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The Voice of European Industry and Research for Next Generation Networks and Services

B5G Service Framework

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Vision Working Group

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EXECUTIVE SUMMARY

The telecommunications landscape is undergoing a profound evolution thanks to the new features introduced recently by 5G and 5G and beyond (B5G), and even more so in the close future by 6G technologies. New ***services*** are expected to drive growth for the industry that is lagging in a currently stagnating connectivity market. Virtualisation of network elements over generic compute infrastructure enable programmability, and thus service flexibility and scalability. It will be possible to offer "Everything-as-a-Service" (XaaS), with examples like Network-as-a-Service (NaaS) or AI-as-a-Service (AIaaS) being cited often. However, the industry lacks shared definitions of what constitutes a "service" beyond technological functions. Thus, it is also challenging to structure business models in a multi-actor ecosystem and set prices in ways that reflect value of services.

To better understand the impact of the abovementioned, ongoing evolution, this white paper proposes a **service framework** to be used for B5G and 6G research, strategy, and operations. It decomposes a service into its **functional** provisioning (what the network does), its **servitization or value-in-use** (how customers derive benefit), its **non-ownership** structure (rights to use rather than own assets) and its degree of **human interaction** (co-creation), and how variety is added to the service with human or digital means.

This white paper emphasises how the telecommunication industry can embrace a service-centric business model through developing a clear understanding of value creation in the ecosystem of stakeholders involved in service delivery. That should happen while learning from the servitization tradition in other sectors, better understanding actor roles and aligning business models with the characteristics of the different players.

The detailed discussion on these themes presented in this white paper aims at enabling telecom stakeholders to navigate the complexity of B5G service delivery and to support innovation and the development of economic sustainability towards 6G.

6G-IA Vision sub-working group for Business Validation, Models, and Ecosystems (BVME)

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1. WHY EXPLORE B5G SERVICES?

The question of how to monetize investments in 5G and B5G[1], and later in 6G, is currently receiving a lot of attention. The 6G-Industry Association (6G-IA) sub-working group ***Business Validation, Models, and Ecosystems*** (BVME)[2] has published four white papers on how to validate business opportunities with users and customers in the B5G ecosystem [1][2][3][4].

Nevertheless, there is still a recurring demand for answers to two questions: 1) what are the future B5G and 6G revenue streams that lead to economic growth? and 2) how to set prices? We address these questions by introducing a framework for exploring ***B5G services***. **The framework complements a predominantly functional perspective on services with concepts such as value-in-use and rights to use.** This aims to enable companies to understand what it takes to do business in a service-centric economy, set prices, create and capture market growth, while also integrating environmental, social, and economic sustainability values [5].

In recent years, the telecom industry has increasingly adopted the term *"service"* to denote a strategic transformation in both offerings and operational focus. The frequently used expressions "Everything/Anything/Experience-as-a-Service" (XaaS), reflect the sector's shift towards service-centricity. For example, the 2024 6G Vision white paper [6] identifies a range of telecom services, such as Artificial Intelligence-as-a-Service (AIaaS), Network-as-a-Service (NaaS), and Logic-Network-as-a-Service (LNaaS), and refers generally to 6G-enabled services, user services, wholesale services, and application services. These are seen as central components of the emerging 6G ecosystem and growth. Similarly, the 2025 BVME white paper on B5G emerging business models [4] emphasized service-oriented ecosystem roles, including the well-established Communication Service Provider (CSP) and the Service Aggregator (SA). There is also a recurring reference to how services beyond connectivity can lead to market growth and revenues for telcos, introducing new business opportunities through differentiated services [7].

In these sources, the underlying assumption is that a focus on *services* brings something new, and that it will change the market and facilitate revenue and profit growth for those involved. **However, what constitutes a service beyond technological functions is not well defined and there is a lack of knowledge on business domain aspects such as user value and rights.** It is recognised that the term *service* has been used for offerings in the telecom industry for centuries, e.g., when the telegraph *service* opened in London in 1839 [8]. Nevertheless, it is still important to explore how recent dynamics in telecom have been driving innovation and are fostering the introduction of new service offerings and expectations

[1] The term B5G signals an inclusion of technological evolution beyond 5G
[2] BVME is a sub-working group of the 6G-IA working group Vision and Societal Challenges

among industry stakeholders. Moreover, to ensure further growth, the telecom industry needs to capture the aspects of service-centric offerings that go beyond connectivity and pure technological functions. While this whitepaper addresses the dimensions beyond technological functions, the challenges related to achieving precise and well-defined service specifications of such technological functions should not be neglected.

The virtualisation of network elements has accelerated the transformation towards a service-centric business by enabling the current generation (5G) of network technology functions to increasingly utilise generic compute infrastructure rather than function-specific physical infrastructure, and this is expected to increase further with 6G. This transition supports flexible, scalable, and programmable networks capable of delivering differentiated functions - and *services* - across the B5G and 6G ecosystem. These advances have created new opportunities to deliver value through service-based business models that are agile and adaptable to customer needs and market demand. In addition, there has been a move from offering hardware (HW) as a physical product to leasing services, along with a transition to cloud computing services and away from private, on-premises deployments.

To support the telecom transformation to service-centricity, we provide complementary definitions of the concept of services that go beyond technological functions and then apply them to current and emerging actor roles and offerings in the telecom market. **The goal of this white paper is therefore to enable a more precise mapping, identification and description of current and emerging *services and their pricing models,* and in turn pave the way for new economic growth.** This is particularly important for services shaped by technological convergences between telecom and e.g., cloud and artificial intelligence.

To achieve this goal, **we present a service framework that enables industry practitioners to explore how services are delivered and who is involved in that service delivery**, developing an understanding of how value is generated in the B5G ecosystem users of these services. **This focus on the broader value created through the use of telecom-based services, supports decision making on pricing for new services delivered by advanced network technology, providing opportunities for increasing economic returns in the telecom industry.**

The white paper is structured as follows: Section 2 introduces some service examples from the telecommunication industry, providing an overview of the topic, before further details are presented in later sections. Section 3 helps to define what is meant by a service in the telecommunication industry, while Section 4 outlines a service framework for B5G and 6G, based on specific service definitions. Section 5 applies the service framework to existing and emerging B5G services. Section 6 examines B5G service pricing models and considers the customer perspective. Section 7 provides the summary and recommendations.

2. ALREADY DEFINED B5G SERVICES

Before introducing the framework that is used to more formally identify and describe telecom services, we briefly recapture some of the existing services in telecom and some of those emerging as the B5G business ecosystem developments.

Within telecom, the Communication Service Provider (CSP) has been a prominent, yet generalised actor role together with the Network Operator (NOP), while the *Mobile* Network Operator (MNO) is specific to the mobile domain [9][10]. These are all actor roles who offer a service. The BVME white paper "Emerging 5G and beyond ecosystem business models" describes that a CSP delivers *"communication services (voice, media, Internet, data network, IoT, etc.)"* [4]. Furthermore, the CSP relies on services offered by the NOP, which offers *"network services (e.g., connectivity, value-added services), across part or all segments of the network (i.e., access, transport, core)"*. It is also noted that usually, the CSP and NOP *actor role*s are controlled by one *actor* (i.e., one firm). Thus, the NOP services to the CSP are internal. In particular, the CSP and NOP roles are well defined in the 3rd Generation Partnership Program (3GPP) standards (e.g., [11]), which is necessary to distinguish responsibilities and interfaces in architecture and operation. The sources reveal how an understanding of these responsibilities and interfaces are crucial for specifying how a service can be offered to another user or customer. This replicability is at the core of the ambitions of flexible, scalable, and programmable networks in B5G and 6G.

The BVME white paper "Emerging 5G and beyond ecosystem business models" [4] provided further descriptions of telecom actor roles in the Industry 4.0 (I4.0) domain, reproduced in Table 1. Some actor roles are well known across the Information and Communication Technology (ICT) industry, such as System Integrator (SI) and Application Supplier (AS). Others are newer or more specific actor roles to the emerging B5G and 6G era, such as Digital Service Provider (DSP) and Data Centre Service Provider (DCSP). For the emerging B5G and 6G ecosystem business models, the Service Aggregator (SA) (as defined in Table 1) is an interesting actor role that may represent the party that takes advantage of service offerings enabled by programmable networks as well as applications, cloud, and even 5G and 6G industrial devices offered as-a-service.

Actor roles in Table 1 have different business models (for details see [4]). Their descriptions distinguish actor roles based on the intensity of their labour and capital expenditure (CAPEX). For example, the SI role is labour intensive (human resources and technology expertise are key assets), typically with revenue and pricing models per project or hour. The NOP (together with the CSP) is CAPEX heavy with strong incentives for standardized operation, often with a subscription model. Regardless of these differences, both actor roles conduct their business according to recognized applications of the term service.

Table 1 Actor roles in 5G/B5G ecosystems for I4.0 [4].

