amdocs open 5G network slicing management platform

5G network slicing – a foundation for an agile monetization platform

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 resources can be physical or virtual, and either dedicated to a particular slice or shared between slices. Network slicing enables CSPs to provide elastically scalable and dedicated logical/virtual networks to support specific service requirements that address the specific requirements of use cases, services, industries and customers.

Multiple network slices share the same physical network infrastructure, control, and support systems, but are distinct and isolated from one another. This isolation is essential for providing guaranteed resources for mission-critical applications, with critical traffic dedicated to a particular network slice, or special properties such as low latency, lower cost or massive scaling of the network slice.

5G promises a world of unprecedented speed and differentiated quality of service that has the potential to unleash a wide array of new services and business models.

However, to maximize 5G monetization, service providers need to be **fast** to deploy, **open** to drive innovation, **smart** to efficiently orchestrate a dynamic network, and **quick** to capture every revenue opportunity. By utilizing the latest NFV and SDN technologies and practices to abstract the physical infrastructure from the logical network architecture, service providers can adopt a Monetization Platform approach to support the end-to-end services lifecycle, turning their 5G networks into agile monetization platforms.

The benefits of network slicing

5G network slicing is set to become a significant business enabler in terms of differentiated customer experience, simplified operations, capex efficiency, and revenue generation.

Creating revenue opportunities for operators

Network slicing allows operators to serve customers with higher service grade. By tailoring services to the needs of specific customer segments, CSPs can increase the service value and charge premium service fees.

Network slicing also enables operators to reach new customers by offering customized solutions for different industry verticals, enabling large volumes of customized use cases to create completely new, additional revenue streams.

Enhancing customer experience

Network slicing enables mobile operators to offer specialized services to address precisely the specific needs of customers with tailored technical, performance, regulatory, security or other requirements. Thus, by provisioning dedicated customized network slices, operators can improve service performance, customer experience, and therefore customer satisfaction.

Providing efficient and simplified operations

As network slices will be isolated from one another, provisioning, maintaining, scaling, and also terminating a network slice can be done with no impact, service disruption, or degradation on other network slices. Real-time instantiation of network functions and dynamic resource allocation allow optimizing the resources allocated to each network slice. This will also enable testing and launching of new services and use cases faster to the market while lowering risks and cost of investments.

Realizing cost efficiency

The isolated nature of network slices dictates that network functions and resources for each network slice are dynamically scaled according to real traffic/service demand. Network slices are built with only relevant network capabilities that match the needs of the supported service, use case, or business case they serve. Different network slices could still share network resources and functions to gain better cost efficiency.

Virtualized 5G core and RAN – the foundation of network slicing

The network evolution from EPC (Evolve Packet Core) to 5GC (5G Core) and virtualized RAN (Radio Access Network) plays a vital role in creating a powerful programmable network platform for enabling mobile operators to extract more value from their networks. As network elements and functions across the RAN, Edge, and Core are virtualized and sliced out as one integrated end-to-end service, mobile operators will be able to create virtual networks for answering the needs of specific services, enterprise customers, or entire industries.

The 5GC network is founded on Service-Based Architecture (SBA), where control plane NFs (Network Functions) expose their services to other NFs using Service-Based Interfaces (SBIs). 5GC will decouple network functions from hardware, implement component-based functions, adopt a stateless design and lightweight, open interfaces, and thus will be more agile, easily scalable, flexible, and open. The 5GC NFs are organized as smaller, manageable and loosely coupled stateless services and stateful backing services, allowing each service to be individually deployed, scaled, and upgraded. This architecture enables mobile operators to open up their networks, utilize best-of-breed NF software from many different vendors, benefit from flexible deployment of NFs, and create an agile and scalable platform which supports the introduction of software-driven services that accelerate innovation and TTM.

5GC NFs expose their services to other NFs via well-defined 3GPP SBI HTTP/2 RESTful APIs that support diverse service types. Using scalable cloud native architecture provides the ability to spin up the exact number of specific NFs to gain the most efficient utilization of network resources when accommodating high-peak rates. This architecture also allows distributed deployment of 5GC NFs where some functions are placed closer to the edge of the network to reduce latency. Using virtualized, scalable, core network functions enables service providers to allocate dedicated network functions to specific network slice services or to allow a number of network slices, which can dynamically scale when needed, to share the same network function.

