ISSN 1330-3651 (Print), ISSN 1848-6339 (Online) https://doi.org/10.17559/TV-20180524095500
Original scientific paper

The Influence of the Cost Reduction Directive on the Broadband Roll

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Abstract: This paper presents a view of network roll out to enable digitalization and economic growth. The policy overview and analyses of the alternative connections among the network points provides us with the same picture, i.e., the market is competitive, but also gives us the potential to roll out high-speed networks with lower costs and in shorter time periods. As the policy and real-data analyses suggest, the inclusive cooperation of the stakeholders and the empowerment of the relevant bodies are essential to ensure that the proposed system will work. Connectivity should lose the label of a development inhibitor and become a key factor in the consciousness of all the sectors.

Keywords: broadband; connectivity; digitalization; network; spatial data

1 INTRODUCTION

Worldwide developments in the electronic communications market have influenced different initiatives at the European level as well as at the national level of the individual Member States. Digitalization is refocusing on the online operation of businesses and public administration. A modern, reliable network is a necessary condition to achieve the planned goal of a digital society. In this case it is clear that all the policies, emerging from the need to enable rapid development, are market driven. This rapid service development should force Europe to think beyond the network roll out. Infrastructure projects should be finished by now and Europe should deal with the digital economy.

The European Commission realized the need for a rapid and ambitious infrastructure roll out and published the Digital Agenda for Europe 2020 [1], which established the targets of 30 Mbit/s for all European citizens and 100 Mbit/s for half of the households. After introducing the Digital Agenda for Europe, the European Commission initiated a change in the concept of regulation with non-discrimination and costing methodologies [2] that should incentivize investment and encourage the deregulation in geographical areas with the presence of multiple next-generation access (NGA) networks.

For this contribution, the most influential directive, issued by the European Commission, is Directive 2014/61/EU on measures to reduce the costs of deploying high-speed electronic communication networks [3] (referred to subsequently as the Cost Reduction Directive) that introduces the importance of sustainable network roll out with compliance, with the aim of lowering the costs of construction, enhancing competitiveness and encouraging multiple approaches to network roll out. In 2016 the European Commission introduced an initiative called Gigabit society [4, 5], accompanied with 5G action plan [6], which was an upgrade of the initial plans of the Digital Agenda on the gigabit level. Because regulations should follow the political goals, the updated European Electronic Communications Code is expected to move from asymmetrical regulation to the elements of co-investment and symmetrical regulation, which should ensure rapid construction and enough investment to achieve the political goals. The research problem was identified already through the political agenda of the European Commission, which is aiming for network roll out. Since the largest cost of the network roll out is civil engineering, the reuse of existing alternative infrastructures, including an appropriate public-utility infrastructure, would seem to be a reasonable decision for fast NGA network roll out. The aforementioned initiatives encouraged an analysis, based on the Cost Reduction Directive, which includes symmetrical regulation and cross-sector utility infrastructure use for the high-speed network's roll out. We see the benefits of the infrastructure reuse in the savings, environmental burden and faster roll out.

In this article we emphasize the possibilities for the reuse of infrastructures, both the suitable telecommunications infrastructures, such as ducts and pipes, as well as the cross-sector utility infrastructure. In the search for alternative connections we used the GIS system tool, as described in the methodology part. Theoretically, the use of GIS systems in the regulation would be among the main contributions of this article, with the empirical evidence of the possible reuse of infrastructure. With the article we would like to test the hypothesis that the Cost Reduction Directive is the policy that can be used in practice and we can assume it as being market driven. One of the main elements is the reuse of networks, both the telecommunications network and the cross-sector utility network.

In the first part we are looking into the policy frame, further explaining European policy and then the Slovenian policy situation. Later, we aim to find the existing literature on the topic, which has already dealt with the problem in the past. This led to the Slovenian policy and the market situation, and so to the reasons that led us to an analysis of the alternative connections between two network points, with a focus on the results and designing the process for detecting possibilities for infrastructure reuse. In the analysis we initially describe the data and the methods, and then later the results. In the discussion part we deal with the gap between the policy and analysis and the subsequent implementation in practice.

2 THEORETICAL AND POLICY FRAME AND RELATED LITERATURE

Discussing regulatory issues already demands an interdisciplinary approach, combining legal, economic and

technical points of view. In our article we are also including the geo-informatics view on the subject matter with a practical approach. While a significant amount of literature can be found on the subject of network roll out and regulation, the connection between GIS systems and telecommunications roll out and regulatory issues is rare. Even literature connected with infrastructure reuse is not very common. In that sense we see the article as an attempt to link all the mentioned perspectives and to widen the regulatory view. First, we needed to set the policy frame, both in the European Union and also the Slovenian implementation. Nevertheless, we can derive many useful conclusions from the existing literature, which is briefly summarized below. For an easier placement of the analysis, we made a short overview of Slovenian fixed-broadband market at the end of this section.