Actor Roles	Description
Vertical Customer	The company/organisation which buys the required communication and I4.0-specific application services, tailored to the needs of a specific use case of interest.
Service Aggregator (SA)	Entity that curates and aggregates service offerings from multiple other providers (with potentially different roles) to offer complete value-added end-to-end (E2E) solutions to enterprise customers (e.g., a factory)/Vertical Service Providers. The Service Aggregator serves as a single point of contact for the vertical customer that consumes an E2E solution. For building and delivering the aggregated service, the Service Aggregator is supported by a System Integrator.
System Integrator (SI)	Complementary and supportive role towards the SA role. Brings together different subsystems into a unified system that functions seamlessly. The SI is highly involved in the setup phase of a solution, facilitating the design, integration, implementation, testing, and validation of the E2E solution. In the operational phase, the SI is responsible for the maintenance and scaling of the solution.
Digital Service Provider (DSP)	Offers digital services, i.e., online application/information services that are consumed by the Vertical Customer. These digital services are integrated with communication, and potentially infrastructure services, offered by other roles in the value network. The DSP may not be the developer of the whole digital service, but parts of it may be contributed by application suppliers.
Application Supplier (AS)	Focus on the development of applications, using Application Programming Interfaces (APIs) to adapt Software (SW) to the network etc., and these applications are usually specialized and specific to certain vertical sectors, e.g., I4.0, media, automotive. Contrary to the DSP, the application supplier does not participate in the provisioning phase of the solution.
5G Industrial Device Supplier	Supplies 5G and beyond equipment necessary for the provisioning of the complete vertical solution towards the vertical customer. This actor role is expected to often provide equipment via the Service Aggregator, rather than directly to the vertical customer. These devices may be user equipment, robots/cobots, AR/VR glasses, etc., that may be deployed on an industrial floor or utilized by the end-users (customers) for the consumption of vertical services.
Communication Service Provider (CSP)	Focuses on the delivery of communication services (voice, media, Internet, data network, IoT, etc.) relying on the network services offered by a Network Operator (see below). Usually, an actor that adopts the communication service provider role also adopts the network operator role.
Network Operator (NOP)	Maintains and operates a network, offering network services (e.g. connectivity, value-added services), across part or all segments of the network (i.e., access, transport, core). The network service may be offered in the form of Network Slice-as-a-Service (NSaaS) or Network-as-a-Service (NaaS), e.g., public network integration with non-public network (PNI-NPN). er
Data Centre Service Provider (DCSP)	Offers cloud services, from multi-purpose virtual machines (VMs) / containers to complete virtualised infrastructure management solutions, over virtualised / physical infrastructure that includes computational, storage, networking or IoT resources.
Private Network Operator	Operates a private network, local access/radio. Can bundle network and other communication services. Can be realized in different ways and may substitute a NOP in an ecosystem configuration or be seen as a sub-role of the NOP

In the next section we discuss in detail the definitions of service to more precisely distinguish service offerings in the emerging B5G and 6G markets.

3. DEFINING SERVICES

3.1. REVIEW OF SERVICE DEFINITIONS

The goal of this section is to provide an understanding of what a service is in the telecommunication industry domain. The review indicates that definitions in telecom are oriented towards **functional** aspects of the underlying communication technologies. This contrasts with definitions in the broader business domain, which focus on a wider set of parameters, covering more detailed aspects of the service (i.e., the **what, why**, **who,** and **how** aspects of the service).

To elaborate, the concept of **servitization and value-in-use** has been developed in the manufacturing sector over the last two decades. It describes how manufacturers unlock additional revenue streams by offering services tightly coupled to physical goods, focusing on the value created for users through the use of those goods. We consider this concept also fitting for the telecom industry, where the fundamental underlying technology (network functions analogous to the physical goods in the manufacturing sector) can be built upon in numerous ways to create value and capture revenue for *service* providers. Moreover, there are also synergies with definitions in the business and marketing domain, where **non-ownership** and **human integration** are distinguishing characteristics.

The series of definitions help us better describe telecom services and various related concepts. We use SaaS as an illustrative example, then present a B5G services framework that integrates these concepts and explains how services are differentiated across several dimensions. Then, we provide a generalised description of deploying services, elaborating the essential functional and business relationships necessary to derive value when offering different types of services in the telecom market.

3.1.1. FUNCTIONAL DEFINITION (WHAT)

Each of the main Standard Development Organizations (SDOs) in the telecommunications industry define the word service slightly differently, but generally they refer to it as a **set of capabilities or functions offered to users or systems over a network**. For example, the International Telecommunication Union Telecommunication Standardization Sector (ITU-T) [12] defines service as *"a set of functions offered to a user by an organization"*. In this view, the "what" of a service is a function, and it involves a provider (organization) and a user in a one-directional relationship. The functional definition does not elaborate "function" but defines an *"item; entity; element"* as *"any part, device, subsystem, functional unit, equipment or system that can be individually considered"*. It is added that *"an item may consist of* *hardware, software or both, and may also include people, e.g., operators in a telephone operator system"*. From this we can infer that functions can be created in many ways, potentially with human support. The main resource for creating the function is an extended understanding of the telephone operator system. Notably, the ITU-T definition elegantly separates the service function from the technologies enabling its realisation. In other SDOs and telecom industry organizations / alliances, "functions", or "functionalities" similarly dominate the understanding of a service, for example [13][14]:

- In 3GPP a service is typically defined as a set of functionalities provided to a user or application via the network.
- The Global System for Mobile Communications Association (GSMA) [15] often refers to services in the context of mobile operator offerings, such as voice, SMS, data, roaming, and value-added services.
- The European Telecommunications Standards Institute (ETSI) [16] defines a service as a logical entity that performs a specific function and can be composed of other services or functions.
- TM-forum [17]] conceptualizes a service as (mostly) internal capabilities to realize a product facing a customer, where the product can take many forms.

3.1.2. SERVITIZATION - VALUE-IN-USE DEFINITION (WHY)

We start our exploration of additional definitions of services by turning to the servitization concept, developed in the manufacturing industry. Baines et al [18] note that *"….servitization is the term given to a transformation where manufacturers increasingly offer services that are tightly coupled to their products"* and that in the manufacturing industry, customers' practices range from internal service delivery (i.e., doing it themselves), to fully outsourcing service provision (i.e., having someone else to do it for them). The servitization definition aligns with the latter: *"Those customers "who want us to do it for them" will contract for the "capability" offered through their "use" of a product, and have the manufacturer take care of everything else"*. The premise is that customer value is extracted from using an object, not from the object itself. This also affects payments: a feature of such advanced services is *"revenue payments structured around product usage"*.

Thus, the servitization concept gives further insights into service value propositions, and how to monetize and set prices. It suggests pricing models based on rights to use, and on the outcome of using the service, e.g., the waste reduction a manufacturer achieve.

3.1.3. NON-OWNERSHIP AND RIGHT TO ACCESS DEFINITIONS (HOW)

Lovelock and Gummesson [19] introduce non-ownership as a basis for definition of a service. This approach posits that *"services offer benefits through access or temporary possession, instead of ownership, with payments taking the form of rentals or access fees."* Here, the service is the access to a resource: one side (the user) obtains the right to access, and the other side (the provider) owns the resource and allows that access. This is a relatively simple relationship, where the service on offer is purchased without any co-creation between entities, although what is provided and how access is implemented may vary. In this view, there is clearly a resource that someone purchases the right to use (e.g., telecommunication infrastructures, expertise or a physical place).

3.1.4. HUMAN INTERACTION DEFINITION (WHO ARE INVOLVED, HOW)

In the field of marketing, Vargo and Lusch's widespread Service-Dominant Logic (SDL) approach defines service as "the application of specialized competences (knowledge and skills) through deeds, processes, and performances for the benefit of another entity or the entity itself." [20]. Here, the "what" of a service is specialized competences applied in a **bi-directionally relationship and co-creative process** among multiple entities. The value proposition lies in the benefits one entity gets from another's applied competence. We refer to this as a **human interaction** definition of service. If a basic resource (operand service) is present (e.g., a physical asset), SDL sees the service (the applied knowledge and skills) as the operant resource acting on the operand resource to produce an effect. The SDL holds that all economies are service economies in this sense. We do not find that SDL covers all aspects of telecom services and suggest that it is complementary to the three other services definitions explained above.

3.1.5. SERVICE VARIETY

Other perspectives also shed light on defining services. **Variety,** or customization, is sometimes discussed as part of a service definition. For example, the authors in [22] use multiple approaches to define service for environmental sustainability, finally seeing service as "variability through interaction". The authors in [23] imply that competence and customer co-creation inherently deliver variety, whereas those in [21] argue that variability through human means is not a defining feature distinguishing services from goods. Paradoxically, many sectors have achieved high standardization through digitization while still offering customers many, even more, options and variations. How variety can be added to a service by both human and digital means is something that we integrate into our service framework.

