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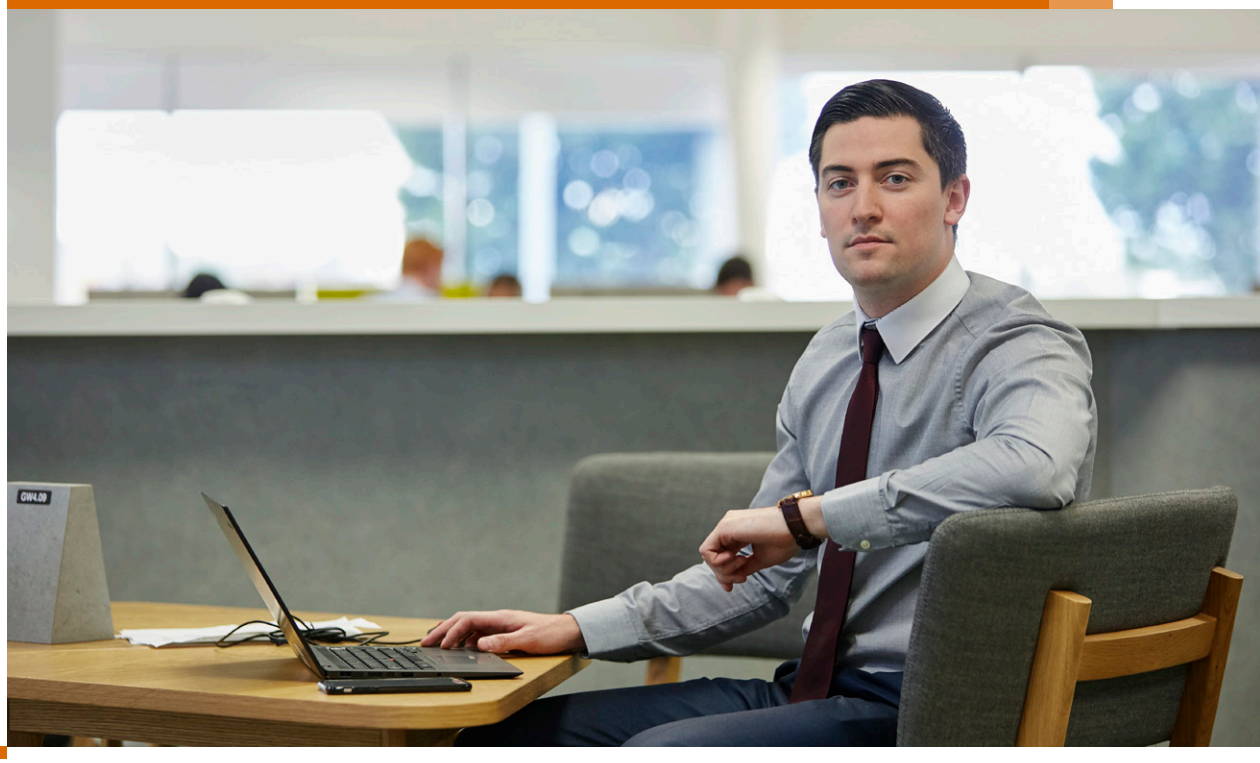
Insights for telecom, cable, satellite, and Internet executives

The software-defined carrier:
How extending network virtualisation architecture into IT BSS/OSS architectures opens up transformational opportunities for telecom and cable operators



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For the chief technology officers (CTOs) and chief information officers (CIOs) of major telcos and MSOs, transformation enabled by software-defined networking/network function virtualisation (SDN/NFV) is currently high up the strategic technology agenda. Many leading operators have already made great strides in implementing virtualisation technologies in their communications networks, realising significant cost and efficiency gains as a result. But the benefits achieved to date are only the start. To increase them still further, there's clear potential for carriers to expand SDN/NFV across the entire enterprise—first into the IT and data centre network, and then into the wider business. The resulting boost to performance and consolidation of duplicate capabilities can be both dramatic and pervasive, equipping telcos to deal more effectively with the parallel profound changes now under way in their competitive landscape, customers' behaviour, and environment for innovation.