2.1 Legislative and Regulatory Situation in the EU

As mentioned in the introduction, Europe is aiming to rapidly develop its infrastructure, in order to give priority to the development of Industry 4.0 and the digitalised economy. For that reason, many initiatives and directives were developed, as described in the following.

In 2010 the European Commission realized the need for a rapid and ambitious infrastructure roll out and published the Digital Agenda for Europe 2020, which established the target of 30 Mbit/s for all European citizens and 100 Mbit/s for half of the households. Industry was reluctant to share the ambition, but tried to present concerns, mostly linked to severe regulation and tough market conditions. The updated paper on the Digital Agenda from 2014 quotes many benefits that the connectivity will bring to the European single market, like smart cities, so boosting the European Union in terms of digital research, development and innovation. From the same source we can learn that the first target, basic broadband for all, was achieved in 2013, although speeds above 30 Mbit/s were generally not introduced. That is especially the case for rural areas, as described in the publication Digital Agenda for Europe, which explains the work of the EU and the results.

In the meantime many Member States started with state-aided projects. The Slovenian ministry conducted two projects named "Open Broadband Network" [7, 8], which focused on the strictly rural networks, considered as white spots. White spots are the areas where there is not sufficient network coverage and at the same time no commercial interest in infrastructure roll out from the operators. Projects were led by the municipalities and the contractors were mostly new entrants to the telecommunications market, except for one. The contractors had to ensure open networks and were not allowed to ensure retail offers as the vertically integrated operators. Their function was to build and manage the telecommunications networks, but not present competition on the retail market, since the state aid was the main investment source. The two projects resulted in approximately 30,754 connections, and of those, approximately half were taken up. Unfortunately, the target speed in these projects was not high enough, but at least they ensured rural areas with basic broadband. In the past year a new project was in preparation, this time with the corresponding speeds. The operators already expressed their commercial interest and the relevant ministry is working on designating the white spots.

Of course, the funds are not large enough to cover the whole of the European Union with broadband connections above 100 Mbit/s, or even 30 Mbit/s. One of the first actions that led to the change of the concept of regulation was the Recommendation on consistent non-discrimination obligations and costing methodologies to promote competition and enhance the broadband investment environment, which should incentivize investment and encourage the deregulation in geographical areas with the presence of multiple NGA networks. The above-mentioned recommendation is introducing looser regulation in competitive areas, with the aim to incentivize private investments.

To split the investment burden among multiple players on the market, the most influential directive, issued by the European Commission is the Directive 2014/61/EU on measures to reduce the cost of deploying high-speed electronic communications networks (the Cost Reduction Directive), which introduces the importance of sustainable network roll out. The Cost Reduction Directive had to be transposed by 1 January 2016, while the national measures needed to be applicable by 1 July 2016. The Slovenian Telecommunications Act, which is transposing the Cost Reduction Directive, came into force in August 2017, but the delayed transposition did not influence the implementation, since the previous Telecommunications Act already contained some basic elements: publishing the call for co-investment, the symmetric use of telecommunications and other infrastructure and the legal basis for state-aid projects were also included in previous Telecommunications Acts.

In 2016 the European Commission introduced an initiative called Gigabit society, accompanied with the 5G action plan, which upgraded the initial plans of the Digital Agenda to the gigabit level. Beside that, there are plans to cover public spaces such as parks, squares, public building, libraries, health centres, and museums everywhere in Europe with free Wi-Fi, called WiFi4EU [9]. Gigabit society aims to cover all schools, transport hubs, public service organizations and digitally intensive enterprises with symmetric gigabit connections by 2025. The 5G action plan sets a roadmap for enabling private and public investment into 5th-generation mobile networks. The main issues are harmonized spectrum awarding among the Member States and harmonising the implementation.

Because the regulations should follow the political goals, the updated European Electronic Communications Code is expected to move from asymmetrical regulation to the elements of co-investment and symmetrical regulation, which should ensure rapid construction and enough investment to achieve the political goals. It gives some more powers to national regulatory authorities (NRAs), to better understand the market development. It is also giving NRAs the possibility to empower the market by encouraging more co- investment agreements. Because of the geographical market consideration, the deregulating of the market became feasible and that should empower operators to establish more flexible wholesale agreements and cooperate with the political strategies in the sense of following the coverage targets. As we will examine in more depth later, also Inderst and Peitz [10] emphasized the

sufficiency of ex-post interventions and regulations for avoiding the risk of anti-competitive behaviour. Without knowing the final version of the European Electronic Communications Code, we can assume looser, ex-ante asymmetric regulation, with a focus on symmetric remedies and investment incentives.

