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Independent market research and competitive analysis of next-generation business and technology solutions for service providers and vendors

Network Slicing:
OSS/BSS Key to Commercial Success

A Heavy Reading white paper produced for Tech Mahindra

Tech Mahindra

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INTRODUCTION

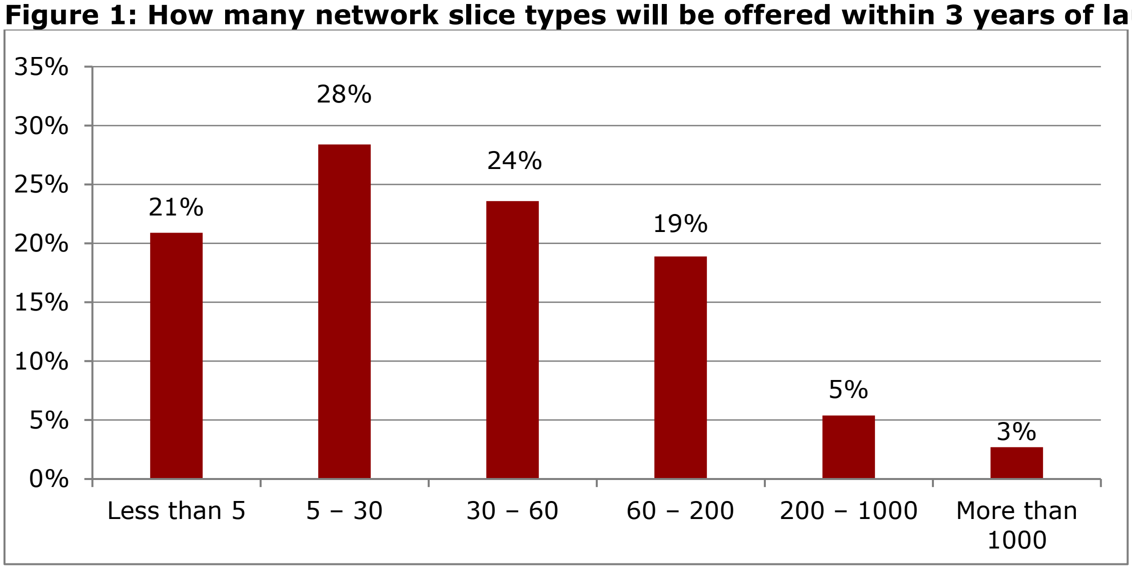
According to a recent Heavy Reading survey, almost all communications service providers (CSPs) are considering network slicing. Roughly half plan to launch it within 3 years of commercial 5G launch and around a fifth plan to do so within 1 year. However, while many operators are talking about network slicing, very few have figured out how to operationalize and monetize it. Network slicing uses the principles of modern cloud architecture to run multiple logical networks as virtually independent business operations on a common physical infrastructure. Each logical "slice" meets service-specific requirements for network priority, latency, data rate, quality of service (QoS), and other key performance indicators. Each slice type can have different versions of the following:

- Radio access technologies (RAT)
- Activated core network features in the control and user plane
- Resource dimensioning and locations

Operators expect this slicing capability to lead to new revenue opportunities from customized services. The classic three service types that have been propounded for some time are enhanced mobile broadband (eMBB), ultra-reliable low latency communications (URLLC), and massive machine-type communications (mMTC). In theory, the number of slice types is limitless, as there could be slices for different applications (e.g., video gaming and virtual reality) or even individual customers. Enterprise customers could be offered a mobile network as a service slice with guaranteed uptime to support factory automation. Network slicing could also allow much more granular configuration of mobile virtual network operator (MVNO) wholesale services than is possible today.

As **Figure 1** shows, there is a broad range of estimates of how many network slice types will be on offer. At the conservative end, many think the three classic scenarios (eMBB, URLLC, and mMTC) will suffice. The optimists envision a future with hundreds of slice types.

Figure 1: How many network slice types will be offered within 3 years of launch?



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Source: Heavy Reading, December 2018

HOW DOES NETWORK SLICING DIFFER FROM QOS?

