

**ASSESSING THE NEEDS OF RURAL BUSINESSES FOR
6G CELLULAR NETWORKS**
Enhancing Digitalization in Sparsely Populated Areas

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Tässä opinnäytetyössä arvioidaan maaseutualueiden yritysten tarpeita ja odotuksia tulevia 6G-mobiiliverkkoja kohtaan. Tutkimuksessa keskitytään digitalisaation edistämisen mahdollisuuksiin harvaan asutuilla alueilla. Opinnäytetyön tavoitteena on ymmärtää yritysten kohtaamia erityishaasteita laadukkaiden datayhteyksien saatavuudessa sekä selvittää, miten uuden sukupolven mobiiliverkot voisivat tukea liiketoiminnan kehitystä. Tutkimus toteutettiin yhdistämällä määrällisen kyselytutkimuksen ja laadullisten haastattelujen aineistot, jotka oli kerätty osana Interreg Auroran rahoittamaa Arctic 6G -projektia.

Tutkimusaineisto koostui 148 kyselyvastauksesta sekä Lapin harvaan asutuilla alueilla toimivien yritysostonajien, yhteisötoimijoiden ja alueen asukkaiden haastatteluista. Tutkimuksen tulokset osoittavat, että digitaalinen kahtiajako ja digitaalinen epätasa-arvo ovat merkittäviä ongelmia. Monilla yrityksillä on käytössään epävakaat, hitaat tai muuten yritystoiminnan kannalta riittämättömät verkkoyhteydet. Nämä puutteet estävät digitalisaatiota, heikentävät operatiivista tehokkuutta ja rajoittavat taloudellista kilpailukykyä.

Tutkimustulosten perusteella voidaan todeta, että Lapin maaseutuyritykset tarvitsevat vakaita ja nopeita tietoliikenneyhteyksiä voidakseen hyödyntää digitaalisia markkinoita ja omaksuakseen edistyneitä teknologioita, kuten pilvipalveluja, IoT-ratkaisuja ja data-analytiikkaa. Johtopäätöksenä opinnäytetyössä todetaan, että kaupunkien ja maaseudun välisen digitaalisen eriarvoisuuden vähentäminen on tärkeää kestävä liiketoiminnan kasvun edistämiseksi ja ylläpitämiseksi maaseutualueilla. 6G-verkkojen käyttöönotto yhdistettynä kohdennettuja infrastruktuuri-investointeja tukevien poliittisten toimenpiteiden ja osaamisen kehittämisohjelmien kanssa voi merkittävästi edistää näiden tavoitteiden saavuttamista.

Avainsanat digitalisaatio, digitaalinen kahtiajako, digitaalinen epätasa-arvo, 6G-verkot, maaseutuyritysten kehittäminen

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This thesis research assesses the needs and expectations of rural businesses for future 6G cellular networks, with a focus on enhancing digitalization in sparsely populated areas. The thesis aims to understand the specific challenges these businesses face in accessing high-quality data connectivity and how next-generation networks could support their development. A mixed-methods approach was used, combining a quantitative questionnaire conducted under the Interreg Aurora Arctic 6G project and qualitative interviews with business representatives and community stakeholders.

The research material comprised 148 questionnaire responses and several interviews from rural Lapland. The analysis revealed significant digital divide and digital inequality issues, with many businesses experiencing unstable, slow, or insufficient internet services. These shortcomings in connectivity were identified as major obstacles to digital transformation, operational efficiency and limiting economic competitiveness.

The findings highlight that rural businesses demand stable, high-speed internet connectivity to fully utilize digital markets and to adopt advanced technologies such as cloud services, IoT, and data analytics. This thesis concludes that closing the urban–rural digital gap is essential for fostering and sustaining business growth in rural regions. Deployment of 6G networks, when coupled with targeted infrastructure investment, supported by policy measures, and capacity-building initiatives can significantly help in achieving this goal.

Keywords digitalization, digital divide, digital inequality, 6G networks, rural business development

CONTENTS

1	INTRODUCTION	7
1.1	Motivation and Background	7
1.2	Knowledge Base.....	8
1.3	Purpose, Objective, and Thesis Question Framing	9
1.4	Research Design and Approach.....	10
1.4.1	Methodology	11
1.5	Ethical Foundation and Reliability.....	12
1.6	Schedule and Required Resources	12
1.7	General Structure of the Thesis.....	13
2	BACKGROUND THEORY	14
2.1	Digitalization	14
2.1.1	Challenges of Digitalization	15
2.2	Digital Divide.....	16
2.2.1	Observation of Digital Divide	17
2.2.2	Effects of Digital Divide.....	18
2.3	Digital Inequality	19
2.3.1	Observation of Digital Inequality	20
2.3.2	Effects of Digital Inequality	21
3	RESEARCH DESIGN	22
3.1	Research Approach.....	22
3.2	Research Methods.....	24
3.3	Research Process	25
3.4	Questionnaire Implementation.....	28
3.5	Interviews	29
3.6	Data Analysis.....	30
4	QUESTIONNAIRE ANALYSIS AND FINDINGS	32
4.1	General Sentiments and Trends.....	32
4.1.1	Existing Internet Connectivity and Usage	33
4.1.2	Digital Divide and Inequality	34
4.1.3	Urban–Rural Gaps in Connectivity	36
4.1.4	Impacts on Daily Life and Work.....	37

4.1.5	Business and Industry Effects	38
4.1.6	Future Expectations and Industry Benefits	41
4.2	Comparing Connectivity Groups	42
4.2.1	Challenges Faced Due to Poor Internet Service	43
4.2.2	Digitalization Levels and Practices	44
4.2.3	Internet-Dependent Devices and Cloud Services	46
4.2.4	Business Sectors Most Affected by Poor Connectivity	48
5	INTERVIEW ANALYSIS	51
5.1	Impact of Connectivity Issues on the Economy	52
5.2	Safety Concerns	53
5.3	Technological Limitations and Digital Exclusion	53
5.4	Expectations and Recommendations from Businesses	54
6	DISCUSSION	55
6.1	Reflection on Rural Business Needs and Connectivity	55
6.2	Implications of Enhanced Digitalization Through 6G	56
6.3	Strategic Steps for Stakeholders and Policymakers	56
6.4	Quantitative and Qualitative Findings	57
7	CONCLUSIONS	59
7.1	Actionable Recommendations	59
7.2	Reflection on Research Questions	62
7.3	Future Outlook	63
	BIBLIOGRAPHY	65
	APPENDICES	67

FOREWORD

This thesis research was written as part of the Arctic 6G project, funded by the Interreg Aurora Programme. I would like to express my gratitude to my thesis supervisor, Tanja Suomalainen, for her guidance, comments, and encouragement throughout this research process. Her support has greatly contributed to the quality and depth of this work.

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Martti Ahvenjärvi

1 INTRODUCTION

This chapter introduces the research context and the importance of digitalization in rural areas. It focuses specifically on the challenges that businesses in sparsely populated regions are facing. Chapter outlines the thesis's motivation, research questions, objectives, methodological approach, and the overall structure. Laying the groundwork for understanding how 6G networks and improved connectivity could address the digital divide and digital inequality that rural enterprises experience.

Digital transformation of businesses has become a major driver of economic growth and development as of the time this research was done. However, businesses located in sparsely populated and rural areas face unique challenges. The high-quality data networks necessary for digitalization are not accessible everywhere. There is a growing need to understand how advanced technologies can support the specific demands of rural enterprises. This thesis studies what businesses in rural areas want and need from 6G networks. It focuses on how enhanced data connectivity can help businesses' digitalization and development.

This thesis is a part of the Interreg Aurora project – Arctic 6G. The project aims to address the challenges rural regions face. The division between cities and the countryside in terms of access to secure and reliable connectivity services has increased. Societal resilience of the rural area can only be guaranteed by having access to generally available broadband connections and internet services across the whole region. (Arctic 6G 2024)

1.1 Motivation and Background

Lapland University of Applied Science (Lapland UAS) participates in the Arctic 6G -project with a specific goal to study the challenges rural regions have regarding robust internet services. (Arctic 6G 2024) The choice of this topic is motivated by the increasing importance of digital infrastructure in modern business environments. At the same time, digital inequality and the digital divide between cities and rural areas are increasing. Even conventional businesses must rethink and reinvent their business models to stay relevant and impactful, as customers are demanding more digital services and better experiences.

Becoming “digital” is mandatory for companies to succeed in the changing business environment of digital age. (Grabowska & Otolá 2020)

The connectivity issues and challenges businesses face, especially in rural and remote areas, often hamper their ability and possibility for growth and business development. As a part of the Arctic 6G project Lapland UAS conducted a survey for local businesses and residents to understand how area locals see the existing situation and what direction they’d hope for future connectivity technologies to develop. It is critical to analyse how businesses in these rural, sparsely populated regions, perceive their opportunities to grow and digitalize, and what role new mobile networks, such as 6G, can play in their development strategies. By providing comprehensive research on these businesses’ expectations for 6G technology, this thesis aims to contribute valuable insights to both policymakers and telecommunications providers on how to implement 6G infrastructure effectively to meet these needs.

1.2 Knowledge Base

The main underlying topics covered in this thesis are digitalization, digital inequality, and digital divide. Digitalization can be defined as a practice of using digital technologies in a company’s business model (Ng, Tam & Lim 2018.) Digital inequality and digital divide are terms used in studies when referring to differences in groups or individuals’ access to information and communication technologies. This inequality usually stems from individuals’ socio-economic status or the regions’ infrastructure where they live. (Scheffer 2024, 68-69.) The phenomena are not limited to only individuals, they are very much relevant and their impact is visible also when evaluating the digital landscape where businesses operate, reducing businesses’ opportunities to develop and stay economically resilient to changes (Morris, Morris & Bowen 2022.)

Earlier studies have shown that small and medium-sized enterprises (SMEs) are important for the European economy. These SMEs employ about half of the workforce in Europe. (Eurostat, 2022.) Development capabilities for SMEs differ greatly depending on their location. Although digitalization is often considered to

be a global phenomenon, enterprises in sparsely populated areas are having significantly more difficulties in capturing the benefits. (Saarela, Hänninen, Muhos & Jokela 2018.) This can be somewhat credited to the fact that remote enterprises seem to be least connected (Salemink, Strijker & Bosworth 2017).

My thesis research is framed within the context of the Arctic 6G project, utilizing material, questionnaires, surveys, and responses gathered from rural businesses and residents. This data is compared against semi-structured discussions and interviews with businesses and representatives of communities and business areas, which were conducted after the online survey.

Digitalization, digital inequality, and the digital divide between remote and populated areas have been studied quite extensively, so reference material is readily available. Studies on digitalization issues in rural areas of Armenia have come to similar conclusions, that availability of reliable connectivity is becoming a main concern and pain point in remote areas (Arion, Harutyunyan, Aleksanyan, Muradyan, Asatryan & Manucharyan 2024.) The effects of the digital divide between rural and populated areas are also touched on by Partala, Jantunen, Kuukkanen & Merikoski (2024) in their research.

1.3 Purpose, Objective, and Thesis Question Framing

The primary objective of this thesis is to analyse the needs and aspirations of rural businesses regarding next-generation data networks. This is done through the introduction of the concept of digital inequality and finding ways to narrow the digital divide between cities and rural areas. This research identifies what businesses value in new technology and the ways in which advanced information networks can support their digital transformation. In addition, the thesis provides actionable recommendations for telecom providers and local policymakers on how to implement 6G networks to foster rural business growth.

Main research questions (RQ) are the following:

RQ 1. What are the specific needs, expectations, and aspirations of businesses in sparsely populated rural areas regarding the implementation of next-generation (6G) data networks?

This question focuses on understanding what rural businesses value and expect from 6G technology, providing insights into their priorities and the potential benefits they foresee.

RQ 2. How can the implementation of advanced 6G information networks enhance the digitalization and development of businesses in rural areas?

This question addresses the practical implications of 6G technology for rural business growth and digitalization, as well as the strategies that stakeholders can use to meet these needs effectively.

RQ 3. What actionable steps should telecom providers and local policymakers take to support the digitalization of businesses in rural areas?

This question focuses on finding out practical examples of how policymakers could support areas businesses and growth. Concrete actions arise from the existing needs and pain points of businesses in the area.

1.4 Research Design and Approach

With a research design, it is possible to outline an overall strategy or framework that a researcher uses to integrate the various components of the research in a coherent and logical way. Research design is the blueprint for conducting a research project, ensuring that the research questions are answered accurately and efficiently. This subchapter explains the research approach and methods used in this thesis, and how the data is gathered and analysed.

Mixed methods research is an approach that uses both quantitative and qualitative research methods within a single research study. This gives a more comprehensive understanding of the research problem. Quantitative methods,

such as surveys or experiments, provide numerical data that can be statistically analysed to identify patterns or test hypotheses. Qualitative methods, such as interviews or case studies, use narrative data to find deeper insights, behaviours, and motivations for studied phenomenon. (Creswell & Creswell 2018, 14.)

Mixed methods combine both approaches, which lets researchers use the best parts of each to get a more complete picture of the research question. This improves the validity of the findings and addresses both broad trends and specific contexts (Hesse-Biber & Nagy 2010, 3–6). This thesis uses mixed methods research approach, because this research involves both qualitative, such as interviews and unstructured discussions, and quantitative questionnaires data collection techniques.

1.4.1 Methodology

Questionnaires are a versatile data collection method for gathering information from respondents through structured or semi-structured questions. Surveys are done often in paper-based or online format. They work especially well for reaching large groups of people, such as geographically dispersed rural businesses. Questionnaires allow for standardized data collection that is easy reproduce later in similar manner and to analyse statistically. By using a combination of closed-ended and open-ended questions, questionnaires can capture both broad trends and more nuanced perspectives. Questionnaire can be designed to keep respondents anonymous, which can make answers more honest, but the quality of the data depends on how clear and well-designed the questions are. (Pickard 2013, 206, 210–211.) In my research, I use the survey to find out how ready rural businesses are for 6G networks and what their needs are. This survey gives me both general trends and specific information.

Interviews are a qualitative data collection method. By having direct, face-to-face or virtual conversations with the respondents, researcher is able to do in-depth exploration of experiences, opinions, and motivations. They are especially useful for getting in-depth, detailed insights that might not be possible with more structured methods like surveys. (Pickard 2013, 196) Interviews can be

structured, semi-structured, or unstructured. This offers flexibility and adaptability in how questions are asked and how responses are collected. This method encourages open-ended discussions, allowing respondents to elaborate on their answers and providing the researcher with the ability to probe deeper into specific areas of interest. The questions asked are more open and conversational than they are in a survey. Interview data is analysed in a qualitative manner. (Walle 2015, 72-73.) In this thesis, interviews add to the survey by giving more personalized insights about how rural businesses see and plan for the use of 6G networks. This helps us better understand their specific needs and challenges.

