

Gisca, Oxana; Matinmikko-Blue, Marja; Ahokangas, Petri; Gordon, Jillian; Yrjölä, Seppo

Conference Paper

A regulatory perspective on local mobile communication network business in Europe: legitimacy considerations

32nd European Conference of the International Telecommunications Society (ITS): "Realising the digital decade in the European Union – Easier said than done?", Madrid, Spain, 19th - 20th June 2023

Provided in Cooperation with:

International Telecommunications Society (ITS)

Suggested Citation: Gisca, Oxana; Matinmikko-Blue, Marja; Ahokangas, Petri; Gordon, Jillian; Yrjölä, Seppo (2023) : A regulatory perspective on local mobile communication network business in Europe: legitimacy considerations, 32nd European Conference of the International Telecommunications Society (ITS): "Realising the digital decade in the European Union – Easier said than done?", Madrid, Spain, 19th - 20th June 2023, International Telecommunications Society (ITS), Calgary

This Version is available at:

<https://hdl.handle.net/10419/277966>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 860364.
This communication reflects only the author's view and that the Agency is not responsible for any use that may be made of the information it contains.

Authors:

Oxana GISCA
Doctoral Researcher,
University of Oulu

Marja MATINMIKKO-BLUE
Research Director, Center for Wireless Communications,
Adjunct Professor, University of Oulu

Petri AHOKANGAS
Professor of Future digital business,
Adjunct Professor, University of Oulu, Finland and Aalborg University, Denmark

Jillian GORDON
Professor of Entrepreneurship,
Adam Smith Business School, University of Glasgow, UK

Seppo YRJÖLÄ
Professor, University of Oulu
Principal Engineer, Nokia

A regulatory perspective on local mobile communication network business in Europe: legitimacy considerations

Abstract

Local cellular mobile communication networks have evolved as a novel concept and deployment model, and a prerequisite for their future emergence is the radio spectrum, which is a scarce resource. Regulatory approaches are expanding at the national, regional, and international levels making legitimacy of the local 5G and future 6G mobile communication networks an existing multi-faceted consideration. This paper provides an analysis of the regulatory approaches taken by national regulatory authorities (NRA) considering local 5G mobile communication networks. The focus is the European level, with Finland and UK as case examples. The article applies business model thinking to the regulatory realm of local mobile communication networks in Europe as an approach to the legitimacy considerations identified. The paper paves way to a new perspective for understanding and developing regulatory approaches and advancing sound and efficient regulatory actions.

1. Introduction

The current regulatory framework for telecommunications is evolving at the EU level (Bauer & Bohlin, 2022). In this context, innovation, newness and emergence are sources of concern for both regulatory agencies and legislatures (Ranchordás & Roznai, 2020). Any regulatory framework that applies to a fast-moving industry may become outdated, irrelevant, or a source of distortion without a proper approach – a regulatory regime may prove ineffective if new business and technology advancements become limited regarding their expansion. What elements of the regulatory approach needs to be adapted to support innovation remains a dilemma, although the purpose of regulation

should be adaptable to shifting economic and technical realities. Traditional legislative process is known to be lengthy, complex, and unpredictable, and as a result, it may not be agile enough to deal with emerging change in a timely and effective manner. To avoid impeding technical growth, most electronic communications legislation in the EU is technology and service neutral.

Local mobile communication networks have emerged as a new concept and model of deployment, allowing different stakeholders to have their own local 5G networks (Matinmikko, Latva-Aho, Ahokangas, Yrjölä & Koivumäki, 2017). However, the legitimacy – or the acceptance of these networks – is a multi-faceted challenge that impacts local networks business in practice. In extant research, local mobile communication networks were introduced for 5G with the micro operator concept that combined connectivity with specific or tailored content services in spatially confined domains like factories (Ahokangas, Matinmikko, Yrjölä, 2021). The introduction of new local 5G and beyond networks deployed by different stakeholders to complement traditional nationwide mobile network operators' (MNOs) is considered by National Regulatory Authorities (NRA) more broadly as of June 2023. Several countries have made their deployment possible via local spectrum licensing, complemented with other updates to regulations, resulting in new business opportunities for local 5G operations. Consequently, MNO and other stakeholders have established local and often private networks within specific facilities (Ahokangas, Matinmikko-Blue, Yrjölä & Hämmäinen, 2021).

The deployment of local 5G networks in different EU countries depends on the regulatory approach undertaken by the national regulatory authorities (NRAs) in relation to spectrum assignment policy, whereby making spectrum available through local licensing has emerged in several countries (Matinmikko-Blue, Yrjölä, Ahokangas, & Hämmäinen, 2021). Appropriate regulatory approaches are urgently needed for local operators to become legitimized and realize the innovation and growth potential embedded in this concept. To this aim, the business model approach can serve the sense-making and help understand the legitimation process for the new concept of local mobile communications networks in a given regulatory context. The business model has become the contemporary paradigm for innovating and communicating about business and researching organizational behavior in dynamic business environments. The business model approach can be seen as comprising concrete choices (on opportunities, value creation, and advantages needed for conducting business) and the consequences of these choices (in terms of scalability, replicability, and sustainability of business) (Casadesus-Masanell & Ricart, 2010). Legitimation, in turn, refers to the *“generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed systems of norms, values, beliefs, and definitions”* (Suchman, 1995). By analyzing the regulatory status of two European countries, this paper investigates the regulatory considerations toward local mobile communication networks businesses, underlining business model thinking and ecosystem legitimacy considerations as with novel stakeholders the mobile communications ecosystem and its roles are expected to become changed. The paper aims to answer the following research questions:

- How do European regulators consider local mobile communication networks?
- What legitimacy considerations arise and how can they be understood with a business model approach?

The paper is set out as follows. Section 2 highlights the ecosystem legitimacy, business model antecedents and outcomes as key theoretical concepts; section 3 introduces the research methodology; section 4 presents the context of local 5G network business; section 5 presents the regulatory framework for local mobile communication network; section 6 presents the result of the analysis by emphasizing the regulatory considerations, and business model outcomes and antecedents from regulatory perspectives. Finally, section 7 discusses the theoretical conclusions and underlines the limitations and future research avenues.

2. Theoretical approach

This section provides the key theoretical concepts used for analyzing the regulatory approaches on local mobile communication network businesses in Europe. It comprises the ecosystem legitimacy and business model-related antecedents and outcomes.

2.1 Ecosystem legitimacy

As an emerging innovation, local 5G and future 6G networks may share several challenges related to “industry legitimacy” (Kwak & Yoon, 2020; Marano, Tallmann & Teegen, 2020). Legitimacy, in general terms, was defined by Suchman (1995) as the generalized perception or assumption that the action of an entity or organization is designed as proper or appropriate within a socially constructed systems of norms, values, benefits and definitions. We consider legitimacy as a process and focus on the processual aspects that lead to its emergence (Suddaby, Bitektine & Haack, 2017) as an outcome. Legitimacy is a condition reflecting perceived consonance with relevant rules and laws, normative support, and alignment with cultural-cognitive frameworks, which are displayed in a way that is visible to outsiders (Scott, 2008). Legitimacy is particularly important during the emergence phase of a business ecosystem, when the ecosystem faces *liability of newness* and low legitimacy (Freeman, Carroll, & Hannan, 1983; Singh, Tucker, & House, 1986; Stinchcombe, 1965).

Generally, a (business) ecosystem can be considered as “*a community of interdependent yet hierarchically independent heterogeneous participants, who collectively generate an ecosystem value proposition – often emerge through collective action, where ecosystem participants interact with each other and the external environment*” (Thomas & Ritala, 2022). Four different elements of ecosystems are presented by Autio, Nambisan, Thomas and Wright (2018) as a cohesive logic: (1) ecosystem contingencies, which comprise policies and regulations, culture and institutions and the economic, industrial base; (2) ecosystem structures, which include stakeholders, roles, and relationships; (3) ecosystem processes, which include knowledge sharing and spillover; business and experimentation; the emergence of new stakeholders; scale-up; and, (4) ecosystem goals and outcomes. Ecosystem legitimation therefore, leans on two complementary aspects: actions that align with normative expectations and discourses that build cognitive coherence.

