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MONETIZING 5G SLICING

Turning a game-changing concept into an operational reality

Author: Tim McElligott, Senior Analyst
Editor: Dawn Bushaus, Managing Editor

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Report Author:
Tim McElligott
Senior Analyst
tmcelligott@tmforum.org

Report Editor:
Dawn Bushaus
Managing Editor
dbushaus@tmforum.org

Chief Analyst:
Mark Newman
mnewman@tmforum.org

Editor, Digital Content:
Arti Mehta
amehta@tmforum.org

Customer Success & Operations Manager:
Ali Groves
agroves@tmforum.org

Commercial Manager, Research & Media:
Tim Edwards
tedwards@tmforum.org

Global Account Director:
Carine Vandevelde
cvandevelde@tmforum.org

Digital Marketing Manager:
Anna Kurmanbaeva
akurmanbaeva@tmforum.org

Monetizing 5G slicing: Turning a game-changing concept into an operational reality

We hope you enjoy the report and, most importantly, will find ways to use the ideas, concepts and recommendations detailed within. You can send your feedback to the editorial team at TM Forum via editor@tmforum.org

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Parsippany,
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www.tmforum.org
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The big picture

Network slicing **peaked** on the infamous Gartner Hype Cycle in August 2019. With that milestone well behind it, communications service providers (CSPs) are taking steps to make 5G network slicing a reality. Within their organizations, doubters are being brushed aside; trials are moving ahead; and expectations are running high.

This is not to say that all challenges have been resolved. 5G slicing won't be able to go mainstream until there is widespread deployment of Standalone 5G, which likely will take about a year or so. Another important obstacle lies in rolling out network and service management, orchestration and monetization solutions to support slicing.

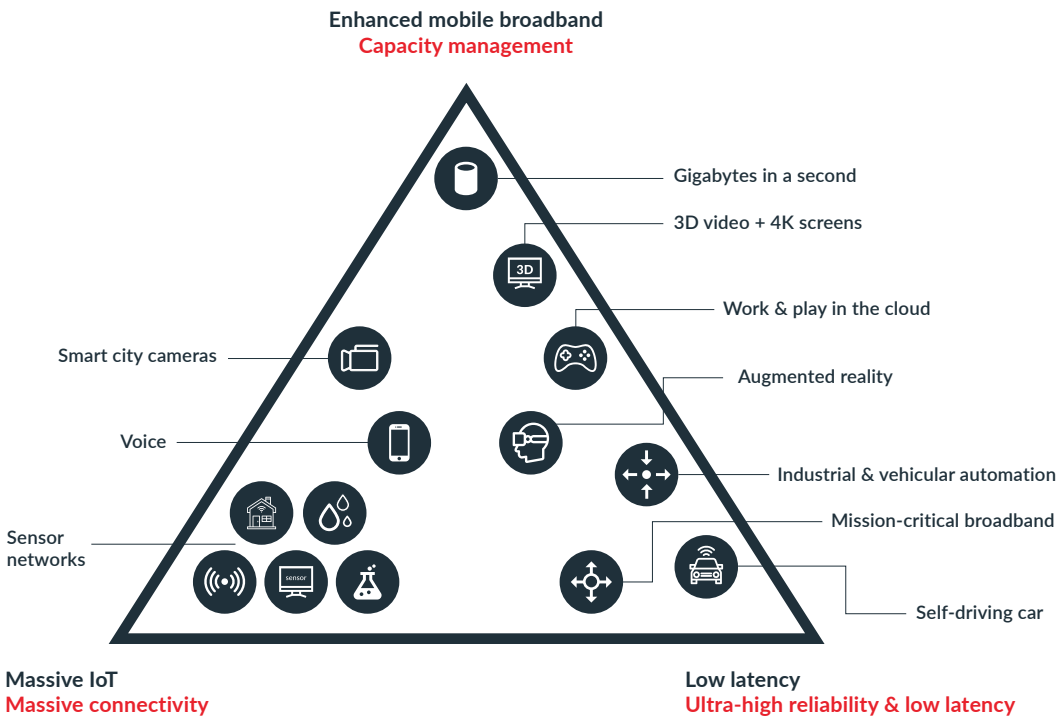
The latter is the focus of this report. Now is the time for CSPs to nail down their operational approaches to slicing and figure out how to turn it from a technical connectivity capability into customizable enterprise services that can be monetized easily end to end across partners.

What is 5G slicing?

Telecom networks traditionally have been designed to manage traffic at peak times, but network slicing gives customers the ability to scale network resources up and down as needed based on many variables. Using slicing and network as a service (NaaS), CSPs are developing new business models to provide varying levels of service to enterprises.

Services could be based on performance characteristics such as quality of service, throughput, latency, capacity, location, security level or time of day, among others.

What are the use cases for 5G?



TM Forum, 2020 (source: ITU)

Standards bodies such as the International Telecommunication Union and 3GPP have defined three broad categories of use cases:

- **Enhanced mobile broadband (eMBB)** delivers ongoing improvements to mobile data connectivity characterized by increased throughput and improved coverage and capacity. It will also enable fixed wireless access services which are competitive with fixed broadband.

- **Massive machine-type communications (mMTC)** enables mass adoption of internet of things (IoT) services across many verticals. It requires reliable indoor coverage and the ability to support a very high density of devices.

- **Ultra-reliable low-latency communications (URLLC)** offers connectivity for mission-critical applications that require very low latency and high reliability and security.

Aiming for automation

As mobile operators evaluate solutions from suppliers to support 5G slicing, they need to ask these questions:

Can the supplier provide truly open, multi-vendor support?

Is automation inherent in their approach to service management?

Can they manage services end-to-end across core, transport and radio access networks, and between operator and cloud networks?

Can they support the full lifecycle of slicing services from design to delivery and ongoing service management and monetization?

Do they enable self-service?

Automation will be crucial for CSPs to deliver services based on slicing capabilities end to end across digital ecosystems made up of multiple partners. Operators must be able to support self-configuring, self-healing and self-optimizing network infrastructure to deliver zero-touch, zero-wait and zero-trouble services. Full lifecycle automation from design to creation, fulfillment, assurance, monetization and decommissioning is necessary.

Read this report to understand:

- What the drivers are for network slicing
- Which use cases and verticals are most promising
- Why it's important to talk about slicing in terms customers can understand
- How CSPs are testing slicing concepts as part of the TM Forum Catalyst Program and other proofs of concept
- How CSPs intend to deploy network slicing capabilities
- Why automation and lifecycle management are critical for 5G slicing
- How standards development organizations and open source groups are collaborating to advance network slicing

Section 1

Network slicing gets real

Today network slicing is more than just an exciting idea. After six years of preparation and two years of missing out on consumer revenue that never materialized from deploying 5G New Radio, communications service providers (CSPs) are successfully testing slicing capabilities with the hope that a year from now they will be successfully delivering and managing new slicing-based services to companies in many verticals.

To get there, it is crucial for CSPs to break the habit of talking about network slicing in technical terms. 5G slicing will not appear as an item in the service catalog. It is not a service; it is a means of delivering customized services. Customers won't ask for a slice, and they don't need to know their service is being delivered using slicing technology.

A recent TM Forum exploratory report called ***Focus on services, not slices***, which draws on the results of TM Forum Catalyst proofs of concept, offers this view of network slicing from the operator's perspective: "Network slicing is network virtualization, allowing multiple logical networks to run upon a shared physical network infrastructure. The objective is to allow a mobile network operator to partition its networking [and compute and storage] resources to allow for very different users (tenants) to multiplex over a single physical infrastructure, thereby maximizing utilization and providing a better return on invested capital for the operator. These partitions, or slices, would be created to match the technical requirements of different types of use cases."

