# laying the foundations for 5G network slicing monetization

# 1. introduction

5G promises a world of unprecedented speed and differentiated quality of service that has the potential to unleash a wide array of use cases, new services, and business models. Network slicing is the cornerstone of 5G architecture, which enables the support of diverse 5G services. Essentially, a network slice is a logical network that serves a defined business need with a particular set of characteristics, and comprises all the required network resources, which are configured and connected to each other. Network slices will span across the 5G RAN, transport and core domains, and will utilize physical and virtual network resources that can either be dedicated to a particular slice or shared between slices. End-to-end orchestration and automation are essential for the provisioning, deployment, operation, and maintenance of network slicing.

Network slicing enables CSPs to provide elastically scalable hybrid (logical and virtual) networks to support diverse services with specific performance and control requirements on a common network platform to address a large variety of use cases, services, industries, and customers. Offering specialized services to address precisely the specific needs of customers with tailored technical, performance, regulatory, security or other requirements will enable operators to improve service performance, customer experience and therefore, customer satisfaction.

Network slicing introduces unprecedented monetization opportunities, since it enables CSPs not only to monetize 5G services but also their 5G network capabilities.

Various technologies and innovations from different technical domains have substantially contributed to network slicing progress in different Standards Developing Organizations (SDO). 3GPP could be considered as the forefront ambassador for network slicing. 3GPP conducted a number of studies about the concept of network slicing in 5G networks and defined the requirements, use cases, and orchestration and management of network slicing for next generation networks. 3GPP is also collaborating closely with the relevant network virtualization standards organizations, such as ETSI NFV ISG, to ensure the network slice can run in the virtualized environment and operators can have a seamless end-to-end network slice resource management capability, including the virtualized resource for the network slices.

Telecom industry organizations like the GSMA and NGMN (Next Generation Mobile Networks) describe the business drivers, concepts, and high-level requirements of E2E network slicing from the operator's point of view. The GSMA has initiated the Network Slicing Taskforce (NEST) project to harmonize slicing definition, identify slice types with distinct characteristics, and consolidate parameter and functionality requirements.

Operational management studies of 5G and network slices have been carried out by the TM Forum. These studies confirm the value of intent-based management using closed control loop to manage multiple 5G workload types (e.g. eMBB, mMTC, uRLL), whilst simultaneously fulfilling diverse customer SLAs and optimizing underlying network and computing resource usage – in particular for systems based on network functions virtualization which have high volumes and velocity of change that cannot be managed using traditional approaches. According to the TMF, 5G technology is conceived not only as an improvement of the bandwidth capacity of current mobile broadband networks, but as an extension into new capabilities enabling new use cases. Such Network capabilities can be considered as a "Customer Facing Service" (CFS) for enabling CSPs to monetize their 5G network capabilities. Following its studies and a number of catalyst PoCs, the TMF published 5G Network Slice Implementation Guidelines that provide detailed implementation principles for the complete network slicing lifecycle management process (e.g. modeling, catalog management, ordering, delivery, charging and assurance).

ONAP (Open Networking Automation Platform) provides an operational environment that is real-time, AI/ML-enabled and provides policy-driven orchestration and automation, to introduce and manage new services and resources across their full lifecycle in the entire network. Automation is key to managing complex network slices that will be composed of PNFs (physical network functions), VNFs (virtual network functions), CNFs (cloud native network functions) and services across multiple segments/domains of the 5G network. Significant work has been done in ONAP to enable the end-to-end lifecycle management of network slices. Amdocs is one of the top contributors to ONAP and plays a significant role in projects such as network slicing management and the adoption of relevant GSMA recommendations and ETSI standards by ONAP. In particular, ETSI Zero-touch Network and Service Management (ZSM) plays a pivotal role in bridging between holistic end-to-end automation and other standardization bodies or open source projects. ETSI ZSM003 provides the specification for end-to-end, cross-domain network slicing management and orchestration architecture.