2.2 Business model approach: antecedents and outcomes

The business model has become the contemporary paradigm for innovating and communicating about business and understanding firm behavior in increasingly dynamic business environments. Business models have been depicted in extant research with numerous templates that typically describe the structures, resources, and activities required for conducting business, including components such as offering, value proposition, business advantages, differentiation, key activities for selling, marketing, and delivery as well as the revenue and cost models. The business model is thus a tool for value creation and capture (Amit & Zott, 2001). Ahokangas (2023) argues that conceptually, opportunity value and advantage frame the business model concept as antecedent constructs, whilst scalability, replicability and sustainability frame it as outcome constructs (Osterwalder & Pigneur, 2010; Foss & Saebi, 2017; Amit & Han 2017). In this context, opportunity means something positive to be reached (Holm, Sammalisto, Grindsted & Vuorisalo, 2015).

Opportunity is strongly dependent on the external context (Atkova, 2018, p. 20). Value creation can be a source of competitive advantage, and competitive advantages are needed by organizations to become and remain competitive (Casadeus-Masanell & Ricart, 2010). Competitive advantage enables the creation of greater value for an organization and its shareholders and stakeholders, and thus, it gives a competitive edge over competitors (Iivari, Ahokangas, Komi, Tihinen & Valtanen, 2016). Scalability refers to the ability of the business to deal with the business volume, business space, and business model change, and it refers to its internal growth beyond the scale or volume the model was

initially developed for (Juntunen, Ahokangas & Nguyen, 2018). Replicability refers to “the innovator firm’s learning about and refining its (new) business model by choosing the necessary components to replicate that model in suitable geographical locations, by developing capabilities to routinize knowledge transfer, and by maintaining the model in operation once it has been replicated” (Aspara Hietanen, & Tikkanen, 2010, p. 43.)

Finally, sustainability “*helps describing, analyzing, managing and communicating (i) a company's sustainable value proposition to its customers, and all other stakeholders, (ii) how it creates and delivers this value, (iii) and how it captures economic value*” (Schaltegger, Hansen, & Lüdeke-Freund, 2016, p. 6). The processes of value (co-)creation and (co-)capture (Bengtson & Kock, 2000) and value sharing (Verstraete & Jouison-Laffitte, 2011) link business models to the business ecosystem, where the replicability (Martins, Rindova, & Greenbaum, 2015), scalability (Nielsen & Lund, 2018a, 2018b), and sustainability (Schaltegger et al., 2016) are realized.

3. Research methodology

This research has been conducted with the logic of analytical induction and the epistemological assumptions of social constructionism (Easterby-Smith, Jaspersen, Thorpe & Valizade, 2021). It focuses on the prominent telecommunications regulatory regimes from Europe and explores how regulators consider local mobile communication networks in the development of regulatory policy. The study has adopted a case-study research strategy (Eisenhardt, 1989; Yin, 2010). The case study technique was considered to be the most appropriate to develop a deeper understanding of the influences and drivers of regulatory policy using qualitative data (Stake, 1978; Milles & Huberman, 1994; Yin, 2014). Drawing from the works of Baxter and Jack (2008, p. 555), the study adopted a three step approach to collecting data including 1) preparatory work, 2) identification of the cases and 3) data collection and analysis.

Step1. Preparatory work and Data Sources.

We have reviewed relevant business and technical literature on local mobile communication network businesses. In addition, we scrutinised the legal provisions applicable to local communication networks, including reports of specialized international organizations, industry reports, and other legal literature deemed as relevant. This material enabled the identification of specific themes to be explored during the data collection phase.

Step 2. Identification of the examined cases

Following a thorough assessment of the collected information, two countries (Finland and UK) were selected as case studies from the CEPT member countries that have advanced with the deployment of local 5G mobile communication networks. They were selected primarily because Finland has an essential role in the information technology and communication sectors (Lehtilä, Alén, Korpisaari, & Himmanen, 2023), being one of the first country to deploy 5G. As a "digital pioneer," legislation granted affordable broadband access the status of a legal right (Ala-Fossi, 2015). Practically and statistically, Finland is one of the most connected nations in the world, with 96% of households having access to broadband internet. The UK was selected because of its highly innovation-oriented approach to telecommunication and its technical advancement.

Step 3. Data Collection

We interviewed representatives from the national regulatory authorities in order to gain an indepth understanding of the development of the local mobile communication industry and the role of different stakeholders at the national level in the considered two case countries: Finish Transport and Communications Agency (Traficom) in Finland and the UK’s communications regulator Ofcom. Our

data collection strategy encompassed different sources of information for the countries. We collated information on contextual legalities, as well as, the challenges and trends in the industry. We built on this by combining it with data drawn from the interviews with the regulators. In preparation for the interviews, we developed a semi-structured interview protocol along pre-identified themes using open-ended questions. We focused on a number of areas that we believed would enable to better understand the overall regulatory perspectives including: the role and responsibility of the organization, exploring and understanding the current situation of the local mobile communication network in the country, exploring the regulatory considerations given to local mobile communication networks in the country or body, and probing the historical background of those developments. Moreover, we probed on what the expected impacts behind those developments might be, and sought to understand the established drivers, motivations and challenges in implementing the European and international regulatory provisions at the national level regarding local mobile communications networks. Finally, we also asked exploratory questions on the future actions planned for local mobile communication network businesses and how collaborations with other NRA and stakeholders may feature or take place. The interviews lasted between one hour and one hour and fifty minutes, they were recorded on teams and transcribed verbatim. Specifically, we interviewed senior managers from regulatory authorities who are responsible for policy development and the drafting of regulatory strategy. Interviewing such individuals helped us to capture relevant aspects of the historical legal developments of local mobile communication network.

Step 4. Data analysis

We chose a method based on the comparative study of two countries from Europe (Finland and the UK) to explore the mechanism, drivers and motivations that enable the successful adoption of regulatory measures for the deployment of local mobile communication networks. We began by reviewing the primary interview data via transcript, notes and the secondary data that we collected in the legal documents for each of our two cases. Following this we started to code the data within each case, using a thematic approach (Flick, 2006; Yin, 2010). We engaged in an active and thorough reading of the data, noting ideas for possible patterns and seeking out similarities and differences (Braun and Clarke, 2006). We searched the sentences that contained references to the drivers and motivations and how the regulatory actions could create value, to the key approach and the actors involved in the process. Each of the identified statements were assigned a descriptive label that reflected the concept represented in the specific portion of the text. This enabled us to generate a list of codes that were consolidated across the two cases.

Next, by interacting between primary and secondary data and our literature reading, we generated sub-codes that shared common characteristics into emergent themes. Some of these themes were consistent with the existing business model approach literature (e.g. opportunity, value, advantage, sustainability replicability scalability) while others emerged from our case evidence (stakeholder consultation, demand, promoting innovation). Finally, by further abstractions, we grouped our analytic sub-themes into three main aggregated themes of regulatory considerations, challenges and opportunities, which reflect the key elements of the overall story of the regulatory approach in deploying future local mobile communication networks. This paper reflects the authors' views based on interviews and additional research, as opposed to being the views of the interviewed organisations.

4. Context of local mobile communication network businesses in Europe

A recent study by the Global Mobile Suppliers Association (GSA) on the global deployment of private mobile communication networks that incorporate 4G and 5G technology showed that the number of private mobile networks reached beyond Europe 1,077 in the fourth quarter of 2022, (GSA, 2023). Local mobile communication networks are networks that cover a spatially confined area using cellular mobile communication technology such as 4G or 5G. Early work defined local "micro

operator” concept is “*an entity that combines connectivity with specific content services in spatially indoor confined domains, being dependent on the availability of spectrum resources*” (Ahokangas, Moqaddamerad, Matinmikko, Abouzeid, Atkova, Gomes & Iivari, 2016; Matinmikko, Latva-Aho, Ahokangas, Yrjölä, & Koivumäki, 2017). Traditionally, MNOs have deployed nationwide mobile communication networks. Location-based and context-driven local wireless connectivity requirements in different verticals, such as manufacturing and logistics, have also piqued the interest of businesses (Ahokangas, Matinmikko-Blue, Yrjölä, Seppänen, Hämmäinen, Jurva, & Latva-aho, 2019). Local mobile communication networks aim to meet the specialized requirements of certain vertical industries to complement MNOs (Guirao, Wilzeck, 2017). Examples include ports, factories, and mines, where the area is typically under the jurisdiction of a single organization, but where multiple organizations can operate and benefit from shared infrastructure and locally tailored services to enhance their operations in the area.