1.5 Ethical Foundation and Reliability

Reliability refers to the consistency and stability of the data collection process. Reliable process ensures that the results are replicable and trustworthy. Validity, on the other hand, means that the data is correct and true, and that the results and findings accurately show what the research question and goals were.

This thesis uses a mixed methods approach, combining quantitative and qualitative data collection techniques to triangulate the findings. Approach enhances the reliability and validity of the collected data. This research aims to improve its credibility and reliability by cross validating the results from different sources. This makes sure that the conclusions are well-supported and trustworthy.

This thesis research trusts the questionnaire data to be true. Survey was conducted in a way that kept the respondents' identities secret, which lowers the chance of bias or social desirability. The questionnaire was designed to be clear and easy to understand, minimizing the risk of misinterpretation. Interviewees' identities are also anonymized in this study.

1.6 Schedule and Required Resources

Between December 2023 and June 2024, the Arctic 6G -project conducted a survey and a round of interviews with businesses and residents of Finnish

Lapland area. People who filled out the survey and gave their contact information were part of the group that was interviewed. Two interviewers conducted the interviews and transcribed the discussions, which formed the main qualitative data for this research. In April 2025, an extra questionnaire was sent by email to some area representatives.

After data collection was done, data analysis begun in November 2024. Statistical methods were used to evaluate questionnaire responses. Webropol survey platform was used as a main tool for this analysis. Thematic analysis was applied to the transcribed interviews.

1.7 General Structure of the Thesis

This thesis consists of seven main chapters followed by a bibliography and appendices. The first chapter introduces the thesis topic, research objectives, the data used, and an overview of the literature. The second chapter goes through the main topics and underlying literature and previous studies. The third chapter outlines the research approach, methods, and process for data analysis. The fourth chapter presents the main findings from the initial survey. In the fifth chapter, the interviews are analysed and their relevance and contribution to the survey findings are verified. The following chapter discusses the findings of the research and compares them to the existing knowledge base. In the final chapter thesis concludes on the findings, practical implications are summarized, and potential future studies and actions are proposed.

2 BACKGROUND THEORY

In this chapter, key theoretical concepts underpinning the research — digitalization, digital divide, and digital inequality — are presented and analysed. The chapter discusses existing academic literature, clarifying these concepts' definitions, impacts, and relevance to rural business contexts. This theoretical foundation frames the subsequent analysis of primary research data.

Defining both the digital divide and digital inequality is important. Both these terms represent distinct yet interconnected aspects of technology-related disparities. Differentiating these concepts allows us to better analyse the root causes and outcomes of digital disparities and design interventions that address both access and the broader consequences of digital participation.

2.1 Digitalization

Digitalization can be described as a transformative force enabling businesses to enhance their competitiveness. It involves the adoption and integration of advanced digital technologies, such as artificial intelligence, big data analytics, and digital supply-chain tools, into business processes. These technologies help firms improve productivity, innovate products and services, and adapt to global economic challenges. (EIB 2024)

Digitalization's role as a strategic enabler for business growth is clear. Digitalization is more than just technology adoption—it's a dynamic capability that transforms value creation and enhances strategic flexibility. Firms leverage digital tools for market penetration, product development, operational efficiency, and new market exploration. It also supports agility and learning, enabling businesses to anticipate market shifts and integrate with digital ecosystems. Digitalization's effects span pre-growth factors, growth processes, and outcomes, making it integral to competitive advantage and innovation. (Matalamäki & Joensuu-Salo 2022)

For rural businesses, digitalization means adopting and integrating digital technologies to address challenges and take advantage of opportunities in the digital economy. It enables businesses in remote and low-density areas to overcome geographic isolation, connect to broader markets, and enhance operational efficiency. With the help of digital tools, such as e-commerce platforms, online networks, and advanced digital applications, rural businesses can expand their reach, improve customer engagement, and competitiveness on a larger scale. These technologies are essential for making rural economies more diverse, keeping people from moving to cities, and helping local economies grow. (Partala et al. 2024, Tiwasing, Clark, & Gkartzios 2022.)

2.1.1 Challenges of Digitalization

Rural businesses face many digital challenges, such as poor infrastructure, which for example limits their access to broadband and mobile networks. The "last mile" connectivity problem is a big problem for many rural areas. This is when reliable broadband services do not reach remote areas. (Tiwasing et al. 2022.) Digitalization is not only about access to internet connections, but also about the capacity and capability to use and integrate digital technologies effectively. This includes developing and building a digital culture in organizations, using digital tools for customer engagement, and using technology to innovate new processes and services. (Partala et al. 2024.)

There are challenges with digitalization, especially for SMEs, which often do not have enough money, technical expertise, or time. Many companies have trouble integrating digital tools and technologies, such as AI and big data into their strategies. This can lead to a competitive disadvantage and potentially poor return on investments. Organizational rigidity, including resistance to change and weak governance, further hampers digital transformation. Additionally, businesses cannot fully take advantage of new technologies for innovation and adapting to the market because they do not have all the digital skills they need. If companies do not have required strategic flexibility it is hard to transition to digital ecosystems. This makes it difficult for companies to connect their

digitalization efforts with their long-term plans for growth and competitiveness. (Matalamäki & Joensuu-Salo 2022)

2.2 Digital Divide

Arion et al. (2024) define digital divide as the gap in the level of digitalization between rural and urban areas, which negatively affects balanced territorial development. This phenomenon reflects how social and economic differences and unequal access to digital technologies, resources, and skills, make it hard to achieve fair regional development.

The digital divide is the ongoing and growing gap between how easy it is to get to and use data infrastructure, especially between cities and rural areas. Rural areas are often in significant disadvantage because of their low population density, longer distances, and market conditions that discourage investments in new technologies. This divide leads to material inequalities (connectivity) and social inequalities (inclusion). Rural areas lack both the technology and infrastructure they need and the opportunities to use and adopt it. The digital divide is seen as part of a larger "rural penalty", which means that people living in rural communities have problems that make it harder for them to participate in the increasingly digital information society. (Salemink et al. 2017.)

In their research, Morris et al. (2022) define the digital divide as the gap in digital connectivity levels between urban and rural areas. They focused on rural areas, such as those in Wales, and how often they are at a disadvantage because they do not have as good access to reliable broadband and mobile networks. According to their findings, this divide makes it harder for rural businesses, especially SMEs, to operate effectively, adopt new technologies, and compete in the market. This limits their ability to be entrepreneurs. Their resilience and recovery from setbacks are also limited. The digital divide gets worse the further away from urban centres businesses are. Rural areas have slower adoption and less access to high-quality digital infrastructure.

2.2.1 Observation of Digital Divide

There is a clear digital divide between rural and urban areas when it comes to access to digital infrastructure, the use of technology, and digital literacy. Rural regions consistently face inadequate broadband and mobile network coverage due to high deployment costs, geographic isolation, and limited market incentives for telecommunication companies to invest in new technologies. This lack of reliable, high-speed internet limits access to a wide range of technology options, which leaves rural areas dependent on monopolistic markets that reduce service quality and affordability. (Salemink et al. 2017.)

Beyond infrastructure, socio-economic and cultural factors make the divide worse. Rural populations frequently display lower levels of digital literacy and limited engagement in training programs, resulting in basic technological proficiency and reduced ability to fully utilize digital tools. The dominance of smartphones over more versatile devices, such as lap tops, combined with limited skill levels, shapes usage patterns that favour entertainment and communication over professional development, e-governance, and financial services. (Salemink et al. 2017, Arion et al. 2024)

Rural businesses also experience significant challenges, including restricted access to digital tools essential for innovation, global market entry, and operational efficiency. Limited digital maturity within organizations—characterized by low adoption of advanced technologies and insufficient strategic digitalization—further impedes economic development. Key sectors like agriculture and tourism are disproportionately affected, as businesses in these industries face barriers to adopting digital solutions for marketing, data management, and customer engagement. (Partala et al. 2024.)

Geographic and demographic factors intensify these disparities. Regions farther from urban centres, particularly those with aging populations or cultural resistance to technology, face additional hurdles. The divide extends beyond mere access, encompassing systemic inequalities in skills, resources, and opportunities. Without targeted policies and investments in connectivity, digital

literacy, and capacity building, rural areas remain disadvantaged, perpetuating socio-economic inequities and impeding inclusive regional development. (Partala et al. 2024, Morris et al. 2022.)

2.2.2 Effects of Digital Divide

The digital divide significantly impacts individuals and businesses in rural areas. It keeps socio-economic gaps from closing and limits opportunities for growth and innovation. For individuals, inadequate digital connectivity and low levels of digital literacy make it harder to access essential services, such as remote education, telemedicine, e-governance, and online financial platforms. These restrictions make it harder to generate income from opportunities like remote work and e-commerce, making the economic inequality between rural and urban regions even bigger. Vulnerable populations, including low-income households and the elderly, are particularly affected, facing barriers to adopting digital tools and skills. The lack of access to digital resources also causes a "brain drain," in which skilled people move to cities and urban areas with better internet connections, further weakening rural economies. (Salemink et al. 2017, Arion et al. 2024.)

The digital divide makes it harder for businesses to compete, innovate, and operate efficiently. Rural businesses cannot use e-commerce, digital marketing, and productivity-boosting technologies as easily because they do not have access to reliable broadband and advanced digital tools. This limitation has big impact on important rural industries, such as agriculture and tourism, which struggle to leverage new innovative technologies and take advantage of global market opportunities. The lack of digital infrastructure and skills makes it harder for entrepreneurs to start new businesses, which limits their ability to diversify and expand internationally. This puts rural businesses at a big disadvantage compared to their urban counterparts. (Salemink et al. 2017, Arion et al. 2024, Partala et al. 2024.)

These challenges collectively reduce rural businesses' ability to handle economic shocks, as highlighted during the COVID-19 pandemic when digital tools became necessary. The cumulative effects of the digital divide restrict rural communities'

capacity to innovate, adapt, and thrive in a digital economy. Closing this divide requires targeted investments in infrastructure, tailored digital literacy programs, and providing strategic support to help individuals and businesses to fully participate in the digital age and promote regional development that includes everyone. (Morris et al. 2022)

2.3 Digital Inequality

According to Heeks (2022), digital inequality refers to the disparities in the benefits and impacts of digital technology use. It is more than the binary focus on access and adoption seen in the digital divide. While the digital divide is often used to categorise different groups as "haves" versus "have-nots" digital inequality provides a broader and deeper understanding of how digital technologies shape and reinforce societal inequalities, even among those who are digitally included. It includes both "being left out of" and "being included in digital systems in a bad way", with a focus on how systemic and relational factors make inequality worse. Digital inequality highlights the processes where marginalized groups are incorporated into digital systems in ways that disproportionately benefit more powerful groups.

Zillian & Zillian (2020) give digital inequality the same definition as Heeks, but in their research, they also make a point that digital inequality encompasses a broader spectrum of issues, including differences in the quality of engagement with digital tools and the outcomes derived from their use. This concept highlights that just having access to technology such as computers, the internet, and smartphones is not enough to make things fair in the digital age. Instead, it considers how factors such as person's socio-economic background, education, age, gender, and cultural norms affect their ability to use digital tools to improve their lives. Digital inequality thus emphasizes how digital competencies, such as being able to solve problems in tech-rich settings and having meaningful online interactions can either make social differences worse or better.

De Marco (2021) includes the digital divide as a basic form of digital inequality. He calls differences in physical access to devices and the internet the "first-level

digital divide". The second level of the digital divide is about how well people can use technology, which is affected by their digital literacy and skills. The third level of the digital divide looks at differences in the results or benefits of using digital technology, like better economic or social mobility. In his study on digital inequality, De Marco emphasizes that just having access to technology does not mean that everyone can use it or get the same benefits. It includes more in-depth aspects of digital engagement, such as income, education, and location, which all affect how well people can use digital resources.

2.3.1 Observation of Digital Inequality

De Marco (2021) talks about three main ways that digital inequality can be seen: differences in access to, use of, and benefits from digital technologies. First, differences in material resources affect how easy it is to get access to high-quality technology and internet connections. Second, digital skills, including operational, informational, and strategic competencies, vary significantly among individuals. To get the most out of digital spaces, you need to know how to use these skills. Frequent exposure to and availability of technology correlate strongly with enhanced digital capabilities. Third, there is digital inequality because the results of using technology are different for different people, like better economic opportunities that are still not evenly distributed. People who are better at using technology and have more resources are more likely to get real benefits from their online interactions. Observing digital inequality through these three dimensions provides a framework for understanding what it means and how to develop targeted interventions. (De Marco 2021.)

Zillian & Zillian (2020) also make the same point that digital inequality can be observed in the fact that people who use same digital tools get different benefits or results. Groups that already have more resources also benefit more from digital technologies. For instance, digitalization of health care services is more helpful for people who have access to the right technologies. For others the same development might mean that the physical service isn't available anymore and their skills are inadequate for using the digital service.

2.3.2 Effects of Digital Inequality

Structural factors like unequal resources, institutional biases, and unequal dependencies can make digital inequalities even worse. These factors allow more powerful actors to control and take advantage of less powerful participants. Thus, digital inequality is not merely a function of access disparities but reflects deeper systemic imbalances in power and value distribution within digital ecosystems. (Heeks 2022.)

Businesses suffer from digital inequality indirectly through the workforce capabilities and market dynamics. The unequal distribution of digital skills among employees, shaped by their access to technology, impacts organizational efficiency and innovation. This gap can make it harder for a business to fully adopt and benefit from emerging technologies, which can hurt productivity and competitiveness. Digital inequality also affects consumer behavior and market reach. People who do not use digital devices or do not have access to them as much are less likely to interact with digital platforms. This limits the effectiveness of digital marketing, e-commerce, and online customer engagement strategies. This can make it harder for businesses to reach and retain diverse consumer bases. On the other hand, consumers with higher digital literacy tend to buy and use more sophisticated and advanced products and services. Businesses that cannot meet these demands because of their region's digital inequality risk losing business opportunities. (Zillian & Zillian 2020.)

3 RESEARCH DESIGN

This chapter goes into detail about the methodological approach adopted in this thesis, explaining why a mixed-methods approach involving both quantitative questionnaires and qualitative interviews was chosen. It describes the procedures for data collection and analysis techniques. Ethical considerations are discussed. This chapter ensures transparency in how the research was carried out to maintain reliability and validity.