This whitepaper discusses the critical role of network slicing lifecycle management and orchestration for enabling monetization of 5G slices in accordance with recent industry frameworks and standards.

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# 2. 5G network slicing monetization use cases

With the huge investments by operators in 5G, leveraging network slicing for 5G monetization and revenue generation will undoubtedly be a key foundation in their 5G monetization strategy. As mentioned previously, the network capabilities and especially the network slice QoS capabilities, are considered customer-facing capabilities and subject to monetization as we describe in the following sections.

# 2.1 monetization of 3GPP-defined network slicing use cases

3GPP has been developing 5G network technology all together with new business use cases and requirements from the network in order to allow Network Slicing monetization. The following table summarizes the main use cases leveraging network slicing technology and a list of capabilities that may be applicable for monetization.

| Use case | Capabilities |
|---|---|
| **Enterprise Connectivity** | **A mobile network operator (MNO) provides slices for business customers with capabilities of LAN emulation** for employee smartphones (e.g., voice, high-speed data), and internet connectivity to support the business's social media and advertising needs |
| | **Slices are customized by customers** to better meet their specific needs, using APIs provided by MNO – Network Slice as a Service |
| | **Business ensures slice privacy** with all communications within the slice encrypted by a **third-party encryption** algorithm |
| **IoT Scenarios – Private slices** | **A business requires isolated sets of network capabilities**, so MNO provides network slicing as a means to deliver private slices (e.g. VPNs) |
| | **A business may arrange for a number of private slices** to differentiate service offerings for different types of users and equipment<br>• Robotic manufacturing equipment may be assigned to a specific slice<br>• User access to databases and office equipment may be assigned to a separate slice with different KPIs |
| | Some equipment may need to have **access to more than one of the private slices** used by the business |

Based on the above-described use cases, the following network capabilities can be monetized:

- **Capacity on demand** – A user can configure a slice with a required capacity with a pre-defined traffic baud rate, dynamically modifying it between pre-defined limits.
- **Security and encryption** – A user can allocate an isolated network slice with an application level-based encryption.
- **Latency by slice** – A slice may be allocated with geo-location constraints close to a user edge allowing a required traffic latency.
- **Number of sites/devices per slice** – A user can configure a group of members/users or devices belonging to the same slice and exchange their content within an allocated slice.
- **User traffic pre-emption and prioritization** – Network resources can be shared among several slices so that the slices can be assigned with different levels of priorities; when there is no user traffic in higher priority slices, the resources may be allocated to lower priority slices.

