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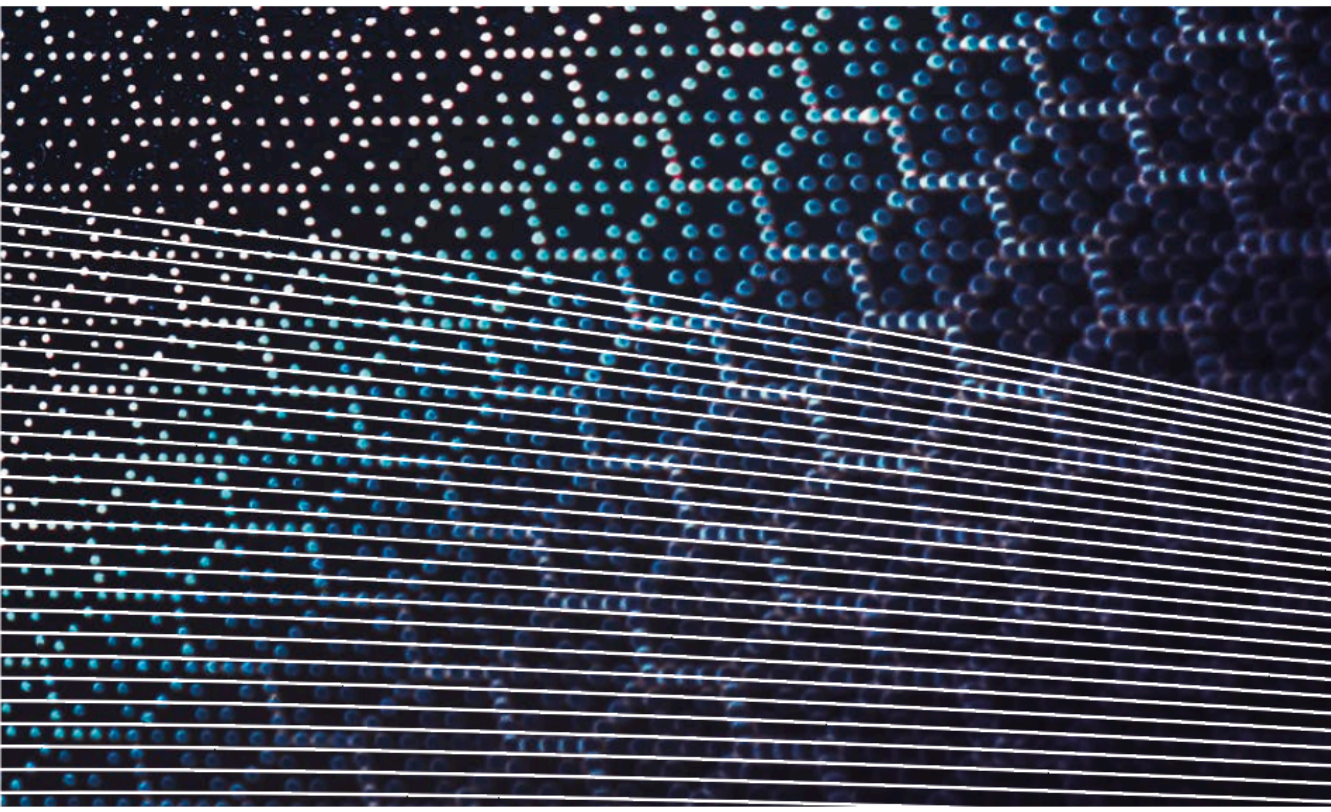

DIGITAL ECONOMY IN CENTRAL AND EASTERN EUROPE

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Preface

China-CEE Institute announced a “Call for Proposal” research program in May 2020. Among the proposals received, one research proposal is “Digital Economy in Central and Eastern Europe”. What we are presenting here is the result of this research project, conducted by a research team from Infokommunikációs Stratégiai Kutatások Intézete (ISKI Consulting Limited, Hungary), Tongji University (China) and Corvinus University (Hungary).

The project is composed of two separate subsections. The first subsection is the CEE subsection that focuses on analyzing the regional development in CEE countries in digital economy, and the other is the Hungarian Country Case subsection that concentrates on the special features of the Hungarian digital economy. In both sections, the research team used a combination of primary and secondary research methods.

The analysis result is summarized in the first chapter of the book, where the research team calculated the regional average of each DESI indicator and compared its development with that of the EU average, compared each CEE country Digital Economy and Society Index (DESI) indicator with the regional average and identified some common development features for the region, and also analysed each regional country's development for the period of 2016-2020, taking into account 36 detailed DESI indicators. The second chapter focuses on national initiatives in Central and Eastern Europe by using secondary research methods, and the third chapter provides an analysis of cooperation potential between China and the CEE region in the infocommunications sector. The Hungarian Country Case is covered by two chapters: The fourth chapter provides an overview of the national digital programs in Hungary and also presents a comparison of Hungary’s DESI indicators with that of EU member countries, and the fifth chapter sheds light upon China-Hungary

cooperation in the infocommunications sector via a more detailed approach.

The China-CEE Institute, registered as a non-profit limited company in Budapest, was established by Chinese Academy of Social Sciences (CASS) in April 2017. The Institute aims to build ties and strengthen partnerships with academic institutions and think tanks in Hungary, Central and Eastern European countries, as well as other parts of Europe. The China-CEE Institute encourages scholars and researchers to carry out joint researches and field studies, organizes seminars and lecture series, holds training programs for students and junior researchers and publishes publications, etc.

The views in the book are represented by the individual authors instead of the China-CEE Institute. I hope this book will help enrich the research literature on digital economy in CEE countries.

Prof. Dr. CHEN Xin

Executive President and Managing Director, China-CEE Institute

Deputy Director General, Institute of European Studies, CASS

Research Methodology and Topics

The starting point of our research plan was the objectives given by the Call for Proposal by the Chine-CEE Institute:

- to analyse the development of the digital economy in the CEE countries, including its status quo, its preparedness, and its potential for the catching-up process.
- as an addition to the above to provide a specific country analysis

As a consequence, we have divided the project into two separate subsections.

The **CEE subsection** focuses on analysing the regional development in CEE countries, the **Hungarian Country Case subsection** concentrates on the special features of the Hungarian digital economy. In both sections, we used a combination of primary and secondary research methods.

For the CEE study, there is a comprehensive, publicly available database that could be used for our regional analysis. From 2015 on, the EU Commission publishes its yearly Digital Economy and Society Index (DESI) database and country reports. DESI is a composite index that summarises relevant indicators on Europe's digital performance, and the country reports evaluate the development of digital economies of EU Member States.

The DESI covers the five critical aspects of the digital economy:

- The Connectivity dimension measures the deployment of broadband infrastructure and its quality.
- The Human Capital dimension measures the skills needed to take advantage of the possibilities offered by digital services.
- The Use of Internet Services dimension accounts for a variety of online activities, as well as online shopping and banking.
- The Integration of the Digital Technology dimension measures the digitization of businesses and e-commerce.
- The Digital Public Services dimension measures the digitization of public services, focusing on eGovernment

The 2020 DESI database, published in May this year, provided for us an excellent opportunity to measure and evaluate the progress of the region in the most critical dimensions of the digital economy for the period 2016-2020. The availability of such DESI dimensions like digital skills or Integration of digital technology by businesses helped not only to evaluate the present status quo, but also the preparedness and the potential of the region for catching-up the more developed countries. The DESI database covers the EU member states, the biggest and the more developed countries in the CEE region. Unfortunately, some countries from the Western Balkan region, like Serbia, North Macedonia, or Albania, are missing.

The result of our analysis was summarized in the first chapter of our paper, where the following method was used:

- We calculated the regional average of each DESI indicator and compared its development with that of the EU average.
- We compared each CEE country DESI indicator with the regional average. We identified some common development features for the region.
- We also analyzed each regional country's development for the period of 2016-2020, taking into account 36 detailed DESI indicators.

In the second chapter of our paper **on national initiatives in Central and Eastern Europe**, we used secondary research methods. In the framework of its Digital Agenda strategic program, the EU Commission has requested the national governments to develop and publish their National Broadband Plans National Initiatives on Digitizing Industry (e.g. Industry 4.0 programs). These national programs are publicly available, and because the planning methodology is similar in the different countries, they are comparable with each other. Our research has identified some common features of them and also evaluated the progress of their implementation.

The third chapter of our paper provides an **analysis of cooperation potential between China and the CEE region in the infocommunications sector.** This is an unexplored but promising area for further research. The concept of "Digital Silk Road" is a widely used term; both the Belt & Road and 17+1 Cooperation official documents have references to it. In this chapter, we also give an overview of the regulation of digital markets in the European Union. If Chinese digital

companies want to enter and operate on European markets, they have to understand and adapt to these rather complicated rules. The third topic in this chapter is the EU Commission Recommendation on Cybersecurity of 5G network. There is a lot of publicity on this topic, but most of the publications are one-sided, without referring to official EU documents. We provide a detailed analysis of these official documents and present the next steps of this ongoing regulatory process.

The **Hungarian Country Case** is covered by two chapters.

The fourth chapter of our paper provides an **overview of the national digital programs in Hungary** and also presents a comparison of Hungary's DESI indicators with that of EU member countries. In the analysis, we used the public DESI 2020 database, but also ISKI's own Hungarian market database as well. We will concentrate on the comparison of Hungarian development trends with that of the region and of the whole European Union.

In the last five years, the Hungarian government has issued several development programs concerning the digital economy. ISKI took part in the design of the Superfast Internet Project (SZIP) financed by EU structural funds. This was a very successful program, and it makes sense to pay special attention to this project.

In the fifth chapter, the **overview of China Hungary cooperation in the infocommunications sector** can be more concrete than the third chapter for the CEE region. Our team members have got several years of working with Chinese infocommunications companies like Huawei or ZTE, and they are aware of their recent plans and projects. We have summarized the lessons from the bilateral cooperation in the period 2003-2019. We have also provided insight into the ongoing 5G projects with the participation of the above Chinese companies. Finally, we have presented the results of interviews with representatives of market players and observers on the future development potential of bilateral cooperation. In our opinion, Hungary can provide an example for the other regional countries, how to use the benefits coming from the bilateral cooperation and at the same time complying with the EU rules

Main Results

Without going into detail, we present some of our main findings from certain chapters in order to raise the attention of those readers who are interested only in a special chapter.

The analysis of CEE countries based on the DESI indicators gave the following interesting results:

- In 2020 taking into account the overall development level of the digital economy of the CEE countries is just slightly below the average of the EU28. The regional average of overall DESI scores of EU11 countries is just 7 points less than that of the EU28 countries.
- On the other hand, the differences between the overall DESI scores of individual CEE countries are rather substantial. Romania and Bulgaria are the most important laggards; Estonia and Lithuania have the highest scores.
- Taking into account the increase of the DESI connectivity index, the CEE region has reached excellent results in the past five years. In 2020 the regional average of connectivity index even exceeds the EU level. Hungary and Latvia are the leaders; Bulgaria and Croatia are the laggards. The differences between the individual countries are rather substantial.
- Taking into account the digital technology integration index, the position of the CEE region is far worse than in the other dimensions. In 2020 the regional average is 11 points below the EU average. The differences between the individual countries are rather substantial. Hungary, Bulgaria, Romania, and Poland are the most important laggards.

From the chapter on the cooperation between China and the CEE region in the infocommunications sector, we have selected the following conclusions:

- Although Digital Silk Road as a concept can be found in different official BRI documents and was always on the agenda of different BRI events, in Central and Eastern Europe, this concept was basically not implemented in practice.

- The above statement is also valid for 17+1 Cooperation. Some topics related to the digital economy are mentioned in the official documents, but in most of the cases without going into details and without setting up concrete implementation measures.
- On the other hand, from the analysis of the recent official documents of BRI and 17+1 cooperation we can see that they correctly identify those areas which have the highest potential for future development. Business digitization and e-commerce are those issues where the digital economies of Central and Eastern European countries are lagging the other EU member countries, and the cooperation with Chinese companies could deliver substantial benefits for both parties.
- From the assessment of the official EU documents on Cybersecurity of 5G networks, we can conclude that there are no binding EU regulatory rules on this issue. The recommendation and the toolbox, although they provide some guidance, but also ensure substantial room for national governments to make their own choice between security and economic aspects of network implementation. The Commission carefully avoided the country- and vendor-specific statements. This provides certain relief for such Chinese vendors like Huawei and ZTE.

From the chapter on the national digital programs in Hungary, the following statements are the most important:

- In 2014, the Hungarian government prepared the National Infocommunications Strategy (NIS) for the period 2014-2020, in accordance with the Digital Agenda initiative adopted by the European Union in 2010. Based on this, the Hungarian government set the goal of making the development of telecommunications infrastructure a top priority. Specific objectives related to the development of broadband infrastructure were set, namely, to provide local access with at least 30 Mbps bandwidth in uncovered areas by 2018and also by 2020, 50% of households should have an Internet connection with a bandwidth of 100 Mbps or more. Most of the market participants joined the above program through strategic agreements with the government.
- In order to achieve its objectives, the Hungarian government used all the means at its disposal, be it a political, regulatory, or public policy tool for

development. The basic pillar of the resources needed to achieve this goal was the European Union support, for which a specific program was launched, the Superfast Internet Access Program (SIP). Based on the recent DESI connectivity indicators, we can state that Hungary, in terms of infrastructure development, has definitely made substantial progress.

- In the first half of 2020, the Hungarian government drew up an industry strategy for 2021-2030, called the National Digitization Strategy (NDS). According to the status of the NDS, it has passed the stage of public discussion; after processing the comments, the Hungarian government plans to adopt it during the autumn period of this year. NDS is covered in detail later in this material.

From the chapter on China Hungary cooperation in digital industries, we can conclude:

- In the past fifteen years, Hungary was an excellent entry point for Chinese telecom companies to the EU markets. Pan-European EU telecom service suppliers, like Deutsche Telekom, Vodafone or Telenor, were interested in Chinese products, but they were afraid to use them in their core Western European markets. A Central European market like Hungary was a testing ground for them to gather some experience with these vendors without taking too much risk. Chinese fintech companies, IoT companies, or cloud service companies can follow the example of Huawei or ZTE. They can also take Hungary as an entry and reference point for the European markets.
- Concerning 5G network security issues in Hungary, we can state that contrast with other central European countries, like Poland and the Czech Republic, the Hungarian government tries to avoid geopolitical considerations. Its approach is based on the objective criteria of risk assessment. This opinion enjoys wide-ranging political support; even the opposition parties accept it. The government has ambitious development goals. It wants Hungary to be among the first in the EU to adopt 5G technology after 2020. The Chinese vendors like Huawei and ZTE have a strong market position, being the exclusive suppliers of the second and the third mobile service companies on the Hungarian market. This

situation provides excellent opportunities for the above two Chinese companies.

