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High-speed Broadband Internet Connection Enablers and Barriers in the Small State Context: The Case of Estonia

Master's thesis
Programme Technology Governance and Digital Solutions

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Tallinn 2023

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ABSTRACT

In 2016, the EU has declared, that to increase the European competitiveness and innovation, provide challenging earning opportunities for young people, prevent relocation of economic activity, and attract inward investments, the member states need to start developing high-speed broadband connection networks to every household. For these investments subsidiary funds were established and the aim was to make Europe the best continent with the high-speed broadband network coverage. According to these ambitions the Ministry of Economic Affairs and Communication in Estonia conducted consultations for the "Estonian Broadband Development plan 2030".

Compared to other European member states, Estonia is a small country territorially, and very small in terms of population. Estonian current policy, to build as many high-speed internet broadband NGA networks with as few financial means as possible has not been cost effective. Broadband NGA networks have just been built, without any mapping and deeper consultation with local municipalities or communities and the connected consumers rate is also very low.

This paper aims to explain the enablers and barriers of the high-speed broadband network development through a qualitative case study, semi-structured interviews, and document analysis.

Key words: broadband network, NGA, rural internet, community resilience.

List of Abbreviations

GDP – Gross Domestic Product

OECD – The Organisation for Economic Co-operation and Development

UK – United Kingdom

ICT – Information and Communication Technology

MEAC - Ministry of Economic Affairs and Communication in Estonia

EU – European Union

EC – European Commission

NGA – Next Generation Access

DAE – Digital Agenda for Europe

ISP – Internet Service Provider

CDD – Community-Driven Development

TEP – The Techno-Economic Paradigm

ELA SA – Eesti Lairiba Arenduse Sihtasutus / Estonian Broadband Development Foundation

ITA – Estonian Info Technology and Telecommunication Association

RRF – Recovery and Resilience Fund

ERDF – European Regional Development Fund

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"*The growth of the Internet will slow drastically, as the flaw in 'Metcalfe's law'–which states that the number of potential connections in a network is proportional to the square of the number of participants–becomes apparent: most people have nothing to say to each other! By 2005 or so, it will become clear that the Internet's impact on the economy has been no greater than the fax machines*."

Paul Krugman, 1998[1]
American Economist,
winner of the Nobel Memorial Prize in Economic Science

[1] Paul Krugman, in his article "Why Most Economists' Predictions Are Wrong" <i>The Red Herring<i/>, June 1998

INTRODUCTION

The years from 2020 spring until today have been a heavy challenge for all the world. People, governments, businesses and even nature, were put instantly into a situation that was so surreal. People were forced to stay at home due to pandemic, factories and businesses shut down, governments put into a war situation.

First there was panic: what now, how will we continue? Pretty soon came the understanding, that everything cannot be shut down, because there were vital services that needed to be run – people needed things that are produced, like food, electricity, heat. But people also needed services like banks, governmental services, schools, and news. One possibility to provide all sorts of services and protect the service providers there is to work remotely, to work outside the office. This declared already a new need, a need for a good quality internet connection. It all was reachable in cities and towns, but people had possibilities to move out from cities, because they had summer homes or houses, they could use, instead of staying in the city apartment surrounded by concrete walls.

This all brings us closer to the problem, that has been a topic in Estonia for a quite a long time – a very poor internet connectivity at Estonian periphery areas. Internet connection is good in cities and bigger boroughs, but not in small villages or sparsely populated areas. In those areas internet often is provided through air, which has a poor capacity for providing qualitative connection and access. There were already users, who had in trouble using the internet connection during their daily life. Then suddenly all the children were forced to have distance learning through internet, by having online classes and some of their parents also started working from home, but the capacity with those users was full and was not able to accommodate any more users.

“In January 2016, the European Parliament underlined the role of private investment in Internet connectivity networks for digital progress and the role of a stable regulatory framework in enabling all players to invest in all areas, including rural and remote ones. Likewise, the European Council called in June 2016 for very high capacity fixed and wireless broadband connectivity across Europe, as a precondition for future competitiveness, and for telecoms regulatory reform to

incentivise major network investments while promoting effective competition and consumer rights" (European Comission, 2016, p. 2).

All this is moving us towards the governmental plan of Estonia, to bring high-speed and ultra-fast internet connection into every household in Estonia, no matter where this household is situated and concentrating highly on periphery areas. The project was already launched by the Ministry of Economic Affairs and Communication of Estonia (MEAC) in 2016 but has still no result. Already in 2016, the MEAC acknowledged that internet connection has become an elementary need for keeping up the services related with internet usage and they also saw that the telecommunication enterprises are more willing to develop their infrastructures in densely populated areas than in sparsely populated areas and therefore a *digital cap* between different areas was more expanded and showed no sign of decrease (Majandus ja Kommunikatsiooni Ministeerium (1), 2016). And the situation has not changed during the 6 years in between, the project started in 2016, failed and instead of success, brought unnecessary costs and unfulfilled expectations to local municipalities and people.

Also looking from the demographic perspective, currently by Statistics Estonia on 31. December 2021, we had 1 331 824 people living in the country, from whom 614 567 lived in Tallinn and in its surrounding areas, so approx. 46% of the whole population is concentrated in and around Tallinn within 50 km circle (Eesti Statistikaamet(1), 2022). Approx. 30% of the population is declared as living in rural areas (ibid.), one could argue that there are benefits, which make people to leave the periphery areas, such things might be like better job with better salary, better infrastructure, better education system, and better living conditions, that might include the better access to high-speed internet connectivity. Coming back to statistics: in 2021 there were over 523 000 households (which makes approx. 92% of all households) in Estonia who have internet connection, from whom over 150 000 are in rural areas, from those 523 000 (almost 91%) have broadband internet and approx. 29% of those households are in rural areas (Eesti Statistikaamet, 2022).

Another important statistical figure in this topic is density. Available statistics from 2019 say that Estonian density, inhabitants per square kilometre is 30,5, which positions Estonia on to the 6. position before Latvia, Sweden, Finland, Norway, and Iceland (Eurostat, 2022). But must be acknowledged, that all the following countries have larger territorial surfaces that Estonia, and 4 of the following countries are 2,5 times or even more larger than Estonia, and their territory is

mostly located in arctic regions, which mostly is unsuitable for living and also explains the low average of density. European average density is 109,0 inhabitants per square kilometre, which is 3,5 times bigger than in Estonia (ibid.).

For today the Ministry of Economic Affairs and Communication in Estonia is conducting consultations for a new plan called “Broadband Development Plan for 2030”. In this paper documents, and conclusions through interviews, about this consultation is investigated and introduced more detailed in further chapters.

In this paper, the author would like to get answers to the following research question:

- What kind of enablers and barriers are impacting the development of broadband networks in “small states” like Estonia?

In order to answer the question, the author has structured the paper as follows: the first part of the work provides the overview of history and background for explaining the tenors that the technology and processes of high-speed broadband development has been shaped, together with chosen theories to characterize the first research question. The second part of the work is giving overview of the chosen metodology and description of the current situation with Estonian high-speed broadband development plans and the correlation with the global trends and theory pointed out in the first chapter.

For the empirical section, to obtain data, document analyzes and semi-structured interviews were conducted with market participants, representatives of rural communities and local municipalities, also public sector policy makers. In the process of choosing the interviewees principles were adapted that all counterparties, who are related with the high-speed broadband development were present, and the perspectives and results of the questioning were not one-sided. Questions were compiled so that all interviewees had the equal eventuality to impart their aspects and that there will be no biased favors towards any party.

1. THEORETHICAL OVERVIEW

1.1 Historical background

Only 30 years ago the common way of internet connection was dial-up access. 26th March 1990 was the day, when Estonia was adapted into permanent internet connection with the rest of the world (Laanpere, et al., 2022). From the late 1990s started the competition to invest into development of broadband networks (Gerli', Van der Wee, Verbrugge, & Whalley, 2018). Local and central governments started to subsidize these developments and this approach considerably increased the private sector interest into broadband development (ibid.). During the liberalization of electronic communications markets in EU the late 1990s, the European Commission issued several directives to activate the market and to eliminate the possibility for the state-owned operators to keep the monopoly position in market, because they owned the infrastructure (Briglauer, Gugler, & Haxhimusa, 2016). With directives other operators were also enabled to use the loops and this opportunity increased price competition with positive effect (ibid.). One could argue that without this kind of approach the price of ICT services would have been rather high for the end users and the development would not have been so rapid.

On the other hand, former telecommunications monopolists argue that regulations are decreasing innovation and investment stimulus, also other monopolistic bottlenecks may emerge (Briglauer, Gugler, & Bohlin, 2013). Investing into new infrastructure under regulations, is creating uncertainty and high risks which are influencing the investment decisions overall (ibid.). That's why the role of national and local governments subsidizing politics is very important for minimizing the deployment cost and increasing the willingness to invest (ibid.). There are two approaches from regulators to achieve the socially efficient investment level for the NGA networks (Tselekounis & Varoutas, 2013). First is that the regulator sets a particular investment-contingent access price, for the investment risk compensation, and second is that regulator is setting the marginal cost of access for the access price, after the investments are in place, for maximizing the social welfare (ibid.). Still the old and new systems are working in parallel and competing for the

customers, so the regulations must be made in a way, that they assess the investment and competition results (ibid.).