Research design is the systematic plan or framework that guides the overall structure and strategy of a research. It includes the choice of research approach, data collection methods, techniques for analysis, and procedures for validating the results and findings. Research design serves as the foundation for a coherent and credible study. It does this by defining what data is needed, how it is collected, and how conclusions are drawn. It makes sure that every part of the research, from identifying the problem to interpreting the results, fits together in a way that is logical, transparent, and methodologically sound.

Given its central role, a carefully planned research design is very important for getting good results and adding useful insights and information to the field of research. In the upcoming sub chapters, I go into more detail about the chosen research approach and methodology. The processes involved are outlined and the used data analysis techniques are described.

3.1 Research Approach

The main method chosen for this thesis was quantitative research approach, because it uses structured questionnaires to collect measurable data and is supported by existing studies in the field. Quantitative research uses structured systematic methods to test theories, explore relationships amongst variables, and provide results that can be applied to other situations. My thesis research uses a survey research design to look at trends, attitudes, or opinions in a group of people. (Creswell & Creswell 2018)

Using questionnaires, which typically have closed-ended or structured questions, supports the collection of numeric data. This fits with a postpositivist view of the world, which emphasizes objectivity, testing hypotheses, and using statistics to validate findings. (Creswell & Creswell 2018) This thesis's research reflects and build on and add to what has already been done by comparing my findings with the existing knowledge base, which helps to place the work in the larger body of literature in this field.

Survey research, as a key quantitative design, allows for investigating specific research questions or hypotheses by collecting data from a sample that represents a larger population. Statistical analyses are the main way for interpreting the data, identifying relationships, and comparing the results to prior findings. This makes sure that the research is thorough and organised. (Creswell & Creswell 2018)

Along with the survey research method providing the main part of the research material, this thesis also includes some parts of the free-form interviews as supporting qualitative data. Interviews serve as a method for collecting detailed, context-rich data directly from participants. Conducting interviews requires planning, including the development of open-ended questions that encourage participants to share comprehensive and nuanced responses. Interviews can vary in structure, from highly structured formats to semi-structured and unstructured conversations, depending on the research goals. Throughout the interviews, researchers must remain attentive listeners, responsive to the participants' answers, and willing to explore new directions as they arise during the dialogue. (Creswell & Creswell 2018, Gillham 2000)

By combining quantitative and qualitative datasets, research can be verified to align with the hypothesis. This methodology enables me to position results of this thesis in the context of the existing body of knowledge. These results will add to the ongoing discussions in the field, and provide insights that can be generalized and acted on.

3.2 Research Methods

Survey research is a systematic approach for collecting data from a specific group of people. It's primary focus is on questions providing quantifiable information, although it often also includes open-ended questions to get more detailed answers. It is a widely utilized method because of its ability to quickly and easily find general patterns of thought, behaviour, and attitudes in a group of people. Surveys give a structured way to answer "how" and "why" questions with real measurable data. Surveys gather information that can be statistically analysed by using structured tools like questionnaires or structured interviews. This makes them great for descriptive reporting and hypothesis testing. (Hammond & Wellington 2021, Cowles & Nelson 2015.)

In survey research, it is important to know the difference between observation and questioning. Surveys focus on what people say in their responses to structured questions, but observations look at actual behaviours. These two approaches often provide different insights into the same phenomenon. For example, social, cultural, or psychological factors could cause differences between what people say they believe and how they act. This shows how important it is to look at survey data in the context of the bigger picture. Understanding these nuances helps researchers avoid making simple conclusions and do more in-depth analysis. (Cowles & Nelson 2015).

Surveys also face challenges, such as nonresponse rates, sampling errors, and biases in question design. These problems show how important it is to make questions that are clear, fair, and interesting, and to choose the best way to deliver them, whether it is online, in person, or over the phone. Cultural and situational factors also affect the results of data collection. Surveys must be done carefully to make sure they are accurate and include everyone. For example, online and mixed-mode surveys, have made data collection easy and efficient. However, these innovations come with problems, such as keeping response rates high and dealing with new types of bias. (Cowles & Nelson 2015).

In the context of a quantitative research approach, survey research offers a robust method for exploring relationships among variables and generalizing findings to a broader population. Surveys are structured, which makes sure that data collection is consistent. They can also be combined with secondary data or other methods, which makes the analysis more in-depth. By combining survey data with observational or other forms of data, researchers can achieve a more comprehensive understanding of their subjects. (Cowles & Nelson 2015). Carefully crafted questions, pilot testing, and standardised procedures are often used to make sure that surveys are reliable and valid. This makes surveys a cornerstone of research in fields ranging from public health to education and market analysis. They give researchers a way to explore a wide range of topics in a specific way. (Hammond & Wellington 2021.)

Interviews are particularly effective when the goal is to explore individuals' experiences, meanings, and perspectives in depth. Interviews allow participants to express themselves in their own words, which can give researcher information that he might not be able to get from other ways of gathering data, like surveys or observations. Researchers develop an interview protocol with open-ended questions that guide the conversation while still leaving room for new ideas and insights to come up. The relationship between the interviewer and participant is crucial. Building rapport and trust encourages participants to be honest and open. Interviews are not just a way to get information but also a collaborative and interpretive process that requires the researcher to be flexible, active listener and think about what they hear. (Creswell & Creswell 2018, Gillham 2000)

3.3 Research Process

The research process, particularly in survey-based research, involves several stages that are all connected and meant to make sure the results are accurate and reliable. The process begins with conceptualizing the research questions and designing a framework that includes measurement, sampling, data collection, and analysis. These foundational steps give the research a structured way to stay on track and keep its focus. Questioning is the main part of survey-based research that helps researchers learn about people's attitudes, behaviours, and

opinions. Observational data and other complementary methods can provide additional context and help in understanding the phenomenon under investigation. (Cowles & Nelson 2015, Saldana 2011).

In survey research, the design and development of reliable instruments are very important. This includes choosing questions that are clear and fair, checking for cultural sensitivity, and addressing possible errors like sampling bias, nonresponse, and measurement error and inaccuracies. Pretesting techniques, such as cognitive interviews and focus groups, help refine and improve survey tools by finding and addressing potential issues before they are used on a large scale. Mitigating mistakes in surveys makes sure that the data collected is accurate and trustworthy, which makes the results more credible. (Cowles & Nelson 2015, Saldana 2011).

Data analysis in survey research involves coding, processing, and applying statistical methods to draw meaningful conclusions. Triangulation, which combines survey results with other data sources like observational or secondary data, makes the results more valid and complete. Ethical considerations, such as informed consent and data confidentiality, are integral to the process, along with careful record-keeping to support transparency and to make future replication possible. (Cowles & Nelson 2015). Surveys are a powerful way to learn about complicated social issues and get useful information by using well-designed instruments, iterative refinement, and a variety of data collection methods. These elements make survey-based research a robust and flexible way to study complex social, behavioural, and economic phenomena. (Cowles & Nelson 2015, Saldana 2011).

After collecting data through interviews, transcription takes place, which turns recorded conversations into written form. These transcripts are then subjected for detailed analysis. Data analysis typically involves coding the transcripts to identify patterns, themes, and categories that align with the research questions. Getting rich, real, and reliable qualitative data from interviews as part of the research process, demands adaptability and methodological rigor. (Creswell & Creswell 2018, Gillham 2000)

The Arctic 6G survey was conducted between December 2023 and June 2024. Interviews regarding topics relevant to the questionnaire and the project were conducted in December 2023. At the beginning of my thesis research, I did an analysis of the questionnaire data. This initial data analysis helped to further refine and focus the research questions. Research questions were formulated to be relevant for the Arctic 6G -project, but also to enable and give room for my research to explore chosen topics from a wider perspective.

The research questions were chosen to focus on businesses and socio-cultural aspects of the challenging internet connectivity landscape in arctic regions. These same topics had been studied in other regions and social backgrounds. Earlier research formed a solid theoretical background for my thesis work. I focused the questionnaire data analysis to find out if similar patterns, as in previous research, could also be identified from the Arctic 6G survey.

Since the interviews were already conducted before the start of my research, I was not able to influence the questions to align with my research aims. However, the interview transcriptions still offered valuable data to support my research hypothesis. The patterns of digital inequality and digital divide were identifiable both from the survey and interview data. Consent for publishing names of participants was not asked in the original interviews, therefore, the data needed to be anonymised for this thesis research. (Seale, C, Gobo, G, Gubrium, J.F., & Silverman, D 2004) Full transcripts of the interviews were condensed to summarize the key topics relevant to this thesis. A summary table of these interviews is presented in Appendix 2. Later interviews are referenced by their ID from that summary.

In the final part of the research process in April 2025, I sent out an email questionnaire targeted at four Leader areas in northern Finland. Leader areas aim to support and enhance local communities and businesses, improving overall regional vitality. The core principle of Leader activities is to leverage the skills, knowledge, and engagement of local residents to foster community development. By contacting these area representatives, I hoped to deepen the knowledge on

my specific research questions. Area representatives' answers would effectively be considered as a summary of the whole area's residents' and businesses' thoughts and perspectives on my research topic. However, only one area representative submitted their response, so the impact of this email questionnaire for this thesis was limited. This questionnaire is presented in Appendix 3.

3.4 Questionnaire Implementation

The questionnaire formed an integral part of the Arctic 6G project, which seeks to advance new mobile network technologies in Arctic regions (Appendix 1). Jointly developed by partner universities, the survey was administered through the Webropol platform and included multiple-choice, scale-based, and open-ended questions. It remained open from December 2023 to June 2024 and was promoted through social media channels, project discussion events, and direct emails to 1364 recipients identified using the Talostutka Finnish business information service.

In total, 148 responses were received, translating to a response rate of roughly 10%. Participants represented a diverse demographic, including entrepreneurs, business owners, employees, and students, covering a broad range of age groups and regional backgrounds. Completing the survey required 10–20 minutes. Respondents were asked questions about daily usability, existing performance, and future needs for more advanced mobile network technologies in the Arctic area.

The survey results serve a dual purpose. First, they help pinpoint the functional gaps in present connectivity options, highlighting the practical challenges faced by users in rural and remote Arctic areas. Second, they guide the work carried out by Lapland UAS, which focuses on identifying the connectivity requirements of businesses operating in these regions, ensuring that future 6G deployments meet real-world demands. In this context, the survey results offer valuable insights into how next-generation technologies could facilitate business development and digital transformation, supporting the long-term viability of Arctic communities.

Questionnaire targeting leader area representatives was sent out as an email. Those questions were formulated after the data collected in Arctic 6G survey and interviews had been analysed and the research topic for my thesis was established. Questions were designed to give further deeper insights to the perceived digital divide and the effects of digital inequality.

3.5 Interviews

Interviews were carried out in December 2023 across several sparsely populated areas in Finnish Lapland, notably in Ivalo, Inari, Salla, and Kittilä. Interviewees included representatives from various local businesses, community groups, educational institutions, and individual entrepreneurs, ensuring a broad representation of rural stakeholder perspectives.

The interviews comprised both individual and group discussions. Specifically, two larger group interviews were organized at educational institutions, including students and staff. Additionally, focused discussions and individual interviews were conducted with key local stakeholders and business operators, such as tourism entrepreneurs, representatives from reindeer husbandry, village association leaders, and infrastructure specialists. All together, approximately 67 individuals participated in these interview sessions. The discussions explored respondents' experiences and perceptions regarding the state and impacts of existing mobile networks and their expectations for future developments, particularly in relation to 6G technology.

Interviews followed a semi-structured format, addressing predefined topics while allowing flexibility for respondents to elaborate freely on their experiences and concerns. One of the group interviews was conducted as an open discussion session, rather than an interviewer-led interview. Key themes included existing network reliability and coverage, impacts on daily business and community life, safety concerns, digital exclusion, and recommendations for policy and network improvements. Practical experiences, such as issues faced during peak tourist seasons, challenges in emergency communications, and difficulties in adopting

digital technologies, were extensively documented. The qualitative approach enabled an in-depth exploration of the local experiences of digital inequality, providing nuanced context and supporting the quantitative data obtained earlier through the survey.

3.6 Data Analysis

Data analysis in a survey-based research is a critical phase that transforms raw data into meaningful insights, answering research questions, and validating hypotheses. The process begins with data cleaning and preparation, where responses are checked for accuracy, missing values are addressed, and inconsistencies are resolved. For surveys, open-ended responses are often coded into categories to facilitate analysis. Descriptive statistics, such as measures of central tendency and variability, provide an overview of the data, highlighting key patterns and characteristics of the surveyed population. (Cowles & Nelson 2015, Saldana 2011.) As the questionnaire was not specifically developed for my thesis research, a preliminary analysis of the questions was carried out. Individual questions and their meaningfulness to this particular research needed to be evaluated in the context of the research questions formulated for this thesis. This step cleaned and filtered out all the irrelevant data.

Quantitative surveys often use inferential statistics to find connections between variables and apply the results to a larger group of people. Examples of these statistics are correlation analysis and regression. When surveys include open-ended questions, qualitative methods like thematic or content analysis uncover deeper patterns and narratives. Triangulation, or the integration of data from multiple sources, enhances the robustness of the analysis by providing a comprehensive understanding of the research topic. Charts and graphs help people understand complex results by making them easier to understand for a wider range of people. (Cowles & Nelson 2015, Saldana 2011.)

Qualitative research data analysis is an iterative, interpretive, and systematic process aimed at identifying patterns, themes, and meanings within the collected data. It begins once data collection starts and continues throughout the research

project, allowing early insights to inform subsequent data gathering. The process typically involves transcribing interviews, observations, or other textual data verbatim. Researchers then develop themes by clustering related codes together, looking for deeper patterns, relationships, or contradictions within the data. Constant comparison is often used, where data are continually compared across sources to refine categories and deepen understanding. Researchers must be self-aware and acknowledge how their perspectives and interactions influence interpretation. The final goal is to present findings that are both reliable and meaningful, usually organized around themes that answer the original research questions. (Creswell & Creswell 2018)

Throughout the process, it is very important to deal with biases and make sure that the results are correct. Rigorous methodological practices and transparent reporting help reduce the chances of mistakes, like sampling biases or measurement errors. Every step of the analysis is based on ethical concerns, such as keeping participants' information private and being honest about the data. The iterative nature of data analysis allows researchers to refine their focus as insights emerge. This makes the approach thorough and adaptable. Together, these practices make data analysis a cornerstone of research, delivering reliable and actionable outcomes. (Cowles & Nelson 2015, Saldana 2011.)