3.1.6. SERVICE DEFINITIONS SUMMARY

Table 2 highlights core ideas from each service type. The bottom row shows that every service definition refers to some fundamental resource or investment (a physical goods or infrastructure). Above that, each approach emphasized a different aspect: the **functional** layer (which is the domain view in telecom), **servitization** and value-in-use, **non-ownership** access to resources, and **human** interaction (co-creation and applied competence).

Table 2: Service definitions structured in layers and approaches.

Service Type	Service Definitions			
Human Interaction - Service-Dominant Logic	*"we define services as the application of specialized competences (knowledge and skills) through deeds, processes, and performances for the benefit of another entity or the entity itself"* *Service is an **operant** resource – competence applied for benefit* Vargo and Lush, 2004, 2008 [20] [23]			
Non-ownership and right to access	*"services offer benefits through access or temporary possession, instead of ownership, with payments taking the form of rentals or access fees"* Lovelock & Gummesson, 2004 [19]			
Servitization and value-in-use	*"customers "who want us to do it for them" will contract for the "capability" offered through their "use" of a product, and have manufacturer take care of everything else"* Baines et al, 2013 [18]			
Functional approach (telecom)	Service: *"A set of functions offered to a user by an organization"* ITU-T, 1994 [12]			
Physical goods layer (all service definitions refer to some form of resource)	SDL: "operand resource" Vargo and Lush, 2004 , 2008 [20][23]	Non-ownership: "Resource" / "Telecom infrastructure" Lovelock & Gummesson, 2004 [21]	Servitization: "product" Baines et al, 2013 [18]	*Telecom functional: "telephone operator system"* ITU-T, 1994 [12]

Across all these definitions, certain commonalities exist: a service always focuses on "*the what*" (i.e., the definitions describe what a service is, especially in contrast to a physical product). There are usually at least two sides, e.g., a giver and receiver – possibly collaborating in creation of the service. A receiver is often a user or a customer, while the provider is selling *something*. Definitions may describe how the *something* is created, from a concrete delivery of *something* to an act of co-creation by multiple parties. A service's value proposition is tied to the *something* as well as the relationship type between the parties. The service definitions also describe a resource "on top of" which the service is enabled, or which is the focal point for co-creation between parties.

Table 3 summarizes how the four main service definition approaches vary on these aspects.

Table 3: Service definitions and key characteristics.

Service definition category	What the service *is*	Sides of the service	Relation-ship between sides	Service delivery, process	Example service value proposition	Underlying resource
Human Interaction - Service-Dominant Logic	Competence (knowledge and skills)	Multiple entities	Bi-directional Co-creation	Deeds, processes, per-formances	"competence applied for the benefit of someone"	Competence (may act on tangible **operand** resources)
Non-ownership and right to access	Access to a resource	Side with access, side with ownership	One directional	Access is given	"right to use"	Resource (e.g., telecom infrastructure)
Servitization and value-in-use	Value-in-use (capability delivered via use)	User vs. provider (of user value)	One directional	Contract for capability offered through use	"the use of an object, not the object itself" providers "take care of everything"	The object (product)
Functional approach (telecom)	Function (set of functions offered)	User vs. Organi-sation (provider)	One directional	Created in many ways, (via a technical interface)	"a set of functions offered / provided"	Operator system (network infrastructure)

3.2. SERVICE EXAMPLE – SAAS

Software as a Service (SaaS) draws on all the above definitions, clearly exemplifying the service approach. Ted Golding [24] suggests that: *"SaaS is a business and software delivery model that enables organizations to offer their solutions in a low-friction, service-centric model that maximizes value for customers and providers. It relies on agility and operational efficiency as pillars of a business strategy that promotes growth, reach, and innovation."*

A definition from IBM [25] is more functional, while reflecting the non-ownership concept: *"Software as a service (SaaS) is a cloud-based software delivery model in which providers host applications and make them available to users over the internet. SaaS users typically access applications by using a web browser or app." … "The SaaS provider is responsible for* *operating, managing and maintaining the software and the infrastructure on which it runs. The customer simply creates an account, pays a fee and gets to work."*

Clearly, the non-ownership regime and rental/access fee model is key in these understandings of SaaS, where shared infrastructure for SW hosting is essential. Looking deeper into Ted Golding's definitions, he also emphasizes the surrounding capabilities that orchestrate the shared environment (e.g., onboarding, billing, and analytics). These constitutes the control plane, while the shared infrastructure and resources form the application plane.

A key success factor to SaaS is how a company uses its expertise to build a frictionless interface that welcome and serve the users - this *service* aspect distinguishes SaaS from a mere product or function. (Golding even suggests that the application plane is always shared in SaaS, whereas in theory, the SaaS model can support tenants with dedicated resources in the control plane). We do not directly use SaaS definitions in our service framework, but they have helped us shaping our thinking.

4. B5G SERVICE FRAMEWORK

From the above definitions and application to telecommunication services, a framework for defining services emerges. It is proposed that the aspects shown Figure 1 should be considered when assessing an offering as a service. The arrow indicates that different aspects build on each other and work together.

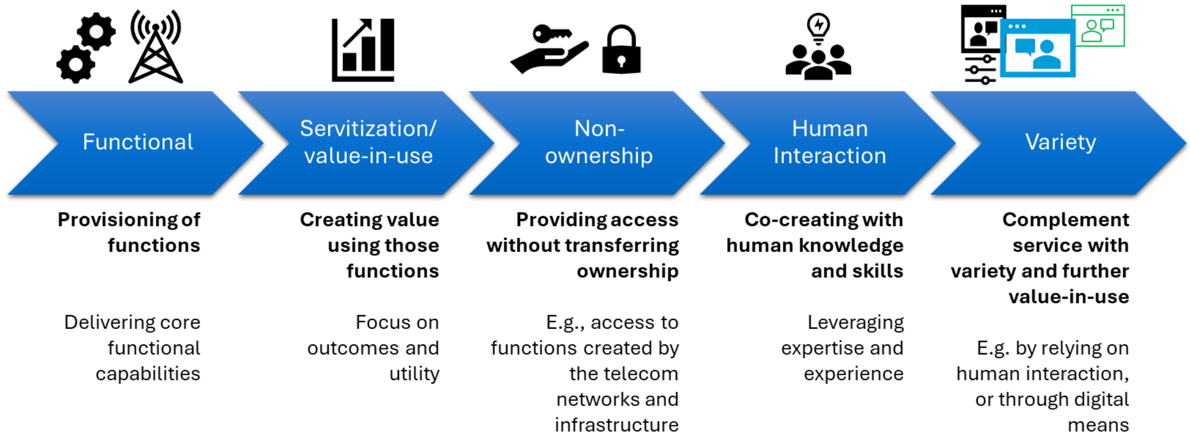

Figure 1: The B5G Service Framework.

This framework allows us to discuss how the technology itself is changing, and how this has effects along these five dimensions. For example, over the last 40 years, digitalization and automation have dramatically decreased the human interaction in telecom, yielding very standardized mass-market services. In the 5G and beyond era, virtualisation, softwarization, programmability, and network exposure promise increased access to new functions and features, as well as greater variety in service offerings enabled by digital means [2]. The service framework allows analyses of the *service* dimension of offerings beyond pure functions. Moreover, it opens for aligning different aspects of service offerings to actor roles in the B5G business ecosystem, and in adjacent domains such as cloud. Most importantly, it helps describe how a service can improve the ability to understand value creation within the ecosystem, find pricing models and set price levels.

We acknowledge that value propositions for a service may extend beyond what is captured in the service framework, also into values associated with social, environmental, and economic sustainability. However, for the purpose of this white paper, we assume that value propositions are captured by the "value-in-use" assessment.

4.1. PERSPECTIVE ON SERVICE BUSINESS RELATIONSHIPS, INTERFACES, AND CONTRACTS

For progressing the discussion on services and their composition, it is worthwhile to elaborate on the different sides of a service, e.g., the provider and user, and their type of relationship. We define relevant terms for these sides and apply them to describe both functional and business relationships.

4.1.1. ACTOR ROLES SEPARATION

We reuse the terms "actor" and "actor roles" for the business entities in the telecommunications market [9][10]. There are three reasons for the separation when discussing services:

- **Technical:** Different areas of technology development and speed can reside in different business actor roles. Technical interfaces differ from relationships between actors and actor roles and should be treated separately. Technology can trigger new actor roles or render existing ones obsolete, while the underlying actors (companies) remain.
- **Economic:** Actors that are service users vs. producers may take on multiple actor roles. The business relationship is different from the technical interfaces.
- **Regulatory:** Regulatory constraints in technical or business domains may enforce certain separations of actor roles.

We maintain the duality of the user-provider pair to describe the relationship between the actor roles.

