



## IDC TECHNOLOGY SPOTLIGHT

# Unlocking the Full Potential of 5G with Software-Mediated Networking

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Adapted from *NFV/SDN Will Be Foundational to 5G Rollouts — Unified Network Road Map Emerges*  
by Patrick Filkins, IDC #US43696118

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*Telecom service providers will be essential partners in the digital economy, with mobile networks favorably positioned as information highways for global business. 5G networks will be digital enablement platforms due to their ability to not only enhance connectivity but also empower industry stakeholders to use data for better decision making. This entails a new network approach, leveraging cloud and software-mediated networking (e.g., NFV/SDN), and new technologies, such as big data and analytics, artificial intelligence, and automation to provide value-added data services in conjunction with ultrafast connectivity. Service providers successfully able to leverage these technologies are likely to separate themselves from peers in both service delivery and business performance, particularly when 5G network slicing emerges. This IDC Technology Spotlight looks at Tech Mahindra's role in accelerating service provider transformation by addressing the network requirements for the virtually guided, 5G digital service provider.*

### Introduction: NFV, SDN, and 5G Road Maps Primed to Intersect

While the LTE era enhanced mobile data revenue streams, service providers have largely struggled to sustain incremental revenue gains from voice and messaging services. Indeed, mobile service commoditization is progressing, with ARPUs remaining relatively flat, and industry players interlocked in heightened competition to protect their traditional profit pools. IDC estimates the mobile market will achieve a 2% CAGR from 2017 to 2021, driven by limited growth in mobile data usage and M2M applications, partially offset by declines in spending on traditional mobile voice and messaging services.

Additionally, the exploding demand for digital media on a range of devices poses a significant long-term problem for telecom service providers as networks are further pressed to meet strict service-level agreements. This outlook is prompting many service providers to invest in new ways to address network bottlenecks, limit capex and opex, and capitalize on new revenue opportunities.

With 5G networks set to be deployed in 2018/2019, service providers are poised to embark on a new journey, which will be defined by fresh revenue opportunities but accompanied by an equal, if not deeper, set of challenges. With over 100 publicly announced 5G RAN trials as of 1Q18, and progress being made through standards groups, capacity concerns are being addressed, but deploying a new air interface and mobile core is only a portion of what will be required to excel in the 5G era. To build an agile, programmable, and elastic network, operators will need to embrace NFV/SDN adoption throughout the network infrastructure stack. Doing so will produce a differentiated network, able to offer premium, custom-fit services on the fly. Those able to overcome identified barriers related to NFV/SDN, such as integration and interoperability, are likely to separate themselves from peers in both service delivery and business outcomes, particularly when 5G, IoT, and digital media services achieve mainstream adoption.

Simultaneously, industry verticals are hastening their own transformations. In fact, IDC estimates that worldwide spending on digital transformation technologies will expand at a CAGR of 17.9% by 2021 to more than \$2.1 trillion. As the digital ecosystem blooms, digital service providers will become a key business platform based on their ability to connect, aggregate, and securely distribute network traffic in near real time. While this vision remains a couple of years away, the window to prepare is closing, signaling operators are best served to prioritize NFV and SDN projects now. The best-case scenario will be a fully virtualized network stack, which is unrealistic given that operators are expected to run both physical and virtual infrastructure in tandem for the foreseeable future. Therefore, migrating to virtually led environments over time will become the norm.

For reference, it is worth drawing parallels to enterprise cloud adoption, whereby a select few cloud providers have come to dominate the space by leveraging an early foundation in cloud-native infrastructure and virtualization, enabling them to offer service repositories consisting of traditional compute, networking, and storage, but also analytics, application services, and developer tools on demand. As some service providers move closer to this model, the opportunity exists to differentiate while creating higher barriers to entry from smaller competitors over the long term.

While this outlook paints a rosy picture for the digital service provider, success will not be easy. Running multivendor, hybrid environments is bound to add network complexity. One solution is to enlist services from a vendor-agnostic integrator that is better positioned to stitch multiple software instances into a carrier-grade, virtual network platform. Additionally, service providers are collaborating within a broad range of ecosystems to drive innovation, where they are working with traditional and new stakeholders to refine and execute transformation initiatives.