4 QUESTIONNAIRE ANALYSIS AND FINDINGS

This chapter presents the results of the Arctic 6G project's quantitative survey. General trends and specific findings about existing internet connectivity, perceived digital inequality are identified and analysed. Their meaning for businesses in rural areas are explored. The analysis also looks at how different groups of respondents see and feel about internet connectivity and how it affects their lives. This offers more detailed insights into how the quality of internet connectivity influences business activities and development opportunities.

This chapter demonstrates the results of the questionnaire questions that were best at answering the research questions for this thesis. Some of the questions were not useful for this study, so they were filtered out before the analysis. Appendix 1 shows the set of questions that were used for this thesis research after they were filtered.

4.1 General Sentiments and Trends

The "Arctic 6G - Survey" provides a comprehensive look at internet connectivity in Northern Finland, focusing on the Arctic region, with 148 respondents offering insights into existing usage, challenges, and future expectations. This analysis is directly relevant to the themes of digital divide and digital inequality, especially in highlighting how connectivity issues in rural and sparsely populated areas hinder business development opportunities.

First analysis is made to the whole set of answers without any groupings. This gives opportunity to observe sentiments and trends that span the whole respondent group. This is important since the 148 respondents represent quite diverse demography of areas, distribution shown in Figure 1, industries, devices and connections.

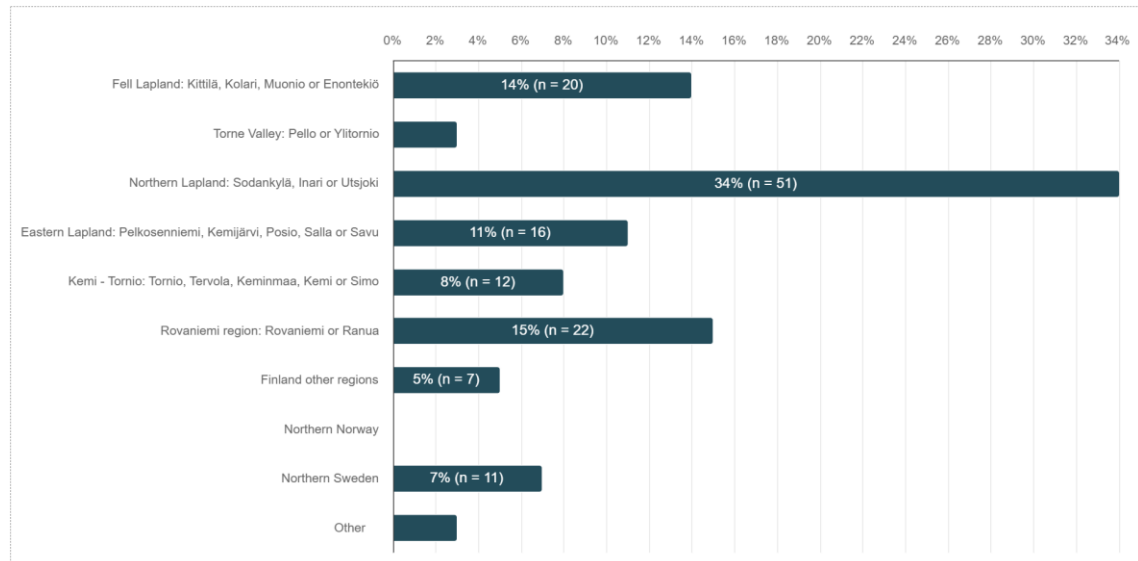


Figure 1. Where do you live? (Arctic 6G)

4.1.1 Existing Internet Connectivity and Usage

Internet connectivity is almost unanimously seen as an essential in the Arctic communities surveyed; 99% of respondents rated the internet as important in their daily life, with 83% calling it “very important”. This high dependence spans personal and professional spheres. Nearly everyone uses internet-enabled devices regularly – 99% own a smartphone and 86% use a computer (laptop or desktop) for online activities. This penetration of connected devices underlines how deeply the internet is woven into the daily routines of people, from staying in touch with others to accessing services and entertainment.

The most common connection types were mobile 4G (78%) and 5G (31%), followed by fixed connections (37%), indicating a reliance on mobile networks in rural areas where fixed infrastructure is limited. A significant finding is the assessment of existing internet connections, with 17% of respondents reporting challenges due to slow or unreliable internet. Specific issues included coverage gaps, with speeds as low as 0.1-1.5 Mbps in some areas, and disruptions affecting work, education, and daily activities.

Figure 2 presents data on which tasks the internet is used for. Respondents highlighted the need for fast and reliable internet for various activities. For work and education, reliable connectivity is crucial. As one person noted, “We use an

electronic patient data system in real time... [but] connectivity isn't good enough", referring to difficulties retrieving medical data in the field. This illustrates that even critical jobs like healthcare now rely on stable internet. Internet access is critical for everyday convenience, but also a requirement for many vital tasks.

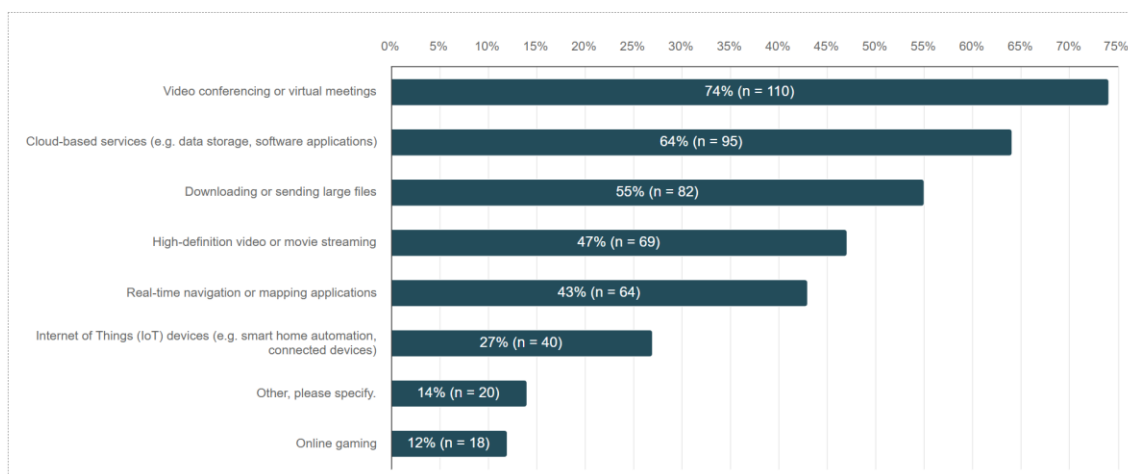


Figure 2. For which of the following internet services do you need a fast and reliable network connection for? Select one or more. (Arctic 6G)

About three-quarters of respondents need fast internet for video conferencing (74%) and cloud services (64%), highlighting how common remote meetings, online collaboration, and data storage have become in northern areas. These statistics underline the critical role of the internet for business operations, particularly in remote areas where video conferencing and cloud services are essential for remote work and customer interactions.

4.1.2 Digital Divide and Inequality

Figure 3 presents respondents' perception of their existing internet connection status. Many respondents are dissatisfied with the quality of their internet connections. Only 16% of respondents rate their local internet service as "Excellent," and roughly 43% say it is "Good." A significant share, however, describe it as only "Fair" (28%) or "Poor" (12%), and a few (1%) even report having no available internet at all. In practical terms, this means that nearly 40% of people in these Arctic regions struggle with subpar connectivity. (Figure 3)

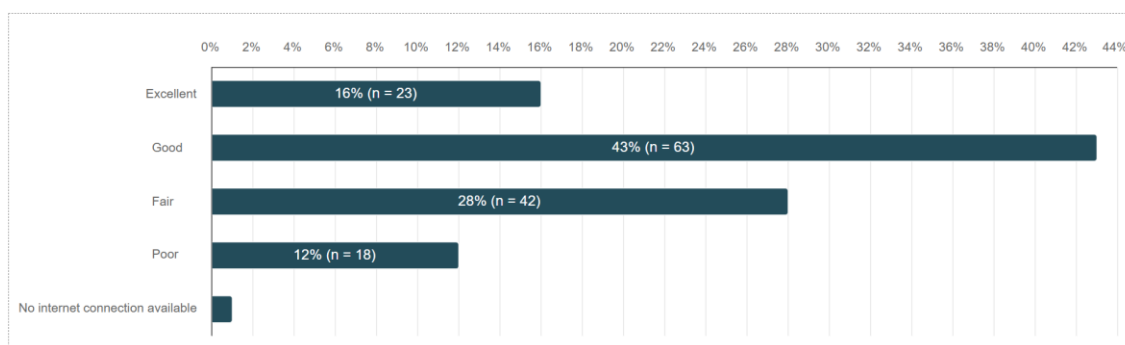


Figure 3. How would you rate the current internet connections in your residential area?

More than three-quarters (78%) of the respondents have experienced slow or unreliable internet, causing problems (Figure 4). These connectivity issues manifest in various frustrating ways. Frequent outages and slow speeds are a common refrain – one resident reported their connection “often cuts out or is slow, only – 0.1–1.5 Mbps”, making even simple tasks difficult and time-consuming. Even those who theoretically have high-speed 4G or 5G connections find that the service can be inconsistent. For example, a respondent described that a 5G mobile connection “sometimes has the connection dropping” unexpectedly. Others noted that their 4G network gets “completely congested” during peak evening hours, to the point that “nothing works” at those times. Even though basic connectivity exists for most, reliability is a serious issue – connections might meet needs one moment and fail the next. As one person summed up, “We have all the extra antennas and everything, but still, we have a lot of problems with the network... it complicates doing work [and] studying on the computer”. This inconsistency leaves residents constantly dealing with interruptions, slow downloads, and dropped communications.

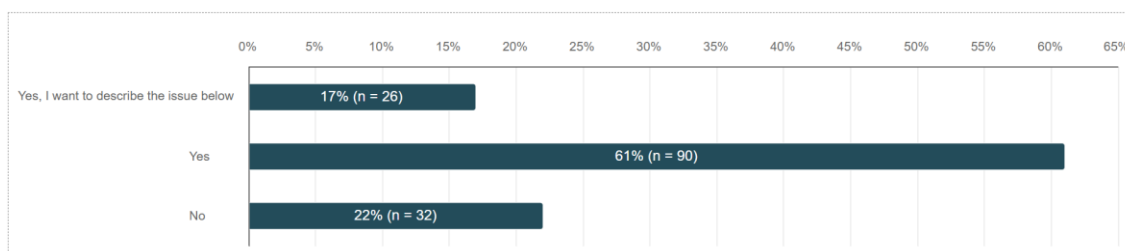


Figure 4. Have you encountered challenges due to slow or unreliable internet connectivity?

4.1.3 Urban–Rural Gaps in Connectivity

95% of respondents noticed differences in internet performance between densely populated areas and remote regions, clearly illustrating the digital divide (Figure 5). Many rural villages lack reliable infrastructure; several people mentioned cellular “blind spots” where there is no signal even for basic phone calls. By contrast, those in town centers might have access to 5G or fiber; about 37% of respondents overall have fiber-optic at home, but this is concentrated in more developed areas. Generally, though, the pattern is clear – connectivity diminishes with distance from urban hubs.

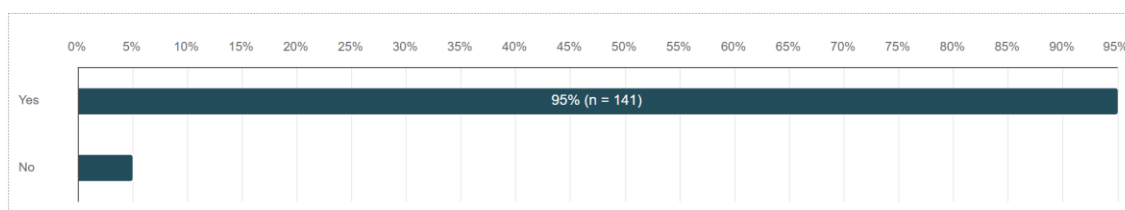


Figure 5. Have you noticed a difference in internet connectivity between populated areas and remote regions?

The community strongly voices that this gap must be closed: 95% say it’s important (68% “very important”) that internet services work consistently in both urban and rural areas (Figure 6). In comments, people call for “reliable connections also [in] sparsely populated areas so that living outside a city doesn’t mean second-class internet.” The digital inequality between Arctic townships and outlying settlements affects everything from entertainment to essential communication, effectively making location a determining factor in one’s online experience.

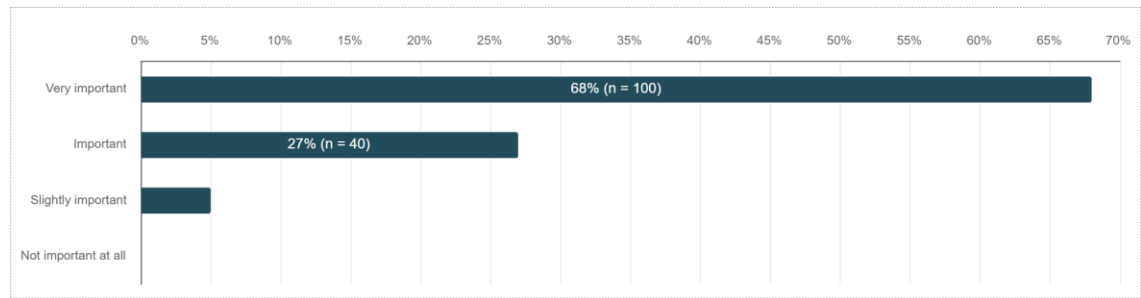


Figure 6. How important is it to you that internet connections and services work consistently both in urban areas and in rural areas?

4.1.4 Impacts on Daily Life and Work

Slow or unreliable internet has tangible consequences on individuals' daily activities. Leisure and communication are affected due to poor connectivity, and many mentioned having to retry basic online tasks. Important personal business can be derailed: a respondent described the frustration of filling out official forms online only to have the connection drop at the last step, resulting in an error and lost data. Such incidents force them to start over, wasting time and effort. Another common issue is the inability to use modern services like streaming or real-time navigation when connections lag.

Work and study are especially hampered by unreliable internet. Several respondents who try to work remotely from rural homes or cottages shared that it's often not feasible. Online meetings with colleagues or teachers where video calls drop or video quality turns so poor that "the picture is grainy [and] videos freeze" during remote lessons. In such cases, productivity and learning are clearly impeded.

