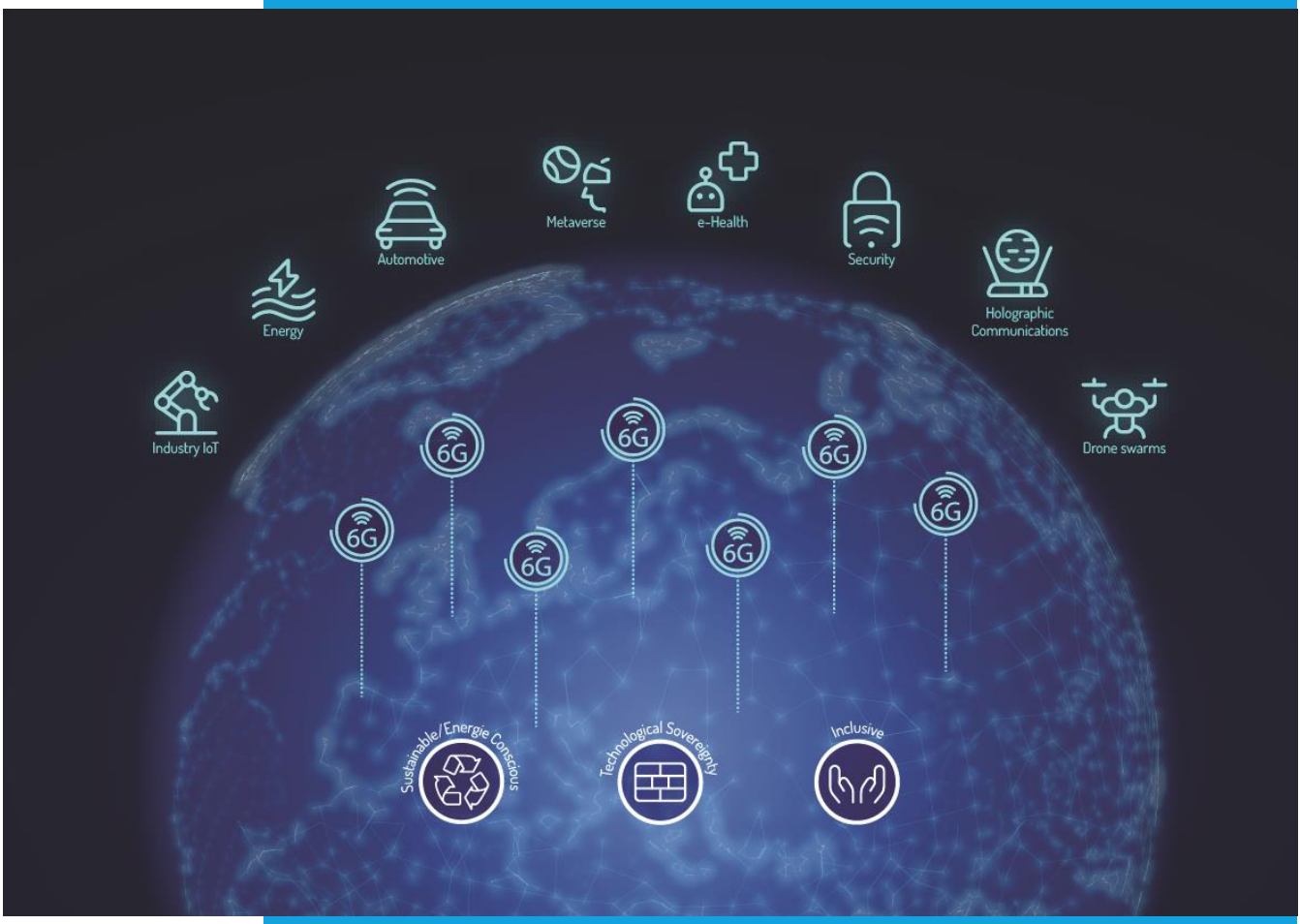
6G Smart Networks and Services Industry Association
(6G-IA)

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## White paper – short version

# 5G AND BEYOND 5G ECOSYSTEM BUSINESS MODELLING

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# EXECUTIVE SUMMARY

In the telecommunication sector, the evolution of service delivery models in the 5G era was triggered by two technology-driven trends. The first one pertains to the industry transformation needed as a means to overcome poor cost efficiencies and low flexibility in delivering services covering a wide range of requirements, as defined by the new service classes introduced by 5G: enhanced mobile broadband (eMBB), ultra-reliable low latency communications (URLLC) and massive IoT (mIoT). The second trend relates to a technological paradigm shift towards full softwarisation of network functions and a novel network architecture based on disaggregation thereof.

These trends provoked a transition from linear value chains, with simple relationships between vendors and operators, to complex value networks, which imply a multitude of relationships between several enterprises to formulate and deliver a value proposition to the customer. We use value networks to model ecosystem-based value creation in these complex systems. We differentiate between a provisioning ecosystem, catering to developing and delivering 5G and beyond 5G services, and a vertical ecosystem, which uses 5G and beyond 5G services in combination with other technologies to deliver applications to vertical customers.

Although these trends promote innovation at various levels, they also pose challenges for enterprises in identifying their position in the value network of the relevant ecosystems and formulating their business models. Business modelling is generally well understood as a conceptual structure that explains how an enterprise operates and intends to achieve its goals towards creating value for its customers and monetising on its activities. However, in the new context of business activity in the new 5G ecosystem, the business models of different enterprises are interdependent. This becomes more of a challenge, especially when markets are immature, and the business relationships are not well-established, and thus there are multiple configurations of how an ecosystem can be realised.

Enterprises in 5G and beyond 5G should follow an *ecosystem business modelling* approach that considers all potential configurations of how an ecosystem can be formed, i.e., potential business models that will be adopted by other players and the resulting network effects. The inherent ecosystem dynamics induce an iterative process for enterprises to continuously adjust and optimise their initially formulated business models, following the interactions with other ecosystem actors. The necessity for continuous adjustment calls for business modelling tools that help them to streamline this process. Furthermore, in order to ensure an alignment with the ambition of 5G and beyond 5G technology vision to meet sustainability goals - as defined by the United Nations Sustainable Development Goals (UN SDGs) - enterprises must adapt their understanding of how business models are developed and how they can evolve.

With sustainability in mind, business models should prioritise long-term values over short-term interests and gains, and combine these with the definition of extended values that consider societal and environmental sustainability targets along with economic outcomes. A sustainability-oriented business model ensures that value creation, delivery, and capture ensure an organisation to contribute to tackling sustainability challenges and promote

sustainable development. Furthermore, embracing systemic thinking allows bidirectional interactions with internal and external actors to reflect upon potential outcomes and to capture capacities through stakeholder integration.

Aiming for the development of sustainability-oriented business models in the context of ecosystems, we propose an iterative ecosystem business modelling methodology composed of five steps, named as “expand”, “focus”, “design”, “business case development” and “iteration”.

**1) "Expand" step:** an enterprise identifies the scope of the ecosystem, including the potential number of relationships with other actors and the potential frequency and extent of changes in the relationships. In this step, the enterprise also identifies possible other ecosystems it could be part of with its defined business model.
**2) "Focus" step:** an enterprise settles its value proposition, including economic, societal, and environmental value, and identifies the necessary capacities to deliver value. In this step, it formulates the activities in the ecosystem that best fit its strategic goals, considering the ecosystem dynamics, and identifies potential disruptive factors.
**3) "Design" step:** the specific enterprise business model is analytically defined, using established advanced tools that consider sustainability-oriented business modelling elements. The challenge here is to model and compare multiple business models in the context of varying relationships with other actors as part of the dynamics of the ecosystems. This calls for a new generation of modelling tools that can logically associate possible business models and analyse and compare the outcomes.
**4) "Business case development" step:** an enterprise can follow existing approaches on sustainability-oriented business and revenue models, with which it can estimate and compare its market opportunities.
**5) "Iteration" step:** defined as a step in its own right to cater for the importance of the necessary adjustment and optimisation of the business models introduced above.

The practical application of ecosystem business modelling can imply the segmentation of an ecosystem into smaller sub-ecosystems as a means to handle complexity. It employs the aforementioned concepts and tools to comprehensively analyse the potential of an enterprise to engage in the ecosystem and its sub-ecosystems. This potential is evaluated through a sustainability-oriented ecosystem business model assessment, which ideally is substantiated by concrete turnover/cost/revenue models and the ability to compare the viability of different assumptions made along the entire modelling process.

Concluding, this white paper provides a methodology as a recommendation for sustainability-oriented business model innovation and development based on five steps. These steps were derived from experiences in numerous 5G PPP projects, where a multitude of modelling tools have been used to tackle the problem of positioning a viable business in the value network and formulating a desirable value proposition for their customers. Readers are invited to access the extended version of this white paper (here) to better understand the analysis methods used to articulate business value within these projects. In that version of the paper, the reader is provided with more detailed guidance on how to practically implement the full range of steps introduced here. From this, an understanding can be derived of best practices that companies can follow to assess the wider ecosystem in which they operate and their role in it.

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# 1. INTRODUCTION

The Ecosystem Business Modelling Challenge

We could claim that the business models in the 5G and beyond 5G era are not more complex than they were during the launch of 4G or 3G. This would be the case if we assumed a simple continuation of service delivery, revenue generation and profit models. However, 5G and beyond network technologies introduce fundamental technological transformations compared to earlier generations. The resulting technologies allow for a much more open market, and as a consequence dramatically increasing the number of alternative business models available and driving the market towards emerging business ecosystems. Although ecosystem-based markets can be highly beneficial for participants [1], they create significant complexity in deriving appropriate business models that ensure profitability for each of the enterprises involved while delivering the expected value to customers.