- From the personal interviews with the market players, we can conclude that Huawei and ZTE, the two Chinese companies that are present in the Hungarian market for many years, have outstanding reputations among their Hungarian partners. Vodafone and Telenor, the two Hungarian mobile companies who use Chinese equipment in their present mobile networks, are keen to preserve this relationship and want to rely on these Chinese companies to implement their 5G network too.

1. Analysis of digital economies of CEE countries using Digital Economy and Society Index

1.1. Introduction of Digital Economy and Society Index (DESI) database and annual country profiles

Digital Economy and Society Index (DESI) is a composite index that summarises relevant indicators on Europe's digital performance and tracks the evolution of EU Member States in digital competitiveness.

DESI covers the five critical aspects of the digital economy:

- The Connectivity dimension measures the deployment of broadband infrastructure and its quality.
- The Human Capital dimension measures the skills needed to take advantage of the possibilities offered by digital.
- Use of Internet Services dimension accounts for a variety of online activities, such as the consumption of online content (videos, music, games, etc.) video calls as well as online shopping and banking.
- The Integration of the Digital Technology dimension measures the digitalization of businesses and e-commerce.
- The Digital Public Services dimension measures the digitization of public services

In 2015 the EU Commission had approved its Digital Single Market (DSM) and had identified the completion of DSM as one of its ten political priories. The DSM Strategy[1] was built on three pillars:

- Access: better access for consumers and businesses to digital goods and services across Europe;
- Environment: creating the right conditions and a level playing field for digital networks and innovative services to flourish;

[1] https://ec.europa.eu/digital-single-market/en/policies/shaping-digital-single-market

- Economy & Society: maximising the growth potential of the digital economy.

The DESI database was designed in a way to able to track the implementation of the Digital Single Market strategy. Since 2015 every year, the EU Commission publishes its annual DESI country profiles, which monitors progress in digital policies in the EU Member States. The country profiles combine the quantitative data from the DESI database, with the analysis of countries' policy initiatives, challenges, and examples of best practices.

With the DESI, four main types of analysis[2] are possible:

- A general performance assessment: to obtain a general characterization of the performance of individual Member States by observing their overall index score and the scores of the main dimensions of the index.
- Zooming-in: to pinpoint the areas where Member State performance could be improved by analyzing the scores of the index's sub-dimensions and individual indicators.
- Follow-up: to assess whether there is progress over time.
- Comparative analysis: to cluster Member States according to their index scores, comparing countries in similar stages of digital development.

[2] Digital Economy and Society Index (DESI) 2020 Methodological note

All of the five dimensions have some subdimensions and several individual indicators. As we will use all indicators in our subsequent analyzes, we present them in the tabular form below.

Dimension	Sub-dimension	Indicator
1 Connectivity	1a Fixed broadband take-up	1a1 Overall fixed broadband take-up
		1a2 At least 100 Mbps fixed broadband take-up
	1b Fixed broadband coverage	1b1 Fast broadband (NGA) coverage
		1b2 Fixed Very High Capacity Network (VHCN) coverage
	1c Mobile broadband	1c1 4G coverage
		1c2 Mobile broadband take-up
		1c3 5G readiness
	1d Broadband price index	1d1 Broadband price index

Illustration 1 Definition of Connectivity Dimension

The connectivity dimension has four subdimensions and eight individual indicators. It covers both the take-up and coverage and also the fixed and mobile networks.

Dimension	Sub-dimension	Indicator
2 Human capital	2a Internet user skills	2a1 At least basic digital skills
		2a2 Above basic digital skills
		2a3 At least basic software skills
	2b Advanced skills and development	2b1 ICT specialists
		2b2 Female ICT specialists
		2b3 ICT graduates

Illustration 2 Definition of Human Capital Dimension

The human capital dimension has two subdimensions and six individual indicators.

Dimension	Sub-dimension	Indicator
3 Use of internet services	3a Internet use	3a1 People who never used the internet
		3a2 Internet users
	3b Activities online	3b1 News
		3b2 Music, videos and games
		3b3 Video on demand
		3b4 Video calls
		3b5 Social networks
		3b6 Doing an online course
	3c Transactions	3c1 Banking
		3c2 Shopping
		3c3 Selling online

Illustration 3 Definition of Use of Internet Services Dimension

The use of internet services combines three subdimensions and eleven individual indicators.

Dimension	Sub-dimension	Indicator
4 Integration of digital technology	4a Business digitization	4a1 Electronic information sharing
		4a2 Social media
		4a3 Big data
		4a4 Cloud
	4b e-Commerce	4b1 SMEs selling online
		4b2 e-Commerce turnover
		4b3 Selling online cross-border

Illustration 4 Definition of Integration of Digital Technology

The integration of digital technology dimension has two subdimensions and seven individual indicators.

Dimension	Sub-dimension	Indicator
5 Digital public services	5a e-Government	5a1 e-Government users
		5a2 Pre-filled forms
		5a3 Online service completion
		5a4 Digital public services for businesses
		5a5 Open data

Illustration 5 Definition of Digital Public Services

The digital public services dimension has one subdimension and five individual indicators.

1.2. Overview of DESI indicators of the Central and Eastern European region in the period 2015-2020

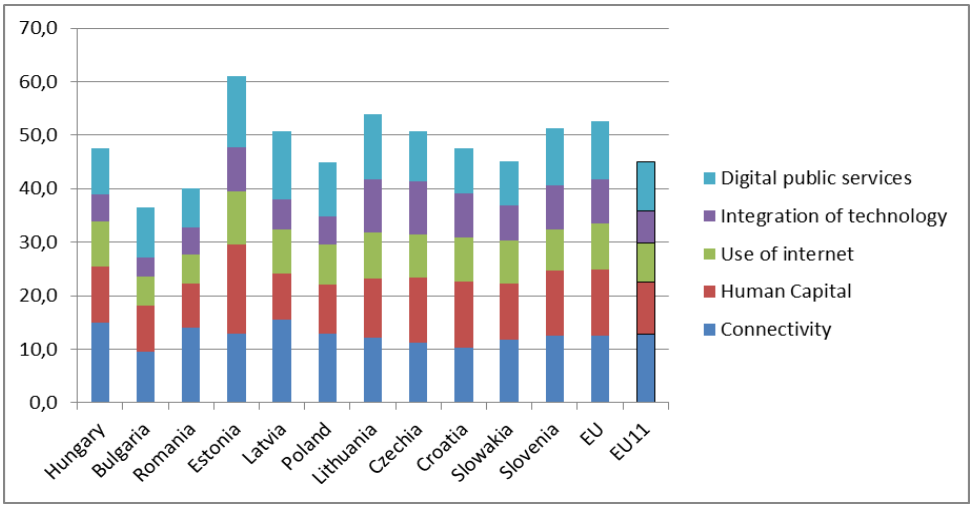


Illustration 6 Comparison of DESI 2020 Indicators of EU11 Countries

Concerning the overall DESI index, the gap between the EU average and the CEE countries is not substantial, less than 10 points. More importantly, the development level of the majority of regional countries is even closer to the EU level. There are only three countries Bulgaria, Romania, and Poland, which are lagging. At the same time, it should be seen that these three countries have the largest populations in the region and therefore have a significant impact on the development of the regional average level.

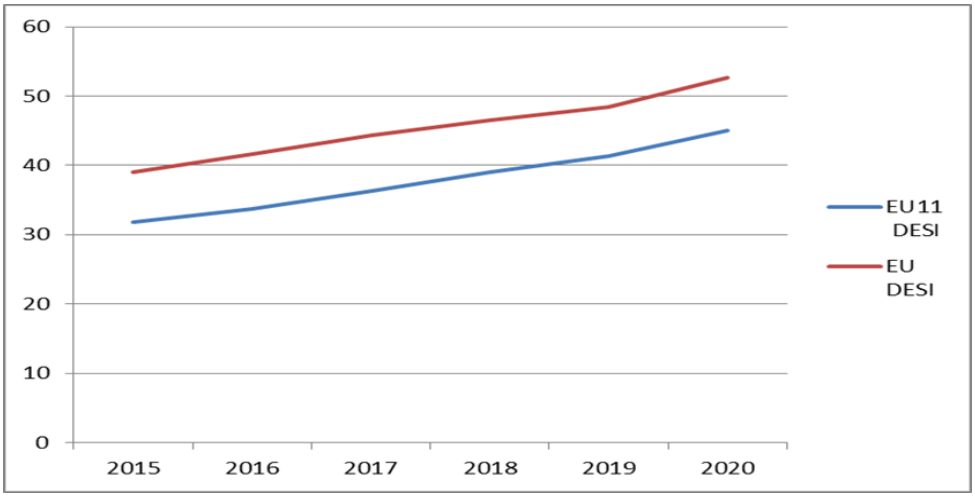


Illustration 7 Development of DESI Indicators of EU11 Countries

As for the change in the overall DESI index, there have been fundamentally favorable trends in the last five years. Although the regional average lags behind the EU level, the difference remained unchanged, the improvement of the overall DESI for the EU as a whole and the Central and Eastern European countries were similar.

Of course, one can ask why the development gap in the field of the digital economy has not decreased since, in terms of the macro indicators of the economy (GDP, employment), there has been a clear trend of catching up in recent years. We will see later in this study that the governments in the region have made significant investments in the digital economy. In order to finance these investments, a large amount of EU funds (Structural Funds) were used. These structural funds are intended to help the less developed countries of Eastern Europe to catch up, so they are not available to the more developed countries of Western Europe.

	EU 11 2016	EU11 2020	EU28 2020
1a Fixed broadband take-up	4,55	8,15	10,14
1b Fixed broadband coverage	10,10	15,89	14,49
1c Mobile broadband	8,10	15,60	15,79
1d Broadband price index	11,18	11,38	9,64
2a Internet user skills	**18,74**	**20,58**	**28,23**
2b Advanced skills and development	15,63	18,76	21,06
3a Internet use	10,60	16,04	19,30
3b Activities online	16,76	21,27	24,13
3c Transactions	**9,28**	**10,87**	**14,59**
4a Business digitization	**12,45**	**16,68**	**25,34**
4b e-Commerce	**10,20**	**13,19**	**16,03**
5a e-Government	43,94	61,95	72,00

Illustration 8 Comparison of EU11 and EU28 DESI Indicators

The table above proves why there is no contradiction between the facts that although the referred government investment has been successful, there was no breakthrough in the catching up of the digital economy as a whole.

The catch-up of the region is visible in the connectivity dimension, where government intervention and financing played a significant role. At the same time, there are three other dimensions, where the government's role and its impact were limited.

The skills of Internet users are an area where government programs are not expected to deliver rapid results in the short term. Another critical factor is the educational level and openness of the existing workforce in acquiring new knowledge. It is clear that more developed countries have an advantage in the latter area. Even if we can explain the significant difference between the European and regional averages of Internet user skills, it is clear that future government programs will need to pay more attention to this topic.

The other three indicators, where there is a significant difference between the regional and the EU average, are all related **to business internet use**. The gap in online transactions, business digitization, and e-commerce reach is rather substantial. The explanation for this phenomenon can be found in the specific

regulatory system of the EU. This regulatory framework aims to create effective competitive markets, which is incompatible with state support for any particular sector by the government. EU's structural funds can be used to finance infrastructure development, like the implementation of broadband networks, but there are limitations to use the same funds to support the digital transformation of local companies. The corporate sector of CEE countries is struggling to use digital technologies in their operations since these companies are not able to finance these costly investments.

1.2.1. Connectivity

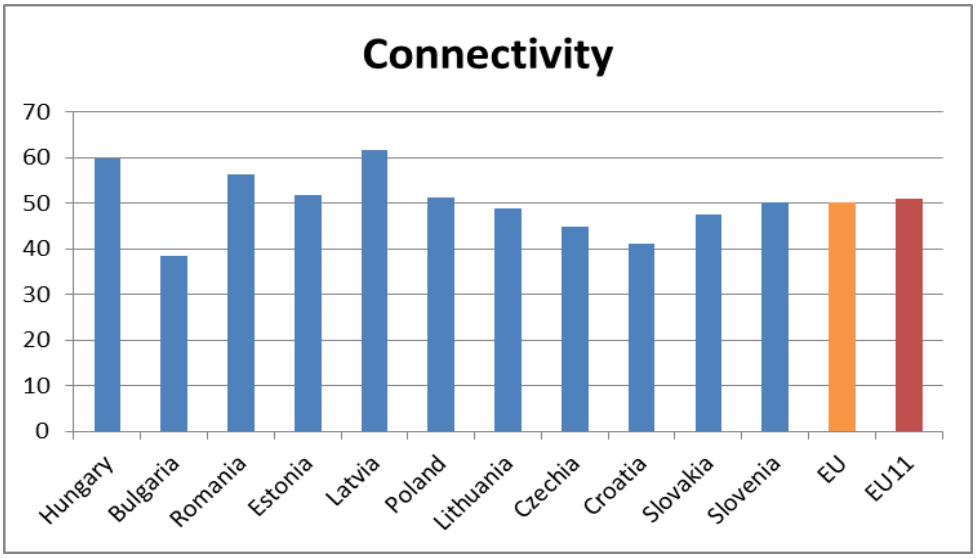


Illustration 9 Comparison of Connectivity Dimension

Connectivity is the dimension of DESI where the countries in the region have practically reached, in some cases even exceeded, the EU level. It is noteworthy that in this indicator, even the difference between the countries is not significant, only Bulgaria and Croatia hang out from this line. Five countries stand out with well above average values: Hungary, Romania, Estonia, Latvia, and Poland.