Separating the definitions of actors and actor roles also helps identify stakeholders and how trust is built between them through technical, economic, and regulatory means. This is important, as refinement to requirements (e.g., those found in [26]) can be discerned by considering future business actor role models. Past generations centred on the relationships between MNOs and their subscribers (and between MNOs for roaming, RAN sharing, etc.). B5G network slicing introduces new actor role models, including multi-tenancy, vertical markets, and service optimization.

Key terms and concepts are used in the remainder of this sub-section:

- **Stakeholder**[3]: A party that holds an interest or concern in the telecom ecosystem.
- **Function:** Any self-contained unit or system that can offer its use as a functional service.
- **Actor:** An enterprise (business or administrative domain) that consumes function services or contributes to service provisioning. This is also the owner of resources.
- **Actor role:** Handles a well-defined function, or functions. An actor may hold several actor roles, and a given actor role can be adopted by multiple actors.
- **Technical Interface (Reference Point):** The technical manifestation of a relationship in the telecom system. An interface consists of several related technically specified linkages between functions, governed by a contract.
- **Business relationship:** An association between two actor roles (or instances of them) encompassing the functions they control. (A business relationship cannot exist between technical functions alone; we need the actor role(s) and their business relationship(s) to address the business aspects of a service).
- **Contract:** The context defining constraints for one or more interfaces to operate under - essentially the legal agreement governing the technical interfaces and business relationships between two actors. (This is where the rights to access are defined, and service levels and prices set.)

4.1.2. TECHNICAL INTERFACES

Communication services (telecom offerings) are realised through a set of complementary technical functions. Each function is atomic and could be offered by a single actor role. This concept can be used in a virtualised or non-virtualised context. In 5G and beyond, such an atomic network function usually refers to a Virtual Network Function (VNF).

The separation of actor roles and a clear definition of network function responsibilities enable the functional modularisation of the architecture. Even more, it could imply that the functional modularisation of the architecture should be defined by business models, i.e., the business actor roles could define the technological architecture.

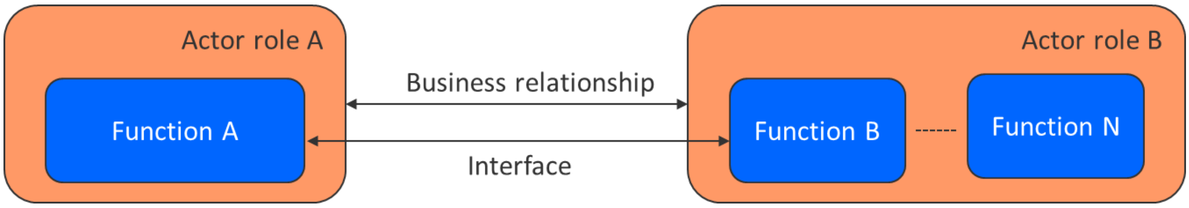

Figure 2: Identification of interfaces.

[3] A more elaborated definition is: Stakeholder refers to any individual, organization, or institutional entity that directly or indirectly influences, contributes to, or is affected by the development, deployment, regulation, standardization, operation, or use of telecommunications systems, services, and infrastructure.

Figure 2 illustrates this point with two actor roles, A and B. Actor role A provides Function A, and actor role B provides other functions, such as Function B … Function N. A technical interface (reference point) can be identified between Function A and Function B allowing information exchange between these functions. The information flow depends on the user-provider assignment of the functions.

The interface is the technical manifestation of the relationship between actor role A and actor role B, but the roles also have a business relationship. A business relationship cannot be between technical functions; the actor roles and their business relationship are needed to handle the services' business aspect. In Figure 2, the actor roles are shown as independent of specific actors present in the ecosystem (see next sub-section).

4.1.3. MAPPING ACTOR ROLES TO ACTORS

Figure 3 illustrates the relationship between actors and actor roles.

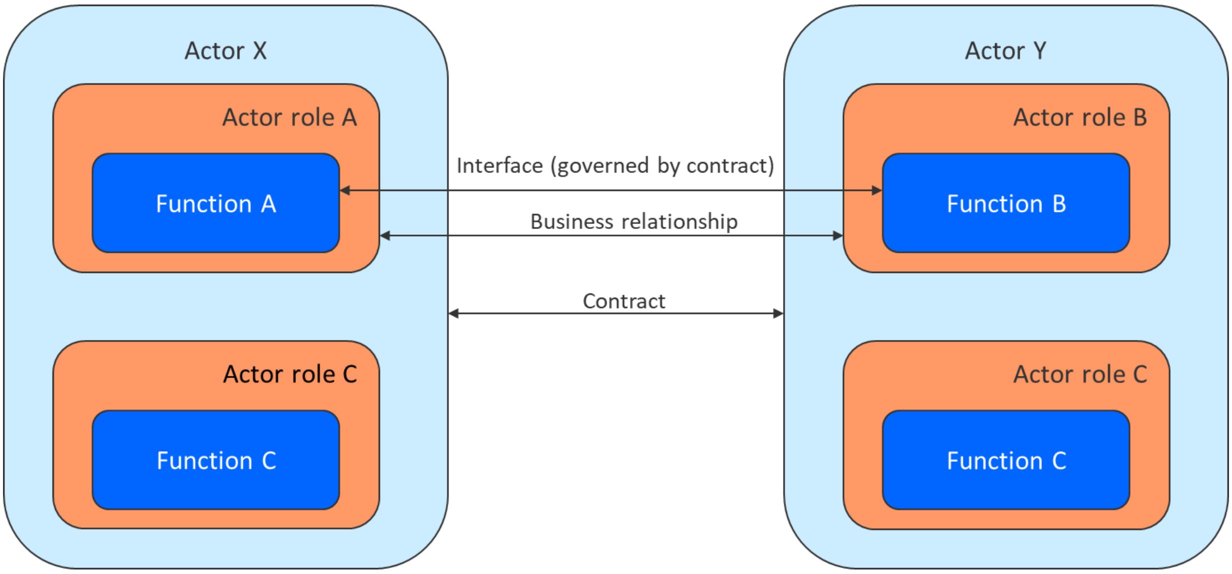

Figure 3: Mapping of actor roles to actors.

The following relationships apply:

- Each actor role is performed by one or more actors. For example, Actor role C (e.g., Network Service Provisioning) might be assumed by both Actors X and Y.
- Each actor, such as X, can assume one or more actor roles, for instance roles A and C.
- A business relationship exists between actor roles (e.g., network operators).
- The contract between the actors governs the business relationship and technical interfaces between the functions performed by the actor roles assumed by actors.
- The direction of technical interfaces and business relationships can be one, two, or multi-directional.

4.1.4. USAGE OF SERVICES

One actor may offer a functional service (via an interface to the function) to another actor (a customer). Figure 4 expands on the previous concepts, adding a third actor Z who runs a Function D, which consumes Y's Function B as a customer through a technical interface.

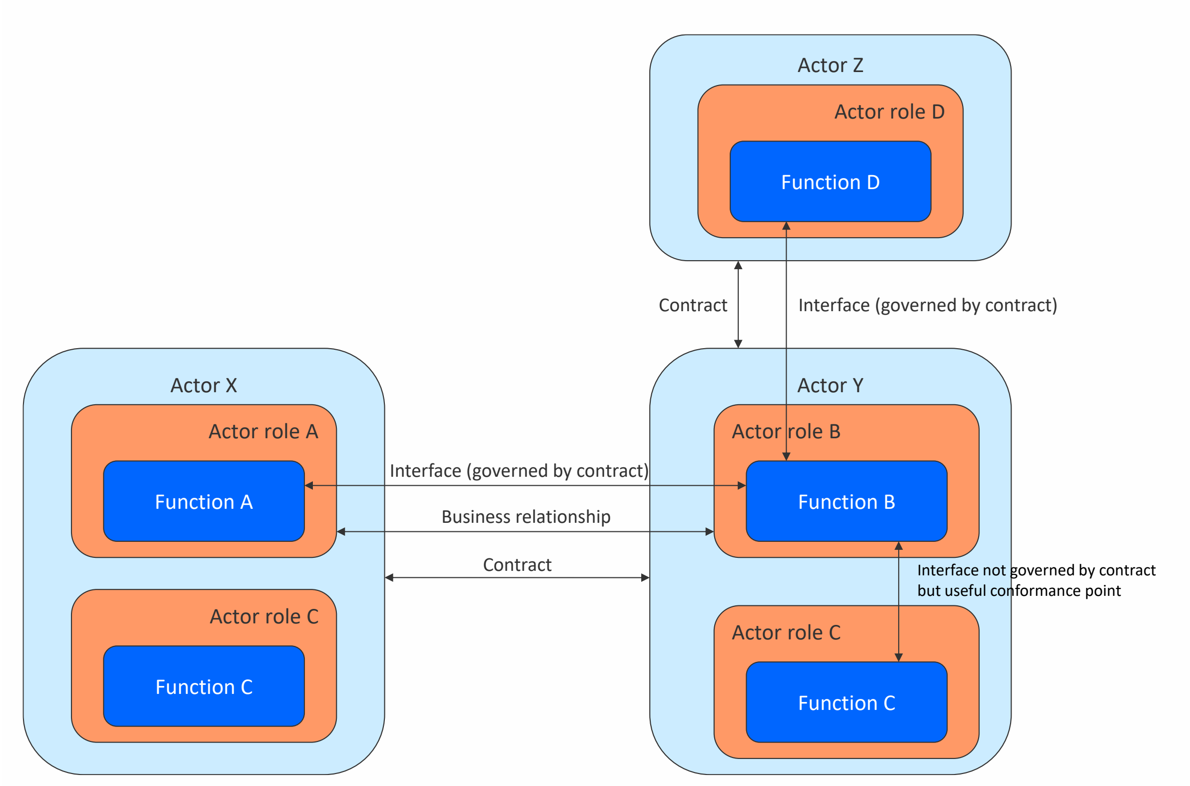

Figure 4: Usage of services.

