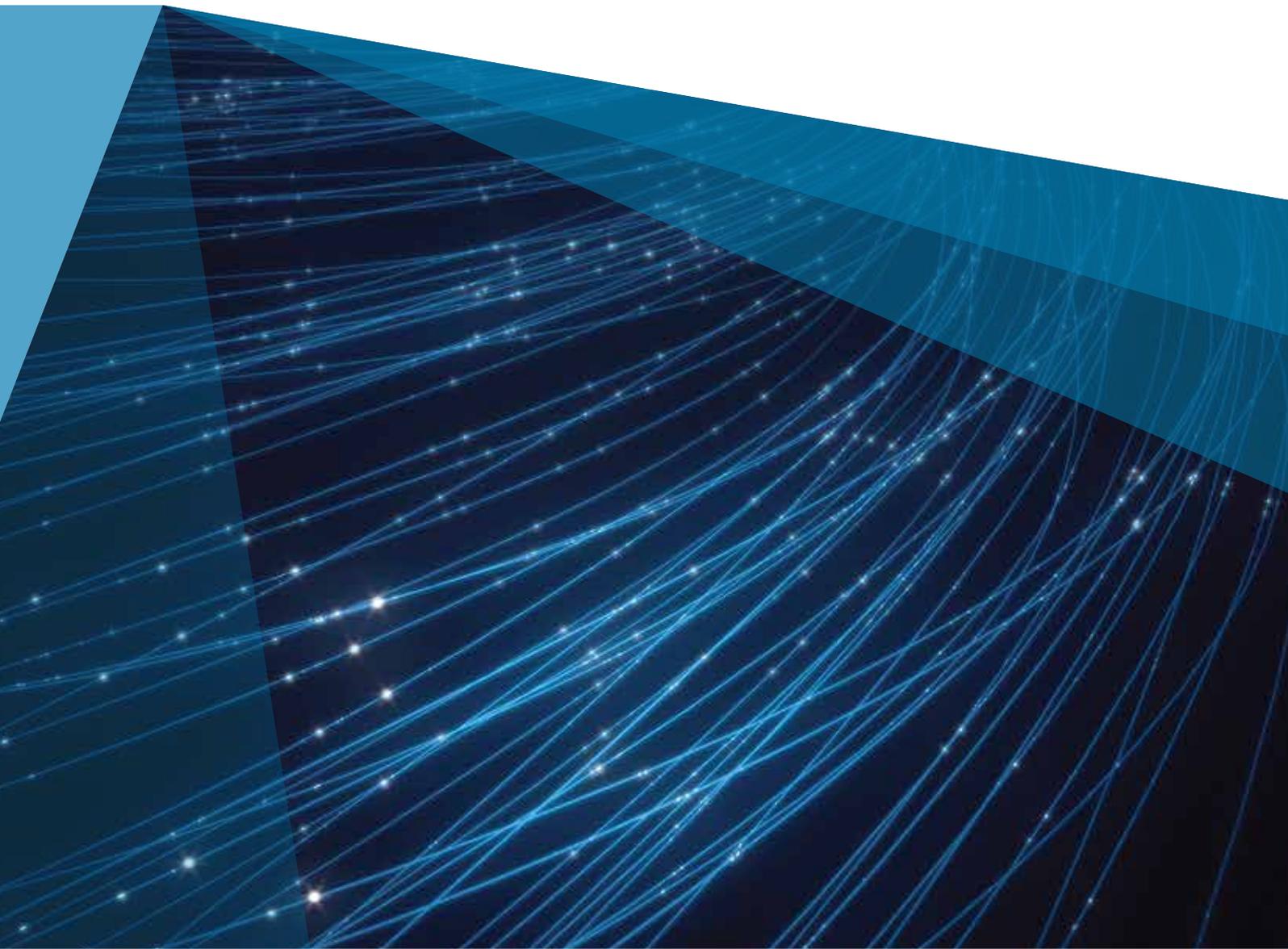


PROGRAMMABLE INFRASTRUCTURE WILL TRANSFORM TELECOMS

SDN AND NFV ARE POTENTIAL GAME
CHANGERS FOR TELECOM OPERATORS



PROGRAMMABLE INFRASTRUCTURE WILL TRANSFORM TELECOMS

Software-defined networking and network function virtualization are disruptive technology innovations that are gaining traction across the telecoms industry. In recent years, they have delivered operational and investment efficiencies. The consensus is that telecom operators can expect to capture a 15 percent reduction in total cost of ownership following implementation of SDN (software-defined networking) and NFV (network functions virtualisation). While that is a decent return on investment, it is loose change compared to the drastic changes to a telecom operator's top line and business model that these disruptive technologies can bring. Here, we focus on this side of the SDN and NFV story.