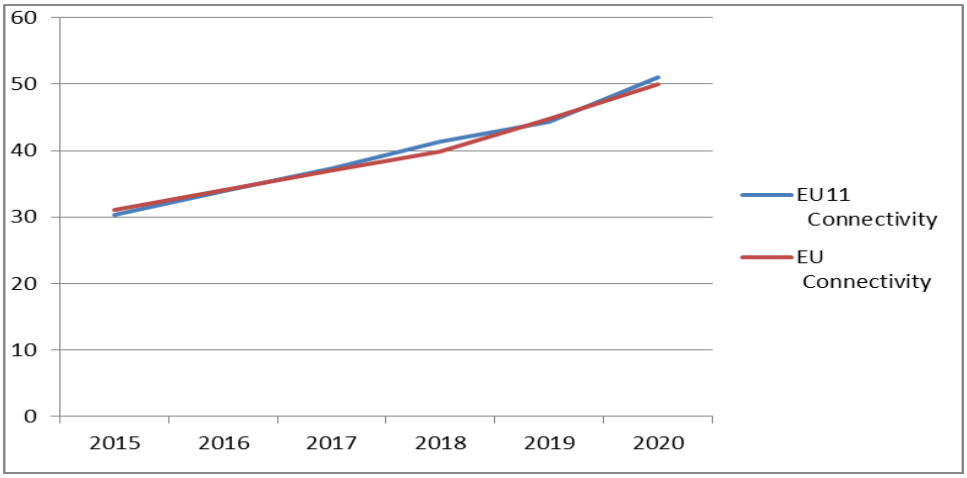


Illustration 10 Comparison of Connectivity Dimension Development

Over the past five years, the DESI connectivity index has grown very rapidly. In both the European Union and the Central Eastern European region, the rate of growth has exceeded sixty percent. The regional and EU trajectories follow practically the same pattern, and in none of the years, was there a significant difference between the values of the indicators.

Two factors played a role in this significant outcome. One is that the development of infrastructure, the establishment of broadband networks, was the area where the Commission of the European Union undertook to formulate long-term quantitative targets at the Community level. The other is that they have succeeded in assigning an appropriate toolkit to these strategic objectives, part of which was that the less developed countries in the Central and Eastern European region could use the Structural Funds for investment financing.

The strategic program was published in the form of a Communication from the Commission with the title: Connectivity for a Competitive Digital Single Market - Towards a European Gigabit[3]. In this document, the Commission set out a vision for a European Gigabit Society, "where availability and take-up of very high capacity networks enable the widespread use of products, services, and

[3] EU COM(2016) 587 final

applications in the Digital Single Market. This vision is operationalized through three strategic objectives for 2025"[4]:

- Gigabit connectivity[5] for all main socio-economic drivers such as schools, transport hubs and main providers of public service as well as digitally intensive enterprises.
- All urban areas and all major terrestrial transport paths to have uninterrupted 5G coverage
- All European households, rural or urban, will have access to Internet connectivity offering a downlink of at least 100 Mbps, upgradable to Gigabit speed.

According to EU expert estimates, reaching the above vision and objectives for 2025 is to require an overall investment of c. EUR 500 billion over the coming decade, representing an additional EUR 155 billion over and above a simple continuation of the trend of current network investment.

To provide an appropriate regulatory and financial framework for the implementation of the above investments, the EU Commission has envisaged three packages of measures.

- Adoption and implementation of a new Electronic Communications Code, which will provide regulatory incentive for the implementation of high-capacity broadband networks in all Member States.
- Adoption and implementation of EU level 5G Action Plan to foster a coordinated approach for the deployment of 5G infrastructures. It covers common frequency allocation rules and a harmonized time-table for 5G mobile service introduction
- Combination of public support via grants and preferential financial instruments to finance the different investment projects.

[4] EU COM(2016) 587 final
[5] According to EU Communications Gigabit connectivity is to be understood as cost-effective symmetrical Internet connectivity offering a downlink and an uplink of at least 1 Gbps.

		2016	2020	EU28 2020
1a1 Overall fixed broadband take-up	% households	62,86 %	67,42%	77,63%
1a2 At least 100 Mbps fixed broadband take-up	% households	10,64 %	30,38%	25,86%
1b1 Fast broadband (NGA) coverage	% households	66,45 %	80,99%	85,85%
1b2 Fixed Very High Capacity Network (VHCN) coverage	% households	27,38 %	54,84%	44,03%
1c1 4G coverage	% households (average of operators)	0,00%	94,52%	96,47%
1c2 Mobile broadband take-up	Subscriptions per 100 people	72,54	122,55	100,17
1c3 5G readiness	Assigned spectrum as a % of total 5G spectrum	0,00%	13,99%	20,52%
1d1 Broadband price index	Score (0 to 100)	0,00	75,87	64,24

Illustration 11 Detailed Connectivity Indicators

The definitions of connectivity indicators are continually being updated by EU Commission experts. They seek to ensure that these indicators are suitable for monitoring the progress of the ongoing strategic programs like the European Gigabit Society or the 5G Action plan. Accordingly, in the last few years, we can find separate indicators for the at least 100 Mbps fixed broadband take-up and for Very High Capacity Network (VHCN) coverage key targets from the European Gigabit Society or 5G readiness a key target from 5G Action Plan.

Taking into account the connectivity targets for these programs for 2025, the undoubtedly significant progress over the last five years seems less outstanding.

In 2020 only 30,4% of households had access to at least 100 Mbps fixed broadband service, which far from the targeted 100%. There was significant progress in Very High Capacity Network (VHCN) coverage, but in order to achieve full coverage, further efforts are needed.

Similarly, indicators of readiness to deploy 5G networks are somewhat disappointing. As already mentioned, the EU Commission, in its 5G Action Plan envisaged that mobile networks based on the 5G standard would start operating by the end of 2020. Compared to this target, it can be seen from the above table, that the authorities have allocated only 14% of the frequencies required for operation. In this regard, the Central and Eastern countries are lagging behind even compared to the EU average.

1.2.2. Human Capital

The human capital dimension of the DESI has two sub-dimensions covering 'internet user skills' and 'advanced skills and development.' The former is calculated based on the number and complexity of activities involving the use of digital devices and the internet. The latter includes indicators for ICT specialists and ICT graduates.

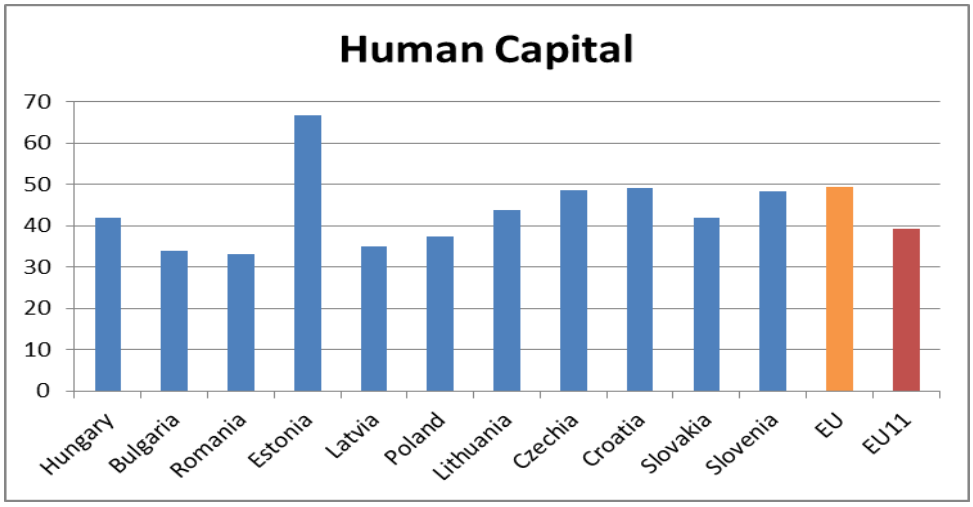


Illustration 12 Comparisson of HumanCapital Dimension

According to the latest data, Estonia is leading in human capital indicator, and interestingly, all the other regional countries are lagging far behind. Bulgaria and

Romania have the lowest rank. As we have mentioned before, there is a significant more than 10% gap between the values of EU and regional average

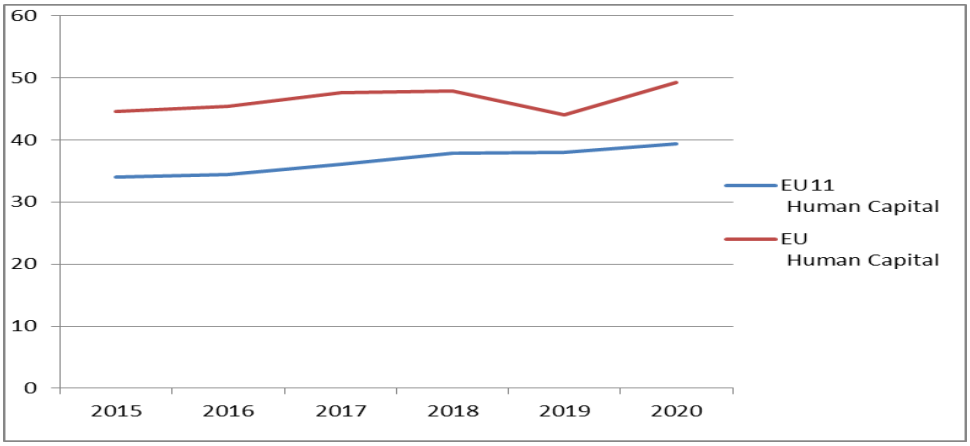


Illustration 13 Development of HumanCapital Dimension

As for the change in human capital indexr over the past five years, the situation is no better here either. The progress in Central and Eastern European countries was minimal.

		2016	2020	EU28 2020
2a1 At least basic digital skills	% individuals	41,55 %	44,69 %	58,32 %
2a2 Above basic digital skills	% individuals	17,56 %	21,01 %	33,31 %
2a3 At least basic software skills	% individuals	44,30 %	46,93 %	60,57 %
2b1 ICT specialists	% total employment	2,54%	3,08%	3,90%
2b2 Female ICT	% female	0,85%	1,05%	1,39%
2b3 ICT graduates	% graduates	1,52%	4,22%	3,60%

Illustration 14 Detailed Human Capital Indicators

Although already 75% of citizens of the region used the internet in 2019, some barriers still persist. Lack of relevant skills remains by far the most important factor deterring households from having internet access at home. Moreover, given that this factor limits awareness of potential benefits from digitization, it may also be among the reasons behind the large numbers of regional households that still claim not to have internet access at home because they do not need it. The lack of

above basic digital skills also creates barriers for the digitalization of small and medium-sized businesses.

The advanced skills and development sub-dimension looks at the workforce and its potential to work in and develop the digital economy. This takes into account the percentage of people in the workforce with ICT specialist skills and includes a separate indicator on female ICT specialists. At the same time, it looks at the share of ICT graduates.

According to the Human capital thematic chapter of DESI 2020 report, during 2018, many EU enterprises that recruited or tried to recruit ICT specialists reported difficulties in filling such vacancies; it was experienced by 64% of large enterprises and 56% of SMEs. This problem is especially critical in Romania and Czechia, where at least 80% of enterprises that recruited or tried to recruit ICT specialists reported such difficulties.

To solve human capital issues, the EU Commission has developed a Digital Education Action Plan. The Plan was issued in 2018 and will be implemented by the end of 2020. The Action Plan has 11 actions across three priorities[6]:

- Priority 1: Making better use of digital technology for teaching and learning:
    - Action 1 - Connectivity in schools
    - Action 2 - SELFIE self-reflection tool and mentoring scheme for schools
    - Action 3 - Digitally signed qualifications
- Priority 2: Developing digital competences and skills:
    - Action 4 - Higher Education Hub
    - Action 5 - Open science skills
    - Action 6 - EU Code Week in schools
    - Action 7 - Cybersecurity in education
- Action 8 - Training in digital and entrepreneurial skills for girls
    - Priority 3: Improving education through better data analysis and foresight:
    - Action 9 - Studies on ICT in education
    - Action 10 - Artificial Intelligence (AI) and analytics
    - Action 11 - Strategic foresight

[6] https://ec.europa.eu/education/education-in-the-eu/digital-education-action-plan_en

1.2.3. Use of Internet services

The use of internet services dimension covers three areas: internet use from the quantitative aspect, online activities including social networks, and online transactions like shopping, selling, and banking.

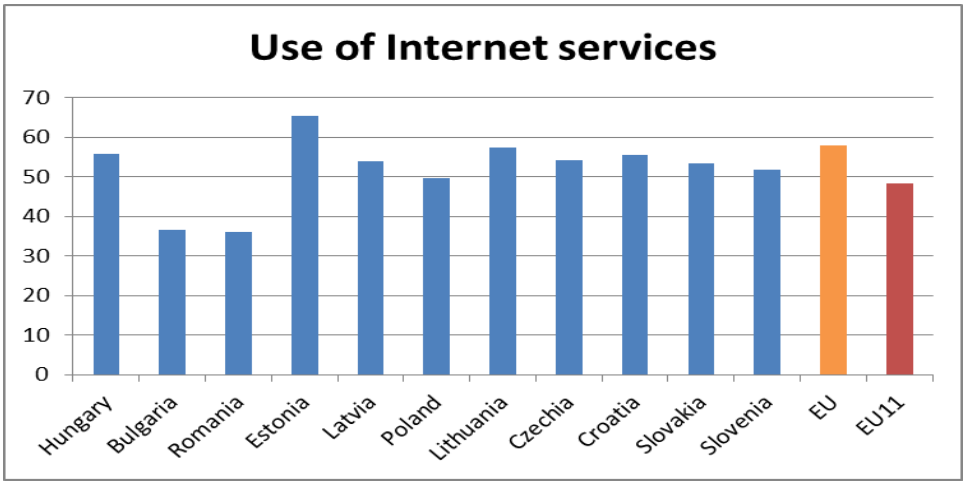


Illustration 15 Comparisson of Use of Internet Services Dimension

The gap between the EU and the regional average of this indicator is not substantial, less than 10 points. The majority of regional countries have very similar levels. Romania and Bulgaria are the two exceptions; in these two countries, the development level is about 15 points lower than the regional average.

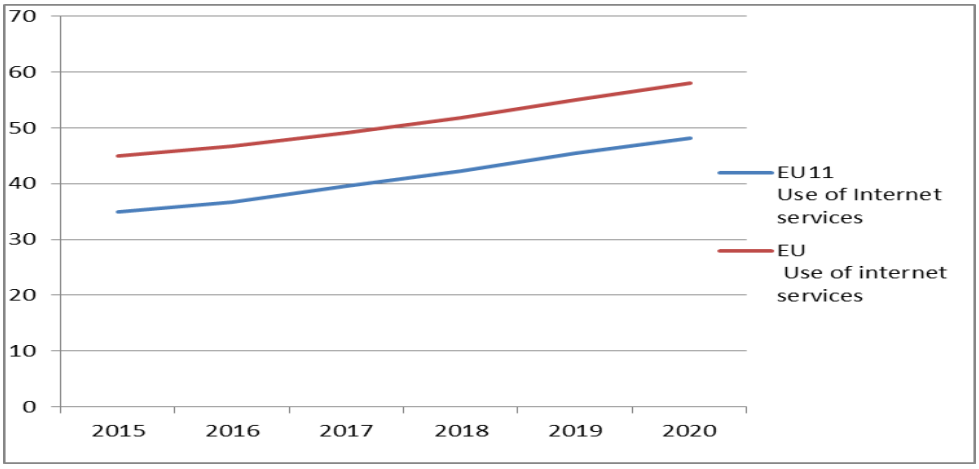


Illustration 16 Development of Use of Internet Services Dimension

The development paths of the EU and of the region have similar shape, but the gap between the two did not change. There was a significant rise in both groups; however since the value is still rather low further development can expected.

