

Political and Economic Contexts of Implementing 5G in Poland and in Selected European Countries

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Abstract—The technology race to achieve the position of an economic leader is a phenomenon that has been taking place all over the world. The 5G technology has become a vital component of this race over the recent years. The technical capabilities it offers and the role it may play in the economy have become the subject of political debate and are at the very core of the “war for technology” between two superpowers: China and the United States. The European Union is aware of the fact that the position Europe enjoys on the international arena depends, to a large extent, on how quickly European countries will develop and implement 5G. Are individual European member states capable of seamlessly implementing the assumptions of strategies and plans concerned with the development of 5th generation technologies? Will the security of 5G networks be ensured in Europe? These are just some of the issues that are analyzed in this article with their economic and political context taken into consideration. A broader perspective is presented, with primary focus on the global geopolitical situation and on the conflict between China and the United States. The study was conducted by relying on an in-depth analysis of strategic state documents, reports drawn up by institutions tasked with implementing and monitoring the development of 5G technology, as well as literature on the subject and online resources.

Keywords—5G technology, cybersecurity, economy, Europe, mobile networks, telecommunications.

1. Introduction

Europe, as well as the rest of the world, is currently implementing fifth generation (5G) cellular technologies. After its technical standards have been agreed upon, the solution is now in the deployment and commercialization phase. 5G is a term that used to describe the fifth generation of mobile network systems supporting mobile voice and data transmission, with Internet access included [1].

5G is not a new concept. It is neither the first nor the last generation of mobile networks. It is merely an update of the technological solutions dating back to the early 1980s, first having the form of analog mobile telephony (1G) and then transformed, in 1991, into digital cellular telephony with the added feature of short text messages (SMS) (2G). The

next step in the development process took place at the beginning of the 21st century, when the third generation (3G) telephony offering fast (by the then-standards) data transmission and Internet access (from 14 to 28 Mb/s). Nearly a decade later, in 2009, the 4G version enabled data to be transferred with the speeds of up to 300 Mb/s. The 5G version being implemented currently will not only speed up the transmission of data by up to 60 times (up to 20 Gb/s), but it will also support more devices per square kilometer (up to 1 million for 5G, and up to 100,000 for 4G) and will reduce transmission delays within the radio network (from 50 ms in 4G to 1 ms in 5G) [2]. While 5G is a regular technological evolution, it is said to be a breakthrough technology [3], since the qualitative change it brings does not concern its technical capabilities, but the role that the 5G may play in the ecosystem of connected devices.

The strategic character of 5G networks may be one of the reasons why this technology has become the cause of the so-called *cold war on tech* [4] and the subject of information warfare that is largely based on misinformation. For the first time in the history of the telecommunications sector, communication technology has become the subject of trade wars and geopolitical games conducted on such a wide scale. Some researchers believe that the term “cold war on tech” is abused in this context [5], as one of the conditions for the cold war to be fought is the formation of blocks, and these are not present here. However, one cannot fully agree with this statement, and the entire political and economic situation is much more complex and highly dynamic, as discussed later in the article.

Along with the start of the public discussion on 5G, fueled by disinformation activities, social protests are mounting in Europe. Protesters demand a full ban on 5G technology, and their actions are not limited to verbal objections, but extend to destroying critical infrastructure, e.g. setting fire to cellular masts.

The purpose of the article is to take a broader look at the current situation related to the deployment of 5G in Poland and in selected European countries. The analysis will focus on two contexts: economic and political. Specific phenomena related to 5G will be presented here, while a detailed

description of its rollout in individual European countries will not be provided. Examples pertaining to the individual countries are also relied upon to depict specific trends that were not observed during the deployment of previous generations of telecommunication technologies. The study was conducted by relying on an in-depth analysis of strategic state documents, reports drawn up by institutions tasked with implementing and monitoring the development of 5G technology, as well as literature on the subject and online resources.

2. Literature Review

The review of literature on political and economic contexts of implementing the 5G technology in Poland and in selected European countries aims to present the current findings in this area and to identify research limitations. Based on current reports and literature, one may determine the approach to this technology adopted by government agencies and the practices they apply while implementing the proposed strategies for regulating wireless connectivity in the context of 5G. The outcomes of the review will identify the results of the work performed in this field.