SDN AND NFV GROW UP

SDN and NFV have come a long way over the past decade. The promise of flexibility and efficiency inherent in these two technological disruptions has fueled extensive standardization and development work by equipment vendors and operators alike.

SDN adds flexibility in network design and operations through the separation of the data forwarding function (i.e. the traffic handling plane) and the control function (i.e. the signaling plane). This basic idea was first applied in local area networks with high throughput and efficiency requirements, like those of a data center. SDN allows network administrators to initialize, control, and manage network behavior dynamically through software interaction via abstract open interfaces. It evolved as a remedy to the static nature of traditional networks.

As a result, SDN transforms the legacy static network architecture and allows for a more dynamic, scalable, and cost-effective network, while meeting the increased and ever-changing performance and volume requirements of telecom operators. SDN's application to carrier-grade wide area networking (both fixed and mobile) is advancing, with full-blown commercial deployments probably not more than three to five years away.

NFV hinges on the principle of decoupling the hardware and functionality from the information technology infrastructure virtualization wave of the past 20 years. The architecture paradigm is based on replacing the network of custom hardware appliances with a set of virtual machines running different software and processes, while leveraging a network of standardized high-volume servers, switches, and storage devices. Such virtualization of the wide area network environment has reached a tipping point, with proven vendor solutions and multiple operator proofs of concept and implementations. (See Exhibit 1)

Exhibit 1: Leading multi-country operators have embarked in SDN/NFV transformation*1

EXAMPLE	SDN/NFV PROGRAM	KEY FEATURES
1  AT&T + Orange	Global open source partnership Effort to jointly standardize global SDN/NFV	<ul style="list-style-type: none"> Partner a joint SDN/NFV system from two service providers <ul style="list-style-type: none"> – Developing common guidelines/ templates
2  Vodafone	OCEAN – global NFV program One NW/IT solution – 26 markets	<ul style="list-style-type: none"> Centralization of core functions in a single “factory” design over 11 markets Wide deployment of virtualized core functions worldwide and optimized E2E service orchestration
3  Telefonica	UNICA – global NFV program Continuous global roll-out function	<ul style="list-style-type: none"> Implementation of service cloud delivery center and SDN/NFV labs Continuous global roll-out of SDN/ NFV products
4  MTN	Global cloud hub model Multi-country DC Hub and spoke network normalization	<ul style="list-style-type: none"> Multi-country Data Centre Hub and spoke network normalization Efficient transmission system to reduce latency risk
5  Singtel + Airtel	Commerollalized NFV/ SDN revenue Singtel + Airtel partnership for NFV/SDN enterprise solutions	<ul style="list-style-type: none"> Launching NFV based router and firewall service for enterprises in the APAQ region and SDN service Providing high speed data connectivity in a single network across the globe

*1 Not an exhaustive list

Source: CXO Interviews, Cisco, Netronome, Quali Systems, Ovum, Oliver Wyman analysis

The case for SDN and NFV adoption has been justified on a total cost of ownership reduction basis. The logic is as follows: In the medium to long term (five to 10 years) cheaper, more-commonly available hardware (common off-the-shelf hardware) will replace specialized, vendor-proprietary boxes, while software-based functions will deal with all the networking complexity from a virtualized core.

These processes will help telecom operators reduce their investment (capital expenditure) and operating costs (operating expenditure). As previously mentioned, the emerging industry consensus is that SDN and NFV technology should deliver a total-cost-of-ownership reduction of 10 to 15 percent compared to a deployment of traditional optimized infrastructure.

