Virtualized B2B solutions for cable MSOs

Part 2: Differentiate cable B2B connectivity services with service and network orchestration

White paper

Cable multiple-system operators (MSOs) have an unprecedented opportunity to substantially increase their service revenues by giving businesses the support they need to maximize the benefits of cloud technology. This paper is the second in a two-part series describing an end-to-end virtual business-to-business (B2B) solution architecture that enables this capability for cable MSOs. The previous paper highlighted how cable operators could leverage cloud technologies to develop easy-to-manage connectivity solutions targeted at business customers. In this paper, we explore the wider aspects of service fulfilment and assurance. We show how cable operators can leverage a virtualized framework of network and services orchestration and automation to offer differentiated business services that adapt to today's cloud-enabled world.
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Businesses of every size and description are shifting towards greater reliance on private and public clouds for access to mission-critical applications. This has generated demand for lower cost, more flexible ways to extend virtualized resources to multiple locations and on-the-go workforces. The telecoms industry is referring to this opportunity as dynamic enterprise services (DES). MSOs can take the lead in satisfying this demand by leveraging a cloud-friendly, multi-layered virtual network architecture to create a connectivity and value-added service model that far outperforms what is available today.

In a landmark survey conducted on behalf of the Metro Ethernet Forum, the Vertical Systems Group\(^1\) reported that an evolution is underway from static networking services to more versatile dynamic network services. The global survey included communication service providers (CSP) and a wide range of enterprise verticals and provides valuable insight on the direction of the networking services market. Findings include how enterprises wish to directly control their wide area network resources or cloud access on demand and, for CSPs, how revenue-generating dynamic offerings will impact the Carrier Ethernet market.

This is a very dynamic environment. SMBs' and large enterprises' desire for new services is changing, along with the competitive landscape to provide them. Target services could include compute & hosting, networking including SD-WAN, hosted and managed mobility, unified communications, and professional services. However, a wider range of service providers are competing for enterprise ICT budgets – often offering a very comprehensive service portfolio, client intimacy, management tools and service accountability. These competitors include cloud-oriented hosting and connectivity providers.

There is certainly a requirement for flexible, reliable and fully-featured service bundles at both ends of the business customer scale:

- Many SMBs do not have IT staff and are looking for simple ways to buy and configure service bundles and may even require advice.
- Many enterprise CIOs want to offload a lot of the service management and are looking for service aggregators who offer more than just a technical solution.

Most CSPs today, including cable operators, do not have a networking and IT infrastructure that is able to compete with large online providers who invest massively in IT to enable speedy, flexible and scalable service provisioning that is relevant for enterprise customers both large and small. Cable's strategy in this new environment has to include capabilities around the automated provision of cloud-ready connectivity and value-added services. This may also mean leveraging tactical partnerships to build out portfolio and expand existing customer bases.

Notably, for DES, SD-WAN has achieved traction in the market as the technology to create flexible VPN connectivity for business services over which value-added services may be offered. In a 2017 study*, analyst firm OVUM found that for SD-WAN, 34% of respondents have trialed or deployed the technology in some form. Another 30% expect to work with the technology within two years, and 74% of existing deployers expect to grow their SD-WAN footprint formally or opportunistically.

Two connectivity scenarios are of particular interest to MSOs:

- A new standalone SD-WAN-based VPN for multiple customer sites.
- A SD-WAN-based branch office extension to an existing larger Internet Protocol/Multiprotocol Label Switching (IP/MPLS) VPN.

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*Ovum Enterprise Network Services Study 2017
Complementing these connectivity services, MSOs can easily offer value-added services such as firewalls, internet breakout, anti-malware or connectivity to public cloud applications in a fully automated manner, facilitating a great customer experience and generating up-scope possibilities. In fact, offering SD-WAN connectivity bundled with associated value-added services is the entry point for many cable operators into the previously untapped dynamic enterprise services market.

**MSO networks are evolving**

Fortunately, cable operator networks are in constant evolution. On the back of current investment to provide gigabit capable ultra-broadband access and transport for fixed and mobile we will see the need for intelligent network resource control and analytics based on virtualization technologies. An end-to-end virtualized architecture for the automated provision of business as well as residential services will be part of the evolving MSO network, the virtual co-existing with the physical. Furthermore, to achieve scale as the industry further embraces the cloud era, cable operators will deploy more and more virtualized resources, distribute their data centers and make their networks elastic and programmable via SDN control.