In recent years, the opportunities for operators to use SDN/NFV in their communications networks have become widely recognised—and increasingly widely exploited.

Already, many leading carriers have initiatives under way that aim to virtualise large parts of their network and the associated services. By integrating SDN and NFV, operators have found they are able to gain improved automation, reduced costs, faster service request response times, and better security and reliability. Given these benefits—and the related positive impacts on customer experience and speed to market—it's easy to see why carriers are embracing these technologies so readily.

However, many operators are facing a number of hurdles that make the transformation of their networks more difficult, and lengthy, than they would like. For one, building a coherent transformation roadmap that is market-backed, and focuses on using virtualisation to drive not only bottom-line but also top-line benefits, can be a challenge. Also, transitioning an organisation that—in many cases—is grounded in waterfall-method, carrier-grade engineering practices (and associated talent and culture), to an operating model that is much more software-focused and embraces concepts such as agile, DevOps, and multi-cloud operations at scale, is a far from trivial undertaking, especially if decades of ingrained habits and thousands of people are in play. Finally, carriers need to re-think their relationship with strategic technology suppliers for the 'software-defined era', and often find that their own interests in transforming the technology stack are not necessarily aligned with their suppliers' interests and incentives.

As more and more operators weigh up the opportunity to extend virtualisation beyond the communications network and into their IT infrastructure (customer-facing and back-office applications), it's increasingly clear that the full potential presented by SDN/NFV architecture is actually much greater than the benefits related to the network. Carriers can leverage this architecture to optimise their entire Service Delivery/Service Assurance (SD/SA) stack (BSS/OSS), by—in some cases—collapsing similar processing capabilities found in the SD/SA stack into the SDN/NFV virtualised network functions (VNFs) and micro-services that have been developed. These SD/SA capabilities are typically tied to service-related data and business processing that is duplicated in the network provisioning process, meaning the benefits in terms of complexity reduction and cost synergies can be substantial. A fully integrated SDN/NFV architecture that incorporates traditional BSS/OSS (business support systems/operations support systems) capabilities also opens up the potential for real-time, artificial intelligence (AI)-driven decision support for a carrier's end-customers, by leveraging event monitoring and control capabilities across all aspects of the service, not just the network.

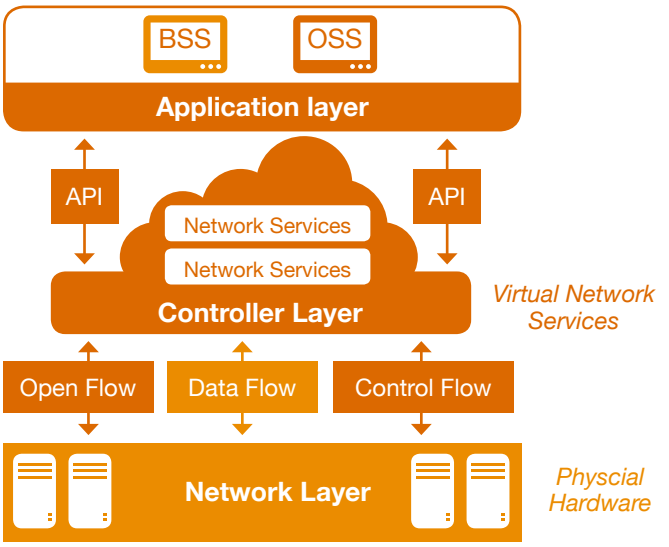
Interestingly, the implications of carriers navigating through this territory successfully can extend beyond the telecoms industry itself. The same technologies are relevant to several other adjacent sectors, such as broadcast media and content distribution. This new virtualised architecture opens up new opportunities that many of these players have not even considered in terms of gaining the ability to provide new services to their customers.

What is SDN/NFV?

Software-defined networking (SDN)

Is an approach to computer networking that allows network functionality and associated services to be managed through the abstraction of lower-level functionality (see Figure 1). This is achieved by decoupling the system that makes decisions about where traffic is sent (the control plane) from the underlying systems that forward traffic to the selected destination (the data plane). This simplifies the management of the network and makes it faster to configure and more efficient.