Because 5G is relatively new, there is little literature on the implementation of the technology itself, especially with an emphasis placed on the political and economic context. Most of the papers are concerned with technical issues [6]–[11]. These articles are dealing with the deployment of networks, compatibility, and other similar technical aspects. The authors of [12] have looked at 5G in more detail and undertook an analysis of the technological change taking place and of its impact on the society. Transition from 4G LTE to 5G is an archetypal example of technological change. In their analysis, they provide a complementary scenario-based assessment of 5G infrastructure strategies in relation to mobile traffic growth and potential development of the Internet of Things (IoT), Smart Cities or other technology developments (services) that rely on digital connectivity. The experience of the United Kingdom, the Netherlands and India is given as an example [13]–[15].

According to Fettweis and Alamouti [16], the 5G technology is a critical step in the development of wireless connectivity. The authors of [17] argue that 5G cellular communications will be another paradigm shift redefining our future and impacting our societies in ways which cannot be foreseen. A Qualcomm report [17] describes the benefits of 5G and focuses on the commercial benefits achieved by implementing this technology. As noted by the authors of the report, this network standard will significantly expand the potential of various spectra, and its high-band properties will help increase capacity in various areas.

Additional information about the economic context of 5G implementation is offered by a report drawn up by Deloitte [18]. It describes the current competitive trends in the market and the innovative networks that are necessary for the transition from 4G to 5G. The increase in poten-

tial profits that wireless carriers may generate thanks to the launch of the new system is a motivation to seek quick implementation of the plan [18]. As a result, the pace of the transition process may differ in individual countries and the scope of the work that needs to be performed may be different as well [19]. Therefore, a need arises to design and introduce specific laws and regulations required to implement 5G.

Some authors focus also on security-related aspects of 5G [20]. In recent years, many authors have been focusing on Huawei and on China's position in the technology race (with particular emphasis placed on cybersecurity). The authors of [21] are concerned with standardization and examine China's standard-related initiatives undertaken on the international scene, perceiving these from the point of view of techno-nationalism and of China's specific interests in Europe. In [22], Kowalski examines the Czechia–China relations in the 2010s, focusing on the theoretical framework of relationalism – an approach, adopted by the Czech ruling and financial elite in an attempt to gain economic benefits from the partnership with China. It is important to know that Prague was selected as the center of European operations of the powerful – at least until recently – CEFC China Energy corporation.

As far as the economic and political context is concerned, three articles are of particular importance. Lemstra [23] asks the following question: “What explains the success of 2G GSM and how can it be applied to create success with 5G in the European Union?” In an attempt to answer this question, the article presents two images of potential 5G futures, titled “evolution” and “revolution”, serving as an input to the political debate on 5G leadership options. These images reflect two extremes in terms of potential 5G futures. Evolution follows the pattern of previous generations and current trends. Revolution clearly breaks away from these trends and from the path to leadership with 5G, as it leverages the power of standard APIs to build specific services, enabling network virtualization as the architectural backbone of 5G.

The problem of Chinese technological presence in Europe is described by Kavalski in [24]. He concentrated his attention on CEE countries. Kavalski offers a brief overview of the history of this relationship by focusing on the “17+1” mechanism. The article asks whether there is anything other than an instrumental economic justification for CEE countries' willingness to partner with China. This is also one of the topics of this article. The problem of information and trade war between the US and China is also raised by Longtin [25]. Focusing on the geopolitical context, he explores the innovation policies of Nokia and Huawei to understand how the Chinese company was able become the leader of that sector.

The number of publications on 5G is immense. However, it is difficult to identify any papers focusing on political and economic contexts of implementing the technology. Social, technical and economic challenges related to 5G are described by Pandey *et al.* [26], but in the context of India.

Insights concerning the UAE are given by AlRaesi and Habibur [27] who describe the proactive approach to the deployment of 5G. Its comparison with the European approach and the results achieved may be a very interesting subject for future studies.