The described policy frame, both in the European Union and in Slovenia, could be extremely useful in practice, as is apparent in the following analysis. The most important part is the effective infrastructure roll out to ensure digitalization, which would not be possible without a network. Digitalization enhances the economic growth and development of the country with optimized administrative burdens.

For the network roll out, the coordinated civil works in the case of local authorities at different levels are important: a single methodology of permit granting and rights of way, transparency of planned civil works published at a single information point; a special request from environmental, public safety, public health and spatial arrangements and similar demands. These improvements in public administration functioning should increase the investment incentives because of increased transparency and predictability.

The critical point of the implementation is the division of the roles among the regulator, local authorities and ministries, and at the same time giving them all the power and the obligation to influence the market. Some of the points should be further elaborated on and it would take some additional action to improve the knowledge and inclusion of the stakeholders. Local authorities already play an important role in the education and coordination of the stakeholders, such as permit granting. At the same time the single-market initiative needs to be kept in mind, so the bureaucratic burden for the potential transnational operators will not de-stimulate the market developments.

However, the policy frame answered the market needs. At the same time, the policy is creating a market need with its demands for more capacity and network. In the literature selection we decided to look deeply into the investment decision making and at the network roll out and regulation, while the theoretical connection between the GIS systems to the telecommunication roll out and regulatory issues is rare. As our analysis is corresponding to the need for roll out, the policy frame is dealing with the same issue. The literature connected to infrastructure reuse is not very common. Nevertheless, we selected the corresponding contributions, summarized in the following.

2.1 Related Literature

As one of the most important contributions, we see the research of Lemstra and Melody [11], being a complete overview of several markets in the European Union. In the introduction the authors describe the investment decisions and the influence of regulation on the market. They link the efficiency of the market actors to the regulatory activities that are shaping the market environment. Further on, the explanation of the authors' views on the European single market and the diversity of its Member States demonstrate the difficulties in establishing a harmonized environment. The essence of the book, presenting different dynamics of the broadband networks, is the outcome of the analysis: the analysis sets additional questions about whether different programs would be needed to reach the goals of the Digital Agenda and what are the possibilities to even set the common goals for the European Union. The roll out of the NGA network is undoubtedly demanding a heavy investment. The authors describe the developments of the concept of the ladder of investment. As there were a lot of success stories, not many operators "climbed" to their own infrastructure, which only happened where the density of the end-user database was large enough and the access to passive fibre was enabled. The analysis provides an overview of 12 European countries, which reflect a "common market" rather than a "single market" because of the situation being too diverse. In any case there are some common features, such as the open access to the passive infrastructure, across utilities and in-house wiring. The involved policy makers in the broadband-network roll out are governments, regulators and local authorities. Each of them has an important role to play in the process, from stimulating demand to removing barriers [11].

The latest leads to the same concept as derived from the actual policy frame: facilitating the network roll out and achieving the goals of the Digital Agenda. The same as our goal, to find the best way to deploy a broadband network, the research is designing a complete roadmap for the most important stakeholders, including governments, regulators and local communities.

Regulation is undoubtedly one of the main factors in the process of investment decisions, especially for the deployment of a high-speed broadband network. Beginning with the 1980s and continuing into the 1990s, the telecommunications industry in almost all countries experienced privatization, or at least some degree of corporatization [12]. That was not the case for Slovenia, however, where incumbent carrier is still state property.

The need for the liberalization of natural monopoly markets emerged in early 1990s, when the incumbent carriers used to have a monopoly. At the time, the prices were high and the end users were all at the mercy of the operator, to have the one and only service available, i.e., fixed telephony. In Slovenia alternative operators emerged with the dawn of the mobile-telephony service. Worldwide liberalization combined with the growing need for communication, resulted in the rapid development of communications technologies and has led to competition in the market. Regulation undoubtedly contributed to the competitive market arrangements, but following the main principle, that the regulation should only last while it is necessary and leave the market to the “invisible hand” principle after the competition is mature enough, does not seem to take place in the regulator's mind. The sense of indispensability and the need to justify their existence, often leads to overregulation, investment inhibition and subsequent damage to the market. NGA policy discussions are thus marked with policy challenges and elaborations as to what degree static efficiency must be sacrificed to achieve the desired level of investment [13]. At the moment the most comfortable situation is to maintain the service competition on the SMP network. Because of the strict regulation, the SMP’s incentive to invest is low and the main condition for market development is not fulfilled. While the cost-orientation rule is there to prevent operators having significant market power (SMP) from ex-ante, cost-

based, wholesale prices, a level playing field is still emphasized for the access seekers who are given a number of safeguards to be able to compete under comparable conditions to those of the incumbents [14].