Appealing to customers

The slicing Catalysts TM Forum members have championed over the past few years (see page 8) have focused on the technical aspects of provisioning and billing for slices, because it is critical to understand how slicing-based services will work before they can be sold to customers.

Benefits and challenges of network slicing

Benefits	Challenges
Leverages virtualization for faster time to market	Needs automated orchestration to turn up and tear down slices
Differentiated, use case specific logical networks	Requires close attention to internal resource allocation
Service characteristics can be dynamic & based on policy	Lack of standards for QoS KPIs and metrics
Customized enterprise solutions	Interference/contention of resources
Monetizes performance-based services	Difficult to charge for services with dynamic QoS based on policy
Helps all parties execute SLAs	Complexity of end-to-end service assurance
Eliminates long-standing regulatory hurdles to prioritization	Questions about how to slice virtual RANs

TM Forum, 2020

TM Forum Catalysts demonstrate network slicing

Catalyst	Champions	Focus
5G optimized capacity & E2E experience	BT, Verizon	This Catalyst demonstrated real-time, dynamic, automated planning, operation and spectrum optimization for multiple slices guaranteed with service level agreements. It also included blockchain-based settlement across multiple CSPs.
5G intelligent service operations	AT&T, BT, KDDI Research Orange, NTT, TIM, Telenor, Vodafone	This project demonstrated how immersive services and dynamic and static network slices supporting eMBB, mMTC and uRLLC can be operationalized, orchestrated and monetized by an ecosystem of partners. This included end-to-end slice management, dynamic service orchestration, reactive and proactive assurance, and dedicated policy management.
5G ride on!	BT, Orange, Telecom Italia	This project is exploring how network slicing can be used for emergency services by focusing on the use of autonomous 5G network management capabilities across multiple operators and geographies to support an electric vehicle charging ecosystem. Previous phases included *5G Riders on the storm* and *5G intelligent service operations* (see above).
5G riders on the storm	BT, KDDI, Orange, Telecom Austria Group, Telecom Italia and Telenor	This Catalyst explored how to respond when a dynamic weather event such as flooding or a storm creates unexpected demand or an outage on the network. The team demonstrated a solution multiple parties responding to the storm and included a smart city operations center. They also looked at how 5G's unique capabilities can guarantee that network services used by medical or other mission-critical industries are not interrupted by surges or outages.
The Aviator: Enabling multi-vertical innovation through 5G slicing	AT&T, BT	With a focus on the airline industry, this project will demonstrate how complex, multi-partner 5G services can be designed, mapped to slice types and ordered in a few clicks via a marketplace, deployed using orchestration and predictive assurance, and then charged and billed. Previous phase included 5G optimized capacity &E2E experience and 5G intelligent service planning and optimization (see below).
5G intelligent service planning and optimization	AT&T, BT, Orange, NTT, TIM	This team looked at how to design 5G networks and automate optimization, focusing on deployment of slices in hybrid networks made up of physical and virtual components. The key, they discovered, is managing bandwidth across all the network segments and assuring optimal network performance while satisfying customers' varying demands for quality of service.
5G pricing and monetization innovation	China Mobile, China Telecom	This project explored a new pricing and charging method based on 5G business models for vertical industries. Specifically, it looked at the multi-dimensional, dynamic pricing and charging model needed for 5G slicing.
5G Operations & Monetization	China Mobile	This project looked at virtual and augmented reality gaming services from cloud-based partners to improve monetize opportunities by letting CSPs engage with digital to partners to offer multi-sided business models. The team used a 5G "virtual slice" (as described by 3GPP) to orchestrate and manage gaming experiences.

But the user's point of view will be different, and the exploratory report points out that talking about the technical aspects of delivering slicing and exposing the complexity to users poses a risk to adoption.

Instead CSPs and their partners must focus on what slicing enables for customers and on the user's experience. This means paying attention to service design, ordering, self-service modifications, pricing based on quality of service, charging and lifecycle management.

Operators involved in the Catalyst projects believe that the market success of slicing will be related to how simple it is for customers to use services based on slicing technology. Ordering and consuming slices need to be as frictionless as possible, and standard slice templates and APIs are important to making that happen, which we'll discuss in Section 2.

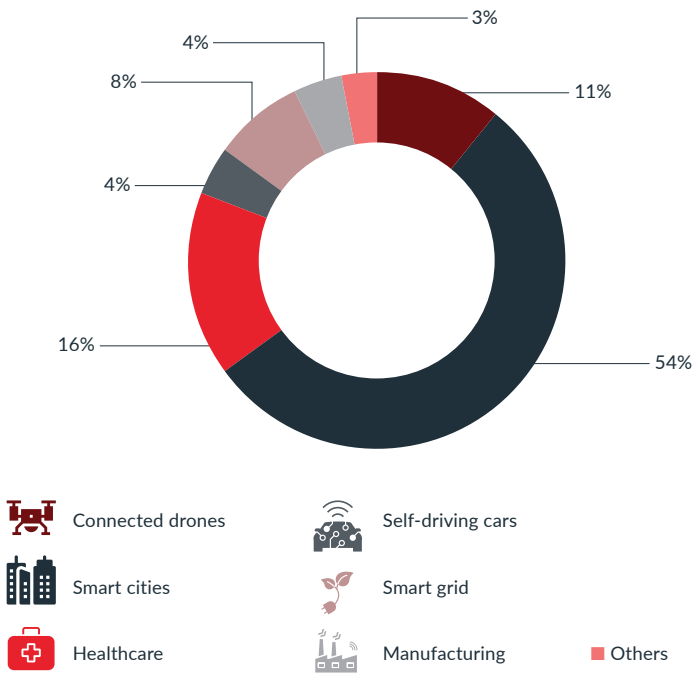
Beyond terminology, it is important for CSPs to consider the potential benefits of and challenges to implementing 5G slicing, as illustrated in the graphic on page 7, and to be able to address challenges. Monetizing performance, for example, is a goal, but it's difficult to charge based on quality of service.

Where's the opportunity?

A survey conducted for a companion report called *5G future: Business models for monetization* found that B2B services enabled by network slicing ranked second among CSPs asked to identify which services would have the greatest long-term and short-term impact on their businesses. CSPs believe network slicing will help them optimize capacity utilization and allow them to provide dedicated 5G network and service capabilities to enterprises in many vertical markets.

The graphic below shows which they believe hold the greatest potential, with smart cities leading the others by far. Within cities, applications relying on data from a wide range of sensors and devices will have different performance requirements, so they are a prime candidate for services based on network slicing.

Which verticals will CSPs target with slicing?



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When it comes to network slicing, the viability of vertical markets must be viewed through a new lens because of the Covid-19 pandemic and growing civil unrest. Until the pandemic, United Nations data showed that 55% of the world's population lives in cities with a prediction that 68% would by 2050. But people may begin leaving cities for suburban areas or smaller cities and towns.

This does not negate the need for smart cities or network slicing, but it complicates investment in 5G base stations because an increase in remote working and working from home means capacity might be needed in suburban or rural areas rather than city centers, which is where most current investment is happening. The healthcare industry could see the opposite effect with the need for sensors to monitor health and telehealth driving an increase in slice-enabled services. Likewise, the pandemic and civil unrest could increase the demand for drones and other surveillance solutions.

Proving the concept

CSPs also are developing use cases for entertainment, transportation, mining, education, emergency services and multi-access edge computing (MEC), and they are conducting trials and proofs of concept to address the challenges of delivering slice-based 5G services to these industries. A recent Amdocs survey shows that 84% of the 50+ CSPs surveyed claimed to be involved in trials this year. While the table on page 8 features the TM Forum Catalysts that are addressing 5G slicing, the table opposite shows other industry trials. In the next section, we'll look more closely at the support system capabilities required to deliver and manage services based on network slicing.