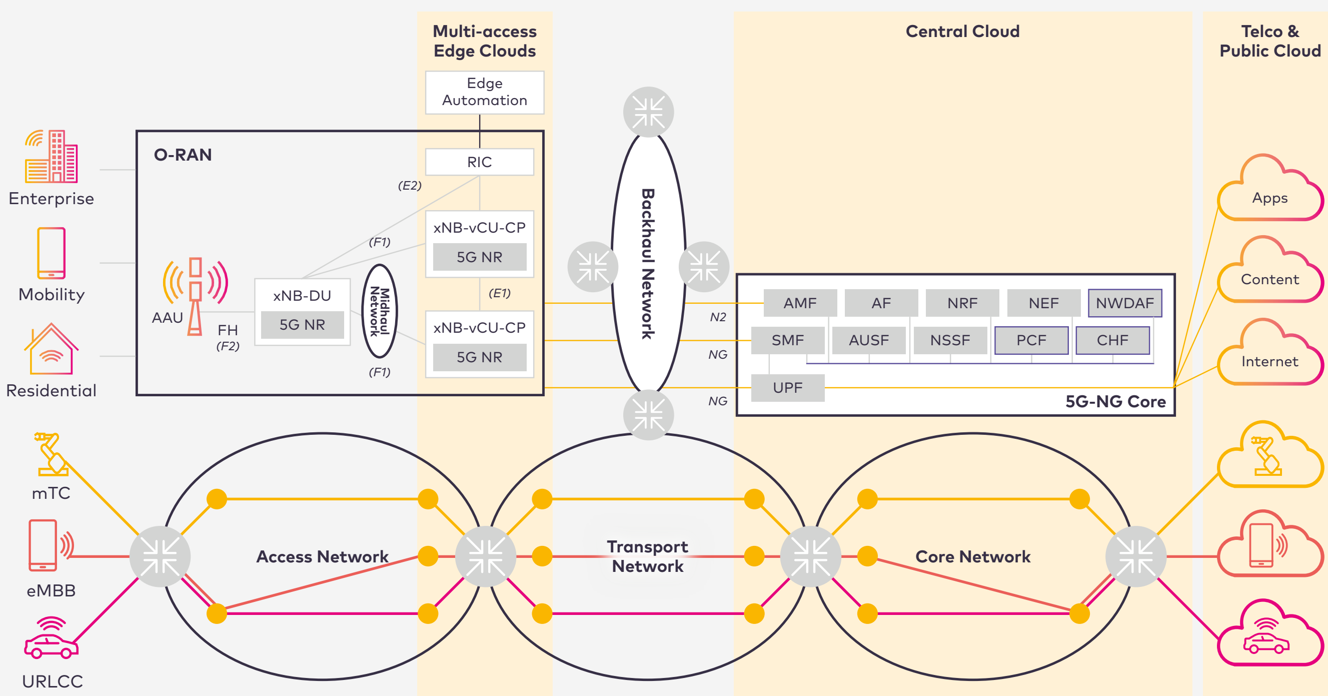

Figure 1: Network slices use dedicated or shared network functions across multiple network domains

The new 5G RAN (AKA NG-RAN) architecture, which was specified in 3GPP Release 15, supports slicing and flexible deployment of the RAN building blocks. The NG-RAN radio base stations (known as gNBs) incorporate three main functional modules – the Centralized Unit (CU), the Distributed Unit (DU), and the Radio Unit (RU) or Active Antenna Unit (AAU) – which can be deployed in multiple combinations, according to the mobile operator's requirements and preferences. The CU can be further disaggregated into CU User Plane (CU-UP) and CU Data Plane (CU-DU), accommodating the separation between the control plane and the user plane.

The 5G service-oriented virtualized and fragmented core network, together with the NG-RAN, can realize on-demand orchestration and rapid deployment of network functions and sub-slices while meeting the elasticity, low latency, and high availability requirements, laying a solid foundation for network slicing and monetization of 5G network assets.

Smart, efficient and dynamic 5G network slicing service orchestration

As network slices will be utilizing NFs and resources across the various network segments from access to core (and in many cases also deployed on a public cloud), managing the lifecycle of network slices poses a major operational challenge for the mobile operator. An end-to-end perspective is crucial for meeting the needs of diverse services, use cases, and business models. The 5G network and telco cloud infrastructure layer host the physical and virtual resources needed to create network slices. These include both virtualization software and hardware comprised of memory, compute, storage, and networking resources.

Managing the lifecycle of network slices requires the instantiation, and ongoing maintenance and health check, of numerous NFs deployed in multiple, different virtual and physical environments. Furthermore, to gain maximum operational efficiency NFs will be instantiated and scaled in an automated, zero-touch operations mode so 5G networks can deliver their promise of dynamic flexibility, agility and scalability, which in turn will allow provisioning the network slices to answer various use cases and customer needs.

To achieve this, 5G network slicing will need to be based on SDN and NFV technologies and principles which enable dynamic programmability and control. The automation of network slice operations will be based on creating and designing service models and operational policies in advance. These will enable closed loop operation based on fault and performance monitoring, as well as providing the ability to utilize advanced analytics and machine learning to maintain the service intent. Furthermore, this mode of operations will optimize the consumption of network and cloud resources while ensuring service and slice KPIs.

Since the provisioning of network slices utilizes NFV and SDN to abstract the physical infrastructure from the logical network architecture - and as each network slice may have its own network architecture, protocols, and security settings - the best way to gain this automated network slicing operation is by using an NFV management platform with a multi-domain NFV orchestrator.

The network slice will span across the RAN, Transport and Core networks. The necessary VNFs will be deployed to each network slice, based on the specific service it serves. These VNFs can then be scaled on demand with changes in service and performance requirements. In a virtualized network, the NFV orchestrator is required to coordinate the coexistence of network slices and to make sure that the required resources are available for each one. For this reason, the orchestrator is hierarchically positioned at the top of the network to coordinate RAN, Edge and Core network operations and services across the network.

In the next section we will review the various stages of managing the 5G network slices using Amdocs' Open 5G network slicing management platform.