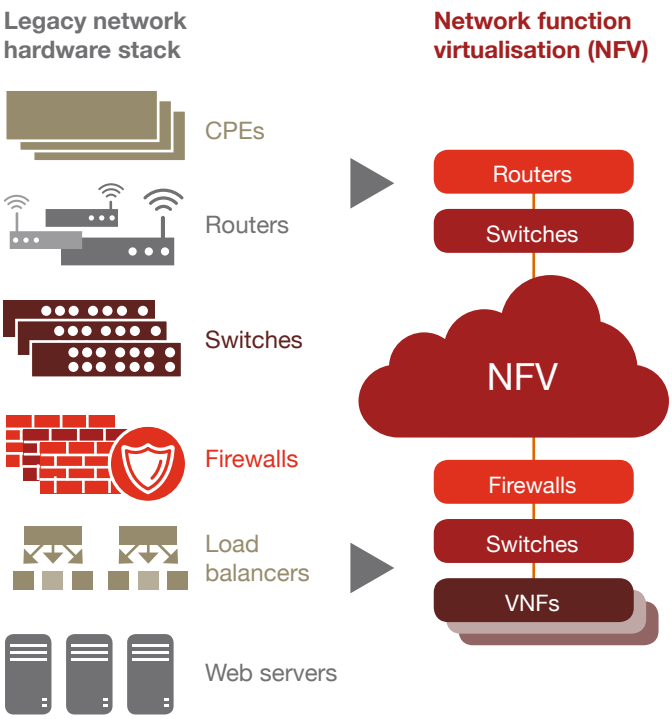
Figure 1: SDN network architecture



Network function virtualisation (NFV)

Is a network architecture that virtualises entire classes of network node functions into building blocks that may be connected—or chained—to create communication services. NFV relies upon, but differs from, traditional server virtualisation techniques used by enterprise IT. It is achieved by introducing virtualised network functions (VNFs). VNFs may consist of one or more virtual machines running different software and processes, on top of industry-standard high-volume servers, switches and storage, or even cloud computing infrastructure, instead of having custom hardware appliances for each network function.

Figure 2: Legacy hardware stack, and the stack enabled by NFV



Three imperatives for making the leap to virtualised networks

Three imperatives for making the leap to virtualised networks

Carriers are making progress in tackling the core technology-related questions, including solution architecture/design, technology assessment and the transformation to network virtualisation. However, precious few have taken concrete steps to expand the flexibility and reach of virtualisation beyond just customer premises equipment (CPE)—making this uncharted territory for telecoms operators and network technology providers alike.

Virtualisation of the network will naturally begin to move development and deployment of network services and associated elements from a hardware installation and configuration process to an IT software development methodology and systems development life cycle (SDLC) framework delivery process. For carriers undertaking this journey, there are a number of enablers that are critical to success. Getting these right will be equally as important as the core technology work in achieving and accelerating the desired outcomes.

1. Clarify a market-backed transformation sequence and governance

Our experience shows that carriers who approach SDN/NFV transformation purely from a network technology-led mindset generally struggle to gain momentum and realise the full benefits. To avoid these issues, the virtualisation/transformation sequence needs to be driven by a combination of customer impacts (both positive and negative), new product/service strategy, and the potential for new revenues and cost efficiencies (in both technology and operations).