As expressed by many experts in the SNS Smart Networks and Services Industry Association (6G-IA) [2] sub-working group on Business Validation, Models, and Ecosystems (BVME), the resulting difficulty that arises when designing business models in the context of 5G and beyond 5G ecosystems, is effectively summarised in the following (fictitious) statement:

"As an enterprise in the 5G ecosystem we struggle to define our sustainability-oriented business model because there are so many key partner enterprises we do not control, and so many alternative combinations."

The challenge is highlighted if we consider a single enterprise operating in a traditional (linear supply-chain) market. In such a situation, the business model definition ideally evolves as a result of a nested process, as illustrated in Figure 1. The process starts from an enterprise's strategic plan that explains which specific long-term goals an enterprise expects to achieve and how. From its strategic plan the enterprise derives a business strategy, which sketches the steps needed to achieve its long-term goals. The next step in the process is defining a business model that identifies how the enterprise creates economic and societal value. It also provides concrete steps to deliver this value and capture the associated revenue. Embedded in its business model, each enterprise will define one or more business plans and formulate associated business cases that support the execution of the business strategy.


Figure 1: Nested process for the evolution and development of a business model

However, this ideal and sequential process is challenging to apply for an enterprise that struggles to catch up with the pace of technological development and the need to reposition

itself in a dynamically changing ecosystem. This effect is particularly evident in the 5G and beyond 5G market environment, which is evolving rapidly with a plethora of emerging new products and services, as illustrated in Figure 2. Enterprises are in urgent need of tools to help them quickly adapt to competitive pressures through sustainability-oriented business models.

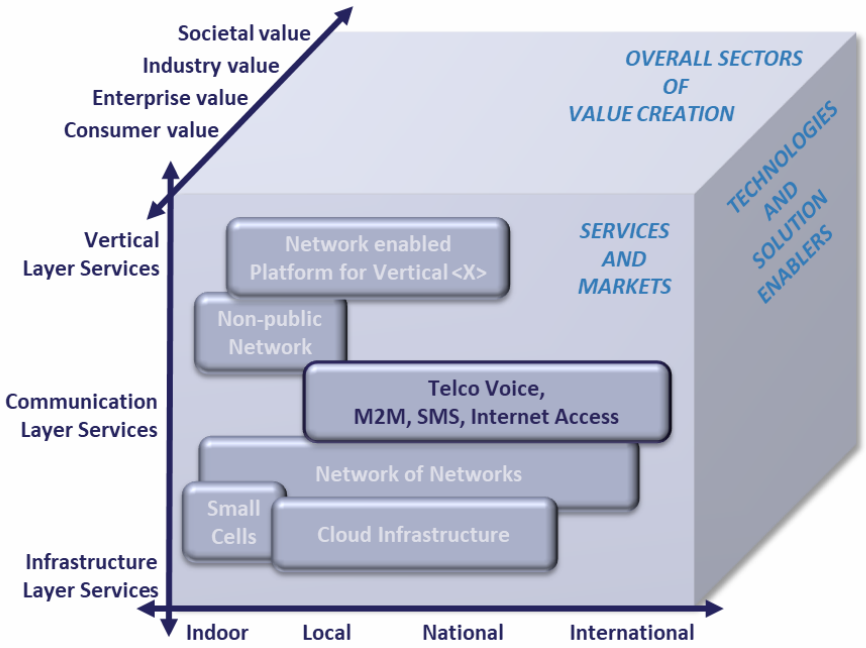


*Figure 2 Plethora of traditional and new services, across multiple domains*

To support the discussion, we need to clarify the conceptual background of ecosystem. [1] defines a 5G ecosystem as a complex network of interacting cross-industry actors who work together and depend on each other to define, build, and deliver value-creating customer solutions. The depth and breadth of potential collaborations among actors characterise the ecosystem, with each actor delivering a piece of the solution and thus contributing to the strength of the overall ecosystem. The power of the ecosystem comes from the fact that each actor can derive profitable returns without the need to own or operate all components of a solution. In a *business ecosystem,* the relationships can transition from transactional to strategic, and the business model impact changes from incremental to disruptive, as depicted in Figure 3. The intention is not just to aggregate value (1+1=2) but to generate additional value (1+1>2). Thus, all enterprises in the ecosystem should acquire more value than they would capture independently.

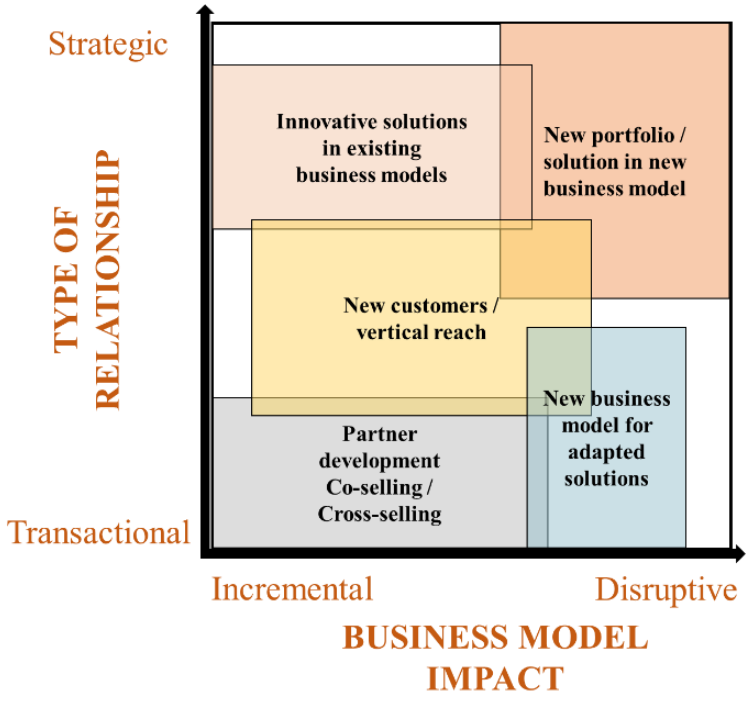


*Figure 3: Ecosystem collaboration ambition*

In the context of 5G PPP [3] projects, the white paper on *Business Validation in 5G PPP vertical use cases* [6] proposes a flow of business development activities in 5G and beyond 5G ecosystems. These activities guide the enterprises participating in these projects in positioning themselves in the ecosystem value network. Lean Start-up methodologies inspire the business development activities, which are divided in four phases: Customer validation, Solution alignment, Business Model, and Growth Trajectory.

Similarly, following the argumentation in [6], we assume that no enterprise operating in the 5G and beyond 5G ecosystems could individually deliver on the full value proposition to the customer. Therefore, before designing a business model, it is necessary to align understanding with partner enterprises on how to jointly present a value proposition and deliver a solution which properly meets customer's expectations. Therefore, when starting to design an ecosystem-based business model, each enterprise must acknowledge its dependency on other enterprises and rule out the possibility of serving the customer alone.

New Market Dynamics Driven by Technological Transformation

Although it is often argued that complex ecosystems existed with previous-generation telecom networks, the business models that eventually emerged were much simpler, in most cases, exhibiting a linear one-to-one cooperation flow. As illustrated in Figure 4, previous business models tended to be linear. In contrast, today's cooperation tends to be more circular and cooperative, building upon multilateral cooperations based on the skills and capacities of each interacting enterprise in the ecosystem. As a result, ecosystem-based value creation can be modelled and presented by means of value networks.

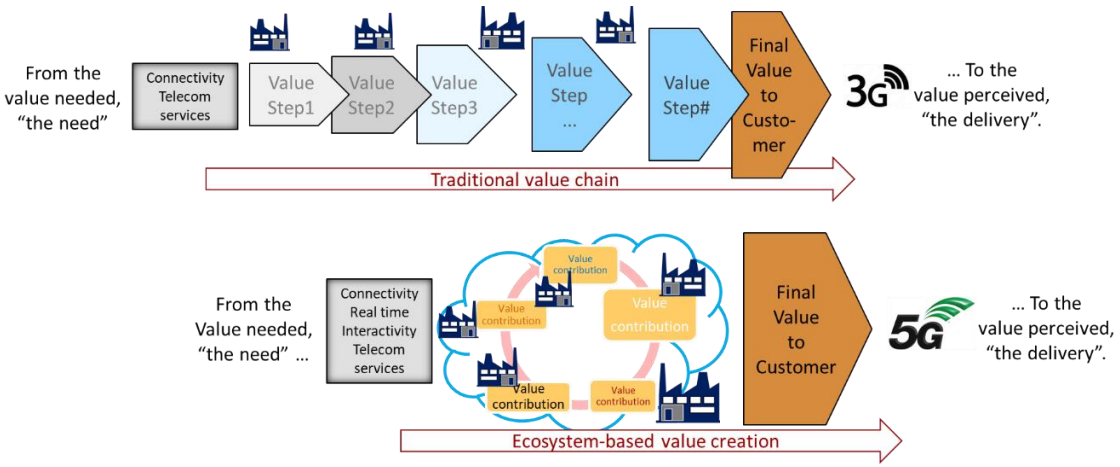


*Figure 4: Transition from linear value chain to ecosystem-based value creation*

An example of this is seen from the past 3G era, where the association between a vendor and an operator was a simple linear relationship of order-delivery and was enough to deliver telecom services to the market. The emergence of 4G and, more notably, 5G evidenced the need to establish more complex cooperation arrangements. One trigger of this need was the softwarisation of the telecom infrastructure, which implied a transition from pure telecom technologies to information and communication technologies.