Designing and setting up network slices

The process of creating network slices starts with on-boarding of the VNFs into SDC (Service Design and Creation) module. Next, VNFs are chained with PNFs, network connections, and resources to create specific network slice services. Amdocs' Open 5G solution is powered by the Linux Foundation's Open Networking Automation Platform (ONAP). It uses ETSI-defined TOSCA modeling for the network slice building blocks such as VNFs, PNFs, and the network services themselves as well as GSMA Generic Network Slice Templates (GST) thus ensuring commonality, flexibility and reusability. SDC contains a catalog of modeled network functions and services which can be easily reused in order to create new network slices and services in unprecedented speed and time. A service instance is realized by one or more network slice instances (NSIs), that in turn may consist of network slice subnet instances (NSSIs).

The service attributes are updated by SDC in CatalogONE. Products are created from services by Product Designers and then Product Managers make products and offers sellable by adding descriptors containing pricing, discounting, and promotion specifications. These design time relationships will be through the Offer and Product levels of CatalogONE.

For each service defined, SDC associates definitions, processes, and policies for management and execution of this service. The BSS, OSS, and the Service Orchestrator integrate seamlessly via these shared definitions and models to radically improve time-to-market for new services, products, and offers.

A service provider's ability to transform themselves and develop new services or re-use existing services in new ways is constrained by the speed of the network engineering create, test, integrate and debug cycle – typically a very manual, document-based and time-consuming process. SDC enables service creation automation, testing and debugging, packaging, and distribution, and is an important first step in shortening the service development lifecycle and reducing engineering and IT costs.