As 5G mobile networks evolve technologically, a slew of new 'as-a-service' business models have emerged (Ahokangas, Matinmikko-Blue, Yrjölä, & Hämmäinen, 2021; Cave, 2019; Morgado, Huq, Mumtaz, & Rodriquez, 2018). Other stakeholders beyond MNOs in the mobile business ecosystem can also offer these as-a-service model, it complements the MNOs offerings and has its basis in the on-going regulatory developments. Such advancements are centered on local spectrum access rights (Matinmikko, Latva-aho, Ahokangas, & Seppänen, 2018; Bhattarai, Park, Gao, Bian & Lehr, 2016), and flexible network implementations for network virtualization (Wan, Haider, Gao, You, Yang, Yuan, & Hepsaydir, 2014). 5G will accelerate digitization in tandem with scalable business models that extend beyond connectivity services to give diverse content context and commerce platform offerings, which will require the development of new regulatory models to govern the mobile business ecosystem (Bauer, 2015).

To avoid impeding the development of local 5G and forthcoming 6G networks, regulators have begun investigating the potential adjustments to introduce local mobile communication networks with a special focus on spectrum assignment decisions in a number of countries (Matinmikko-Blue, Yrjölä, Ahokangas & Hämmäinen, 2021; Gisca, Matinmikko-Blue, Ahokangas, Yrjölä, & Gordon, 2022). National regulators are exploring, how to establish long-term compromises in spectrum management decisions that balance efficient spectrum usage, fairness, competition, and innovation in the emerging local mobile communication network market (Matinmikko-Blue, Yrjola, & Ahokangas, 2023). As NRAs seek to provide access to a greater number of spectrum users, local access solutions combined with shared access solutions are of interest. Authors in (Alen-Savikko, Bu-Pasha, Himmanen, Korpisaari, Lehtilä, & Vesala, 2020), for example, analyze network and spectrum regulation and continuing legislative reform for implementing EU provisions to respond to the need to simplify the licensing procedure in Finland.

5. Regulatory Framework for local mobile communication networks

The electronic communication market is highly regulated with varying degrees at national, regional and international levels. The regulation of telecommunications has gone through significant changes and regulatory considerations during recent decades. Such regulatory developments have had a direct impact on the ecosystem legitimacy of local mobile communication networks (Ahokangas, Matinmikko-Blue, Yrjölä & Hämmäinen, 2021). Regulators in different countries have employed different strategies for local 5G networks (Cave, 2018), resulting in different regulatory approaches for local mobile communication network businesses. Recent studies on regulatory advancement (Matinmikko, Latva-aho, Ahokangas, & Seppänen, 2018; Bauer, 2015; Bauer, Bohlin, 2022; Gisca, Matinmikko, Ahokangas, Yrjola & Gordon, 2022) have identified key regulatory elements to be taken into account by regulators and businesses. Generally, the regulatory framework can be divided into three levels (see Figure 1): international, regional and national, which are discussed in more detail in the following.

INTERNATIONAL, EUROPEAN AND NATIONAL LEVEL REGULATORY FRAMEWORK FORUMS FOR LOCAL MOBILE COMMUNICATION NETWORKS

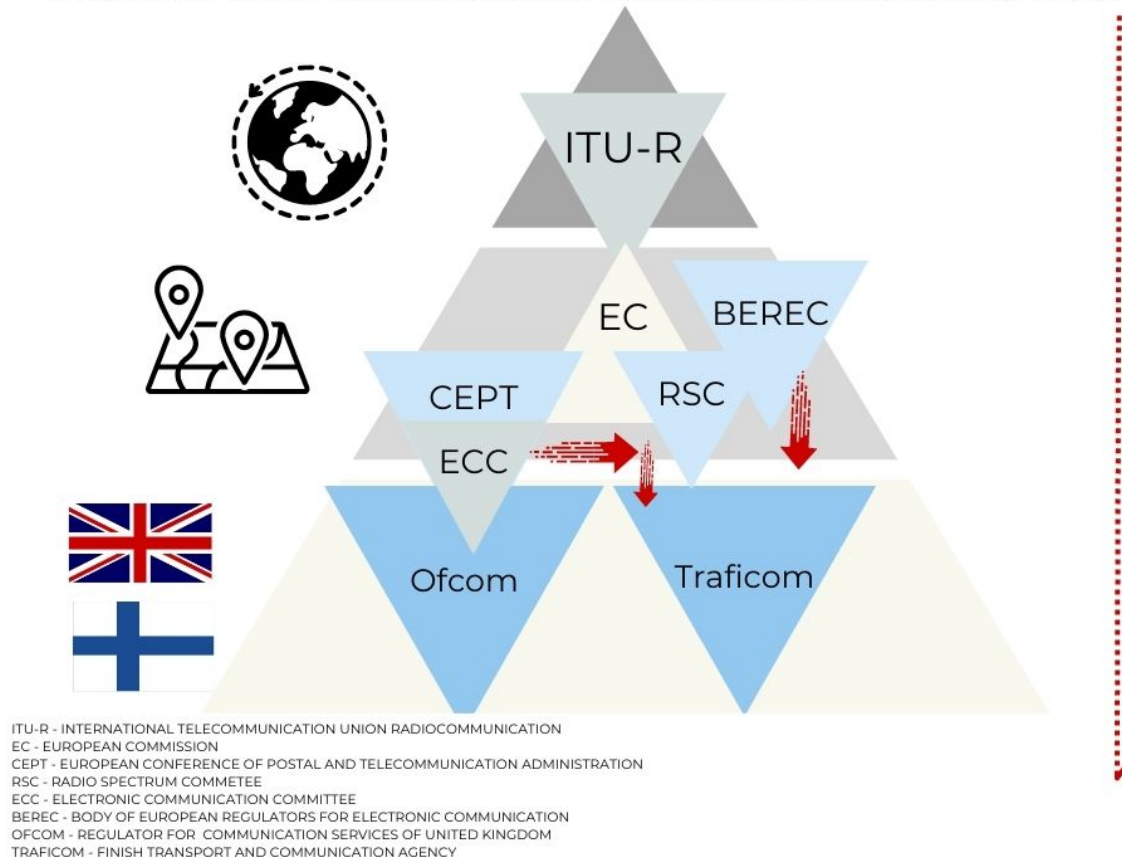


Figure 1. Overview of the regulatory framework, including international, regional and national levels.

5.1 International-level regulatory framework forums

At the international level, the International Telecommunication Union Radiocommunication (ITU-R) sector is the global agency responsible for the management of the radio-frequency spectrum and satellite orbit resources. It plays a fundamental role in the global harmonization of spectrum matters including interference management. ITU-R makes decisions on spectrum allocations once in four years via the World Radiocommunication Conferences (WRCs) revising the Radio Regulation, which is an internationally binding treaty agreement governing spectrum use. The ITU-R allocates spectrum bands for different radiocommunication systems including mobile communication systems through the WRCs. It also defines the radio related requirements for International Mobile Telecommunication (IMT) systems, which include cellular mobile communication systems such as 4G and 5G. The ITU-R conducts sharing studies between different radiocommunication services when preparing for the spectrum allocation at the WRC. This spectrum harmonization reduces the potential for harmful interference. The specific assignment of the spectrum access rights to the band is a national matter.

5.2 Regional-level regulatory framework

Regional-level regulatory frameworks act at the intersection between international and national levels and have different roles depending on the region. In the case of Europe, regional regulatory authorities that are relevant to local mobile communication networks are the European Commission (EC) and Electronic Communication Committee (ECC) that is an autonomous committee of the European Conference of Postal and Telecommunications Administrations (CEPT). The ECC brings together 46 countries to define uniform laws and regulations in electronic communications and associated

applications for Europe, as well as develop a harmonized approach to spectrum use through nonbinding decisions and recommendations

The EC issues mandates to the CEPT of ECC, setting out tasks to be performed and a corresponding timeframe (EC Decision No 676/2002/EC, 2002). Based on the mandates, CEPT of ECC drafts technical implementation measures for harmonizing the use of radio spectrum. For example, the EC mandated CEPT to study harmonization of the 3.8–4.2 GHz band for low-power and medium-power applications on a local basis which specifically addresses shared access (Radio Spectrum CEPT Mandate, December 2021). The CEPT ECC issues decisions and recommendations as (soft law) directly to NRAs but in this case the implementation is voluntary.