The ongoing softwarisation and disaggregation of telecommunication technologies induce the relevance of the ecosystem approach to 5G and the forthcoming expected 6G markets [1]. This transformation in the 5G ecosystem is *intentional*, meant to mitigate current poor cost efficiencies and low flexibility, as well as *enforced* upon the industry by customer demand and competition. The different facets of this technological transformation include the transition from:

- equipment-based solutions to a platform-based foundation for the delivery of services
- "silo" network deployments to multi-domain, interoperable networks
- "closed" networks to open systems which expose network capabilities for customers and partner enterprises alike to innovate upon.

The disaggregation of technologies promotes interoperability and innovation, lowering barriers for new entrants. This technological transformation also facilitates new contenders to promote and develop disruptive business models while supporting the interaction of multiple ecosystems, such that value providers can cooperate and compete and where customers may choose among alternative offerings. The accessibility to the technologies enabled by open and interoperable systems creates multiple ways of addressing the market needs based on different business model formulations among suppliers, developers, integrators, service providers etc.

5G Non-Public Networks (NPNs) [7] are an illustrative example. A customer may ask an operator for an end-to-end solution or directly delegate the implementation of the private network to an equipment vendor or integrator. The traditional telecom operator is relegated to just connectivity. These multiple scenarios, occurring in different markets and all their

variances, will instigate alternative business models. In each model, the contribution of a single enterprise will be different, and therefore the resulting profits will be redistributed differently.

To address the complexity described above, the white paper *5G Ecosystems* [1] partitions the ecosystem into a *5G provisioning ecosystem* and a *5G vertical ecosystem*, which are complementary to each other. The *5G Provisioning Ecosystem* caters to developing, delivering, and providing 5G services while the *5G Vertical Ecosystem* applies 5G services in combination with yet other technologies and offers them to vertical customers and users (see Figure 5).

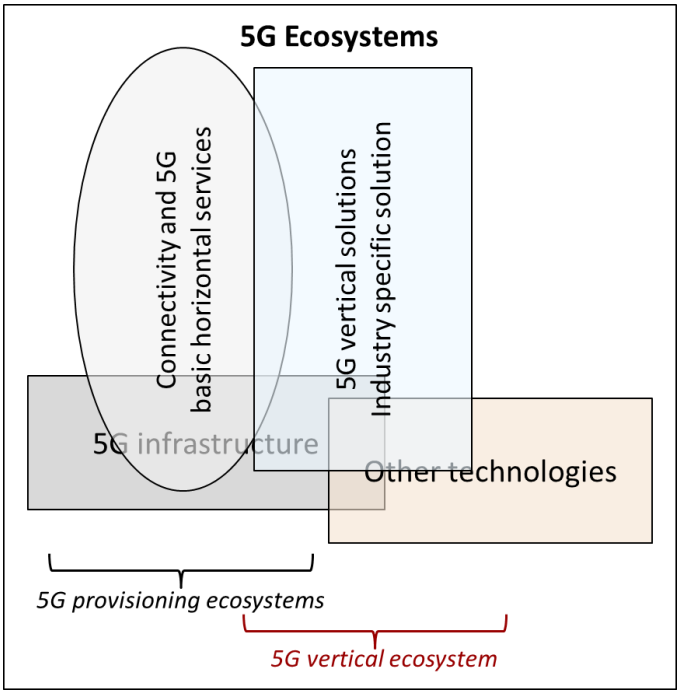


*Figure 5: Partitioning of the 5G ecosystem*

The roles in the 5G provisioning ecosystem include, among others, Service Providers, Network Operators, Hardware and Software Suppliers, Cloud providers, Datacentre Providers and Solution integrators. The roles in the 5G vertical ecosystem include, among others, Software Providers, Data Processing and Hosting Providers, Service integrators, Computer Consultancy, as well as vertical sector-specific roles from sectors such as industrial automation, healthcare, or automotive. The enterprises that are assuming the aforementioned roles may vary. Therefore, this white paper addresses the needs of a wide diversity in mind, from incumbent enterprises to new market entrants, from large corporations to small and medium enterprises.

Inherent Uncertainties of Ecosystems

Previous work of the 6G-IA working group on Business Validation, Models, and Ecosystems (BVME) has presented a detailed discussion on how current trends in the 5G market demonstrate ecosystem characteristics [1]. As discussed earlier, the ecosystem approach has significant benefits. The enterprises depend on each other and aggregate value from each other to deliver value to their customers, drive innovation and grow the market beyond what a single enterprise alone would be capable of.

However, ecosystems suffer uncertainties and tensions as the business models mature because cooperating enterprises compete for market share and continually refine their business strategies. This often causes changes in the role they play and impacts the business models of others in the ecosystem.

Such uncertainties stem from the dynamic nature of ecosystems, where an enterprise's contribution to the market can become less relevant, less effective, or even obsolete, or its market share can rapidly erode. This erosion can be caused by other, potentially more dominant enterprises that expand investments within the roles they assume or that invest to position themselves in new, competing roles within the ecosystem. Despite these challenges, operating in an interdependent ecosystem is still in the best interests of all 5G stakeholders for maximising value creation and associated revenues and thus promoting innovation and market growth.

Framework to Mitigate Ecosystem Challenges

To help reduce the challenges arising from the inherent ecosystem dynamics described above and to support enterprises in making informed business decisions regarding their engagement in the 5G market, this document aims to provide a detailed overview of effective 5G business modelling tools and frameworks. It will support all stakeholders in the 5G and Beyond 5G ecosystems to make more informed investment decisions, encouraging market growth.

We take learnings from the complex 5G ecosystem sketched so far, where we infer that there is no single business model but rather a plethora of different interrelated business models at play. Due to the large number of business model formulations, we cannot emphasise one 5G business model but rather derive different business models for the numerous opportunities that 5G facilitates. This calls for a framework to address the gap between a single enterprise's business model development and the complex mixture of business models for the many other enterprises in a 5G ecosystem. The overall goal of a framework is to allow each enterprise to reap value and profit from innovation and market growth.

The overall partitioned 5G ecosystem described above further stresses the necessity for such a framework. Even in cases that allow for finer-grained segmentation, considering, for example, network creation, horizontal services, vertical applications etc., we can employ the framework to describe for each of the finer segments a specific ecosystem and associated business models for each participating enterprise. Most likely, every enterprise can participate in multiple ecosystems simultaneously, with a separate business model in each, and their aggregation will contribute to the execution of the enterprise's business strategy. It is interesting to note that the ambitions of an enterprise's business model will condition and influence the overall ecosystem.

A critical element to consider in the creation of viable business models is the increasing focus on how enterprises can extend their value contributions to society beyond shareholder and economic value by addressing social and ecological sustainability alongside economic sustainability. This focus also addresses goals as formulated, for example, in the United Nations Sustainable Development Goals (SDGs) [8] and the European Green deal. In order to comply with these normative frameworks, this paper combines 5G ecosystem business modelling with approaches to model sustainability-oriented business model design. After introducing the

relevant business modelling approaches, we extend the focus to sustainability-oriented business modelling, before adding the ecosystem perspective.

To address the targets outlined in this section, the remainder of this white paper is structured as follows: Section two distinguishes between deriving business models for one company versus business modelling of the wider ecosystem. Section three describes a framework proposed by the 6G-IA working group on Business Validation, Models, and Ecosystems, building on its experts' insight, and opinions aggregated from many 5G PPP projects and 6G-IA members. Finally, section four summarises the paper and suggests recommendations.

The reader is invited to also access the extended version of this white paper (here), which provides two additional sections: The first one of these provides alternative examples of how a business model can be designed in an ecosystem context, catering for the interests of the many different enterprises, while the second one provides concrete examples from 5G PPP projects and discusses them in light of the provided framework.

# 2. BUSINESS MODELLING APPROACHES

Commercial exploitation of technology developments implies that someone seeks to position a product in the market with a defined business model. As the term suggests, "business *model*" is a model of the business one is running or plans to run. A business model is usually developed from the perspective of one enterprise. With the emergence of interdependent 5G and beyond 5G technologies and solutions, we need additional means to develop business models that work for the many enterprises creating value together in 5G and beyond 5G ecosystems. Note that we assume that enterprises are actors with intent and agency, that is, they are entities with specific objectives and the power and resources to fulfil them, thus can aim at a specific future and take actions toward it. We implicitly assume that such entities can intentionally form ecosystems. Thus, we do not elaborate on the case that ecosystems and markets may well evolve in a more accidental way.

## 2.1. BUSINESS MODELLING FOR THE SINGLE ENTERPRISE

The typical interpretation of the term "business model" refers to *one* "enterprise's plan for making a profit. It identifies the products or services and the business plans to sell, its identified target market, and any anticipated expenses." [8]. Another typical, though broader, definition is the following: "A business model is a conceptual structure that explains the flow of the business, how a business operates and intends to achieve its goals. It supports the viability of the business and provides a description of what and how a company creates value for its customers and delivers it to the market and most importantly, how it will make money" [9]. Thus, the business model concept can be used to capture how existing business is carried out and to plan for a desired business opportunity (see also [1] and [10]). Or, as the organisational theorist David Teece defines it, a business model "describes the design or architecture of the value creation, delivery, and capture mechanisms [an enterprise] employs." [11].