Note that Y's technical interface for Function B may be the same interface used by:

- Z's Function D,
- X's Function A,
- Y's own Function C

If Functions B and C are within the same actor (Y), their technical interface is internal – not governed by a contract. It is still useful to define that interface (as a conformance point) and we suggest a *business relationship* even within one actor (Y) for consistency.

4.2. MAPPING SERVICE FRAMEWORK AND SERVICE RELATIONSHIPS

By systematically structuring functions, actor roles, and actors, we can identify different relationships and their constitutions. This allows us to specify what a service is in a telecom context, both in terms of their technical functions and business aspects, helping to elaborate on its value, rights, and pricing. This is captured in Table 4, and we suggest that all listed elements are necessary and sufficient to describe a service. The human oriented service definitions, Service-Dominant Logic, is not captured in Table 4.

Table 4: Combining service relationships with service definitions aspects.

Entity	Relationships	Relevant aspects of service definitions
Function	Functional relationship / technical interface	"set of **functions** offered", ITU-T, 1994 [12] "**capability**", Baines et al, 2013 [18]
Actor role	Business relationships between actor roles	"to a **user** by an **organization**", ITU-T, 1994 [12] "**customers** "who want **us** to do it for them"", Baines et al, 2013 [18]
Actor (company)	Contractual relationship between actors	"**customers** [...] will **contract** for the "capability" offered", Baines et al, 2013 [18] "**access** or temporary possession, **instead of ownership**", Lovelock and Gummeson, 2004 [19]
Actor (company)	Payment and pricing defined in a contract	"revenue payments structured around **product usage**", Baines et al, 2013 [18] "with payments taking the form of **rentals** or **access fees.**", Lovelock and Gummeson, 2004 [19]

A service is a defined set of capabilities or functions provided by a network or system to enable communication and support applications. The functions are provided in a technical interface governed by the business entity actor role. The actor role, via the function, delivers value through use to other actor roles which are users, devices, or other systems. Actors are business entities holding the actor roles. A service gives the right to use, but does not transfer ownership between actors. These rights are governed by a contract between actors. The contract also specifies performance levels, operational features, payment, and other business logics.

5. B5G ECOSYSTEM ACTOR ROLES MAPPED TO THE B5G SERVICE FRAMEWORK

In prior BVME work, an understanding of the B5G ecosystem was provided in terms of active actor roles and how these roles generate value in the ecosystem [4]. This section builds on the services framework introduced in Section 4 to explore how different B5G ecosystem actor roles map to that framework, outlining how key roles contribute to service delivery and revenue generation.

For example, the NOP actor role operates at the functional layer of the framework, focussing on technical capabilities exposed by the network (programmable network functions and services defined by ITU-T and 3GPP). Within this layer, the NOP transforms physical infrastructure into functional capabilities consumed by other actor roles and applications.

System aggregators / integrators, CSPs, and DSP translate the underlying network functions into solutions, digital experiences, and integrated offerings that deliver outcomes for enterprises and end-users. Compared to the NOP role, these roles represent a shift from infrastructure-based resource provision to more function-based service offerings and, ultimately, towards more sophisticated services where customer value and pricing are based on outcomes rather than asset ownership. In a layered service ecosystem of interacting stakeholder roles, technical functions, human interaction, and business value come together to shape complementary next-generation services.

The 5G Industrial Device Supplier is another interesting actor role to examine via the service framework. This role provides physical devices, increasingly via a servitization model (devices-as-a-service). The provisioning of radios, sensors, and industrial HW centres on tangible infrastructure and devices that enable connectivity. Additional customer value is then provided by layering services that extend from the HW to network functions and finally to higher-level capabilities exposed to applications and verticals.

This section discusses service differentiation for various B5G and 6G ecosystem actor roles, distinguishing between more mature roles and newer, emerging ones. For relevant services and actor roles, we mostly draw on inputs from three relevant sources [2][3][4].

5.1. MATURE B5G SERVICES

The services and actor roles in Table 5 have been present in the telecom industry for some time and are relatively mature. For example, the **functional** aspect of a CSP's offering is connectivity to the (mobile) network, capabilities like voice communication, internet access, and other applications which run on the Internet. The **servitization** (value-in-use) aspects comes from using the service to reach many customers or applications over the Internet. The **non-ownership** aspect is the right to use the service by entering a contract with the CSP. Regarding **variety**, traditionally CSPs have included labour-intensive customer support as part of their offerings, though many now have strong incentives to re-create variety and differentiation through digital means.

Another way to understand the CSP service is a real example: a mobile operator's monetisation strategy for a smartphone, which goes far beyond simply reselling a physical device. While the handset itself sits in the **physical goods layer**, the operator builds multiple value streams by layering **network functions, digital services** (e.g., including cloud storage), and **experience-based offerings like music applications** on top of the device. This transforms the phone sale from one-off product transaction into an ongoing revenue engine across the life cycle of the device. Similarly, to sell a **Wi-Fi broadband service** to consumers is a mixture of physical and servitized goods component, such as fibre-to-the-home, broadband network functions, and home Wi-Fi router (often leased). Importantly, installation inside and to the home, is performed by human expertise.

The Data Center Service Provider, while newer to telecom, is also fairly standardized. The **functional** aspect is the operation of a cloud environment. The **servitization** (value-in-use) comes from having someone to efficiently host your applications (potentially lower latency, if it is closer to premises, and taking care of energy efficiency and environmental sustainability goals). The **non-ownership** aspect is the right to use the cloud services by contracting with the provider.

In Table 5, we generally do not add **human** co-creation aspects to the described services. If a CSP were co-creating and using its own expertise with customers, it would essentially be acting as a consultant or SI, which falls into a different actor role and thus, service definition. On the other hand, installing a home broadband service require human expertise and labour at the customer's premises.

Table 5: Traditional actor roles and services.

Service / actor role	Function (what it offers)	Servitization (value-in-use)	Non-ownership (access rights)	Human interaction	Variety (human / digital)
Communi-cation Service Provider	Offer functions such as access to a (mobile) network and further functions as Voice, Internet	Connect people, resources, applications Providers "take care of everything"	User gets the right to access the network and use functions like Internet	NA	Customer service (mix of human and digital support)
Smartphone -as-a service (e.g., Apple iPhone via operator)	Cloud storage, music service (bundled with device)	The ability to store music/photos online; can listen to music anywhere.	Right to access music services; right to store data in cloud.	NA	Customer service (mix of human and digital support)
Wi-Fi broadband service	Internet connectivity; in-home Wi-Fi router capability	Access to Internet and wireless connectivity for devices in the home.	User gets the right to use on-premises equipment and access the Internet	Includes installation of fibre-to-the-home, and in-home network.	Customer service (mix of human and digital support)
Network infra-structure as a Service	Operation of passive or active network elements for others	Advanced infrastructure that is up-to-date and shared Provider "takes care of everything"	User gets right to use the infrastructure	NA	Not specified; p resumably digital man agement.
Network as a Service	The operation of a network on behalf of others	Offloads the user's need to invest in their own network Provider "takes care of everything"	User gets right to manage and use the network	NA	Not specified; p resumably digital man agement.
Network operator	Operates a public network	Provides a public wireless network with predictable QoS and mobility; energy efficient; Interconnection Provider "takes care of everything"	Users (e.g., CSPs) get the rights to manage and use network slices and capacity	NA	Mainly from digital means
Data Centre Service Provider	Operates a cloud environment	Efficient application hosting, low latency (if near customer), green (energy efficient) Provider "takes care of everything"	Users get the right to use cloud services	NA	Mainly from digital means

5.2. EMERGING B5G SERVICES ADDRESSING VARIETY AND VERTICALS

This subsection builds on the description of standardised B5G services in the preceding subsection by outlining emerging B5G services that leverage advances in networking to enable new levels of service differentiation. By definition, these services have added elements of **variety**, delivered either by digital means or (in some cases) human involvement - however, in our examples below, variety predominantly comes from digital means.

