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## Hexa-X/6G as a General Technology Platform for Business Model Innovation

Interviewed by Christian Nielsen

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An interview about the latest mobile communications technology is naturally done on older technology platforms, namely 4G. Initially, Petri is driving from Oulu to Toholampi in his car, and I am on the train to Copenhagen. After Petri arrives at his destination, we switch to WiFi and record the interview before it is transcribed by Teams software.

**CN: Could you explain what 6G is all about?**

**PA:** 6G is the latest generation of mobile communications technology to be launched to markets by 2030. It is currently at the vision stage; the United Nations body ITU-R should decide on the global vision for 6G by the end of 2023 (Ahokangas et al., 2023c). After that, it will enter the standardisation and development stage, which means that it starts the discussion of whose patients will be used as a basis for the 6G implementations. The first 6G services will be launched a year or two before the expected 2030 launch.

**CN: What is the difference between 6G and 5G?**

**PA:** The current latest mobile communications technology generation in use is 5G. There are three different versions of 5G being deployed, one for the consumers called the enhanced mobile broadband and then two other cases that are more for the industrial or organisational users. First, massive machine-type communications could be used, for example, in smart cities for Internet-of-Things applications, and the other is called ultra-reliable low latency communications that are needed, for example, in factories, especially for robots (ITU-R, 2015). Still, it could also be used in hospitals for medical devices. Currently, we have enhanced mobile broadband for consumers available in hotspots like cities and most urban areas, but not in rural areas yet. Today, approximately 20-30% of the possible 5G coverage is still 4G, so there is a lot of growth potential.

It has yet to be determined exactly what 6G will become. Still, it is expected to be increasingly used

beyond humans by machines and autonomous things, as well as communities and organisations, for use cases such as immersive communications, reliable and trustworthy communications, massive digital twinning, sensing for sustainability, or even connecting the unconnected. It is also expected that future 6G will deeply integrate with artificial intelligence. For example, we have been discussing these in our recent book, *The Changing World of Mobile Communications* (Ahokangas & Aagaard, 2023).

**CN: When do we expect 5G to be fully rolled out?**

**PA:** A good question. 5G is being rolled out constantly and developed further based on the original vision. At some point, a decision will be made that the next technology release will be called the 6G.

Already, 5G and 6G will increasingly bring new kinds of stakeholders to the mobile communications scene. Vodafone expects that by 2030, there will be a million private local 5G networks in Europe<sup>1</sup>. So, think about all the possible use cases where you could go indoors and provide private mobile connectivity to improve the efficiency of operations. Another new opportunity is sustainability sensing of the environment (Matinmikko-Blue & Arslan, 2023). And then, of course, connecting the unconnected. These are the opportunity discussions ongoing around 6G. Of course, the commercial side of these is something that has yet to be learned, but these examples indicate new growth beyond the matured consumer business.

**CN: So now you explained a little bit about where we are with 5G and the timeline for 6G. What will be the major differences between what we can see now, both in the consumer segment and the two industrial segments? And then what? What will we be able to do with the 6G in the future?**

**PA:** Well, for the consumers, the expected most likely use case builds on virtual and augmented reality-based services that require wider bandwidth and lower latency enabled by 6G. For example, something

<sup>1</sup> <https://www.communicationstoday.co.in/a-million-private-5g-networks-by-2030-a-million-just-in-europe-says-vodafone/>

that we call immersive communications. Different use cases will be developed for industry and other verticals, like secure zones or twinning. Companies and cities are expected to be interested in paying for them, especially all the communications that are needed around and for critical infrastructures like energy systems and logistics.

**CN: So, what you are talking about here resembles many expressions used in relation to the metaverse (which is covered in greater detail in this special issue in Rosenstand et al., 2023).**

**PA:** Yes, exactly. They are the first steps towards the metaverse.

Concerning this, something is based on novel technical capabilities, like the combination of communications and sensing, which is new (Uusitalo et al., 2021). When communications go to higher spectrum bands, radios can be turned into radars that can sense the environment and even recognise people. These features come in handy in metaverse applications.

It is important to note that there are many regulations around sensing and when communications and artificial intelligence are combined. These regulations will impact the business models and business model innovation.

**CN: I know that you have developed business models for 6G companies. How will 6G influence business model innovation for companies using 6G?**

**PA:** First of all, 6G is a new kind of general-purpose technology for which the innovation landscape will change. No single company can do 6G innovation alone, but as a part of an ecosystem: ecosystemic effort is needed to create seamless services and devices around 6G connectivity (Yrjölä et al., 2022).

The key thing here is that to profit from 6G innovation, companies need to change from the traditional single-company-controlled logic of discrete or enabling technologies into surviving in the ecosystemic context of integrated general-purpose technology

platform infrastructures that comprise connectivity, cloud services, and artificial intelligence (Haefner and Gassmann, 2023; Ahokangas et al., 2023a). Already, organisations like cloud service providers are selling connectivity bundled with the cloud services or everything else that you can do with the cloud.