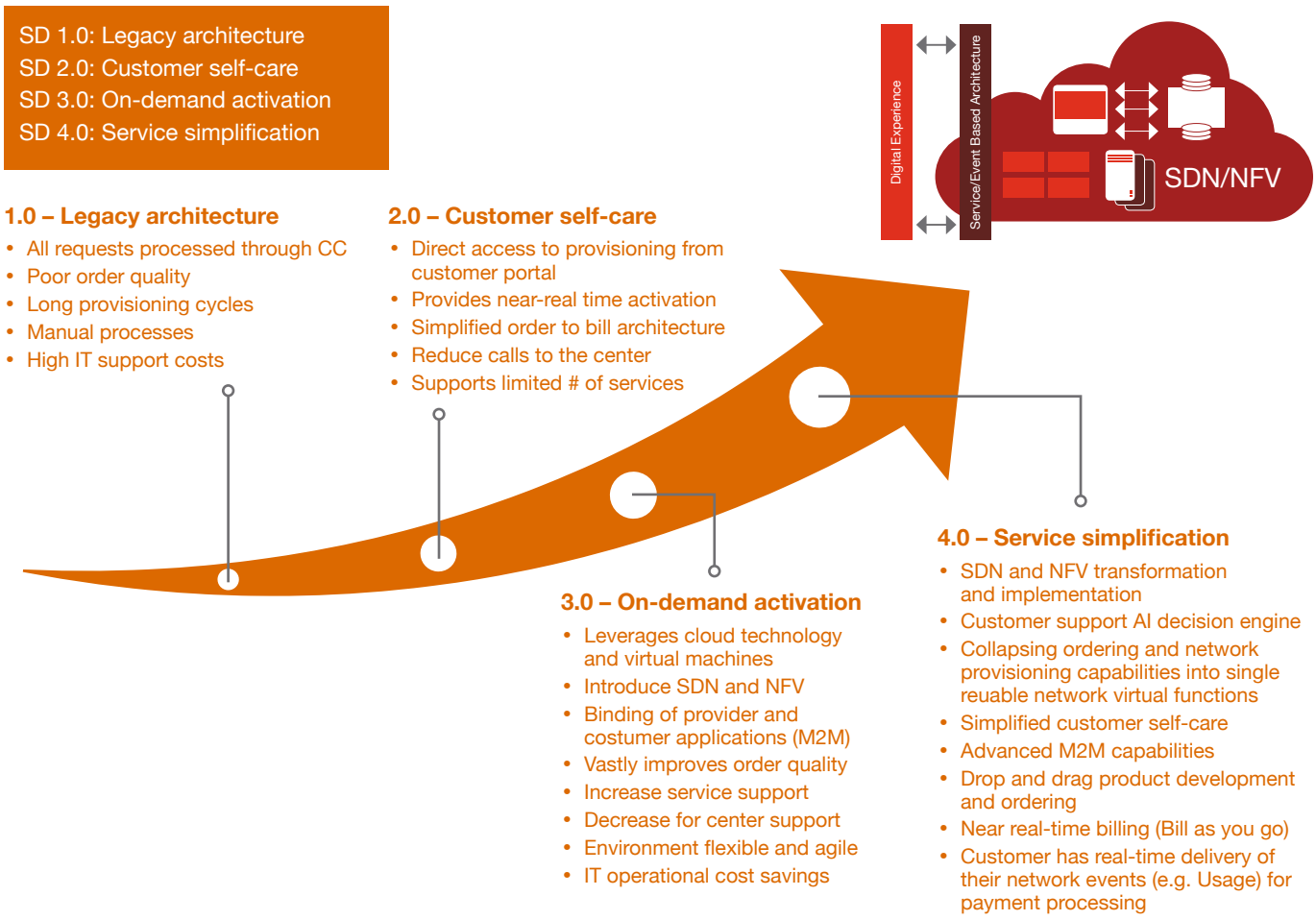
In our work with carriers we see at least four major recurring themes. These are grouped around underlying clusters of services, each of which has the potential to drive significant new business through product and service differentiation, as well as delivering step-changes in efficiency and changing carriers' cost-to-serve economics. The four principal themes are:

- **Evolved Packet Core**—with significant upside in enabling 5G and IoT customer use cases and new services, which rely on the increased network configuration and deployment agility and efficiency that can only be achieved through virtualisation of the suite of associated services, including MME, PGW, SGW, ePDG, PCRF, subscriber data management, and more.
- **SD-WAN**—as the next stage in the evolution of enterprise-grade networking services, with the ability to blend MPLS and high-speed internet access more efficiently providing a compelling case to create value for B2B and B2G customers, based on a virtualised network platform that allows carriers to deploy advantaged economics at any scale level.
- **CPE**—with compelling service and support efficiency economics based on software-defined management capabilities across a host of devices at the network edge, including managed routers, firewalls, load balancers, IPS, DPI, and so on.
- **SD-DC**—as a lever to take carriers' data centre assets to the next level of effectiveness and efficiency by integrating distributed physical assets into one virtualised data centre fabric. This has the effect of flattening and streamlining network routing architectures through dynamic VLANs and virtual firewalls and load-balancers, and ultimately integrating third-party data centre capacity to gain extended flexibility.