		2016	2020	EU28 2020
3a1 People who have never used the internet	% individuals	25,39 %	15,42 %	9,45%
3a2 Internet users	% individuals	64,73 %	77,55 %	85,26 %
3b1 News	% internet users	74,00 %	74,42 %	72,16 %
3b2 Music, videos and games	% internet users	0,00%	72,61 %	80,60 %
3b3 Video on demand	% internet users	0,00%	13,12 %	31,08 %
3b4 Video calls	% internet users	47,05 %	64,41 %	59,78 %
3b5 Social networks	% internet users	66,92 %	72,80 %	64,91 %
3b6 Doing an online course	% internet users	4,77%	6,14%	11,17 %
3c1 Banking	% internet users	39,92 %	50,34 %	65,99 %
3c2 Shopping	% internet users	44,07 %	56,26 %	71,46 %
3c3 Selling online	% internet users	16,39 %	14,34 %	22,60 %

Illustration 17 Detailed Use of Internet Services Indicators

Concerning the number of internet users, the 78% penetration ratio is quite an achievement. The usage of social networks is also not far from the universal level. The only substantial difference between the regional and EU level can be found in transaction indicators (online banking, shopping, and selling). It seems that the Central and Eastern European enterprises have just started to enter in the age of online markets.

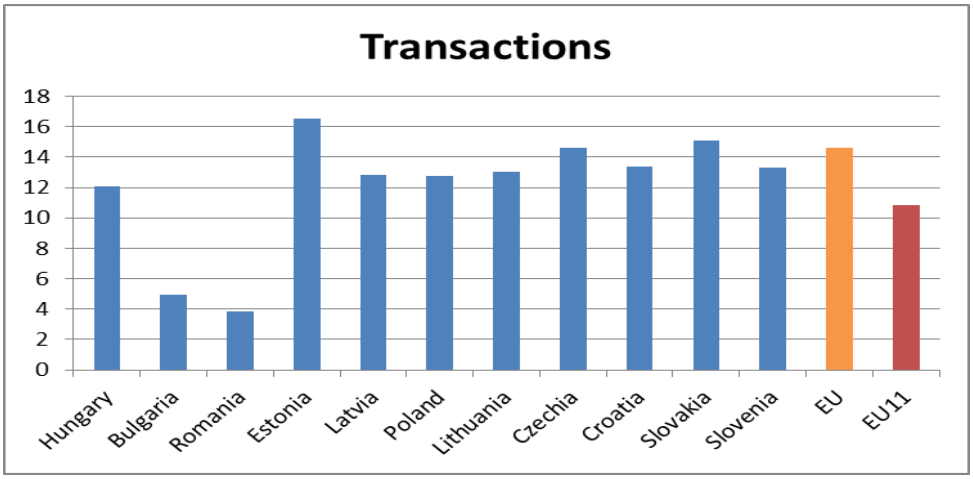


Illustration 18 Comparisson of Transactions Subindicator

The chart above shows that there are actually two countries Bulgaria and Romania, whose low indicators are pulling down the regional average.

1.2.4. Integration of technology

Digital technologies help businesses improve their services and products and expand their markets. The digital transformation of businesses opens up new opportunities and supports the development of new and trustworthy technologies. This dimension measures the digitization of businesses and e-commerce

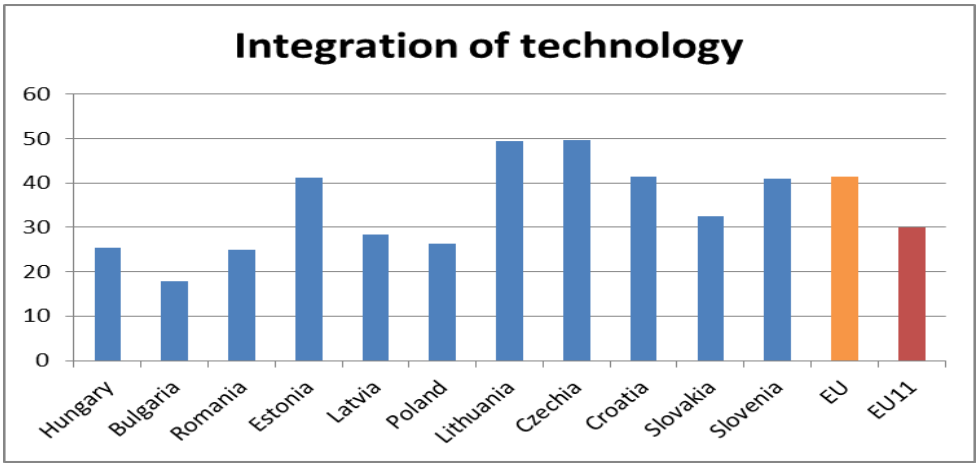


Illustration 19 Comparison of Integration of Technology Dimension

As we have mentioned earlier, there is a significant gap in terms of this dimension between the EU and the Central and Eastern European countries. In the same time, there are rather big differences between the different Central and Eastern European countries too. At the top Czechia, Lithuania, and Estonia exceed the level of the average EU level, at the bottom, Hungary, Bulgaria, and Romania are by a big margin below the average regional level.

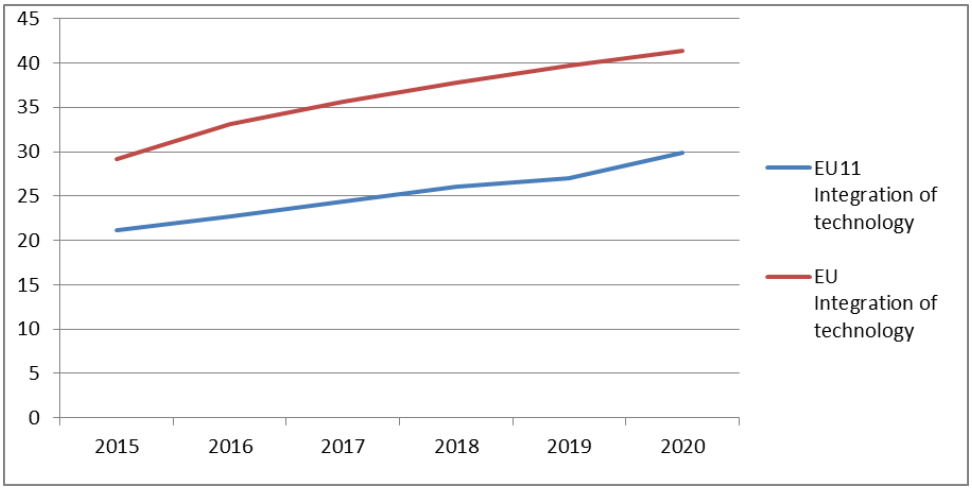


Illustration 20 Development of Integration of Technology Dimension

The difference between the EU and the regional average did not change during the last five years, the 10 points gap remained. The progress in Central and Eastern European countries has been rather modest.

		2016	2020	EU28 2020
4a1 Electronic information sharing	% enterprises	23,38 %	27,55 %	34,41 %
4a2 Social media	% enterprises	9,37%	14,27 %	25,17 %
4a3 Big data	% enterprises	0,00%	8,69%	12,26 %
4a4 Cloud	% enterprises	5,55%	9,92%	17,85 %
4b1 SMEs selling online	% SMEs	11,17 %	14,42 %	17,53 %
4b2 e-Commerce turnover	% SME turnover	4,97%	6,07%	11,09 %
4b3 Selling online cross-border	% SMEs	4,91%	6,97%	8,38%

Illustration 21 Detailed Integration of Technology Indicators

Looking into the detailed indicators, both in the business digitalization and e-commerce areas, we can identify substantial future development potential. Only 9% of enterprises use big data services, and only 10% of them use cloud services. This level is well below the requirements of advanced business management.

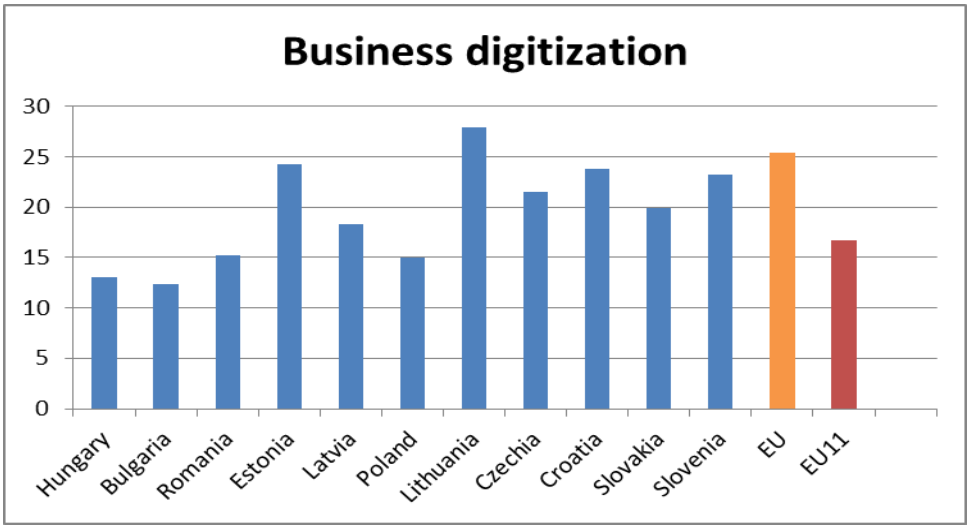


Illustration 22 Comparisson of Business Digitation Subindicator

In terms of differences between the countries, there are only two countries Estonia and Lithuania, whose business digitization indicator exceeds the EU average, and the indicators of the four bigger regional countries Hungary Bulgaria Romania and Poland are even below the regional average.

Illustration 23 Comparisson of e-Commerce Subindicator

Concerning the e-commerce indicator, the difference between the EU and regional average is smaller than in terms of business digitization. At the same time, the differences between the indicators of the countries of the region are significant,

and there is a big difference between the leading Czech Republic and Bulgaria at the bottom of the list.

1.2.5. Digital public services

Digital public service is a new, fast-growing sector of digital economies. Effective e-government can provide a wide variety of benefits, including more efficiency and savings for both governments and businesses. It can also increase transparency and openness. This dimension measures both the demand and supply sides of digital public services as well as open data.

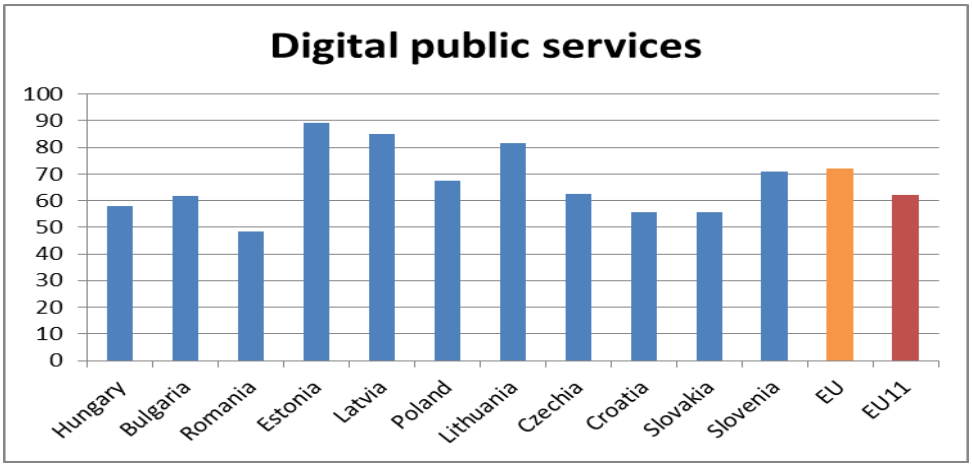


Illustration 24 Comparison of Digital Public Service Dimension

Estonia has the most developed e-government system among all EU member countries. The other two Baltic States, Latvia, and Lithuania also have very high levels compared to the EU average. At the low end of the ranking, there are three countries Hungary, Bulgaria, and Romania.

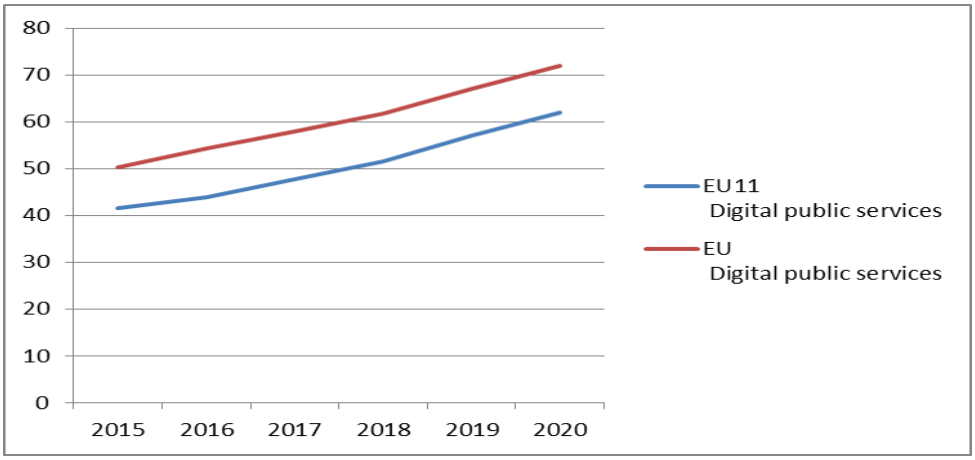


Illustration 25 Development of Digital Public Service Dimension

In the field of e-government, the countries of the region have made relatively significant progress; the value of the indicator has risen by almost 30% in the last five years. Similar progress was made in other EU member countries. As a consequence, the difference of 10 points between the EU and the regional average did not change.