1.2 EU regulations for market empowering

EU has declared that the "broadband connectivity is of strategic importance for European growth and innovation in all sectors of the economy and for social and for territorial cohesion"/ … /" The achievement of Europe 2020 objective of a smart, sustainable, and inclusive growth depend also on the provision of widespread and affordable access to high-speed Internet infrastructure and services. Meeting the challenge of financing a good-quality and affordable broadband infrastructure is a crucial factor for Europe to increase its competitiveness and innovation, provide job opportunities for young people, prevent relocation of economic activity, and attract inward investments" (European Comission, 2013, p C 25/1). Technology has gradually improved over time and together with broadband networks the digitalization of different sectors and more efficient information exchange, and processing has increased GDP in OECD countries by 4,34% in the period of 2002 – 2016, the UK has even declared that the network access is a legal right for every citizen (Koutroumpis, 2019)

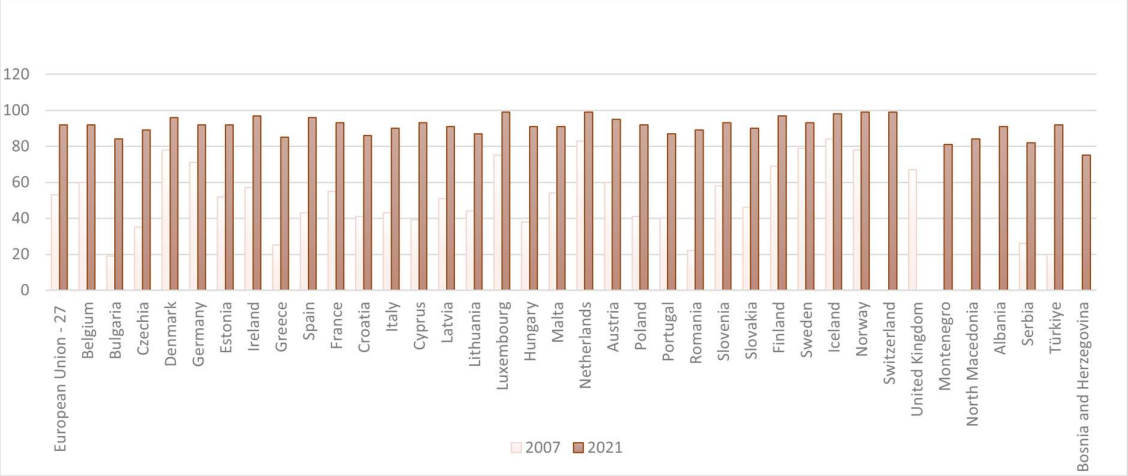

Figure 1. Percentage of EU households who have internet access at home by all means. Comparison of 2007 and 2021. The population considered is aged 16 to 74. Source: (Eurostat, 2022)

According to 2021 Eurostat statistics 80% of the EU population aged between 16-74 uses internet daily bases, and 8% declared that they have never used internet at all (Eurostat, 2022). As shown in *Figure 1*. in 2007 there were 53% of the EU households, who had access to internet and to 2021 this percentage has risen to 92%, there is included all kind of access, not only broadband (ibid.).

This graphic determines that the growth is relatively high and during the years of development the inequality between EU countries as decreased intensively.

1.2.1 Ways of developing the municipal or subsidized networks

The EU has released several directives in accordance to develop the retail markets and enable the service-based competition. Gerli' et al. (2018) in their paper have concluded the wide range of different directives and recommendations. With Directive 2002/21/EC the incumbents, with significant market power, had to enable new entrants to access the network local loops (Gerli', Van der Wee, Verbrugge, & Whalley, 2018). With recommendation 2010/572/EU and Directive 2013/466EU extended access obligations to any operator in control of NGA bottlenecks and all users were provided the same process and conditions (ibid.). With next Directive 2014/61/EU the major improvement was done in order of sharing and coordinating the existing infrastructures and the cooperation between the telecommunications companies and utility providers to reuse existing infrastructures for NGA (ibid.). With the Digital Agenda for Europe (DAE), dated on 2010 lot of targets were set for the member states by 2020, and they also included that there should be universal access to broadband and superfast broadband and in order not to harm the private investments and distort competition, the guidelines for state aid were adopted and they regulated that the public fonds could only be used in areas, where none or just one NGA network is expected to be within three years (ibid.). Subsidized networks had to be accessible to all market members, and the main aim was to make the developments with minimum costs (ibid.). One of the most expensive parts of the development is the engineering of the passive infrastructure like ducts, trenches, and poles, but there were utility providers who had already established a huge network of these kind of infrastructure and some of them have also developed a long-distance fibre network for their internal use and some of them even had already entered the broadband market (ibid.). The EU regulations have obliged municipal providers to play under the same terms as the private companies and most of the projects have adopted the open-access model buy offering their passive infrastructure to multiple internet service providers (ibid.)

The EC sees that the regulations are the beneficial and effective approach for NGA investments because the expected profits should lower the net present value for the investment projects, that the service-based operators have a risk-free access without having the same regulative obligations that the already operating companies have and the wholesale of the infrastructure should cover the financial investment (Briglauer & Gugler, 2013). But the operators see it differently, as still there

is a high risk of low demand on the wholesale level, which might not compensate the financial losses from development for the infrastructure operators (ibid.).

In *Figure 3*. we can see the suggestions of M. Van der Wee, that how the broadband markets are influenced by market, policy, and technology. The market regulates the demand and competition where the policy is dealing with the regulatory measures and forms of public interventions (Gerli', Van der Wee, Verbrugge, & Whalley, 2018). One could argue that this is the biggest influential part of this framework, through the public ownership and support (ibid.). If the utilities are at least partially owned by the public entities, then also regulations and other policy drivers are more actively covered (ibid.). Both dimensions are again supported by the technology through innovations in deployment techniques and transmission standards (ibid.).

Governments need to plan very cautiously their socially desirable targets, because with the high potential for governmental failure or planning uncertainty gives the proofs to market side, that these kinds of developments are more efficient with market-driven approach, through the technological neutrality in supply and NGA service need in demand side (Briglauer & Gugler, 2013).

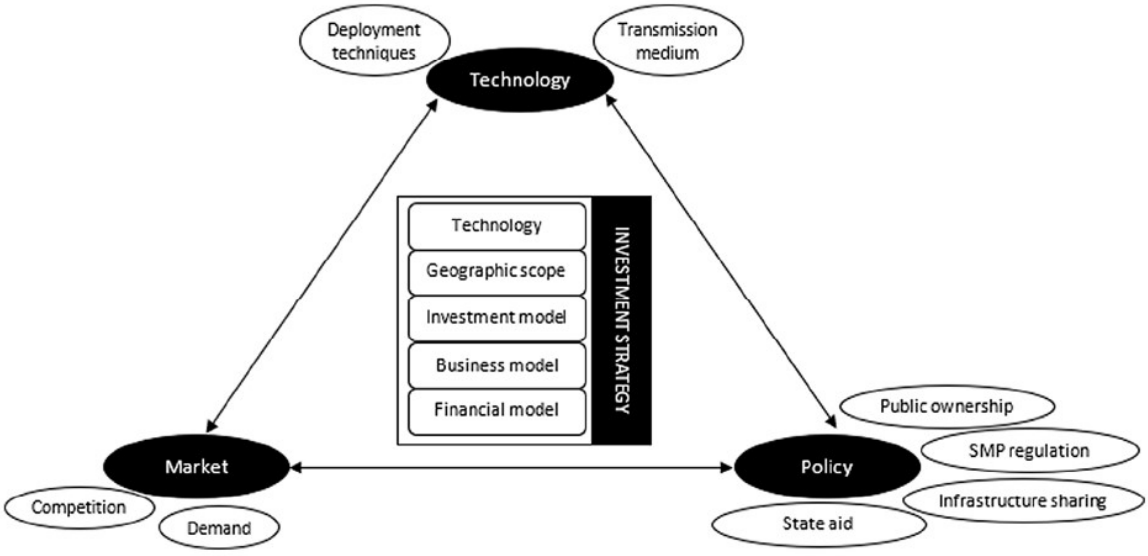

Figure 2. The Market-Policy-Technology framework. Source: (Gerli', Van der Wee, Verbrugge, & Whalley, 2018)

1.2.2 Community Networks

EU countries are practicing four different models of investment into connectivity:

- Publicly run municipal network - the network is built by municipality or country, and they also own the networks, all market participants can lease the network.
- Private municipal networks – government procures the building. Private operators can use it through concessions.
- Operator subsidies – government is subsidizing the private operators, buy funding the gaps that could leave some of the operators out.
- Community networks – local communities build their own access networks. Governments can support by co-financing or other kind of help.

(Echikson & Zarra, 2018)

Community Networks are filling caps in ends, where the profit margin, even with all subsidiaries for commercial developments, is not covering the costs (Echikson & Zarra, 2018). In the same paper Echikson & Zarra are referring, that the EC is not favoring any models, but is admitting, that the long-term investment model, together with community networks, is one of the best solutions for improving the service (ibid.).