The Radio Spectrum Policy Group (RSPG) brings together high-level government officials from EU member states. The RSPG provides strategic advice on high-level spectrum policy issues to the Commission, European Parliament, and European Council. The RSPG develops Opinions and other deliverables as foreseen in its annual Work Programme, or on request. The RSPG published an opinion on spectrum sharing in 2021 (Radio Spectrum Policy Group, 2021). In the opinion, the RSPG states that the "Member States could consider sharing solutions, and other alternative/complementary approaches such as leasing, that may help vertical industries and other spectrum users to access spectrum on mutually beneficial basis, in particular to address local access needs".

The Body of European Regulators for Electronic Communications (BEREC) is an autonomous body that helps develop and improve the internal market for electronic communications networks and services. Additionally, BEREC helps the European Commission (EC) and the NRAs implement the EU regulatory framework for electronic communications. It provides advice on request and on its own initiative to European institutions and complements, at the European level, the regulatory responsibilities carried out by national regulatory authorities. The NRAs and the European Commission are required to give the uttermost consideration to any opinion, recommendation, guidelines, advice, or regulatory best practice adopted by BEREC.

5.3 National level regulatory framework

National Regulatory Authorities (NRAs) are the national level bodies and their roles and structures vary between countries. In European Union member countries following the provisions of the Directive 2018/1972, NRAs are competent institutions established at the national level and empowered with rights and obligations to implement ex ante market regulation, including the imposition of access and interconnection obligations; performing radio spectrum management and decisions or providing advice regarding market-shaping and competition elements of national processes related to the rights of use for radio spectrum for electronic communications networks and services; contributing to the protection of end-user rights in the electronic communications sector.

In Finland, the Finnish Transport and Communications Agency (Traficom) is the competent Authority regarding communication networks and services. The Act of electronic communications Services (917/2014)(ECSA) is the main legal document that aims to promote the provision and use of electronic communications services and ensure that everyone in Finland has reasonable access to communications networks and services. Another goal is to ensure that radio frequencies are used efficiently and without interference, promote competition, and ensure that communications networks and services are highly reliable, safe, and affordable. It also seeks to protect the privacy and secrecy of electronic communications. It specifies in detail the duties of Traficom. Following the provisions of the ECSA, art.303-304 establishes Traficom as the competent Authority with regard to spectrum matters.

Traficom introduced the regulatory provisions that enabled local mobile communication networks in 2009. Finish legislation contains license and license exemptions requirements. Each license stipulates

the conditions for use. Local licensing via administrative allocation mechanisms has been allowed in low bands (20 MHz in the 2.3 GHz band) and high bands (850 MHz in the 25 GHz band), which allows different stakeholders to acquire permission to use spectrum for local mobile communication networks for private and small-scale public use. Under section 95 of the ECSA "the allocation and usage of the radio frequency bands is defined nationally by the government decree." The Government decree on the use of radio frequencies and the frequency plan 1246/2014 sets the scene and under section 9a of April 2021, establishes the local mobile communications networks for small-scale public telecommunication. Traficom is also contributing to European work to harmonise the 3.8 - 4.2 GHz band for local mobile networks across the EU.

Outside of the EU, Ofcom is the NRA for electronic communications including local mobile communication network businesses in United Kingdom. Ofcom's powers and duties are derived from the Communications Act 2003(CA03) and the Wireless Telegraphy Act 2006 (WTA06). In combination, these are the applicable laws on Ofcom's and duties and functions as regards spectrum management, including authorization . It specifies the wireless telegraphy license, grants of recognized spectrum access, management of spectrum access, management of radio spectrum and enforcement.

Strategically the work of Ofcom is focused on three key areas, instrumental in delivering its objectives and enabling innovation and growth across all industry stakeholders. These are, the support of wireless innovation, licensing to fit local and national services and promoting spectrum sharing.(Ofcom, Supporting the UK Wireless Future, 2021).

UK introduced a new licensing approach to provide shared and localized access to spectrum bands for local wireless connectivity applications in 2019. Two new approaches were adopted including Shared Access License and Local Access License. The Shared Access license that is a component of a novel spectrum sharing framework. The Shared Access license, which provides access to four spectrum bands 1800 MHz, 2.3 GHz, 3.8-4.2 GHz, and 24.25-26.5 GHz. (Enabling wireless innovation through local licensing, July 2019). Another type is Local Access license, which allows other users to access spectrum that is already licensed to a national level MNO in locations where an MNO is not using their spectrum. The Local Access License is available in 800 MHz, 900 MHz, 1400 MHz, 1800 MHz, 1900 MHz, 2100 MHz, 2300 MHz, 2600 MHz and 3,4 GHz bands. Spectrum trading is based on a commercial agreement between the parties with very little Ofcom involvement.

6. Results description

This section puts forward the results of the analysis and sets out a number of regulatory considerations for local mobile communication networks. The results description reflects the authors' views based on interviews and additional research, as opposed to being the views of the interviewed organisations. The ecosystemic way of thinking and the ecosystem legitimacy theoretical lens enhances our understanding of what impacts the emergence and development of local mobile communication network businesses. The business model approach enables us to consider how regulatory actions might advance the local mobile communication network business.

6.1 Regulatory considerations

The subsection below highlights the regulatory considerations in regard to local mobile communication network business. It emphasizes the role and responsibility of the regulatory authorities from Finland and UK and states the current situation at the national level, the actions undertaken, and the regulatory themes under priority consideration. Moreover, it depicts the drivers for regulatory actions and what are the future focus of those actions.

6.1.1 Case Finland

In Finland, Traficom plays the key role as the competent authority for local mobile communications businesses. Its responsibilities, as outlined in the ECSA articles 303-304, are diverse and cover various aspects of the telecommunications industry. One of Traficom's key tasks is spectrum management and supervision. This involves overseeing the allocation and efficient use of radio frequencies for mobile communications. Traficom is responsible for planning the frequency spectrum, coordinating telecommunication industry standards, and allocating spectrum resources appropriately. Additionally, Traficom collates and publishes information about the availability, quality, and pricing of network services. This helps to provide transparency in the market and enables consumers to make informed decisions about their telecommunication services. Another significant responsibility of Traficom is the collection of information on violations and threats to information security within the network, communications, and added value services. It investigates any reported violations or threats and takes appropriate actions to mitigate risks and ensure the security of communication networks. Traficom also acts as a national cybersecurity certification authority, contributing to the overall cybersecurity framework of the country. It establishes and maintains certification processes and standards to ensure the reliability and security of communication networks and services. It develops supporting decisions and guidelines that outline the options for utilizing frequency bands, the intended purposes of their use, frequency reservations and applications, as well as the licensing terms and associated costs. Furthermore, it actively cooperates with the industry to bridge the gap between research and the interests of the industry regarding regulation. This collaboration aims to foster innovation and development while ensuring that regulatory frameworks align with technological advancements and industry needs. Moreover, Finland has a very ambitious climate and environmental strategy.

In the context of local mobile communication networks, Traficom grants spectrum licenses to applicants committed to developing a local mobile communication network business. Traficom has opened the 2.3 GHz and 25 GHz bands for local licensing for any stakeholder to apply. Detailed information on existing licenses are documented and is available online (Traficom, 2023). Local licenses are for private and, under certain circumstances, also for small-scale public networks and fixed wireless access. As well Finland has adopted a relatively new cybersecurity provision to protect core network functions that complement existing regulations. According to this provision, using a telecommunications device is not permitted in critical parts of the public network if it can endanger national security and defense when used. This also applies to local networks connected to certain universal communications networks (Section 244a ECSA).