For example, and with reference to Table 6, a provider of a *Network slice instance as-a-service* follows similar patterns to other services: The **functional** aspect is delivering a dedicated network slice instance to the user. The **servitization** (value-in-use) aspect helps the customer to get a higher efficiency and quality in production by meeting specific connectivity needs that standardized services cannot deliver (e.g., achieving lower latency and jitter for 5G industrial devices in an I4.0 setting). The **non-ownership** aspect is the right the user gets to manage and use the slice instance via a contract with the provider. The **variety** aspect of this service comes from **digital** means, specifically, the programmability of B5G and 6G networks that allows slices with custom attributes to be instantiated as needed.

Table 6: Emerging B5G services.

Service / actor role	Function (what it offers)	Servitization (value-in-use)	Non-ownership (access rights)	Human inter-action	Variety (human / digital)
Network slice instance as a service	Operation of a private or public network that delivers a slice instance.	Meets specific connectivity needs that standardized service cannot (e.g., ultralow latency, jitter). Provider "takes care of everything"	User gets the right to manage and use the network slice instance.	NA	Digital means (SW defined slice management)
Private network as a Service (PNI-NPN)	Operating a private network on behalf of a customer.	Provides network control, specific QoS, potential autonomy for the customer's operation. Provider "takes care of everything"	User gets the right to manage and use the private network	NA	Digital means (remote network management)
QoS on (immediate) demand	Operating a public network to provide specified QoS on demand	Addressing sudden shifts in QoS requirements for connectivity. Provider "takes care of everything"	User gets the right to manage and request QoS when needed.	NA	Digital means (on-demand network QoS management)

Furthermore, there are services provided in the 5G/B5G ecosystem that complement the previously described services, applied across various verticals. I4.0 is used in Table 7: for illustration, sourced from the BVME white paper on emerging business models [4]. We recognize that with AI, human resource-heavy actor roles, such as System Integrators, may change business and pricing models due to a shift from manual towards autonomous integration, AI-enabled systems, as well as moving from reactive support models to predictive and proactive service delivery. In 5G/6G, AI empowers ICT system integrators to design, deploy, and operate intelligent, adaptive, and automated solutions by embedding predictive analytics, autonomous decision-making, and real-time optimisation across the full integration lifecycle.

Table 7: Vertical-specific slice-as-a-Service for e.g., Industry 4.0, PPDR, mobility.

Service / actor role	Function (what it offers)	Servitization (value-in-use)	Non-ownership (access rights)	Human interaction	Variety (human / digital)
Service Aggregator	Curates and aggregates service offerings from multiple providers	E2E solution; risk off-loading for the customer; single point of failure consolidated (i.e., the provider handles complexity) Provider "takes care of everything"	Once the composite services are up and running, the user gets the right to use the E2E solution.	Aggregation and curation of multiple providers' services (significant human role in integration and coordination - see SI role)	Some human effort to deliver the service; digital tools for management
System Integrator	Competence, domain specific insight (integration role rather than standalone function)	The value from the integration can be set according to the value it eventually brings to the user, e.g., a more efficient operation of an airport	NA (usually, the SI is not providing ongoing access - see Service Aggregator)	Integrates subsystems into a unified, seamless system	Value delivered through human means; upfront integration, consultancy, etc (primarily in setup phase)
Digital Service Provider	Digital services integrated with communication and infrastructure	Bundles network and compute services with smart applications (factory automation, etc.) often domain specific Provider "takes care of everything"	User gets the right to use the digital service	May involve some human service delivery, but largely automated.	Some human involvement in service delivery; digital management tools for service

5.3. FUTURISTIC B5G AND 6G SERVICES

Table 8 summarise three services which are emerging with B5G and 6G, namely, Artificial Intelligence-as-a-Service (AIaaS) *and* Data-as-a-Service (DaaS), and as a subcategory Sensing-Data-as-a-Service (SDaaS).

AIaaS is a cloud-based model [27], where the **functional** AI aspects are capabilities like machine learning, natural language processing, or computer vision. The **servitization** (value-in-use) aspect is that a user can consume sophisticated AI tools and APIs from the cloud instead of building complex AI models and infrastructure from scratch. Many organizations find the upfront time and expense of developing a custom AI platform prohibitive; an AIaaS platform lets them utilize AI without those investments. The **non-ownership aspect** is the right to use AI services (with pricing models such as subscription or pay-per-use). AIaaS provides out-of-the-box platforms that add to **functional** and **value-in-use aspects**: they are easy to set up, making it simpler to experiment with various cloud platforms [28], services, and machine learning algorithms [29]. AIaaS grants access to pre-trained AI models via the cloud, meaning users can quickly scale resources up or down as needed, which can affect the price levels. Similar to other cloud-based services, AIaaS providers also manage model updates, infrastructure and security for the users, support different data sources which enables integration with users' data environment. According to a report from Verified Market Research, the global AIaaS market is predicted to reach $273 billion between 2024 and 2031 and demonstrate a compound annual growth rate of 45.9% [30].

DaaS is a concept explored by e.g., the project 5GMETA [31] in connected, cooperative and automated mobility (CCAM) market, as reported in a 5G PPP white paper [32]. In that DaaS example, the data is the core resource. The Data Producer actor role produces data; the **functions offered** to users are the data sets themselves. The **servitization and value-in-use** for the user is that they *"gain access to a wide range of valuable, real-time data, enabling them to enhance their services and applications"* [32]. The **non-ownership** aspect described is that the customer gets the right to use the data, but the ownership of the data is not transferred. Several **pricing models** are suggested, granting rights without ownership (e.g., subscriptions or revenue sharing - essentially outcome-based pricing). Their discussion of pricing models includes factors that can affect price levels (e.g., volume of data or data quality). The white paper [32] also explains that making data available for others to use monetizes it for the data producers. Thus, DaaS in the CCAM market is a compelling case to study to understand the service concept and emerging services in telecom.

SDaaS is a focused subcategory of DaaS in which the core asset is real-time or near-real-time sensing data streams exposed from network and vertical-site infrastructures (e.g., RAN/O-RAN, transport, core, edge, on-prem IoT) as mentioned in [33][34][3][4][35]. Like DaaS, SDaaS preserves **non-ownership** (rights to use, not transfer) and servitization (value-in-use), and it can be consumed by actors to enable/provide services such as digital twins, predictive maintenance, and situational awareness envisioned in B5G/6G. However, considering the high cost of sensing-enabled RAN, and a multi-layer 6G-ecosystem, viewed from a techno-economic perspective, pricing models can go beyond the DaaS granting data rights without ownership (e.g., subscriptions or revenue sharing - essentially outcome-based pricing). In practice they can include also **granting RAN resources dedicated for sensing,** purposely deployed and provisioned for the end-user, even with a co-investment scheme. The reason is that provisioning SDaaS involves layered Total Cost of Ownership (TCO) across: (i) Infrastructure actors (e.g., DCSP/IP, transport and RAN/O-RAN infrastructure providers) that bear significant CAPEX for sensors, radio units, fronthaul/backhaul, and edge compute; (ii) Network Operation actors (RAN/CN NOPs) that incur OPEX to operate sensing functions, in-network processing, exposure APIs, and security/compliance; and (iii) Service Provisioning actors (VISPs/CSPs/DSPs) that can integrate, curate, and monetize the streams.

Table 8: Emerging B5G and 6G services.

Service / actor role	Function (what it offers)	Servitization (value-in-use)	Non-ownership (access rights)	Human interaction	Variety (human / digital)
AI as a service	Machine learning, natural language processing, computer vision capabilities provided via cloud	Allows users to leverage compl ex AI models and infrastructure without building them from scratch. Providers "take care of everything"	User gets the right to use AI capabilities	NA (AI services are delivered via cloud with no human intervention in standard use)	NA (service access and scaling are through digital platforms)
Data as a Service	Produces and curates data for users to consume	Value comes from using the data in new contexts and applications.	Users get the right to use data (no transfer of data ownership)	NA (data is provided via digital platforms)	Digital means for access to data (APIs, portals, etc.)
Sensing Data as a Service	Produces and curates data for users to consume. Deploys purposely built/configure infrastructure for service provisioning.	Value comes from using the data in new contexts and applications.	Users get the right to use data (no transfer of data ownership). Granting RAN resources dedicated for sensing	NA (data is provided via digital platforms and infrastructure)	Digital means for access to data (APIs etc.).