Operators have had techniques to ensure QoS for particular traffic types for many years. Network slicing builds on existing technologies such as the following:

- **Differentiated Services (DiffServ):** IETF RFC 2475 published in 1998.
- **eDecor:** A 3GPP Release 14 feature (an enhanced version of Release 13's dedicated core network selection mechanism, Decor).

While these techniques can already be applied to 4G mobile networks, 5G will expand on them, enabling more automated, end-to-end network slicing. What distinguishes 5G network slicing is that it is not restricted to applying QoS solely in transport and the core, as with DiffServ. Rather, 5G network slicing has the ability to also apply QoS in the radio frequency (RF) domain. Unlike DiffServ, 5G slicing will be able to discriminate between the same types of traffic (Voice over Internet Protocol [VoIP], video, and Internet of Things [IoT]) coming from different tenants. 5G slicing will also, unlike DiffServ, be able to isolate specific traffic streams (e.g., for privacy and security reasons) to restrict them to certain areas of the network (e.g., a dedicated server).

In 4G, the basic granularity of QoS control is the Evolved Packet System (EPS) bearer. The service type is mapped to a specific EPS bearer, and all the data flows on that bearer are given a certain QoS guarantee. In 5G, the QoS model is based on QoS flows. A protocol data unit (PDU) session provides a connectivity service between a user equipment (UE) and the data network. The QoS flow is the finest granularity of QoS differentiation in the PDU session. User plane traffic with the same QoS flow receives the same traffic forwarding treatment (e.g., scheduling, admission threshold, etc.). 3GPP's 5G QoS indicator defines for a given flow:

- **Priority level:** 11-66
- **Packet delay budget:** 5-300 ms
- **Packet error rate:** 10^{-2} to 10^{-6}
- **Maximum data burst:** 160-1,358 bytes

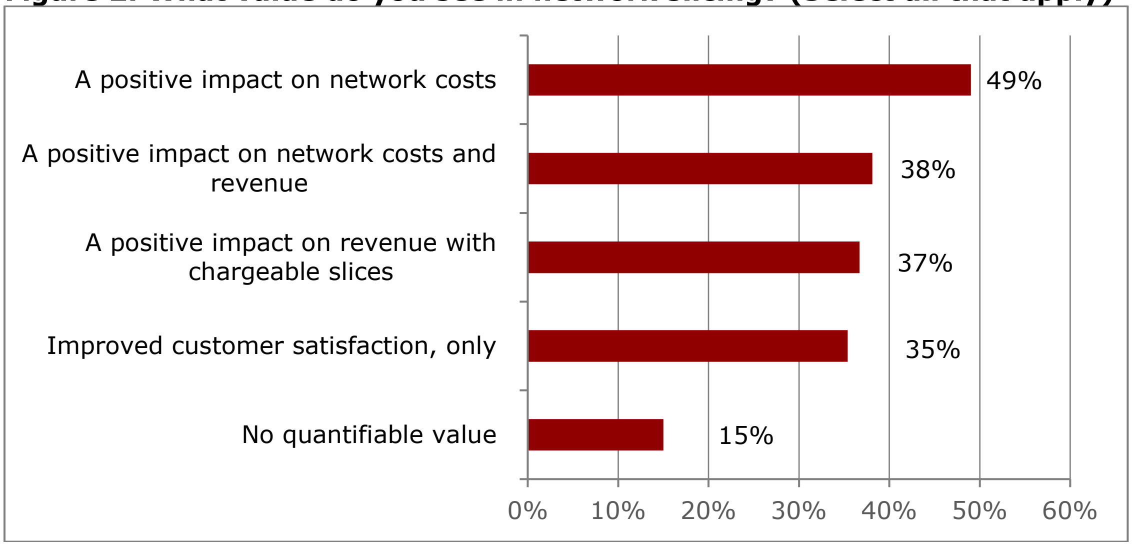
For each PDU session, the Network Slice Selection Assistance Information (S-NSSAI) is carried from the core to the radio access network (RAN). The RAN will use the slice identity to ensure consistency between the QoS and network slice, including the resource allocation and scheduling policy, etc. As such, the key difference between QoS and network slicing is that traditional QoS is only applied in the core network whereas with network slicing, this flow-based quality differentiation is carried all the way through to the RAN.