# 2.2 introducing the 5G Network Slice as a Service (NSaaS) model

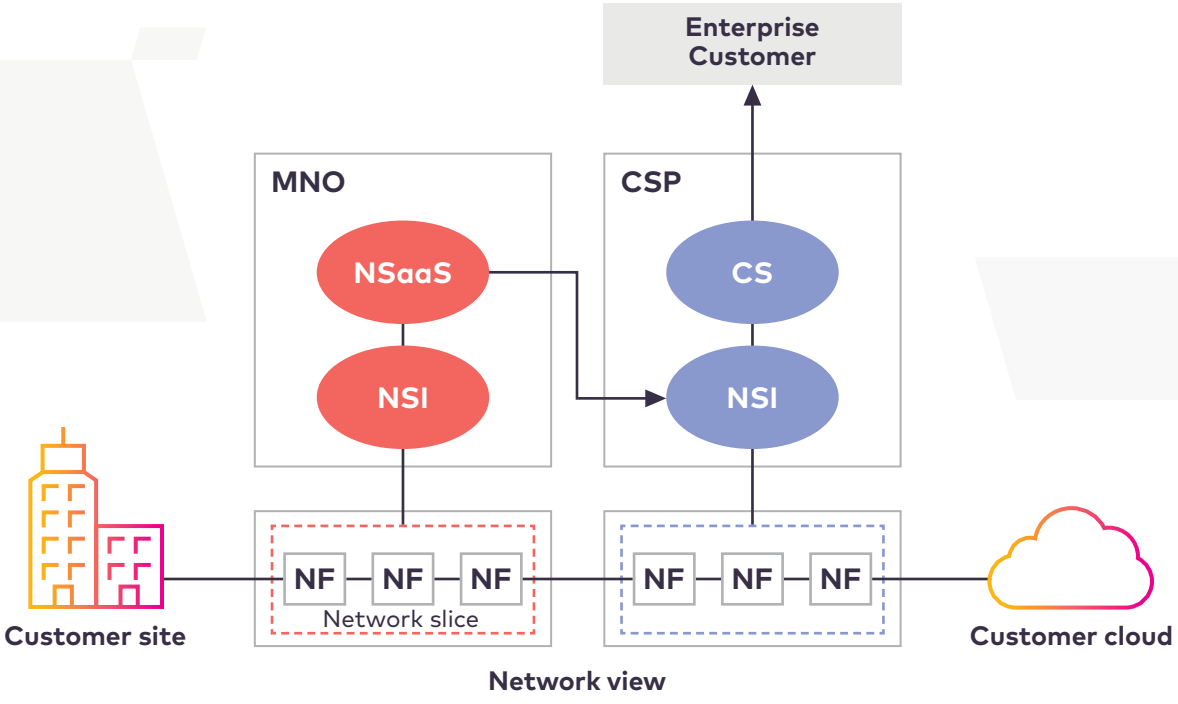
The Network Slice as a Service model is specified in 3GPP TS 28.530 and provides recommendations that will enable MNOs to offer whole 5G network slices as a service to either end customers or other CSPs. In turn, these CSPs can offer their own services (e.g. communication services) on top of the network slice instance they obtained from the MNOs. The NSaaS model allows a CSP to manage the network slice instance they obtain from an MNO via a management interface exposed by the MNO.

The figure below illustrates an example of how Network Slice as a Service can be used by a CSP who utilizes the network of an MNO to deliver communication services to its enterprise customer.

a) The MNO has created a dedicated NSI (network slice instance) which is used to provide a network slice as a service to the CSP.

b) The CSP utilizes the offered network slice capability provided by the MNO and adds additional network functions on its own network to establish the new, end-to-end new network slice instance for providing the communications services (CS) to its enterprise customer.

c) The enterprise customer consumes the end-to-end network slice capabilities provided by both the MNO and the CSP, and may be provided with an interface to configure the slices to apply the capabilities described in the previous sub-section.




Network view

Depending on their NSaaS service offering, MNOs may impose limits on the NSaaS management capabilities exposed to the CSPs or end customers who consume the service, and they in turn, can self-manage the network slice instance according to NSaaS management capabilities exposed and agreed by the NSaaS provider. The NSaaS model will allow CSPs to unleash a whole new world of network services and monetization opportunities that can support complex B2B and B2B2x business models.

# 3. virtual network resources monetization

In a highly competitive market, one of the main goals of mobile operators' 5G strategies is to innovate, create, test and deliver services more rapidly, while also saving costs and still delivering a high quality of service (QoS). To achieve this, most operators are basing their 5G network strategy on building new networks that leverage software-defined networking (SDN) and network functions virtualization (NFV) – the technologies driving a shift from legacy, purpose-built hardware infrastructure to service-driven, programable networks.

NFV and cloud technologies will play a crucial role in mobile operators' journeys to 5G. Network functions that rely on microservices-based, cloud-native architecture frameworks are virtualized and hosted in a cloudified network infrastructure. Furthermore, loosely coupled microservices-based network functions can be dynamically and independently scaled and consumed, radically improving system agility.

Network slices will utilize RAN, transport and core network functions (NFs) or components of network functions where some of them, if not most, will be VNFs and CNFs. Network slice capability metrics would be mapped to network and infrastructure resources (VMs, VNFs/CNFs, bandwidth, network ports, etc.). Hence, CSPs will be able to take advantage of virtualized resource-based charging as specified in ETSI NFV-EVE008 for the purpose of network slicing monetization.