6. HOW TO MONETIZE A B5G SERVICE

6.1. SERVICE PRICING MODELS AND LEVELS

Based on our framework we suggest the following when considering the pricing models for a service. A **pricing model** is defined in a contract between actors and shaped by the rights to use or value-in-use. The right to use can be captured in well-known models, such as subscriptions, licenses, time-bound access, pay-per-use, or package deals. The servitization (value-in-use) introduces the option of outcome-based pricing, where the customer pays for the outcome of using the service (e.g., a decrease in factory waste). Within one pricing model, the **price level** may vary with the quality of a function (e.g., access to lower latency, geographic scope, etc.). An achieved outcome can decide a price level, e.g., a 10% reduction in waste leads to a 5% price increase (we are here not discussing implementation challenges for an outcome-based price model). Beyond outcomes, price levels can be set by capturing customers' various values-in-use (e.g., having effect on time, reach, quality, energy, cost and many more domain-specific aspects). Moreover, competition can always affect the price level but affects the price model to a lesser extent. Scarcity of resources and services may also affect perceived value and, in turn, willingness to pay and price levels, e.g., specific human competences or HW on demand.

Table 9: Service aspects, price models, and service-based drivers of price levels.

	Function	Servitization (value-in-use)	Non-ownership (Right to access)	Human Interaction	Variety (Human / Digital)
Service price models	N/A	Pay for outcome	Pay for right to use	Pay per hour or per project	N/A
Factors affecting price levels	Quality of function, bundles Scarcity of function	Level of outcome achieved Value-in-use, affecting users' time, quality, reach, risk, etc.	Usage parameters: time, volume, geography, flexibility, delivery time, session length, context, device count	Scarcity of human expertise and competence; delivery time.	Human co-creation involvement; degree of differentiation/ personalization; delivery time
Costs affecting price levels	CAPEX; scalability of solution	Uncertainty and risks	OPEX	OPEX; human resource and competence scarcity and expertise costs	CAPEX, OPEX, scalability

Labour-intensive services involving human interaction are often priced per hour or per project. However, even for such services an outcome-based model can sometimes be applied. Table 9 summarizes how different service aspects relate to pricing models and service-based drivers of price levels.

The cost side of delivering the services (CAPEX, OPEX) also plays a role in pricing decisions, particularly regarding cost-efficiency and scalability. This holds for the core *resources* used to create and operate the service functions (infrastructure or human competence). Furthermore, cost- and investment-sharing can be negotiated between providers and customers, impacting key building blocks of different actors' business models (e.g., cost structure, key resources, and key partners).

From previous work in BVME [1][2][3][4] we have learnt that network features in a B5G ecosystem function together with e.g., devices and applications. This is also indicated in some of the service examples provided above. Eventually, network operators' prices are not set in isolation; customers' value-in-use is affected by many components.

6.2. B5G SERVICE AND PRICE MODEL EXAMPLES

The above pricing models and levels are generic. In this section we apply the pricing models to examples and discuss some applied approaches.

Network Service for Industry AR-glasses (I4.0): A manufacturer needs a network to support Augmented Reality (AR)-glasses used for inspecting high-value objects produced. The **functional** aspect of the service is an indoor wireless network with high bandwidth and low jitter. The **servitization (value-in-use)** for the manufacturer is the higher inspection efficiency and accuracy, leading to higher customer satisfaction. The **non-ownership** aspect is the right to connect devices and use network capabilities operated by the provider (the manufacturer does not own the network). To identify the right solution to this problem, a **human-based co-creation** process could have taken place (e.g., a collaborative design between provider and manufacturer). A **digital** tool might be offered to manage the network usage (e.g., connected industrial devices and their access rights). If the service **price model** is "right to use", it could be implemented as a subscription. The **price levels** might be affected by technical metrics like jitter, business aspects like number of AR glasses that can connect simultaneously, or even the manufacturer's increased end-customer satisfaction levels. This last point is interesting in terms of value-in-use, particularly if higher end-customer satisfaction leads to fewer product returns and thus lower operating costs for the manufacturer. The value of these types of saving could also be accounted for in the pricing level.

On-demand Gaming Network Boost: A common monetization example is a consumer who wants a better network experience while gaming. The **functional aspect** of this service is an outdoor network with low latency. The **servitization (value-in-use)** for the gamer is the ability to achieve higher in-game performance (e.g., win competitions and prizes, and create content that generates revenue). The **non-ownership aspect** is the right to connect one's device to and use a customized network capability operated by a provider. A **digital** tool could be offered to manage network usage (e.g., controlling which gaming devices get the boost and when). If the service **price model** is "the right to use", it could be realized by a pay-per-use or per gaming session. The **price levels** might be affected by geographical constraints, or by business factors like lead time for on-demand orders (e.g., scheduling a boost in advance vs. instantly).

Flat connection charges have helped the telcos simplify charging [36], however, it can be seen as an example of how telcos set a price on a function instead of the value. The fierce competition for market shares has created a race to ever cheaper subscription prices. Even new costly service features in subscriber packages have not unleashed increased willingness to pay. Furthermore, the fact that one operator rolls out a new feature requires other operators to eventually follow suit. This results in new costs for the operators with no increase in revenue, and as illustrated in Figure 5, the question arises as to who pays for the new features.

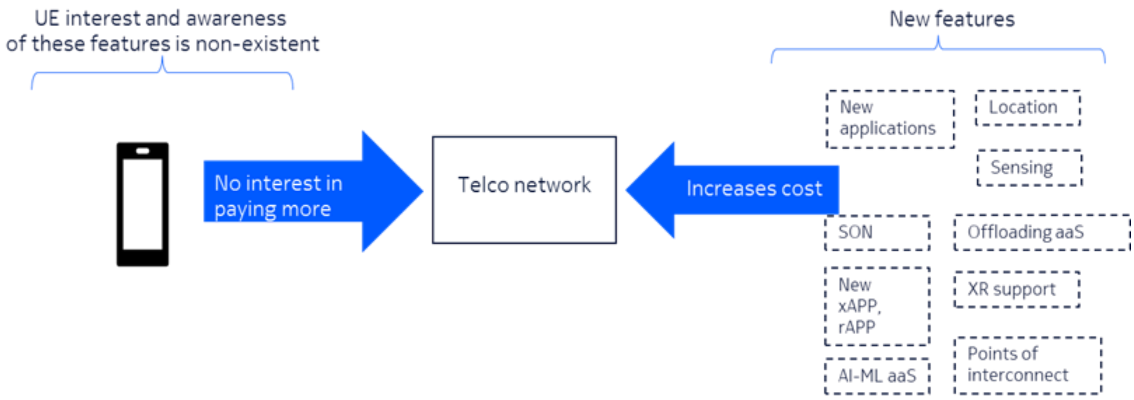

Figure 5: Who pays for the development of new features for the network

There is a silver lining, however. In the evolution towards 6G, more varying devices and form factors (e.g., robots, helmets and clothes, in-body devices, glasses, tools, moving vehicles) intended for different service functions need to be handled differently with the emerging virtual and programmable networks, and network slicing. The challenge is still to **create *differentiation* by combining the relevant network features to specific devices and applications so that the users and customers perceive value-in-use and pricing can be set accordingly**.

However, *smart phone owners* may still have some interest in buying a more expensive connection without a clear benefit. E.g., T-Mobile US seems to have taken steps in packaging and emphasising value-in-use and rights to access by advertising better value, quality and connectivity to its customer base (see Figure 6). Thereby, they have increased their market share. For yet other operators, the challenge remains to add network features combined with devices, applications, and other offerings, to increase perceived value-in-use, and thus legitimately increase prices to their existing customer base.

This challenge is exactly what this white paper seeks to address: the proposed service design framework bridges network technology and business perspectives and supports telcos to better develop price models and levels in the emerging B5G and 6G markets.