During the 1970s and 1980s, a major change took place in the world economy, the so-called economic neoliberalism (Simpson, 2010). It was based on a deep belief that competitive efficiency works through market forces (ibid.). It was found that efficiently functioning markets ensure long-term benefits through better quality of goods or services, and faster and more dynamic development of technology (ibid.). But this neoliberal approach has neglected the rural broadband infrastructure development because it is not commercially profitable and viable (Sutherland, 2016). As the telecommunication companies are concentrating only in the areas, that are profitable, the rural area communities have started to raise out because they need to keep their social resilience, by keeping community growth and transformation through developing capacities at the individual and community scale, as they are focusing on digital support or stimulating demand within the community (Ashmore, Farrington, & Skerratt, 2017). Also running the whole infrastructure development process by mapping, identifying the funding possibilities, and all the way down even to run the service as a community Internet Service Provider (ISP) (ibid.).

1.2.2.1 Example of success: Optic fibre to all houses on Gotland, Sweden

Gotland is an island in Sweden and the largest island of the Baltic Sea. It is mainly rural, with 60% of the population living in the countryside in farmhouses that are spread out over large areas (Stahl, 2022). Gotland is a kind of community, that has come to and understanding that in order to foster economic growth and competitiveness it is not enough to only focus on developing products and services, but the focus needs to be shifted from economic goals to the improvement of society in general and for increasing the individual's life quality and sustainability (Hossain & Sjöström, 2021). 2010 the local community institution and municipality conducted a broadband strategy that declared, that with a limited budget, with local community engagement, collaboration, and political consensus they are developing operator neutral fiber broadband connection to every household (Stahl, 2022). The biggest populated place Visby was not included in the strategy, because it was expected to be relying on market, also many of the households are holiday homes, but they needed to be included for financing balance (ibid.). Target was set that for 2020 there should be at least 90% of the permanent households covered with fiber internet connection (ibid.). Community was included with labor and giving permission to use land, so that every household contributed with approx. 3 days of manual labor and doesn't ask rent for the land used (ibid.). Estimated production cost for one house was 2000 -2500,00 €/per house and finally, every house paid directly about 1800,00 € and the private investments to this project were 37,1 million € (inside here is counted that the 3 days manual labor for every household, valued as 75 €/per day), market actors put 12,6 million € and the Municipality of Gotland 2,3 million € and last the EU funding was 2,0 million € (ibid.). In the result there is more cooperation between different parishes, plus fast over 4 Gbps internet, there are more developed e-services and digitally supported entrepreneurship (ibid.). Also, in some parishes the community organizations are contributing as ISP-s, because still there was no interests from the telecommunication enterprises to become an ISP (ibid.).

One could argue that what happened in Gotland was a Community-Driven Development (CDD). Definition says that: "CDD gives control of decisions and resources to community groups" /… / "CDD is a way to provide social and infrastructure services, organize economic activity and resource management, empower poor people, improve governance, and enhance security of the poorest" (Dongier, et al., 2003, p. 303).

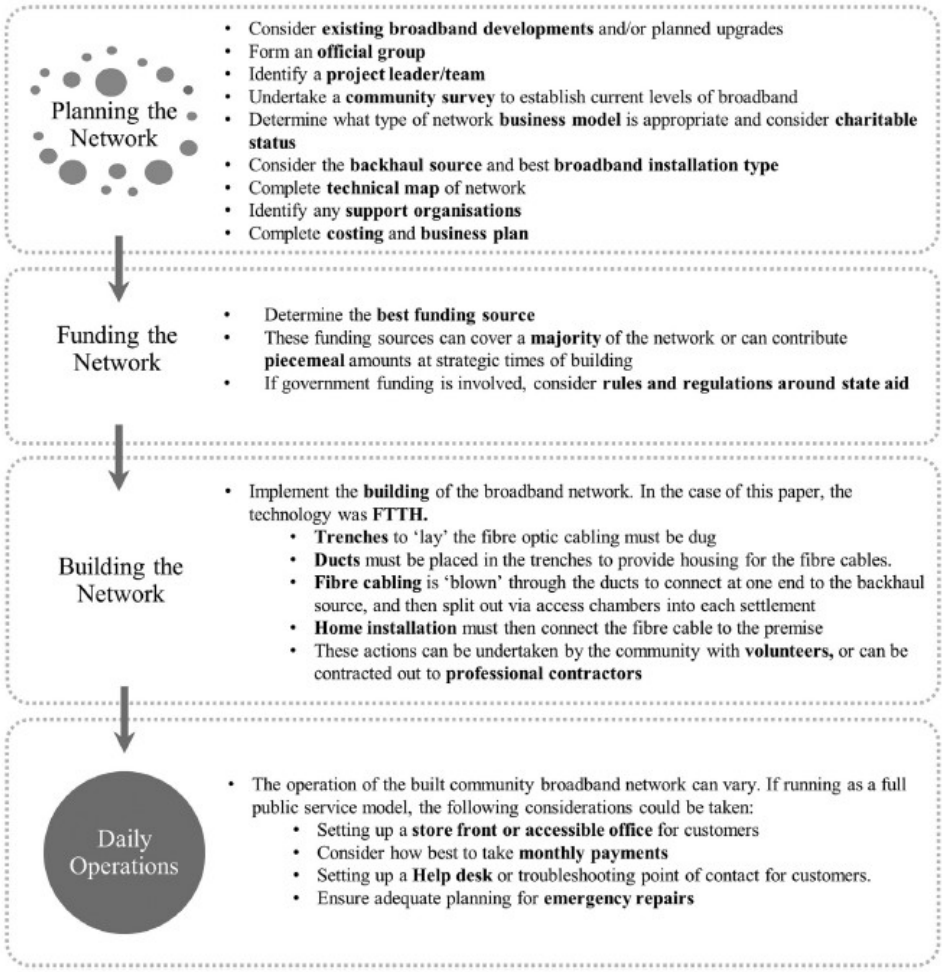

Figure 3. Processes for Community-led Broadband. Source: (Ashmore, Farrington, & Skerratt, 2017)

In order the CDD to succeed is to be part of the broader development strategy, for improving quality of the public services delivery by governmental reforms, investments in productivity and integration (Wong & Guggenheim, 2018). "Community-led broadband has further strengthened concepts of local identity, and developed new spatial understandings of community identity, which can enhance a sense of community and shared culture." (Ashmore, Farrington, & Skerratt, 2017, p 423). Every community may take a different path in their development route, although Ashmore et al. 2017 have composed outline guide for the community-led broadband development process *Figure 3*.

1.3 Theories relevant for the high-speed broadband development

The need of development of high-speed broadband connections is a part of technological evolution. Over time technology has evolved so highly and fast, that in some steps it is hard for the society to keep up with the pace. In these situations, society needs a push or exampling from the political and administrative side.

This subsection gives overview of theories that are chosen to describe the relevance of the drivers and barriers of the high-speed broadband developments, according to analyse in further chapters the empirical findings of the research performed for this paper. First theory chosen is The Techno-Economic Paradigm (TEP) which characterizes the evolution and maturity of the technology, also explains the necessity to expand all technological achievements into social level and why it is crucial, that the advantages brought by TEP is distributed all over the society and used for every individual wellbeing.

Second theory chosen is Community Resilience which characterizes the community's ability to adapt to changes through mitigating local people, creation of organizational linkages. How in some context the survival of the community is on community own hands and keeping the pace with economical environmental developments can only be led by communities?

Last section of theory is describing the concept of "small states", for explaining situations Estonia, as a small state, needs to function in.

1.3.1 The Techno-Economic Paradigm (TEP)

"A *technological revolution* can be defined as a powerful and highly visible cluster of new and dynamic technologies, products and industries, capable of bringing about an upheaval in the whole fabric of the economy and of propelling a long-term upsurge of development."/… /"Each technological revolution, then, is an explosion of new products, industries and infrastructures that gradually gives rise to a new TEP, which guides entrepreneurs, managers, innovators, investors and consumers, both in their individual decisions and in their interactions, for the whole period of propagation of that set of technologies" (Perez, 2003, p. 8). *Figure 4*. visualizes this definition.

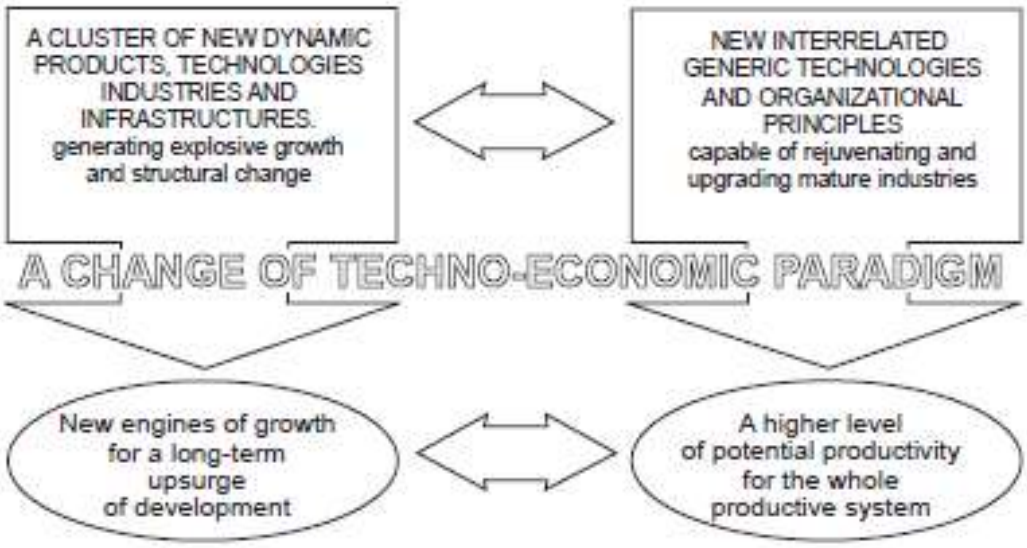

Figure 4. The double nature of technological revolutions. Source: (Perez, 2003)

When the new technological revolution is recognized and considered successful, the development is not cumulative, instead it is a step process that is taking huge leaps or surges, which can last decades, by changing the economy and society at large (ibid.). Process evolves from the small start-ups and ends with diffusion from core countries into peripheries, within the core countries and outside (ibid.). Paradigm shift opens huge possibilities to preserve and increase the gains of development, and there is also a great possibility to fall behind (ibid.). The key role also is on financial capital, which enables the shifts to take in place through investments (ibid.).