In addressing any of these themes, it helps to start from the perspective of market demand and to be clear on what customer use cases will be viable and required at scale, and at what price points. This market view then requires a supply counter-piece to help pinpoint what network services will be required, and when, what target cost needs to be achieved, and how to strike the right balance of sharing economic benefits with customers in order to grow revenue and market share versus optimising retained margin.

One key attribute for driving this level of clarity is financial rigor, supported by a holistic perspective across the business and technology stack that takes both the top and bottom line into account. But even more importantly, the go-to-market and technology transformation roadmap needs to be approved and governed by a cross-functional coalition of leaders who can combine customer, product and technology perspectives into an integrated view of the true economics, with the ability to manage dependencies between the go-to-market, product and technology management disciplines (see Figure 3).

Figure 3: Illustrative roadmap for the SDN/NFV transformation journey



2. Design and build a cloud-centric operating model

Communications operators have traditionally delivered network technology with a focus on closed systems and physical assets and resources, engineered at carrier-grade levels of reliability and durability. SDN/NFV implies a complete overhaul of this approach—with the result that every carrier contemplating this step is likely to face significant gaps in its talent base and its process and support tool footprint, as well as in its staffing and organisational models.

To make the leap to SDN/NFV, carriers will need to move from a traditional waterfall model to a cloud-centric, agile and/or Design Thinking approach, supported by the required elements in terms of organisation, talent, training, processes and tools. Given the scale, complexity and duration of the transformation journey, a 'big bang' redesign tackled in one go is not a realistic option. Instead, there is a need to synchronise the standing-up of agile/DevOps 'pods' with the technology transformation sequence.

A further imperative is detailed modelling of the highly automated target state quote-to-bill process flows, not only for new service requests but also for dynamic changes and cancellation scenarios that may be triggered either by the customer or controller. Also, looking specifically at VNF, carriers should embrace a 'VNF factory' approach: they will need a set of rigorous processes and capabilities to manage the VNF microservices, release acceptance and certification, together with automated testing frameworks to avoid wasted delivery cycles during integration testing and vendor on-boarding.

Bringing all these elements together, carriers should undertake a methodical design exercise to blueprint and operationalise a new cloud-centric operating model in a way that not only addresses the core architecture, engineering and operations cadence, but also defines critical management and control elements with regards to areas including security, cost and consumption management, or talent management, just to name a few.

3. Re-think supplier relationships at the strategic and transactional Level

In their efforts to virtualise the network, we see many carriers run into roadblocks and bottlenecks as they reach the limits of their existing supplier relationships.

At the strategic level, one of the inherent difficulties in SDN/NFV transformation lies in the significant dependency on the same network technology that OEMs that have lived long and prosperous lives using to build and maintain networks in the 'hardware-defined era'. On the one hand, these OEMs need to play an integral part in SDN/NFV transformation by developing and releasing software-defined services as well as service migration tools and methodologies for carriers, supported by professional services. But on the other, these same OEMs have a strong vested interest in preserving their installed technology base and associated revenue streams from maintaining and upgrading these networks.

With this in mind, carriers need to weigh up their options carefully when selecting strategic suppliers for the software-defined era. In some cases, they will need to strike a balance that provides their legacy suppliers—which have found themselves on the critical path to SDN/NFV transformation—with a way to retain some of their existing revenues, by setting gain-share incentives for efficiency improvements and tying future revenue commitments to transformation milestones. In other cases, bringing in new suppliers can add a desired disruptive/competitive element to accelerate transformation and drive the right behaviours. As so often, there is no hard-and-fast rule or prescribed recipe for success. But what's always needed is careful deliberation based on each carrier's specific technology legacy and supplier base.