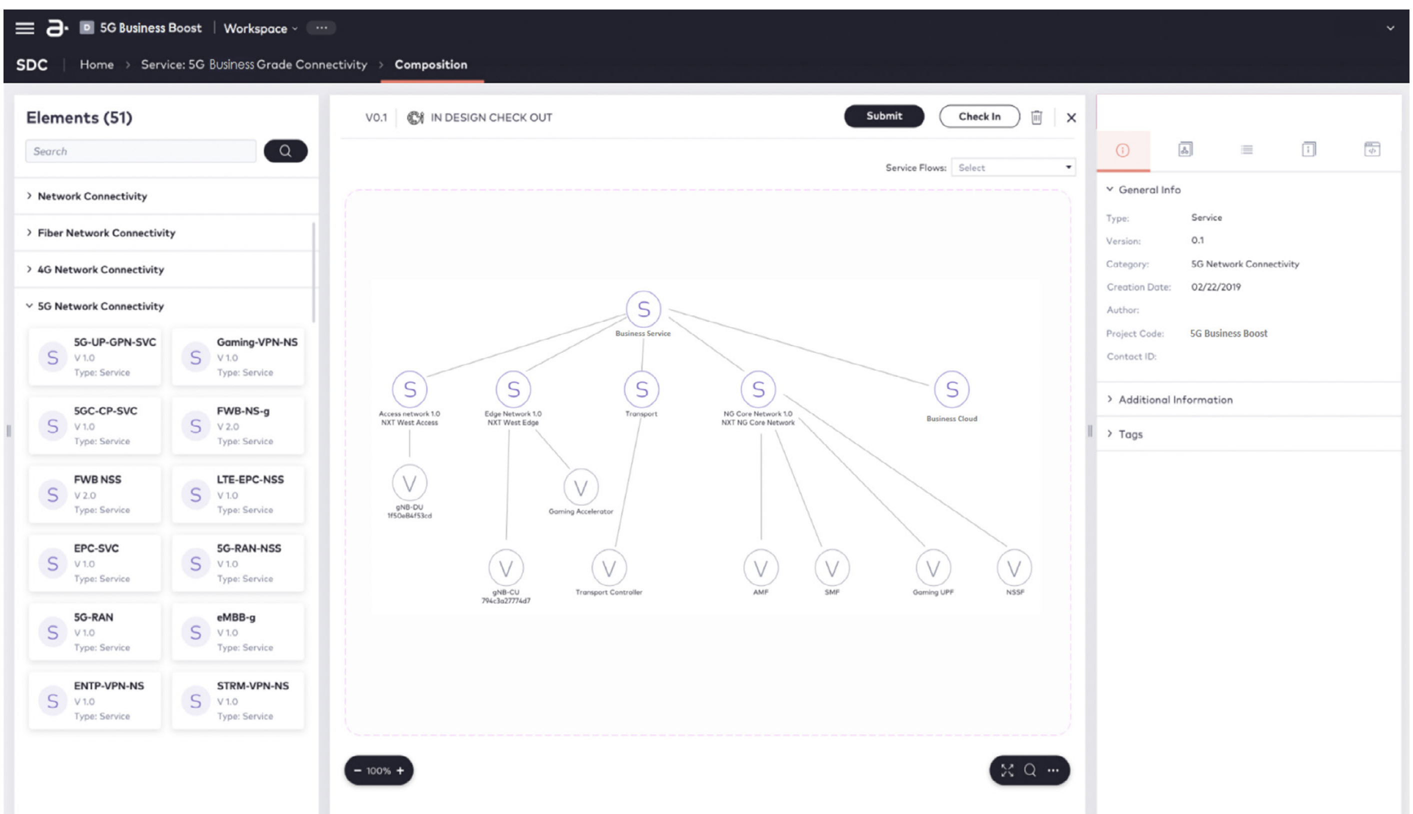

Figure 2: Network slice service design

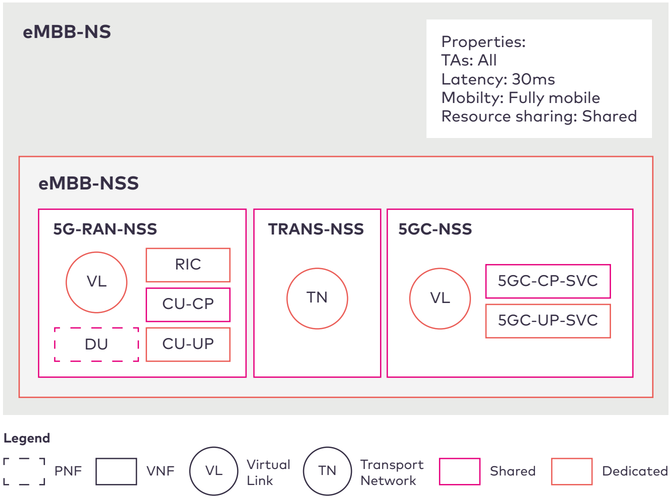

Figure 3: Network slice modeling

The combination of network slicing templates with platform modularity and programmability helps realize significantly shorter time to market, as well as cost savings when new network slices need to be provisioned. This is made possible by the ability to reuse building blocks from existing network slices or to replace them with other NFs in the catalog and perform any necessary changes to meet the new network slice requirement. Because new services are created within a dedicated network slice, the service creation time is simplified, and the isolated nature of network slices reduces the risk that the new service will impact any other service sharing the same resources.

Continuous end-to-end network slicing service orchestration

As soon as the network slice activation is triggered the NFV orchestrator is responsible for the instantiation of the NFs and their resources in order to establish network slicing across the network domains. The NFV orchestrator instantiates the necessary VNFs, PNFs, network resources and connections end to end across the different network domains for deploying the service into the network by interacting with infrastructure, network and application controllers as required.

The NFV Orchestrator optimizes VNF deployment in line with defined criteria (as traffic KPIs, SLAs for cost, etc.) for a specific service implementation and ensures the workloads of VNFs properly utilize the underlying hardware processing, storage and networking capabilities. The establishment of network slices is done by executing an automated workflow for setting up all the required network slice components, network connections, and resources across all network and telco cloud domains.

Automating the network behavior and operation requires that policies are set during the service design time and enforced at run time. These policies are sets of conditions, requirements, constraints, attributes, or needs that must be provided, maintained, and/or enforced to enable the service delivery in accordance with its defined service characteristics and commitments to customers. Policies are set to individual network functions comprising the network slices and to the end-to-end network slice services.

The continuous network slicing orchestration is done across multiple layers of the architecture and includes instantiation, configuration, scaling, termination, updates and decommissioning. The orchestrator is responsible for fulfilling service business orders into efficient and effective network-oriented service implementation plans using pre-defined workflows and deployment optimization across the distributed network and cloud environments. The orchestrator enforces and implements policy rules to continuously assure that network services are up and running in accordance with the defined criteria. The system policy engine triggers healing and scaling of resources across the network to elastically adjust to demand variations based on the specified design, as well as analytics and policies to enable the necessary response to ensure the service meets its committed service agreement. The NFV orchestrator selectively adds and remove functions, services and resources with zero manual touch, by leveraging automated workflow processes for deploying and performing ongoing management of end-to-end network slice services across all CSP network domains.