**Figure 1. Virtualization domains in cable operator networks**

This future environment will be both network-aware and service aware so it can dynamically provision and deliver services. Operating under SDN control, the IP and optical transport layers will be integrated. Access will be simplified, fiber will move closer and closer to the customer location and key capabilities will be virtualized to reside in either the edge or the core. Hub offices will enable cable-edge cloud hosting: many functions will be virtualized and hosted at these locations. The Operations Support System (OSS) will be radically simplified. Ultimately, one single, converged network will serve residential, business and mobile users consuming cloud-based content and applications.

Today, creating a framework for the automated provision of DES serves as a blueprint for this future model of cable networks and services.
Delivering dynamic enterprise services

Figure 2. Dynamic enterprise services on the cable network

Figure 2 highlights a framework for how enterprise services can be dynamically ordered, configured, delivered and maintained in order to compete in the cloud era.

At the top, some services examples are shown grouped into 3 general areas.

- **Network connectivity services**: these are well known services such carrier ethernet, IP-VPN or data center interconnect. SD-WAN is also included here.
- **Cloud services**: Here we consider how enterprise connectivity can be securely extended to include access to applications in public, private or hybrid clouds. For example, offering direct SLA access to cloud operators for enhanced VPNs, or to SDN-enabled data centers providing infrastructure as a service (IaaS), platform as a service (PaaS) or software as a service (SaaS).
- **Managed services**: here we see a focus on value-added services including security and IoT device management. The fulfillment of these services bundled with connectivity must be automated.

Many of these services are offered today, typically via manual configuration of cable networking platforms and resources – as shown at the bottom of the graphic. These include cable access, hub routing, aggregation and transport, core, data center and applications, and enterprise CPEs.

The focus of dynamic enterprise services is the automation of these tasks so that cable operators can easily and quickly offer enterprise connectivity and value-added services in a personalized fashion and at scale. This requires orchestration. Orchestration ensures the automated fulfillment of the relevant service components and there are a variety of approaches to this, with differing levels of complexity to match the focus and scale of the cable operator’s own business services strategy.
In Figure 2, we show network orchestration and service orchestration;

- Orchestration of the required connectivity between networking components to deliver the end-to-end service. In terms of our focus on B2B connectivity via SD-WAN techniques, we should consider underlay and overlay. The underlay network will provide IP connections between enterprise customer sites and the cable operator data center. The new SD-WAN configuration sits on top of this as an overlay configuration.

- Orchestration at the service level. Here we contemplate the end-to-end connectivity of network components and value-added services across and beyond the cable operator network to include off-net customer branch sites or public cloud services.

These areas are supported by customer portals (product portals or extensions of cable operator portals that allow enterprise prospects to order dynamic enterprise services). Initially, professional services may be required to ensure correct integration of systems and capabilities for commercial deployment. The ultimate objective here is to achieve full automation as the cable operator’s business services customer base expands. The framework, although covered by Nokia solutions, is modular in nature and serves as a guide to creating a virtualized B2B services delivery architecture composed of multi-vendor open platforms.

**Approaches to vB2B service delivery**

Over recent years, cable operators have taken a pragmatic approach to leveraging virtualization in their networks and business services is no exception. SD-WAN offers a compelling use case for entering the B2B market or enhancing existing physical connectivity offers and growing the customer base. Automation and speed to market of new services are key features of virtualized technologies. But how much automation is desirable for a given cable operators’ B2B strategy?

Nokia’s experience in partnering with both cable and telco providers has led to discussions around bottom-up and top-down approaches to the delivery of new virtualized enterprise services. Some MSOs wish to start with simple to deploy networking solutions and build upon that. Others may contemplate the larger scale business requirements from day one. Described below are three building blocks to fuel an MSO’s strategy for delivering dynamic enterprise services. These may be taken in an evolutionary fashion or individually depending upon the maturity and scale of the cable operator's existing business services operations.

**SD-WAN connectivity.** Automated VPN branch connectivity performed as an overlay to an existing IP underlay. This can be achieved with our Nuage Virtualized Network Services (VNS) solution. It represents a quick to market, easy way to enter the business services market with virtualized connectivity and includes a portal to assist with configuration of the overlay.