An essential part of the analysis was to identify the regulatory themes that entail attention. From the Traficom perspective, the spectrum management, interference, and security of electronic communications, telecommunications industry standards, availability, quality and prices of network services, and information security in respect of network services and competition are themes that are under regulatory attention. Traficom incorporates several essential drivers and motivations into its regulatory actions pertaining to local mobile communication network businesses. These drivers aim to foster a competitive and accessible environment while ensuring the highest standards of quality, reliability, and security. One of the key drivers is the promotion of innovation. The authority actively engages with industry stakeholders, research institutions, and experts to stay informed about emerging trends and to create a regulatory framework that encourages and supports innovative initiatives. Harmonization of the use of bands at the European level is an additional essential driver. To ensure a consistent approach to spectrum management and other regulatory aspects, the Traficom endeavors to be a forerunner and align its regulations with those adopted at the international and regional level.

Traficom is committed to fostering the supply and use of electronic communications services across Finland. This includes ensuring that everyone in the country has access to communications networks

and services under reasonable conditions. The agency works to bridge the digital divide, especially in remote or underserved regions, by fostering infrastructure deployment and encouraging service providers to extend coverage to these areas. Traficom seeks to promote digital inclusion and social connectivity and enable the activity of local mobile communication network business by facilitating access to dependable and affordable communication conditions. Competition is a driving force behind Traficom's regulatory actions. The agency is committed to fostering a competitive market environment that promotes innovation, reduces prices, and enhances service quality. Efficient and interference-free usage of radio frequencies is the next driver. The agency seeks to allocate and manage spectrum resources in an efficient and interference-free way. Confidentiality of electronic communication and privacy protection are significant priorities for Traficom. The agency sets stringent requirements and regulations to safeguard the privacy and confidentiality of users' electronic communications. It ensures that service providers adhere to robust security measures and data protection standards. Traficom recognizes the importance of promoting environmentally friendly practices in the telecommunications sector. It encourages the adoption of energy-efficient technologies, the reduction of electronic waste, and the use of renewable energy sources in network infrastructure. By promoting environmental sustainability, Traficom aims to minimize the environmental impact of the telecommunications industry and contribute to a more sustainable future.

Future regulatory considerations for Traficom include interest in the frequency range of 3.8 to 4.2 GHz promoting least restrictive conditions relying on national flexibility. Traficom is actively exploring the possibility of defining geographical boundaries for spectrum allocation specific to local networks. This involves determining the size of the geographical area that would fall under such designations.

6.1.2 Case United Kingdom

In the UK, Ofcom is the competent regulatory authority for local mobile communication networks businesses. It is responsible for spectrum management and enforcement. It oversees and provides directions to a range of spectrum projects. This includes an approach to spectrum access for private networks and local uses of mobile technologies.

Under its current framework, Ofcom has adopted two different mechanisms for making spectrum available:

- i) A 'local access' mechanism, which enables interested parties to apply to use spectrum for which mobile network operators hold national licences, where that spectrum is not currently being used, with this option available only a time limited licence period.
- ii) A 'Shared Access' mechanism, where localised spectrum licenses can be granted for either low or medium power use in a range of spectrum bands that have been harmonised for 4G or 5G technologies, with sharing occurring both between new users, and with existing band users (for example, earth stations) and licences available on an indefinite basis.

Ofcom's responsibilities include the provision of an overarching access framework, assessment of case by case interference between other shared access users, frequency assignment, user authorization and licence grants.

There are approximately 30 local network offerings in different locations across the UK. A number of 1600 licenses in shared access products were recorded, of which 900 are focused on local 5G provisions that cover a mixture of services such as industrial and factory connectivity. Some are addressing 5G broadcast needs, and some are 5G based, fixed wireless access provisions for local to-the-home sort of gigabit style connectivity. There are approximately 30 local network offerings in

different locations across the UK. Detailed information on licenses and transmitters are documented and is available online in open access. (Ofcom, Spectrum information portal, 2023).

In 2023, its relevant publications have included a position paper on adaptive spectrum access (which included consideration of private network use cases) and a 'Call For Inputs' on the evolution of its Shared Access framework for private network users. Ofcom included in its strategic spectrum management document the illustration of potential future trends relevant for spectrum sharing such as changing external context (for example, health care and well being, environmental concerns, the resilience and security), changing technology (for example, more use of much higher frequency bands, radio technology progress, more centralized network functions, satellites, retirement of analog services), changing application demands (for example growing capacity demand, use of more smart devices, super reliable services, smart city and industrial IoT, robotics and drone, connected vehicles).

The UK regulator places significant importance on various priority themes that guide their future streamlined actions. Overarching organisational priorities are set out in a Plan of Work, with its Spectrum Management approach set out in regularly updated Spectrum Management Strategy and Spectrum Roadmap. Spectrum management is a key area of focus for the UK regulator. The limited availability of radio frequencies and the increasing demand for spectrum to support various wireless communication services in the same locations is an acknowledged fact. The regulator works to efficiently allocate and manage spectrum resources, ensuring that they are utilized in a way that maximizes their potential and meets the needs of different stakeholders that develop diverse services. By effectively managing spectrum, the regulator aims to promote fair competition, encourage innovation, and enable the growth of wireless communication technologies.

One of the key drivers highlighted by Ofcom in its Spectrum Management Strategy and Spectrum Roadmap is the support for new uses and innovations. The authority recognizes the importance of encouraging the development of emerging technologies and services that utilize spectrum resources. By facilitating the introduction of innovative applications, Ofcom aims to support economic growth, enhance productivity, and create new opportunities for businesses and consumers. Ofcom also emphasizes being demand-driven and forward-looking in their approach. They strive to anticipate and meet the evolving demands of businesses and consumers, while also identifying future opportunities for innovation. By proactively addressing emerging trends and technologies, Ofcom aims to facilitate the development and deployment of advanced communication networks and services.

Another aspect of future regulatory considerations for Ofcom is meeting the evolving demand in the telecommunications market. Enhancing accessibility to the spectrum is a key consideration for Ofcom. The authority recognizes the need to make it easier for businesses to access spectrum resources, particularly for supporting local wireless connectivity applications. By streamlining the licensing process and promoting flexible usage arrangements, Ofcom aims to encourage the deployment of localized networks and enable businesses to explore alternative connectivity solutions beyond traditional approaches. The authority recognizes the need to adapt to changing consumer needs and technological advancements. By staying proactive and responsive to market demands, Ofcom aims to ensure that the telecommunications sector remains dynamic and capable of meeting the ever-growing requirements of businesses and consumers. Ofcom also emphasizes the importance of providing opportunities for businesses to innovate. The authority understands that innovation is key to driving growth and fostering a competitive market environment. By creating a regulatory framework that encourages and supports innovation, Ofcom aims to stimulate creativity, technological advancements, and the development of new services and solutions within the industry.

Finding the right balance between flexibility and spectrum efficiency is a significant consideration for Ofcom who has a statutory duty to ensure that spectrum resources are utilized efficiently to meet

the growing demand from the industry. At the same time, Ofcom recognizes the need for flexibility to accommodate different uses and technologies. By striking this balance, Ofcom aims to optimize spectrum usage while allowing for innovation and accommodating the diverse needs of industry stakeholders. Finding the right balance between flexibility and spectrum efficiency is a significant consideration for Ofcom.

In terms of future work, Ofcom is exploring the possibility of making parts of the 26 GHz band available for shared access, particularly in urban areas. This approach would enable multiple local mobile communication networks to access the spectrum for various applications, fostering efficient use. Ofcom may also consider conducting national spectrum auctions to allocate licenses for this shared access, ensuring fair and transparent distribution of spectrum resources.

The authority also understands the significance of international cooperation and coordination in spectrum management, and potential benefits and economies of scale from local or regional harmonization. By aligning their policies and practices with global standards where this is possible and appropriate and by collaborating with international counterparts, Ofcom aims to ensure efficient spectrum utilization, minimize cross-border interference, and facilitate seamless global connectivity.

Another aspect of future regulatory considerations for Ofcom is meeting the evolving demand in the telecommunications market..

Finding the right balance between flexibility and spectrum efficiency is a significant consideration for Ofcom. The authority acknowledges the importance of ensuring that spectrum resources are utilized efficiently to meet the growing demand from the industry. At the same time, Ofcom recognizes the need for flexibility to accommodate different uses and technologies. By striking this balance, Ofcom aims to optimize spectrum usage while allowing for innovation and accommodating the diverse needs of industry stakeholders. Finding the right balance between flexibility and spectrum efficiency is a significant consideration for Ofcom.