## **Key Trends: Accelerating Network Innovation Remains an Industrywide Objective**

While transforming into a digital service provider will take time, industry consortia have emerged as a key instrument to accelerate network innovation. Interestingly, this marks a shift from prior network eras (e.g., GSM and LTE), where a select group of vendors led the innovation and service providers aligned with these technology road maps. However, many service providers are experimenting with ways to unencumber themselves from legacy vendors. The idea is to accelerate innovation and unlock new ways to drive down costs and monetize networks. The following key trends are driving network innovation:

- **Service providers are moving past initial rollouts and launching NFV and SDN projects in adjacent network domains.** While the EPC and IMS have been virtualized by several MNOs in the 4G era, RAN virtualization appears to be the logical next step in the evolution of the mobile network. RAN is moving from coordinated RAN in the case of 4G to centralized RAN in the case of LTE-Advanced and finally to cloud RAN in the 5G era. vRAN, which is generally synonymous with cloud RAN, is quickly becoming the next focus area, as service providers push to have end-to-end virtual networks in place to support network slicing. Additionally, with a majority of mobile network capex mapped to the RAN, it makes sense that most service providers are interested in reducing costs in this domain.
- **Multi-access Edge Computing (MEC) is increasingly viewed as essential to enabling many 5G applications.** While centrally pooling data into large, cloud datacenters has enabled service providers to generate value, the construction of smaller, edge clouds is increasingly viewed as a path to support a new class of applications. This could include an IoT application, such as a drone used for public safety, or any service requiring near-real-time access to network information and processing. As such, MEC is expected to be a vital aspect of many 5G services, whereby ultralow latency and high-bandwidth connectivity are supplemented and enhanced by edge compute capabilities. Enhanced edge computing capabilities will place service providers squarely at the intersection of the digital economy, whereby they can become a leading platform for new applications deployed from the edge cloud.

- **NFV and SDN are becoming pervasive, but cloud native is the real goal.** While it has not been easy, leading NFV and SDN adopters are slowly beginning to benefit from their initial investments. As such, some service providers are moving past initial virtualization projects and pressing for cloud-native frameworks. This shift has been discussed for many years but is only now beginning to happen. Cloud-native architectures will fuel service agility, as service providers are able to automatically address demand by shifting resources throughout their network footprints, on a standard platform.
- **Orchestration platforms will become indispensable.** Many telecom service providers have already deployed SDN controllers and/or orchestration platforms to automate portions of virtual networks. As network virtualization becomes more pervasive, further emphasis will be placed on management and orchestration (MANO) platforms as not only an automation tool but also a service agility enabler. Indeed, 5G network slicing will require a robust MANO platform that is able to manage dozens of network slices at once. This platform will allocate resources to fulfill a specific contract, enabling custom services to be run simultaneously from a single core network. To date, this work is largely driven by consortia, such as ONAP and OSM, with limited code from both initiatives running in live networks. Additionally, with the standalone 5G NR standard set to be released in June 2018, it is expected that a handful of ongoing pre-standards network slicing trials will grow to encompass the majority of those already trialing 5G RAN solutions.
- **Artificial intelligence/machine learning (AI/ML) and robotic process automation (RPA) are fueling the push to a zero-touch network.** Once forward-looking technologies, AI/ML and software robots that are used to accomplish manual tasks are now being integrated as part of service provider networks. For example, service providers can leverage AI/ML for hardware and software predictive maintenance, whereby the network recognizes a potential fault ahead of time. This preventive approach can reduce overall costs tied to network downtimes and the manual labor needed to fix downed networks.
- **Data will become a new profit pool for digital service providers.** IDC forecasts that the global data sphere will grow to 163ZB (that's a trillion gigabytes) by 2025. That's 10 times the 16.1ZB of data generated in 2016. With that in mind, we expect 5G networks to dramatically increase capacity and throughput, further fueling the global rise in data traffic. Digital service providers will leverage data not only to make their traditional connectivity businesses better and more efficient but also to unlock new revenue sources, such as selling targeted digital advertisements or network insights. Therefore, it is expected that digital service providers will own and operate highly valuable data platforms to enhance their market position. Successfully making this transition will require careful consideration about how to adhere to stricter data laws, such as those defined by the GDPR in Europe, but also around the best way to integrate data platforms into virtual networks.