3. Political Context – Europe and Member States

It is assumed in literature that the features of 5G networks listed in the introduction, such as higher bandwidth, reduction of delays and increased number of connected devices (up to 1 million per square kilometer), will contribute to boosting competitiveness and innovative nature of the economy [28]. The use of sensor networks or autonomous vehicles and robots will accelerate the adoption of Industry 4.0. 5G networks and the services offered based thereon will make peoples' lives easier. Uneven pace of and delays in the deployment of these networks will create inequalities and may result in digital re-exclusion of large areas of Europe.

The deployment of 5G in Europe is based on two strategic documents: 5G for Europe: *An Action Plan and Connectivity for a Competitive Digital Single Market: Towards a European Gigabit Society* [29]. In these documents, two main objectives were adopted: enabling 5G connectivity as a fully developed commercial service in at least one major city by 2020, and uninterrupted and secure access to the 5G network in all urban areas and on all major terrestrial transport paths by 2025. 5G networks are to be developed in Europe by relying on the 700 MHz [30], 3400–3800 MHz [31] and 26 GHz [32] frequency bands. According to European Union documents, the Member States were to develop their own strategic documents for the deployment of 5G networks.

According to the European 5G Observatory [33], despite the recommendations of the European Commission, only 11 EU countries have published their national 5G development strategies. These include: Austria, Germany, Italy and Estonia. Some countries have also published national broadband plans. In total, various forms of 5G deployment plans were announced by 27 European countries (26 in the EU and the United Kingdom).

In Poland, the *National Broadband Plan* [34] has been drawn up and was amended by the government on March 10, 2020 the *5G Strategy for Poland* that was made available to the public for consultation in January 2018 was to be another of the key documents, but the consultations have not been completed as of the end of June 2020 and the document has not been officially adopted [35]. These documents are based, to a considerable extent, on their European counterparts and on the goals, time frames and tools set and developed for the deployment of 5G. Problems with refarming the 700 MHz band for 5G systems that were caused, inter alia, by the delay in concluding a cross-border agreement with Russia [36] and by the need to adapt the

digital terrestrial television network [37] accordingly, resulted in the postponement in issuing the applicable clearance until the second half of 2020 [38]. Consultations concerning the 3.4–3.8 GHz frequency band auction documentation were in progress until the end of February 2020. Ultimately, the auction has been scheduled for March 7, 2020, but due to the COVID pandemic, it was postponed and then canceled altogether. Confusion concerning the 3400–3800 MHz band auction delayed the Polish launch of 5G services relying on those frequencies by at least six months, despite the fact that all operators call for those frequencies to be made available to them as soon as practicable [38].

To accelerate the deployment of 5G in Poland, it is imperative that a tender or an auction be held and that bands be made available. Legal regulations required to facilitate investment processes and construction of 5G network infrastructure need to be passed as well. It was only at the beginning of 2020 that standards setting the permissible electromagnetic field levels were adjusted to EU requirements [39], [40]. Polish EMF standards in effect previously were originally introduced in 1984 and were based on Soviet Union specifications from an era when no cellular networks existed. They were extremely restrictive and contributed to slowing down the expansion of 4G networks [41].

The specific traits of 5G networks deployed in urban environments require the installation of a dense network of small transmitters (3.4–3.8 GHz or 26 GHz). Therefore, in order to offer 5G coverage in urban areas, it is necessary to install a great number of small antennas on urban infrastructure (buildings, road signs, power line posts, etc.) [41, p. 35]. On June 30, 2020, the European Commission adopted an *Implementing Regulation on small-area wireless access points or small antennas*, ordering the installation of such small base stations in all member states based on a permit-exempt deployment regime [42]. In Poland, under the *Act on supporting the development of telecommunications networks and services*, the obligation to obtain a building permit has been partially abolished and replaced with an obligation to notify given project. Fees due for access to vertical infrastructure have been waived as well [41, p. 36]. At the same time, however, the Ministry of Environment listed base stations as undertakings that may exert a significant impact on the environment, thus doing away with the facilitating measures introduced previously [43]. According to the Polish Chamber of Information Technology and Telecommunications (PIIT) and the Polish Chamber of Commerce for Electronics and Telecommunications, this will definitely hinder the construction of 5G networks. Regulation of the Minister of Digitization on the minimum technical and organizational measures and methods that telecom companies are required to adopt to ensure the security or integrity of networks or services, will enter into effect by the end of the year [44]. The said Regulation requires operators rendering 5G services to comply with 5G cybersecurity standards related, inter alia, to threat

identification and prevention mechanisms. It also ensures competition between suppliers and calls for conducting security audits. Regardless of the said Regulation, special requirements will also be laid out in the decisions pursuant to which right to use the 3400–3800 MHz band will be awarded in an auction or a tender, but the wording of these requirements still remains unknown.