With the evolving of the market and market needs, the regulatory concepts and the framework also need to evolve. The proposal of the European Electronic Communications Code is a Directive that represents the European regulatory framework and which is now under the consideration of European Parliament and the Council.

Briglauer and Cambini [15] analyzed the European Electronic Communications Code, whose main goals were to incentivize investment in new high-speed broadband infrastructure in its initial phase. Three main categories, i.e., co-investment, symmetric regulation and technological neutrality, were the most important features of the revised regulatory framework. The authors pointed out the need for soft regulation to encourage investments. One of the main concerns outlined by the authors is that introducing symmetric regulation with the same intensity as the asymmetric regulation nowadays will not achieve the main goal of incentivized investment, but continue to burden the market with intrusive and "un-smart" regulation. Co-investment is the second concept to foster investments. Especially in areas with a limited scope for infrastructure competition, co-investment seems a promising concept to foster network investment. Sharing risks related to future demand and market exposure, cost reductions, capital formation in the case of capital market imperfections, and the primacy of voluntary agreements are the salient features of effective, successful, co-investment models. However, the authors warn that mandatory open access might destroy the free economic initiative and will not achieve the desired effect. The bottom line of the research is that the European Electronic Communications Code should be implemented in the proper manner, with the clear perspective of its first aim.

Bourreau et al. [16] also address the co-investment proposal in the new regulatory principle. It is clear that the costs for network roll out are extremely high, and if the access price is too low, the incentive for investment cannot be achieved. Shared investment expenditure among different players is especially useful outside of urban areas, where the investment is even higher than in densely populated areas. The second issue is the demand uncertainty. When the investor starts to build the network, it cannot be sure that there will be enough demand. The access seeker on the other hand, already has the information and can decide whether to enter or not. The regulatory concept of cream-skimming is only actually present when the conditions are good. In that case, the investor alone is taking the risk, while the award is shared among the investor and the access seekers. The authors warn of the trade-offs with high-speed-network roll out, which are the lower prices and higher coverage. The access price is low and that discourages investors from rolling out in the expensive areas, which are scarcely populated and have no competition in terms of infrastructure.

As already mentioned in the policy frame part, the types of agreements and the regulatory approach are influencing the market to a great extent. Even though the authors [10] focus on a duopoly, some of the main results can also be used in the market with significant market power operators, which are asymmetrically regulated. In the analysing the interplay among ex-ante and ex-post access contracts, the access regulation and investment incentives, the authors show that the application of access contracts, both ex-ante and ex-post, are leading to more investment, less frequent duplication of investment and dampened competition. In a situation where rapid network roll out is needed, the regulatory principles need to adapt to the market needs.

The above mentioned studies are focused on infrastructure roll out and co-investment, but mainly from the regulatory point of view. Like when presenting the analysis for the practical usage of GIS systems related to the co-investment and especially the shared usage of the networks, both telecommunications as well as cross-sector, we found the linkage between telecommunications and GIS systems as a rare contribution. The idea of the reuse of infrastructure depending on spatial information gained interest as a good way to simplify and optimize the network planning and reuse process [17-19].

Nevertheless, Coutinho et al. [20] describe the GIS-based system for urban planning. They describe the Decision Support System (DSS) related to the so-called Spatial Decision Support Systems (SDSS). With the spatial, multi-criteria nature of infrastructure planning and investment decisions, the system developed in this article is a typical Multicriteria Spatial Decision Support System (MC-SDSS)[21,22]. Like with the analysis presented in our article, this MC-SDSS also presents planning and investment decisions and the visualization of the available alternatives on maps. The main difference is that we are using our analysis for the needs of regulatory action, while urban planning is wider in the sense of the types of infrastructures and narrower in considering only urban areas. But except from the goal, both systems are designed in a similar way, using the principle of alternatives to find the appropriate link between two points, using different relevant factors, since these are different researched networks, i.e., water and telecommunications.

Besides the literature, we used the European Commission's impact assessments, and several working papers, which are described in the test itself, providing either the policy basis or additional arguments on the topic. Like when going through the policy frame and literature, we found undisputable support for the hypothesis. Not only that the entire proposed and relevant European Union policy frame is demanding a rapid telecommunications-networks roll out, but also the need for cost reduction is generally recognized. So the method we are presenting in our contribution should be considered by the decision makers before implementing remedies, which often represent a too heavy burden for the investors in the infrastructure.