		2016	2020	EU28 2020
5a1 e-Government users	% internet users needing to submit forms	55,83 %	61,92 %	67,31%
5a2 Pre-filled forms	Score (0 to 100)	37,56	45,02	59,38
5a3 Online service completion	Score (0 to 100)	69,15	82,66	89,75
5a4 Digital public services for businesses	Score (0 to 100) - including domestic cross-border	62,05	74,95	87,63
5a5 Open data	% of maximum score	0,02	0,63	0,66

Illustration 26 Detailed Digital Public Service Indicators

As the above table shows, the different scores have rather high values. Besides the connectivity, the e-government is the other dimension where the EU has achieved good progress in implementing its Digital Single Market strategy. Estonia is a role model for the whole EU community, but the other regional government also pay close attention to this topic.

1.3. Country profiles

1.3.1. Bulgaria country profile

Overall DESI

Bulgaria has the lowest score among the 28 EU member countries in the overall DESI for 2020. There are three general factors which impacted this poor result:

- Bulgaria has the lowest GDP per capita in the European Union
- Compared to the other Central and Eastern European countries Bulgaria joined the EU relatively late, only in 2007
- In recent years there were many government crises which had a negative impact on the economy

	Bulgaria	EU11	EU
Connectivity	38.5	51.0	50.1
Human Capital	33.9	39.3	49.3
Use of internet	36.6	48.2	58.0
Integration of technology	17.9	29.9	41.4
Digital public services	61.8	62.0	72.0
DESI	**36.4**	**45.1**	**52.6**

Illustration 27 Bulgaria Comparison of DESI

Bulgaria performs relatively well in connectivity, and it has made improvements in e-government. In the other three dimensions, especially the integration of technology, it lags far behind the other countries in the region. The government is aware of the need to change this unsustainable situation. According to the DESI

2020 country profile, "the Ministry of Transport, Information Technology and Communications is in the process of drawing up a document entitled 'Digital Transformation of Bulgaria for 2020-2030'. That will cover the potential of digital transformation for growth, work and prosperity, healthcare, energy policy, equal opportunities and social participation, and government transparency."[7]

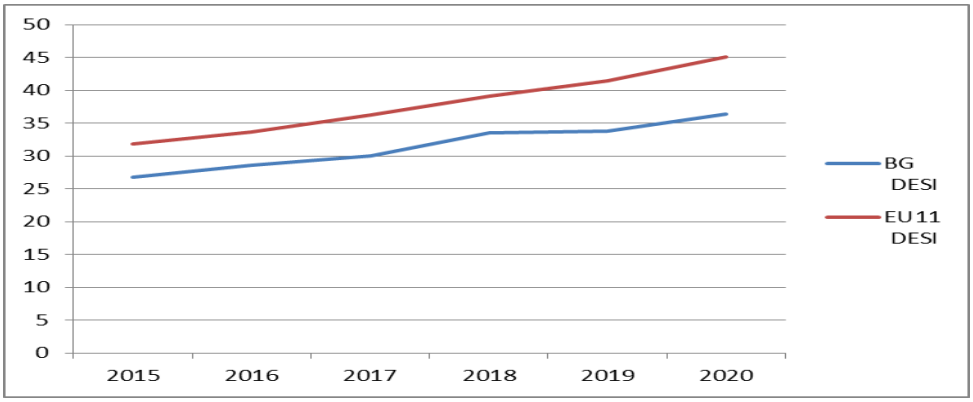


Illustration 28 Bulgaria Development of DESI

As we can see from the above chart, in relative terms the overall performance of the country has even worsened in the last three years. The difference between the country and the regional average in the overall DES score was only 6 points in 2018, but to this year, it increased to nine points.

Connectivity

As we have mentioned, the connectivity dimension used to be a bright spot in the Bulgarian digital economy. Unfortunately, the development has also slowed down, in the last three years the gap between the regional and country score has widened to 13 points

[7] DESI 2020 Bulgaria country profile

		2016	2020[8]	EU11 2020
1a1 Overall fixed broadband take-up	% households	55.48 %	57.77 %	67.42%
1a2 At least 100 Mbps fixed broadband take-up	% households	3.06%	10.99 %	30.38%
1b1 Fast broadband (NGA) coverage	% households	71.79 %	77.09 %	80.99%
1b2 Fixed Very High Capacity Network (VHCN) coverage	% households	32.24 %	41.98 %	54.84%
1c1 4G coverage	% households (average of operators)		80.66 %	94.52%
1c2 Mobile broadband take-up	Subscriptions per 100 people	69.81	103.19	122.54
1c3 5G readiness	Assigned spectrum as a % of total 5G spectrum		0	13.99%
1d1 Broadband price index	Score (0 to 100)		71.93	75.86

Illustration 29 Bulgaria Detailed Connectivity Indicators

With an overall connectivity score of 38.5, Bulgaria ranks at the bottom EU countries.

Fast broadband coverage (NGA) improved from 72% in 2015 to 77% in 2019 and VHCN coverage from 32% in 2015 to 42% in 2019. Bulgaria still has a gap to fill

[8] As we have mentioned in the previous chapter, we use data from the DESI 2020 database, but actually they reflect the .market status in 2019. This statement is valid for all of the following tables in this chapter.

in fixed broadband network deployment to reach the regional average. It ranks at the bottom in overall broadband take-up with only 58% households subscribing and 11% on take-up of high-speed fixed broadband of at least 100 Mbps.

The mobile broadband indicators, compared to the fixed broadband, are relatively good; the average 4G coverage was 81% in 2019, with a take-up 103 of subscriptions per 100 people in 2019.

"Bulgaria scores 0 on the 5G readiness indicator. Overall, it has assigned only 14% of the spectrum for wireless broadband. Assigning this spectrum has been challenging due to military use and aircraft communications use of parts of the 700 MHz and 800 MHz bands. Insufficient spectrum assigned could negatively affect coverage and timely 5G deployment."[9]

Human capital

Bulgaria has an overall human capital score of 33.9 points, which is very low compared to the regional average of 39.3 points. The progress in this dimension was rather moderate. The gap to regional average score remained basically unchanged in the last five years

		2016	2020	EU11 2020
2a1 At least basic digital skills	% individuals	31.22 %	29.40 %	44.69 %
2a2 Above basic digital skills	% individuals	12.75 %	11.29 %	21.01 %
2a3 At least basic software skills	% individuals	33.27 %	30.90 %	46.93 %
2b1 ICT specialists	% total employment	1.90%	3.00%	3.08%
2b2 Female ICT specialists	% female employment	1.27%	1.85%	1.05%
2b3 ICT graduates	% graduates	2.80%	3.70%	4.22%

[9] DESI 2020 Bulgaria country profile

Illustration 30 Bulgaria Detailed Human Capital Indicators

The overall level of basic digital skills in Bulgaria is the lowest in the region. People with at least basic digital skills account for 29% of the total Bulgarian population aged 16 to 74, against a regional average of 45%. Only 11% of people have the above basic skills, equivalent to half of the regional average. ICT specialists now account for 3% of total employment marking an increase, although this figure remains a small proportion of the workforce given the labour market shortages. Female ICT specialists account for 1.8% of total employment, slightly above the regional average.

According to the DESI 2020 country profile, "The education system is currently being modernized. Although reforms do not fully capture the magnitude of the digital transformation, there is a greater focus on improving digital skills levels. Government support for training in STEM and ICT faculties has brought about a revised school curriculum. Computer modeling was introduced in the third year of school, starting in the 2018-2019 school year. There are now more classes with IT profiles in upper secondary school, such as the national program 'Education for IT careers'"[10].

Use of internet services

Bulgaria has a score of 36.6 in the use of internet services, which ranks 10th among the eleven regional countries. The gap to the regional average is widening. In the last year, it has reached 11 points.

.		2016	2020	EU11 2020
3a1 People who have never used the internet	% individuals	34.72 %	24.49 %	15.42 %
3a2 Internet users	% individuals	54.59 %	66.84 %	77.55 %
3b1 News	% internet users	70.12 %	66.05 %	74.42 %

[10] DESI 2020 Bulgaria country profile

3b2 Music, videos and games	% internet users		64.22 %	72.61 %
3b3 Video on demand	% internet users		9.39%	13.12 %
3b4 Video calls	% internet users	82.18 %	84.65 %	64.41 %
3b5 Social networks	% internet users	74.40 %	77.79 %	72.80 %
3b6 Doing an online course	% internet users	4.84%	3.39%	6.14%
3c1 Banking	% internet users	9.44%	12.62 %	50.34 %
3c2 Shopping	% internet users	30.63 %	30.76 %	56.26 %
3c3 Selling online	% internet users	15.82 %	9.33%	14.34 %

Illustration 31 Bulgaria Detailed Useof Internet Serivces Indicators

67% of Bulgarians use the internet against a regional average of 78%. 24% of them have never used it - the highest level of non-use in the EU. Bulgarian internet users are above the regional average when it comes to social network activities (78% vs 73%).

Bulgarian internet users are less keen to use other online services, especially online banking. Only 13% of internet users take advantage of it compared with the regional average of 50%. Only 31% of internet users shop online, against a regional average of 56%.

Integration of technology

Bulgaria has a score of 17.9 in the Integration of digital technology by businesses, which is the lowest score among the eleven regional countries. The gap to the regional average is widening, and in the last year, it has reached 12 points.

		2016	2020	EU11 2020
4a1 Electronic information sharing	% enterprises	24.93 %	23.39 %	27.55 %
4a2 Social media	% enterprises	8.39%	10.22 %	14.27 %
4a3 Big data	% enterprises		6.66%	8.69%
4a4 Cloud	% enterprises	3.86%	5.87%	9.92%
4b1 SMEs selling online	% SMEs	5.71%	7.26%	14.42 %
4b2 e-Commerce turnover	% SME turnover	3.06%	2.20%	6.07%
4b3 Selling online cross-border	% SMEs	2.77%	3.21%	6.97%

Illustration 32 Bulgaria Detailed Integration of Technology Indicators

Bulgarian companies struggle to take advantage of the opportunities offered by online commerce: only 7% of SMEs sell online (against 14% of the regional average), 3% of total SMEs sell cross-border, and only 2% of their turnover comes from the online segment. Although Bulgarians make intensive use of social media for personal purposes, only 10% of firms use it to promote their business, against a regional average of 14%. On a more positive note, 23% of businesses share information online against a regional average of 34%.

To change this rather dire situation, "Bulgaria's Council of Ministers approved the strategy paper 'Plan for Digital Transformation of Bulgarian Industry (Industry 4.0)' as a precursor for the strategy for Bulgaria's participation in the fourth industrial revolution up to 2030. A working group with representatives from the Ministry of Economic Affairs, the employers' organizations, and the ICT sector are finalizing the document."[11]

[11] DESI 2020 country profile

Digital public services

In the last years, Bulgaria has made some progress in digital public services. It is the only DESI dimension where its score is equal to the regional average of 62 points.

		2016	2020	EU11 2020
5a1 e-Government users	% internet users needing to submit forms	64.15 %	60.90 %	61.92 %
5a2 Pre-filled forms	Score (0 to 100)	22.66	34.14	45.02
5a3 Online service completion	Score (0 to 100)	64.428 6	79.375	82.66
5a4 Digital public services for businesses	Score (0 to 100) - including domestic cross-border	65.03	92.57	74.95
5a5 Open data	% of maximum score		57.42 %	63.03 %

Illustration 33 Detailed Digital Public Service Indicators

The number of e-government users is rather high, with 61% of internet users submitting forms online, close to the regional average of 62%. The country is also performing well in providing digital public services for businesses where it scores 93%, well above the regional average of 75%.

1.3.2. Romania country profile

Overall DESI

Romania has a score of 40.0 in overall DESU, which ranks 10th among the eleven regional countries. There are three factors which play an important role in this outcome:

- Romania's GDP per capita is significantly lower than in other regional countries
- The country joined the European Union in 2007, later than other regional countries
- Romania has had four different governments over the last three years
-

	Romania	EU11	EU
Connectivity	56.2	51.0	50.1
Human Capital	33.2	39.3	49.3
Use of internet	35.9	48.2	58.0
Integration of technology	24.9	29.9	41.4
Digital public services	48.4	62.0	72.0
DESI	**40.0**	**45.1**	**52.6**

Illustration 34 Romania Comparison of DESI

Taking into account the different dimensions, Romania has the highest score in connectivity. The 56.1 points exceed even the regional average by a significant margin. All the other scores are relatively low. Some examples: almost one-fifth of Romanians have never used the internet, and less than a third has at least basic digital skills.

In February 2015, Romania adopted its National Strategy on the Digital Agenda for Romania for 2020, but the monitoring reports on its implementation are not available. In January 2020 the government set up two new bodies to oversee the digital economy:

- Authority for Digitalisation of Romania (ADR) will be responsible for information technology, information society issues, and the national interoperability network.
- Ministry of Transport, Infrastructure and Communications will have responsibilities for policy development in the area of electronic communications and the implementation of policies related to electronic communications infrastructure

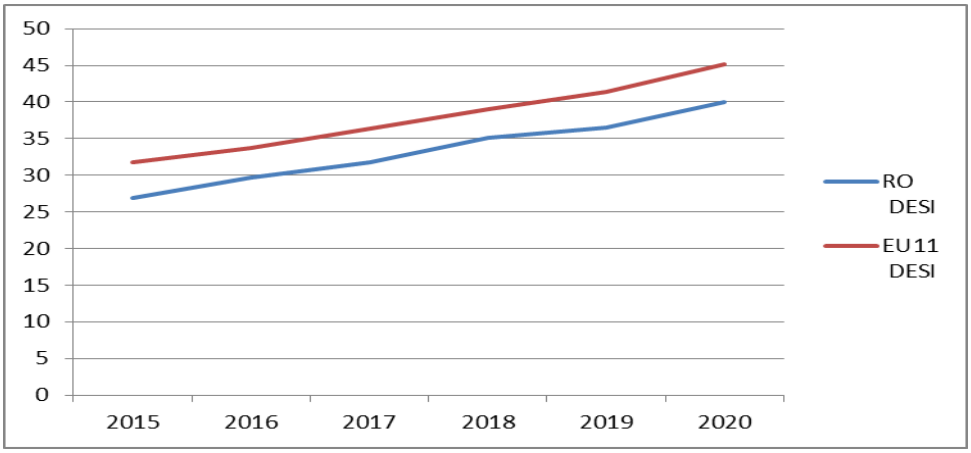


Illustration 35 Romania Development of DESI

As for the change in overall DESI score, the difference of 5 points between the regional average and Romania's score remained unchanged in the last five years. It seems the further efforts are needed in order to start a catch-up process.