4. Economic Context. Development of Commercial 5G Networks

As far as the technology relied upon in designing 5G networks and user terminals is concerned, one may state that its implementation is already underway in Europe. However, contrary to previous predictions by experts, it is not the industrial sector, but users of high-speed Internet who have turned out to be the first customer group. The search for European “unicorns” harnessing the potential of 5G networks is still ahead of us.

The first 5G smartphones were introduced in Europe in the second and third quarter of 2019. The first commercial deployments focus on offering enhanced mobile broadband (eMBB) services, with increased bitrate for data transmission customers. Solutions involving a significant reduction in delays, ultra reliable low-latency communication (URLLC), and an increased number of devices (massive IoT) have not yet been implemented commercially.

By the end of March 2020, 5G commercial services were deployed in 10 countries: Austria, Finland, Germany, Hungary, Ireland, Italy, Latvia, Romania, Spain and the United Kingdom [45]. Tests are still underway in other EU countries. By the end of 2019, over 181 tests were announced, and 5G networks were launched commercially in 130 EU cities. So far, Italy, Germany, France, Spain and the United Kingdom have conducted the highest number of tests in Europe.

In Poland, due to administrative delays in making the harmonized European spectrum available to operators (caused by the reasons described in the part of the paper dealing with the political context), the implementation of the first commercial 5G services, forced by commercial demand and strong competition among Polish operators, occurs with the use of frequencies other than those comprising the European harmonized bands. Polkomtel has launched a commercial service using the 2.6 GHz band, with Play and T-Mobile Polska relying on the 2.1 GHz band. Orange Polska announced that these services would be launched in July 2020, under reserve that this deadline may be postponed to the end of the year [46].

As far as tests of the 5G technology relying on the EU-wide harmonized bands are concerned, the first tests of 5G networks operating in urban areas were performed in September 2018 by Orange Polska [47]. In June 2019, another mobile operator, Play, cooperating with the Office of Electronic Communications, Łódź University of Technology, Ericsson and the Łódź Special Economic Zone,

signed an agreement to join the *S5 – Akcelerator* pilot program. It aims to foster innovative solutions relying on 5G technology [47]. Therefore, Łódź has become Poland’s first city mentioned in the *5G for Poland Strategy* to pilot the solution. 5G devices have already been tested by T-Mobile and Polkomtel as well. The aforementioned tests are of technical nature and are subject to restrictive territorial limitations, with the services offered not being available commercially. Unlike in many other EU countries, no research or development programs concerning 5G tests and pilots promoting the technology (i.e. identifying economic unicorns and innovative services) have been conducted or established in Poland.

The cost of investing in 5G networks is huge, and the expenditures may be even higher due to reckless regulatory decisions taken in light of the trade war discussed below. Therefore, profitability may only be ensured by finding users who, by offering innovative services for industry or agriculture, will foster demand for telecom services that are more expensive than telephony or regular (even fast) Internet access. Simultaneously, it is important to ensure that the cost of building these networks remains as low as possible. These barriers in Poland were to be resolved by the *Polish 5G* agreement [48] proposed in 2019 at the initiative of Exatel, the Polish Development Fund Group and four operators: Orange Polska, T-Mobile Polska, Polkomtel, and Play. Its goal was to create a business (wholesale) model for building a common infrastructure for the 700 MHz band. The state would have a majority shareholding in the project and would contribute the 700 MHz frequency band, while the operators would make passive infrastructure and financial contributions [49]. However, no specific solutions have been reached so far.