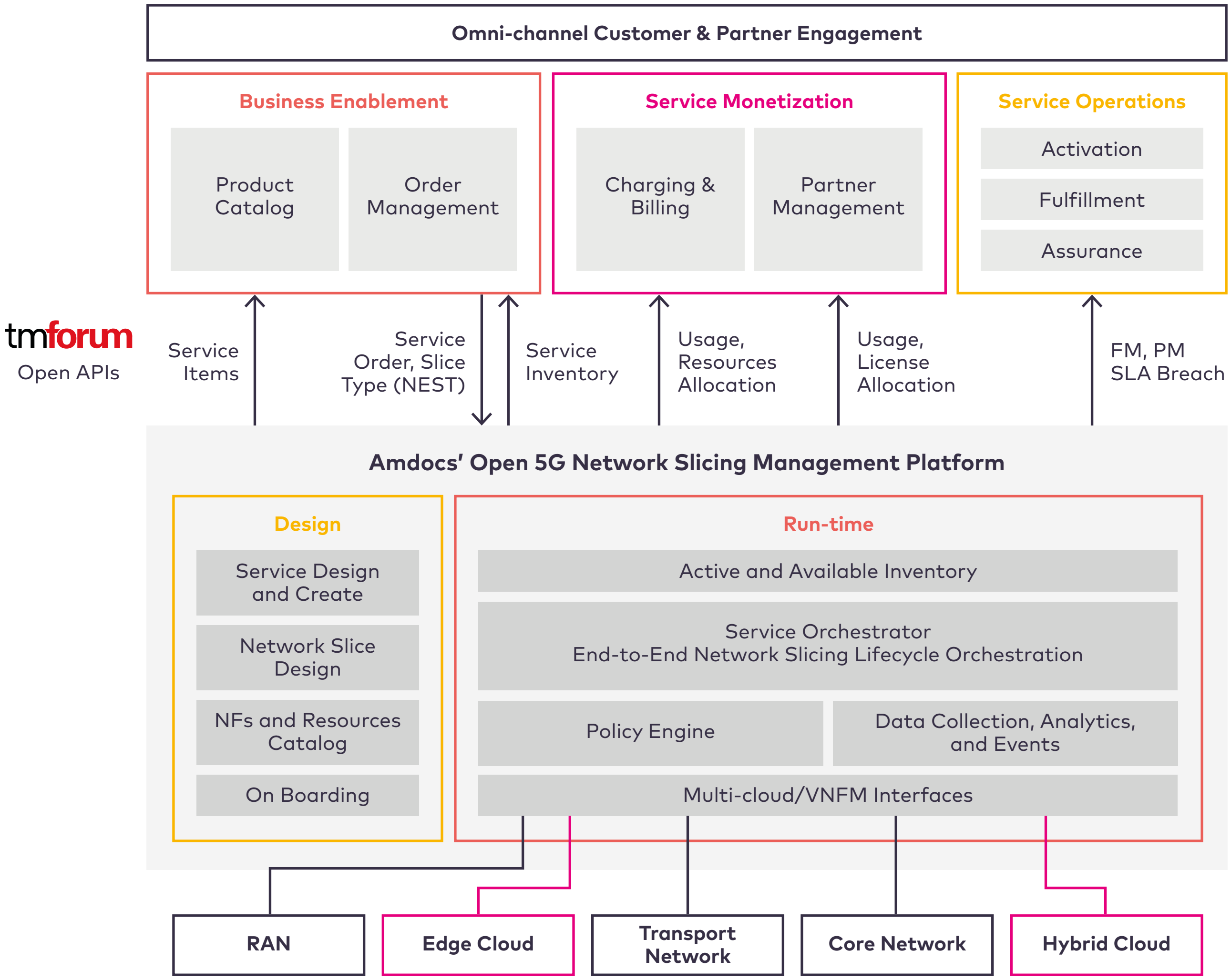

Figure 4: Amdocs' Open 5G network slicing management platform

Real-time end-to-end 5G network slicing operations

5G networks introduce a true model for network slicing that extends all the way from the UE through the RAN, Edge, Core and even beyond to the public cloud. The new 5G service-based architecture includes new functions that have been designed from the ground up to make 5G slicing highly scalable with dynamic resource allocations driven by network orchestration and automation systems. Nevertheless, it is important to take into consideration that network slices will also utilize physical network appliances and components. Hence, to ensure that 5G keeps its promise for agile, fast and low latency connectivity, an advanced, hybrid active inventory system must be used for end-to-end visibility across the hybrid network.

Amdocs' platform tightly integrates the end-to-end service orchestration with the real-time hybrid inventory, as well as with the order fulfilment system, network monitoring and control systems. The platform's active hybrid inventory module continuously monitors the resources and performance of the hybrid network components. As a result, an analytics framework can closely monitor the behavior of 5G network slice services by collecting data and performance indications from physical and virtual elements (compute, storage and network) across the network infrastructure.

Powered by the system policy engine, and in response to the real-time measured key performance metrics (such as throughput, packet loss, latency, and jitter), Amdocs NFV orchestrator triggers the appropriate actions required for the network slices' service assurance at all times. Action may include healing and/or scaling of the resources to elastically adjust to demand variations based on the specified design, analytics, and policies to ensure the required responses are provided and the committed SLAs are met.

Essentially, based on the predefined policies, the NFV orchestrator selectively adds and removes functions, services, and resources with zero touch, using automated processes for deploying and performing ongoing management – end to end across all the network domains.

Furthermore, service providers can also automate the operational testing and assurance of the network slices by provisioning a set of critical testing and assurance functions such as validating the performance of new slices, proactively monitoring service levels, and isolating faults.

As a result, the end-to-end service orchestration and assurance automation maximizes the efficient utilization of network resources as well as the network performance in real time and across all of its domains, thus ensuring that 5G network slicing fulfills its true potential.

5G network slicing enables new monetization opportunities

Network slicing enables mobile operators to provision dedicated network slices for specific services or customers. By offering specialized services to address precisely the specific needs of customers with tailored technical, performance, regulatory, security or other requirements, operators can improve service performance, customer experience and therefore customer satisfaction. Network slices can be monetized through Network Slice as a Service, bundled into offers for enterprise customers, and as a quality differentiator for consumer services. By tailoring services to specific customer segments, CSPs can monetize based of QoE and thus increase service value and charge premium service fees. For example, service providers will create dedicated network slices for gamers, or for UHD video subscribers and will be able to offer differentiated charge plans according to the service characteristics.