That said, operators will face challenges in realizing potential cost savings. External vendors will protect their business by hiking prices on software licenses related to network functions or by selling specialized support services at a premium. And internally, operators will need to take costs out of the business through painful streamlining of networking functions, while dealing with their legacy technologies.

Above and beyond cost savings, SDN and NFV will prompt paradigm shifts in operators’ revenue models. We will explore the nature and extent of those implications here.

SDN AND NFV-RELATED REVENUE TRANSFORMATION

In today's context, a telecom operator typically expects to achieve a multi-fold reduction of the unitary input cost from the network and IT "factory" over the next five to 10 years. That is, providing a gigabyte will have to be done at a tenth of the cost of today to preserve margins.

More importantly, telecom operators also anticipate that new business streams such as mobile financial services, e-commerce, and content, will represent a larger slice of the revenue chart than traditional telecom services.

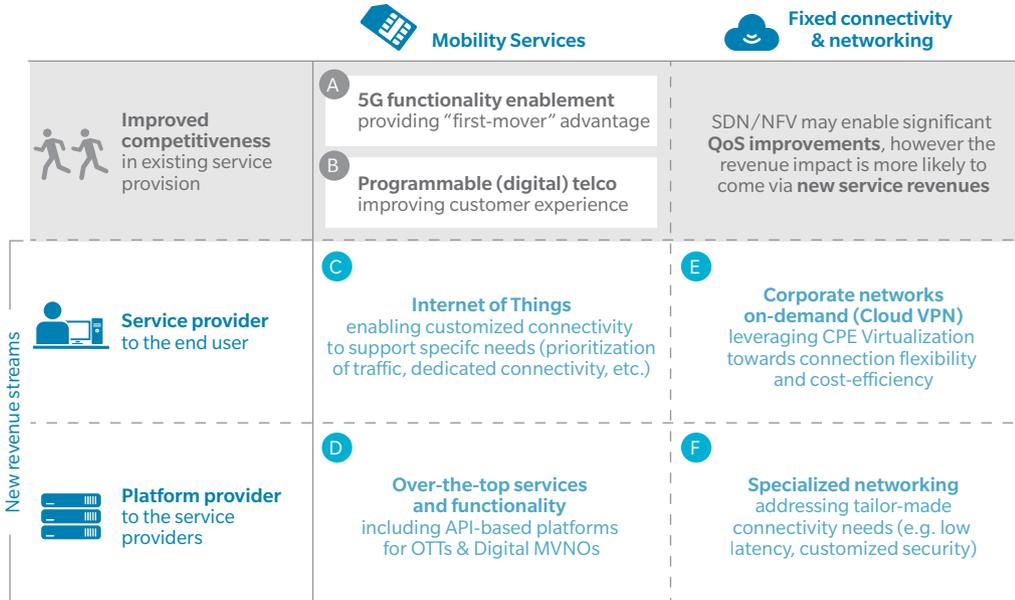
However, these new telecom service lines typically dilute earnings before interest, taxes, depreciation, and amortization when compared to the core telecom business. This has prompted much soul searching by chief technology officers and chief marketing officers when choosing pathways of future growth and enablement strategies as they try to meet profitability expectations. Choosing the right use cases for implementation becomes strategic.

Numerous applications or use cases have been proposed for SDN and NFV technologies, ranging from highly technical, cost-oriented applications (i.e. integrated server-and-network load balancing at the heart of the network) to somewhat piecemeal but more top-line related applications (i.e. specialized networking, customer-premises equipment virtualization). As with previous technology disruptions, only a few of the theoretical use cases will go the distance and have real transformational impact.

Next, we discuss the use cases that Oliver Wyman considers to be the front runners for success. (See Exhibit 2) Careful consideration of the rationale for these cases and their associated infrastructure requirements should inform, in our view, the mid- to long-term design and planning of networks and IT.

Exhibit 2: Selected top line “use cases” range from specialized networking to Digital MVNO enablement

NEW REVENUE STREAMS ENABLED BY SDN/NFV
HIGH LEVEL CATEGORIES



5G ENABLEMENT AND MULTIPLE-ACCESS ORCHESTRATION

5G is expected to be a significantly more radical step in the network design and operations paradigm than the previous steps from 2G to 3G and from 3G to 4G. The technology community is preparing itself for a truly multi-technology, multi-access, multi-service, and multi-data-model environment – an all-encompassing standard to cover the needs of a fungible and highly efficient network.