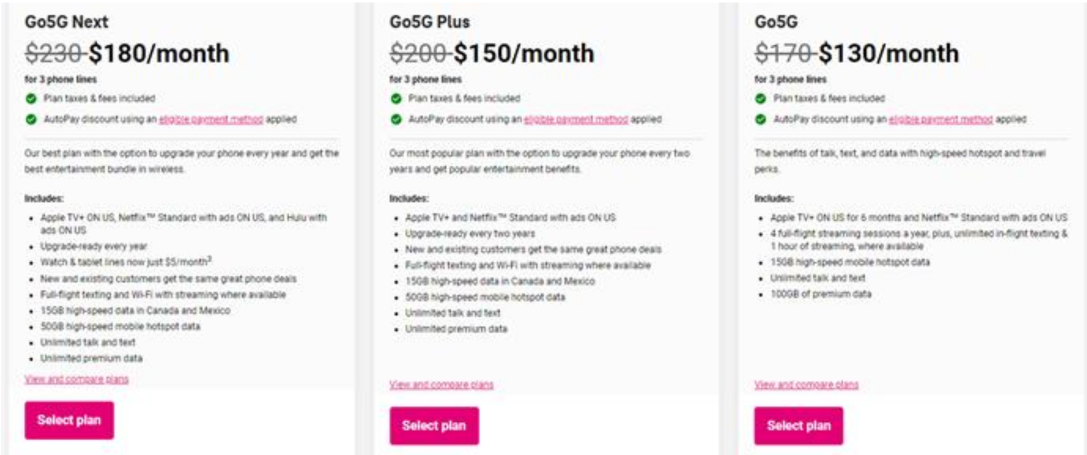

Figure 6: Differentiating smart phone subscriptions

6.3. THE B5G SERVICE PLATFORM

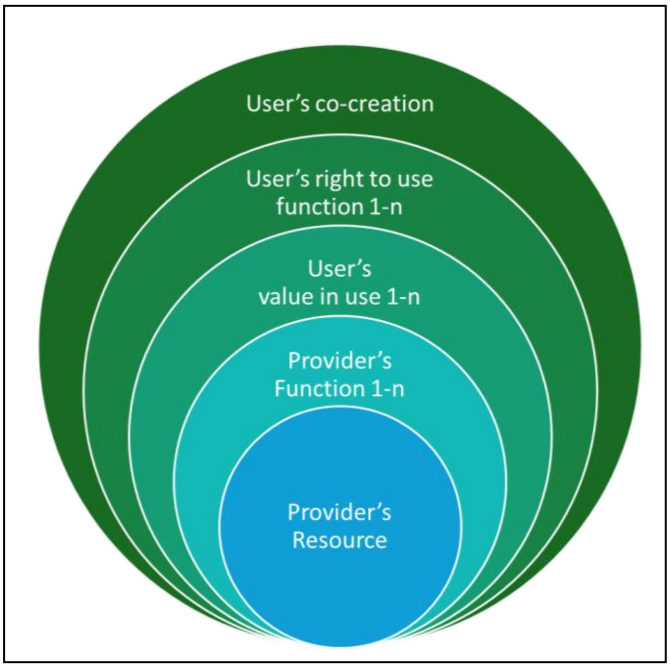

Figure 7 Aspects of service definitions combined as a service platform

According to recommended innovation practices [1], designing a service and B5G ecosystem solution should always start with a customer problem, either directly or via complementors in the ecosystem. However, our service framework also allows for centring around the resource / network side and offers a conceptual architecture of a service platform. In Figure 7 the resource might be a network operated and owned by a Network Operator (or a combination of many resources together creating functions). From this resource, many functions can be offered to users. Users extract value-in-use in many ways by using the service, and the service also consists of the users' right to use the function, with no transfer of ownership. All this may be framed in a customer-provider interface where the service is co-created.

With this, the investment in and operation of a resource is disentangled from the functions it offers. However, to be economically sustainable, the resource should support many different functions and user rights. We reiterate how telecom's functional service definitions elegantly distinguish the service function from the enabling technologies; the platform can use virtualised network functions, programmable infrastructure, and their exposure as enabling mechanisms. Or, from the user perspective: if the rights to use a function are adequately provided, it does not matter how the technologies enable it.

We acknowledge that operators of public mobile network are interconnected, and that services and users are at different end-points, and thus "off" or "on" a home network. Thus, the global telecommunication service platform may be constituted by different operators, which again are combinations of yet other resources and providers, thus, a truly multi-stakeholder platform in a platform ecosystem (see also [2]).

7. SUMMARY AND RECOMMENDATIONS

This white paper explores the emerging B5G landscape from a service perspective. We start by explaining why it is necessary to look beyond connectivity alone, arguing that the real value and profit of B5G investments will be delivered through services that build on virtualised network functions and programmable infrastructure. We give examples of actor roles – from CSPs and NOPs to integrators, aggregators and digital service providers – and document how their differing cost structures and revenue models contribute to service delivery within the current B5G ecosystem.

7.1. SERVICE FRAMEWORK

We propose a **service framework** that decomposes a service into its **functional** provisioning (what the network does), its **servitization or value-in-use** (how customers derive benefit), its **non-ownership and right to use** structure (rights to use rather than own assets), its degree of **human interaction,** and how variety is added to the service through human or digital means. We apply the framework to current and emerging telecommunication services, demonstrating the feasibility of the framework and building new insight in how different service components contribute to a service's total perceived value. The application areas of the framework span advanced B5G and emerging 6G functionality and can be combined with yet other technologies and features.

7.2. PRICING MODELS

The service framework enables a more structured analysis and exploration of B5G pricing models. The **right-to-use** without ownership explains the relevance of e.g., continuous subscriptions or pay-per-use price models. **Value-in-use** explains how prices are decided not only from functional capabilities, but the users' and customers' perceived values. In turn, this opens for further exploration of the revenue and pricing aspects in B5G and 6G business models, and reasoning around potential market growth.

7.3. STRATEGIC RECOMMENDATIONS TO THE INDUSTRY

The challenges for a service-centric telecom sector lies not only in developing and exposing functions as services, but **to understand users' value-in-use and from this suggest service price models and levels**. The industry's goal is to move from connectivity as a raw commodity to an enabler of enhanced business and consumer value. The proposed framework is intended to highlight opportunities for right- and value-based pricing models and **advocates for experimentation** with hybrid subscriptions, revenue sharing and other performance-based billing, to capture new revenue streams rooted in verified stakeholder value.

The BVME sub-working group holds that innovation should be driven from understanding user and customer expectations and, in turn, translate these into sustainable and market-ready services [1]. This white paper maintains the idea that a complex and dynamic ecosystem involves multiple actor roles who jointly create value and deliver services (see BVME whitepapers [3][4]). Thus, when using the service framework, we recommend **exploring all the actor roles involved in service delivery and considering the value creation throughout the ecosystem**. Crucially, this means considering not only users' value but also how a service operation may extract and impact the values of yet other stakeholders.

The white paper describes opportunities with new service approaches but does not elaborate on further barriers to achieve the goals. Indeed, we have taken inspiration from the Information and Technology (IT) industry such as SaaS providers, but we have not discussed the competition. The IT industry works under different regulations in faster cycles than the telecom industry – this is further exacerbated by the introduction of AI functionality. **Thus, barriers and competition have not been covered in this white paper and is a topic left for future work.**

7.4. RECOMMENDATIONS TO RESEARCHERS IN THE B5G AND 6G COMMUNITY

European research and innovation projects typically must deliver results related to the technology in focus, e.g., increasing technology readiness levels, technology validation, and contributing to standardisation. Moreover, there are also high expectations for exploitation, market development, definition of business models and cases, and sustainability compliance. The proposed service framework can guide different expertise on how to combine their aims for technology excellence with business success in a service and value-centric era.

Technology development must still focus on service *functions*; however, it is imperative to enable services to be composed and delivered from a *commercial* perspective. **Service business model development** must detach from the technological and functional perspective, have full focus on customers' value-in-use and how to capture revenues from this. Furthermore, a value approach must include all relevant stakeholders to sufficiently address concerns along all sustainability pillars: social, environmental, and economic. A service model on the one hand reinforces, the importance for virtualised network functions, programmable infrastructure - providing flexibility and tailor-made solutions required to satisfy the complexity of different stakeholders and their potentially conflicting values, while on the other hand, highlights the continued significance of an ecosystem business modelling approach centred around stakeholders and their extended value propositions [1][2][3][4].

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9. ABBREVIATIONS

Abbreviation	Full text
3GPP	3rd Generation Partnership Project
5G PPP	5G Public Private Partnership
6G IA	6G Smart Network and Services Industry Association
AI	Artificial Intelligence
AIaaS	Artificial Intelligence as a Service
API	Application Programming Interfaces
AR	Augmented Reality
AS	Application Supplier
B5G	Beyond 5G
BVME	Business Validation, Models and Ecosystems
CAPEX	Capital Expenditure
CCAM	Connected, Cooperated, and Automated mobility
CN	Core Network
CPE	Customer Premises Equipment
CSP	Communication Service Provider
DaaS	Data-as-a-Service
DCSP	Data Centre Service Provider
DSP	Digital Service Provider
E2E	End-to-End
HW	Hardware
I4.0	Industry 4.0
ICT	Information and Communication Technologies
IoT	Internet of Things
NA	Not Applicable
NaaS	Network as a Service
NOP	Network Operator
NPN	Non-Public Network
NSaaS	Network Slice as a Service

KPI	Key Performance Indicator
KVI	Key Value Indicator
LNaaS	Logic-Network-as-a-Service
ML	Machine Learning
MNO	Mobile Network Operator
OPEX	Operating Expense
O-RAN	Open Radio Access Network
PLC	Programmable Logic Controller
PNI-NPN	Public network integration with non-public network
RAN	Radio Access Network
SA	Service Aggregator
SaaS	Software-as-a-Service
SDaaS	Sensing-Data-as-a-Service
SDL	Service-Dominant-Logic
SDO	Standard development organizations
SI	System Integrator
SNS-JU	Smart Network and Services Joint Undertaking
SME	Small and Medium sized Enterprises
SW	Software
TCO	Total Cost of Ownership
TS	Technical Specification
VISP	Virtual Infrastructure Service Provider
VNF	Virtual Network Function
VMT	Value Mapping Tool
VM	Virtual Machine
VR	Virtual Reality
XR	Extended reality
XaaS	Alternative interpretations: Experience-as-a-Service Everything-as-a-Service

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