According to Perez (2003) and visualisation on *Figure 5* the TEP is divided into two periods 1) *installation period* and 2) *deployment period*. Installation period is consisting of the a) irruption phase which inaugurates the surge, because the old TEP has matured, and the investment money is looking the opportunity to prevent the stagnation of economy and is characterized through divergence between the old and new (ibid.). Second phase, b) the frenzy phase, is the period where the financial bubble occurs, paper economy decouples from the real economy, very small portion of the top is rich and getting richer, regions within countries and globally differ a lot, some flourish, other wane, provoking massive migration from poor areas to the richer areas (ibid.). During the period the process of productivity explosion reaches more, buy new infrastructure and possibility to promise more (ibid.).

Deployment period consist also two phases c) synergy phase when the basic infrastructure for the revolution should be installed and usable and the dynamic expansion can began through the measures of social protection of the weak with income redistributions and technology is seen as a positive force and the future looks bright for all (ibid.).

Last phase d) maturity is concluding the shift of the paradigm when there are not many newcomers in the market or new profitable investments left and the new technologies are starting to arise behind the current (ibid.).

The two periods are although combined with *turning point* (ibid.). In this period should take place the balancing of the two periods where the economy shifts from the frenzy mode into synergy mode, by social rethinking and reconsidering, and this is crucial point when decisions must be made to increase social cohesiveness and improving general wellbeing or to stay stuck in frenzy phases extreme individualism (ibid.).

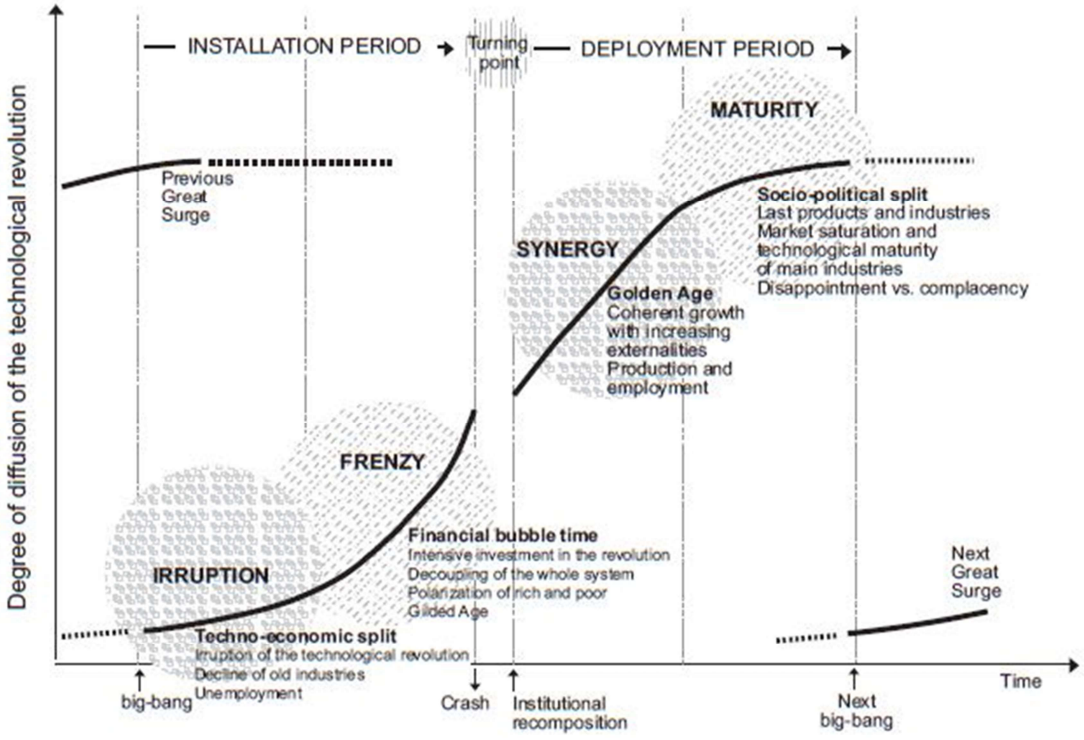

Figure 5. Four Phases of Techno-Economic Paradigm. Source: (Perez, 2003)

1.3.2 Community Resilience (CR)

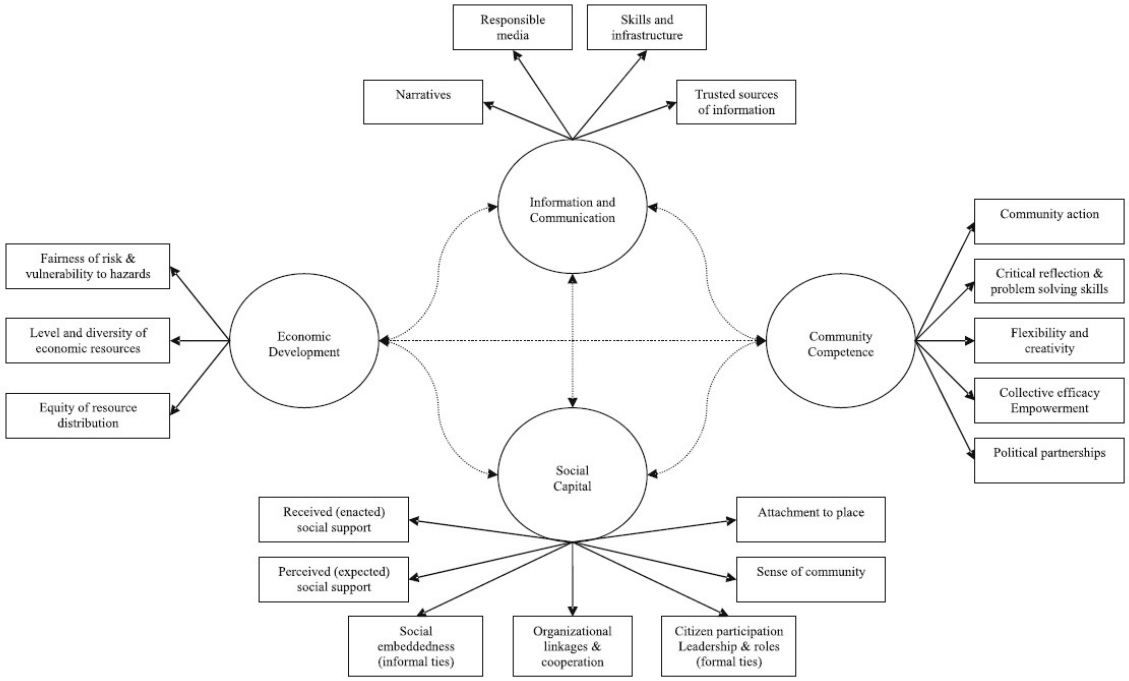

Figure 6 . Community resilience as a set of networked adaptive capacities Source: (Norris, Stevens, Pfefferbaum, Wyche, & Pfefferbaum, 2008)

Resilience has a big variety of definitions, which are highly dependent on academic discipline, authorship, and audience (Ashmore, Farrington, & Skerratt, 2017), but most of them successfully in adaption to stress or other opposition and with exceptions, still distinguish resilience from "resistance" (Norris et al., 2008). In the same paper Norris et al. have composed a table of representative definitions of resilience, composed by different authors through the years, and in relevance with CR and with this paper, author would like to choose following definition: „The ability of community members to take meaningful, deliberate, collective action te remedy the impact of a problem, including the ability to interpret the environment, intervene, and move on."(ibid. p.129).

In their research Glass et al. (2022) argue that despite CR being a well-researched topic, it is still unclear, why some communities are more resilient than others (Glass, et al., 2022). One of the possibilities is that some communities have more capacity to deal with shocks "bounce backs" or have more *potential* capacity factors, or all the discussions around the CR is about the community capability to respond to the "emergencies", but instead "… a resilient community must have the

capacity to take advantage of opportunities and to “create the change proactively”” (Glass, et al., 2022 p.684). Norris et al.(2008) have composed a network of resources that compile a set of capacities community needs for being resilience (*Figure 6*).

Community is a complex system that includes many different stakeholders’ groups or individuals (Wilson, 2012). These actors are bounded with networks of power which can emerge variances between different groups within the community and the community resilience can be hollowed (ibid.).