Connectivity

Romania's connectivity score has increased by 20 points in the last five years, which is an outstanding result among the Central and Eastern European countries.

		2016	2020	EU11 2020
1a1 Overall fixed broadband take-up	% households	60.32 %	65.67 %	67.42%
1a2 At least 100 Mbps fixed broadband take-up	% households	27.72 %	48.70 %	30.38%
1b1 Fast broadband (NGA) coverage	% households	70.41 %	81.98 %	80.99%
1b2 Fixed Very High Capacity Network (VHCN) coverage	% households	58.18 %	68.15 %	54.84%
1c1 4G coverage	% households (average of operators)		85.45 %	94.52%
1c2 Mobile broadband take-up	Subscriptions per 100 people	58.57	86.18	122.55
1c3 5G readiness	Assigned spectrum as a % of total 5G spectrum		21.25 %	13.99%
1d1 Broadband price index	Score (0 to 100)		91.57	75.87

Illustration 36 Romania Detailed Connectivity Indicators

Both in fixed network coverage and take up Romania's scores are equal to or exceed that of the regional average. The strong infrastructure-based competition in Romania, mainly in urban areas, is reflected in the indicators in which the country performs very well, namely fixed very high capacity network (VHCN) coverage and at least 100 Mbps fixed broadband take-up (68% and 49%

respectively). As regards take-up of at least 100 Mbps broadband, Romania still largely outperforms the regional average (49% versus 30%).

Romania lags behind on 4G coverage (85%, well below the EU average of 95%). The mobile broadband take-up indicator is the lowest in the region.

Romania scores 21% in the 5G readiness indicator, much higher than the regional average. The 5G licensing seems to be on track, 38% of the spectrum harmonized at EU level for wireless broadband has been assigned. Besides that, a national strategy for the implementation of 5G in Romania was adopted in June 2019.

Human capital

Romania has the lowest rank among the Central and Eastern European countries in Human Capital dimension, and its ranking did not change over the last five years

		2016	2020	EU11 2020
2a1 At least basic digital skills	% individuals	26.28 %	30.97 %	44.69%
2a2 Above basic digital skills	% individuals	8.97%	10.33 %	21.01%
2a3 At least basic software skills	% individuals	28.65 %	35.07 %	46.93%
2b1 ICT specialists	% total employment	1.60%	2.20%	3.08%
2b2 Female ICT specialists	% female employment	0.80%	1.19%	1.05%
2b3 ICT graduates	% graduates		5.60%	4.22%

Illustration 37 Romania Detailed Human Capital Indicators

Only 31% of people aged between 16 and 74 have at least basic digital skills (44% in the region). As for the above basic digital skills, Romania has the lowest score in the region, with only 10% of individuals. The percentages of ICT specialists represent a much lower proportion of the workforce than in the region (2.2%,

against a regional average of 3.9%). Romania is performing well with regard to ICT graduates, ranking high in the region, with 5.6% of all graduates.

Romania has a National Coalition for Digital Skills and Jobs[12]. This open platform includes several stakeholders, ICT companies, associations, training providers, and NGOs involved in the digital transformation and has political backup from the government. The coalition's activities are in line with the National Strategy for Digital Romania 2020, having as objective the development of digital skills.

[12] DESI 2020 Romania country profile

Use of internet services

Romania's score in Use of internet services is also very low, just 36 points, the worst in the region. This ranking did not change in the last five years. This development is closely related to the low level of basic digital skills in the country.

		2016	2020	EU11 2020
3a1 People who have never used the internet	% individuals	31.80 %	17.66 %	15.42%
3a2 Internet users	% individuals	51.79 %	71.56 %	77.55%
3b1 News	% internet users	67.17 %	54.87 %	74.42%
3b2 Music, videos and games	% internet users		63.08 %	72.61%
3b3 Video on demand	% internet users		10.21 %	13.12%
3b4 Video calls	% internet users	42.24 %	66.90 %	64.41%
3b5 Social networks	% internet users	78.27 %	81.70 %	72.80%
3b6 Doing an online course	% internet users	7.42%	4.11%	6.14%
3c1 Banking	% internet users	9.57%	11.35 %	50.34%
3c2 Shopping	% internet users	17.56 %	29.42 %	56.26%
3c3 Selling online	% internet users	4.91%	3.42%	14.34%

Illustration 38 Romania Detailed Use of Internet Serivces Indicators

18% of individuals aged 16-74 have never used the internet (regional average: 15%). There are two online activities in which the country ranks higher than the regional average. These are the use of social networks (82%, versus a regional average of 73%) and video calls (67%; regional average: 64%). In online transaction subdimension, like the use of online banking (11%), shopping (29%) is the lowest among regional countries, mainly due to a lack of trust in digital technology.

Integration of technology

Romania has the lowest score among the regional countries on the Integration of digital technology by businesses, 5 points below the average of 30 points. Although there was some improvement over the last 5 years, this ranking did not change

		2016	2020	EU11 2020
4a1 Electronic information sharing	% enterprises	21.99 %	23.48 %	27.55%
4a2 Social media	% enterprises	6.48%	8.37%	14.27%
4a3 Big data	% enterprises		11.12 %	8.69%
4a4 Cloud	% enterprises	5.70%	7.30%	9.92%
4b1 SMEs selling online	% SMEs	7.39%	11.40 %	14.42%
4b2 e-Commerce turnover	% SME turnover	4.85%	4.92%	6.07%
4b3 Selling online cross-border	% SMEs	1.93%	5.79%	6.97%

Illustration 39 Romania Detailed Integration of Technology Indicators

23% of Romanian enterprises share information electronically, while only 8% use social media (regional average: 14%). There was a slight improvement in the share of SMEs selling online, from 8% in 2015 to 11% in 2019, but this remains well below the regional average of 14%. SMEs are increasingly selling online across borders, but this applies to only 6% of the total number of SMEs, compared to a regional average of 7%.

Digital public services

On Digital public services Romania ranks last among the EU member states. The gap between the regional average and the country's score is very large (14 points).

		2016	2020	EU11 2020
5a1 e-Government users	% internet users needing to submit forms	94.03 %	82.21 %	61.92%
5a2 Pre-filled forms	Score (0 to 100)	5.50	10.38	45.02
5a3 Online service completion	Score (0 to 100)	53.57	70.25	82.66
5a4 Digital public services for businesses	Score (0 to 100) - including domestic cross-border	40.57	53.30	74.95
5a5 Open data	% of maximum score		57.42 %	63.03%

Illustration 40 Romania Detailed Digital Public Service Indicators

Romania has a high ranking for e-government users, with 82% of internet users, versus a regional average of 62%. The low scores for pre-filled forms and online service completion, where the country ranks last, indicate a systemic problem with the quality and usability of the services offered. There was no improvement in digital public services for businesses, for which Romania also ranks last.

According to the DESI 2020 country: "The main barriers to achieving digital public services in Romania are:

- the lack of coordination between public institutions in setting up such services;
- the migration of IT specialists from the public sector to the private sector or to other countries;
- the overall lack of digital skills."[13]

[13] DESI 2020 Romania country report

1.3.3. **Estonia country profile**

Overall DESI

Estonia has a score of 61 points in overall DESI, which is the highest value among the Central and Eastern European countries. It ranks 7th out of the 28 EU Member States in the 2020 edition of the European Commission's Digital Economy and Society Index (DESI).

	Estonia	EU11	EU
Connectivity	51.9	51.0	50.1
Human Capital	66.7	39.3	49.3
Use of internet	65.4	48.2	58.0
Integration of technology	41.1	29.9	41.4
Digital public services	89.3	62.0	72.0
DESI	**61.1**	**45.1**	**52.6**

Illustration 41 Estonia Comparison of DESI

With the exception of the connectivity dimension, Estonia excels in four out of five dimensions of DESI. The country's score in the human capital dimension is 27 points higher, in the digital public services dimension is 27 points higher than that of the regional average. Despite the availability of a skilled labor force, a key challenge in the Estonian economy remains the digitization of companies that do not yet take full advantage of the opportunities offered by digital technology. The score in the integration of technology dimension is only equal to the EU average.

"Estonia had reviewed and updated its 'Digital Agenda 2020' strategy in 2018. This undertaking is anchored in clear and transparent criteria, which will help the country in implementing the necessary measures to achieve its ambitious targets.

By the end of 2020, the government plans to prepare and adopt the digital strategy for the next 5 years."[14]

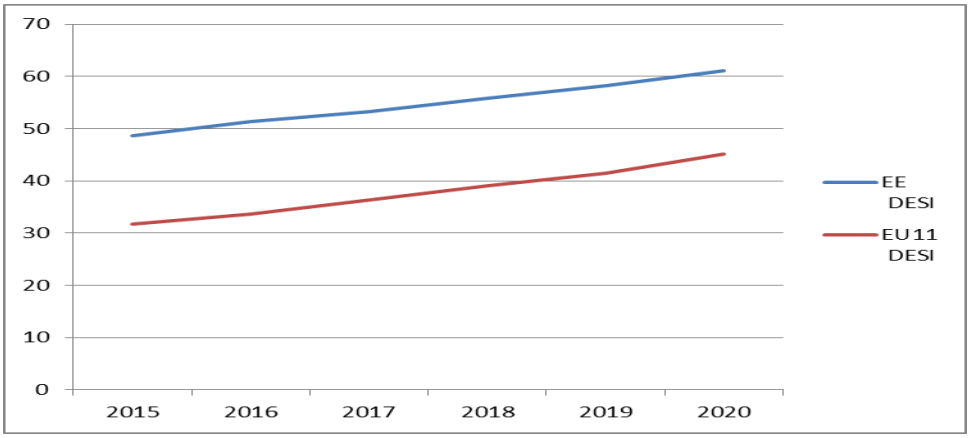


Illustration 42 Estonia Development of DESI

The excellent performance of the digital economy in Estonia is not a new phenomenon. In 2015 Estonia's score in overall DESI had exceeded the regional average by 15 points, and this gap did not change over the last five years.

Connectivity

The rise of Estonia's connectivity score has slightly slowed down since 2018, but the country's score of 51.9 is still higher than the regional average.

		2016	2020	EU11 2020
1a1 Overall fixed broadband take-up	% households	77.10 %	82.61 %	67.42%
1a2 At least 100 Mbps fixed broadband take-up	% households	5.02%	14.08 %	30.38%
1b1 Fast broadband (NGA) coverage	% households	78.13 %	83.69 %	80.99%

[14] DESI 2020 Estonia country profile

1b2 Fixed Very High Capacity Network (VHCN) coverage	% households	47.54 %	57.45 %	54.84%
1c1 4G coverage	% households (average of operators)		97.90 %	94.52%
1c2 Mobile broadband take-up	Subscriptions per 100 people	104.52	152.15	122.55
1c3 5G readiness	Assigned spectrum as a % of total 5G spectrum		0.00%	13.99%
1d1 Broadband price index	Score (0 to 100)		69.81	75.87

Illustration 43 Estonia Detailed Connectivity Indicators

In very-high capacity networks coverage, Estonia reaches 57% of its households being covered against a regional average of 54%. The country performed very well in the take-up of mobile broadband, with 152 subscriptions per 100 people; the regional average is 122 subscriptions per 100 people. Estonia also scores quite well on fixed broadband take-up, reaching 83%. Estonia's weak spot is the take-up of fixed broadband reaching speeds of at least 100 Mbps, where, despite the excellent availability of very-high capacity networks, it lies well below the regional average; only 14% of households subscribe to such speeds.

"Estonia scores 0% on the 5G readiness indicator. As of January 2020, the award of 5G pioneer bands in Estonia was still pending. The public offer for the 3.6 GHz band opened in March 2019, but an operator contested the design of the tender, which led to its suspension. The Estonian authorities anticipate some difficulties in allowing the use of sufficiently large blocks in the 3.6 GHz band due to restrictions stemming from cross-border coordination issues with non-EU countries."[15]

[15] DESI 2020 Estonia country profile

Human capital

Estonia ranks the 1th in the region and the 3rd in the EU on the Human capital dimension. The country's score of 68 is 28 points higher than the regional average. It also exceeds the EU average by 18 points. The development trend is also quite impressive; in the last five years, the score has increased by 11 points.

		2016	2020	EU11 2020
2a1 At least basic digital skills	% individuals	64.51 %	61.58 %	44.69%
2a2 Above basic digital skills	% individuals	37.44 %	37.03 %	21.01%
2a3 At least basic software skills	% individuals	65.46 %	62.46 %	46.93%
2b1 ICT specialists	% total employment	3.90%	5.70%	3.08%
2b2 Female ICT specialists	% female employment	1.54%	2.58%	1.05%
2b3 ICT graduates	% graduates	5.30%	7.40%	4.22%

Illustration 44 Estonia Detailed Human Capital Indicators

62% of the population have at least basic digital skills, and 37% have above basic digital skills, both above the regional average (45% and 21% respectively). The percentage of ICT graduates (7.4%), ICT specialists (5.7%), and female ICT specialists (2.6%) in Estonia are also higher than the regional average.

Despite these visible results, 84% of businesses have identified skills shortages as some of the main obstacles to investment. The Estonian government is committed to launching a number of initiatives to ensure the supply of ICT specialists and the acquisition of higher ICT skills in traditional sectors of the Estonian economy.

The Estonian Lifelong Learning Strategy aims to ensure that 80% of the population acquire digital competences by 2020).[16]

Use of internet services

Estonia ranks 1st in the region and 7th in the EU on the Use of internet services. It reached a score of 65, 17 points higher than the regional average. This ranking did not change over the last five years.

		2016	2020	EU11 2020
3a1 People who have never used the internet	% individuals	9.05%	7.25%	15.42%
3a2 Internet users	% individuals	85.82 %	88.43 %	77.55%
3b1 News	% internet users	90.52 %	89.30 %	74.42%
3b2 Music, videos and games	% internet users		83.32 %	72.61%
3b3 Video on demand	% internet users		26.57 %	13.12%
3b4 Video calls	% internet users	46.16 %	58.91 %	64.41%
3b5 Social networks	% internet users	63.15 %	72.19 %	72.80%
3b6 Doing an online course	% internet users	9.79%	15.46 %	6.14%
3c1 Banking	% internet users	91.25 %	89.46 %	50.34%

[16] DESI 2020 Estonia country profile

3c2 Shopping	% internet users	66.09 %	75.09 %	56.26%
3c3 Selling online	% internet users	21.22 %	20.17 %	14.34%

Illustration 45 Estonia Detailed Use of Internet Serivces Indicators

Overall, the use of the internet in Estonia is high (88% of individuals [aged 16-74]). People in Estonia are active in a range of online activities, the most popular being reading the news (89%, against a regional average of 74%) and banking (89%, against 50% at the regional level). Estonia also performs above the regional average in playing music, videos, and games (83%), using social networks (72%), and shopping online (75%).