At the tactical, transactional level, a software-defined technology stack implies significant changes to basic—but nevertheless critical—operational processes across the technology supply chain. For example, licence management is a tedious but relatively straightforward process with regards to on-premise, dedicated technology stacks anchored in hardware. In the software-defined era, with dynamic re-configuration of networks and on-demand scaling of capacity and service levels, aspects including VNF licensing models, the associated licence lifecycle management and ultimately supplier billing will require a new set of robust processes and tools.

Expanding SDN/NFV from networks into IT…

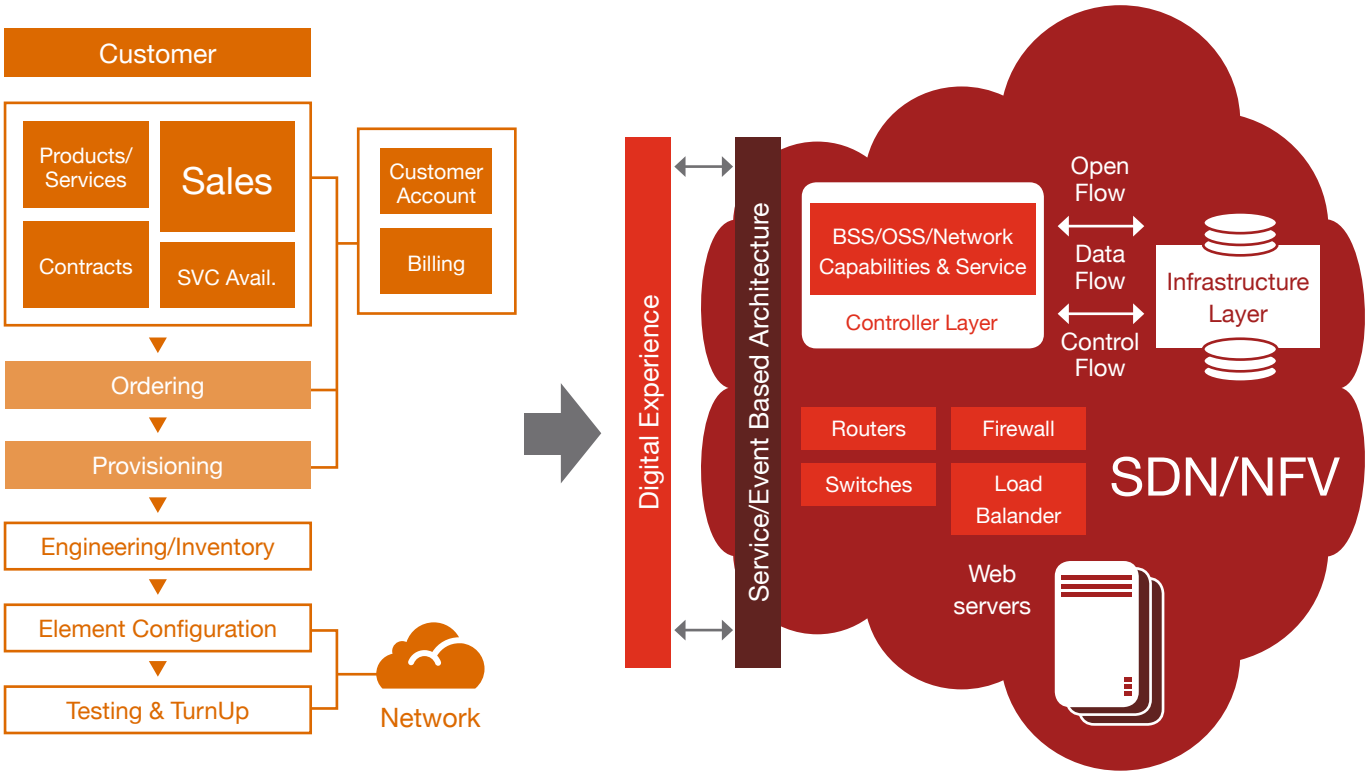
Looking beyond the network, SDN/NFV now provides carriers with the option and ability to replace their current BSS/OSS processes with the newly-developed virtualised network capabilities. Leveraging these capabilities opens up new opportunities for streamlining BSS architectures, while also providing dynamic provisioning of services, enhanced service assurance, and greater opportunities for services on-demand and customer self-care—ultimately creating a streamlined end-to-end Service Delivery (SD) architecture.