On the other hand, research programs have been introduced by governments of other countries: willing to stimulate the country’s economic growth, the UK government allocated 200 million pounds for testbeds and trials of new applications [50], Germany provided 26 million euros in funding to support three research projects focusing on cities, the medical sector and university campuses [51]. The Czech government also organized a competition for cities that are eligible to obtain. 2 million Czech crowns for testing their 5G networks [52]. The authorities of Vienna came up with a city-led initiative allocating 20 million euros to the development of the 5G network in the Austrian capital [53].

Some governments have set up special organizations, such as *Invest in Finland* – an entity operating in Nokia’s motherland [54]. It is a government organization dedicated to financing innovation and promoting trade, travel, and investment. One of its goals is to implement “communication of the future” systems. It was the Finnish mobile operator Elisa [55] that launched the world’s first 5G network. Hungary implemented an interesting solution by launching the *5GC project – the Hungarian 5G Coalition (5GK – Magyarországi 5G Koalíció)* [56], comprising representatives of the government, market players, and academia

members. Its purpose is to plan and coordinate the implementation of the network in Hungary. Thanks to this initiative, Hungary has become one of the first European centers for 5G development (alongside Austria, Germany and Estonia). The first switchboard in Hungary was commissioned in July 2018 at the Magyar Telekom headquarters in Budapest [57].

All European countries need to invest in constructing 5G networks due to two reasons: economic competitiveness and citizens' access to next-generation digital services. Such investments will also translate directly into attracting modern, technologically-advanced projects, i.e. the so-called Industry 4.0, thus increasing the number of jobs on the market. According to the European Commission, 5G networks will be one of the most important components of the digital economy in the next decade. It is estimated that global revenues related to the development of 5G-based services will amount to 225 billion euros in 2025 [28, p. 21]. With such data taken into consideration, the trade war on tech fought by the world's superpowers is of great financial significance as well.

5. Network Security in the Context of a Global Conflict of Superpowers

The projected economic and geopolitical importance of 5G results in many countries paying close attention to the option of interfering with the free market and the freedom of economic activity by introducing specific rules to ensure the security of 5G networks [58]. So far, operators have been enjoying full independence in choosing suppliers of their network components, remaining responsible for the security of their networks and for ensuring confidentiality or compliance with regulations set forth in the General Data Protection Regulation (GDPR). The initial lack of specific European regulations regarding 5G networks resulted in the approaches taken by different countries not being uniform. Consequently, due to its economic dependence, Europe has become a venue of a direct "trade war on tech" between the US and China. As a result, network security has become a part of the political agendas of European countries deliberating their economic interventions policies.

Globally, the most controversial steps (justified by the need to ensure the security of the network and of the economy), were taken by the US. By means of an executive order, the country banned the use of telecommunications equipment manufactured by companies recognized as a threat to the national security [59]. The order concerned mainly manufacturers from China, as it was this country that was identified as a "strategic competitor" in the US national security strategy [60].

China is developing the so-called Digital Silk Road (DSR). The project assumes that undertakings in the field of technology, 5G networks and e-commerce will be implemented in cooperation with selected countries. The goal of DSR is to promote China's own technology standards. The ri-

valry with the U.S. and the importance of the digital sector during the COVID-19 pandemic have exerted even more pressure on China [61].

Huawei Technologies, a Chinese company founded in Shenzhen in 1987, is at the very center of the dispute. It is one of the leaders in the 5G technology market, is present in 170 countries around the world and has been active on the European market since 2000. The controversy around the company stems, inter alia, from the escalating dispute between the US administration and China. Both of these countries are engaged in growing competition for global technology leadership. The US has made multiple allegations against the Chinese tech tycoon, accusing it of stealing trade secrets of American companies, violating international bans and supplying Iran with equipment that allowed it to monitor anti-government demonstrations in Tehran in 2009, and of attempting to conceal Huawei's business exchanges with North Korea, taking place despite the economic sanctions imposed on this country [62]. Allegations of corporate espionage have been made as well [63]. The company disputes the said allegations, while the Chinese Foreign Ministry accuses the US government of "economic bullying behavior" and of misusing security issues to "suppress Chinese enterprises with unwarranted charges" [63]. In addition, Huawei filed a lawsuit in New Orleans in December 2019 challenging a recent FCC decision that prohibits U.S. operators from using federal subsidies to purchase Huawei equipment [64]. At the same time, the US calls on other allied countries to boycott the implementation of Huawei's 5G technology, using NATO structures for this purpose as well [65].