However, many service providers are planning to leverage network slicing in order to provide better services for a wide range of industry verticals like utilities, transportation, manufacturing, IoT, entertainment, health, automation and smart cities etc. It will also open up new business opportunities for mobile operators as they will be able to allocate dedicated network slices for media and content partners and benefit from new sources of revenue. Amdocs' platform integration with a service catalog allows service providers to adopt a fail fast mode of operation, incorporating real-time pricing of new services and features, fast and easy price plan configuration, and the ability to automatically sequence launch activities.

Amdocs' solution for 5G monetization and operation breaks down the IT/Network barrier and enables service providers to tap into the 5G opportunity with a full suite of 5G-enabled BSS, including the industry's first 5G-ready online charging system (OCS), which enables the creation, management and monetization of all product configurations that are made possible by 5G network slicing.

Network slicing use case examples for supporting sports and esports

Recent research* conducted by Ovum for Amdocs shows that beyond the significant impact of major sports and esports events on 5G rollout timelines, they are also influencing 5G network design. According to senior network decision-makers, a focus on supporting live sports and esports with 5G is encouraging the adoption of new architectures such as NFV, network slicing, and mobile edge computing, all of which are important for successful monetization of 5G in sports and in general (Figure 5). It is also driving the prioritization of 5G network deployments around sports stadiums, enabling improved network tuning and optimization, and leading to denser 5G radio and network infrastructure in these areas.

Q: What is the most significant way in which live sports events and sports-oriented use cases are influencing your company's 5G network design and deployment plans?

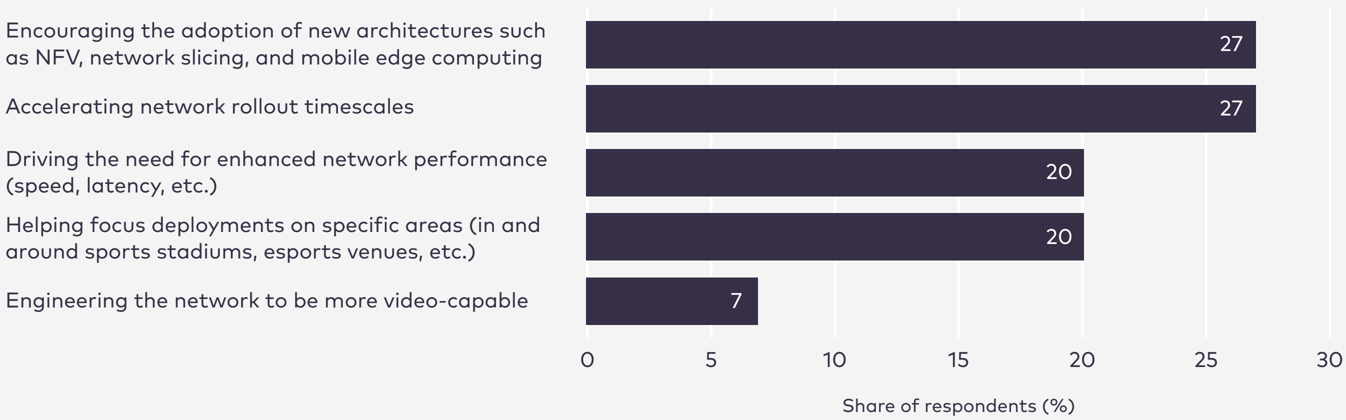

Figure 5: Sports and esports are driving adoption of new 5G network architectures

Source: Ovum global operator survey* for Amdocs

The resulting network performance gains in terms of speed and latency will further enhance customers' 5G experience. The enhanced network capabilities of 5G will also improve mobile operators value proposition and will introduce new partnerships and business model opportunities for them. In the next section we will review the significant role of network slicing orchestration for enabling sports service use cases.

Use case 1: End-to-end network slice for premium sport fan subscribers

Ovum's research shows that nearly two-thirds (63%) of the world's largest network operators' plan to use augmented reality (AR), virtual reality (VR) or a hybrid of these technologies, supported by 5G, to offer richer viewing experiences to fans, both at sports stadiums and while watching at home. Promising speeds up to tens of times faster and with lower latency than 4G, 5G opens the possibilities for new types of entertainment and in-stadium experiences. Audiences could, for example, watch instant replays and 360-degree streams or look up player stats via AR and VR technology, bringing them much closer to the action.

Mobile operators are optimistic about the impact of 5G on sports-related business lines and believe they could increase their ARPU by offering sport-related services over 5G. Ultra-high throughput, very low latency and radio network capacity offered by 5G will for instance ensure the desired premium high-quality video streaming which will allow mobile operators to offer high-quality and differentiated entertainment experiences for sports fans.

AR wearable devices require significant computing power for supporting real-time video transmission, computer vision, machine learning, speech recognition, rapid access to databases, and more. This poses significant performance requirements on the network for ultra-reliable and low latency communication at unprecedented bandwidth and latency as well as very high throughput from the programmable 5G air interface.

One key 5G technical challenge is how to squeeze more data into a much faster, more efficient, and less expensive connection. Various strategies such as carrier (spectrum) aggregation, much higher frequency spectrum, and densification of the network with small cells are deployed to address this challenge. 5G New Radio also introduces innovative technologies such as scalable numerology to support diverse spectrum deployments (from 1 to 90GHz), and a flexible slot-based frame structure to reduce latency.