As Figure 4 shows, the traditional service delivery stack (to the left of the arrow) is essentially linear in nature, starting with sales and ending with the network providing the service. It is usually characterised by multiple development towers aligned by service, with redundant application capabilities/functionality, data stored across the towers, long service delivery times and relatively low levels of customer self-care. Flattening the stack by collapsing the required network capabilities into the SDN/NFV controller layer means that key BSS/OSS ordering/provisioning functions no longer need to pass data up and down a linear stack through multiple interfaces.

…creates opportunities to remove duplicate functions and engineering work

As a result, this proposed architecture will reduce data redundancy, remove duplication of functions between the BSS/OSS and network provisioning, cut development time and time-to-market for new functionality, and enable faster provisioning cycles through customer self-care.

Figure 4: Expanding SDN/NFV to the Service Delivery/Service Assurance (SD/SA) stack



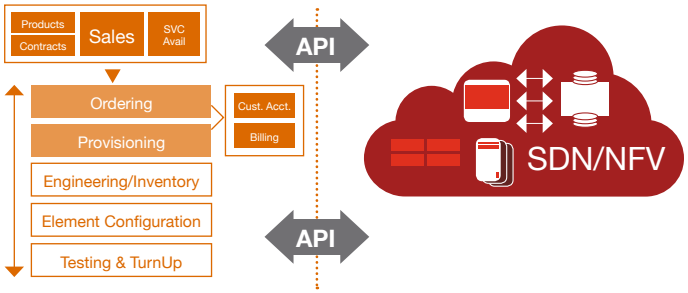
To date, operators looking to achieve closer integration between their BSS/OSS stack and new SDN environments have tended to do so by creating application programming interfaces (APIs) to communicate with the SDN environment. However, while this approach will deliver some benefits, it fails to optimise the entire sales-to-activation process landscape. Ultimately, the only way to achieve this is by integrating as much BSS capability as possible into the SDN/NFV controller by leveraging similar capabilities developed as VNFs and microservices. Doing this means the BSS stack can be re-focused on lighter-weight customer-facing functionality, with all service-level network provisioning processing managed and executed by the microservices and VNFs developed in the SDN/NFV controller.

Figure 5 sets out PwC's evolutionary vision for the next phases of SDN/NVF architecture. As the schematic shows, it begins with the development and implementation of the core controller and network VNFs. This phase tightly integrates the BSS/OSS environments, provides the customer with a simplified and intuitive digital experience, and introduces the ability to integrate the architecture into other industries while creating new customer services.

Realising these benefits will require close alignment between Business, IT application and network microservices/NFV capabilities, in order to ensure consistency and avoid duplication of processing, while also enabling faster time to delivery, reduced development costs and high implementation quality. Carriers should scale up the new model by starting with 'pilot pods' that work side-by-side with the existing organisation, and speed up mobilisation by seeding new roles and skills with outside talent.

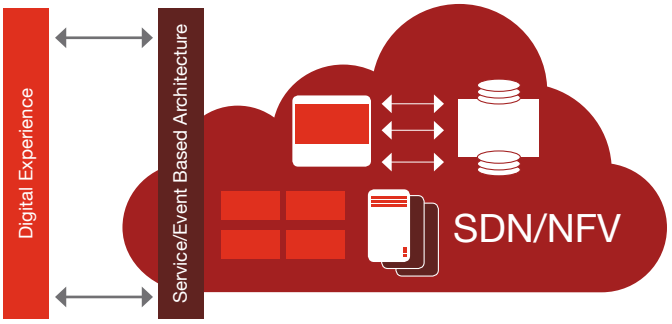
Figure 5: PwC's view of SDN/NFV evolutionary change