2.3 Situation of the Broadband Market in Slovenia

The digital economy and society (DESI) index [23] is one of the tools monitoring the digital development and consequently telecommunications-market developments in the European Union. The DESI index allows an objective comparison among Member States regarding the same, pre-established factors. The DESI index is a composite of different dimensions: connectivity, human capital/digital

skills, use of internet by citizens, integration of digital technology in businesses and digital public services. For our analysis, the main observed dimension is connectivity, with the sub-dimensions: fixed broadband, mobile broadband, as well as speed and affordability. Fixed broadband is the main observed sub-dimension in this paper, because the national strategy aims to connect all households with a fixed next-generation access (NGA) line with 100 Mbit/s and upward, while the mobile broadband network is perceived as complementary.

Slovenia, as seen in the results of the DESI index, has not managed to match the European average, even though there are several NGA infrastructures covering urban areas: the incumbent's mix of networks, including copper gigabit-capable passive optical networks (GPON); the cable operator's data-over-cable service interface specification 3.0 (DOCSIS 3.0) coax network; and new entrant's fibre-to-the-home (FTTH) network. There is still quite a significant potential for growth in the number of fixed broadband connections and roll out of the network.

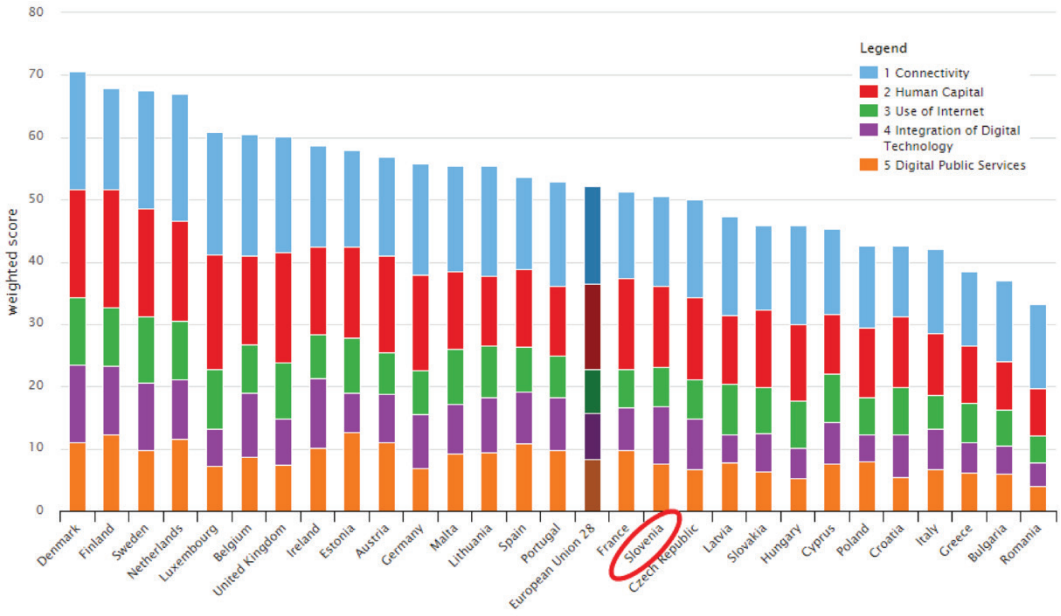

Figure 1 Digital economy and society index, by main dimensions of the DESI [24]

The common aim of the Digital Agenda for Europe, the European gigabit society and the National Strategy of Digital Slovenia 2020 is to cover the territory of the European Union and individual national areas to enable digitalization. Europe cannot afford a lack of investment, but needs to develop Member States' authorities' awareness of the importance of common goals, so that they will be able to act as enablers for development and growth. A similar idea was presented in the State aid guidelines [25], which predicted the granting authorities for executing state-aid projects. The common understanding of the importance of implementing high-speed broadband networks would significantly shorten the predicted period for network roll out.

Historically, in the Slovenian telecommunications market the emergence of the FTTH networks occurred in 2005, initiated by the alternative operator, T-2, which still holds the leading position in the market share for FTTH connections. Those connections were mostly built in urban areas and as a new entrant T-2 was free from any regulatory burdens, since the access obligation was dedicated to the incumbent, Telekom Slovenije. That is why the duplication of network occurred, since other operators were not able to reach the end users, except via the unbundled copper network. When the incumbent started to duplicate the fibre network, the unbundling followed immediately. At about the same time, the cable operator Telemach started to expand its services and networks by both taking over small cable operators and introducing DOCSIS 3.0 protocols for enabling broadband on coaxial networks. Nowadays, Telemach usually builds the HFC (hybrid fibre coaxial) networks and has reached over 25% of market share on the Slovenian market. The incumbent's market share represents 34% of retail connections at the national level.