This approach has been considered by 3GPP as one of the options for network slicing monetization and suggests that the following virtualized resources are subject to charging in an NFV environment:

- Virtualized CPU including processor and memory
- Virtualized storage including volumes of storage at either block or file-system level
- Virtual network including networks, subnets, ports, addresses, links and forwarding rules, for the purpose of ensuring intra- and inter-VNF connectivity
- VNF instances
- Network service instance

For monetizing the usage of virtual network function resources, chargeable events providing information for rating and billing purposes should be collected by the charging system. Chargeable events can be related to the usage of network and infrastructure resources as well as for management tasks, such as reservation, instantiation, scaling, and termination of virtual resources.

Therefore, chargeable events can be classified into these categories:

- Resource usage events based on allocated resources for using in the network slice
- Management and orchestration events based on NFV orchestrator operation to manage resources
- Network slice performance and analytics events based on collection of network slice performance metrics

The online charging model for monetization of VNFs as a service use case, described in ETSI NFV-EVE008, can therefore be extended and used for monetization of NSaaS use cases.

# 4. what are CSPs saying about network slicing monetization?

With virtual infrastructure and programable 5G networks, the granularity and speed with which CSPs can introduce and deliver services will substantially impact their ability to monetize the network. Network slicing is the cornerstone of the 5G architecture that will enable this and open up a new world of monetization and revenue generation possibilities.

To better understand whether this is indeed a top-of-mind concern for service providers, and to better understand CSPs' current approaches to 5G network slice management and monetization, Amdocs recently conducted a survey of 50 mobile operators across the globe. Here are some of the key research findings:

- 64% believe that CSPs must roll out 5G network slicing in the next 2 years to **open up new revenue streams and successfully compete with OTT** players like Google, Amazon, and Microsoft
- 76% believe that **network slicing is the next real gamechanger in customer experience**, enabling tailored, fit-for-purpose and diverse use cases that empower the digital world
- 52% believe Network Slice as a Service (NSaaS) will be the leading approach to network slice monetization, while 30% expect to charge for specific QoS parameters (e.g. throughput, latency)
- 70% believe their current operational systems cannot handle the adaptive, real-time resource allocation needed for 5G network slicing management
- 76% believe that to cut time-to-market and reduce fail risk/cost, it is vital to **automate** the end-to-end network slice lifecycle from design to fulfilment and operations
- Integration with ordering and charging was ranked by 9 out of 10 respondents as one of the top 3 capabilities of a network slicing lifecycle management solution

The research findings indicate that CSPs recognize the significant importance of network slicing to their future 5G monetization possibilities. They know the technology empowers them to offer specialized services that address the precise needs of customers, by tailoring them to meet the specific technical, performance, regulatory, security, or other requirements to improve service performance and customer experience, and enhance customer satisfaction.

The challenge however remains in identifying the means of reaching this end state. Specifically, how do you manage these network slices from end to end, given their composition of multiple network functions, controlled and managed by different network domains (5G RAN, transport and core networks) across a hybrid network?

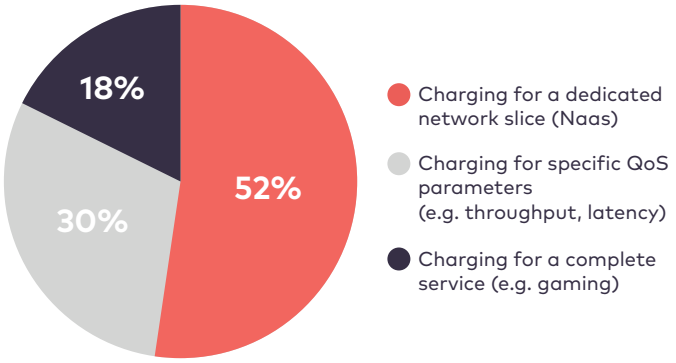



Figure 2: Leading approach to network slice monetization[1]