So, the innovation of the potential of 6G lies in the combination of connectivity with all the other types of data usage (Hurmelinna-Laukkanen & Yrjölä, 2023). A good example is context data, meaning the location of activities or contextual awareness of what is happening in the environment. That kind of data collected, analysed, reported, and utilised for different kinds of services form the basis for different context business models. Also, context-related business models could form the basis for monetising privacy as a service with the help of artificial intelligence.

**CN: So this means that for business model innovation, you have to think more about ecosystems, which Lingens (2023) goes into detail with?**

**PA:** Exactly. Business models and ecosystem innovation will become inseparable in this context (see Ricart 2023). So now the question is, how do you create platforms that attract service providers? And then the question also is how to enable lock-in with consumers or whatever type of customers you might have. To me, business model innovation-related theories like the 'nice' framework – novelty, lock-in, complementarity and efficiency (Amit & Zott, 2001) – or discussions around business model content, structure and governance (Zott & Amit, 2010; Foss, 2023) might have completely different meanings in ecosystemic general-purpose technology cases compared to traditional focal-company-specific cases.

**CN: What should be done next in 6G planning, especially considering value creation, delivery, and capture with 6G?**

**PA:** Of course, the customer is always important. The question is how you ensure the continuity of the services you build. Technically and architecture-wise,

things still need to be done to enable new business models.

Continuing the 5G architecture, we are now in a situation where the system's control point is the mobile network operator. I see that to be something that might change in the future. The over-the-top Internet players with lots of content might have completely different ideas of how to commercialise 6G connectivity, as they can also monetise connectivity as a part of their services.

And then there is the question of all the different devices to be used in the future. It will be about more than just mobile phones; connectivity will merge with very different types of devices in the future. It is already in all new cars and can be in whatever kind of future devices, including virtual glasses or clothing.

**CN: So, you talk about the future here. What type of research will be needed before we are ready to move into 6G commercialisation?**

**PA:** Technical development is, of course, one thing. The other side that should concern business model researchers is regulation. I think there are three elements to understanding business model innovation in high and new technology contexts.

Technology is there to enable things, so we need to understand what it may bring us and how it may evolve (Ahokangas et al, 2023). Then, of course, numerous regulatory aspects need to be considered.

Spectrum regulation is one in the telecom sector, but also all the competition regulation, platform regulation, data regulation, consumer rights regulation, sustainability regulation, artificial intelligence regulation, cybersecurity regulation, and regulations related to national sovereignty, to mention a few.

Regulation increases and gets more complex all the time. If and when you are doing business model and business model innovation research, understanding the regulatory context and its impacts on businesses is crucial.

**CN: I am delighted that you mentioned that regulation would significantly affect business model innovation (because it is the theme of another contribution to this special issue (see Nielsen, 2023)).**

**PA:** This is what I have asked myself. Our new book, "The Changing World of Mobile Communications: 5G, 6G, and the Future of Digital Services", explores this, among others (Ahokangas & Aagaard, 2023).

However, I see a crucial thing as a beyond-regulation thing: sustainability and resilience, especially social and societal sustainability and resilience (Ahokangas et al. 2023b). How should mobile communications support them? How do we ensure that 6G infrastructures are sustainable and support social and societal sustainability and resilience?

Think of critical infrastructures which call for cybersecurity and raise national sovereignty-related concerns. Privacy and security concerns depend on cultural differences and are reflected in how data ownership, for example, and privacy and security are seen in Europe, the US, or China (Ahokangas et al. 2023b).

**CN: So, there is also a cultural aspect here?**

**PA:** So yes. Social and societal values differ, putting pressure on how you do business model innovation. It's not possible to have the same business models globally. Social and societal differences between countries influence how you practice business.

If you think about this discussion on the backlash on internationalisation because of what has happened during the past 20 years, this becomes evident. Many jobs have been transferred to the east, and now they are required to come back. The global turmoil and political situation also influence how you can do business and with whom you do business.

It's already been said in Europe that we should collaborate with like-minded countries. To make sure that our values prevail. This whole business innovation landscape has changed and becomes not only something that you think about as how to commercialise a technology, but you have to consider the regulation, values, and national interests much more.

**CN: And for 6G, this means what?**

**PA:** Connectivity is already the backbone of all digitalisation in modern society. Ubiquitous, affordable, and trustworthy connectivity is increasing in importance from that kind of perspective and combined with artificial intelligence, we will see new opportunities arising. But then, the question is how can we utilise those opportunities because there is so much regulation. We have variety and differences in values globally. We have global 5G. My concern is do we get global 6G. I'm not completely sure of that now. From the innovation perspective, this strongly influences the scalability and replicability of business models and their sustainability in the long term.

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