Other industry trials of network slicing

Trial	Goal
Telenor/Telefónica	Demonstrated on-demand creation of slices with different characteristics and end-to-end orchestration of the slices using Open Source MANO.
Singtel/Nokia	This ongoing trial is showing how an enterprise could access a secured network slice on demand with assured security and network performance based on latency, bandwidth and availability.
China Telecom/ZTE	Explored uses for network slicing and MEC in 5G networks to enable intelligent manufacturing and industrial IoT applications in China.
A1 Telekom Austria Group and Telia	In this ongoing trial, A1 and Telia are co-developing and testing Nokia's slicing capabilities using LTE and 5G. The capabilities can be deployed via a software upgrade into existing LTE and Non-standalone 5G networks to start.
Deutsche Telekom	Conducted a trial in a multi-vendor environment with integrated Standalone 5G NR and core components. It used a newly developed business support system complemented with Open Networking Automation Platform (ONAP) open source for end-to-end orchestration.
Orange Belgium	As part of an ongoing trial, Orange Belgium has launched a 5G testing hub, the first Standalone 5G network in Belgium which will be used by industrial partners. 5G capacities are not just added on top of regular 4G/3G technologies but deployed as a separate network enabling network slicing.

Section 2

How to deliver services based on 5G network slicing

A key benefit of 5G slicing is that it allows communications service providers (CSPs) to monetize varying levels of service. For example, they can price based on guarantees of availability, level of quality, level of security, throughput, latency and many other performance indicators. Operators' biggest decision, in fact, may be which service model to offer.

To monetize services based on slicing, CSPs can provide guaranteed service level agreements (SLAs) based on customized performance metrics, such as quality of service, or they can offer network slicing as a service (NSaaS), which builds slice templates with tailored characteristics to support a specific service. For customized performance metrics, operators need to decide how many to support individually and how much to charge for them. For NSaaS, they must create slice templates, which are models based on users' requirements and applications that are mapped to the network resources required to support them. Operators also must build self-service capabilities for customers to consume these slices on demand for indefinite periods of time and create pricing mechanisms.

Massimo Banzi, Senior Standardization Manager, Telecom Italia, thinks CSPs will monetize 5G slicing using the NSaaS option. "It has to be as a service because we are talking about services that cross nations and cross operators," he says. "That takes collaboration."

This collaboration must include pre-defined agreements between the parties involved in delivering an end-to-end service. Such agreements need to spell out which participant is responsible for provisioning and orchestrating a service, providing the connectivity on demand and managing the business arrangements, Banzi explains. They also need to define suitable APIs that automate workflows to activate services on demand.

"We are not ready yet," he says. TIM expects to support static 5G slicing beginning this summer, connecting various universities in Milan and Paris, he adds, but true dynamic slicing is not possible yet because it requires automation (see Section 3).

Emerging 5G standards

As noted, the effect of the Covid-19 pandemic on the rollout of 5G is uncertain. CSPs and governments could decide to pull back from capital investment in anticipation of lost revenue and slower growth, or they could follow the lead of Singapore and move straight to deploying Standalone 5G in anticipation of economic recovery. CSPs may need to do the same when it comes to 5G network slicing: plan for a high-demand future and leapfrog to an operations environment that can monetize slicing.

It would help CSPs' decision-making considerably if 3GPP's 5G Release 16 specification were not further delayed. If the organization stays on track, the specification should be published by the end of June. However, there is already enough guidance in previous releases for operators to identify suppliers that are able to deliver solutions for operationalizing and monetizing slicing. In addition, CSPs can begin experimenting with mapping service types to various slice templates.

GSMA proposes use of a generic slice template (GST) that "defines a set of common slice attributes the industry can use on which to base the description of a network slice type."

Suppliers, CSPs and enterprise customers can use the attributes along with other proprietary attributes if they want to set up custom slices. Slices can then be described by filling the GST with values for all or a subset of attributes. The result is called the Network Slice Type (NeST), which vendors can use to define product features, customers can use to understand contractual agreements and CSPs can use with partners. The *5G riders on the storm* Catalyst (see page 8) used this approach.

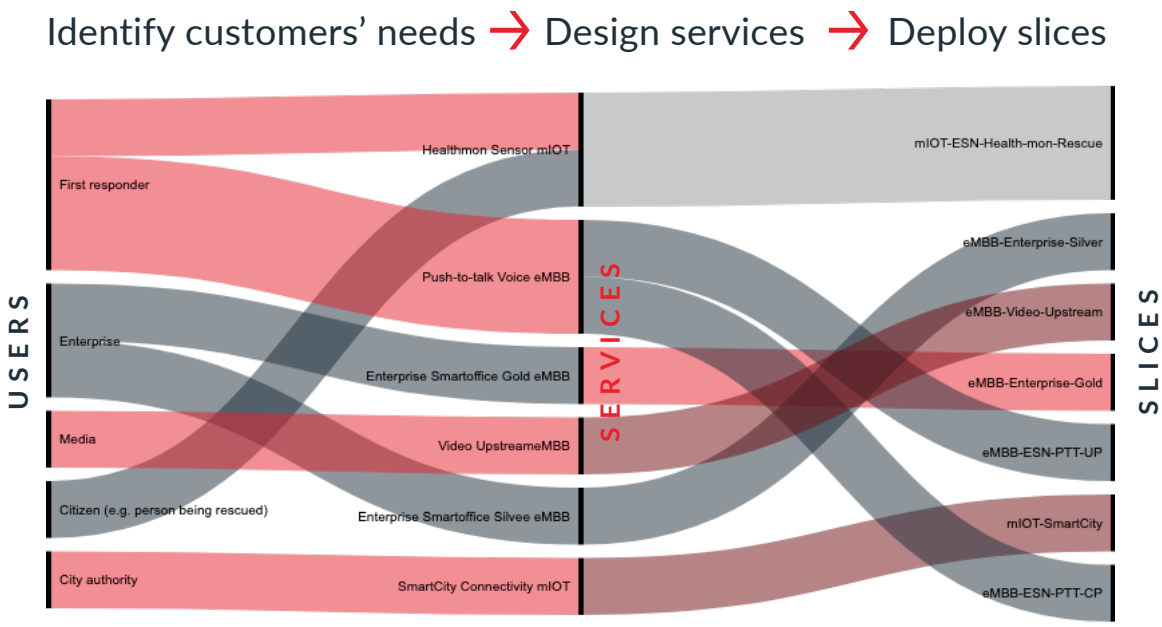
The GST is part of a GSMA Network Slicing Task Force created to harmonize definitions of slicing, identify standardized types of slices with distinct characteristics, and consolidate parameters and functionality requirements. The task force is looking across all vertical industries to determine how to capture common information into templates.

Mapping requirements

By mapping customers' requirements to services and then mapping services to slice templates, CSPs hope to shield users from the complexity of the underlying technology, which will make services based on slicing much easier to design, put into a catalog and sell. The graphic below from a TM Forum exploratory report called *Focus on services not slices* illustrates how service-to-slice mapping would work. The key points are that services aren't necessarily mapped 1:1 with slice types and that users may use multiple services.

"It is dangerous to assume 1:1 relationships, as happens when people talk about services and slices interchangeably," says Dave Milham, Chief Architect, Service Provider Engagement, TM Forum. "The examples in the *5G riders on the storm* Catalyst make it clear that 1:1 relationships aren't the norm."

Frictionless service-to-slice mapping



TM Forum, 2020

He adds: “The other issue is that there isn’t clarity about how many slices are supported in network. Users may presume they have dedicated slices like a private line, but this is unlikely. They most likely will be on shared slices of a specific type.”