While at least three operators were competing over urban and suburban areas, the rural area remained covered by the incumbent's copper network. The state strategy was to deploy at least basic broadband to all the Slovenian citizens, so the relevant ministry (at the time the Ministry of Education, Science and Sport) initiated the projects of "Open broadband network", which focused on the strictly rural networks, considered as white spots. The first project was initiated in 2007 and the second in 2010. White spots are the areas where there is insufficient network coverage and at the same time no commercial interest for infrastructure roll out from the operators. Projects were led by the municipalities and the contractors were mostly new entrants to the telecommunications market, except from one. The contractors had to ensure open networks and were not allowed to ensure retail offers as vertically integrated operators. Their function was to build and manage the telecommunications networks but not represent competition on the retail market, since state aid was the main investment source. The two projects resulted in approximately 30,754 connections, from those approximately half were connected. Unfortunately, the target speed in those projects was not high enough, but at least rural areas had basic broadband. In the last year a new project is in preparation, this time with the corresponding speeds. The operators already expressed their commercial

interest and the relevant ministry is working on designating the white spots.

Member States must design the national strategy, the framework scheme and the individual tenders in order to compete for resources. The Ministry of Education, Science and Sport issued a renovated strategy with the goal of 100 Mbit/s for every household in 2014. The ministry published the call for commercial interest in 2015, which was the basis for determining the white areas. The call was a major success, since six operators expressed an interest in building broadband connections with the minimum requested speed of 100 Mbit/s. The expressed commercial interest represented at least 200,000 connections in following three years, until 2019. There is a reasonable chance that Slovenia will eventually be covered by a high-speed broadband network. The estimation shows that the remaining white spots present 28,000 connections, which are going to be the subject of state aid.

In the roll out of such a number of connections, the cooperation of public administration is needed. Effective administrative procedures including the correct implementation of European policy framework would lower the costs, which would represent the main contribution from the government, apart from the state aid. The appropriate regulatory approach would be a reconsideration of present remedies and enabling the symmetrical shared use of telecommunications networks, as well as cross-sector utility networks. The following analysis proves that there are many alternatives for connecting points or network elements and the corresponding civil engineering costs could be significantly lower.

3 ANALYSIS OF THE ALTERNATIVE CONNECTIONS BETWEEN TWO LOCATIONS

For successful market development, the theoretical existence of alternative connections is not enough. With a real data analysis, gathered from official databases in the Republic of Slovenia (RS), our aim was to find out whether there are possibilities for alternative telecommunications network roll out with the reuse of the cross-sector public utility infrastructure. The infrastructure is owned by the network operators and on the tracks where the SMP operators' network already exists. We investigated the possibility of alternative connections between existing and planned network points on a fixed location. The representative sample, which represents almost 50% of network points, was taken into account. The analysis was examining the existing public infrastructure, which can be used as a service for production, transport of distribution and could have a potential for reuse:

- electronic communication networks (back-hole and access)
- natural-gas networks (transportation and distribution pipelines);
- electricity networks (distribution and transmission) including public lighting;
- heating networks;
- sewage, waste water and drainage networks.

The national databases used in the research are:

- cadaster of public infrastructure (PI);
- register of spatial units (RSU);
- single operators information system (EIS).

3.1 Description of the System of Databases in RS, Important for Research

The cadastre of public infrastructure (PI) in the Republic of Slovenia was designed as a centralized point of the infrastructure owners, who supply the system with data, and data users. Its purpose is to register all the infrastructures, especially for local and state spatial planning, to prepare the database for the registration of legal rights (ownership) on infrastructures, and to establish a system for the prevention of damage. The establishment of the PI cadastre system resulted in direct benefits to the system users, as they can quickly obtain data on all the PI objects at a particular location. The surveying and mapping authority of the Republic of Slovenia (SMA) is managing the whole system, while owners are responsible for providing data, and geodetic surveyors are responsible for quality [26]. The context and challenges of mapping for the utility infrastructure are: spatial management, quality drafting of the (spatial and other) planning acts at the national and local levels, preparation of the investment schemes and infrastructure construction programs, real-estate mass valuation, cost reduction called "Call before you dig" and easy access to basic data of the public utility infrastructure. The following types of infrastructure are registered: traffic infrastructure (roads, railways, airports, harbours, cableways), energy supply infrastructure (electric energy infrastructure, natural gas infrastructure, heating infrastructure, oil transport infrastructure), municipal infrastructure (water-distribution system, sewer system, waste-management infrastructure), water infrastructure, telecommunications networks (ducts, lines, masts, antennas) and at the latest stage of 2013 the electronic communication network termination points (Broadband coverage information system) [27]. The information about broadband coverage for the entire territory of the Republic of Slovenia has been prepared thoroughly. The system was based on planning and decision-making processes in the field of broadband communication, as one of the priorities of the Digital Agenda for Europe. The spatial database of broadband coverage could be recognized as best practice, which can be applied in other European countries. The context and challenges of mapping the network termination points are:

- designation of white areas,
- geographic segmentation,
- coordination of civil-engineering works,
- cost reduction and model for defining the development of the broadband infrastructures (also in less-populated regions).