Integration of technology

Estonia ranks 5th in the region and 14th in the EU in the Integration of digital technology dimension. Its score of 41 points is equal to the EU average, but 11 points higher than the regional average.

		2016	2020	EU11 2020
4a1 Electronic information sharing	% enterprises	22.25 %	25.51 %	27.55%
4a2 Social media	% enterprises	9.40%	15.56 %	14.27%
4a3 Big data	% enterprises		10.82 %	8.69%
4a4 Cloud	% enterprises		25.94 %	9.92%
4b1 SMEs selling online	% SMEs	12.15 %	17.23 %	14.42%
4b2 e-Commerce turnover	% SME turnover	8.09%	12.08 %	6.07%
4b3 Selling online cross-border	% SMEs	6.13%	9.39%	6.97%

Illustration 46 Estonia Detailed Integration of Technology Indicators

Estonia has better scores than the other regional countries in a number of criteria, such as in the use of social media by business (16% versus 14%), in the share of

SMEs selling online (17% versus 14%) and the share of businesses selling online across borders (9% versus 7%).

Estonia invested in trainings on e-commerce for new entrepreneurs as well as active businesses, via County Development Centres network, located in each county." The government is also committed to making progress with new digital technologies and to strategically investing in them. In July 2019, it adopted the national Artificial Intelligence (AI) strategy for 2019-2021. The goals of this strategy include advancing the uptake of AI by the private sector, and by providing practical examples on the use of AI applications to solve specific use cases."[17]

Digital public services

Estonia ranks 1st place in the EU on Digital public services. Its score of 89 points exceeds that of the EU average by 17 points, that of the region by 27 points.

		2016	2020	EU11 2020
5a1 e-Government users	% internet users needing to submit forms	94.73 %	93.15 %	61.92%
5a2 Pre-filled forms	Score (0 to 100)	95.14	89.63	45.02
5a3 Online service completion	Score (0 to 100)	96.43	97.88	82.66
5a4 Digital public services for businesses	Score (0 to 100) - including domestic cross-border	93.09	100	74.95
5a5 Open data	% of maximum score		67.44 %	63.03%

Illustration 47 Estonia Detailed Digital Public Service Indicators

[17] DESI 2020 Estonia country profile

Estonia has well-developed e-government and e-health systems, with all central government services, as well as municipalities providing services online. It has of the highest shares (93%) of e-government users in Europe. Estonia also performs very well across all the other indicators of e-government analysis, like the provision of digital public services to businesses.

In its Digital Agenda 2020 program, the government set the objectives to ensure that the full range of online public services is user-friendly and cost-effective. Promoting the use of and opening up information gateways, including the Estonian Open Data Portal, would help the country achieving those goals.[18]

[18] DESI 2020 Estonia country profile

1.3.4. Latvia country profile

Overall DESI

Latvia has a score of 51 points in overall DESI, which is 5th among the Central and Eastern European countries. It is above the regional average by 5 points.

	Latvia	EU11	EU
Connectivity	61.8	51.0	50.1
Human Capital	35.0	39.3	49.3
Use of internet	54.0	48.2	58.0
Integration of technology	28.3	29.9	41.4
Digital public services	85.1	62.0	72.0
DESI	**50.7**	**45.1**	**52.6**

Illustration 48 Latvia Comparison of DESI

Latvia excels in two dimensions: connectivity and digital public services, here its scores are higher even compared to the EU average. In the other three dimensions, its score is close to the regional average but lags behind the EU average. The weak link of the Latvian digital economy is the integration of technology dimension. The score of 28.3 shows that the Latvian business sector still fails to take advantage of the opportunities offered by digital technologies. Latvia also scores well below average in digital skills. More than half of the population still lack basic digital skills, and ICT specialists represent 1.7% of total employment only (EU average: 3.9%).

“The current Latvian Digital Agenda Strategy dates back to 2013 when the Latvian government approved the Information Society Development Guidelines for 2014-2020. The guidelines cover ICT education and skills, internet access, modern and efficient public administration, e-services and digital content for society, cross-border cooperation for the digital single market, ICT research and

innovation, and trust and security. Many plans and projects are in place to implement the strategy."[19]

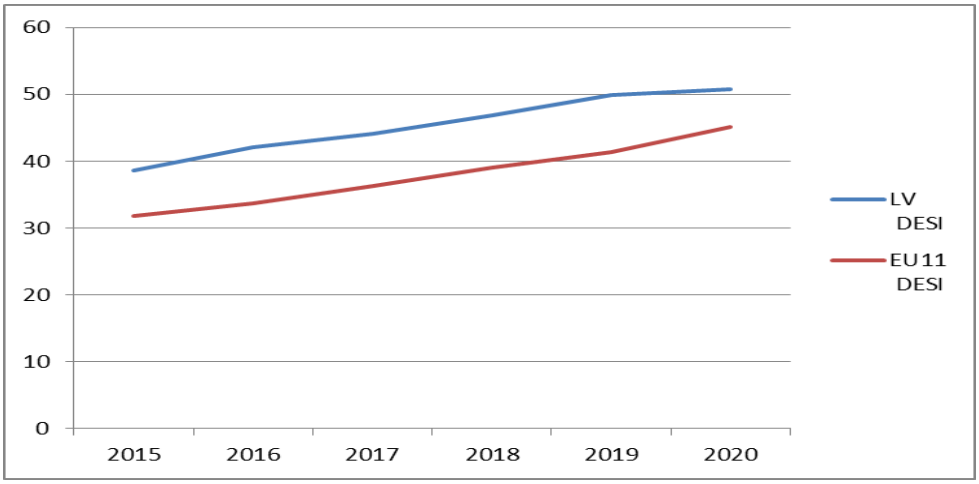


Illustration 49 Latvia Development of DESI

In the last two years, the development of the digital economy has slowed down compared to the average of other regional countries.

Connectivity

Despite its relatively high score in connectivity, the county's development in the last years was still quite remarkable. According to the DESI 2020 report, Latvia was on the 4th place in the EU ranking

		2016	2020	EU11 2020
1a1 Overall fixed broadband take-up	% households	64.77 %	63.52 %	67.42%
1a2 At least 100 Mbps fixed broadband take-up	% households	27.32 %	38.13 %	30.38%

[19] DESI 2020 Latvia country profile

1b1 Fast broadband (NGA) coverage	% households	90.69 %	93.09 %	80.99%
1b2 Fixed Very High Capacity Network (VHCN) coverage	% households	84.97 %	88.06 %	54.84%
1c1 4G coverage	% households (average of operators)		99.32 %	94.52%
1c2 Mobile broadband take-up	Subscriptions per 100 people	65.18	127.46	122.55
1c3 5G readiness	Assigned spectrum as a % of total 5G spectrum		33.33 %	13.99%
1d1 Broadband price index	Score (0 to 100)		76.90	75.87

Illustration 50 Latvia Detailed Connectivita Indicators

The country's main strengths are the extremely advanced coverage of fast broadband (NGA) (93% against the regional average 81%), and near-complete average 4G coverage (99% against regional average 95%). Latvia also performs well as regards to very high capacity networks (VHCN), with coverage remaining at 88% in 2019, much higher than the regional average of 55%.

There were fast developments in at least 100 Mbps fixed broadband take-up (from 27% in 2015 to 38% in 2019) and mobile broadband take-up (from 66% in 2015 to 127% in 2019)

The national 5G roadmap was approved by the Cabinet of Ministers in February 2020. Latvia is one of the front-runners in preparation for the deployment of 5G, ranking 5th on the 5G readiness indicator with 33% of 5G spectrum assigned. Commercial 5G services are available in the cities Jelgava and Daugavpils. Overall, Latvia has assigned 47% of those spectrum bands which harmonized at the EU level for wireless broadband, of which a part is also available for 5G.

Human capital

In Human capita dimension, Latvia ranks 9th among the Central and Eastern European countries and 24th among EU countries, with several indicators deteriorating in the last years.

		2016	2020	EU11 2020
2a1 At least basic digital skills	% individuals	49.20 %	42.96 %	44.69%
2a2 Above basic digital skills	% individuals	25.54 %	24.45 %	21.01%
2a3 At least basic software skills	% individuals	50.88 %	43.89 %	46.93%
2b1 ICT specialists	% total employment	2.00%	1.70%	3.08%
2b2 Female ICT specialists	% female employment	0.94%	0.48%	1.05%
2b3 ICT graduates	% graduates	3.60%	5.00%	4.22%

Illustration 51 Latvia Deatailed Human Capital indicators

Basic and advanced digital skill levels are rather low. Only 43% of people aged 16 to 74 have at least basic digital skills, and only 24% have advanced skills. The percentage of ICT specialists is lower than the regional average (1.7% vs. 3.1%). Latvia performs well above the regional average, however, on graduates with an ICT degree (5% vs. 4.2%).

Although Latvia does not have a specific digital skills strategy, the development of digital skills is addressed in several sectoral policies. Digital skills are included in both the primary and secondary curricula in Latvia. Coding and computational thinking have also now been introduced in the compulsory curricula and will be implemented from next year.

Use of internet services

Overall, the use of Internet services in Latvia is slightly above the regional average, but the rate of progress is slower than in the other regional countries.

		2016	2020	EU11 2020
3a1 People who have never used the internet	% individuals	18.18 %	11.59 %	15.42%
3a2 Internet users	% individuals	74.92 %	83.72 %	77.55%
3b1 News	% internet users	87.31 %	78.46 %	74.42%
3b2 Music, videos and games	% internet users		75.97 %	72.61%
3b3 Video on demand	% internet users		15.24 %	13.12%
3b4 Video calls	% internet users	55.09 %	66.00 %	64.41%
3b5 Social networks	% internet users	72.61 %	75.07 %	72.80%
3b6 Doing an online course	% internet users	4.91 %	5.13 %	6.14%
3c1 Banking	% internet users	81.21 %	83.10 %	50.34%
3c2 Shopping	% internet users	47.62 %	53.75 %	56.26%
3c3 Selling online	% internet users	6.99 %	10.27 %	14.34%

Illustration 52 Latvia Detailed Use of Internet Serivces Indicators

84% of the population use the internet at least once a week, which is higher than the regional average of 78%. More than 3 out of 4 Latvian internet users read online news, listen to music, play videos or games online, or use social networks. As for transactions, although 83% bank online (well above the regional average of 50%), e-commerce is lagging behind only 54% shop and 10% sell online.

Integration of technology

On the Integration of digital technology, the Latvian score is below the regional, although the difference is minimal, just 1 point. The progress in Latvia was quite fast from 19 points in 2015 to 28 in 2019.

		2016	2020	EU11 2020
4a1 Electronic information sharing	% enterprises	15.86 %	32.26 %	27.55%
4a2 Social media	% enterprises	10.27 %	19.27 %	14.27%
4a3 Big data	% enterprises		7.71%	8.69%
4a4 Cloud	% enterprises	5.87%	10.92 %	9.92%
4b1 SMEs selling online	% SMEs	8.30%	10.80 %	14.42%
4b2 e-Commerce turnover	% SME turnover		5.33%	6.07%
4b3 Selling online cross-border	% SMEs	3.92%	6.60%	6.97%

Illustration 53 Latvia Detailed Use of Integration of Technology Indicators

In the last years, Latvia improved on the use of electronic information sharing (which is now in place in 32% of Latvian enterprises) and on the use of social media (19% of Latvian enterprises), in 2019 they are above the regional average for both indicators (34% and 25% respectively).

Latvian enterprises do not make sufficient use of the opportunities provided by big data and cloud computing. Only 8% use big data, and 11% take advantage of cloud computing. On e-commerce, only 11% of SMEs sell online (significantly below the regional average of 14%). However, the share of SMEs engaged in e-

commerce across border to other EU countries increased in the last two years. Now it is equal to the regional average (7%).

The digital transformation of the Latvian economy is addressed in broader national strategies and guidelines (such as the 2014-2020 National Development Plan, the 2014-2020 Guidelines for Science, Technology Development and Innovation, and the 2014-2020 Guidelines for National Industrial Policy). In June 2019, the Latvian government adopted its national AI strategy, following a public consultation). The document defines the way forward in promoting the use of AI solutions over the next three years and invites ministries to identify areas where AI can be exploited for the automation of public administration tasks.

Digital public services

In Digital public services, Latvia ranks 2nd among the Central and Eastern European countries and 5th among the EU countries. Its score is 23 points higher than the regional average. The progress was very fast in this dimension, which shows the government's determination to develop this sector

		2016	2020	EU11 2020
5a1 e-Government users	% internet users needing to submit forms	76.51%	83.06%	61.92 %
5a2 Pre-filled forms	Score (0 to 100)	50.86	85.63	45.02
5a3 Online service completion	Score (0 to 100)	85.43	96.38	82.66
5a4 Digital public services for businesses	Score (0 to 100) - including domestic cross-border	80.00	90.18	74.95
5a5 Open data	% of maximum score	84.97%	74.95%	63.03 %

Illustration 54 Latvia Detailed Digital Public Service Indicators

Latvia scores above average on all indicators in this area. The share of e-government users in the population reached 83%. The 90 point score (out of 100) for services provided to businesses is also very high.

On services for businesses, setting up companies online is supported by national legislation. A person wanting to register a company online can submit all necessary documents to the Register of Enterprises. People can also register key life events online. There are currently more than 800 public services available digitally.

"In 2020, the government adopted the 'Public Service Development Plan 2020-2023'. This plan sets the policy strategy for years to come and reinforces digital public services by enhancing: proactive service provision, user-centricity built around key life events, coordinated and integrated approach in service design, cross-border services."[20]

[20] DESI 2020 Latvia country profile

1.3.5. Poland country profile

Overall DESI

Poland had an overall DESI score of 45 points, which is equal to the regional average. It is on the 9th place close to the bottom of the regional ranking.

	Poland	EU11	EU
Connectivity	51.3	51.0	50.1
Human Capital	37.3	39.3	49.3
Use of internet	49.6	48.2	58.0
Integration of technology	26.2	29.9	41.4
Digital public services	67.4	62.0	72.0
DESI	**45.0**	**45.1**	**52.6**

Illustration 55 Poland Comparison of DESI

Poland's scores are in every dimension very close to the regional average, but except for the connectivity they are well below the EU average. Lower scores show that the integration of digital technology and the use of internet services are the most challenging areas.