5G is expected to handle different frequency bands with different access types and offers that operate seamlessly across multiple service and data environments. The chief technology officer mandate to manage that transition could be critical in mature telecoms markets, where players compete for a convergent space (triple and quadruple play). At the same time, operators must continue to provide a consistent, flexible, and digital customer experience, where customers are humans, not service consumers.

SDN and NFV will undoubtedly be the foundation for 5G to realize the vision of a customer-oriented seamless network function. Carriers who understand and prepare for this will develop a sustainable competitive advantage.

PROGRAMMABLE TELECOM AND MULTI-MICRO-BRANDS

Recently we've seen the emergence of a digital "client," or digital-only interaction seeker. This customer demographic will rise in numbers as younger generations become telecom service users. To meet their expectations, operators are moving part or all of their customer experience on-line through multichannel digitization or a fully-fledged "telco in an app" play. Often the "telco in an app" goes beyond automation and digitization to become a fully-fledged segmented play with dedicated marketing, sales, and care models.

Regardless of the chosen level of digitization, operators are likely to seek ways to address different microsegment needs with narrowly-targeted and customized digital propositions running on the same network platform. SDN and NFV reduce the development and maintenance cost of these activities while allowing operators to seamlessly run much more granular pricing and provision tactics.

In some cases, this may take the form of a cobranding initiative with key external partners, similar to a mobile virtual network operator. The more agile, more granular customer proposition refinement or simply the lower entry costs for micro-brands would enable more-fragmented marketing and branding strategies and better value extraction from customer bases.

INTERNET OF THINGS AND THIRD-PARTY REVENUES

To be competitive in the Internet of Things space, operators will need to provide agile traffic prioritization and routing, in many cases with extremely low latency. SDN, and to a lesser extent NFV, can enable many of the applications and required network characteristics through the build-up of an object-oriented common language, which would allow easier and standardized device and network integration for external IoT eco-system developers.

In other words, SDN will enable different access and customer-premises equipment management, as well as seamless backwards compatibility, making an SDN-compatible network a better host for these solutions. Despite the extreme dilution of the machine-to-machine connectivity revenue per device, the global IoT market is expected to grow to between \$5 trillion and \$8 trillion, with telecom operator opportunities in the range of tens of billions of dollars.

In any case, operators will require revenue sharing schemes (up to 85 percent based on current agreements) in their partnerships with device manufacturers, which will also require flexible and controllable charging mechanisms, again an application of SDN technologies.

OVER-THE-TOP SERVICES AND FUNCTIONALITY

Network application programming interfaces (API) enable operators to integrate services such as messaging, payment, location-based services (LBS), telephony, and web real-time communications (WebRTC). Some of these services are already considered mainstream or, at the very least, a must-have in the core operator portfolio, but are implemented with ad-hoc or vertical-stack solutions.

True competitive advantage in this space is up for grabs by operators who understand what is mission-critical for their partners and incorporate the capability to offer almost real-time tailored services in their design. SDN and NFV are revolutionary compared to current API technology and solutions, as they truly abstract and advertise network functionality in an almost unconstrained, intuitive way for external parties. As a result, SDN and NFV could bring operators closer to realizing their long-held ambition of creating a services ecosystem.

CORPORATE NETWORKS ON DEMAND

Enterprise customers have long taken advantage of ever more reliable Internet access to replace their expensive virtual private network-dedicated access with best-effort Internet links and Internet-based VPN solutions. This type of over-the-top solution is not only cheaper but also easier to control and faster to deploy.

As commercial Internet access becomes faster, more reliable, and more widely available, some unconventional or non-incumbent players, such as Aryaka and Embrane, are moving into the cloud-VPN space. The unprecedented risk for telecom operators is that these startups will feast on their revenue.

An SDN- or NFV-based carrier grade network offers telecom operators a chance not only to bite back, but to gain an advantage over new players. Virtualized customer-premises equipment and configurable connectivity in real time through SDN-enabled interfaces give the client flexibility, control, and cost reduction.