The project can also be provided as an example of good practice for other European Union Member States. The objectives of the public utility infrastructure database are [27]:

- efficient broadband and infrastructure deployment,
- damage reduction,
- sustainable investments,
- shared usage of public-utility infrastructure,
- quality basic data determining the location,

- identification of individual facilities,
- regular maintenance of data,
- simple transmission of data to users.

A total of 7,500,000 facilities and 212,000 km of infrastructure have been recorded in the Public Infrastructure (PI) cadastre since its establishment on January 1st 2006 (2,900,000 facilities and 94,500 km of electronic communications). By now it has collected nearly 90 % of all existing infrastructure in Slovenia.

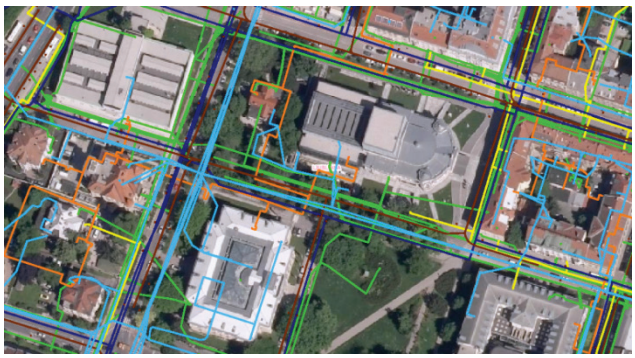

Figure 2 Data of PI cadastre shown in an ortho-photo map (yellow - gas; green - electricity; blue – water; orange – heating; brown – sewage; light blue – electronic communication)

The basis for the Register of spatial units is the integrated database with location and descriptive data, established in 1995. The central database is maintained by the SMA with the help of applications for management, maintenance and the issuing of data. The basic spatial units are: spatial districts, settlements, municipalities, postal districts, administrative units, statistical regions, streets and house numbers. In the register, house numbers are registered and connected to the building cadaster and have a certain position in the space, which was also used in the research of the basis for the determination of the position in the place of individual locations of the network point.

The incumbent operator had to establish the Single operators' information system (EIS), as demanded in an ex-ante regulatory decision on the old relevant market 4: Wholesale (physical) network infrastructure access (including shared or fully unbundled access) at a fixed location. In EIS incumbent operator must enable seekers to access the information about the geographical coverage of all locations, where co-location is possible, including the information on individual connections, connected to the collocation with the accuracy of the street and house number.

3.2 Description of the Process for Detection of Potential Reuse of Infrastructure among the Network Points and Analysis Results

The possibility of alternative fibre-network roll out with the reuse of existing infrastructure was analysed using all of the existing connections between network points from a representative sample. We were looking for possible alternative connections, shorter or same length as the existing SMP network length. We developed the algorithm, which then automatically analysed all the possible connections between two network points, taking boundary conditions into account.

Boundary conditions for the search of the shortest path were established at the 200 m passed from the network point (the same as the home passed criteria). The gaps topology control applies the boundary condition of 0.05 m. The reason for the establishment of this condition lies in the fact that the official data is not always accurate. In the case of electronic communications spatial data, there is a lack of vertex on the crossing between the access and the backhaul network. The algorithm should automatically attach the correct access network to the first shaft of coupling for the backhaul network. Unfortunately, those network elements are not a part of the PI cadastre, because that algorithm set the points on the crossings to enable the segmentation of individual connections. The boundary condition was set to 4, which enabled a maximum of 5 segments for one connection.

The algorithm compares and presents the existing position and length of the incumbent operator's network between two network points and the length of the calculated connections, suitable for reuse by various infrastructures. Fig. 4 presents the compared lengths, the home passed distances, and the owners of the reused infrastructure. It shows the existence of three alternative connections, all of them shorter than the SMP connection. The home passed distances do not exceed 40 meters in any case, as the picture also shows.

Figure 3 The shortest alternative links between network points across different infrastructures using the developed algorithm (red - electricity; brown - sewage; light blue - electronic communication) and related analysis results.

The existing particular length of electronic communications for the incumbent operator is 1701 m between first network point (NP1) and second network point (NP2). The results of the analysis from figure 4 are:

- length of electronic communication network is shorter by 216 m with home passed of 16 m (NP 1) and 2 m (NP 2) and two PI owners;

- length of sewage network is shorter by 238 m with home passed of 17 m (NP 1) and 11 m (NP 2) and one PI owners;
- length of electricity network is shorter by 202 m with home passed of 22 m (NP 1) and 37 m (NP 2) and one PI owners.