Once mature, network slicing should have much greater automation thanks to orchestration platforms such as Open Networking Automation Platform (ONAP; see here). This should enable network slicing to be delivered more cost-effectively, making it economic to provide network slicing-based services that today are limited to niche use cases.

WHAT VALUE DOES NETWORK SLICING BRING?

In a recent Heavy Reading survey, see **Figure 2**, we asked CSPs where they saw the value in network slicing. Surprisingly, the top response was cost reduction. Around 40% of respondents said it would positively affect revenue. Fifteen percent of respondents were skeptical that there was any quantifiable value.

Figure 2: What value do you see in network slicing? (Select all that apply)



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Source: Heavy Reading, December 2018

Adopting network slicing rather than building dedicated networks for different service types would certainly generate a cost savings. But implementing network slicing is unlikely to lead to any significant cost savings compared with today's one-size-fits-all network. Dedicated slices for service types could increase overall network efficiency. For example, an IoT slice for smart meters would not need the mobility and IP Multimedia Subsystem (IMS) capabilities of the network. But the cost savings potential seems marginal.

So where is the new revenue going to come from? The idea is that rather than simply selling buckets of bytes with a few service-level agreements (SLAs – for enterprise customers), mobile network operators (MNOs) will be able to market highly differentiated "slices" of network capacity. These must be carefully priced and positioned to make them more attractive to the enterprise than basic connectivity plans – yet more profitable for the operator. Organizations that might benefit from a dedicated slice include emergency services, healthcare, and industrial plants. Another obvious opportunity for network slicing is in the wholesale/MVNO market. Operators could offer network slices on a wholesale basis, allowing third parties to sell them on to enterprise users in addition to some value-added services. However, the risk here – like in the case of IoT – is that MNOs become relegated to dumb network slice vendors while the value-added services are captured by third parties.

Network slicing should enable operators to be more agile, launch customized services more quickly (e.g., for a music festival or sports tournament), and target smaller opportunities. Slicing enables isolation during service deployment and reduces interoperability testing, thereby enabling faster launches. However, the operator will need to develop an ecosystem of partners to exploit such short-lived or small opportunities.

In the initial phase of network slicing, operators are likely to launch a handful of slice types (e.g., eMBB, URLLC, and mMTC) with multiple tenants per slice. Over time, the number of slice types should increase and become more service specific (e.g., video gaming and smart meter connectivity). Eventually, we could see application-specific slicing (e.g., Netflix video streaming), although this could run into net neutrality restrictions in some countries. Vodafone UK's chief technology officer (CTO), Scott Petty, recently commented that, "If net neutrality is applied, the whole premise of network slicing will fall apart."

It is even feasible to have customer-specific slices that are fully configurable via a portal. Enterprise customers could specify their necessary data rate, latency, reliability, and security. An automotive manufacturer might want a URLLC slice for autonomous vehicles, an eMBB slice for in-car entertainment, and a mMTC slice for vehicle diagnostics.

By moving away from the one-size-fits all approach of current networks, slicing should allow operators to be more creative in their service offerings. Slicing should maximize their revenue potential while still using the same underlying infrastructure.

WHAT IS HOLDING BACK NETWORK SLICING TODAY?

According to the CTO of Vodafone UK, "Private LTE trials have relied on network slicing, but it is a couple of years away from broad availability and maturity and vendor products."

Network slicing for 5G is not due to be standardized until 3GPP Release 16, which is not expected until 2020. Adding to the uncertainty over the business case for network slicing is the risk that enterprises will purchase their own 5G spectrum and build their own networks. Germany left 100 MHz of mid-band airwaves out of its recent auction for this purpose. The U.K.'s regulator, Ofcom, recently unveiled proposals to award spectrum in the 3.8 GHz-4.2 GHz range to anyone who wants to build a local 5G network. Mansoor Hanif, Ofcom CTO, thinks traditional operators aren't moving "fast enough." As the quote below from a French railway executive indicates, enterprises also have their reservations about network sharing.