**Adding value added services** to differentiate or personalize B2B products. Cable operators can extend connectivity services with value-added service chaining in the data center (DC) for on- and off-net destinations. Orchestration capabilities will be required to achieve this in an efficient manner. The Nokia Virtual Networks Orchestration solution (VNO), powered by CloudBand Network Director (CBND), leverages service descriptors, plug-ins and REST APIs to interface with the relevant networking platforms to automate fulfillment of the desired enhanced overlay service. VNO changes the project structure of a SD-WAN product launch plan, essentially by decoupling the network and IT tracks to a large extent and can show time to market (TTM) and improved total cost of ownership (TCO) from day 1 – even with the simple SD-WAN overlay solution.
Multi-domain services orchestration. The wider aspects of deploying dynamic enterprise services may require MSOs to look for tools and capabilities that allow for the effective design and deployment of complex multi-domain services. This business led approach contemplates how to achieve service fulfillment across different domains including physical, virtual, underlay, overlay, IT or 3rd party environments etc. At Nokia, this is achieved with our FlowOne service orchestration suite and can be used in combination with VNO as a domain orchestrator for overlay networks.

Now let’s explore these steps in more detail.

SD-WAN overlay connectivity

This type of connectivity was discussed at length in our previous paper. As an overlay solution, cable operators can automate virtual private networking connectivity wherever the enterprise customer has IP connectivity. This means that SD-WAN based VPNs can be set up on-net where the cable operator offers IP connections via a router or a cable modem, or off-net across the internet. The Nokia solution for achieving this is Nuage VNS. Within the data center, SDN controllers ensure correct profiles and configuration are applied to branch office CPEs that are brought automatically on-line as part of the enterprise VPN. A centralized Nuage gateway performs tunnel terminations and other functions. Internet breakout and firewalling/filtering may be applied within the basic connectivity solution. A Nuage portal handles the configuration options as well as offering performance statistics. The Nuage solution can interface to other network and service orchestration platforms, such as VNO, via a set of APIs.

Figure 3. Basic SD-WAN connectivity with Nuage

Nuage solutions, on offer since 2014, have gained good market traction with major operators worldwide as part of their strategies for B2B services delivery, as well as recognition by the Metro Ethernet Forum (MEF) as a third network solution.2

SD-WAN connectivity solutions are made simple with Nuage VNS. However, for further market differentiation, cable operators may wish to look at how they can orchestrate an extension of this basic connectivity by adding some key value-added functions or services, or embrace other SDN-enabled networking components (such as vCPE gateways) in the end-to-end connectivity scheme. For this, we need the Nokia Virtual Network Orchestration solution.

Adding value added services

Nokia VNO automates the setup of SD-WAN overlay services from the data center to branch sites across the private cloud of the service provider, or across the public cloud, with security being enabled by IPsec, for example. Additionally, a broad range of multi-vendor virtualized security and other value-added service (VAS) applications can be enabled by establishing network connectivity through service chains in the data center. This is achieved by enterprise portal-defined and customized services that VNO automates and

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2 Third network solutions offer orchestrated, dynamic versions of previously static services.
creates across the WAN, the SD-WAN and the data center. The scope of automation includes enterprise-customized service chains in the data center, as well as the various network connectivity deployment options established all the way from the enterprise branches through the data center, as well as across the network equipment supporting the service.

Off-net and on-net branches with Nuage-controlled network endpoints, or bridged devices terminated on a provider-side CPE virtualization application on the Nokia Virtualized Service Router (VSR), become interconnected through automation within the same enterprise private domain.

Multi-vendor VAS applications, such as virtualized firewalls, network address translation, anti-DDoS, access control, WAN optimization, load-balancing, mail-scanners, and even virtualized routing with the Nokia VSR, can be automatically chained into the enterprise private domain through VNO. To leverage these as part of a B2B offer and automate how these VAS work alongside branch connectivity, Nokia proposes the CloudBand Network Director. CBND performs all the required NFV orchestration for the network.

With VNO, network providers gain end-to-end network orchestration and the automation needed for the rapid deployment of dynamic enterprise services. What’s more, they get DevOps agility, allowing incremental use cases to be added or updated efficiently with the fastest time to market. Simplicity and flexibility are also assured.