In Europe, attitudes toward this technology war vary from one country to another. At the initial phase of the network security debate, Washington secured the support of Romania, Poland, Estonia, Latvia, and the Czech Republic, all of which signed joint 5G security statements or memorandums with the US government [66]–[70] declaring their intention to provide access to their 5G networks to "trusted suppliers" only. The statements themselves, however, are of little value. They must be backed up by laws forcing telecom companies to abide by their terms. In Poland, the government fast-tracked regulations on 5G security, canceling the 5G spectrum auction that was already in progress and demanding the telecommunications market regulator (President of the Office of Electronic Communications) to include specific obligations in the terms of the repeated auction [71]. As of the end of June 2020, this has only resulted in delaying the process of making the 3400–3800 MHz spectrum band available to Polish 5G layers by at least six months.

The Estonian Parliament passed amendments to the Electronic Communications Act, requiring operators to coordinate with the national communications authority on 5G deployment [72]. This means that national security and intelligence agencies will be able to interfere in the process by imposing restrictions on supplier selection. The Czech Republic turned out to be a strong European supporter of the

American approach, relying on the *Prague principles* [73] that have allowed to reach a Western consensus on Chinese suppliers [74].

The German government is skeptical of Washington's allegations against Huawei. German operators (Deutsche Telekom and Vodafone) operate 4G networks that rely (to over 50%) on Huawei hardware [74]. Germany also fears that a ban on purchasing equipment from Chinese suppliers will seriously damage its economic ties with China – the country's largest trade partner. Deutsche Telekom has presented an analysis in which the exclusion of Huawei from the 5G market is labeled as the "Armageddon scenario" expected to generate additional 3 billion euros in costs [75]. Discussions are ongoing, however. Under the pressure of the parliament and Angela Merkel's smaller coalition partners, the German Federal Ministry of the Interior proposed, in May 2020, a draft law [76] that would enhance the security requirements binding upon 5G providers, simultaneously providing the ministry with new powers to block non-trusted suppliers. It remains known how the government plans to assess the trustworthiness of suppliers, as unspecified certification mechanisms are being considered.

France has adopted a different approach, as it has attempted to assume a leading role in 5G security in Europe. National security checks were carried out in the country, focusing on cybersecurity policies in effect at the individual operators, as well as on their suppliers choices. In 2019, the government, operating via the Cybersecurity Agency, was authorized to block base stations (RAN) used by service providers if their operation would pose a threat to national security. The said right was added to the package of regulations binding upon telecom companies [74]. The entire telecommunications infrastructure has been recognized as being of critical importance for the state – an approach that paves the way for deep interference with economic freedoms. However, no final decisions to exclude Huawei from the process of building 5G in France have been made so far. The Chinese are trying to influence the decision-making process in Paris by promising to invest millions in constructing Europe's largest manufacturing base [77]. However, the outbreak of the pandemic has put that process on halt.

The decisions of Italy, Belgium and the Netherlands also seem to be important for both the US and China. In 2019, the government of Italy – the EU's third largest economy – adopted Legislative Decree No. 64/2019 (DL 64/2019), which amends the law known as the *Golden Power Legislation* (*Legislazione sul potere d'oro*), governing the state's powers to intervene in transactions involving enterprises operating in the defense, national security, communications, energy and transport sectors ("strategic sectors") [78]. The change allows the government to block contracts between operators and equipment suppliers [79]. At the end of 2019, new cybersecurity "perimeter" regulations were passed, which would impose new requirements on telecommunications and IT services used in "strategic sectors" [80]. The government is now finalizing the list of enterprises,

sectors and government organizations that would be subject to the stricter regime.

Belgium is a strategic country, as it is a host for the NATO headquarters and the key EU institutions. The country's intelligence services have recommended the government to limit the use of "non-trusted suppliers". The administration is working on law amendments that are to restrict the participation of Chinese suppliers, at least in the so-called "core" of the network [81].