> *"On paper, network slicing is very promising. But let's remember that at this stage, the 5G spectrum is still not available in France. There is no service model, operating model, or even end-to-end testing. We are at the beginning of the 5G story; everything still has to be built and proven."*
>
> *– Sébastien Kaiser, Director, Connectivity & Networks at SNCF*

Network slicing will present various operational challenges:

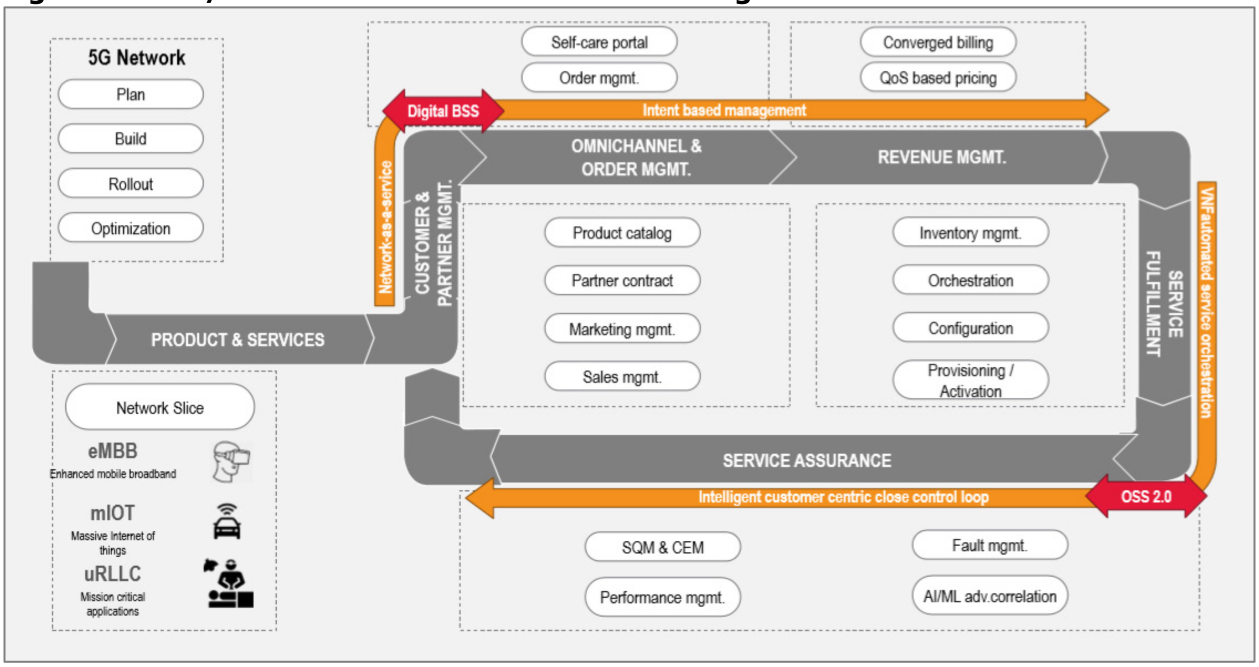
- **Configuration capability:** Allowing customers to adjust and modify the network functions as well as underlying resources within the network slice instance provided for them will present a new challenge to MNOs.
- **Monitoring capability:** Monitoring traffic characteristics and performance (e.g., data rate, packet drop, and latency), end user's geographical distribution, etc., and per session/user/slice instance-based monitoring, etc. will also be challenging.
- **Control capability:** Enabling customers to use application programming interfaces (APIs) provided by the operator to control network service will present another challenge.

The automation and monetization capabilities of network slicing must be developed first, before operators can take advantage of this new technology. This process includes the following:

- Network slice and resource life cycle management
- Commercial slice offerings
- Subscriber management

As **Figure 3** suggests, operations support system/business support system (OSS/BSS) capabilities such as partner management, order management, and service assurance will be key to the success of network slicing. On the OSS side, there is a need for dynamic orchestration of network slices that can automate the slice design-to-deployment-to-assurance cycle, including closed loop control. On the BSS side, there is a need for more dynamic offer creation, dynamic fulfillment, and dynamic charging and billing. Network slicing will bring additional complexity both to the network and the OSS/BSS that supports it. Different SLAs must be defined and monitored. Different slices will have different prices, all of which needs to be tracked for accurate billing. A modernization of real-time charging capabilities may be necessary to enable differential pricing on services with differentiated quality of experience between slices.