From the perspective of one enterprise's operation, any mode of presentation helping the comprehensive identification of all pieces influencing the company's business positioning would be valid. Figure 6, illustrates a meta-model of the most common business model canvas definitions [12]. For further information, please refer to [12], [11], [14], [15].

## 2.1. SUSTAINABILITY-ORIENTED BUSINESS MODELLING

Besides the commercial and pecuniary focus of business modelling, there is increasing emphasis on how businesses of any scale or constitution are directed towards values of sustainability as normative goals from global frameworks and agendas. In traditional economic theory, companies create benefits for their customers, financial returns for their shareholders and investors, generate income for their employees, and taxes to the state. However, this constellation is not alone sufficient for creating sustainability-oriented business

and adhere to new norms. It does not account for environmental costs and potentials for value creation, nor does it consider the interests and values of other stakeholders [16] that are affected by this business and that may contribute to its failure or success.

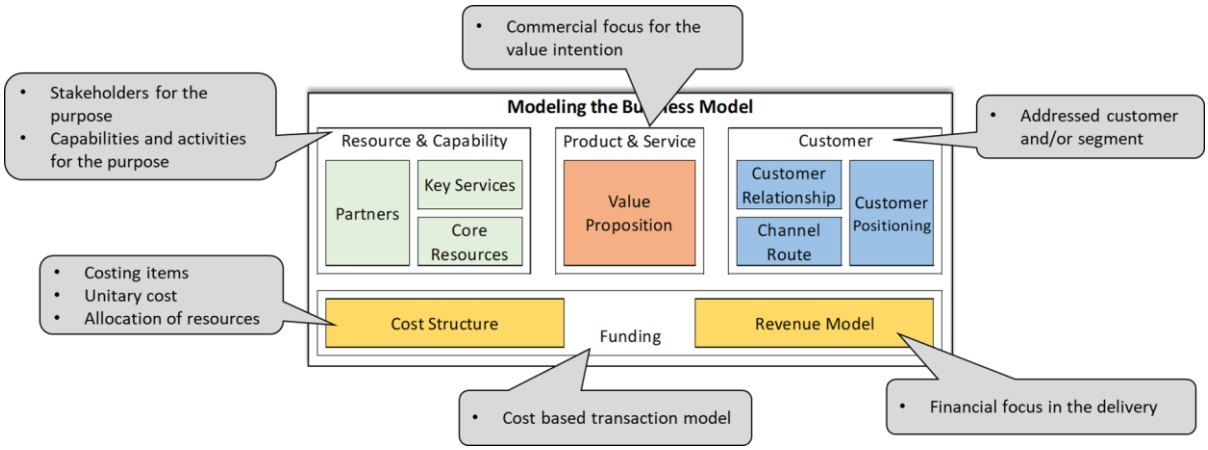


*Figure 6 Metamodel of prevailing Business Model Canvas Definitions [12]*

Even associations like the Business Roundtable of more than 200 CEOs of major US companies are moving beyond this conventional view on value creation and stakeholder commitments and claim that companies should serve all their stakeholders [14]. Normative frameworks such as the United Nations Sustainable Development Goals (SDGs) [8] and the European Green Deal require new business in general to comply with increased sustainability standards. These frameworks are further reinforced by the EU Taxonomy [17], [18] and the Corporate Sustainability Reporting Directive [19], [20] that requires even mid-sized companies from 2023 to professionalise their sustainability reporting and in many cases to innovate their business model in a sustainability-oriented manner.

A sustainability-oriented business model introduces value creation, delivery, and capture which allows an organisation to contribute to tackling sustainability challenges and promote sustainable development. Or, in the language of global sustainability governance frameworks, sustainability-oriented business models contribute to reaching the United Nations SDGs.

Integration of additional types of value and further stakeholder relations constitute sustainability-oriented business. Sustainability-oriented business model development applies at least four guiding principles, namely sustainability orientation, extended value creation, systemic thinking, and stakeholder integration [21]. **Sustainability orientation** refers to prioritising values of sustainability over short-term interests and, for instance, expressing "purpose, vision and/or mission in terms of social, environmental, and economic outcomes" [22] p. 121). **Extended value-creation** considers different types of (monetary and non-monetary) value being created or, in some cases, being destroyed or missed [15]. In addition to economic value, social value, and ecological value are not just side-effects but essential components of a business model (e.g., in terms of inclusive participation, energy saving, or positive contributions to the strengthening of ecosystems). **Systemic thinking** emphasises social interactions to integrate external and internal resources and bidirectional relationships between actors, including the necessity to reflect upon potential outcomes. Finally, **stakeholder integration** acknowledges the crucial role of market and non-market actors in

accessing and acquiring resources and capacities necessary for developing and implementing business models [21], [23].

Stakeholders such as regulators or communities embedding new business are not just affected by business activities but can also play a crucial role in contributing to its success and therefore resemble ecosystem partners in a business ecosystem. Still, just like the principle of extended value creation, additional stakeholders add further complexity to the already wide range of distinguishable parts and potential connections in modelling new business.

The key challenge here is to find viable paths to deal with this complexity of different business model components or activities, different types of (economic, social, and ecological) value creation and different stakeholders, including ecosystem partners, being involved without running into an overwhelming complexity. The good news is that much of this complexity stems from considering numerous options that are only theoretically relevant, whereas in each real case, the range of alternative constellations and development paths is quite limited. What we need is a business modelling methodology that integrates sustainability orientation consistently in each of the steps and that ensures that sustainable value creation is considered from the outset, and not just as "end-of-the-pipe" assessment.

Useful resources are already available, including the *EU Taxonomy* [17] to trigger and direct private investment in environmentally sustainable economic activities, a taxonomy of business model design patterns accounting for economic, social and ecological value creation [24], [25], practically proven tools to model sustainable business [21], and a generic process model developed and applied for 5G vertical business ideas in projects, such as in [26], including examples of sustainability-oriented 5G business models. An approach for integrating a societal value perspective in the process of 5G and beyond 5G development, which may also provide insights for business modelling, is suggested by the concept of value indicator analysis, as outlined by the 5G IA Societal Needs and Value Creation Sub-Group of the Vision and Societal Challenges Working Group [27].

## 2.2. BUSINESS MODELLING IN ECOSYSTEMS

As discussed earlier, the market formulations for 5G and beyond 5G service provisioning has shifted from the "value chains" of earlier-generation telecom networks to exhibit more complex ecosystem characteristics. A brief report on this shift and details on the early identification of various potential ecosystem formulations can be found in [1].

The evolution of an ecosystem is shaped by how individual business models form and vice versa. The factors influencing the ecosystem formation throughout its life cycle are multi-faceted [1] . In the ecosystem formation phase, interactions and dynamics among the collaborating enterprises will go through adjustments to optimise benefits and remunerate enterprises as per their contribution. At this point, enterprises iterate and refine their business models until the ecosystem reaches stability. An enterprise designs a specific business model and seeks to position itself in a business ecosystem. However, the first iteration is probably not the final one. The trials and errors of one enterprise iterating key activities in its business model affect other companies and, in turn, trigger changes in the ecosystem. At this point, the single enterprise in its planning would need to revise its business modelling to capture its interaction

with all the actors in the ecosystem and their business models, as well as the ecosystem dynamics [10] and to promptly develop a viable operational business model. For this purpose, it becomes necessary to have business modelling tools which are able to evidence those changes and the implications for the single enterprise and the ecosystem.

The ecosystem formation phase is depicted in Figure 7, the left showing multiple independent or overlapping enterprises that will enter into ecosystem collaborations. The right side of the figure shows how each enterprise has formed new business models influenced by all other business models. The ecosystem business model emerges in this formation phase based on how the ecosystem actors perceive their roles, key activities, and contributions, and consequently, the distribution of risks and profits between them. The resulting ecosystem business model will be different from the business model of each of the enterprises but will be affected by them.

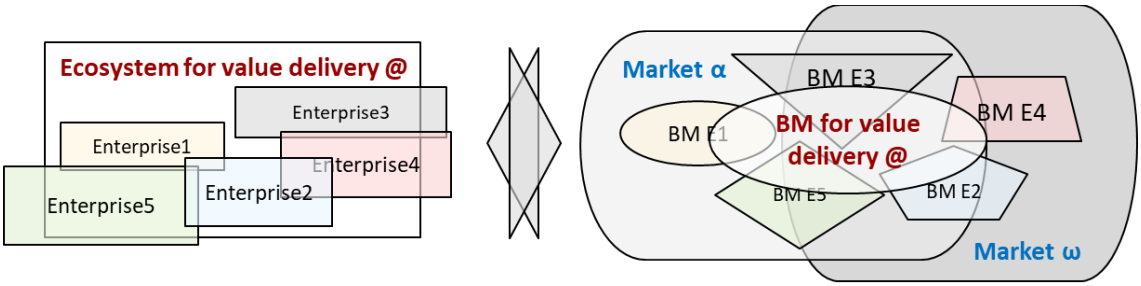


*Figure 7 Iterations of enterprise business models into a stable ecosystem*

Consequently, a shift from single enterprise business modelling to ecosystem modelling is mandated by:

- the evolution of technology and customer needs that require increased collaboration by independent companies, thus implying increased interdependency (also in [28], p. 414]) and
- by the fact that financial reward and market growth will only be unleashed simultaneously by collaborative aggregation of value contributions.