Figure 4 shows that VNO orchestrates a wide range of virtualized platforms and functions such as CPEs, SD-WAN, carrier SDN/backbone, data center, cloud interconnect, and so on.

Figure 4. Virtual Networks Orchestration multiplatform support

VNO is able to flexibly orchestrate dynamic enterprise services beyond simple SD-WAN overlay connectivity by leveraging a network service catalogue that in turn is fueled by a set of network service descriptors (NSD). These descriptors are a logical and physical description of a service within a domain. This brings tremendous flexibility in implementing end-to-end use cases as a number of NSDs may be brought together to create the service. For example, we could have:

- A SD-WAN NSD.
- A data center NSD.
- Public cloud internet NSD.
- Branch office NSD.
When brought together, we can create a connectivity + value-added service offering for a specific enterprise customer. Furthermore, should the specifications of a branch CPE change, we only need to replace that particular NSD to update the service.

In this stage of B2B service evolution, tight integration with the cable operator’s enterprise customer portal is recommended as business starts to scale.

**How VNO automates SD-WAN connectivity with value-added services**

Let’s look at how VNO can automate the fulfillment of a SD-WAN use case.

Cable B2B customers log in to the cable operator’s customer portal which, amongst other functions, allows them to select new business services or purchase an up-scope from an existing configuration. They may, for example, request a new SD-WAN based VPN with certain value-added services. VNO automates the entire fulfilment process:

- The request comes down from the portal to be handled by VNO.
- As nothing is currently established in the data center, the VNO integrates with the ETSI MANO VNF management solution (CBND) to instantiate the required VNFs. These could be 3rd party (e.g. Fortinet or Palo Alto firewalls or network security) or specific Nokia VNFs (e.g. NAT running in a virtualized service router).
- VNO triggers Nuage to create an SD-WAN overlay for branch CPEs. These could be across the cable operator WAN or over the internet. VNO enhances this with security parameters such as an IPSec underlay for internet connected devices.
- VNO can then kick-start the Nuage virtual cloud services to create a service chain all the way through to the required VAS in the data center.
- VNO may also trigger connections to public cloud services (such as AWS) by leveraging Nuage CPEs much in the same way as a standard branch connection.

*Figure 5. VNO creating VAS service chains in addition to basic connectivity*
VNO has a dramatic impact on the fulfillment process compared to legacy or even next-generation OSS systems (NGOSS).

- Dramatic reduction of API calls for OSS fulfillment. Via the use of NSDs, the VNO may typically translate 3 API calls to 200 southbound calls.
- Abstraction in end-to-end network design. Via the use of multiple NSDs, there is less effort needed in modification of end-to-end service design and implementation.
- Accommodates underlying platform changes. Via the use of NSDs, changes to the software releases of underlying network platforms (for example, Nuage SD-WAN) can be accommodated easily.

A cable operator’s internal SD-WAN project involves many stakeholders across the IT and networking divisions, including architects for underlay and overlay, VNF suppliers, network and VNF operations specialists, E2E solution architects, portal designers and B2B product management.

The VNO approach fundamentally changes the structure of SD-WAN service launch projects compared to NGOSS by acting as an intermediary between the IT and the network tracks, effectively separating their respective concerns. This significantly reduces the cost of changes to network service designs. As the number of stakeholders in any phase of the SD-WAN project can be reduced by up to 50%, VNO also reduces the risks due to human error within the project significantly. VNO, therefore, allows the cable operator to become much more agile in delivering new SD-WAN services, applying the DevOps methodologies promised by the new software-defined nature of networking.

The benefits for the cable operator are significant total cost of ownership savings, shorter time to market for new services, a broader addressable market and strategic long-term benefits due to the use of industry-accepted MANO architectures and not being locked-in to a specific vendor.

VNO is a perfect vB2B solution where a cable operator wants speedy automated virtualized B2B service configurations involving SD-WAN or vCPE-based connectivity and value-added services including networking functions, applications or connectivity with public cloud services. In the above cases, the cable operator is most likely willing to configure underlay IP/MPLS services in a traditional fashion. However, if we look not too far into the future to where cable operators’ networks will deliver residential and business services over one common, flexible network fabric, the orchestration functions will need to extend past overlay connectivity and VNFs. The VNO described in this section also exposes open northbound interfaces based on RestAPIs for use with multi-domain orchestration platforms.

