NFV- and SDN- based services by closing the loop between Dynamic Assurance and Dynamic Fulfillment through a common Service and Unified Resource Engine (SURE) that spans networks and IT and automates the discovery and reconciliation of network resources.

Motive Dynamic Operations innovations are implemented based on OSS solution design patterns. Each OSS solution design functionally covers Dynamic Fulfillment, Dynamic Assurance or both. An actual OSS solution implementation includes Alcatel-Lucent and third-party products and software, as well as the required active adaptors—the rules-based software used by OSS components to interact with underlying infrastructure or resource management components.

Service models implement Alcatel-Lucent’s longstanding experience and knowledge concerning operation of services across multi-vendor networks and IT environments. New service models are being developed as part of the Dynamic Operations solution for NFV and SDN.

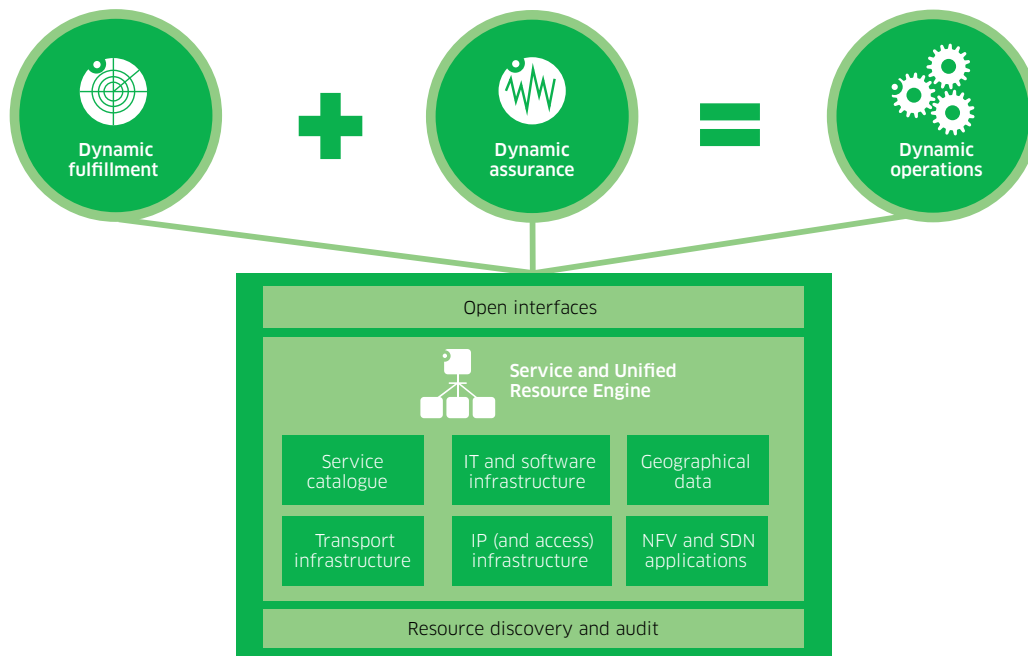
## **The Motive SURE Engine**

In an OSS implementation, abstraction information resides in the Motive Service & Unified Resource Engine (SURE). The Motive SURE creates an end-to-end unified view of existing network technologies, IT data center/cloud configuration resources, as well as physical and VNFs. SURE is subsequently used and enriched by both Dynamic Fulfillment and Dynamic Assurance applications.

The MDO solution creates the foundation for streamlined dynamic service operations that enable service providers to seamlessly migrate existing and new services to efficient, flexible and programmable virtualized networks. As a core asset of the MDO solution, the SURE enables the linkage of the automated service lifecycle management, policy-based dynamic fulfillment and analytics-driven dynamic assurance. Together these components comprise the new and required Dynamic Operations solution that can fully exploit NFV and SDN capabilities. When choosing to achieve automated and highly dynamic operational processes, the Motive SURE provides the underlying data model and API implementations that enable the required level of abstraction to operationalize NFV and SDN.