The Dutch government, traditionally close to the US in regards to cybersecurity and intelligence, also adopted a new law in December 2019 [82]. It allows to ban the sales of goods if there is a suspicion that they may sabotage the telecoms network, or that their suppliers have close ties with or legal obligations towards foreign governments that could pose a security threat. The Netherlands has previously indicated that this means a ban on the use of equipment from high-risk suppliers in the so-called "core" of the network [74].

Those European countries which are undecided, with their governments continuing to consult telecom companies, intelligence services and market regulators on the proposed legal amendments that would eliminate high-risk suppliers, continues to prevail as of mid-2020. These include, inter alia, Spain, Portugal, Luxembourg, Sweden, Austria, and Finland.

The Spanish economy minister announced, in February 2020, that she was working on legal acts regulating network security issues. However, the COVID-19 epidemic caused delays in legislative work and the spectrum auction was postponed to a later date [83]. At the same time, Spain's largest operator, Telefónica, declared that it would reduce the share of Huawei's equipment in the modernized networks, but would continue to use it nonetheless. The second largest operator, Orange, confirmed its cooperation with ZTE, Huawei and Ericsson on the Spanish market [84]. It seems that Spain has adopted a liberal approach focusing on the overriding goal of development and mass-scale deployment of 5G [28].

The above was confirmed on the 10th of October 2020, during the XXXI Spanish-Portuguese summit. Spanish Prime Minister Pedro Sanchez announced that Telefonica guaranteed that 5G coverage in Spain would reach 75% by the end of 2020. This will be done in cooperation with Huawei, although he did not exclude the possibility of cooperating with "other foreign entrepreneurs". Moreover, the governments of both countries announced the adoption of a "Joint Cross-Border Development Strategy". They also planned to work on specific infrastructure projects, with the construction of AVE (high-speed rail) between Madrid-Lisbon and the implementation of a new 5G technology reality, known as "Atlantic Corridor", being the most important of them [85].

No final decisions have been made by Sweden (the home of Huawei's European competitor – Ericsson) and Finland (the home of another European competitor – Nokia) [86]. In Finland, Huawei equipment is widely used in 4G networks. At the same time, the US – a country which is

falling behind in 5G and does not have any domestic suppliers offering 5G networks, is considering purchasing shares in Ericsson and Nokia through its economic tycoons, such as Cisco or Google [87]. Simultaneously, American companies, such as AT&T, Dell, Microsoft, Intel and Infineon, closely support the development of the Open RAN standard. Korea's Samsung and China's ZTE are also involved in the work on that standard, and the participating operators include also China Mobile, Deutsche Telekom, and Orange [88]. However, this solution is not ready yet. The work is ongoing and its results will most likely be harnessed while focusing on the 6G network in 5 to 10 years' time.

An approach similar to that taken by the French (but only in the field of 5G) is considered by Denmark which is preparing legislations classifying the entire 5G network as critical infrastructure [89]. As a result, China, referring to the violation of the *GATT Free Trade Agreement*, threatened to terminate a free trade agreement between the Faroe Islands (an autonomous part of Denmark) and China if Denmark failed to sign the 5G agreement with Huawei [90].

After initial hesitation, Great Britain joined the coalition with the United States and proposed an alliance of 10 countries to reduce reliance on China in the process of introducing 5G technology [91]. Such an alliance would be made up of Australia, South Korea, India and the G7 countries (France, Japan, Germany, USA, UK, Italy, and Canada). The initiative is a result of concerns about Huawei's and ZTE's domination in the process of deploying 5G in Europe. Interestingly, the UK government previously approved Huawei's participation in the construction of the 5G network in the country, but at the same time imposed a cap of 35% on Huawei equipment's market share [92].

As far as European countries open to all 5G equipment suppliers are concerned, one may list Austria whose chancellor has publicly announced that his country is "fundamentally technologically neutral" and does not intend to succumb to US pressure in the area of excluding Huawei from 5G deployment [93]. The prime ministers of Slovakia [94] and Hungary [95] adopted a similar attitude.