In other words, in the cases where a single enterprise aims to become part of an ecosystem to address customer needs, the conventional business modelling for one enterprise becomes less helpful - although useful in the case of a Leading Product Portfolios or of Short Portfolio solutions and simpler market environments. It provides insufficient modelling of interfaces and interactions, complementary benefits, as well as risk, liabilities and revenue sharing constellations. Neither can it sufficiently capture an end-to-end solution for a customer or industry. Moreover, conventional business modelling provides limited capability to maintain consistency and cross-validate business models for partnering enterprises; thus, it makes it practically impossible to capture the impact of changes of partnering enterprises' business models changes onto the enterprise's business model.

Instead, ecosystem business modelling aims to address these gaps, to model innovative complex offerings associated with complex partnerships in a more precise way and shed light on the transformation of the core business of a company. In such cases, business models can be platform-based, value-contribution based and can present multiple facets towards the

customer, while balancing risk-sharing aspects. In this context, ecosystem business modelling aims to capture positions and interfaces towards end-customers, including the escalation approaches in the Customer Relations Management pyramid, interactions and interfaces with other ecosystem roles, and implicit benefits that can be derived from collaboration. The activities/ operations/ services and key capabilities of adjacent stakeholders can be captured and a better-balanced profitability model (possibly capturing complex revenue streams) for all relevant roles and actors can be designed. Moreover, the process of ecosystem business modelling can help in the early identification of and response to disruptive market initiatives by capturing and maintaining an updated view of the market dynamics.

To complement this, embracing the aforementioned sustainability perspective, 5G and beyond 5G ecosystem business modelling can address the sustainability challenges of individual companies and their customers and enhance the sustainability performance of the whole ecosystem. Just like business models of an individual enterprise can be re-framed to ensure their contribution to support societal values and normative goals for sustainable development, 5G and beyond 5G ecosystems can be framed to consider and create likewise economic, social, and ecological benefits. To this end, sustainability-oriented business ecosystems comprise the co-creation of customer value, benefits for participating actors and stakeholders being affected, and contributions to sustainability challenges of customers or participating actors.

Apparently, ecosystem business modelling is more complex than conventional business modelling as it implies good knowledge of the business environment, of the complementarities and of the overlaps of strategic goals between partnering or competing enterprises. It also has an evolutionary character; thus, sustainability-oriented business modelling comes to the foreground. All these aspects need to be reflected in the methodologies and tools to be used for its development. In this context, the next chapter proposes a stepwise approach to ecosystem business modelling and (non-limiting) implementation methods.

# 3. SUSTAINABILITY-ORIENTED ECOSYSTEM BUSINESS MODELLING IN 5 STEPS

Based on the experience of its members and methods aggregated from across many 5G PPP projects and 6G IA members, the BVME WG suggests that ecosystem business modelling can be effectively performed by diving the action in five steps (see Figure 8). The five steps embrace the ecosystem's evolutionary character as a whole and acknowledge the ambition to accurately model all ecosystem participants. The steps are: Expand, Focus, Design, Develop business cases, and Iterate. The five steps address different challenges in business modelling analysis. The sequence of steps reflects the processes that are needed for the analysis and development of an ecosystem business model.

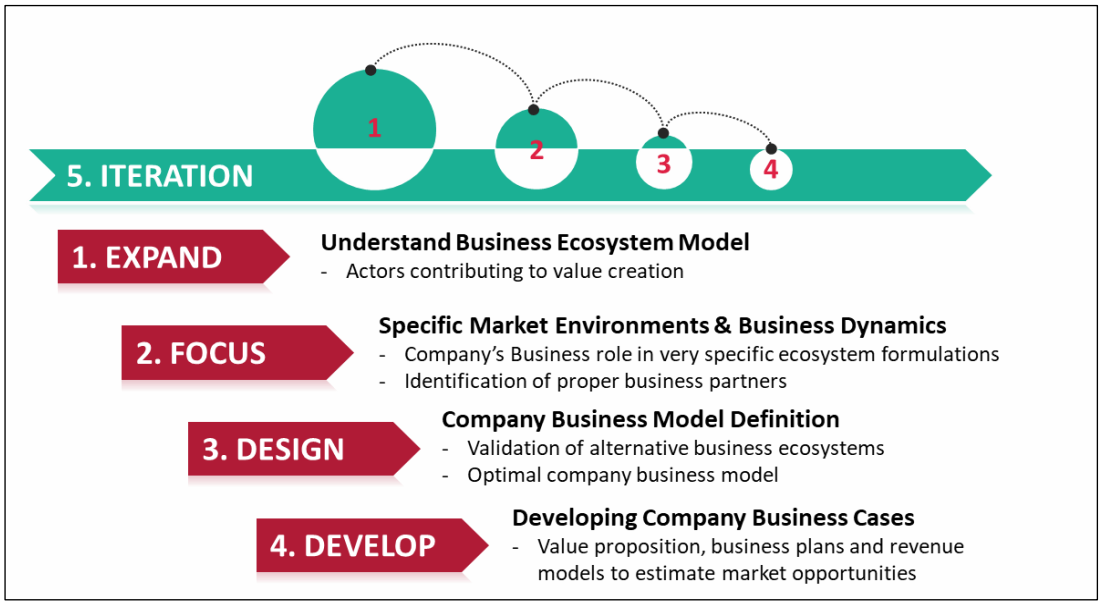


*Figure 8 Five steps for ecosystem business modelling*

The proposed five steps are well aligned with recent business model innovation concepts that suggest a process perspective on business model development including the processes: observe, synthesize, generate, refine, and implement [29]. From this point, we go a step further by suggesting that iterations of these steps are needed both in the theoretic planning and the business model implementation phase.

## 3.1. STEP 1 – EXPAND

A first step in developing business models in an ecosystem context is to **expand** the scope and view towards understanding and modelling potential ecosystems [30]. We assume that the customer value proposition is already identified based on customer and user pains and gains [1]. It is understood that the value proposition is best served by an ecosystem which consists of many and different actors. The challenge addressed in Step 1 is to envision and grasp the potentially vast room of alternatives for ecosystem formation, i.e., how different actors relate in

a context where alternative combinations of many actors and the various necessary roles they assume lead to different ecosystem business model formulations [31]. Thus, *all main actors* contributing to value creation and delivery in the ecosystem should be identified. Next, the potential *relationships* between the actors should be sketched based on their relative position in and contribution to value creation and delivery. In this process, the sustainability values, preferences, and interests pursued and shared by different actors should be explored and acknowledged. Some shared values call for actors to align motivations and collaboration, e.g., sustainability and resilience of the ecosystem, accessibility, and end-user experience.

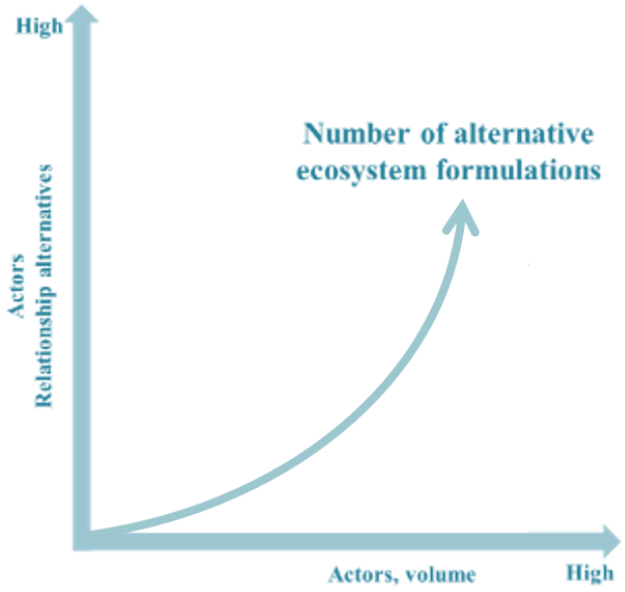


*Figure 9 Number of Ecosystem formulations in relation to the number of participating actors*

This exercise should reveal the multiple alternative configurations of an ecosystem business model. From the perspective of partner activities, the ecosystem configurations could vary according to the ways actors perceive and handle customer relationships, the core resources they possess [1], existing market positions and partnerships [30], as well as the cost structures and specific values actors rally around (see also Figure 6). Besides business, technological factors such as the state of technology disaggregation play a major role.

According to the analysis in [1], the number of ecosystem formulations to be examined can become very high, as it increases with: 1) the number of actors in an ecosystem, and; 2) their alternative relationships, as illustrated in Figure 9.

Besides the number of ecosystem formulations, potential changes throughout their life cycle add complexity and unpredictability to the initial part of the evolution. In addition, a single enterprise may sometimes assume roles in multiple concurrent ecosystems. Thus, the methods used for ecosystem business modelling must handle this complexity.

### 3.1.1. ACTORS – NUMBER AND RELATIONSHIPS

The number of possible ecosystem formulations increases with the number of actors and how they can be related. Consider three actors (X, Y, Z), that collaborate in various forms (i.e.,

undertake different roles and activities) to provide a customer (C) with a value proposition. For instance, in a simple three-actor ecosystem, a system integrator, a communication service provider and a hardware provider (telecommunication vendor) may undertake various roles and activities to provide a 5G and beyond service to a customer. An extensive set of collaboration models to be examined is illustrated in Figure 10. Besides considering linear supply chain and full mesh collaboration in delivery as two extreme alternatives, there are many and all the other potential alternatives. In theory, an enterprise could consider up to 19 combinations (indicatively as shown in Figure 10). Although some collaboration aspects may be well known a priori and may significantly narrow down the number of potential formulations, such an exercise could be used to open up the possibilities and warn against preferring or predicting some alternatives too early.