TM Forum members have also created a service design blueprint to help product development and service design teams create slice-based services. It provides a guided workbook for asking questions to solicit requirements that designers could build into a workable, reusable slice template. The template is in a human-readable document but can also be created as a software code to be machine readable using a markup language such as JSON.

A Slice Management API needs to be developed for the slice catalog and runtime slice instances that combines other service-related APIs such as ordering, inventory, catalog, activation and more. Once a slice can be defined and service characteristics can be mapped to it, the slice can be sold as a service and made extensible across network domains.

In the next section, we’ll look at why automation is required for end-to-end assurance of slicing-based services.

> “ It is dangerous to assume 1:1 relationships, as happens when people talk about services and slices interchangeably... They are not the norm. ”

Section 3

Automation and collaboration are required for end-to-end management

Delivering services based on network slicing across digital ecosystems requires automation in all areas of a communications service provider's (CSP's) business, from business and operational processes to the network itself. Operators must be able to support self-configuring, self-healing and self-optimizing network infrastructure to deliver zero-touch, zero-wait and zero-trouble services. Full lifecycle automation from design to creation, fulfillment, assurance and decommissioning is necessary.

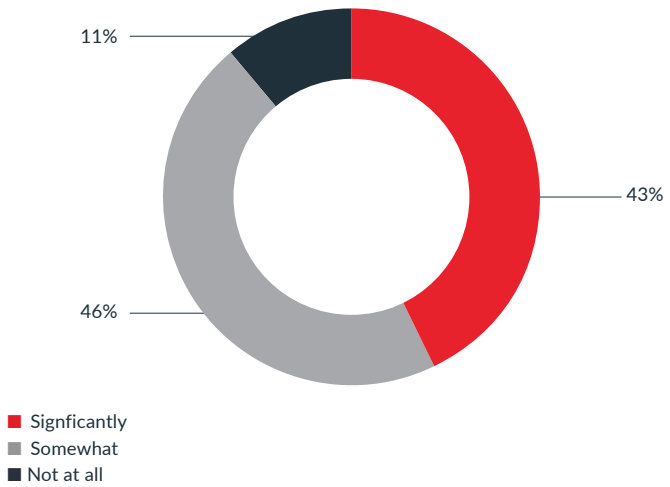
The challenge for operators is not simply to think of new ways to charge for performance attributes. It lies in creating a service management and optimization layer on top of the 5G network that is as responsive and dynamic as the 5G network itself.

Oren Marmur, Vice President and Head of NFV, Amdocs, explains it like this: Today networks are fairly static with fixed service packages and fixed customer types for which the network is configured once, then operated and managed with incremental optimization. 5G is the other extreme: a dynamic environment with new services that must be delivered on demand and for varying lengths of time. "There could be thousands of slices, meaning there are potentially thousands of networks that need to be monitored and managed...so you need to be dynamic. Services will change daily, if not hourly," Marmur says, adding that if the networks (and individual slices) cannot be managed dynamically and assured in real time, then they cannot be monetized.

It's a challenge

Lack of automation is already affecting CSPs' ability to differentiate. A survey conducted for a TM Forum report called *Network automation using AI and machine learning* found that 43% of operators believe relying on manual processes significantly impacts their ability to deliver differentiated, real-time services.

How is lack of automation impacting CSPs' ability to deliver differentiated, real-time services?



TM Forum, 2020

How to differentiate?

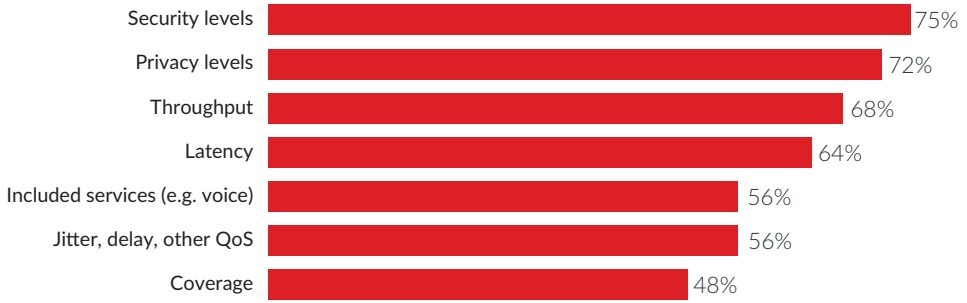
In the same report, CSPs identified which differentiating characteristics they expect to be able to deliver and bill for using network slicing. CSPs can use these attributes to determine which characteristics go into creating a template for a specific kind of slicing service, and metrics for these characteristics can be used to assure compliance with an SLA. But the characteristics also illustrate, again, why it's important to talk to customers in terms they understand, because a customer may not know (or care) how much jitter is acceptable for their video application.

CSPs are counting on Standalone 5G and network slicing to help them target enterprises, but they should learn from the experience so far in 5G consumer markets that they could face challenges in figuring out what customers are willing to pay for. According to PWC, the highest priority for consumers when it comes to home and mobile internet is reliability, but in terms of willingness to pay, consumers are more likely to pay for faster speeds, portability and unlimited data than reliability.

A survey conducted for our 2019 report *5G future: Targeting the enterprise* found that CSPs generate 10% or less of their revenue from B2B services, but in the long term (five to 10 years), the majority of respondents said they expect to be generating over 50% from B2B.

This is because they envision embracing platform business models. Slicing will play a big role in the shift, so long as CSPs choose the right differentiators and implement a service management and monetization layer than can deliver services in the way enterprises want to consume them.

Anticipated slicing characteristics



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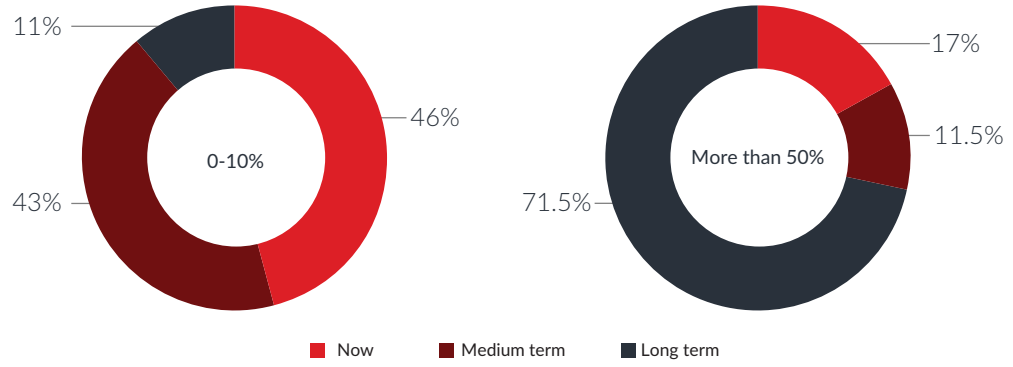
CSP revenue from B2B services



TM Forum, 2020

There are many more ways to differentiate service slices than the performance attributes listed at the beginning of this section. Immediacy is one. Users would expect to pay a premium for a slice they need turned up right away, especially if the requirement for it is short-lived, such as during a special event or crisis situation. User-customizable services is another. People will pay for the ability to easily create and activate services that meet the unique needs of their company – because, well, every company thinks its unique.

"Enterprises may require a combination of dissimilar slices to be available concurrently," adds Dave Milham, Chief Architect, Service Provider Engagement, TM Forum. "In the emergency responder example in the *5G riders on the storm* Catalyst (see page 8), a combination of data messaging and push2talk used different slices, but the service the CSP delivered was both of these working concurrently. If either fails, then the service has failed from the end user's perspective. This is why using the term 'slices' when talking to users is missing an important point."