The president of Russia has assumed a strong stance with this regard. The deal between the Russian company of Mobile TeleSystems and Huawei, concerning the deployment of the 5G network, was signed in an almost ceremonial manner, in the presence of the presidents of China and Russia. According to CNN, "Russia does not share the US security concerns and even suggests that the deal is a try-on for an internet iron curtain" [96]. This stance shows that the notion of a cold war on tech [97] has some justification, although not everyone agrees. Kaan Sahin claims [98] that one of the conditions for the Cold War to come into existence is the emergence of blocks, as it was the case in the second half of the 20th century. According to him, these are absent in this trade war. However, the US administration's policy of polarization and the emergence of a Chinese-Russian block seem to contradict this optimistic assumption. On the worldwide scene, Australia has also introduced a ban on the use of Chinese equipment in 5G net-

works. The division into countries supporting the US and defending themselves against pressure to eliminate Huawei from the market becomes ever more apparent in Europe as well.

We shall see, in the coming years, whether such a division will be gaining in importance, considering the fact that the world is moving towards disintegration of the Internet (China, Russia, Iran, etc.). Will the division of the Internet into separated and filtered regional blocks result in the division of technology providers serving separate regions? It seems that such a thought is becoming ever more prevailing among the important politicians of the superpowers. But does it make any sense? To judge this, one needs to take a step back in their considerations and look at security from the technical perspective.

6. Conclusions

The article reviews the current situation related to the deployment of 5G in Poland and in some other European countries. The rollout of 5G in Europe has been set in an economic and political context, and is presented from a broader point of view, with the global geopolitical situation and the conflict between China and the US taken into consideration. 5G-related phenomena, such as deployment delays observed in some European countries, are also presented. Examples of specific European countries were likewise used to present trends that were non-existent during the implementation of previous generations of telecommunication technologies.

After a critical analysis of reports drawn up by institutions monitoring the development of 5G, as well as strategic documents of the individual states, literature of the subject and online sources, one may conclude that two main reasons exist as to why investment projects concerned with the construction of 5G networks in Europe are of such great importance. The first of those reasons is Europe's desire to ensure its economic competitiveness in its relations with the rest of the world. The other is the citizens' access to next-generation digital services. These two aspects are directly related to the global desire to take advantage of the benefits offered by Industry 4.0 – a phenomenon that is most likely to boost economic growth and create new jobs. Europe's position on the international arena depends on how quickly European countries will develop and deploy 5G. Each country pursues its own economic policy and struggles with other internal problems, meaning that the progress in developing and deploying 5G networks may not be even in different European states.

Network security is also crucial, especially in the context of the global conflict between two superpowers (US and China) over dominance in the deployment of 5G. Due to China racing ahead and the US lagging behind, this conflict is escalating to other countries, including those in Europe. The pressure to exclude the Chinese company of Huawei from the market, exerted by the US, has resulted in divisions, also in the European Union. The dependency of

specific countries on a single 5G vendor will result in the lack of diversity in the area of devices and solutions used. Consequently, the pace of innovation may slow down both at national and European level (in the absence of competition), and the 5G infrastructure may become more vulnerable from the security point of view, especially if multiple operators rely on one vendor only. Such a supplier may come under commercial pressure, be sanctioned, or simply fail commercially. Another key point is that a limited number of vendors may lower the market incentive to develop more secure products. It is not clear whether this higher financial cost will result in greater security, as China will not be eliminated from the supply chain of European producers within the next decade.

5G will be crucial in the context of ensuring economic growth of European countries. At the same time, it is also an element of political discussions centered around technological security, the “war on tech” and information warfare, fueled by disinformation. Therefore, social protests are mounting, also in Europe, demanding a total ban on 5G. The protests are not limited, in an increasing number of cases, to verbal dissatisfaction, involve but also destruction of critical infrastructure. In recent months, Europe has witnessed a wave of antenna towers being set on fire. Unfortunately, in mid-2020, in its documents serving as a foundation for the rollout of 5G in Europe, the European Commission failed to elaborate on how to win social acceptance for 5G and did not propose any actions aimed at expanding the technical knowledge of European societies. This lack of social acceptance, caused mostly by ignorance and fear, could affect the pace of 5G development, thus slowing down Europe’s economic growth and depriving it of its position in the international economic race.

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