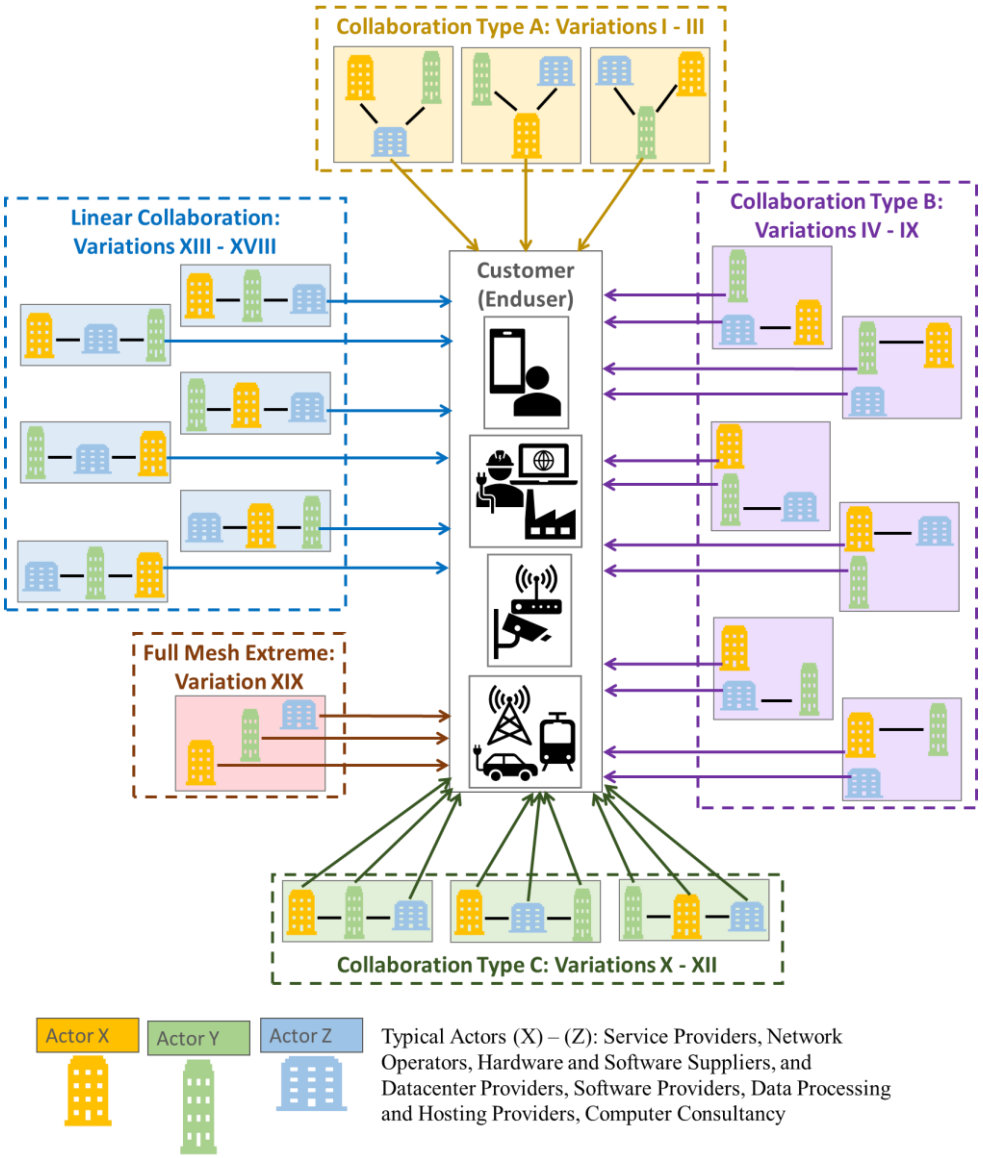


*Figure 10 Three-actor example illustrating potential ecosystem formulations*

### 3.1.2. ACTORS – RELATIONSHIPS AND CHANGES IN BUSINESS MODELS

The multiple actor combinations presented in Figure 10 introduces different potential formulations of the complete ecosystem business model. Each actors' business model should be sketched in the different formulations relevant for an ecosystem. This step also includes defining each actor's core goals and values to define and make explicit the values shared with other actors in various constellations. Depending on their individual business models and relationship characteristics, attributes such as cost, and profit distribution vary.

Furthermore, if key activities in the business model of one actor change, this will affect the relationships among other actor roles as well. For instance, when one partner changes its focus on a key activity, e.g., customer or user support, activities need to be redistributed among actors. Other actors must reconsider their customer support capabilities and how those affect their potential business models. This leads to a redistribution of the ecosystem's value creation, delivery, and profits. Any actor who considers such changes must capture the consequences in its analysis. Such changes may also force the actors into an alternative ecosystem formulation, where e.g., actors' positions relative to the customer and users are changed. The dynamic in the ecosystem caused by such changes will continue till the ecosystem reaches a stable stage.

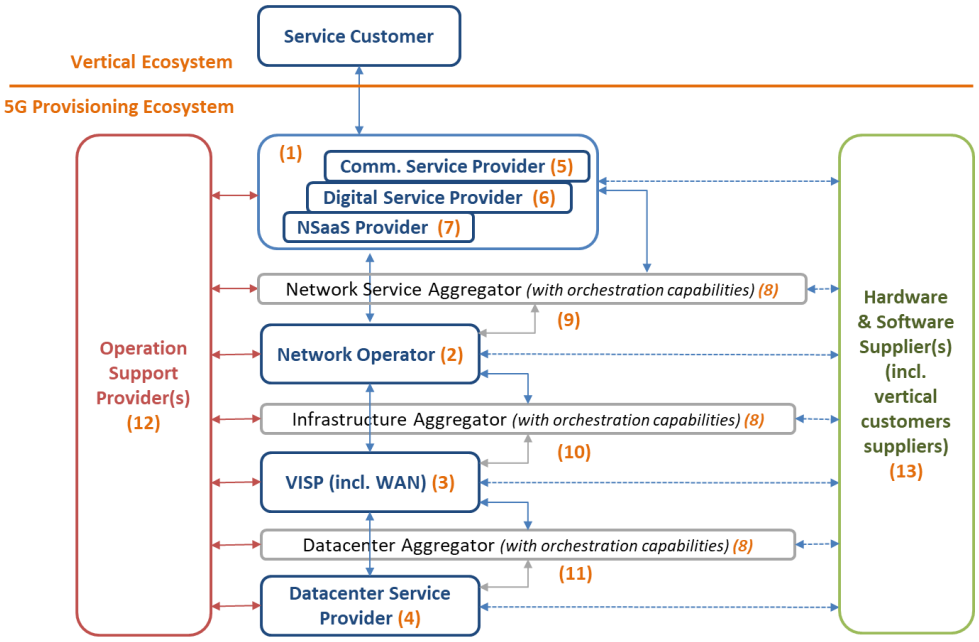


*Figure 11 Roles in provisioning ecosystem [1]*

For instance, the case of 5G provisioning ecosystem, Figure 11 [1], shows many actor roles and their relationships: Service Provider (SP) (1), Network Operator (NO) (2), Virtualisation Infrastructure Service Provider (VISP) (3), Data Centre Service Provider (DCSP) (4) (collectively referred to as Infrastructure Providers), Communication Service Provider (CSP) (5), Digital

Service Provider (DSP) (6), Network Slice as a Service (NSaaS) Provider (7), various aggregation levels (8) and the relevant service provisioning interfaces (9), (10), (11). In the provisioning ecosystem, the resulting ecosystem formulation(s) can be different from this depiction.

### 3.1.3. ACTORS – PART OF PARALLEL ECOSYSTEMS

One actor can be part of several related and parallel ecosystems. Consider the example of a carrier and a vendor illustrated in Figure 12. In a value chain view (left side of Figure 12), a vendor provides 5G equipment to a carrier (network operator). In reality, both the vendor and the carrier have relationships with more competitors, customers, suppliers, and partners - as depicted on the right side of Figure 12. One carrier will most likely be participating in other ecosystems with other vendors to realise its 5G goals. At the same time the 5G service goals need to be coordinated with other actors' service ambitions.

Similarly, the vendor will be participating in many other ecosystems, possibly with other carriers providing the same and other products and services and/or addressing other segments. This multiplication of ecosystems in which an enterprise participates, possibly assuming different roles in different ecosystems, in turn, requires the enterprise to maintain multiple business models. In each case, the enterprise must ensure the viability of the business models and guarantee that they all contribute to the actor's goals.

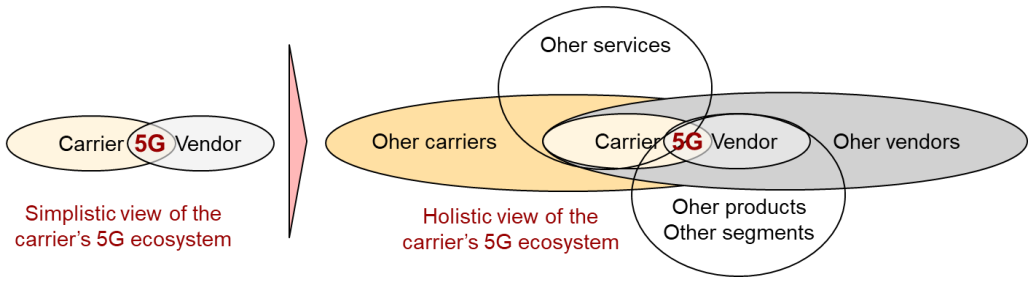


*Figure 12 Actors taking part to several ecosystems*

Similarly, it is difficult to work with a single business model for a vertical actor in a vertical ecosystem, e.g., the healthcare vertical. Usually, the business model of an actor / vertical implies the aggregation of multiple business models, each supporting vertical services with the help of a set of partners. Altogether, they may constitute multiple vertical ecosystems in which the healthcare vertical participates.