6.1.3 Some comparisons between Finland and UK

The analysis establishes that the roles and attributions of the regulatory authorities from Finland and UK are innovation-oriented, and the engagement and collaboration with the industry stakeholders focus on "meeting the demand" and anticipating future framework arrangements schemes. Participation in innovation projects and industry feedback analysis demonstrates an increased interest in applying the most efficient spectrum management mechanism and promoting opportunities for local mobile communication network businesses. Contribution to the work of international and regional bodies and initiatives on the relevant matters confirms a strong national commitment to regional and global harmonization of spectrum use that will facilitate their deployment at a larger scale.

Regulatory themes that constitute priorities for regulatory considerations have a broad ecosystemic approach and are focused on enhancing the opportunities for assigning larger spectrum bands, ensuring value creation and co-creation by maintaining and improving standards in telecommunications and wireless equipment standards, and raising advantages by offering affordable and competitive solutions and conditions for local mobile communication network businesses. Drivers and motivations considered by the regulators emphasize the focus of their priorities such as innovation encouragement, competition fostering, ensuring security and resilience, affordable conditions and sustainability. Future considerations of the regulatory actions emphasize an open approach to foster innovation and create simple and affordable regulatory conditions that will facilitate accessible spectrum conditions for developing local mobile communication network businesses.

6.2 Identified Legitimacy Considerations

In this subsection, considering the ecosystem legitimacy elements we present the analysis results of the regulatory considerations and identify the related challenges from the regulator's perspective.

A priority concern for the regulators is to make sufficient spectrum available when there is demand to as many users as is feasible whilst mitigating the possibilities of interference. This applies to local mobile communication networks where creating enabling conditions for spectrum access in the future to different actors with diverse needs is a priority. One noticeable element in striking the right balance between industry demand and regulatory foresight is the timing of the decision-making process. This approach takes into account both the current market needs and the forward-looking perspective necessary for anticipating future requirements. By closely monitoring industry trends and technological advancements, regulators can proactively assess the demand for spectrum resources and make informed decisions about their allocation. They emphasize the need to align spectrum availability with market demand while considering the regulators' forward-looking approach. This combination will ensure that spectrum resources are allocated when and where they are most needed, optimizing their utilization and facilitating the growth of local mobile communication networks.

The lack of existing coordinated European approach for spectrum bands dedicated to local mobile communication networks appears as an issue, with harmonized spectrum use being a shared goal among regulators. However, this is now being addressed, with CEPT is currently tasked by the European Commission (EC) with determining whether and how the band 3.8 - 4.2 GHz, could be harmonised for shared and local mobile communication networks, which could considerably reduce costs and increase equipment size across the band. This work is ongoing and, in conjunction with the countries that are already in the process of making similar spectrum available for similar purposes, should generate support for ecosystem investment.

One key aspect highlighted by regulators is the availability of equipment specifically designed for the identified spectrum bands, particularly in the case of the 25 GHz range. A lack of equipment availability poses a barrier to the widespread adoption of future local networks operating in the relevant spectrum bands. Regulators emphasize the importance of developing an internationally agreed approach that fosters the growth of the equipment ecosystem and reduces the cost of compatible devices, thus enabling a more accessible and affordable deployment of local networks.

Another legitimacy consideration identified by regulators is the limited awareness and knowledge among companies regarding how to effectively design and build local networks that fully leverage the potential of the available spectrum bands. This requires a collaborative effort between regulators, industry stakeholders, and technology providers. In the context of expansion of local networks, frequency planning and interference management appear as important considerations. As local mobile communication businesses gain their own spectrum and build their networks, the question arises as to who would be responsible for the frequency planning and managing potential interference. It is essential to have clear guidelines and procedures in place to guide these new players and ensure that they operate their networks effectively and without causing interference to other existing systems.

Cybersecurity and risk assessment in the realm of local mobile communication networks is another priority consideration for Finish regulator. Ensuring robust cybersecurity measures and conducting thorough risk assessments become imperative for local mobile communication networks. Regulator understand the significance of guiding new entrants in the local mobile communication sector on best practices to safeguard their networks from potential threats. By providing guidance and support in cybersecurity and risk assessment, regulators aim to promote a secure and resilient environment for local mobile communication businesses.

One of the key objectives of regulatory actions in the realm of local communications networks and services is to ensure that they are sustainable, technologically advanced, of high quality, reliable, safe, and inexpensive. To ensure technological progress, regulators encourage the industry's continuous innovation and adoption of cutting-edge technologies. This includes promoting research and development, facilitating collaboration between industry stakeholders and academia, and providing incentives for the deployment of emerging technologies. Furthermore, regulators emphasize the importance of high quality. When it comes to communications networks and services, security is paramount. They collaborate with stakeholders in the industry to establish best practices for network security, data protection, and privacy management. By prioritizing safety, regulators aim to build trust in communication networks and services. Affordability is an additional important factor for sustainability endeavors.

6.3 The business model approach and regulatory perspective

The subsection presents the identified business model thinking antecedents of the regulatory approach: the opportunities, values and advantages perspectives and the relevant business thinking outcomes: scalability, replicability and sustainability perspectives. Table 1 presents the key findings.

Table 1. Business model approach and the regulatory perspectives

Business model antecedents and outcomes	Finland	United Kingdom
Opportunity “to be something positive to be reached (Holm et al., 2015), strongly dependent on the external context (Atkova, 2018, p. 20).”	<ul style="list-style-type: none"> • Enable diverse types of offerings and specific services for industry vehicles, • Enables new ways of use (moving base stations, non terrestrial networks, e.g. airborne base stations, ad-hoc base stations) • Support new business models • Promote competitive market 	<ul style="list-style-type: none"> • Different players to be able to specify their own network in a way that meets their specific requirements • Maintain a high level of flexibility and simplicity in the process to make it accessible to new players. • Have more control over the security aspects • Possibility to cover a mixture of services (industry or factory connectivity) • Promote a flexible regulation • New business models • Making things affordable for the business by creating a fee structure for the spectrum • Existence of competitive market conditions
Value “value creation, capture and co-creation”	<ul style="list-style-type: none"> • The offering of diverse services, industrial and factory connectivity • Advance future use cases such as small-scale public networks (shopping mall, sports arenas, concert halls, harbors) • Focused to a human-centric and user-centric approach 	<ul style="list-style-type: none"> • A mixture of services, industrial and factory connectivity • Human-centric and user-centric
Advantages “create a greater value for organization, shareholders, and stakeholders, and thus, it gives a competitive edge related to competitors (Iivari, 2016).”	<ul style="list-style-type: none"> • Rational use of resources • Increase the quality of the service • Secure and private communication network • Tailored expertise 	<ul style="list-style-type: none"> • Making spectrum conditions affordable for the business • Increase the quality of the service • Obtain secure and private communication network • Use spectrum most efficiently.
Scalability “an ability to deal with the business volume, business space, and business model change and is refer	<ul style="list-style-type: none"> • To foster the supply and use of electronic communications services and to ensure that everyone across Finland has 	<ul style="list-style-type: none"> • Meeting the demand and the opportunities are there for businesses to innovate in a way that drives growth fundamentally

to its internal growth beyond the scale volume it was initially developed. (Juntunen et. al. 2018).”	access to communications networks and services at reasonable conditions;	<ul style="list-style-type: none"> • Promote ecosystem benefits
Replicability the innovator firm's learning about and refining its (new) business model, by choosing the necessary components to replicate that model in suitable geographical locations, by developing capabilities to routinize knowledge transfer, and by maintaining the model in operation once it has been replicated" (Aspara et al., 2010, p. 43).	<ul style="list-style-type: none"> • Contributing to the harmonized European approach • Opportunity to cover the regional needs 	<ul style="list-style-type: none"> • Contributing to CEPT developments on shared and local access S • Opportunity to cover the regional needs
Sustainability Sustainability "helps describing, analyzing, managing and communicating (i) a company's sustainable value proposition to its customers, and all other stakeholders, (ii) how it creates and delivers this value, (iii) and how it captures economic value (Schaltegger et al., 2016, p. 6).	<ul style="list-style-type: none"> • Promote innovation • Ensure that communications networks and services are technologically advanced, of high quality, reliable, safe, and inexpensive 	<ul style="list-style-type: none"> • To encourage innovation • To make it easier for people and businesses to access spectrum, which can be used to support a wide range of local wireless connectivity applications

An array of identified drivers and motivations that mirror the business antecedents and outcomes of the regulatory considerations and actions for local mobile communication network businesses are presented in Table 1. Opportunities as promoting new business models, diverse types of offerings for industry, applying new technology that enables new services and use cases, making things affordable for the business; identical value as offerings of diverse services, focus on a human-centric and user-centric approach, promoting competitive market; similar advantages as rational use of resources, increase quality of the services, efficient use of spectrum, secure and private communication were highlighted. Notions such as "to foster the supply and use of electronic communications services and to ensure that everyone across Finland has access to communications networks and services at reasonable conditions" and "support new uses and innovations acting on a demand base but also being forward-looking to meet the demand and the opportunities for businesses to innovate in a way that fundamentally drives growth" can be related to the theme of scalability in the business model approach. Similarly, notions "to obtain a harmonized European approach to spectrum management" and "to achieve a harmonized global spectrum policy" relate to replicability. Sustainability was most often related to economic sustainability but also to social sustainability.