## **Benefits: NFV/SDN Maturity Will Be a Key Differentiator in the 5G Era**

The benefits of NFV/SDN as a fundamental enabler in the 5G era will empower many digital service providers to offer differentiated services, all while streamlining operations. Several of the key benefits attributed to a virtually founded, 5G network are as follows:

- **Total cost of ownership (TCO) will be reduced.** Stripping costs out of the network is a leading reason why many service providers were initially drawn to NFV/SDN. As these projects grow to encompass more of the network, including the RAN, the potential to reduce TCO is substantial.
- **Service agility is enabled by network slicing.** While it will be several years before network slicing is mainstream, the foundational work, including the need for an end-to-end distributed telco cloud, will need to be undertaken sooner rather than later. Doing so will better position digital service providers to offer multiple services from a single 5G network platform. From a business perspective, this will support tiered services, which could range from traditional mobile broadband to a premium IoT offering.

- **Networks will become more elastic.** With more and more devices coming online, the networks of the future will need to automatically adjust to significant throughput swings, especially during peak usage times. Using intelligent MANO platforms, the network will be self-sustaining, able to respond to peak data times automatically.
- **Best-of-breed solutions are at the forefront.** Disaggregating software from purpose-built appliances gives service providers new options. This has enabled a cast of new vendors to garner limited commercial traction from many service providers. This "best-of-breed" or "a la carte" vendor selection will require a stronger reliance on network-agnostic consulting and systems integration (C&SI) specialists to make it all work.
- **Emphasizing software over hardware will enable service providers to pursue new business models.** The slow move to white-box appliances continues to disrupt the telecom vendor status quo, with some service providers looking for ways to source directly from ODMs for networking solutions. While this direct sourcing has been limited thus far, it is gaining legs as service providers explore ways to replicate the procurement model demonstrated by their web-scale counterparts.

## Considering Tech Mahindra

As 5G service providers will be heavily defined by digital platforms and cloud-scale efficiency, Tech Mahindra's multifaceted NFV/SDN approach, combined with the company's early 5G work, showcases Tech Mahindra's value proposition as a network-agnostic digital service enabler. From a portfolio perspective, Tech Mahindra addresses NFV/SDN adoption in several ways:

- **Deep involvement in consortia, including as a founding member of ONAP and Open vRAN.** ONAP's contribution to the NFV/SDN landscape continues to grow, as ONAP code is finding its way into many tier 1 orchestration projects. Having background and hands-on experience with ONAP is likely to become a prerequisite as the use of network orchestration expands. Open vRAN, announced at MWC 2018, was formed to bring together industry stakeholders to design, test, and develop proofs of concept for innovative RAN solutions. Furthermore, Tech Mahindra is actively contributing to the Telecom Infra Project's (TIP) mmWave Networks project group, which is attempting to define and advance 60GHz wireless networking solutions.
- **Through VNF-Xchange, an NFV platform.** VNF-Xchange is one of the industry's first network-agnostic NFV platforms, designed to precertify full-stack NFV implementations consisting of multivendor hardware, hypervisors, operating systems, virtual network functions (VNFs), and MANO platforms prior to commercial launch. This includes benchmarking multiple configurations, enabling service providers to bring their strongest NFV stack to market. For instance, Tech Mahindra has introduced multiple solutions from VNF-Xchange including vEPC and VoLTE-as-a-Managed Service. As evidenced by hard lessons learned in many NFV projects that failed to make it out of the lab, this capability has become a critical prerequisite prior to moving from lab work to field trials. Along with its platform, Tech Mahindra leverages its end-to-end services portfolio to provide the front-end consulting through systems integration at the back end.
- **By automating network upkeep with its TRUe platform.** TRUe leverages AI and ML to classify and automatically resolve network faults. Manual intervention, and therefore error, is significantly reduced, ensuring SLAs are met. Furthermore, leveraging RPA, TRUe automates follow-on remediation required to correct the identified fault. All said, TRUe takes service provider networks a step closer to end-to-end automation.
- **Working closely with a new breed of suppliers, such as Altiostar.** Tech Mahindra's investment and close work with Altiostar around vRAN further extend Tech Mahindra's NFV/SDN prowess into the RAN. Altiostar is one of the industry's first vRAN suppliers and has completed

significant work toward the vision of a virtualized RAN running on white-box hardware. As noted, vRAN adoption promises to be a significant cost reduction exercise while playing a major role in network slicing. Additionally, Tech Mahindra and AltioStar are aligned as founding members of the Open vRAN initiative.