1.3.3 Small State

There is no agreed clear definition to describe what a small state is (Muižniece, 2021; Baldacchino & Wivel, 2020). Muižniece in her thesis has presented Baldacchinos & Wivels synthesised definition that is saying that small state is a country with limited capacity of political, economic and administrative systems, sametime being a weaker part of the asymmetric relations, that they cannot change (Muižniece, 2021). Small countries are highly influenced by external factors, especially like decisions made in global markets, which strongly influence the development and sustainability of the industry in small countries: on the one hand, increasing productivity, but at the same time, taking a large number of people and knowledge out of the country, which can again have an inhibiting effect on productivity (ibid.).

The vulnerability of small states mainly revolves around their limited administrative resources, weak bargaining power and the fact that the institutional arrangements are biased in favor of more powerful states. the key to their credibility lies in belonging to an institutional alliance that makes them a reliable and compliant partner (Thorhallsson, 2018). In Estonian case the alliance is EU, which one, of the four priorities is to develope a strong and vibrant economic base (EU, 2023). Being a member of EU, Estonia has strenghtened its policy landscape and put innovation and competitiveness in the centre of the policy agenda, but so far it seems that the biggest challenge is strengthening the innovation capacity and improving the competitiveness of companies (Cepilovs, 2016).

One of the biggest challenges for small countries is also the development of administrative capacity, in which political, economic and administrative reforms play a big role, through its weakening, and leading to decentralization and decrease in cooperation between sectors (Muižniece, 2021). Nevertheless, small countries have to deal with the same functions as large

countries, which can lead to multifunctionalism, which, while creating a better understanding of processes and politics, prevents sufficient specialization and depth of knowledge, affecting both governance and education (ibid.). Small countries need to take advantage of foreign knowledge and technology, with local integration, to diversify their domestic economies and make themselves less dependent on international trade (ibid.). However, excessive focus on local needs can lead to isolation from the international community, so there is a need to balance local development needs with global value creation (ibid.). Bottom-up logic should be used in the private sector and innovation policy, which, however, requires administrative stability (ibid.). The government has a very important role in the implementation of cooperation between transnational innovation systems, which, however, requires being able to implement solutions and understanding the necessity of changes within the system (ibid.).

2. EMPIRICAL ANALYSIS

In this chapter the answers for the research question are sought:

- What kind of enablers and barriers are impacting the development of broadband networks in "small state" like Estonia?

For answering the question first, the methodology of the analyses is presented and following with the current situation description of Estonian high-speed broadband developments plans with analysis current development plans, with connection of theoretical overview. The information gathered through interviews is presented together with document analysis, that are related with the high-speed broadband development in Estonia.

2.1 Methodology

This thesis is composed as a qualitative case study. The aim of qualitative methods is through observing, interviewing, and analysing documents, to find out what the involved people know, think, and feel about the topic (Patton, 2015). Also, from the specific relevance of the social relations the qualitative study is most adequate (Flick, 2023). Research is important for studying social relationships and for getting answers for different social problems, by giving tools to do something better or in a more efficient manner (Kothari, 2004). Comparing with large-scale studies, the qualitative case studies are more focused and to compile further actions, they give more in-depth input (Johnson, 2010).

For juxta positioning the findings, about the enablers and barriers of the high-speed broad development, from the theoretical overview and with the Estonian high-speed development plan the qualitative methods have been used:

- Semi-structured interviews – a hybrid method where the structured questions are asked with the possibilities to move from the fully open-ended questions to more theoretically driven within the progress of the interview (Galletta, 2001).
- Document analyses – revise of electronical and paper documents, available for the topic.

To collect the information related to the topic, interviews with four different counterparties were held. The selection of interviewees was based on principle, that all possible angles of the high-speed broadband development in Estonia is covered and the plurality of the opinions is ensured. During the talk and interaction of the interviewer and respondent, the perspectives relevant to the qualitative interview and the social positions emerge, including the grounded roles and hierarchies of their society (Warren, 2001). The purpose sampling was used to approach the relevant candidates for the interviews. Many contacts were received from the seminar held by the MEAC in September 2022, also web research for finding the relevant organisations and "snowballing" during the interviews. Among the interviewees are representers from the policy maker side, local municipality and community side and market participants side, who stand for the development of the high-speed broadband in Estonian rural areas, so that the development takes place in near future, that the development is cost effective and sustainable. Unfortunately, from 11 sent out requests for interview, only four agreed to answer and discuss. For the transcription of interviews the freeware solution called tekstiks.ee was used (Olev & Alumäe, 2022). Descriptions of interviewees can be found from Appendix 2. The interviewees answers as empirical findings or in-text citings are marked as numbers in brackets in format: for ex. single citation [1], multiple [1;2;3…]. Notes from the seminar held by the MEAC in Estonia on 09. September 2022 is referenced with number 5.

Questions are composed so, that all counterparties have equal possibilities for expressing their understandings and knowledge without favouring any counterparty. Also, flexibility of the interview has been kept in mind, by using interview guide instead of fixed questions, so that the interviewees can lead the interaction in unanticipated directions (King, Horrocks, & Brooks, 2019). The interview guide was composed in compliance with the review of theories related with the rural area broadband development and for understanding that how high-speed internet broadband development plans, in rural areas are already applying in practice, and what are the enablers and barriers of high-speed internet broadband connection development, also keeping in mind the scale-related factors that are influenced by this development (see Appendix 1).

Also notes from the seminar held by the MEAC in Estonia in September 2022, is used in the analyses for giving the wider "picture" of the discussions held around the topic.

Theses explore the assumed future impact and author realizes that the findings cannot be definitive under no circumstances and cannot be transferable for other countries because of their differences in economical level, level of development and density.

2.2 Development path of the high-speed internet connection broadband in Estonia

On 11. August 2009, under the leadership of the MEAC in Estonia, was established non-profit organisation called Estonian Broadband Development Foundation – Eesti Lairiba Arendamise Sihtasutus (ELA SA) (ELA SA, 2022). This foundation was established by the Estonian leading telecommunication enterprises, who were also the members of Estonian Info Technology and Telecommunication Association (ITA), with the supervision of the MEAC (ibid.). The aim of this foundation was to implement project called EstWin, which was generated from ITA vision document[2], which is approved also by the government and establishing that by the year 2018, all Estonian households and companies should have the NGA broadband connections, based on fibre optic cables, and have access to a broadband connection with data speed of 100Mbit/s, especially in rural areas (ibid.). As a result, 98% households, businesses and institutions cannot be farther from the grid, than 1,5 km (ibid.). Plan was to build approx. 6600 km of the broadband base network (ibid.). During the years 2009-2014, the country has invested in the development of the broadband base network approx. 28 million euros of EU subsidies and planned to invest another 41 million euros in subsidies during the period of 2015-2020 (Riigikontroll, 2015).

The visualisation of the current situation of the Estwin broadband base network coverage over the Estonia can be seen on the *Figure 7*. The blue lines reveal where the broadband base network already has established. The broadband base network does not bring fibre optical communication cable to the household's door, it only brings the broadband connection closer (ELA SA, 2022). It is more meant for the telecommunication providers to offer their services and several different operators at the same time, in one area (ibid.) Overall, there were established almost 7000 km of

[2] "Eesti lairiba arendusvisioon" April 2009

broadband base network by the end of 2020 with the cost of 80,6 million euros (Konkurentsiamet, 2022).

Figure 7. The current situation of the broadband base network coverage established by EstWin in December 2022. Source: (ELA SA, 2022)[3]

The Estonian National Audit Office in its report was very resolute, that all the plans made by the government did not bring any benefit and the opportunities of households and institutions to use high-speed internet via broadband connections was not improved significantly by the year 2015, they even stated "*Mobile internet providers and users have so far benefited the most from the establishment of the base broadband network development*." (Riigikontroll, 2015). Also mentioned that this development gave the telecommunication companies possibility to start offering 4G internet solutions, but the quality of the network stability and volume limits are far from equal of high-speed broadband connection and the prices are much higher that the broadband connection fees (ibid.). Mobile networks can, to some extent, replace internet service provided through the high-speed broadband connection, but the broadband communication networks are

[3] ELASA EstWin map

safer and more efficient due to differences in throughput, quality, and volume limitations (Konkurentsiamet, 2022).

"*…the technological description favours mobile network builders, not internet network builders" /... / "the original thought of the development plan was that it is meant for internet service only" /.../ "but today it is also allowed for mobile transmissions or calls, and these devices are listed accordingly, if we made it only an internet-based, closed infrastructure, it would be possible to build significantly more for this money. In other words, the list describes technology too specifically, which is not necessary for using the internet, technology has been made expensive!"* [4]

The National Audit Office stated that Estonian government did not have a plan and the achievement of the goals set for 2015 and postponed to 2020, were under moving in the direction of failure (Riigikontroll, 2015). Strategic planning in public sector is necessary for the creation of a clear vision and setting measurable goals, through critical examination of the environment, assessment of internal strengths and weaknesses, and mapping of external opportunities and threats (Manoharan, Melitski, & Bromberg, 2015). The MEAC in Estonia did not make clear agreements with ELA SA, about the rules of establishing and managing the broadband base network throughout its lifetime, that was developed with the support money from EU, state has put a rely on EU grants conditions and on fact that the base network developing non-profit organisations are owned by the communication enterprises (Riigikontroll, 2015).