On top of that, operators can leverage their long-standing relationships and proximity to clients to protect traditional corporate network revenues. Finally, the SDN-based solution reduces entry costs and makes a feasible case for smaller VPNs (fewer locations, less bandwidth), which could help carriers extend the service to small and medium enterprises.

The global VPN market is forecast to reach \$150 billion by 2026 and is a major source of margin for most operators around the world today. As a result, the application of programmable infrastructure is likely to sit high on operators' priority lists.

SPECIALIZED NETWORKING

Operators have been battling for the best part of the last 15 years to add value to their connectivity services and so avoid the commoditization of their core service. Operators have tried adding content, IT services, or managed solutions on top of connectivity in a bundle, but most have failed to stop the price reduction in broadband and connectivity services. Many operators now find themselves providing ever increasing volumes per client to sustain stagnant revenue levels.

Meanwhile, Internet over-the-top players and specialized network service providers have stolen a march on traditional telecom operators, capturing most of the value-add derived from demand for specialized network solutions and mass adoption of IT services. Google and Amazon offer storage and cloud services enabled by operators' infrastructure; Akamai provides content-delivery and acceleration solutions for media companies or anyone wanting to improve their Internet presence; f5 operates an application delivery business for sectors with very specific networking requirements.

SDN and NFV open a window of opportunity for carriers to enter or regain territory. With these technologies, the telecom operator's network of the future will have some of the over-the-top players' capability in a native or inherent way. Network core performance and security will be easier to define and control in a dynamic, real-time manner. Moreover, some of the key elements of the integration with IT infrastructure and application, such as state-based routing, will be built into the carrier's infrastructure.

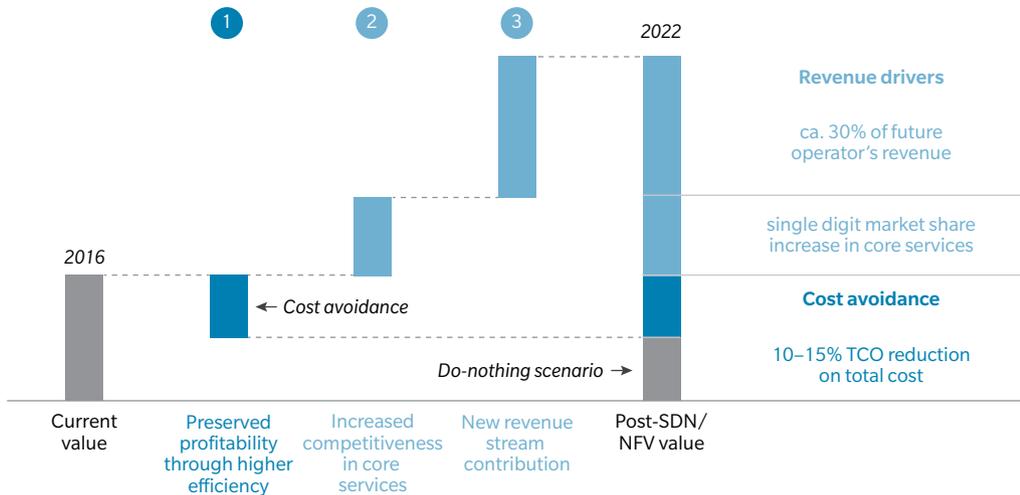
As a result, operators can put their hands up to host advanced innovations such as block-chain-based payment systems, digital crypto-currencies, and financial fraud management systems for financial services. They can also provide supply-chain and other high-frequency transactional services elsewhere.

As these capabilities become central to carriers' networking capabilities, they will be able to further tailor their offers in these areas. Naturally, as networks become truly differentiated for particular applications, connectivity services will become distinct. In return, this will allow operators to secure key spots in the marketplace for high-complexity connectivity provision.