Figure 13 simplifies this with the case of a hospital. When the hospital tries to implement services such as tele-diagnoses, remote surgery, or digitalisation of the hospital facilities, it must participate in multiple ecosystems. Each of these ecosystems delivers a service and has its own business model. The aggregation of all ecosystems and their business models will shape the business model for this particular hospital. The established relationships could be different for any other hospital, even with the same partners.

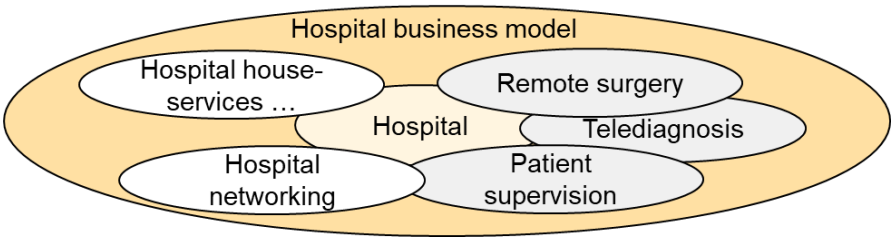


*Figure 13 An example of a provisioning ecosystem surrounding a hospital*

## 3.2. STEP 2 - FOCUS

Ecosystems will eventually evolve into more stable formations and business models that require different value contributions from participating companies. Thus, for a company to properly position its activities, it needs to **focus** on its specific market environment by identifying the formulation(s) that suits the focal company's business dynamics**.** Step 2 addresses the following challenge faced by companies: "to rule out non-durable alternatives at an early stage and carry out more extensive analyses of a subset of more appropriate formulations". Each enterprise decides criteria and explanations for why some alternatives are more attractive than others.

This stage refers to building an enterprise's business model. This includes focusing on an identified subset of the most important/relevant roles directly related to the enterprise's activities and strategic goals. It also includes an analysis of how other different enterprises can fill these roles and how the focal enterprise can fill in a particular position. At this early stage, potential reallocation or disruption of current market positions should be identified. The design of the business models should be subject to several iterations, validating their viability and sustainability – see also the description in 3.1.2.

A key outcome of this stage is settling the enterprise's value proposition, which lies at the core of the business model rationale. The value proposition includes economic value, social value, and ecological value (extended value-creation). It is crucial to ensure the engagement of proper partners that can provide the necessary skills to efficiently allocate the value creation and delivery activities, avoiding gaps and/or overlaps that can cause extra costs, negatively impacting the business results and profits. The early identification of any kind of weakness shall lead to adjustments in the business model structure.

All actors, but in particular a lead partner, should consider their own and others' key capabilities and reflect on if and how others are in a better position to exploit capabilities. Subsequently, other parties must be mobilised to take on relevant roles. Revising and redistributing activities between the parties can lead to changes in their individual business models.

The process of focusing in this step entails excluding groups of stakeholders, in particular non-market stakeholders, from the immediate focus. While this is a necessary step, given the importance of integrating all stakeholders for sustainability-oriented business modelling [21] care should be taken to explicitly acknowledge the existence of stakeholders excluded from the focus in this step. These stakeholders must be again taken into consideration in later steps once the basic actor configuration is fixed.

In case the market is mature enough, the alternative combinations are fewer, and a company's business modelling may start from this second step, given the established ecosystem formulation(s). Also, in the second step, various tools can be used for illustrating a company's business role in very specific ecosystem formulations such as: value (sub-) networks in 5G ESSENCE [32], MATILDA model [33], and the V²-PARK model (as detailed in section 4.2 of the extended white paper [34]).

## 3.3. STEP 3 – DESIGN

Upon focusing on a specific enterprise business model, the third step will be to analytically **design** and **validate** alternative ecosystem business models depending on the level at which the enterprise can assume a role. The challenge addressed in Step 3 is to carry out the actual complex business model designs, and through iterative analysis, identify the optimal one(s) against specific criteria such as value delivery, sustainability, minimum cost, etc. This step goes hand-in-hand with the product/ service/ value-proposition -based business modelling. Also, in this step, there are many ways to represent the devised models, the most common being the Value Proposition Canvas [35], the Lean Canvas [36], and the V ²-PARK model (as detailed in section 4.2 of the extended white paper [34]).

To ensure sustainability orientation in Step 3, companies need to use business modelling tools that have sustainability concerns embedded within them. Tools like the popular Business Model Canvas [12] blend out social and environmental concerns and fall short of facilitating sustainability-oriented business model development. Thus, distinct tools have been developed to better model and create sustainable business [30].

Some of these tools explicitly extend the Business Model Canvas to include sustainability aspects. Examples are: the 'Flourishing Business Canvas' (FBC), which proposes a modelling technique for stakeholder-oriented design of enterprises that enable 'flourishing' across living ecosystems and organised social systems [37], [38], [39], [40]; the 'Sustainable Business Canvas' (SBC), which was developed within the context of the StartUp4Climate initiative [41]; the 'triple-layered Business Model Canvas' (triple-layered BMC) [42], [43]; and the 'Business Model Canvas extended for infrastructure' (BMC infrastructure) [44], which is specifically geared towards designing infrastructure business models that incorporate economic, social, and environmental value streams and propositions.

Other approaches include the 'Value Mapping Tool' (VMT), which was developed to help companies and their wider stakeholder networks design value propositions as a part of sustainability-oriented business modelling [15] and the 'Business Innovation Kit' (BIK) and its extension, the 'Sustainability Innovation Pack' (SIP), which take a values-based, didactic approach to modelling new and sustainability-oriented business models [45], [46], [47], [48]. The latter has been widely used in sustainability-oriented business model design with the help of design patterns [24], [25].

All these tools are widely used and proven in practice. They facilitate integrating the four guiding principles of sustainability-oriented business modelling: sustainability orientation, extended value creation, systemic thinking and stakeholder integration, in the process of business modelling. This allows actors to avoid potential harmful consequences for

sustainability and comply with sustainability standards, and also enables them to actively contribute to solving sustainability challenges and creating value that exceeds benefits for customers and shareholders.

In Step 3, it is possible to develop business model canvases for each of the actor roles in the whole ecosystem and identify the actors in those roles. However, the ability to compare and analyse may get lost in the details. In this complex environment with multiple "business model possibilities", we need a superset of modelling tools/representations that are logically associated and can provide "the ability to compare and analyse". To address this challenge, new approaches in business modelling suggest how alternative business models can efficiently be represented and compared for a focused part of an ecosystem. However, we must take care to attend to the ecosystem end-to-end vision to ensure the compatibility of the ecosystem business model with the individual actors' business models. While the ecosystem as a whole can be profitable, its profit distribution among actors should be fair and attractive enough to be able to mobilise participation. Only the holistic and stable business model design for the ecosystem will ensure the stability of the individual business models and, with that, the sustainability of the business. In section 4 of the extended white paper [34], we elaborate on approaches for such analyses.

## 3.4. STEP 4 – DEVELOP BUSINESS CASE

Eventually, the company can develop a business case based on its specific value proposition, business model, and business plan (see Figure 1 as a reference for the flow). It can follow existing approaches on sustainability-oriented business and revenue models, with which the company can estimate and compare its market opportunities. The challenge addressed in Step 4 would be to estimate the specifics of both costs and revenues and specify how to realize sustainability potentials in emerging markets and ecosystems. Such cost estimation and revenue generation go hand-in-hand with performing a techno-economic analysis of the alternative implementations. Although in this White Paper we do not elaborate further on business case tools, concepts in ecosystem business modelling need to be propagated in the business case development step also.

## 3.5. STEP 5 – ITERATE

As discussed in [1], ecosystem emergence and resulting formulations are subject to uncertainties borne from their dynamic and non-linear nature. This implies **iterations** of the four steps as companies carry out ecosystem business modelling. The challenge addressed in Step 5 is to minimise the risks of moving forward with initial suggestions instead of taking the chance to identify improvements and changes early and with fewer costs incurred.

As noted earlier, ecosystems are not static formulations. Instead, they suffer tension or encounter opportunities as a consequence of multiple possible factors: the market itself matures, customer demand changes, or competing actors appear and deliver the same value. Any of these factors can disrupt an actor's initial position in the ecosystem and its business model. Therefore, iterations should continue when the business models are deployed in the market. Companies must consider if their contribution to the ecosystem can become obsolete,

their market share can rapidly be eroded by dominant enterprises, to expand within their existing role(s), or to take new roles within the ecosystem. In practical terms, a fifth step in the business modelling process is required to address the need for continuous (pro-active or re-active) adjustment of the ecosystem and enterprise business models. This could result not only in role changes of the actors in the ecosystem but also of the stake of each enterprise in the profit model, the sharing of risk and liabilities, etc.

The initial version of an ecosystem business model and the associated business models of the enterprises involved are created in a first implementation phase of Steps 1-4. At this point, the business models should be subjected to stress-tests to validate their robustness, as suggested by [49]. A stress-test will start with identifying stress factors, typically uncertainties mentioned above, with high effects on the business models' probability for success. Thus, companies should reconsider how to iterate the ecosystem business models to ensure continuity and reach some stability as a profitable and sustainable contributor to ecosystem value creation and delivery.