Dynamic self-service is the goal

CSPs are counting on slicing to give enterprises the ability to self-configure services on the fly, which is what they have come to expect from working with hyperscale cloud providers. Following are the steps operators need to take to make this happen:

Join the processes of design and creation, implementation, orchestration, monitoring, assurance, analytics, optimization, decommissioning and resource management into a single automated workflow and automate the lifecycle of slice-based services

Create an open architecture through which multiple suppliers can interoperate and tie ecosystem partners and third-party collaborators into this workflow and architecture

Create services that address specific use cases while allowing customers to choose additional self-selected attributes

Build service descriptions in the product catalog including the required network resources (network functions, access and transport facilities), as well as any potential attributes associated with the service

Model service chains that link service descriptions together

Construct business agreements that extend access, workflow and quality-of-service guarantees across partners

Develop the ability to orchestrate and configure resources across all domains by using open APIs to interact with the controllers and orchestrators managing each domain

Create multiple business models within the charging system to support NSaaS, QoS or other pricing models

Collaborating to get there

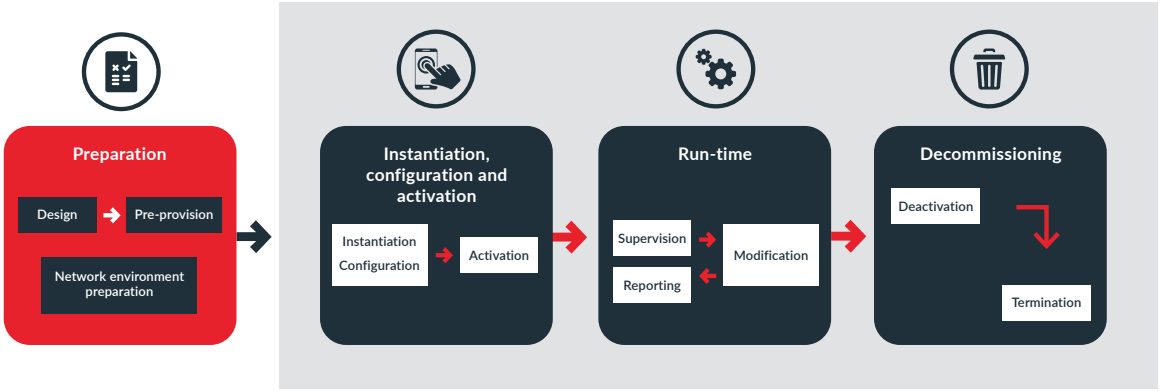
None of the promises of virtualization, slicing, self-healing, self-optimizing and intelligent networks will be realized without open architectures for networks, operations and business capabilities. No single standards development organization, industry initiative or open source group can bring about all the change required to meet the collective goals of transformation. This is why so many organizations are cooperating by sharing knowledge, architectures and APIs.

While working independently, groups such as 3GPP, Broadband Forum, the European Telecommunications Standards Institute (ETSI), MEF, NGMN Alliance, Open Network Automation Platform (ONAP), Open Networking Foundation (ONF), Telecom Infra Project (TIP), TM Forum and others have a role to play in making 5G and network slicing a reality. In order to automate network slicing, one of the first areas of focus necessarily must be on defining the lifecycle of a network slice. The graphic opposite shows how 3GPP defines this lifecycle.

What are the requirements?

But even before this, CSPs must consider the requirements various slices are expected to meet. The TM Forum Open Digital Architecture (ODA), part of the Open Digital Framework (see page 32), builds on 3GPP definitions to create a connectivity service model enabled by 5G, which explains how connectivity services should be modelled in a service catalog.

Lifecycle of a network slice



TM Forum, 2020 (source: 3GPP)

The model captures in a machine-readable manner the material usually provided in a product/service brochure, where it can be formally modelled to automate service lifecycle management. It also dynamically sets constraints on inventory to prevent errors that could occur if services attempt to use resources that no longer exist or have changed.

The table on page 20, which comes from the *ODA Production Implementation Guidelines*, shows the requirements for slices to be able to create connectivity services. These services are exposed in the ODA through the Network as a Service Open API Component Suite.

Management requirements for network slices

General (cross-function) requirements	
Slice types	Various slice types should be supported (e.g. uRLLC, eMBB), and ability for CSP-defined slice sub types should be defined
Cross-domain	It should be possible to manage slices end to end across domains (core, edge, RAN, cloud)
Multi-carrier	Multi-carrier slice management should be supported (e.g., charging, domain specific)
Service order, orchestration and inventory requirements	
Service design	Slices should be supported as part of the service design, service catalog & order template
Slice selection	It should be possible to select slices and subnetworks as part of the service design
Slice lifecycle management	Lifecycle management of the full slice should be supported, meaning instantiation, configuration, enablement and decommissioning or removal
Slice path inventory	Slice path inventory information should be managed (network path selection, VNF, PNF resources, connectivity choices, domains)
Slice virtual resources	It should be possible to assign and orchestrate the virtual resources of a slice (VNFs, microservices, RAN resources, etc.)
MEC support	Application hosting and onboarding at MEC should be supported for the slice when applicable
Load balancing	It should be possible to load balance or re-allocate network and compute resources as required for SLA maintenance
Service assurance requirements	
Slice SLA	The slice SLA should be monitored
Performance management	Performance measurements for slice components should be available from all domains and elements (RAN, MEC, core and virtual resources)
Fast collection & processing	Service assurance should provide processed measurements fast enough to answer the needs of critical applications
Service assurance at the Edge	Intelligent feedback processing at the edge or far edge is required
Interfaces	
Slice support	All functional interfaces should support slices (customer apps, BSS, RAN, MEC, orchestration stack, cloud)
Multi-carrier APIs	Carrier-to-carrier API on slices at different domains should be supported
Billing and charging requirements	
APIs	OSS to BSS API for dynamic slice charging is needed

TM Forum, 2020

TIP targets RANs

Another obstacle to end-to-end management is automation of network infrastructure such as radio access networks (RANs). TIP's End-to-end Network Slicing Project Group (E2E-NS) was created to facilitate a slicing ecosystem that can be deployed over fixed and mobile networks. While much of the group's initial work has been to advance 4G slicing, it is relevant for 5G slicing as well.

TIP's goal of end-to-end management across core, access and transport network is well aligned with TM Forum's work on end-to-end management. Forum members, such as Erik Meijer, who heads up Group Innovation at Deutsche Telekom, increasingly want to link their work across organizations to overcome challenges around people, processes and technology.

In a written response to questions for a recent Q&A, Meijer explained how DT is addressing the challenges of developing an ecosystem approach: "People: we are rapidly implementing Agile work approaches, combining product and IT people in the same delivery teams. Process: see our industry-leading work with TM Forum on the Digital Maturity Model with our Detecon consulting team. Technology: leading the Telecom Infra Project (TIP) and our continuous work with all vendors and TM Forum members at large."

Read this interview to learn more about Deutsche Telekom's approach to ecosystems:

TIP's goals

The TIP E2E-NS project aims to create:

- A selection of market-ready, CSP-sponsored use cases with their own unique rationales and business opportunities
- Low-barrier entry points to network slicing in current and emerging generations to guide CSPs on deploying network slicing offerings that improve the mobile internet experience and drive new top-line revenues
- Common, open architectures that demonstrate how network slicing can be applied in multi-vendor, multi-domain, multi-operator contexts for a range of candidate use cases and services; this will help operators develop slicing solutions that can serve many different needs
- Integrated radio access network (RAN) and core network slicing ecosystems that will provide repeatable blueprints for operators looking to build and launch end-to-end network slicing services
- Clear benefit statements for use cases and business models that communicate the value to stakeholders and operators, ahead of decisions to test and deploy in live networks

Other collaboration

As part of the TM Forum Catalyst Program, Forum members also are working closely with members of MEF and ONAP on slicing lifecycle automation. ONAP's Beijing release, for example, incorporated the work of several Catalyst proofs of concept and included TM Forum Open APIs that were extended by MEF.