The digital divide also introduces safety concerns into daily life. Residents in remote Lapland recounted worrying scenarios where being offline could be dangerous: "If you're in an area with no internet and have an accident, you can't call for help...". Drivers traveling through isolated stretches fear breakdowns in "dead zones" – as one described, if a car fails in a known coverage gap on a remote road, "getting help might be impossible or very delayed," especially in harsh weather. These anecdotes show that beyond inconvenience, connectivity

gaps in the Arctic can literally put lives at risk or leave people feeling unsafe when help is out of reach. In short, unreliable internet touches every aspect of daily life, from mundane tasks and entertainment to critical work, education, and safety, amplifying the sense of isolation in an already sparsely populated region when things go wrong. 80% of respondents have indeed been concerned due to poor internet connection (Figure 7).

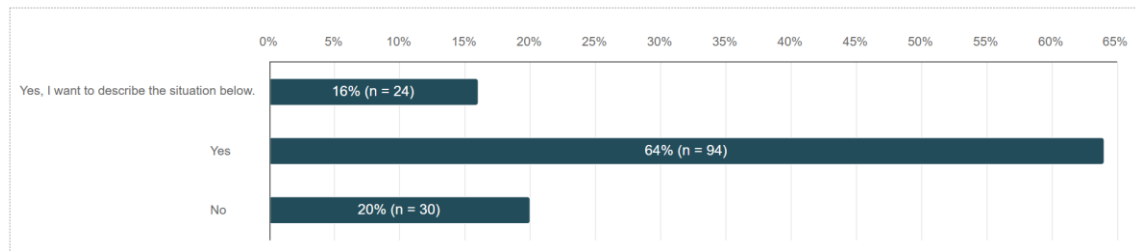


Figure 7. Have you ever been concerned due to poor internet connectivity? For example, a situation where internet access was necessary.

4.1.5 Business and Industry Effects

The survey provides detailed insights into the challenges businesses face in rural and sparsely populated areas, directly impacting their development. Over half of the respondents were entrepreneurs themselves, and many voiced how poor connectivity undermines their operations. Amongst some of recorded direct effects on businesses were: Poor and unreliable coverage, slow speeds and inconsistent performance, limited infrastructure and environmental factors.

Poor and unreliable coverage in rural areas, which by tourism business near Inari Lake was reporting "very poor internet connection", hindered this businesses ability to react promptly to customer requests. Coverage gaps were noted in forested and remote areas like Sodankylä and Kuusamo, with frequent disconnections affecting operations.

Slow speeds and inconsistent performance was highlighted by respondents stating mobile internet speeds being significantly lower than promised (e.g., 10 Mbps instead of 300 Mbps). Many had noticed network overloading during peak times (18:00-21:00), which disrupts business activities like online meetings and

file transfers. In the retail and service sector, unreliable networks mean lost sales. Slow networks make even card payments drag on longer than normal, which frustrates customers but can also directly hurt the business's reputation and revenue.

Limited infrastructure like lack of mobile masts, poorly directed antenna, changing mobile operator coverage and absence of fiber optic connections were stated as recurring issues. Respondents were calling for more infrastructure to improve reliability, especially in sparsely populated areas. Certain industries, like reindeer herders, unique to the Arctic, are hampered by connectivity gaps. Forestry workers and other outdoor industries echoed similar issues: if network coverage fails deep in the woods, coordination and safety checks halt.

Environmental Factors like cold weather, snow, and strong winds make connectivity issues worse, affecting device battery life and signal strength. This poses additional challenges for businesses operating in harsh Arctic conditions.

Identifying these direct challenges is important, as it allows us to study and understand how they have secondary effects on businesses. Arctic businesses are required to spend resources to counter these challenges, which sets them back from their competitors. Most notable effects in the area of business development are faced in: operational efficiency, digital transformation, competitiveness and safety and emergency concerns.

Operational efficiency is hampered by poor connectivity, which disrupts critical functions like customer service, real-time data management, and digital marketing. One respondent specifically noted difficulties in sending invoices and offers promptly, which is leading in lost opportunities for businesses.

Digital transformation is slower in areas affected by poor internet connectivity. Many businesses expressed a desire to enhance digitalization using CRM/ERP systems and cloud services, but unreliable internet stalls progress, with one respondent stating, "If connections don't improve, we cannot develop."

Rural businesses feel less **competitive**. 66% of respondents emphasized the need for equal connectivity to improve work and study opportunities. Businesses fear that poor connection quality is directly affecting their ability to grow and attract talent. Areas can face an employment growth barrier due to inferior internet services. The lack of reliable internet limits remote and hybrid work opportunities, reducing the attractiveness of rural businesses to job seekers and restricting regional economic growth.

Safety and emergency concerns were raised by tourism and emergency services. Unreliable mobile connectivity poses safety risks, such as hindering emergency response in remote areas, impacting business reliability and customer trust.

Figure 8 shows respondents' thoughts on which sectors would benefit most from improved connectivity in Northern Finland. When asked about the topic, the top choices were healthcare (69% of respondents), tourism (55%), and education (55%). These align with the qualitative stories: people recognize that hospitals, clinics, and emergency services need robust networks, that the tourism industry, a cornerstone of the Arctic economy, requires connectivity for bookings, navigation, and customer communications, and that schools and remote learning depend on good internet. Leisure activities (28%) and reindeer husbandry (21%) were also frequently mentioned, reflecting how even recreation and traditional livelihoods are impacted by the digital divide.

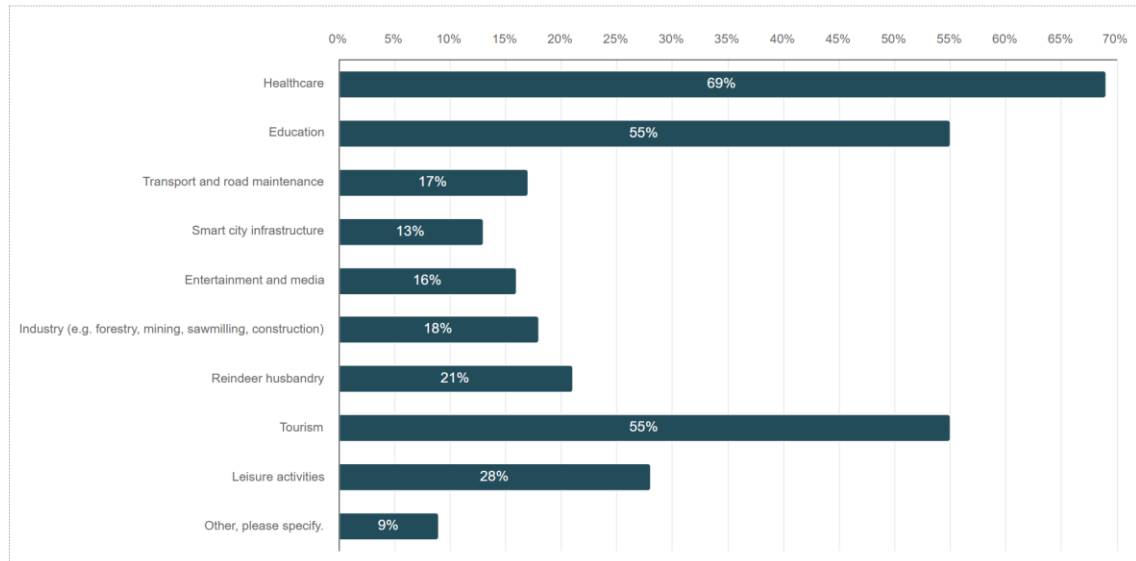


Figure 8. Which industries do you think would benefit from improved internet connectivity in Northern Finland?

The broad range of sectors identified underscores that in today's Arctic, no field is truly offline. From small startups to traditional reindeer herding co-ops, digital connectivity has become a backbone for economic activity, and when that backbone is weak, the whole community feels the strain.

4.1.6 Future Expectations and Industry Benefits

Given these challenges, residents have clear hopes and expectations for improved connectivity. Virtually everyone (over 92%) believes that more advanced internet infrastructure is important to improve work and study opportunities in the North. In open-ended responses, people overwhelmingly called for better coverage and reliability above all. A common wish is that internet access should be "smooth also in sparsely populated areas" – meaning fewer dead zones and stable service even in small villages or remote cabins.

Businesses and individuals are reliant on mobile connectivity 4G (78%) and 5G (32%) in rural areas. The sentiment is that the foundation – reliable 4G and widely available 5G or fiber – must be in place first, before pushing further. These answers provide quantitative data to analyse how connectivity issues affect business operations, productivity, and growth. For instance, 74% needing video

conferencing for work highlight the dependency on reliable internet, with rural areas facing greater challenges.

Respondents expressed a strong desire for improved internet coverage, speed, and reliability, with hopes for 5G expansion and fiber optic connections to support work, education, and leisure activities. Industries identified as benefiting from better connectivity include tourism, healthcare, education, and emergency services, with many emphasizing the need for reliable connections to enhance efficiency and customer service, particularly in remote areas.

4.2 Comparing Connectivity Groups

For additional analysis, respondents were grouped into two groups based on their answer to the question “How would you rate the current internet connections in your residential area?”. This grouping is shown in Figure 9. Those that answered “Excellent” or “Good” were put in group “Good” and those who answered “Fair”, “Poor”, or “No internet connection” were grouped in “Fair” group. This gives an opportunity to compare how the perceived internet connection affects sentiments.

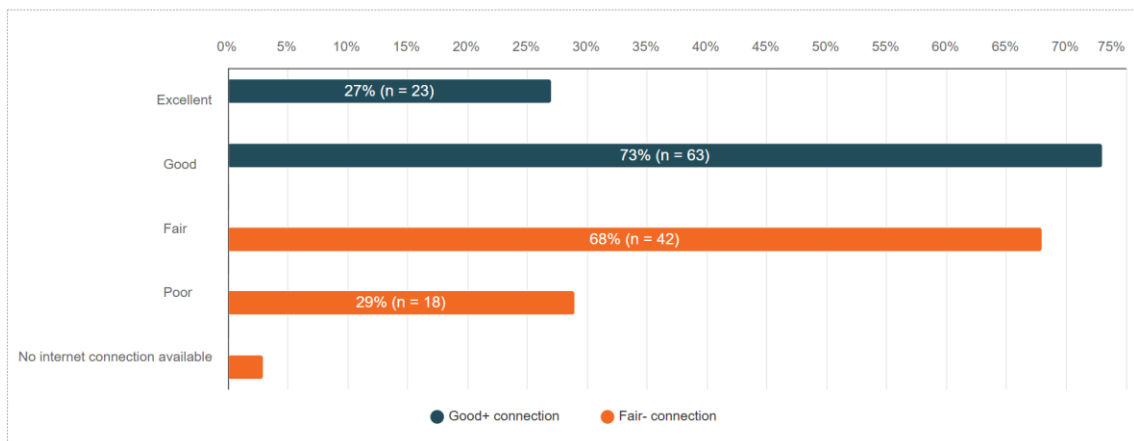


Figure 9. How would you rate the current internet connections in your residential area?

Internet connectivity is widely regarded as critical for day-to-day business operations by both groups. In fact, 100% of surveyed businesses considered reliable internet important to their activities, and a vast majority in each group rated it “very important” (79% of Fair vs ~59% of Good group’s respondents). This

underscores a shared understanding that connectivity underpins modern business processes such as communication, data access, and coordination. However, operational efficiency suffers greatly in the Fair group due to connectivity issues. Figure 10 illustrates how nearly all (over 98%) of businesses in the Fair group have experienced problems with slow or unreliable connections, compared to about two-thirds of those with good connectivity.

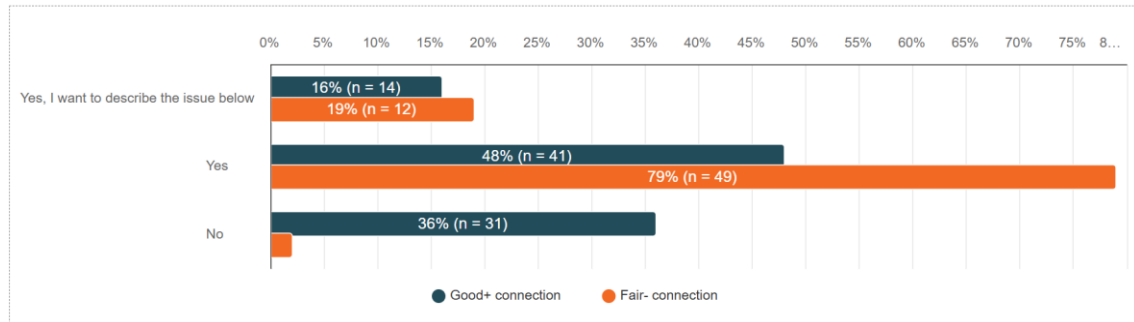


Figure 10. Have you encountered challenges due to slow or unreliable internet connectivity?

In other words, only 2% of the Fair group reported no internet-related challenges, versus over a third of the Good group who have been mostly issue-free. These disparities suggest that while every business depends on the internet for smooth operations, those in poorly connected areas struggle with frequent disruptions that impede their efficiency. Poor connectivity drains productivity – staff must wait on buffering, repeatedly attempt transactions, or even revert to offline methods, undermining their daily efficiency. By contrast, businesses with good internet rarely face such obstacles, allowing them to focus on core operations rather than troubleshooting connectivity. It is clear that reliable broadband makes things run more smoothly. Both groups agree that it is necessary, but only those with good connections can fully enjoy the benefits all the time.

4.2.1 Challenges Faced Due to Poor Internet Service

Businesses in the Fair group report that bad internet service causes a lot of problems that affect everything from customer transactions to internal workflows. A common issue is unstable connections that cut out without warning. Additionally, many Fair group's businesses struggle with insufficient bandwidth.

They give examples like webpages with a lot of data taking a long time to load or large file uploads timing out, which makes digital communication with clients almost impossible during busy times.

Network congestion during busy times or tourist seasons is another big problem. In some Arctic communities, the 4G and 5G mobile networks get too busy at certain times of the day, which stops internet service from working. Even newer 5G networks have problems with dropped connections during busy holiday times in resort areas, so people have to find ways around them. A business in a ski resort area even had to install special directional antennas to get a stable signal, which cost them more money and time just to do basic online tasks.

These examples show how companies with bad internet connections have to be very creative. They have to plan important uploads for times when the internet is less busy, buy equipment to boost signals, or keep manual processes as backups. The Good group, by comparison, reported far fewer of these daily hurdles (over one-third had no major issues), illustrating how quality internet service spares businesses from many such challenges. Notably, even some well-connected businesses do experience occasional slowdowns or minor outages, but the frequency and severity are much lower than for those with only fair or poor service.