Today's SDN/NFV: Standing up the new virtualised network operating environment



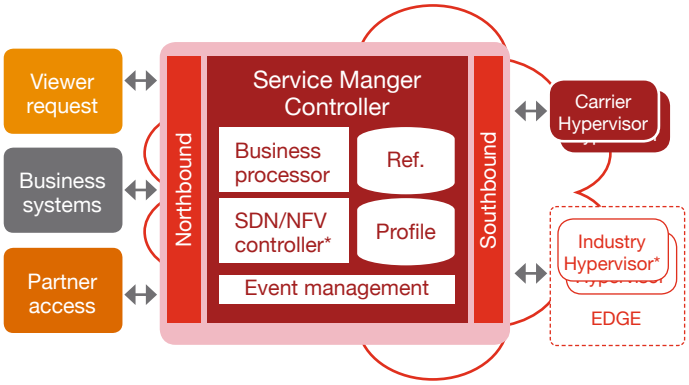
Key Attributes
• No major architecture changes
• Service based architecture to control plane
• Provides real-time provisioning
• Accelerates Time-to-Market
• Customer self-care

Tomorrow's SDN/NFV: Simplifying end-to-end Service Delivery leveraging SDN/NFV



Key Attributes
• Replaces workflow with event driven architecture
• Integrates BSS/OSS & SDN/NFV capabilities and business rules into a shared library and processor
• Optimisation of BSS/OSS architectures
• Reduces operating and development costs
• Simplifies Digital Experience architecture

Future of SDN/NFV: Opening the architecture to support other industries (Broadcast)



Key Attributes
• Creation of a new Service Manager Controller to include SDN/NFV, business rules & inclusion of multiple industries
• Creation of new combined services through partnerships
• Provides new revenue opportunities and partnerships
• Creation of a new customer experience

*Industry independent

An integrated SDN/NFV architecture can unlock benefits on several levels:

- **Resources:** The move to a virtualised network environment means organisations can be consolidated and reorganised, with—for example—network engineers becoming software designers and developers.
- **Development:** While development activity will increase, this will be for functionality supporting the VNFs and microservices, and will be accompanied by significant drop in the number of applications and function points needing to be developed and maintained.
- **Infrastructure costs:** Virtualisation will enable data centres, central offices and CPE to either be eliminated, reduced and/or simplified, leading to lower maintenance and operating costs
- **Customer experience:** Responsive, dynamic reconfiguration of carrier services can be carried out more efficiently in an integrated environment, by using analytics-driven recommendations and decision support for customers, while also opening the way to a more DIY-style approach to technical support.

Building the 'Software-defined carrier'

To survive and thrive in the software-defined era, carriers should consider adopting a new operational and delivery model, powered by virtualisation technologies. The migration towards virtualised networks is not a trivial undertaking, but the business and cost efficiency opportunities on offer are too large to ignore. And the path doesn't end there: extending SDN/NFV principles into IT can unlock a further layer of efficiencies, and enable real progress towards a more integrated, much simpler architecture by eliminating a lot of technical and organisational redundancy.

However, navigating the journey successfully demands much more than technology. It will take a holistic perspective and cross-functional mindset to build the 'software-defined carrier': cloud-enabled, anything-as-a-service, grounded in scalable network and IT services, provisioning and business processes agility, new talent and ways of working—and ultimately new business models and opportunities to protect and grow revenue.

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Endnote

1. PwC, “2015 Global Digital IQ Survey,” http://www.pwc.com/gx/en/services/advisory/2015-global-digital-iq-survey.html
2. Source: PwC Finance benchmark data, Performance surveys — Finance feedback http://www.pwc.com/us/en/increasing-finance-function-effectiveness/publications/pwc-digital-finance-paper.html
3. Source: PwC Finance benchmark data, Performance surveys — Finance feedback http://www.pwc.com/us/en/increasing-finance-function-effectiveness/publications/pwc-digital-finance-paper.html