ONAP's 5G Blueprint contains requirements for the management and orchestration (MANO) layer of 5G. These include supporting physical and virtual functions in the radio network, automation at the edge and real-time analytics that influence lifecycle management actions such as scaling, fault management and performance optimization.

In addition, TM Forum recently published detailed models for mapping Open APIs and information models to 3GPP 5G models. These are available now for TM Forum members to review and comment on and will be shared with 3GPP. If you're interested in reviewing these models, please contact Dave Milham.

To deliver 5G network slicing by the end of next year, a concerted effort on standards and agreements for how to handle end-to-end automation should be led by CSPs through all the organizations mentioned in this report. It will not be easy, but it is achievable. In the next section, we provide some steps operators can take now.

> " To deliver 5G network slicing capabilities by the end of next year, the industry must collaborate on standards "

Section 4

Make it happen – Strategies for operationalizing 5G slicing

While network architects endeavor to enable end-to-end slicing in 5G networks across core, transport and radio access networks, software engineers are working on solutions for designing, instantiating, managing, orchestrating and monetizing slices and the services they support. Now is the time for communications service providers (CSPs) to select partners to help them implement slicing and self-service capabilities for customers. Automation across the network and service management layers is key to slicing's success. Following are steps operators can take to make services based on network slicing a reality in the next one to two years.

Talk services, not slices

Enterprise customers do not care about slicing. They want to know what their options are in terms of service-level guarantees, which service attributes they can select and how the service will help their business. Exposing the complexity of slicing to users poses a risk to adoption.

CSPs know deep down that the market success of slicing will be related to how simple and useable a slice is, so ordering and consuming slices need to be as frictionless as possible. To achieve this, operators must focus on service design, ordering, self-service modifications, quality of service, pricing, charging and lifecycle management. They also must define and create templates for various slice types, and define the mapping of service attributes to those templates.

Know what is important to customers

What users say they want is not always what they need or are willing to pay for. It is important for CSPs to design services that customers are willing to pay for, which means co-creating them. At the same time, CSPs need to ensure they can deliver value in an automated way, on demand, for indeterminant intervals and end-to-end. This begins with being open and vendor agnostic in order to work with others in the ecosystem.

Decide: NSaaS or QoS?

Most CSPs favor network slicing as a service (NSaaS) as their preferred option for monetization rather than charging by individual performance attributes. This model will require coordination with partners and the creation of business agreements between them based on their ability to share real-time data and support zero-touch management and orchestration of resources, which means the solutions they employ must be service aware and be able to turn resources up or down as needed based on the service definition in the product catalog.

Join a proof of concept

As CSPs begin to look for proof points from suppliers that go beyond the traditional request for proposal (RFP) response, they are pressing suppliers to participate in proofs of concept that demonstrate how to operationalize and monetize 5G network slicing. TM Forum Catalyst projects provide an opportunity to conduct research and development outside the organization by collaborating with suppliers, other CSPs and enterprise customers. To find out more about TM Forum's slicing Catalysts or to join one, contact Chief Digital Officer John Gillam.

Make automation a corporate initiative

A recent TM Forum survey showed that a full 89% of CSPs believe lack of automation significantly or somewhat impacts their ability to deliver differentiated services. Many 5G services cannot be delivered without automating processes across domains (business, operations and network), and certainly 5G networks cannot be managed or optimized without significant automation. Incremental automation is fine and should continue, but a C-level focus on organization-wide automation is essential for extending it beyond individual working groups and business units.

Collaborate on automation

To extend automation across partners' domains, such as to cloud providers or other CSPs, and to the enterprise customer requires collaboration among standards organizations and open source communities. CSPs should get involved in groups including TM Forum's Autonomous Networks Project, the Open Network Automation Platform, MEF and the Telecom Infra Project. To learn more about the Forum's work on automation, contact Chief Technology Officer George Glass.

Preparing the way for 5G monetization today – slice by slice

Amdocs' approach to end-to-end network slice lifecycle management

The need for network slice management

5G brings new and exciting monetization opportunities for service providers as they continue to transform along their journey to the cloud and future networks. This is enabled predominantly by the revolutionary ability to move from the traditional 3G/4G 'one size fits all' approach to a business model based on network slices spanning network domains and including virtualized and cloud functions.

Network slicing allows the physical network to be split into multiple virtual networks, akin to going from a single-lane road to a multi-lane highway. This way, slices and services can be configured to the specific needs of disparate customers, applications and industry verticals. While on one hand, this opens the way for innovative revenue streams with targeted customer experiences, it also introduces significant complexity in managing the lifecycle of slices, services and network resources across network domains and multiple vendors.

Recognizing network slicing as an industry gamechanger, Amdocs launched Amdocs 5G Slice Manager to help service providers address this new challenge. An end to end lifecycle management solution for 5G network slices, it encompasses critical processes from design to creation, instantiation and closed-loop operations across the RAN, transport, core and edge domains, as well as the ability to operate across different equipment provider components.

Of course, monetization does not stop with delivery and operations – ordering, charging and billing are essential to complete the lifecycle. Such capabilities are provided by CES20, of which Amdocs 5G Slice Manager is a part. An open, cloud-native, 5G-ready, pre-integrated yet modular BSS-OSS portfolio, it supports the real-time charging of slice consumption as well as configuring, pricing and quoting for complex enterprise services based on network slicing.

End-to-end network slice automation and orchestration

Network slices spanning the RAN, transport and core networks, as well as edge and the cloud, utilize virtual, containerized and physical network functions (NFs) deployed in each network slice instance. To accommodate dynamic scaling in service consumption, these NFs can be scaled up as well as down.

New ways to operate the network, drive new business models and new revenues:

5G opportunities, 5G monetization challenges:

Preparing the way for 5G monetization today – slice by slice

Where services run across a multi-domain network, there is a need for end-to-end 5G slicing management that coordinates the coexistence of different network slices, maintaining isolation and guaranteeing that the required resources are available for each one.

Hierarchically positioned at the top of the multi-domain network management architecture (as specified in ETSI ZSM003), Amdocs 5G Slice Manager fulfils this network slice lifecycle management role.

Network slicing also requires adaptive, automated and real-time systems and processes that can tune the network to business needs. Here, 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.

Meanwhile, the solution's active hybrid inventory module enables vendor-agnostic, continuous monitoring and performance analysis of physical and virtualized network slice components. An analytics framework is responsible for analyzing the performance data and events captured from the network and for interpreting the state of network functions and the role each domain plays in the performance of an end-to-end slice.

Based on massive data collection, statistical modeling and AI/ML analysis, the system also carries out performance prediction and provides early warnings of any degradation of slice performance and SLAs.

An introduction to Amdocs 5G Slice Manager

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 through the following capabilities:

- Lifecycle automation of 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 operator's ordering and charging system to support new business and monetization models, for example network slice as a service (NSaaS) with new levels of performance and functionality

Amdocs 5G Slice Manager is an integral part of a 5G monetization platform that supports complex B2C, B2B and B2B2x business models, unleashing a world of innovative network services and monetization opportunities.

> "By partnering with Amdocs for its 5G Slice Manager, operators can ensure that future network slices can be managed, orchestrated and monetized across their existing infrastructures, which helps protect their current network virtualization investments for 5G."

Stephanie Gibbons, Omdia, April 2020

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Preparing the way for 5G monetization today – slice by slice

Integrating network slice management with the business enablement layer

An essential aspect of 5G network slice monetization is vertical integration between the operational network slice management layer and the business enablement layer, which is supported by the service provider's BSS. Complementary solutions within the Amdocs CES20 portfolio work together with Amdocs 5G Slice Manager to support these integrations, while maintaining an open, modular and API-first approach.