The iteration step can be realised in three phases: 1) business model adjustment phase, 2) business model redesign phase, and 3) business model re-creation phase. The focus of the business model adjustment phase is to perform iterative optimisation of the business model by assessing early results, market developments and current facts and fine-tuning the positioning of the enterprise(s), the processes, the relationships, and the profit/value models. In case adjustments do not prove effective in improving the viability of the business model, the re-design phase is triggered, leading to the business model re-creation phase. In the latter, Steps 1-4 are repeated.

# 4. CONCLUSION AND RECOMMENDATIONS

The business models in the 5G or beyond 5G era are not more complex than they were during the launch of 4G or 3G, when assuming a simple continuation of service delivery, revenue generation and profit models. However, 5G and beyond network technologies introduce fundamental technological transformations compared to earlier generations, which dramatically increase the number of possible alternative business models. This creates significant complexity in deriving viable business models that ensure benefits for each of the enterprises in the ecosystem, while delivering the expected value to customers.

In the cases where a single enterprise aims to become part of an ecosystem and address the customers' needs, the conventional business modelling approach for one focal firm is limited. It provides insufficient modelling of interfaces and interactions, of complementary benefits, and of risk and revenue sharing, while failing to describe E2E solutions for a customer or industry appropriately.

This white paper is a practical guide to ecosystem business modelling in the context of 5G and beyond 5G networks. It consolidates current approaches and best practices in the field. The information herein is useful for a variety of professionals. For example, 1) business owners who have a deep understanding of their industry and market and want to recreate their business model to meet changing needs of their customers; 2) business consultants who specialize in developing sustainability-oriented business models and strategies for different types of vertical industries; 3) management consultants who work with businesses to analyse their operations and identify opportunities for improvement, including the design of new sustainability-oriented business models; 4) marketing professionals who understand the market and want to create a sustainability-oriented business model that meets the needs of targeted vertical customers.

We suggest that ecosystem business modelling can be performed in five steps. These steps embrace the ecosystem's evolutionary character as a whole and acknowledge the ambition to accurately model specific ecosystem aspects. The steps are: **1) Expanding** the scope and view of business modelling from enterprise to ecosystem by investigating alternative ecosystem formulations; **2) Focusing** on sustainable, viable business model formulations for a specific market environment, and for the focal company's business dynamics. This stage includes identifying the potential reallocation or disruption of current market positions; **3) Designing** and validating alternative ecosystem business models, carrying out the actual complex business model designs, and identifying the optimal one(s) against selected criteria (sustainability, value delivery, minimum costs, etc.) supported by tools with the ability to compare and analyse logically associated models; **4) Developing a business case** for the enterprise based on its specific value proposition, business model, and business plan; and finally **5) Iterating** the four steps over time, allowing for assessment and fine-tuning, re-designing and re-creating the business model when needed.

In the extended version of this white paper [34], more detailed guidance on how to practically implement the 5-steps approach is presented. Examples provided include 1) value network-

based approaches, which are tailored to the ecosystem's dynamic nature, 2) the V² PARK[1] approach, which is a practical tool to implement the ecosystem steps approach and to study the effects of changes arising both on the actor level and the ecosystem level through iterative updates, and 3) the value-based and sustainability-oriented approach to ecosystem business modelling, which can be used by ecosystem actors to identify economic, social and ecological benefits to be created through their business models. In addition, the extended white paper also analyses several examples of ecosystem business modelling from recently concluded as well as still running H2020 5G PPP projects. These examples provide an understanding of best practices that companies can follow when considering ecosystem business models, and helped forming the basis of the 5-steps approach presented here.

The paradigm shifts from linear value chains, with simple relationships between vendors and operators, to complex value networks is inducing a significant hurdle to business model evolution. Such evolution must cater for the benefit of the ecosystem as a whole, and not only for the value proposition for a single enterprise. In fact, a business model will not succeed in the long term if it neglects the sustainability of the ecosystem in its social, economic, and environmental dimensions. Hence, we believe that sustainability-oriented ecosystem business modelling, as described in this white paper, will be pivotal for future successful business models in the 5G and beyond 5G era.

Currently, we can only guess how ecosystem business modelling will transpose into the 6G era. However, we can already assume that additional actor roles may emerge, providing new 6G applications, such as holographic communication, the metaverse, or intelligent sensing. Associated with these applications is the potential of generating new revenue streams and cost structures that can attract additional enterprises and stakeholders. In the context of the Smart Networks and Services Joint Undertaking, societal **key values** and **key value indicators** are guiding network research and innovation. Therefore, the work on business modelling must itself evolve as well, to better accommodate value-oriented design, into a continuous process of **value-** and **sustainability-oriented ecosystem business modelling.**

[1] V² PARK is Huawei's registered trade-mark for business model modelling system. Since May 13th 2022, Mark and Logo EU registration numbers are 18598713 and 18598723, respectively.

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# 6. ABBREVIATIONS

| Abbreviation | Full text |
|---|---|
| **5G PPP** | 5G Public Private Partnership |
| **6G IA** | 6G Smart Network and Services Industry Association |
| **BIK** | Business Innovation Kit |
| **BMC** | Business Model Canvas |
| **BVME** | Business Validation, Models and Ecosystems |
| **CSP** | Communication Service Provider |
| **DOI** | Digital Object Identifier |
| **FBC** | Flourishing Business Canvas |
| **NPN** | Non-Public Network |
| **SBC** | Sustainable Business Canvas |
| **SDG** | Sustainable Development Goal |
| **SIP** | Sustainability Innovation Pack |
| **UN** | United Nations |
| **VMT** | Value Mapping Tool |

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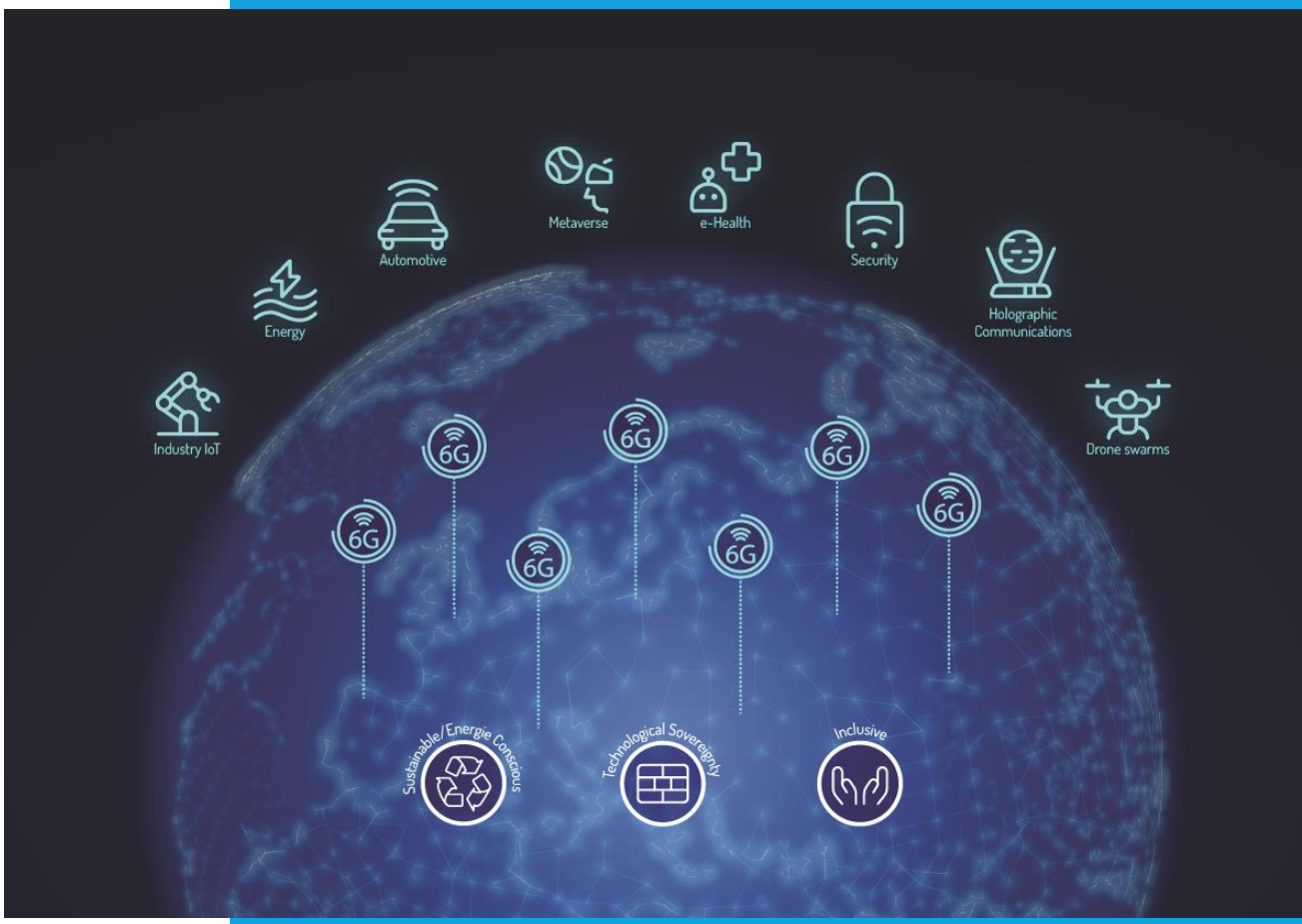


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