Focusing on commercial 5G, Tech Mahindra is building competency by:

- **Working with Intel to open a 5G center of excellence (COE).** To prepare for 5G, Tech Mahindra opened a COE with Intel. The center will be used to expand and refine Tech Mahindra's 5G skill set ahead of commercial rollouts. Additionally, Tech Mahindra is reskilling its 100,000+ workers to cater to software- and digital-led initiatives, including NFV, SDN, and 5G.
- **Working to support new mobile applications.** Compared with prior mobile generations, 5G networks will be stronger enablers for the digital enterprise. Tech Mahindra is working closely with partners to create a seamless mobile edge, leveraging MEC, to empower enterprises to take advantage of 5G speeds. Foremost, digital enterprises are expected to be able to deploy mission-critical applications and take advantage of industrial automation.
- **Leading a TM Forum Catalyst project dedicated to network slicing.** This TM Forum Catalyst project is focused on how 5G network slices can be operationalized, orchestrated, and monetized on a custom basis. As mentioned, this is likely to become a defining characteristic between the 5G-era digital service provider and telecom service providers left offering traditional voice, messaging, and data connectivity services.

## **Challenges**

### **Skill Transformation**

IDC's research with service providers continues to suggest ongoing challenges in the people dimension as service providers pivot from their legacy ways of doing business to a software-driven dynamic culture. This cultural shift will continue to be a major roadblock to the network transformation journey of all service providers around the globe. As networking and IT continue to converge within service providers, they are hard-pressed to bridge the skill gap between the requirements of the new paradigm versus what the workforce offers today. Consequently, many service providers will require a higher level of hand-holding from suppliers to fully achieve their network visions in the 5G era.

### **Interoperability Between VNFs, PNFs, and Management/Orchestration Systems**

Another key challenge for NFV infrastructure is to design standard interfaces between not only a range of virtual appliances resident on a multitenant cloud infrastructure but also the virtualized implementations and legacy equipment or physical network functions (PNFs). Given that one of the goals of NFV is to promote openness, network carriers are most likely to integrate and operate servers, hypervisors, and virtual appliances from different vendors in a multitenant NFV-based cloud. While the aim of consortia and standards groups is to smooth this process, commercial implementation of NFV and SDN has shown that more work is needed before many service providers are convinced NFV and SDN are ready to be fully scaled.

### **Concurrently Managing Virtual and Legacy Physical Appliances**

Despite the promise that a fully virtualized network holds for service providers, it is inconceivable that service providers will abandon the significant investment they have made in their legacy infrastructure. They are most likely to continue to use hardware-based network appliances in conjunction with virtual network functions for the foreseeable future. Hence the ability to manage physical and virtual network functions concurrently is likely to remain a continuing challenge for service providers for some time to come.

## **vRAN Deployments Adding Complexity**

While vRAN promises a range of benefits (e.g., cost savings), seamlessly transitioning from traditional RAN networks to a virtualized, cloud-based model is bound to add layers of complexity. Moving to this model will require service providers to combine IT and network competencies as never before. This has remained a challenge in the early days of NFV and SDN, and it will be no different as service providers move to tackle vRAN.

## **MEC Proving Itself Alongside 5G**

While MEC will be deployed alongside 5G access points, the implementation of real-time data processing at the access edge will present its own set of challenges for service providers. The challenge will include defining which application workloads are best suited for edge nodes and which are best served being sent to the central cloud. Application requirements will dictate the selection, but the system that controls app selection will need to be a fully automated, intelligent platform.

## **The Ambiguous 5G Business Case**

While 5G technologies are likely to unlock new revenue streams, it remains unclear how the technology is best positioned. What is clear is that network slicing will fundamentally change how service providers bring new services to market. The business case issues are likely to be addressed as service providers launch limited trials of network slicing following the release of the standalone 5G NR standard in June 2018.

## **Conclusion**

With 5G rollouts imminent for 2018 and 2019, telecom stakeholders will expect to see their multiyear investments in NFV and SDN contribute to commercial 5G efficacy. Additionally, the transition from monolithic, appliance-driven networks to software- and cloud-led architectures will become ever more pressing as service providers explore new ways to drive 5G-based revenue. However, many challenges remain, including network interoperability, complexity, and performance issues.

When companies consider these issues, the benefits of working with a vendor-agnostic services specialist become clearer. Tech Mahindra's work to date signals that the company is well equipped to address the complexity associated with NFV and SDN projects, which, if completed effectively, are expected to enhance 5G service efficacy and revenue growth opportunities.

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Global Headquarters: 5 Speen Street Framingham, MA 01701 USA P.508.872.8200 F.508.935.4015 [www.idc.com](http://www.idc.com)