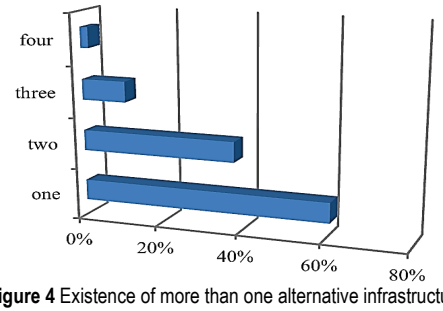

Figure 4 Existence of more than one alternative infrastructure

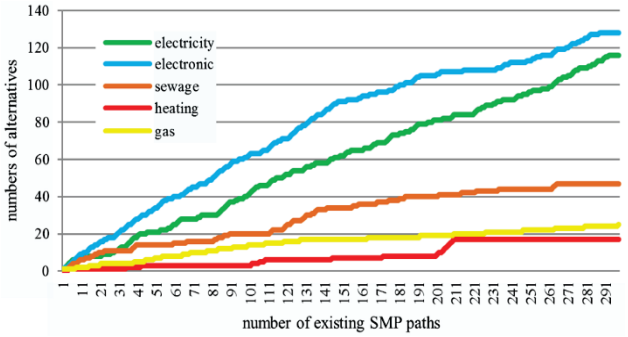

Figure 5 Existence of alternatives by infrastructure

The analysis was made with a representative sample, which took into account the number of alternative connections between two network points of the incumbent operator, with PI taken into account. The analysis showed that in some cases there are several alternatives (natural gas, electricity, heating and sewage networks and electronic communication). With the boundary conditions taken into account, the analysis proved the existence of at least one alternative infrastructure, which can connect two network points in 61%, two alternatives in 38%, three alternatives in 11% and four in 2%. We can claim with great certainty that the results would be improved if all infrastructures in cadastre were properly registered and the positional accuracy was better. The positional inaccuracy is the case of older PI and can in certain cases represent a margin of error of up to 5 metres.

4 CONCLUSIONS

In the article we analysed the possibility of rapid network roll out considering the relevant policy framework and political targets, with the usage of GIS systems. First, we made an overview of the political content and established policies. Next, we placed the discussion into a theoretical context, where we were investigating the works of authors who were already contributing to the issue. Since an identical contribution was not found, we assembled the articles on the infrastructure roll out, investment and GIS systems. Both the policy and theoretical frame show the same outputs, which nevertheless also support our hypothesis. Further on we described the Slovenian telecommunications market, the inspiration for the analysis, which was the empirical test of our hypothesis.

Among the main results is the finding that the reuse of existing infrastructure is actually the common point of all the studies as well as policy documents. The access regulation already exists in the present regulatory framework, while the main differences are the enhanced initiatives for symmetrical and even cross-sector utility regulation, as the development from the asymmetrical regulation of the designation of a significant market power operator.

The analysis confirmed the hypothesis presented in Section 1 of this contribution, saying that the Cost Reduction Directive is the policy that can be used in practice and we can assume it as being market driven. One of the main elements is the reuse of the network, both the telecommunications and the cross-sector utility.

Clearly the idea of the Cost Reduction Directive is that civil engineering costs can be eliminated or at least have a significant reduction with the reuse of existing networks. In the presented case that would be possible in more than 61%, with one possible alternative, 38% with two possible alternatives, and 11% with even three possible alternatives. So the incumbent's network is hardly the only alternative for the connection between two points and therefore that cannot be the case for ex-ante asymmetrical regulation.

Even though the analysis proves numerous regulatory issues, such as the access possibilities for the new entrant and lowering the costs of the network roll out, there are still some issues that are about to be considered. In the sense of the actual use of the network, the important issue is the availability of the network capacities. This issue is covered by Cost Reduction Directive as well, with the obligation of setting the single information point, and investigating in the availability of free capacities by either the NRA or other holder of a single information point. This issue was not considered in the article, but it can represent a challenge for further research.

The results of the analysis show that there are several alternatives to connect two network points, which supports our presumptions that the potential for usage of existing infrastructure for the high-speed broadband networks roll out is extremely high. The market is highly competitive. Both findings lead us to the conclusion that the asymmetrical regulation can be replaced with a symmetrical regulation and cross-sector utility infrastructure usage. In that sense, regulators and decision makers must change the legacy point of view that competition is a final goal. If competition is the final goal, the results are as seen: it has an inhibitory effect, since investors are not incentivized. We must see competition as a market condition that creates a successful and growing market with ongoing development, high quality and affordable prices in the race for end-users.

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