"...what was the worst surprise for me when I got into this field, was that I honestly thought that ELA SA belonged to the government! And then I found out, that it was founded by the telecoms, the telecoms non-profit organisation, then my mouth dropped open - the state artery broadband networks or the broadband base networks are also treated as a business service and made with the support of a market failure, or whatever it was. EU support was received, the telecoms built a base network that went to the masts, from where the service was then offered" [2]

During the year 2022 Estonian National Audit Office and Competition Authority of Estonia have published new reports on high-speed broadband development in Estonia. The conclusions both institutions made, do not differ much of those made with the (Riigikontroll, 2015)[4] report. In the

[4] Lairibavõrgu ehk kiire interneti väljaehitamise tulemuslikkus

new report,[5] from February 2022, the National Audit Office makes a meaningful summary "Despite the 35 million euros allocated to the MEAC in Estonia and the various measures, the availability of high-speed Internet in market failure areas has not improved significantly in view of the ambition of the target set. The target set lags significantly and making high-speed Internet available to all those in need, first shifted from 2015 originally planned to 2020, and has now shifted to 2030" (Riigikontroll, 2022).

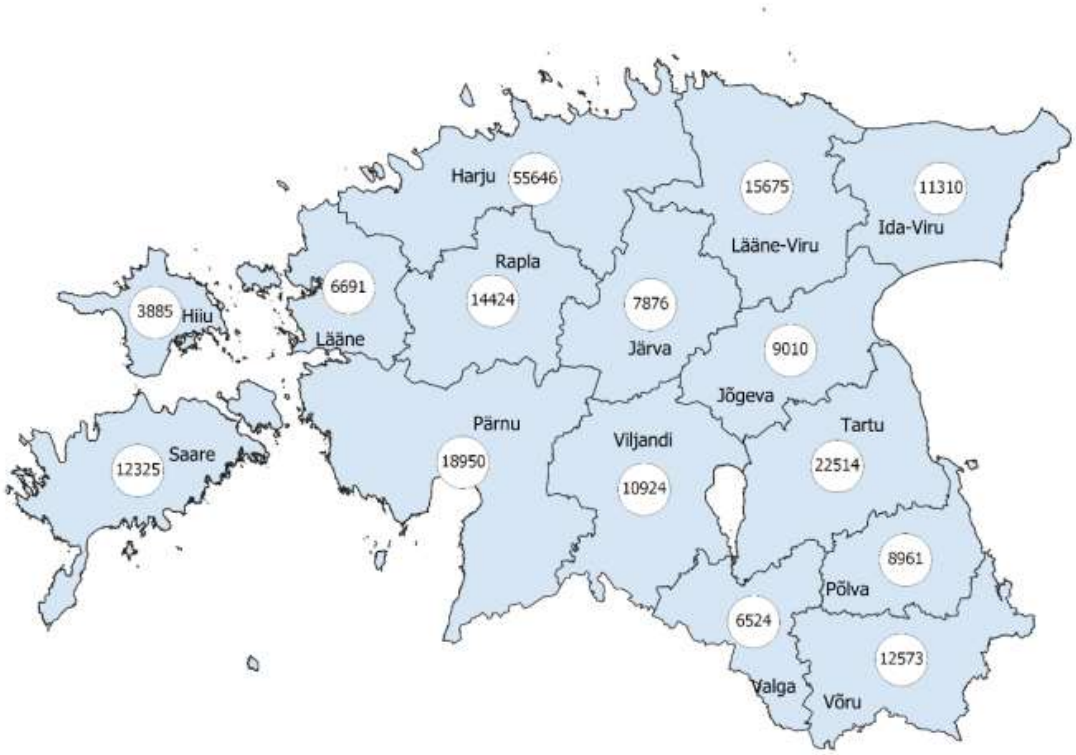

Figure 8. Numerical distribution of address objects located in the market failure areas, in the second stage of broadband access network development by county in the infrastructure measure (as of August 2021). Source: (Riigikontroll, 2022)

In 2018 Estonian Consumer protection and Technical Supervision Agency (TTJA) announced the first public tender for the first support measure, that interested counterparties could start developing the passive broadband NGA for households and enterprises in the market failure region (Konkurentsiamet, 2022). Competition Authority adds that with the first support measure (as of November 2021), there has been built NGA network for 12 813 addresses, from which 3 559 (28%) have joined the network and 2 660 (21%) have started to use the internet service, and the reason is that the consumers consider the cost of the high-speed too high, or they claim that they

[5] Interneti juurdepääsuvõrkude rajamise tulemuslikkus

do not need the connection at all (ibid.). With the third support measure the MEAC in Estonia has set a goal, that over 200 000 addresses in the market failure area must be reached but have not explained how the goal should be achieved (ibid.). Distribution of address objects which technically are counted as potential consumers for the high-speed broadband NGA, located in market failure areas, by county, is shown on *Figure 8*.

"*I can answer that the measures so far have not proven efficiency" / ... / "if we look at how much money has been invested and how few consumers have joined, it would be overblown to use the word "effective" about it"* [1]

"*The content of the broadband plan does not include description, how all address groups are planned to be reached, with which financial means, which means of communication or which processes" /... / "People must also be assured to use the infrastructure"* [5]

Currently the MEAC is conducting consultations with various market participants, representatives of local municipalities, representatives of local communities and other communication infrastructure experts, to approve and put in action the "Estonian Broadband Development Plan 2030" at the beginning of 2023.

2.3 Enablers and barriers

For discussion over the possible solutional enablers and barriers of high-speed broadband connection development in Estonia the following table has been composed according to the findings from document analysis and interviews (*Table 1*). The enablers and barriers have put into categories and added descriptions and examples.

Category	Enabler	Barrier
Economic and financial	- subsidies / support measures - long term budgets - deductibles of the consumers	- Unpredictable short-term budget - high/instable construction cost - low expected return on investment

Market condition	- operator neutrality (e.g., open access to broadband infrastructure)	- small market - consumer preferences - demographic density of rural areas (e.g., old people living in rural areas)
Policy and regulations	- public investment policies - improving legislation	- insufficient legal framework - political instability - bureaucracy
Network	- promotion of cooperation	- weak connectivity between different infrastructure owners/developers
Social and cultural	- involving local communities - active community - demographic factors (e.g., young people moving to rural areas)	- social biases - missing community competence
Technical	- technological neutrality - consideration of future technologies	- hindering descriptions of technology - too broad purpose of communication connections

Table 1: Enablers and Barriers Categories with descriptions.

2.3.1 Economic and financial

During the interview all respondents referred towards one most important barrier – lack of financial instruments [1;2;3;4;5].

"The biggest drawback of the development plan is money" [1;2;3;4]

"*The problem is simply that there are not enough funds in the budget to achieve the entire goal, which is the main problem of development plans. The goal to strive for, is more like a threshold to be reached, but especially in terms of investments, it is difficult, there is not enough money"* [3]

Currently the development funding is based on two EU subsidy funds:

- NextGenerationEU e.g., Recovery and Resilience Fund (RRF) which was established by EU for helping the member states to recover from the economic drawback due to the Covid-19 pandemic (NextGenerationEU, 2022).
- European Regional Development Fund (ERDF) – "Its purpose is to contribute to reducing disparities between the levels of development of European regions and to improve living standards in the least-favoured regions" (European Parliament, 2022)

For the high-speed broadband NGA development MEAC in Estonia has planned to use 24,29 million euros from the RRF, from ERDF has been allocated 45 million euros (Majandus- ja Kommunikatsiooni Ministeerium (2), 2022). These funds set in abundance for the usage of financial instruments provided by the institutions, considering the time frame and implementation mechanisms (ibid.). RRF means are used first, due to the timeframe, that decisions must be made during 2023 and financing instruments can be used until 2026 allowing 100% of co-financing, budget of ERDF is usable during the period of 2021-2027 and also including the three-year transition period, during which the previous budget period funds can still be used, but only 70% of project cost is covered, rest of the cost needs to funded from the state budget or by the beneficiary (ibid.)

A public budget is a formal expression of plans, a forecast of government expenses and revenues (Egbide & Agbude, 2014). For building a quality infrastructure, the budgeting must be efficient and well-integrated (Allen, Betley, Renteria, & Singh, 2020). For the future high-speed broadband NGA development's plans, at least in the next year (2023), no funds from the Estonian state budget have been provided [3], only 1 million euros as the support measure, for community run projects, bigger financing of the building has kept relying on the RRF and ERDF means and there is no long-term budget strategy [3;4]. Governmental investments are long-term capital investments, so the government needs to have a clear picture of each investment project, with its needs and possibilities, so that the distribution of the capital sources make the projects achievable (Bencina, 2007)

"I see that a longer perspective of the budget and stability in financing are missing, so that we can see several years ahead, so that the sector knows to be ready and to come along" /... / "if we say

that there is a stable budget every year, then all parties know to be ready for construction, and we can move faster" [3]

The expectations, for the telecom enterprises, who are building the high-speed broadband NGA networks, are that their deductible, in the investment is 30%. (Majandus- ja Kommunikatsiooni Ministeerium (2), 2022). But most of the telecom enterprises are listed companies and their purpose is to earn profit from investments [1;3]. Telecoms have declared that their perspective expectations for getting back profit, from their investment is approx. 10 years [1;2;3].