[1] Coleman Parkes 5G network slicing survey 2020, sponsored by Amdocs

# 5. amdocs solution for managing and monetizing 5G network slicing

Network slices will span across the RAN, transport, and core networks and will utilize virtual, containerized, and physical network functions that will be deployed in each network slice instance by allocating physical and virtual resources. To accommodate a dynamic growth in service consumption, these NFs can then be scaled out and up. In this multi-domain network, there is a need for an end-to-end 5G slicing management entity that will coordinate the coexistence of network slices and guarantee that the required resources are available for each one. Amdocs 5G Slice Manager fulfils this exact role. Amdocs 5G Slice Manager is responsible for network slice lifecycle management and is hierarchically positioned at the top of the multi-domain network management architecture (as specified in ETSI ZSM003) to coordinate the RAN, transport, and core network slice subnet operations and services, across the network management domains.

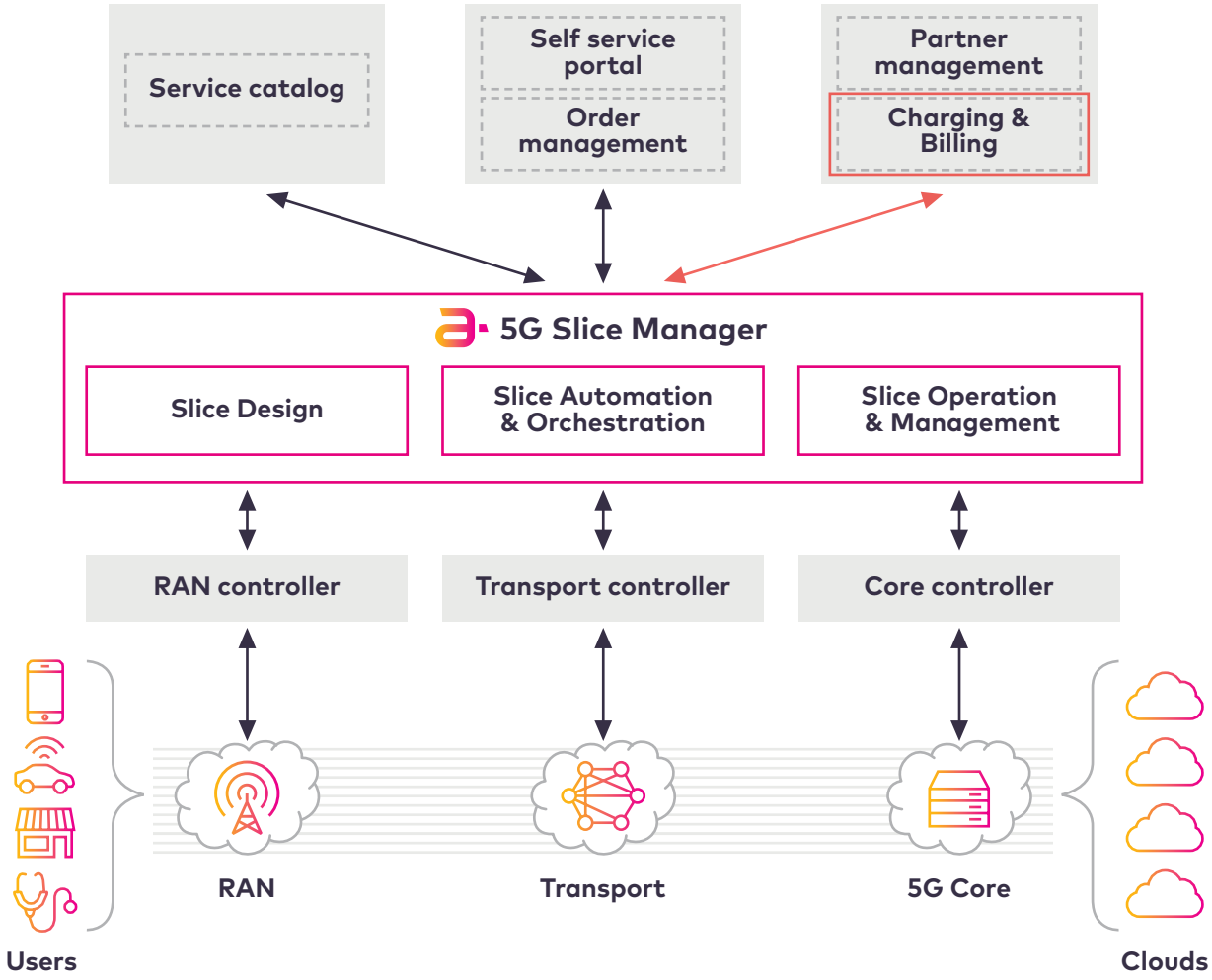



Figure 3: Amdocs 5G Slice Manager

Network slicing requires adaptive, automated and real-time systems and processes that can tune the network to business needs. Amdocs 5G Slice Manager enables the automation of logical network segmentation with slice customization, logical network isolation, and quality of service control in real time.

The solution's active hybrid inventory module enables vendor-agnostic, continuous monitoring and performance analysis of both the physical and virtualized network slice components. An analytics framework is responsible for analyzing the performance data and events that are captured from the network, and to understand the state of network functions and the role each domain has in affecting the performance of the end-to-end slice. Based on massive data collection, statistical modeling and AI/ML analysis, the system carries out performance prediction and provides early warnings of any degradation of slice performance and SLAs.

Since Amdocs 5G Slice Manager coupled with Amdocs' end-to-end service management and orchestration is aware of the network slices' resource consumption, it can also serve as a charging triggering function that passes information about a slice's operations, as well as resource consumption, utilization and performance to the charging function in accordance with ETSI NFV-EVE008 and recent 3GPP Release 17 guidelines.