The analysis identified a range of drivers and motivations that reflect the business antecedents and outcomes of regulatory actions for local mobile communication network companies. The desired outcomes of these actions are focused on promoting the availability of electronic communication services for all citizens under fair conditions, encouraging new use cases and innovations, and facilitating business growth through scalable and replicable solutions. These expected outcomes aim to foster the supply and use of communication services, support business innovation, and ensure a harmonized spectrum management approach both within Europe and globally.

7. Conclusions

This paper has addressed the regulatory considerations to local mobile communication businesses, underlining how they can be approached with business model thinking and ecosystem legitimacy. The paper has identified legitimacy considerations from the regulatory perspective as regulation impacts the deployment and adoption of local mobile communication networks. Especially, the availability of spectrum with local access to the bands allows businesses to set up their own local

networks with greater control over security, resilience, and reliability, which might boost growth and innovation in a variety of industries. This paper has reflected the authors' views based on interviews and additional research, as opposed to being the views of the interviewed organisations.

The paper is first to apply business model thinking to the regulatory realm of local mobile communication networks in Europe as an approach to the legitimacy considerations identified. In this research, we have demonstrated how the business model thinking and its antecedents work as a framework for advancing regulatory actions for local mobile communication network businesses. Our research paves the way for understanding and demonstrating how the business model approach could be utilized for viewing regulatory priorities in the context of ecosystem legitimacy. This paper adds value to the scientific work on business models by using business models as a lens rather than a model. As with any other research, this study has limitations. Firstly, it has focused on the local mobile communication networks in two countries, Finland and the UK, which both have taken actions to enable this new deployment model. Therefore, this study does not provide a comprehensive status in Europe, where countries are in different stages regarding the adoption of local mobile communication networks. The study has predominantly analyzed findings highlighted by the interviewees with specific competencies and roles in their respective organizations. Therefore, the results highlight certain perspectives and may have left out others. Indeed, the application of the legitimacy concept in telecommunication requires more research attention. This work opens a prospective research opportunity for the business model approach and ecosystem legitimacy in emerging market contexts of local 5G and 6G network businesses.

References:

1. Ahokangas, P., Moqaddamerad, S., Matinmikko, M., Abouzeid, A., Atkova, I., Gomes, J. F., & Iivari, M. (2016). Future micro operators business models in 5G. *The Business & Management Review*, 7(5), 143.
2. Ahokangas, P., Boter, H., & Iivari, M. (2018). Ecosystems perspective on entrepreneurship. *The Palgrave handbook of multidisciplinary perspectives on entrepreneurship*, 387-407.
3. Ahokangas, P., Matinmikko-Blue, M., Yrjölä, S., Seppänen, V., Hämmäinen, H., Jurva, R., & Latva-aho, M. (2019). Business models for local 5G micro operators. *IEEE Transactions on Cognitive Communications and Networking*, 5(3), 730-740.
4. Ahokangas, P., Matinmikko-Blue, M., Yrjölä, S., & Hämmäinen, H. (2021). Platform configurations for local and private 5G networks in complex industrial multi-stakeholder ecosystems. *Telecommunications Policy*, 45(5), 102128.
5. Ahokangas, P., Atkova, I., Yrjölä, S. & Matinmikko-Blue, M. (2023). Business model theory and the becoming of mobile communications technologies. In Aagaard, A. & Nielsen, C. (Eds.), *BMI Game changers*. Palgrave MacMillan.UK.
6. Ala-Fossi, M. (2015). The PSM paradox with net neutrality. *Crossing borders and boundaries in public service media. RIPE*, 47-61. Aldrich, H. E., & Fiol, C. M. (1994). Fools rush in? The institutional context of industry creation. *Academy of management review*, 19(4), 645-670.
7. Alén-Savikko, A., Bu-Pasha, S., Himmanen, H., Korpisaari, P., Lehtilä, S., & Vesala, J. (2020). Personal Data Protection, Frequency Regulation and Competition Law in the Context of Smart City Infrastructure. In *Oikeuksia, vapauksia ja rajoituksia: viestintäoikeuden vuosikirja 2019*. Helsingin yliopisto.
8. Amit, R., & Zott, C. (2001). Value creation in e-business. *Strategic management journal*, 22(6-7), 493-520.
9. Amit, R., & Han, X. (2017). Value creation through novel resource configurations in a digitally enabled world. *Strategic Entrepreneurship Journal*, 11(3), 228-242.

10. Aspara, J., Hietanen, J., & Tikkanen, H. (2010). Business model innovation vs replication: financial performance implications of strategic emphases. *Journal of Strategic Marketing*, 18(1), 39-56.
11. Autio, E., Nambisan, S., Thomas, L. D., & Wright, M. (2018). Digital affordances, spatial affordances, and the genesis of entrepreneurial ecosystems. *Strategic Entrepreneurship Journal*, 12(1), 72-95.
12. Act on services in electronic communications 917/2014. <https://www.finlex.fi/fi/laki/ajantasa/2014/20140917>
13. Bauer, J. M. (2015). Governing the mobile broadband ecosystem. *International Telecommunications Policy Review*, 22(2), 1-26.
14. Bauer, J. M., & Bohlin, E. (2022). Regulation and innovation in 5G markets. *Telecommunications Policy*, 46(4), 102260.
15. Baxter, P., & Jack, S. (2008). Qualitative case study methodology: Study design and implementation for novice researchers. *The qualitative report*, 13(4), 544-559.
16. Bengtsson, M., & Kock, S. (2000). "Coopetition" in business Networks—to cooperate and compete simultaneously. *Industrial marketing management*, 29(5), 411-426.
17. Bhattarai, S., Park, J. M. J., Gao, B., Bian, K., & Lehr, W. (2016). An overview of dynamic spectrum sharing: Ongoing initiatives, challenges, and a roadmap for future research. *IEEE Transactions on Cognitive Communications and Networking*, 2(2), 110-128.
18. Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative research in psychology*, 3(2), 77-101.
19. Casadesus-Masanell, R., & Ricart, J. E. (2010). From strategy to business models and onto tactics. *Long range planning*, 43(2-3), 195-215.
20. Cave, M., Genakos, C., & Valletti, T. (2019). The European framework for regulating telecommunications: a 25-year appraisal. *Review of Industrial Organization*, 55(1), 47-62.
21. Decision No. 676/2002/EC on a regulatory framework for radio spectrum policy ("Radio Spectrum Decision").
22. Directive (EU) 2018/1972 of the European Parliament and of the Council of 11 December 2018 establishing the European Electronic Communications Code (Recast) Text with EEA relevance. PE/52/2018/REV/1, OJ EU 2018 L 321/36
23. European Commission official web site [Radio Spectrum CEPT Mandates, Shaping Europe's digital future, December 2022, \(europa.eu\)](https://ec.europa.eu/digital-affairs/en/radio-spectrum) Accessed on 21.05.2023
24. European Commission official web site Radio Spectrum policy Group Opinion, June 2021, [RSPG21-022final_RSPG_Opinion_Spectrum_Sharing.pdf \(europa.eu\)](https://ec.europa.eu/digital-affairs/en/radio-spectrum), Accessed on 20.05.2023
25. Easterby-Smith, M., Jaspersen, L. J., Thorpe, R., & Valizade, D. (2021). *Management and business research*. Sage.
26. Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of management review*, 14(4), 532-550.
27. Freeman, J., Carroll, G. R., & Hannan, M. T. (1983). The liability of newness: Age dependence in organizational death rates. *American sociological review*, 692-710.
28. Flick, U., Kardorff, E. V., & Steinke, I. (2006). *Qualitative forschung*. Sage Publications.
29. Foss, N. J., & Saebi, T. (2017). Fifteen years of research on business model innovation: How far have we come, and where should we go?. *Journal of management*, 43(1), 200-227.
30. Holm, T., Sammalisto, K., Grindsted, T. S., & Vuorisalo, T. (2015). Process framework for identifying sustainability aspects in university curricula and integrating education for sustainable development. *Journal of Cleaner Production*, 106, 164-174.
31. Gisca, O., Matinmikko-Blue, M., Ahokangas, P., Yrjölä, S., & Gordon, J. (2022). Legitimacy challenges of local private 5G and beyond networks in Europe.
32. Global Mobile Suppliers Association, Report on Private Mobile Networks, February 2023, Summary report, <https://gsacom.com/paper/private-mobile-networks-february-2023-summary-report/>, Accessed on 28.05. 2023