"*Every euro you invest somewhere, basically requires a profitability analysis, and you don't put money where it won't come back*" [1]

High-speed broadband NGA development is presented and treated as business model, that should earn profit [2].

"*In the end, it is forgotten, that for whom the investment is for. Does it have to generate money itself or is it a prerequisite to bring money somewhere?*" [2]

Among the address objects, which are listed for the high-speed broadband NGA network building, are objects that do not require connection, like garages and other auxiliary buildings near households, which makes the planning of real financing means significantly more difficult [2;4].

"*In the last workshop, the MEAC representative showed a slide, on which it was written "Building a broadband network in Estonia costs 186 - 376 million euros", with a note - both estimates are adequate. Double the gap and both estimates are adequate?"* [2]

During the time the building cost will vary a lot and it is normal, and very unpredictable. But some calculations, with the current building cost could give an indication, of the real financial need [2;4] Also the deductible of the consumers is still unknown, because there are no precise calculations, it could be put in correlation, in the plan for 2030 for consultations have mentioned 200 euros per connection (Majandus- ja Kommunikatsiooni Ministeerium (2), 2022), but in MEAC seminars have been discussed already about 500 euros [1;2;3;]. National Audit office also gives suggestions that in consideration of cost efficiency state needs to identify households where still is no high-speed broadband NGA or mobile connection is poor or even absent (Riigikontroll, 2022).

2.3.2 Market condition

Market failure is mostly discussed in situations when market is not interested to produce or supply goods that are vital, and in this situation the government intervention is justified (Assaf, 2007). The market failure discussion leads us back to the low expected rate return position that, Estonian density is only 30,5 persons per square kilometre (Eurostat, 2022), and we are talking about villages, small settlements in rural areas, villages with 20 properties [2], there is no market [1;2].

Also, from the demographic perspective in rural areas there a currently living 143 102 people in age range 55-100 and older, and 168 127 people in age range 20-54 (Eesti Statistikaamet(2), 2022) and considering this statistics one could argue that almost half of the population, living in rural areas, are not the target group of high-speed broadband NGA, or are satisfied, with the current solutions, or are not using the internet at all.

"*In fact, there are a very large majority of those, who do not need this very fast internet, for whom nothing happens, if the internet connection drops for a while. Importance may only be for example, that the TV works, which can also be provided without the Internet. They have smaller consumption habits"/... / "and also telecoms, their goal is to invest only as much needed and as less as possible for servicing these customers"* [3]

Because the high-speed broadband NGA network is built under the subsidiaries, the operator neutrality for the infrastructure must be granted (European Comission, 2016). Operator Neutral Network means, that the company, who owns and maintains the network, allows other service providers to use it, so that there can be different kind of services provided by service providers (Karhula, Ikonen, & Juutilainen, 2006). Best solution could be, if the network owner is neutral and has no financial interest to offer services to customers, then service providers can offer their services under equal terms (ibid.). There is a requirement, in building conditions, that at least 5 operators must have possibilities to offer their services [4]. In other hand, the market is small and the interest of five operators is questioned [1;4]. Internet service providers must cover expenses for acquiring and building connections for the provision of services. Depending on how many new customers there are, the profitability of the service will also develop. However, if the percentage of customers who start using the service in a certain region is very small, then the provision of services may not be economically profitable for most telecom companies (Riigikontroll, 2022).

"*If we talk about Estonian island of Hiiumaa today – five companies will never come here, because there aren't so many customers, but three times more expensive equipment still needs to be installed"* [4]

The non-profit organisation ELA SA is presented in discussions as one of the opportunities, who could continue this development path [1;2;4]. Under the ELA SA coordination is built the base network of high-speed broadband NGA, and it would be rational, if ELA SA could continue with the development towards the end consumer [4].

"*In Estonia, there is a very good competence centre called ELA SA, which is a non-profit foundation and does not have to make a profit." /... / "Such a fair wholesale price regulation could come on top of this operator's neutral network"* [1]

2.3.3 Policy and regulations

Policies are a set of forces to control the actors in the policy domain, for the government to control the system, to solve the broad national goals, and policy actions are there with intention to help to meet the goals (Walker, 2000). Stronger development of the infrastructure started after EC declared a strong statement for the broadband connectivity having a strategic importance in European growth (European Comission, 2013).

During the interviews several approaches for the digital infrastructure have emerged from the policy making perspective. There was proposal to declare high-speed broadband network having the same vital national position, as the main national highways or electricity network, that are planned and financed directly from state budget [2].

"*The government's first step should be to make changes in law, and make a political decision that digital infrastructure is vital infrastructure like any other" / ... / "Please don't develop more measures, make a political decision, rethink funding possibilities, make strategic plan and let's do this thing completely differently"* [2]

In these matters opinions vary. There is a thought that it is not so good idea to approach broadband infrastructure so that is totally state owned, but if to put in the same content with roads, then the structure could be similar in management position [4] or as there is only a last 10-15% of the high-

speed broadband NGA to be implemented, then this kind of change would not influence the process remarkably [3].

"*What I am in favor of is, that the base network, built by ELA SA, could be owned by the state, while the now discussed distribution network, could be managed by local municipalities*" [4]

"*Personally, I think that yes, this infrastructure is important and cannot be duplicated and it doesn't make sense either to duplicate. It could be owned by the state, but the result of the plan would still be more or less the same, that as much as the money is given can be built.*" [3]

2.3.4 Network

Governmental and private institutions cover a huge range of different topics, that relationship recognition takes boundlessly long time or sometimes does not appear at all. One could argue that one of the biggest failures of development is parallel development, that there are institutions who are developing the same thing, with varieties, and they have no knowledge, that other institution is planning or implementing similar activity.

All interviewees agree that there is a lack within cooperation also in Estonia, not only between different infrastructure companies, but also within governmental institutions [1;2;3;4].

"There is no such cooperation, no one looks at the big picture" [1]

One of the possibilities would be the force method, which brings back into policy making side – to change the Estonian Building Code, so that no big building projects cannot be implemented without analyzing and establishing the high-speed broadband NGA possibilities [1;2]. There does not have to be built the whole solution, but the minimum requirement must be to establish a cable channel, where the cable could be put, if needed [1;2;].

"*For four years, ITA has pushed this topic very vigorously, so that, for example, the Estonian Transport Authority already takes broadband into account in its projects, but it has not happened.*" [1]

"*It is necessary to develop cooperation within ministry and between ministers, so that infrastructure planning also takes into account the fact, that the Internet is such a normal part of today's infrastructure, communication is left unnoticed in all kinds of planning*" [1]

Leadership through networks means voluntary cooperation between participants, through shared knowledge, values, and strategies between partner organizations, who manage collaboration, plan services and monitor performance together and resolve consequences through dialogue and compromise (Elston, MacCarthaigh, & Verhoest, 2018).

2.3.5 Social and cultural

EC has admitted that the high-speed broadband development projects, that are implemented together with the involvement of communities are the most efficient (Echikson & Zarra, 2018). Also, one could argue that the impact that the high-speed broadband NGA brings to community resilience (see chapter 1.3.2) is very big [1;2;3;4].

The community role in the development process should be increased [1;2;4], this increasing does not have to mean only financial means, but involvement in decision making and in understanding, where the high-speed broadband NGA is very expected, to help the government to map and conduct surveys [2;4].

For the next year government has planned 1 million euros, max. 200 000 for one project, as a test project, form communities to initiate, build and manage high-speed broadband NGA [3], it means that the communities' non-profit organizations can apply for support funding to establish a high-speed broadband NGA in their village or local small region [3]. This approach does not get any assertions from other interviewees, they find that the plan is not good [1;2;4], main reasons are, that community representers do not have enough competences for building such communication networks [1;4], the communities therefore need to become telecommunication company [3]. But in another hand Ashmore et.al saying that the community-led broadband development strengthens the local identity and builds trust (Ashmore, Farrington, & Skerratt, 2017).

"*Let's see how it starts because this measure does not really solve the big problem. There are a lot of those, who would like to get the broadband NGA, but those who are ready to take initiative and control, are rather less*" [3]

"*I do not agree, with the statement, that community non-profit organizations must become a communications company, infrastructure owners yes, but not internet providers*" [4]

All agree that the social impact of having the high-speed broadband NGA in community gives for the community high advantages [1;2;3;4]. Information technology has also become a very important part of the consumption of state services, because states offer many services in their e-environments (Wallace, Vincent, Luguzan, & Talbot, 2015). ICT is also contributing to the fulfillment of civic goals, increasing community cohesion, creating better opportunities for public participation and not to mention improving the quality of life (Oxendine, Borgida, Sullivan, & Jackson, 2003)

People today are already seeking possibilities, to move back from cities into rural areas [2;4]. These people are mostly young and working in positions that is not dependent of the location they are working; they can work from home offices [1;2;3;4]. But if we are considering that they might be working in ICT companies, it could often mean moving big data files and this already requires high-speed connections, and stable connections [2;4]. People are asking from local municipalities, that when the high-speed broadband connection is available in the region, they are interested to moving in [4]. Moving from one region into another is not an easy decision to make and assumingly people, who have children in good schools in Tallinn, are less motivated to do the decision than, those, who have small children, who have not started their education in schools, or people, who don't have children yet, or they have grown up [3]. A completely different target group is coming to live in the country today, but the premise is that people can live and work where they want, and the basic infrastructure is guaranteed [2].