Figure 3: OSS/BSS Enablement of Network Slicing



Source: Tech Mahindra

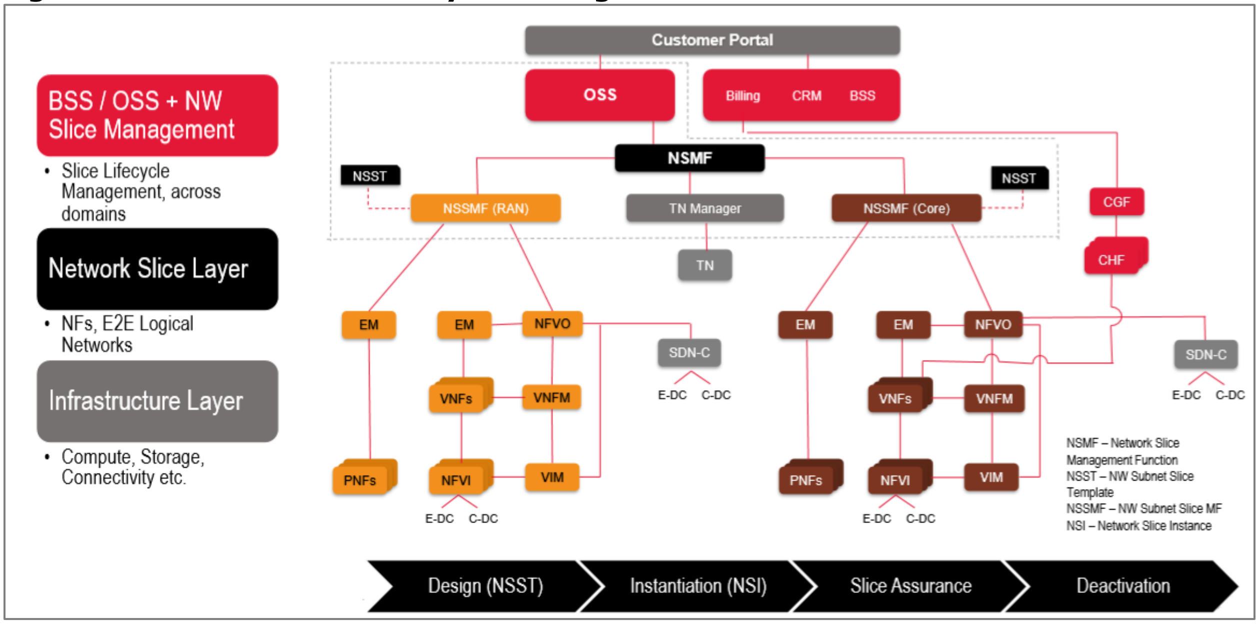
CONCLUSIONS

Network slicing should enable MNOs to get away from charging by the byte or, even worse, charging for unlimited access. Instead, they will be able to charge for highly differentiated "slices" of network capacity. To capitalize on network slicing, operators must not only deploy 5G but also overhaul their OSS/BSS. Automation and orchestration are needed to solve operational challenges around configuration, monitoring, and control and make network slicing cost-effective. Operators need an IT stack that can handle network slice and resource life cycle management, partner management, and product management.

For MNOs to capture value beyond basic connectivity, they must change their business models to address industry vertical-specific ecosystems. This will require a fundamental change in the way operators manage monetization to address the multitude of use cases that network slicing will offer, including fixed wireless access, augmented reality/virtual reality (AR/VR) broadcasting, and industrial IoT.

As **Figure 4** shows, the network slicing capabilities of the infrastructure layer are complex, with myriad acronyms. But these will bring only marginal benefits to operators unless they have BSS/OSS capabilities that allow them to manage network slices over their life cycle and present them to customers in an easily consumable manner.

Figure 4: Network Slice Life Cycle Management



Source: Tech Mahindra