4.2.2 Digitalization Levels and Practices

Reliable connectivity appears to go hand-in-hand with higher levels of business digitalization. The survey asked companies to self-rate their digitalization on a scale from 0 (not at all) to 4 (fully digitalized) across various dimensions. Answers are visualised in Figure 11. Across all aspects, the Good group reported more advanced digital integration on average than the Fair group. For example, when rating whether “Digitalization is evident in the company’s strategy,” businesses with good internet scored 2.6 on average (median 3), whereas those with weaker connectivity averaged only 2.2 (median 2). In practical terms, this suggests that well-connected companies are more likely to have digital tools and online

services explicitly built into their strategic plans, while less well-connected firms are a step behind, possibly focusing on more basic needs first.

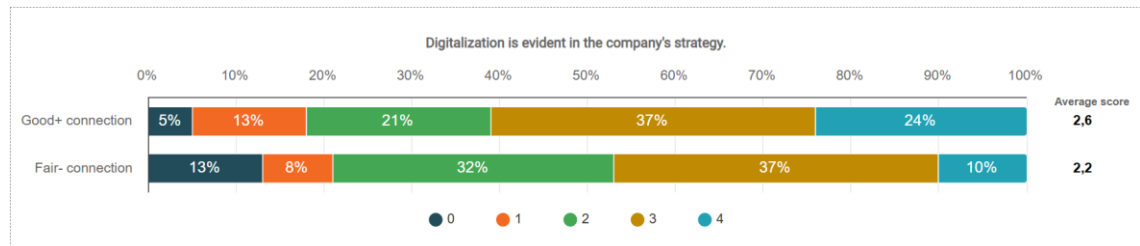


Figure 11. Rate your company's level of digitalization on a scale of 0-4 (0 = not digitalized, 4 = fully digitalized)

Figure 12 visualises the usage of digital solutions in internal operations (such as ERP or CRM systems), showing a similar gap: the Good group’s average self-rating was around 2.6 out of 4, compared to 2.1 for the Fair group. This indicates that companies with better internet are more often leveraging software like enterprise resource planning or customer relationship management platforms in their day-to-day processes, whereas those in Fair group connectivity lag in adoption of these internal digital systems.

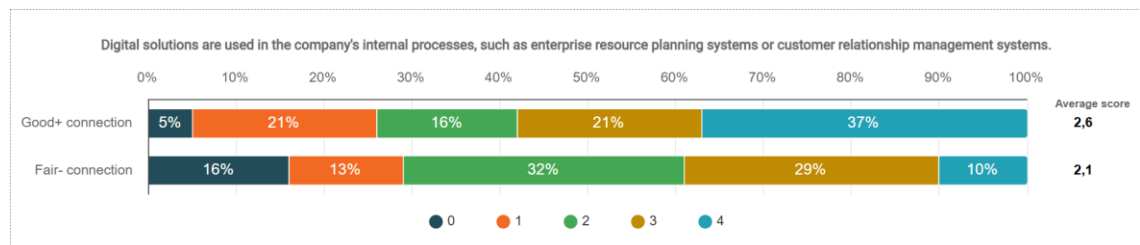


Figure 12. Rate your company's level of digitalization on a scale of 0-4 (0 = not digitalized, 4 = fully digitalized)

It’s worth noting that both groups have embraced digitalization to some degree – even in the Fair group, many businesses report moderate use of digital tools in operations and customer interface. From Figure 13, we see that, for instance, digital tech is utilized in daily business operations at a high level in both groups (median rating around 3 for both). Companies with good connectivity only have a slight edge here (average score 2.8 vs 2.6), implying that even those with connectivity challenges often find ways to incorporate digital tools in their

workflow up to a point. Customer-facing digitalization (such as offering online services or digital platforms to clients) is one area that shows a clearer difference: well-connected firms more frequently provide digital services to their customers (average rating 2.4 vs 2.1).

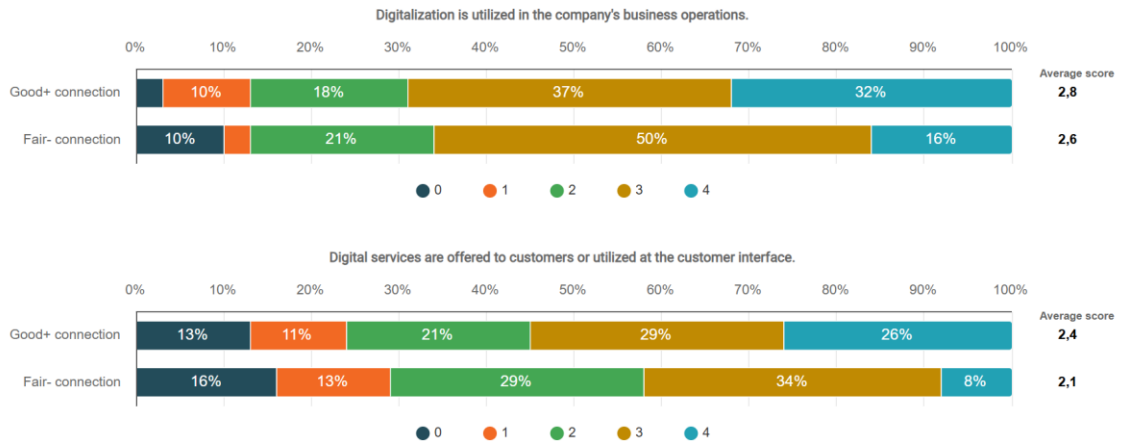


Figure 13. Rate your company's level of digitalization on a scale of 0-4 (0 = not digitalized, 4 = fully digitalized)

For example, a business with robust internet might maintain an interactive e-commerce site or a mobile app for customers, whereas a poorly connected business might stick to more traditional, offline customer service or a very basic online presence due to bandwidth limitations. Still, many in the Fair group aspire to improve – they often recognize the value of going digital, but their existing infrastructure limits how fully they can do so. In summary, better connectivity correlates with deeper digital integration: Good group's businesses are generally more advanced in strategic digital initiatives, use of cloud-based enterprise tools, and offering digital services to customers. The Fair group's businesses have made some digital strides but remain less digitalized overall, likely constrained by the reliability and speed of their internet access.

4.2.3 Internet-Dependent Devices and Cloud Services

Another telling contrast between the two groups is in the types of internet-dependent devices and technologies utilized by the businesses. Some devices, notably the basics – smartphones, tablets, and computers – are nearly universal

in both groups. Virtually every business, regardless of connection quality, uses mobile phones and/or computers for work (around 97–100% of respondents in each segment). This indicates that connectivity challenges do not stop businesses from adopting essential personal devices. However, when it comes to more specialized or bandwidth-intensive equipment, differences emerge. Companies with poor connectivity actually reported greater usage of certain IoT and field devices like GPS trackers and drones, which might seem counterintuitive at first glance. For example, 45% of Fair group's businesses use GPS tracking devices, compared to only 16% of Good group's businesses. Similarly, 26% of Fair group's firms employ drones (for surveying land, monitoring assets, etc.) versus just 8% of the well-connected group. This reflects the industry mix – many Fair group's respondents operate in sectors like reindeer herding, forestry, or remote tourism where such tools are necessary and where infrastructure is the weakest.

In contrast, point-of-sale and office devices show a more even or opposite pattern: about half of Good group's businesses use payment terminals (50%) and a similar 42% of Fair groups businesses do as well, suggesting both groups attempt to conduct cashless transactions even in low-bandwidth regions. The slight lead in payment terminal adoption for Good group's companies could indicate that some very remote businesses avoid card payment systems if the internet is too unreliable, whereas those with decent connectivity have the confidence to use them.

Another critical technology area is the use of cloud services and online platforms. Cloud-based systems (for data storage, software-as-a-service, etc.) can greatly enhance efficiency and collaboration, but they demand reliable internet. The survey results show a nuanced picture: a majority of businesses in both groups do use cloud solutions, but good connectivity clearly helps drive existing adoption, while poor connectivity delays it. About 65% of Good group's connected businesses have already implemented cloud-based processes, slightly higher than the 58% in the Fair group. This gap, illustrated in Figure 14, though not huge, suggests that some poorly connected firms are holding back on cloud migration. In fact, significantly more Fair group's respondents indicated "No, but it is in future

plans” – 18% vs only 6% of Good group’s firms plan to adopt cloud soon despite not using it yet. This implies that many of the Fair group’s companies recognize the value of cloud tools and want to use them, but likely feel constrained by their existing internet quality, pushing their cloud adoption into the future.

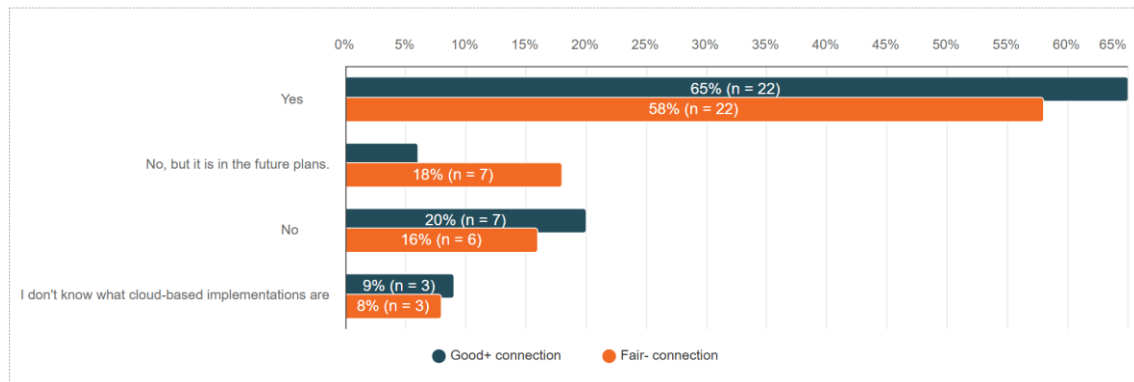


Figure 14. Does your company use cloud-based implementations to carry out internal processes?

Both segments clearly see the benefits of internet-dependent tech: basic ICT tools are ubiquitous, and even advanced devices (sensors, drones) are in use where needed. But poor connectivity imposes a cost – Fair group’s businesses often utilize these tools under less-than-ideal conditions or delay fully leveraging cloud computing due to infrastructure limits. Conversely, Good group’s connected businesses can more readily capitalize on cloud services and are not as constrained in adopting new internet-based devices or apps. The divergence lies in the more data-intensive tech: well-connected firms can confidently expand into cloud platforms and complex digital systems, while those with Fair or no internet tread cautiously, prioritizing only the most essential devices and often deferring cloud adoption until connectivity improves.

4.2.4 Business Sectors Most Affected by Poor Connectivity

Respondents from both groups highlighted certain industry sectors that particularly suffer from or would benefit from improved internet connectivity in the Arctic region. Interestingly, there is consensus on some sectors and divergence on others, reflecting how each group perceives connectivity gaps in their

community. As mentioned earlier, tourism, health care, and education were the top sectors when asked which would benefit from good internet connectivity.

The differences between groups become pronounced with local industries unique to the region, as seen in Figure 15. The Fair group was far more likely to single out reindeer husbandry, as needing better connectivity – 35% of respondents in Fair group chose reindeer herding, compared to only 10% of those with good internet. This suggests that those who actually live or work in reindeer herding areas (which tend to have fair or worse connectivity) acutely feel the need for connectivity. Another slight difference: the “industry” category (forestry, mining, construction) was selected by about 20% of Good group but only 15% of Fair group. This could be because some in Good group are based in towns with industrial operations nearby and recognize the need for better connectivity in those sectors (e.g., data links for mining machines or sawmills), whereas Fair group’s respondents focused on more immediate rural concerns.

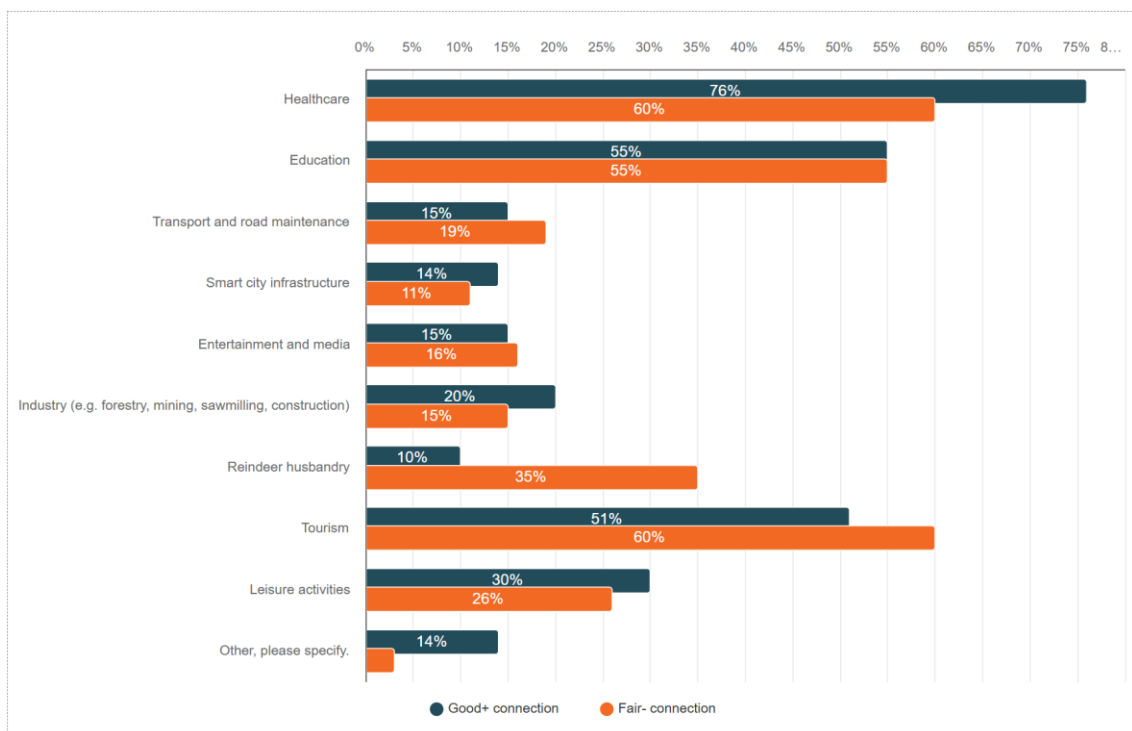


Figure 15. Which industries do you think would benefit from improved internet connectivity in Northern Finland? Choose the top three you consider most important.