Amdocs slice management and convergent charging solutions leverage the latest 3GPP standards developments:

- Service-based interface
- Network slice isolation support
- Distributed architecture for optimal signaling, improved system availability and low latency
- Metering and offline charging at the edge

By enabling the CSP charging system to become aware of chargeable network slicing events, CSPs will be able to revolutionize their monetization and business model capabilities, as they will be able not only to generate a subscriber- or session-based charging report, but a much more comprehensive slice-level report covering:

- Operational events such as slice/service instantiation, termination, activation, de-activation, etc.
- Usage events such as dynamic resource consumption by slice/service/network function
- Performance and analytics events based on collection of network slice performance metrics

Amdocs 5G Slice Manager provides a holistic, automated approach to end-to-end network slice lifecycle management and monetization, enabling 5G networks to be transformed into agile monetization platforms by offering the following capabilities:

- End-to-end lifecycle automation of the network slices across network domains and multiple vendors, enhancing operational efficiency, optimizing network resource utilization and reducing time-to-market
- Responsive, adaptive, and real-time network and processes for tuning network resources to specific business and customer needs in a timely and cost-efficient manner, in order to control and guarantee QoS, SLA delivery and security requirements
- Business and customer-centric slice segmentation fully integrated with the CSP's ordering and charging system to support new business and monetization models (e.g. network slice as a service – or NSaaS) with new levels of performance and functionality

Amdocs 5G Slice Manager therefore can act as an integral part of the CSP's 5G monetization platform, enabling them to best position the organization to revolutionize its service offerings. This in turn, based on a wide range of new 5G use cases, will enable them to unleash a whole new world of network services and monetization possibilities that can support complex B2C, B2B and B2B2x business models.

To find out more about Amdocs 5G Slice Manager, download our comprehensive solution brief.

To learn more on the challenges and benefits of 5G network slicing, visit www.amdocs.com/5G-slice.

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