"*Unintentionally, a large part of our modern working life has gone to the computer, moving data, etc., and it does not matter where you are sitting, whether in Tallinn or Kõpu. Today I have a couple of active letters in my inbox asking: "When it will come and if it will come. I'm about to move my company around, but I would need this amount of speed*"" [4]

2.3.6 Technical

EC set a target of internet connections with download/upload speeds of 1 Gigabit of data per second by 2025 for all schools, transport hubs and main providers of public services, and digitally intensive enterprises. Households should have had access to networks offering a download speed

of at least 100 Mbps, which can be upgraded to 1 Gigabit already by 2020 (European Comission, 2016).

Opinions of the interviewees are divided in separate directions, in this matter. The telecom representative is protecting the vision of technology neutrality and claiming that regular households to not need such speed capacity [1]. One of the definitions of technology neutrality is:" Technology neutrality means that technical standards designed to limit negative externalities (e.g., radio interference, pollution, safety) should describe the result to be achieved, but should leave companies free to adopt whatever technology is most appropriate to achieve the result." (Maxwell & Bourreau, 2014, p 1) Aiming 1Gb/s means establishing high-speed broadband NGA network, which makes it too ambitious and too expensive goal (ibid.). In recent years, during the first discussions over the high-speed internet broadband NGA network building, the matter of volumes has also been raised, but the favoring argument, that if there is already digging in someone garden, then the best possible solution has to be installed, because the future needs are unpredictable [2;4].

"*My personal experience says that a household of five person, who just use a home office and e-school can do very well with a solution below 100Mb/s*" [1]

Local community representer was certain, that there is no question about changing the technological solution from broadband to mobile, because fiber optic cable is passive infrastructure is durable and reliable [2]. Behind the useful life is protection from external factors, plus in some sense unlimited data volume (ibid.)

"*With fiber optic cables, that have been installed approx. 20 years ago, there are no problems with them. Such durability also gives the basis to direct the questions towards the calculation of the expected rate period, so that should we still talk about 10 years, maybe there is no way to define the payback period?*" [2]

The "Estonian Broadband Plan 2030" has set the goal of covering all populated areas with a high-speed internet broadband network, and according to the stakeholder, to achieve the goals, it is necessary to proceed from the neutrality of technology and consider the expediency of using technologies used in different situations (Tele2 Eesti AS, 2022). The choice of technology is mainly determined by the length of the distance and the density of the addresses, so for meeting

the coverage goal, it should be possible to consider whether it makes sense to cover the area with an optical cable or also consider radio solution (ibid.).

Local municipality representer would like to consider Finland example: a mixed solution of broadband network and radio communication [4].

"*Local government built high-speed broadband base networks into every village and radio frequency masts were installed in the middle of the settlement. It's super cheap compared to running cable to every house, plus household appliances are commercially available, which makes maintenance easy and cheap too*." [4]

CONCLUSION

Technology plays a leading role in today's society and economy. Modern society can even imagine what it would be without electricity or cars, not to mention that the growing generations could imagine world without telecommunication technology.

According to Perez (2003) there has been five technological revolutions during the last 250 years, and we are now experiencing the impacts of the fifth, the information revolution – Age of Information and Telecommunication (Perez, 2003). In authors opinion the paradigm is currently in the deployment stage, and synergy phase e.g., Golden Age when the coherent growth with increasing externalities, production and employment is taking place (ibid.). How fast information technology developed in the 1990s was extreme, so investors were constantly in search of novelty, and technological development was booming. It also caused the technology to become obsolete very quickly, the computer bought in the store was already technologically obsolete by that moment, because somewhere in the laboratory engineers had already put together a much better one. By the beginning of the 21st century, it was clear to the world, that people had embraced information technology.

In the wind of physical technology, services also made great technological developments, and not only in the private sector, but also in the public sector. Governments felt the pressure of citizens to adopt e-solutions, because communication between people through e-channels was already common, the demand for the internet and services mediated through it, was extremely high. The winners were those who could stay one step ahead.

In 2016 the EU as declared, that to increase the European competitiveness and innovation, provide challenging earning opportunities for young people, prevent relocation of economic activity, and attract inward investments, the member states need to start developing high-speed broadband connection networks to every household in their countries. For these investments subsidiary funds were established and the aim was to make Europe the best continent with high-speed broadband network coverage. According to these ambitions the Ministry of Economic Affairs and

Communication in Estonia conducted a plan “Estonian Broadband Development plan 2020” today the same plan is reviewed again, and the consultations have been conducted with all interested counterparties to establish new goals and to start implement the “Estonian Broadband Development plan 2030”.

Compared to other European countries, Estonia is a small country territorially, but Estonia is also very small in terms of population, and this population is also concentrated in cities, or today we can even say, that one city – Tallinn. Almost 50% of the Estonian population is situated in Tallinn and its surrounding areas (Eesti Statistikaamet(1), 2022). This indicates that the local market is very small and in rural areas one could argue that there is no market at all. Relying over the market self-regulations or market failures in Estonia does not work. Due to the small size of the market, and that the biggest telecom enterprises on market are listed, and they do as many investments that they need, and as less as possible. They do not invest in regions; they see a low expected rate return. European Parliament underlined the role of private investment in internet connectivity networks for digital progress and the role of a stable regulatory framework in enabling all players to invest in all areas, including rural and remote ones (European Comission, 2016).

During the interviews for this paper all counterparties agree that Estonian current policy, to build as many high-speed internet broadband NGA networks with the less financial means as possible has not been cost effective. Broadband NGA networks have just been built, without any mapping and deeper consultation with local municipalities or communities. Suggestion to succeed, is to ask from the communities, where it is highly expected and to consider their applications for getting the high-speed broadband connection.

Because of the density of Estonian rural areas, experts say that there must be a technology neutrality and the chosen technology must support only internet connectivity and same time be flexible, all solutions should be suitable for the building support measures. Considering financing, Estonian fiscal policy is relying on EU funds - Recovery and Resilience Fund (RRF) and European Regional Development Fund (ERDF). Additional funds added from state budget is expected, to decrease the investment risk of telecom companies and to treat the infrastructure as any other state vital infrastructure.

High-speed internet broadband NGA network is very waited in rural communities. After the Covid-19 pandemic, the way of working has taken on a completely new meaning and dimension. A large

amount of office work is done with computers and the presence of stable and fast internet allows working from any location and makes a person independent of the city environment. Today's generation is an educated and skilled user of information technology, which frees them from the need to live in an urban environment to do rewarding and motivating work. Migration from the city to the countryside has already begun and, at least in Estonia, it is an ever-growing trend. Also, local communities have become more and more active in developing their areas and make them attractive, for those, who already live there and to newcomers. Communities are focusing on their resilience and preserving it, because they don't want to give up their living environment and want to choose where to live and at the same time make a good living.

Community-Driven Development (CDD) is not yet receiving a positive reception from the stakeholders, considering high-speed broadband NGA network establishment, in Estonia. Because it is considered that communication technology is a complex and sophisticated field that requires technical competence, that may not be found in communities. Future costs may become too high for such an approach and the community may experience financial strain with the infrastructure maintenance.

Better and more structured and concentrated planning with better financing solutions, and “Estonian Broadband development plan 2030” will be implemented. It is an important macro-economic or socio-economic change, manifested by the demographic movement of the nation and the creation of jobs. With this, an important change would be made, which would ensure the integrity of the Estonian territory.

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Appendix 1. Interview guide and questions

Context	Question
Broadband development policy perceptions and approaches	• How familiar are you with the EC guidelines for the Application of State Aid rules in relation to the rapid deployment of broadband networks? • Whether these guidelines should be made more widely available to the public for better understanding and knowledge? • What is your assessment of the effectiveness of guidelines? • How the guidelines correspond to today's technological possibilities, whether it would have been necessary to update them in time? • Which is the biggest drawback of the guidelines?
Factors that influence the development in local level (case of Estonia)	• How familiar are you with the Estonian broadband development Plan for 2021-2030? • What is your assessment of the effectiveness of the plan? • Which is the biggest drawback of the plan?
An overview of the practical side	• What would contribute to the better execution of the Estonian broadband development plan? • How the plan should be supplemented in time? • Do you consider the achievement of 100 Mbit/s (downlink) internet speed in rural areas of Estonia to be realistic, optimal or underestimated goal? • What other solutions could be considered for the development of high-speed internet connection, in addition to broadband? • Who should show greater initiative, so that the plan could be executed as prescribed?
Effect to the scale-related factors	• How the participation of the local community should be increased and whether or in what way the initiative of the broadband development should be transferred to the local communities?

	• How the high-speed internet broadband connection in Estonian rural areas could affect the demographic relocation of the population? • How the high-speed internet broadband connection in Estonian rural areas could affect the establishment of enterprises in the rural areas?

Appendix 2. List of interviewees

Interview number	Job role	Expertise field
1	Board member of ICT company	technology, market
2	Board member of municipal infrastructure company / member of community	technology, market, policy
3	Representer of ministry	Policy, law
4	Representer of local municipality/community	technology, market, policy

All the interviews were conducted by the thesis author.

All interviews are recorded and transcribed.

Notes from the seminar held by the Ministry of Economic Affairs and Communication in Estonia on 09. September 2022 is referenced with number 5

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