In essence, poor connectivity has economy-wide repercussions, but especially on sectors that depend on communication and data. Both well-connected and poorly-connected respondents agree that public services (medical care, schooling) and tourism businesses are among the hardest hit by connectivity gaps, since those domains increasingly rely on the internet for delivering services (telehealth, remote classes, online travel info). The Fair group, having firsthand experience, additionally emphasizes traditional and rural industries (reindeer herding, agriculture) that the Good group might overlook. This highlights an important point: improving the internet in the Arctic would not just benefit tech companies but also boost very traditional sectors by enabling modern tools (like tracking devices for herding or drones for farming). The consensus on key sectors provides a roadmap for policymakers – upgrading infrastructure for healthcare, education, and tourism hubs is a shared priority, while specialized support might be needed for connectivity in pastoral areas and industry sites that currently lag behind.

5 INTERVIEW ANALYSIS

This chapter complements the survey analysis by examining qualitative insights gathered from in-depth interviews. These findings illustrate the lived experiences and practical implications of digital inequality, highlighting significant concerns raised by businesses and community stakeholders. The analysis sheds light on how connectivity issues concretely affect safety, business efficiency, technological adoption, and economic sustainability in rural regions. The referenced interviews are summarized in Appendix 2.

The qualitative data obtained from supplementary interviews reinforce the key findings identified in the survey analysis. Interviews conducted with business owners, local community representatives, and other stakeholders from various rural and sparsely populated areas highlighted pervasive issues of digital inequality and illustrated how the digital divide impacts their everyday operations and economic opportunities. (Appendix 2: Interview 1, Interview 3, Interview 6) These interviews thus provide critical depth to the quantitative survey results, emphasizing the need and wish for targeted investments and proactive policy measures aimed at bridging the persistent urban-rural digital divide.

Only one out of the four leader area executive directors gave their answer to the email questionnaire presented in Appendix 3. With only one response, this survey's impact on the thesis research is limited in scope. The answers are not used or referenced in this thesis other than to reinforce signals that the general consensus about the state of mobile internet connectivity seems to be the same regardless of the respondent's position in the rural economic community. Although precise economic impacts were difficult to quantify, businesses acknowledged that poor connectivity clearly reduces service quality, responsiveness, and attractiveness to potential customers. Respondents described practical coping strategies, such as traveling considerable distances to secure reliable connections or entrepreneurs collectively voicing their concerns to telecom operators and local authorities. Respondent recognized that bridging the digital divide could significantly improve business accessibility and foster equitable access to digital services. Interviewee expressed uncertainty about

whether upcoming technological advancements like 6G would meaningfully improve their specific circumstances. Finally, the respondent identified digital skill gaps within businesses, suggesting that tailored training could help companies more effectively leverage future connectivity improvements, thereby enhancing local economic prospects and regional attractiveness.

5.1 Impact of Connectivity Issues on the Economy

The interviews reveal severe connectivity challenges faced by businesses in rural and sparsely populated areas, providing deeper insight into the extent of digital inequality. Businesses described ongoing problems such as unstable and unreliable mobile network coverage, particularly regarding 4G networks, which often perform inadequately or fail entirely. Respondents stressed how these connectivity problems make it harder to use basic and necessary digital services that businesses need to run today, like making online reservations, billing, and customer support. (Appendix 2: Interview 3, Interview 4) These difficulties have been made worse by network upgrades and the phased discontinuation of older network generations, such as 3G, leading to reduced reliability rather than improvements (Appendix 2: Interview 2). The respondents were consistently sceptical of newer technologies like 6G because of a pattern where telecom companies promise high-quality services but then deliver much worse ones. One participant used the metaphor of "selling a Ferrari but delivering a moped" to describe this. (Appendix 2: Interview 1)

These ongoing issues with internet connections significantly impact local economies, especially those that depend on tourism and hospitality. Businesses often have trouble with network overload during busy tourist seasons, which makes it very hard for them to do their jobs. Interviewees gave examples of problems at hotels and other places where poor internet access has made it hard to book and pay for rooms, which has led to operational inefficiencies and unhappy customers. In some cases, businesses have had to revert to traditional, manual operations, which increases workload, reduces their competitiveness, and hurts the customer experience. The economic effects go beyond short-term operational challenges. These connectivity problems make rural areas less

appealing and competitive, which slows down regional growth and development. (Appendix 2: Interview 2, Interview 3)

5.2 Safety Concerns

The interviews provided strong evidence that there are serious safety and security issues associated with poor mobile network connectivity in rural and remote areas. Respondents emphasized that an unreliable communication infrastructure not only makes it hard to run a business, but it also puts people in danger in emergencies. (Appendix 2: Interview 6)

Several interviewees recounted alarming incidents where they were able to make emergency calls but could not get follow-up calls from emergency services because the network did not have enough coverage. Also, it was reported that many digital tools, like GPS-based navigation and mapping apps, were not always working properly, which could be very dangerous for people who live or work in difficult terrain or bad weather. This issue is particularly important in remote regions, where having reliable and accurate internet access can mean the difference between life and death. (Appendix 2: Interview 3, Interview 4, Interview 6)

5.3 Technological Limitations and Digital Exclusion

The qualitative data not only shows safety issues, but also shows that there are bigger technological problems that make it harder for some people to use technology. People who took part in the interview said they had to use multiple subscriptions, different operators, or even pay a lot of money for other solutions like satellite communications to make up for problems with the network. Frequent roaming issues between operators, made worse by the absence of comprehensive national roaming agreements, make these problems even worse, forcing people and businesses to carry multiple devices or SIM cards. This lack of seamless connectivity and compatibility between operators and devices makes it harder to do business every day and makes it harder to adopt and integrate digital technologies. This makes the digital divide bigger and intensifies the sense

of exclusion experienced by these rural communities. (Appendix 2: Interview 4, Interview 6)

The interviews show how important it is for rural communities to have reliable internet access for their long-term vitality and growth. Respondents talked about how ongoing connectivity problems make the region less appealing, which could keep tourists and new businesses from coming. Poor digital infrastructure slows down the economy and limits growth in some areas, making it harder to keep businesses and attract new residents, especially younger populations who seek stable digital connectivity for both work and leisure. Interviewees consistently pointed out that improved internet infrastructure, especially fiber optic networks, could significantly enhance regional appeal and economic resilience, encouraging local development and reducing outmigration pressures. (Appendix 2: Interview 2, Interview 5, Interview 6)

5.4 Expectations and Recommendations from Businesses

Businesses provided clear recommendations and expressed firm expectations regarding future improvements in network infrastructure. They emphasized the necessity for immediate, tangible steps toward improving network reliability, transparency from telecom providers regarding realistic service capabilities, and a stronger governmental role in supporting digital infrastructure expansion. (Appendix 2: Interview 1, Interview 3, Interview 6)

Many interviewees called specifically for the introduction of comprehensive national roaming solutions to ensure seamless connectivity across rural and remote regions, irrespective of individual operator coverage. Furthermore, respondents advocated for closer collaboration among telecom providers, policymakers, and local communities, emphasizing that tailored and cooperative approaches are essential to effectively address unique regional challenges. These qualitative findings thus illustrate a strong and unified call from rural businesses for decisive and inclusive actions to close the digital divide and enable equitable access to digital opportunities. (Appendix 2: Interview 1, Interview 4, Interview 5)

6 DISCUSSION

This chapter puts together and discusses this thesis research's findings which came from both the quantitative survey and qualitative interviews. The chosen mixed methods research approach is evaluated, and research results are compared to the gathered existing knowledge base. The results of this study give us important information about the problems and goals that rural businesses have when it comes to next-generation 6G networks. They do this by looking at both existing theories and adding to our understanding of digitalization, the digital divide, and digital inequality.

The results of both quantitative surveys and qualitative interviews are clearly combined to give a full picture of the connectivity problems that rural businesses face and what they mean. The research data came from 148 questionnaire answers and six interviews that were done as part of the Arctic 6G project. Also, one leader area representative took part by filling out a targeted email questionnaire. The quantitative results offer broad insights into patterns and general perceptions, while qualitative data contextualize these patterns, providing depth through lived experiences and specific examples. These two sets of data work together to give us a better understanding of digital inequality and the digital divide by answering the research questions from different points of view.

6.1 Reflection on Rural Business Needs and Connectivity

Consistent with earlier research by Salemink et al. (2017) and Morris et al. (2022), rural businesses in Lapland have a lot of trouble with bad internet connections, which shows a clear digital divide. This research's findings confirm that poor infrastructure, which is marked by unstable connections and poor coverage, is a major barrier to operational efficiency and growth. Businesses expressed frustrations that align with De Marco's (2021) definition of digital inequality, which says that just having access does not mean that everyone gets the same benefits or engages with technology in the same way.

The clear goal of rural businesses is to have internet access that is as good as that in cities, which is in line with other research that stresses the need to level the playing field for digital opportunities (Arion et al. 2024). Respondents consistently expressed that they need not only better basic connectivity but also reliable, high-capacity internet that would allow them to use advanced digital tools effectively, which is important for their competitive edge.

6.2 Implications of Enhanced Digitalization Through 6G

This thesis research shows that existing connectivity issues make it very hard to use advanced technologies like cloud services, the Internet of Things (IoT), and other technologies that need a strong internet connection. This is in line with observations from Partala et al. (2024). Businesses in rural areas express the hope for the rollout of 6G networks to significantly mitigate these constraints. New technology should enable greater adoption of digital technologies that enhance productivity, innovation, and access to new markets.

In practical terms, businesses highlighted that reliable high-speed connectivity would allow them to transition more effectively into digital business models, utilizing digital platforms to expand customer bases, improve efficiency, and enhance customer experiences. Such developments could fundamentally alter rural economic landscapes by reducing rural-to-urban migration pressures and fostering local economic resilience, aligning with findings by Tiwasing et al. (2022).

6.3 Strategic Steps for Stakeholders and Policymakers

The findings stress the importance of strategic intervention from both telecom providers and policymakers to effectively bridge the existing digital divide. Infrastructure investment is critically needed, specifically targeting rural connectivity improvements as a matter of priority. This aligns with previous research emphasizing the necessity of tailored, region-specific solutions rather than generic national strategies (Matalamäki & Joensuu-Salo, 2022).

Moreover, the significance of digital skills and capacity-building measures emerged clearly from the data. To translate connectivity improvements into tangible business benefits, educational initiatives and continuous professional development programs are essential. This reflects Zillian & Zillian's (2020) assertion that digital inequality can persist even amidst improved access if capabilities remain undeveloped.

An important finding was the value respondents placed on tailored, community-specific solutions. A clear recommendation from respondents was to involve local communities closely in the planning and execution of network expansions, suggesting that bottom-up approaches to connectivity infrastructure development could significantly enhance adoption and effectiveness. In addition, the data strongly support the argument for implementing comprehensive national roaming agreements, which could significantly enhance connectivity, reliability, and usability across sparsely populated areas.

6.4 Quantitative and Qualitative Findings

Table 1 presents a few examples of how the same topics and themes could be found in both quantitative and qualitative data. By explicitly integrating quantitative survey data with rich qualitative narratives, this research provides robust and multifaceted insights into rural connectivity challenges. This combined approach shows both general trends and specific lived realities, making it clear what digital inequality means in real life. The integration strengthens the reliability and applicability of recommendations offered to policymakers and telecom providers, emphasizing that addressing digital inequality effectively requires understanding both statistical patterns and nuanced local experiences.

Table 1. Quantitative and qualitative findings

Quantitative finding	Qualitative finding
92% expect reliable internet to improve competitiveness	Businesses emphasized the critical need for reliable internet, specifically mentioning improvements required for online bookings and digital customer service
78% experience regular disruptions	Interviews highlighted direct operational impacts, such as lost sales, increased workload, and safety concerns, providing concrete examples from tourism and agriculture.
66% prioritize better infrastructure investments	Businesses strongly recommended practical steps such as national roaming agreements and community-tailored infrastructure solutions to improve reliability and coverage.

7 CONCLUSIONS

This final chapter summarizes the most important insights from this thesis research and offers actionable recommendations for stakeholders. It reflects on how future 6G networks makes things more digital and how community-based solutions can help fix the problem of digital inequality in rural areas. This research looks at its limitations and makes suggestions for future research directions. It also puts the findings in the larger context of rural business digitalization, both in terms of their academic and practical value.

The research set out to understand how sparsely populated rural businesses perceive and can benefit from upcoming 6G networks, and the findings highlight a consistent thread: the digital divide between rural areas and cities remains a critical concern shaping all aspects of digitalization. Businesses aspire to fully utilize modern digital tools and services, but are often constrained by unstable, slow, or unavailable networks. Improved connectivity is seen as a foundation for business growth, innovation, and regional resilience.

7.1 Actionable Recommendations

Addressing the digital divide and fostering digitalization in rural areas require concerted actions from both telecommunications providers and local policymakers. The research findings underscore that without intervention, market dynamics alone tend to leave sparsely populated regions underserved. Therefore, stakeholders must collaborate to ensure that 6G networks (as well as existing technologies like 4G/5G and fiber) are rolled out in ways that prioritize rural needs. Based on the research findings and supporting literature, the following actionable steps are recommended: Invest in rural infrastructure, support policies and funding, enhance digital skills adoption, and tailor community-specific solutions.

Investing in rural infrastructure has a direct correlation to how areas' businesses view their ability to operate at the level customers are expecting. Telecom operators should prioritize expanding network infrastructure in rural and

Arctic areas, treating it as a strategic imperative rather than a low-return afterthought. Respondents in the Arctic 6G survey and interview pinpointed the lack of mobile masts and fiber optic lines as a recurring issue, calling for more infrastructure to improve reliability in sparsely populated areas. To meet 6G's promise of ubiquitous coverage, operators need to deploy additional base stations and backhaul links across remote villages and along rural transport routes. Exploring satellite or high-altitude platform integrations for 6G could further extend connectivity to the most isolated locations. Such investments are costly, therefore, public co-investment and subsidies may be necessary. Nonetheless, enhancing rural network infrastructure is foundational to bridging the digital divide: it directly addresses the connectivity gaps that currently leave rural businesses at a disadvantage.