The integration begins with a common catalog serving all BSS and OSS needs. Amdocs CatalogONE is an advanced, unified catalog capable of handling network, commerce and monetization aspects, empowering business users to create and launch new innovative offers in minutes. Once designed, the network slices are updated in CatalogONE, enabling the creation of rich, multi-sided offers including third-party services bundled with the appropriate network slice and other operator assets (e.g. edge resources) to ensure the required service KPIs and SLAs. Pricing, policy and chargeable aspects of the service are also easily configured, together with details of the offering launch parameters.

Once an offer is available and the customer has ordered the service, order management (part of Amdocs DigitalONE) calls on the network slice manager to instantiate a slice (or make the association with and ensure resource availability on an existing slice).

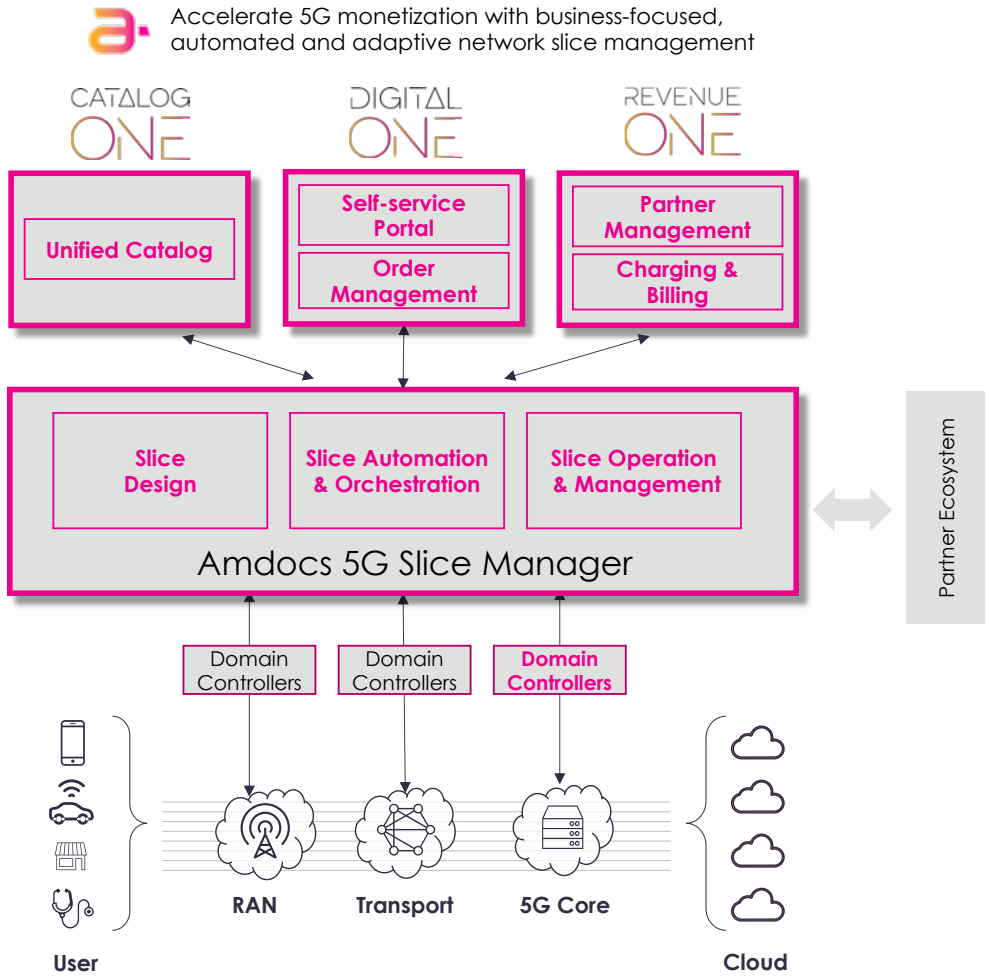

Fig. 1 – Amdocs 5G Slice Manager integrated with the Amdocs BSS

Preparing the way for 5G monetization today – slice by slice

Charging for the service then begins in accordance with the pricing configuration.

Amdocs RevenueONE's convergent charging system enables multi-dimensional charging and billing of a network slice as a service (NSaaS) offering. It does this by collecting chargeable events related to a given network slice from multiple sources, including the core network, infrastructure and the management and orchestration systems of the network slices. The solution can generate not only subscriber- or session-based charging reports, but also much more comprehensive slice-level reports that cover operational, usage as well as performance and analytics events. Since network slices span the radio access network (RAN), transport, edge and core networks, and utilize virtual, containerized and physical network functions, collecting chargeable events from the centralized slice manager simplifies support for innovative business models and pricing plans.

At the same time, because of its cloud-native, distributed architecture, RevenueONE enables deployment of charging functions at the edge, closer to end devices, reducing charging signaling and associated hardware, while enabling localized charging for relevant events.

Another key requirement of 5G network slicing is isolation between network slices. This means that system stress situations that may occur because of heavy traffic in one network slice must not lead to performance degradation in other network slices. With 3GPP Release 15, these isolation requirements now also extend to the charging system. RevenueONE's convergent charging system is the industry's first to support isolation between network slices. The result is that overload, scaling or failures subsequent to increases in charging traffic of a given network slice do not impact charging traffic processing of other network slices.

The vertical integration requirements described above apply throughout the service lifecycle. Any events requiring customer attention are presented via the customer portal, ensuring real-time transparency. This significantly improves customer satisfaction and may also present upsell opportunities based on scaling up a network slice to meet the customer's changing requirements.

Unleashing 5G monetization opportunities

With 5G opening up many new business opportunities for service providers, network slicing has a key role to play. Whether to improve network operations, monetize 5G network capabilities or provide a launchpad for innovative enterprise and industry vertical offerings, it's imperative for every operator to ensure they're optimally equipped with the best solutions to fully maximize this opportunity.

For more on the challenges and benefits of 5G network slice management, visit www.amdocs.com/5G-Slice.

Discover more on the future of monetization and 5G charging here.

> "RevenueONE integrates real-time charging and billing with a unified service catalog and the key billing and charging features that service providers need for 5G services and to support partner services. It is designed to support all lines of business, customer segments, and payment types."
>
> **Sandra O'Boyle, Omdia October 2019**

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Preparing the way for 5G monetization today – slice by slice

The connected car – 5G network slicing enterprise use case

Operational and monetization aspects of a slice-based service

K.I.T.T is a vehicle manufacturer and enterprise customer of a leading service provider. The company leverages the following three slices, each of which enables a different customer offering:

- Broadband slice with infotainment/media package
- IoT slice with a preventative maintenance package based on car telemetries
- Low latency slice (including edge resources), enabling a collision avoidance solution provided by a third party.

K.I.T.T manages and monitors these slices as deployed services through a tailored self-service portal provided by the service provider. Yet increased popularity of its infotainment package means that the broadband slice is becoming congested (approaching 90% utilization), which is reflected in the self-service portal in real time. A scale-up proposal automatically prompts K.I.T.T to extend this slice and pre-emptively avoid any impact on service.

Once selected, the slice is scaled up and the new plan updated with the chargeable elements.

The service change and the charge are both reflected in the self-service portal in a fully transparent, real-time manner. Amdocs 5G Slice Manager, integrated with Amdocs CatalogONE, DigitalONE and RevenueONE, manages, monitors and monetizes the lifecycle of the slice and slice-based services from the self-service portal through design, creation, orchestration and closed-loop operations to charging.