Figure 2. Motive Service & Unified Resource Engine (SURE)



As part of its SURE product offering, Alcatel-Lucent is currently consolidating best practices, information and software available from operational OSS projects worldwide into a catalog of re-usable service models. These models are continuously enriched and refined over time with the intelligence and experiences gained through the introduction of new technologies. Today, existing service models are being extended and new models are being defined as part of the implementation of the Dynamic Operations solution for NFV and SDN.

### Standards-based simplification

Alcatel-Lucent solutions and the SURE abstraction model derive from and extend industry standards, where these are relevant and available. Examples include:

- TM Forum and ITIL/DMTF for operational models and processes
- OASIS TOSCA for VNF descriptor specification
- OpenStack for NFV Infrastructure management, or
- OpenFlow for SDN.

The latter standards being handled at the resource level eventually allow for further simplification at the OSS level; at first, though, they must also be well understood at the OSS level. Interface technologies, such as REST, JSON and XMPP are preferred for API implementation on the new systems. NETCONF/YANG are also candidates to bring further standardization for management of network equipment. Moreover, wider adoption may bring further resource management and related OSS simplifications.

The SURE abstraction model has proven its validity and efficiency in actual project implementations for end-to-end service fulfillment and assurance for today's multi-vendor fixed and wireless access, aggregation, core, transport, data center networks, IT servers, network function and software applications. It is now being extended to cover NFV- and SDN-related services and resources.

The full MDO solution is deployed in the Alcatel-Lucent OSS lab where operational use cases for NFV and SDN operations are elaborated. This Dynamic Operations Enablement Lab leverages the Alcatel-Lucent IP Transformation Center (IPTC), which offers a worldwide IP and optical networking infrastructure, all types of fixed and wireless access networks, an NFV platform solution (CloudBand), a Nuage Networks SDN solution, as well as VNFs, such as vIMS/VoLTE, vEPC, and vCDN. The OSS lab is the hands-on use case engine for designing best-practice NFV and SDN operational processes that support the design and development of the Motive Dynamic Operations solution for NFV and SDN. As part of this process, Alcatel-Lucent is delighted to work with customers to jointly design relevant use cases that test NFV and SDN operations.

## CONCLUSION

The introduction of NFV and SDN is expected to require a period of hybrid service operations, OSS transition and transformation. The innovative Alcatel-Lucent MDO solution, based on proven service models and transformation methodologies, allows each domain to be transformed and abstracted through independent projects in different organizations. This further optimizes and automates current operations and prepares for the introduction of NFV and SDN. The Alcatel-Lucent SURE abstraction model is designed to cover network and IT operations and extends to include NFV and SDN requirements. The abstraction model is a core value that Alcatel-Lucent brings to OSS optimization and transformation projects.

The MDO portfolio automates many of today's manually intensive OSS processes and decisions to dynamically react to network, application and device conditions. The portfolio can also be integrated with Motive Customer Experience solutions to ensure an optimized customer experience. The MDO portfolio also provides near real-time analytics, which allow for intelligent decision making based on dynamically detected conditions.

Alcatel-Lucent is in a unique position to help service providers evolve to Dynamic Operations, as well as introduce, leverage and operationalize NFV and SDN. As a key partner, Alcatel-Lucent can design service providers' best-fit evolutionary or revolutionary migration path for realizing the benefits of an NFV and SDN world.

# ABBREVIATIONS

BSS	Business Support Systems
CBMS	CloudBand Management System
CEM	Customer Experience Management
DevOps	Development Operations
EMS	Element Management System
IPTC	IP Transformation Center
MDO	Motive Dynamic Operations
NFV	Network Functions Virtualization
NMS	Network Management System
OpEx	Operating Expense
OSS	Operations Support Systems
SDN	Software-Defined Networking
SURE	Service & Unified Resource Engine
vCDN	Virtual Content Delivery Network
vEPC	Virtual Enhanced Packet Core
vIMS/VoLTE	Virtual IP Multimedia Subsystem / Voice over LTE
VNF	Virtualized Network Functions
VSD	Nuage Virtual Services Directory