Supportive policies and funding by local and national policymakers have a crucial role in creating an environment that encourages and facilitates rural connectivity improvements. Targeted policies and funding mechanisms should be implemented to incentivize telecommunication companies to serve sparsely populated regions. This could include subsidies, grants or tax incentives for building rural 6G cell sites in remote communities, as well as regulatory support to streamline permits for rural network construction. Prior researches emphasize that without such intervention, rural areas risk remaining perpetually behind in connectivity, perpetuating socio-economic inequalities. Policymakers should also make sure that 6G rollout includes coverage obligations or public-private partnership models so that next-gen networks do not just stay in cities. Governments can help level the playing field by actively directing resources to digital infrastructure in rural areas. Additionally, universal service programs may need to be updated for the 6G era to make sure that everyone has access to high-speed internet as a right, no matter where they live. In short, a pro-rural connectivity policy framework is needed to complement industry efforts and to guide development to areas that do not have enough of it.

Enhancing digital skills and their adoption addresses digital inequality that is caused by the uneven access and natural adoption of modern digital technologies. Closing the infrastructure gap alone will not be enough to close the

digital divide in rural areas. Parallel efforts in building digital skills and encouraging technology adoption are also required. Local governments, schools, and groups that help businesses should start programs to help rural workers and business owners become more tech-savvy and skilled. This could include training workshops on how to use new digital tools like cloud services, e-commerce platforms, and IoT apps, as well as giving small businesses resources or advice on how to create digital strategies. The concept of digital inequality highlights that even with internet access, disparities in skills and effective use can leave rural communities at a disadvantage. So, in addition to rolling out 6G, everyone involved needs to make sure that companies are ready to use advanced connectivity in a useful way. For instance, a small business in a rural area should be able to use 6G networks and have the knowledge and help to run an online marketing campaign or an AI-based analytics tool for their business. Initiatives like innovation hubs, mentorship programs, or collaborations with universities can help translate connectivity into tangible benefits. By improving digital competencies in tandem with access, rural businesses are better positioned to leverage 6G for growth. This helps close the gap in outcomes that defines digital inequality.

Both telecom providers and policymakers should adopt a bottom-up approach by **community-tailored solutions and engagement** with local communities and businesses in planning and delivering digital infrastructure. The needs in sparsely populated Lapland can be unique, as evidenced by respondents highlighting challenges such as extreme weather affecting equipment and industry-specific requirements (e.g., reindeer herding or forestry operations needing connectivity deep in the wilderness). Solutions must therefore be tailored to local conditions. Telecom providers should work closely with community representatives to identify priority coverage areas (such as important tourism sites, remote farms, or logistics routes) and consider deploying small-scale solutions like community Wi-Fi networks or micro-cell sites for hamlets that may not get immediate 6G coverage. Likewise, local governments can facilitate community networks or co-operative internet service models, where appropriate, to fill gaps that large operators might overlook. Engaging residents and businesses in this process helps ensure that the deployed technology actually meets on-the-ground

requirements and gains public support. It also builds digital trust: when rural users see networks being designed for their needs (for example, ensuring backup power for base stations during winter storms, or providing affordable data plans for small businesses), they are more likely to embrace new digital services. Collaboration at the community level thus can improve adoption rates and feedback, guiding further improvements. In essence, a people-centric rollout of 6G – where rural stakeholders have a voice, maximizes the network’s positive impact on business development and help sustain the momentum of digitalization in these regions.

7.2 Reflection on Research Questions

RQ1: What are the specific needs, expectations, and aspirations of businesses in sparsely populated rural areas regarding the implementation of next-generation (6G) data networks?

The findings demonstrate that rural businesses primarily seek stable, high-speed, and widely available connectivity, aspiring for equal digital opportunities compared to urban areas. Businesses emphasized the necessity of reliable internet as foundational to adopting digital services and expanding operational capabilities. They also expressed a strong aspiration to leverage emerging technologies such as IoT devices, cloud computing, and data-driven management systems, which are at the moment constrained by connectivity limitations. Furthermore, the respondents to the Arctic 6G survey highlighted that beyond technological aspects, reliable digital infrastructure is seen as essential for community vitality, business resilience, and attracting new talent.

RQ2: How can the implementation of advanced 6G information networks enhance the digitalization and development of businesses in rural areas?

Advanced 6G networks would mitigate existing connectivity limitations, facilitating the adoption of cloud technologies, IoT, and robust e-commerce platforms. This would enable rural businesses to innovate, improve operational efficiency, and access broader markets, contributing to regional economic resilience and growth.

Enhanced connectivity would also promote diversification of rural economies, empower entrepreneurship, and enable service-based businesses to operate remotely. With consistent high-speed internet, businesses could integrate into global supply chains, participate in digital marketplaces, and utilize real-time decision-making tools, thus positioning themselves competitively alongside their urban counterparts.

RQ3: What actionable steps should telecom providers and local policymakers take to support the digitalization of businesses in rural areas?

The research identified the need for targeted infrastructure investments, policy interventions to incentivize rural network deployment, digital literacy programs, and community-engaged planning processes to ensure that technological advancements translate into real-world benefits for rural businesses. Telecom providers must prioritize rural deployments with a long-term view, recognizing the strategic importance of regional development. Policymakers should create funding mechanisms, regulatory support structures, and digital readiness programs tailored for rural needs. Additionally, fostering collaboration between businesses, academic institutions, and technology providers can accelerate innovation and ensure that rural areas are not left behind in the digital transition.

7.3 Future Outlook

This research was limited to businesses in the Finnish Lapland region. Broader geographic comparisons and longitudinal data collection is necessary to validate and refine these findings across diverse rural contexts. Studies with more diverse respondent groups would further enrich the understanding on the research topics. For this research interview data was collected mainly from participants that faced challenges. This leaves open a possibility for sampling bias. Broader interviews with larger audience could be used to further verify the statements.

As 6G technologies mature, future research should look at how they actually affect rural business ecosystems. Comparative studies across different rural

settings would deepen understanding of best practices. New technologies such as satellite-based 6G connectivity and decentralized network models show a lot of promise for overcoming persistent infrastructural barriers. Longitudinal studies tracking the actual impacts of 6G implementation on rural digitalization over time would increase understanding and help make better recommendations. Better connectivity in rural areas would help balance out territorial development in all areas, reduce the pressure on people to move to cities, and help rural businesses to fully integrate into the digital economy. By addressing both the digital divide and digital inequality, 6G deployment can transform sparsely populated areas into hubs of innovation and economic activity.

In conclusion, the thesis results show that 6G technology has a lot of potential to help rural businesses, but getting the most out of it takes more than just making mobile networks technically better. It requires taking direct action to close the digital divide by improving infrastructure and making inclusive policy measures. Rural businesses have made their needs clear: they want fair access to the internet and the chances it brings. If stakeholders act on these insights by putting money into networks, making policies that help, and teaching people how to use technology, 6G can be a powerful tool for closing the digital divide. This would help sparsely populated areas not only catch up with bigger cities, but also open up new ways for innovation and growth. This would make sure that the digital revolution would bring all regions up to the same level. The conclusions drawn in this thesis reinforce the urgency of closing urban–rural digital gaps and provide a roadmap for achieving a more digitally inclusive future for rural economies.

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APPENDICES

Appendix 1. Arctic 6G – Survey’s filtered question list

Appendix 2. Arctic 6G -project’s interview summary

Appendix 3. Questionnaire sent to Leader areas

Appendix 1 1(3) Questions used from Arctic 6G – Survey

1. Consent to the processing of your data
2. Where do you live?
3. Where do you live? Open text answers
4. How important is internet connectivity in your daily life?
5. How would you rate the current internet connections in your residential area?
6. For which of the following internet services do you need a fast and reliable network connection for? Select one or more.
7. For which of the following internet services do you need a fast and reliable network connection for? Select one or more. Open text answers
8. Have you encountered challenges due to slow or unreliable internet connectivity
9. If you answered yes to the previous question, please describe how it has affected your daily life.
10. How important is it to you that internet connections and services work consistently both in urban areas and in rural areas?
11. Which of the following internet-dependent devices do you use during your leisure time? (Select all that apply)
12. Which of the following internet-dependent devices do you use during your leisure time? (Select all that apply) Open text answers
13. Which industries do you think would benefit from improved internet connectivity in Northern Finland? Choose the top three you consider most important. *
14. Which industries do you think would benefit from improved internet connectivity in Northern Finland? Choose the top three you consider most important. * Open text answers
15. What kind of internet connections do you have? (Select all that apply)
16. What kind of internet connections do you have? (Select all that apply) Open text answers
17. Have you noticed a difference in internet connectivity between populated areas and remote regions?
18. Have you ever been concerned due to poor internet connectivity? For example, a situation where internet access was necessary.

Appendix 1 2(3) Questions used from Arctic 6G – Survey

19. Please describe the specific internet connectivity issue in more detail.
20. How important are advanced internet connections that can improve your work or study opportunities in Northern Finland?
21. What is your current status? Select the response that best describes your current situation.
22. In which of the following sectors do your work?
23. In which of the following sectors do your work? Open text answers
24. Do you need an internet connection for your work?
25. How important are advanced internet connections that enable you to work where you live?
26. Which of the following internet-connected devices do you use for your work? (Select all that apply)
27. Which of the following internet-connected devices do you use for your work? (Select all that apply) Open text answers
28. Which of the following industries does your company represent?
29. Which of the following industries does your company represent? Open text answers
30. Does your company need an internet connection?
31. What internet-dependent devices does your company utilize? (Select all that apply)
32. What internet-dependent devices does your company utilize? (Select all that apply) Open text answers
33. Does your company need to upload, send, or receive large image files or videos in its operations?
34. Please describe the challenges your company faces when uploading, sending, or receiving large files here.
35. Rate your company's level of digitalization on a scale of 0-4. 0 = Not digitalized or not applicable 4 = Fully digitalized
36. Is it important for your company to be able to access CRM (Customer Relationship Management), ERP (Enterprise Resource Planning) systems, or internal databases remotely? For example, patient databases or similar.

Appendix 1 3(3) Questions used from Arctic 6G – Survey

37. Does your company use cloud-based implementations to carry out internal processes?
38. How does the company plan to further develop its digitalization in the near future?
39. What would be the benefits of faster/better internet connections for your business?
40. Do you spend your leisure time in sparsely populated areas, for example, at cottage or being in nature?
41. Do you have different internet needs or challenges in such areas compared to your home or workplace?
42. Please describe the internet needs or issues you have encountered in the previous question.
43. What local conditions do you find particularly challenging for the use of mobile applications? Select a maximum of two conditions that most hinder your usage.
44. What local conditions do you find particularly challenging for the use of mobile applications? Select a maximum of two conditions that most hinder your usage. Open text answers
45. If you wish, please tell us how you think the usability of the applications could be improved in these situations.
46. How do you hope for the internet connections to develop in the future in your area?
47. What kinds of applications/devices do you imagine being used in the future? Or do you have needs that are not fulfilled yet?

Appendix 2 1(2) Anonymised Arctic 6G interview summary, interviews conducted 11.-15.12.2023

Interview ID	Setting	Business Area / Professional Context	
Interview 1	Group interview (Educational institution: staff and students)	Education, general community stakeholders	
	Summary of Relevant Topics		
	Connectivity during peak usage, skepticism towards new technology (6G), digital inequality in educational context.		
	Weather affects connections. Connectivity has decreased as 3G has been dismantled.		
Interview ID	Setting	Business Area / Professional Context	
Interview 2	Group interview (Tourism entrepreneurs)	Tourism management and safety	
	Summary of Relevant Topics		
	Impact of network instability on business operations, digital exclusion, customer dissatisfaction, and safety concerns.		
	Severe mobile connectivity challenges, community-level digital exclusion, impact on remote working and daily life.		
	Mobile operators unwilling to help. Fiber optic might help on location, but not out in the nature.		
Interview ID	Setting	Business Area / Professional Context	
Interview 3	Individual interview (Tourism and accommodation entrepreneur)	Tourism, guesthouse operations	
	Summary of Relevant Topics		
	Severe connectivity problems affecting daily operations, skepticism towards telecom promises, digital exclusion issues.		
	Critical operational disruptions due to poor connectivity, severe safety risks due to unreliable networks, need for stable digital infrastructure.		
	Can't rely on digital services, need to have papers and backup procedures.		
Interview ID	Setting	Business Area / Professional Context	
Interview 4	Group interview (Reindeer herders)	Agriculture (reindeer husbandry), rural safety	
	Summary of Relevant Topics		
	Impact of connectivity on safety and operational effectiveness, problems related to network reliability, roaming issues, technological exclusion.		
	Need to have multiple operators or devices. Lots of areas without connectivity. Need to stop working and move to get connection.		

Appendix 3 1(2) Questionnaire sent to Leader areas

1. Could you describe the specific challenges business in the area face due to current internet connectivity?

(Follow-up: How do these challenges impact daily operations, customer experience, and business growth?)
2. Have connectivity issues ever led to lost business opportunities or revenue for businesses in your area? Can you share a specific example?
3. How does businesses in your area currently manage situations when connectivity fails or becomes unreliable?
4. Do you feel that rural location significantly disadvantages businesses in your area compared to those located in cities with better connectivity? Could you elaborate why or why not?
5. In your opinion, what are the biggest consequences of the digital divide between rural areas and larger cities?

(Follow-up: How does this divide affect local economic growth or community well-being?)
6. What would it mean for businesses in your area if the gap between rural and urban internet connectivity was effectively eliminated?
7. What are your specific expectations or hopes regarding future 6G technology? How do you envision it benefiting businesses in your area specifically?
8. Are there any advanced digital services or technologies (such as cloud computing, IoT, AI-based analytics, etc.) that businesses in your area liked to adopt but currently can't due to connectivity limitations?
9. Beyond basic improvements in speed and reliability, are there particular capabilities you hope 6G would offer to help businesses in your area to innovate or operate more competitively?
10. From your viewpoint, what actions should telecom providers and policymakers prioritize to support rural businesses' digitalization effectively?
11. If you could directly suggest improvements to policymakers or telecom providers regarding internet infrastructure, what would be your main recommendation?
12. How would you describe current capacity or skills of businesses in your area in utilizing digital tools for business purposes? Is there something specific businesses would need to fully benefit from improved connectivity?

Appendix 3 2(2) Questionnaire sent to Leader areas

13. Would additional training or resources related to digital skills and technology adoption help businesses in your area? If so, in what areas?
14. How important do you think improving internet connectivity is for retaining talent and supporting employment opportunities in your community or region?
15. Do you think better internet connectivity could influence the broader attractiveness of your area (for instance, in terms of tourism, attracting new businesses, or encouraging remote workers)? Could you elaborate on this?