These six applications are likely to become imperative in the near future; some of them are realities today and are well past the tipping point to mass adoption. They all hold the promise of either revenue preservation or revenue enhancement and pose design requirements beyond a pure rationale of unitary cost reduction. (See Exhibit 3)

Exhibit 3: SDN/NFV will be a key enabler for the expected revenue transformation

FINANCIAL IMPACT OF SDN/NFV IMPLEMENTATION
 CONCEPTUAL DEPICTION: THREE KEY VALUE DRIVERS



Source: Oliver Wyman analysis

Early adopters of 5G functionality and service digitization, for example, might achieve greater competitiveness and potentially greater market share in core service provision. Other SDN and NFV applications are positioned to drive new revenue streams. Migrations to a next-generation network paradigm (from 2G to 3G or 3G to 4G) or service digitization have historically created early-mover competitive advantages resulting in single-digit market share enhancement.

In most cases, telecom operators will be working in partnership with providers of IoT devices, content, or services. The terms of those agreements will define carriers' expectations for the new revenue streams. However, if we assume that revenue-sharing agreements between telecom operators and device manufacturers, content developers, and specialized service providers remain at current levels, the industry can expect at least 30 percent of future revenues to be driven by new, SDN and NFV-enabled streams.

CHALLENGES FOR SDN AND NFV ADOPTION

So, what are the key elements of SDN and NFV design and implementation to take into account for optimal results? There is no simple, cookie-cutter answer. Telecom operators will have differing starting points, technologically, commercially, and financially. And each will interpret the above-mentioned applications from different perspectives.

In general, though, the challenges that adoption of SDN and NFV technologies brings will be felt beyond technical functions and will lead to some key organizational and cultural challenges.

High on telecom operators' roll-out agenda for SDN and NFV is the review of the basic building blocks of data models and business processes. For years, operators' IT departments have blithely assumed all clients would have a fixed line or could be assigned to a mobile or SIM number. However, this model will be obsolete in the new world of digital natives, and chief technology and information officers will need to put all their chips on the data model of the future and on a new basic logic of telecom services business processes. Both the data model and business processes are likely to differ significantly from today's, which is based on single-service stacks and logic. The migration to the new environment is a major leap, one that will require detailed examination and preparation.

As with many other technological disruptions, SDN and NFV have sparked significant standardization efforts by institutions, vendors, and operators. The jury is out for most of the key technical questions, and the level of interoperability between vendors and solutions is far from ideal.

Chief technology and information officers need to address the significant risks related to the selection of standards. After years of traditional organization, firms' IT and network departments are in silos. They have different working methods, skill sets, and mentalities. A culture clash is likely to manifest itself in the design of the multiple access management and service orchestration functions where the old borders between network and IT blur. The design must be radical to produce the desired savings or enable the truly abstracted, common-network-object business processes that SDN and NFV technologies can deliver. A design that remains too deeply entrenched in the south-bound interface of the old operation support system will fail.

Finally, most operators currently require capital expenditure and technology approval sign-offs that go all the way to board level. This is to ensure optimal deployment of resources in a mature industry like today's telecom business. However, occasionally the outcome is that chief technology and information officers delay hard decisions and avoid the optimal migration path on risk mitigation grounds. This trend has seen some operators move timidly into numerous proof-of-concept or trial phases, or virtualize non-core workflows and services to try to extract learnings and identify the business case for the investment. We believe the change required is so profound that, to be successful, chief technology and information officers must lead the charge and prepare an ambitious, forward-looking plan.

Until now, SDN and NFV adoption has been one of the top priorities on the chief technology and information officer's agenda. But for a telecom operator to extract the maximum potential value from these disruptive technologies, SDN and NFV need to feature high on the agenda of every member of the company's C-suite.

CONCLUSION

SDN and NFV constitute one of the biggest technological disruptions that the telecom industry has seen in the past decade, and one of the biggest opportunities. The technology is now mature enough to change the way networks and IT services are designed, deployed, and operated. The disruption will bring new prospects for revenue protection and capture, as well as cost efficiencies. Opportunities such as cloud VPN, specialized networking, digital value proposition, and multi-micro-brand marketing enablement are likely to outweigh the expected unitary cost reduction.

As a result, the associated use cases should be central to the definition of the future SDN and NFV architecture and implementation path. Operators motivated to embark on the SDN and NFV journey by significant revenue and cost-saving potential will face numerous challenges beyond the technology sphere. Full realization of the potential will require shifts in the organizational and decision-making processes, making SDN and NFV a company-wide consideration.

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