However, even with these technologies, there is still a need to make AR headsets and glasses much more convenient to use and less bulky due to the processing power needed for real-time computing.

5G network slicing will allow an extremely thin hardware footprint to be placed into headsets, making them identical in their look and feel to normal sunglasses. Then, with edge computing, processing can be done in the telco cloud near the user using a suitable mechanism to dissolve any delay or jitter caused by the round trip the data must take between the device and the telco cloud. Essentially, the entire end-to-end network connection and its infrastructure should act as a cohesive platform that is tailored to meet the unique performance requirements for enabling lightweight, battery-efficient AR glasses and spectacular enriched user experience.

Use case 2: Providing network slicing as a service for a sport partner

In Formula 1, a hundredth of a second can be the difference between winning and losing. Formula 1 teams have become dependent on technology, with sensors, servers, connectivity, and unified and secured communications solutions crucial for enabling the analysis of data to improve cars and real-time race day strategies. Having near real-time data is crucial in providing that competitive edge.

Data is gathered from hundreds of telemetry sensors spread out across the race cars and their drivers. Real-time data streams drive the sport in every aspect, including pre-race simulations, real-time decision making by analysts and pit crew, post-race analysis, and the broadcast experience. During testing and racing, compiling information on performance and conditions like speed, exhaust and tire temperatures, engine fluid pressure, oil and water levels, engine RPMs, G-force and driver biometrics, as well as airflow and air pressure to help the race team understand their car's aerodynamic position are just some of the elements measured by the car's array of sensors. The data from the sensors is communicated to the team pit crew using radio with limited bandwidth. The data is shared via trackside LAN with all team members present at the location and also with a broader team at the racing team headquarters. Due to the technical limitations, the team cannot get all the data it would like during the race in real time. A dedicated team of telecommunication engineers always travels to each race alongside the racing team to create and install the required infrastructure and ensure it is up and running. With the racing team's decision-making time frame on whether a car needs to be brought into the pit potentially as low as just 45 seconds, the racing team is reliant on real-time communications between all engineers both trackside and in the team headquarters.

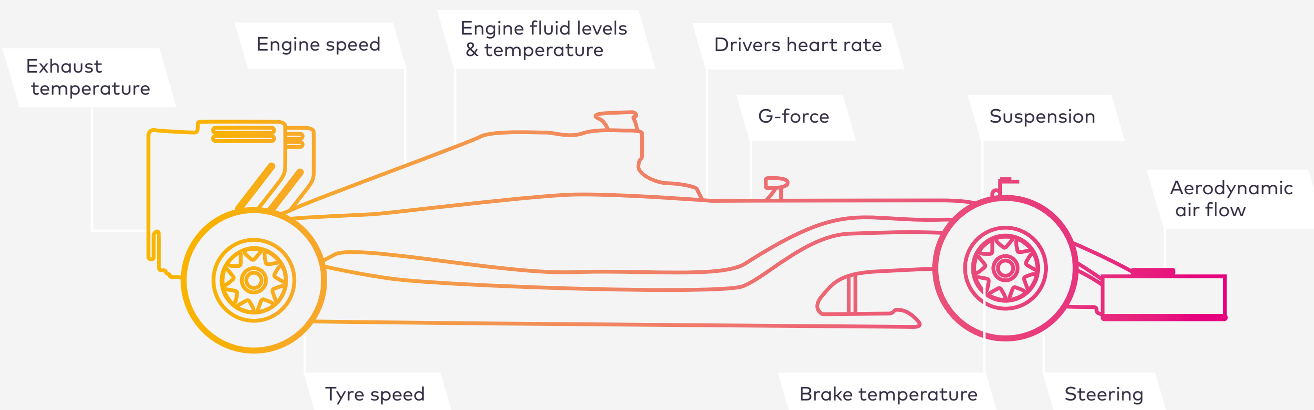

Figure 6: Hundreds of sensors measuring F1 car telemetry data during race

All of this data is subsequently pooled, analyzed, and actioned to shape a race strategy which the trackside crew communicate with the driver.

As large parts of the collected data must be processed and analyzed at the race track, each racing team transports its own computing and storage servers to each race. These mini mobilized datacenters are not only responsible for processing and analyzing the collected data, but also for backing up the information being extracted from each car in the event that the connectivity to the racing team headquarters will be lost.

Once they roll out 5G, nearly all operators (93%) see themselves heavily involved in live sports events in a variety of capacities, including broadcasters of the action (88%), technology partners to event organizers supporting the complex event logistics (70%), and in-venue connectivity providers (67%)*

The concept of providing 5G network slices on demand for a short and limited time as a service for the racing organization or directly to the different racing teams opens new business opportunities for mobile operators for supporting major sport events. The mobile operator can enhance the race area radio network coverage and provide dedicated network slices for delivering the required levels of capacity and connectivity for ensuring real-time data collection from the hundreds of sensors deployed on each racing car.

Furthermore, each racing team could also benefit from mobile operator edge resources and install their data processing and analytics software and tactical unified communication and other applications on it instead of transporting expensive dedicated hardware to the race track. Utilizing the 5G network's inherent low latency, ultra-high bandwidth and dense coverage will enable the racing teams to collect much more data in real time while dramatically reducing their highly complicated and expensive logistics.