**Multi-domain services orchestration**

So far in our approach to vB2B services deployment, we have described simple SD-WAN connectivity that may be leveraged as an entry point into the world of dynamic enterprise services. Then, as an enhancement to this and to provide further differentiation, how cable operators can automate the fulfillment of more complex, overlay connectivity + value-added services offerings. When taking a top-down business oriented approach from day one, cable operators may contemplate the use of orchestration platforms that ingest capabilities and perform complex service design and their publication to MSO commercial platforms. These automate fulfillment of the network underlay – either based on traditional physical network components, or virtual components – as well as any overlay capabilities, value-added applications and 3rd party domains. In this scenario, platforms are capable of interfacing with hybrid network environments and all the associated support systems.
Typically they discover and on-board physical network functions; virtual network functions and network service descriptions; SDN and domain controllers such as VNO; and 3rd party applications. They also logically unify components from the physical and virtual domains. They perform complex end-to-end service design that defines service chaining, policies and required workflows. Importantly, they offer closed-loop service lifecycle management, which means they can adapt to the changing requirements that will be found in a dynamic services environment, such as the sudden request for more capacity. Analytics can be used to predict such demand based upon historical performance, and influence future E2E service designs.

The Nokia solution when adopting this approach is the Nokia FlowOne service orchestrator. FlowOne is a software suite that provides a holistic, end-to-end view and orchestration of digital services - all built on a multi-vendor, multi-domain, multi-technology network and IT infrastructure. It facilitates large-scale automated fulfillment of services by handling the network underlay, IT infrastructure, 3rd party platforms as well as working to the northbound interfaces of VNO as a domain orchestrator, typically handling the Nuage driven service chaining.

Conclusion

Business services are a multi-billion-dollar opportunity for MSOs – if they get the value proposition right. By adopting virtualization to enable dynamic enterprise services, MSOs can steal a march on incumbents by meeting the speed and flexibility of service that enterprises are demanding.

SD-WAN is a key enabler. It gives operators a measured way of delivering dynamic enterprise services and can also enhance existing static connectivity services. Entry-point virtualized connectivity offers can then be enhanced with the inclusion of VNF-based applications and services both on- and off-net.

Nokia helps MSOs along the virtualization path. We highlight three building blocks to fuel an MSO's approach to providing dynamic enterprise services:

- The networking entry-point is SD-WAN to provide automated VPN branch connectivity (using our Nuage VNS solution). Virtualization brings you fast and flexible service delivery capabilities.

- Introduce value-added services that augment and differentiate the connectivity offer, using Nokia Virtual Networks Orchestration, powered by the CloudBand Network Director. Orchestration chains services together to simplify and accelerate turn-up of new services such as virtualized firewalls, network address translation, anti-DDoS, access control or WAN optimization.

- Via a top-down approach, cable operators can scale services with hybrid environment orchestration using the Nokia FlowOne service orchestrator. This performs complex service design and fulfillment and gives unified control across physical and virtual network functions, SDN and domain controllers such as Nokia's Virtual Networks Orchestration, and 3rd party applications.
Abbreviations

AWS   Amazon web services  NAT   Network address translation
B2B   Business-to-business  NGOSS  Next-generation operations support system
CBND  CloudBand network director  NSD   Network service descriptor
CM    Cable modem            NT    Network termination
CPE   Customer premises equipment  OSS   Operations support system
CSP   Communication service providers  SDN   Software-defined networking
DC    Data center             SD-WAN Software-defined wide area network
DDoS  Distributed denial of service  TCO   Total cost of ownership
DES   Dynamic enterprise services  TTM   Time to market
E2E   End-to-end              VAS   Value-added service
ETSI  European Telecommunications Standards Institute  VNF   Virtualized network functions
IP    Internet protocol        VNO   Virtual networks orchestration
IPsec Internet protocol security  VNS   Virtualized network services
MANO  Management and orchestration  VPN   Virtual private network
MPLS  Internet protocol/multiprotocol label switching  VSR   Virtualized service router
MSO   Multiple-system operators  WAN   Wide area network

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