33. Guirao, M. D. P., Wilzeck, A., Schmidt, A., Septinus, K., & Thein, C. (2017). Locally and temporary shared spectrum as opportunity for vertical sectors in 5G. *IEEE Network*, 31(6), 24-31.
34. Juntunen, M., Ahokangas, P., & Nguyen, H. (2018). Business model scalability in the cloud business context. *Journal of Business Models*, 6(1), 19-39.
35. Kwak, K., & Yoon, H. D. (2020). Unpacking transnational industry legitimacy dynamics, windows of opportunity, and latecomers' catch-up in complex product systems. *Research Policy*, 49(4), 103954.
36. Lehtilä, S., Alén, A., Korpisaari, P., & Himmanen, H. (2023). Spectrum regulation and frequency allocation in the context of a smart city—using the regulatory approach in Finland as an example. *Information & Communications Technology Law*, 1-15.
37. Iivari, M. M., Ahokangas, P., Komi, M., Tihinen, M., & Valtanen, K. (2016). Toward ecosystemic business models in the context of industrial internet. *Journal of Business Models*, 4(2).
38. Lund, M., & Nielsen, C. (2018). The concept of business model scalability. *Journal of Business Models*, 6(1), 1-18.
39. Marano, V., Tallman, S., & Teege, H. J. (2020). The liability of disruption. *Global Strategy Journal*, 10(1), 174-209.
40. Martins, L. L., Rindova, V. P., & Greenbaum, B. E. (2015). Unlocking the hidden value of concepts: A cognitive approach to business model innovation. *Strategic Entrepreneurship Journal*, 9(1), 99-117.
41. Matinmikko, M., Latva-Aho, M., Ahokangas, P., Yrjölä, S., & Koivumäki, T. (2017). Micro operators to boost local service delivery in 5G. *Wireless Personal Communications*, 95(1), 69-82.
42. Matinmikko, M., Latva-aho, M., Ahokangas, P., & Seppänen, V. (2018). On regulations for 5G: Micro licensing for locally operated networks. *Telecommunications Policy*, 42(8), 622-635.
43. Matinmikko-Blue, M., Yrjölä, S., Seppänen, V., Ahokangas, P., Hämmäinen, H., & Latva-Aho, M. (2019). Analysis of spectrum valuation elements for local 5G networks: Case study of 3.5-GHz band. *IEEE Transactions on Cognitive Communications and Networking*, 5(3), 741-753.
44. Matinmikko-Blue, M., Yrjölä, S., & Ahokangas, P. (2020, March). Spectrum management in the 6G era: The role of regulation and spectrum sharing. In *2020 2nd 6G Wireless Summit (6G SUMMIT)* (pp. 1-5). IEEE.
45. Matinmikko-Blue, M., Yrjölä, S., Ahokangas, P., & Hämmäinen, H. (2021). Analysis of 5G spectrum awarding decisions: How do different countries consider emerging local 5G networks?
46. Matinmikko-Blue, M., Yrjölä, S., & Ahokangas, P. (2023). Spectrum Management for Local Mobile Communication Networks. *IEEE Communications Magazine*.
47. Morgado, A., Huq, K. M. S., Mumtaz, S., & Rodriguez, J. (2018). A survey of 5G technologies: regulatory, standardization and industrial perspectives. *Digital Communications and Networks*, 4(2), 87-97.
48. OFCOM Spectrum information portal, (<https://www.ofcom.org.uk/spectrum/information/spectrum-information-systems/spectrum-information-portal>). Accessed on 23.05.2023
49. Ofcom "Evolution of the Shared Access Licence Framework" (2023). Accessed on 20.05.2023
50. Ofcom "Enabling wireless innovation through local licensing , Shared access to spectrum supporting mobile technology", (2019), Accessed on 20.05.2023
51. Ofcom "Mobile networks and spectrum, Meeting future demand for mobile data (2022)
52. Ofcom "Shared Access Licence, Guidance document", (2022), Accessed on 20.05.2023

53. Ofcom “Supporting the UK’s wireless future, Our spectrum management strategy for the 2020s”, (2021). Accessed on 20.05.2023
54. Ofcom official website “[Ofcom's plan of work 2023-24](#)”, (2022). Accessed on 20.05.2023
55. Ofcom official website “[Delivering Ofcom’s Spectrum Management Strategy](#)”,(2022) Accessed on 20.05.2023
56. Osterwalder, A., & Pigneur, Y. (2010). *Business model generation: a handbook for visionaries, game changers, and challengers* (Vol. 1). John Wiley & Sons.
57. Ranchordás, S., & Roznai, Y. (Eds.). (2020). *Time, Law, and Change: An Interdisciplinary Study*. Bloomsbury Publishing
58. Schaltegger, S., Hansen, E. G., & Lüdeke-Freund, F. (2016). Business models for sustainability: Origins, present research, and future avenues. *Organization & Environment*, 29(1), 3-10.
59. Scott, W. R. (2008). *Institutions and organizations: Ideas and interests*. Sage.
60. Singh, J. V., Tucker, D. J., & House, R. J. (1986). Organizational legitimacy and the liability of newness. *Administrative science quarterly*, 171-193.
61. Stake, R. E. (1978). The case study method in social inquiry. *Educational researcher*, 7(2), 5-8.
62. Stinchcombe, A. (1965). Organization-creating organizations. *Trans-action*, 2(2), 34-35.
63. Suchman, M. C. (1995). Managing legitimacy: Strategic and institutional approaches. *Academy of management review*, 20(3), 571-610.
64. Suddaby, R., Bitektine, A., & Haack, P. (2017). Legitimacy. *Academy of Management Annals*, 11(1), 451-478.
65. Thomas, L. D., & Ritala, P. (2022). Ecosystem legitimacy emergence: A collective action view. *Journal of Management*, 48(3), 515-541
66. Traficom “Existing Radio Licences in the frequency band 2300-2320 MHz, and 24,05-25,1 GHz” <https://www.traficom.fi/en/communications/communications-networks/existing-radio-licenses-frequency-bands-2300-2320-mhz-and>, Accessed on 23.05.2023
67. Traficom Local 4G/5G Networks, 2022
<https://www.traficom.fi/en/communications/communications-networks/local-4g5g-networks>, Accessed on 23.05.2023
68. Verstraete, T., & Jouison-Laffitte, E. (2011). A conventionalist theory of the business model in the context of business creation for understanding organizational impetus. *Management international*, 15(2), 109-124.
69. Wang, C. X., Haider, F., Gao, X., You, X. H., Yang, Y., Yuan, D., ... & Hepsaydir, E. (2014). Cellular architecture and key technologies for 5G wireless communication networks. *IEEE communications magazine*, 52(2), 122-130.
70. Wireless Telegraphy Act 2006, <https://www.legislation.gov.uk/ukpga/2006/36/contents>, Accessed on 20.05.2023
71. Yin, R. K. (2010). *Qualitative Research From Start to Finish*. Guilford Press, New York.
72. Yin, R.K., 2014. *Case Study Research, Design and Methods*. Sage Publications, Thousand Oaks.