Source: Ovum global operator survey* for Amdocs

Intelligent VNFs deployments for optimizing network slicing performance

Physical and virtual resource management is essential for network operations – and especially true with the promise of end-to-end service delivery. As such, one particularly important feature needed for 5G network slicing is exposing special server hardware features to the VNFs in network slices to help improve or otherwise deliver the required performance and capabilities. Network slices will be provisioned to support different services, use cases and customers/partners and thus will have different requirements – performance, latency, reliability, etc. Network slicing performance optimization can be optimized by placing VNFs on the right hardware to make sure the expected quality of service (QoS) and performance are achieved. Amdocs, together with Intel, is porting Intel's Enhanced Platform Awareness (EPA) capability into the ONAP community where it is called Hardware Platform Awareness (HPA) for use in 5G network slicing use cases.

HPA was first made available in the Casablanca release of the software (Dec. 2018). In adapting the Intel-specific EPA to ONAP, developers used the TOSCA modeling language to model features from numerous CPUs. HPA features include:

- **Node Feature Discovery (NFD):** Detects and advertises hardware and software capabilities of a platform for possible use in scheduling a VNF. Note that in HPA and EPA, NFD is an add on capability for use in a Kubernetes deployment
- **Single Root IO Virtualization (SR-IOV):** SR-IOV divides a PCIe physical function into multiple virtual functions (VF) each with the capability to have dedicated bandwidth allocations. When virtual machines are assigned their own VF they gain a high-performance, low-latency data path to the Ethernet controller
- **Non-Uniform Memory Architecture (NUMA):** With a NUMA design, the memory allocation process for an application prioritizes memory that is local to a processor core because it is the highest performing. ONAP is able to configure VMs to use CPU cores from the same processor socket and choose the optimal socket based on the locality of the Ethernet controller that is providing the data connectivity for the VM
- **CPU Pinning:** Allows a process or thread to have an affinity configured with one or multiple CPU cores. When a 1:1 pinning configuration is established between virtual CPUs and physical CPUs, there is an increase in predictability because the host and guest schedulers are prevented from moving workloads around. Pinning can also help improve cache hit rates
- **Huge Page support:** Provides up to 1-GB page table entry sizes to reduce I/O translation look-aside buffer (IOTLB) misses, helps improve networking performance, particularly for small packets

Working together, Amdocs and Intel are pioneering the ability to make the most of CPU features and capabilities, allowing them to be managed to help improve 5G virtual network performance.

Unleash 5G opportunities and possibilities with Amdocs Open 5G network slicing management platform

With virtual infrastructure and programmable networks, the granularity with which service providers can tailor solutions will make a substantial difference to their ability to monetize the network. Using network slicing, mobile operators could differentiate their service offerings and provide network-as-a-service, opening network capabilities to third parties, and meeting the wide range of 5G use cases that users, businesses and industry are expected to demand.

Amdocs Open 5G management platform enables mobile operators to simplify and automate the creation and lifecycle management of network slices and benefit from an Open, Fast and Smart 5G network.

FAST – Enables Service providers to simplify and streamline 5G network slicing provisioning, reducing time to market for introducing new innovative services.

SMART – Amdocs NFV platform enables service providers to run a smarter software-centric network, infused with intelligence, service-centricity and automation into all aspects of the end-to-end network slicing operations.

OPEN – Adoption of a distributed open architecture that leverages a multi-vendor eco-system provides service providers increased agility, flexibility and improved efficiencies in running a mobile/5G network. Amdocs is pioneering open network solutions, based on open-source and industry standards such as ONAP, ESTI/OSM, TMF and MEF.

MONETIZED – 5G network slicing will create a paradigm shift in monetization from volume to quality, creating many more new opportunities for service providers to tailor networks to partners and services, increasing the value of those offerings.

Amdocs' Open 5G solution is powered by the Linux Foundation's Open Networking Automation Platform (ONAP) and uses ETSI-defined TOSCA-based templates that represent the VNFs and PNFs across the different network domains, as well as their policy and service assurance configurations.

Amdocs Open 5G management platform automates the process of provisioning and modifying network slices and services, ensuring that all building blocks constituting each network slice are deployed based on the specific service requirements that the network slice is expected to provide.

Reusability and the adoption of a template-based approach to simplify the creation of new slices will drive significant cost saving and will eliminate errors and accelerate time to market.

The platform's closed-loop service automation ensures these VNFs will scale on demand to accommodate changes in service and performance requirements. The platform's NFV orchestrator coordinates the coexistence of network slices and guaranties the required network, radio and infrastructure resources are available for each one, from the centralized core all the way to the RAN.

Amdocs was named **winner** of the **Most Innovative 5G Strategy** category in Light Reading's 2019 Leading Lights Awards

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Amdocs is a leading software and services provider to communications and media companies of all sizes, accelerating the industry's dynamic and continuous digital transformation. With a rich set of innovative solutions, long-term business relationships with 350 communications and media providers, and technology and distribution ties to 600 content creators, Amdocs delivers business improvements to drive growth.

Amdocs and its 25,000 employees serve customers in over 85 countries. Listed on the NASDAQ Global Select Market, Amdocs had revenue of $4.0 billion in fiscal 2018.

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