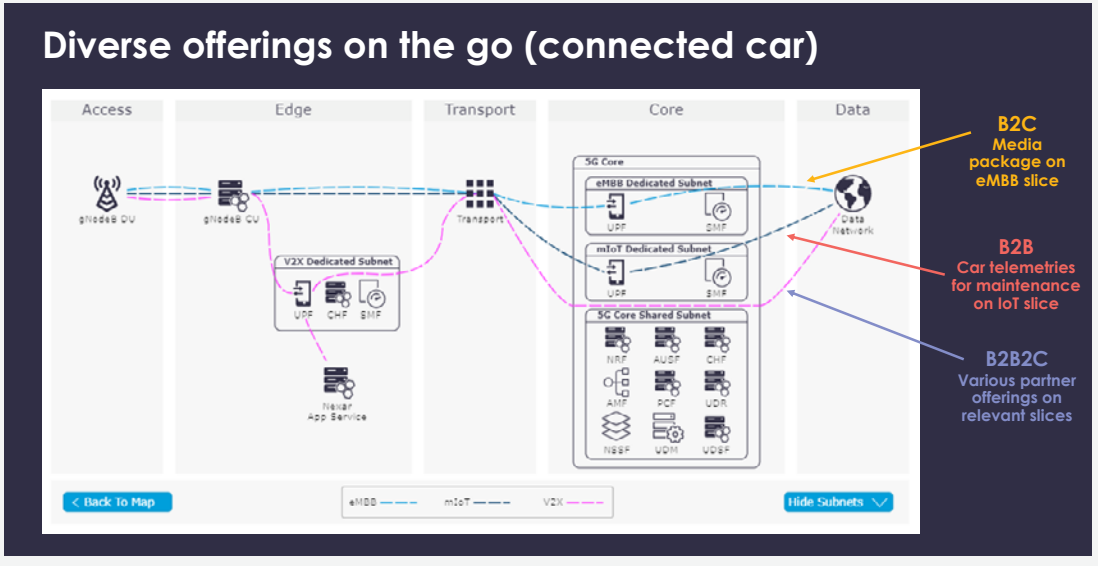


Fig 3. – Connected car use case

TM Forum Open Digital Framework

A blueprint for intelligent operations fit for the 5G era

The TM Forum Open Digital Framework provides a migration path from legacy IT systems and processes to modular, cloud native software orchestrated using AI. The framework comprises tools, code, knowledge and standards (machine-readable assets, not just documents). It is delivering business value for TM Forum members today, accelerating concept-to-cash, eliminating IT and network costs, and enhancing digital customer experience. Developed by TM Forum members through our Collaboration Community and Catalyst proofs of concept and building on TM Forum's established standards, the Open Digital Framework is being used by leading service providers and software companies worldwide.

Core elements of the Open Digital Framework

The framework comprises TM Forum's Open Digital Architecture (ODA), together with tools, models and data that guide the transformation to ODA from legacy IT systems and operations.

Open Digital Architecture

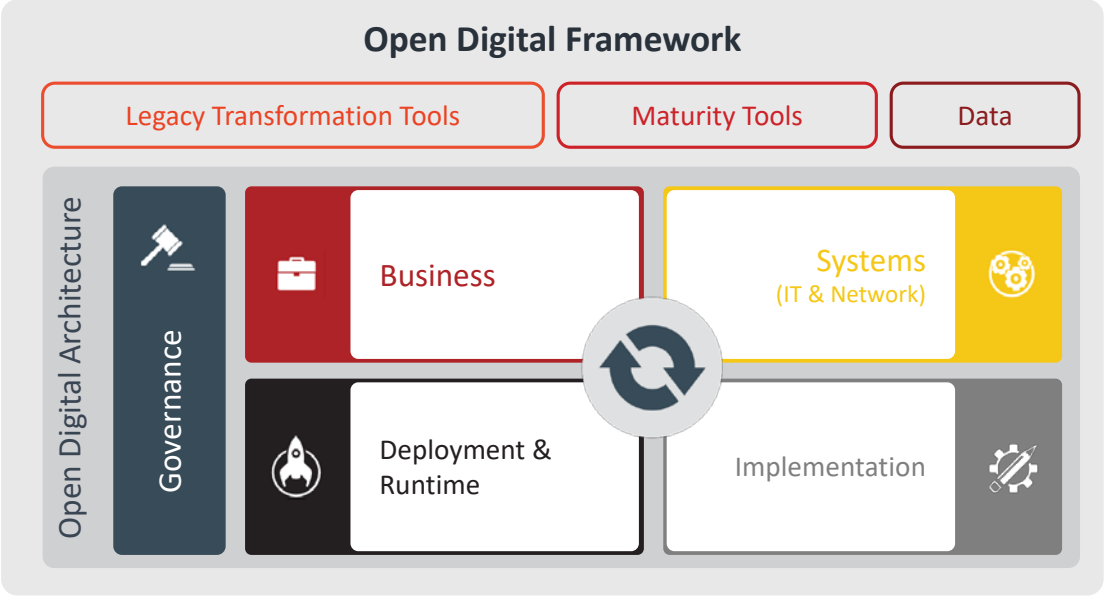
- Architecture framework, common language and design principles
- Open APIs exposing business services
- Standardized software components
- Reference implementation and test environment

Transformation tools

- Guides to navigate digital transformation
- Tools to support the migration from legacy architecture to ODA

Maturity tools & data

- Maturity models and readiness checks to baseline digital capabilities
- Data for benchmarking progress and training AI



Goals of the Open Digital Framework

It aims to transform business agility (accelerating concept-to-cash from 18 months to 18 days), enable simpler IT solutions that are easier and cheaper to deploy, integrate and upgrade, and to establish a standardized software model and market which benefits all parties (service providers, vendors and systems integrators).

Learn more about collaboration

If you would like to learn more about the project or how to get involved in the TM Forum Collaboration Community, please contact George Glass.

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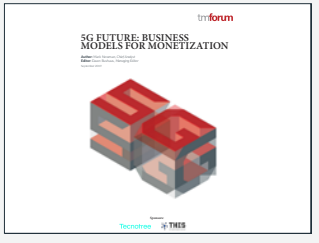
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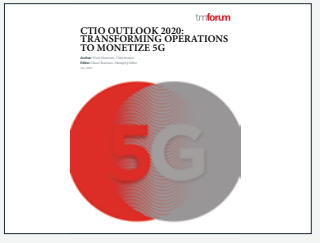
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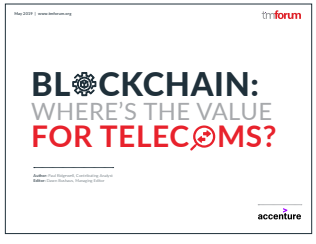
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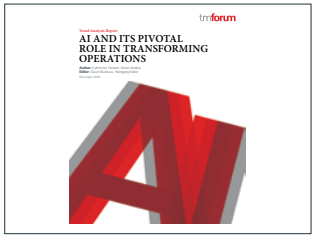
AI AND ITS PIVOTAL
ROLE IN TRANSFORMING
OPERATIONS
AI


REDEFINING THE CTIO
REDEFINING THE CTIO

Meet the R&M team

Report Author:
Tim McElligott
Senior Analyst
tmcelligott@tmforum.org

Chief Analyst:
Mark Newman
mnewman@tmforum.org

Editor, Digital Content:
Arti Mehta
amehta@tmforum.or

Commercial Manager, Research & Media:
Tim Edwards
tedwards@tmforum.org

Report Editor:
Dawn Bushaus
Managing Editor
dbushaus@tmforum.org

Customer Success & Operations Manager:
Ali Groves
agroves@tmforum.org

Global Account Director:
Carine Vandevelde
cvandevelde@tmforum.org

Digital Marketing Manager:
Anna Kurmanbaeva
akurmanbaeva@tmforum.org

For more information about TM Forum's Open Digital Architecture, please contact **George Glass**