"The new Operational program Digital Poland for 2021-2027, co-funded by European Regional Development Fund, is also being prepared. The strategy will include, among others, support for broadband infrastructure, e-services (e-government and e-health), basic and advanced digital skills, upskilling and re-skilling, and skills needed for the future."[21]

[21] DESI 2020 Poland country profile

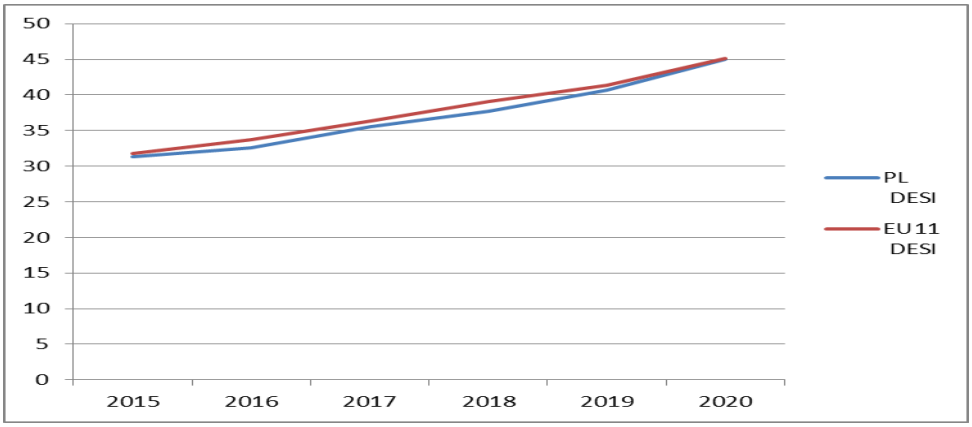


Illustration 56 Poland Development of DESI

In the last five years, the progress in the development of the digital economy was relatively fast. It was in line with the EU and regional trends.

Connectivity

Connectivity was a bright spot in Poland's development. The score increased from 31 points in 2015 to 51 points in 2019.

		2016	2020	EU11 2020
1a1 Overall fixed broadband take-up	% households	57.36%	62.34 %	67.42%
1a2 At least 100 Mbps fixed broadband take-up	% households	4.79%	27.57 %	30.38%
1b1 Fast broadband (NGA) coverage	% households	60.71%	75.92 %	80.99%
1b2 Fixed Very High Capacity Network (VHCN) coverage	% households	8.98%	60.31 %	54.84%

1c1 4G coverage	% households (average of operators)		99.15 %	94.52%
1c2 Mobile broadband take-up	Subscriptions per 100 people	94.11	175.70	122.55
1c3 5G readiness	Assigned spectrum as a % of total 5G spectrum		0.00%	13.99%
1d1 Broadband price index	Score (0 to 100)		81.48	75.87

Illustration 57 Poland Detailde Human Capital Indicators

Poland has achieved significant progress on the fixed very high-capacity networks coverage (60% compared to the regional average of 55%). In mobile broadband take-up, Poland ranks first in the EU, with 176 subscriptions per 100 people. The Polish market boasts one of the lowest retail prices in the EU – it scores 81 on the broadband price index, compared with the regional average of 76. It remains slightly above the regional average in terms of average 4G coverage (99%) but is below the regional average in terms of NGA broadband coverage (76%).

Poland scores 0% in the 5G readiness indicator. Until now, Russia, Belarus, and Ukraine have not indicated the date for releasing the 700 MHz band from TV transmission. This is the prerequisite before assigning the 700 MHz spectrum band for 5G purposes in Poland.

Human capital

In Human capital, Poland ranks 8th in the region and 22nd in the EU. Its score of 37.3 points is below the EU average by 12 points. The progress in the last five years was only moderate, but it was in line with the regional trends.

		2016	2020	EU11 2020
2a1 At least basic digital skills	% individuals	40.04%	44.45 %	44.69%
2a2 Above basic digital skills	% individuals	15.07%	21.29 %	21.01%
2a3 At least basic software skills	% individuals	42.93%	46.09 %	46.93%
2b1 ICT specialists	% total employment	2.60%	3.00%	3.08%
2b2 Female ICT specialists	% female employment	0.81%	0.92%	1.05%
2b3 ICT graduates	% graduates		3.50%	4.22%

Illustration 58 Poland Detailed Human Capital Indicators

The scores of basic and advanced digital skills are equal to the regional average, with 44% of individuals between the ages of 16 and 74 having at least basic digital skills. The supply of ICT specialists is gradually growing but remains rather low, 3% of total employment.

Poland finalized the preparation of a new Digital Competence Development Programme, which targets the development of digital skills, coordinated centrally by the Ministry of Digital Affairs. It will focus on digital skills needed by citizens, ICT specialists, and employees of SMEs and public administration. It is expected to be adopted in 2020.

Use of internet services

In Use of internet services, Poland ranks 9th in the region and 23rd in the EU. Its score of 49.6 points is below the EU average by 8 points. The progress in the last five years was in line with that of the other Central and Eastern European countries.

		2016	2020	EU11 2020
3a1 People who have never used the internet	% individuals	27.08%	15.48 %	15.42%
3a2 Internet users	% individuals	64.81%	78.27 %	77.55%
3b1 News	% internet users	68.56%	75.21 %	74.42%
3b2 Music, videos and games	% internet users		74.64 %	72.61%
3b3 Video on demand	% internet users		15.33 %	13.12%
3b4 Video calls	% internet users	40.61%	60.39 %	64.41%
3b5 Social networks	% internet users	60.88%	65.94 %	72.80%
3b6 Doing an online course	% internet users	3.82%	6.69%	6.14%
3c1 Banking	% internet users	45.89%	58.76 %	50.34%
3c2 Shopping	% internet users	52.86%	65.74 %	56.26%
3c3 Selling online	% internet users	17.84%	17.01 %	14.34%

Illustration 59 Poland Detailed Use of Internet Serivces Indicators

The proportion of people who have never used the internet decreased by 12% in the last five years. Polish internet users are active in a variety of online activities, just as in the rest of the region. The most popular online activities are reading the news, listening to music, watching videos, playing video games, and using social networks. 75% of Polish internet users read news online.

In online transactions, Poles are more active than their counterparts in other regional countries. The score of online shopping of 66% and that of online banking of 59% are both much higher than the regional average.

Integration of technology

As regards the Integration of digital technology in businesses' activities, Poland ranks 9th among the Central and Eastern European countries and 25th among EU countries. Both are very close to the bottom; however, the progress has accelerated in recent years.

		2016	2020	EU11 2020
4a1 Electronic information sharing	% enterprises	20.86%	28.54 %	27.55%
4a2 Social media	% enterprises	8.36%	14.07 %	14.27%
4a3 Big data	% enterprises		7.89%	8.69%
4a4 Cloud	% enterprises	4.43%	6.67%	9.92%
4b1 SMEs selling online	% SMEs	9.59%	12.83 %	14.42%
4b2 e-Commerce turnover	% SME turnover			6.07%
4b3 Selling online cross-border	% SMEs	3.78%	5.32%	6.97%

Illustration 60 Poland Detailed Integration of Technology Indicators

The progress in of integration of digital technologies by the business can be seen from the detailed indicators as well. 13% of SMEs sell online, 14% of enterprises use social media, 7% use cloud services, and 8% analyze big data.

Poland is committed to progressing and investing in digital technologies. In 2019, it launched several major initiatives, including the Foundation Future Industry. The platform's goal is to increase the competitiveness of entrepreneurs by supporting their digital transformation. The platform will be coordinating, standardizing, and supporting activities implemented by Polish Digital Innovation Hubs (DIH).

"Poland launched extensive work on the Artificial Intelligence Development Policy for 2019-2027. Its goal is to enter a narrow group of 20-25% of countries building Artificial Intelligence (AI) and increase investments, coordinate research funding, and monitor the impact of AI on the labor market. The policy will also be a part of the Polish Strategy of Productivity as well as of the Strategy of the Efficient State 2030."[22]

Digital public services

In Digital public services, Poland ranks 5th in the region and 20th in the EU. Its score of 67.4 points is below the EU average by 5 points. The progress in the last three years was in line with that of the other Central and Eastern European countries.

		2016	2020	EU11 2020
5a1 e-Government users	% internet users needing to submit forms	42.99%	54.24 %	61.92%
5a2 Pre-filled forms	Score (0 to 100)	63.00	58.00	45.02
5a3 Online service completion	Score (0 to 100)	80.00	86.75	82.66
5a4 Digital public services for businesses	Score (0 to 100) - including domestic cross-border	70.03	75.38	74.95
5a5 Open data	% of maximum score		77.65 %	63.03%

Illustration 61 Poland Detailed Digital Public Service Indicators

Except for pre-filled forms, there was significant progress in all other indicators of the digital public services dimension. The share of e-government users increased from 43% in 2015 to 54% in 2019, On the availability of e-government

[22] DESI 2020 Poland country profile

services for business, Poland scores 75 out of 100, which corresponds to the regional average.

Two programs: “The Strategy for Responsible Development and the Integrated State Digitisation Programme (PZIP) lays down the basis for the digitization of public administrations. After recent reviews, the PZIP will focus more on modernization and on improving the quality of the administration's relations with the public.”[23]

[23] DESI 2020 Poland country profile

1.3.6. Lithuania country profile

Overall DESI

In 2019 Lithuania had an overall DESI score of 54 points, which is higher than the regional average by 9 points. The country is on 2nd place in the regional ranking, and it ranks 14th among the EU member countries.

	Lithuania	EU11	EU
Connectivity	48.9	51.0	50.1
Human Capital	43.8	39.3	49.3
Use of internet	57.3	48.2	58.0
Integration of technology	49.5	29.9	41.4
Digital public services	81.4	62.0	72.0
DESI	**53.9**	**45.1**	**52.6**

Illustration 62 Lithuania Comparison of DESI

In recent years, Lithuania has improved in most of the measured areas. In particular, it performed exceptionally well in the integration of digital technology and digital public services. However, some areas such as human capital are still below the EU average in spite of recent improvements.

Lithuania's digital strategy, the Information Society Development Programme for 2014-2020, was adopted in 2014 and amended in 2017. The strategy covers all areas of the digital economy and society: digital skills; digital content in the Lithuanian language; investments in high-speed broadband; e-government; use of open public data and innovative e-service creation; security; reliability; and interoperability.[24]

[24] DESI 2020 Lithuania country profile

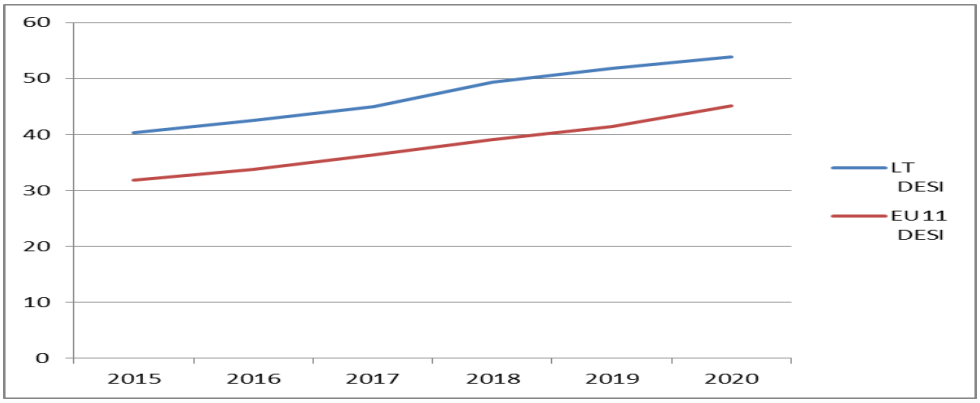


Illustration 63 Lithuania Development of DESI

In the last five years, the progress in the development of the digital economy was relatively fast. It was in line with the EU and regional trends; as a result, the 8 points advantage in DESI score to regional average remained unchanged.

Connectivity

Lithuania progressed slower than the regional average in Connectivity dimension, scoring only 6th amongst the Central and Eastern European countries.

		2016	2020	EU11 2020
1a1 Overall fixed broadband take-up	% households	59.76 %	67.96%	67.42%
1a2 At least 100 Mbps fixed broadband take-up	% households	10.19 %	32.00%	30.38%
1b1 Fast broadband (NGA) coverage	% households	49.60 %	69.44%	80.99%
1b2 Fixed Very High Capacity Network (VHCN) coverage	% households	49.60 %	61.02%	54.84%
1c1 4G coverage	% households (average of operators)		99.83%	94.52%

1c2 Mobile broadband take-up	Subscriptions per 100 people	64.33	103.21	122.55
1c3 5G readiness	Assigned spectrum as a % of total 5G spectrum		0.00%	13.99%
1d1 Broadband price index	Score (0 to 100)		78.61	75.87

Illustration 64 Lithuania Detailed Connectivity Indicators

Lithuania comes out very strong in mobile, both in terms of broadband take-up, and 4G coverage. The scores are 122 subscriptions per 100 people, and 100% for 4G coverage. Concerning the fixed network coverage and take-up, the results are more mixed. The take-up of at least 100 Mbps fixed broadband increased very fast; the Very High Capacity Network (VHCN) coverage is also much higher than the regional average. On the other hand, the progress on overall fixed broadband take-up was rather slow.

"Lithuania's 5G readiness indicator is 0%. Cross-border coordination issues with Russia related to the 5G 700 MHz and the 3.6 GHz bands persist. Lithuania hopes to conclude an agreement on the 700 MHz bands after Russia decides on moving broadcasting from this band, even though this will only allow the band to be used for 5G after 2022."[25]

[25] DESI 2020 Lithuania country profile

Human capital

The progress in the Human capital dimension was higher than in the other Central and Eastern European countries. In 2019 Lithuania's score was 44 points, 5 points higher than the regional average.

		2016	2020	EU11 2020
2a1 At least basic digital skills	% individuals	51.24 %	56.15%	44.69%
2a2 Above basic digital skills	% individuals	30.29 %	32.30%	21.01%
2a3 At least basic software skills	% individuals	53.84 %	58.03%	46.93%
2b1 ICT specialists	% total employment	1.70%	2.70%	3.08%
2b2 Female ICT specialists	% female employment	0.57%	1.37%	1.05%
2b3 ICT graduates	% graduates	2.10%	2.70%	4.22%

Illustration 65 Lithuania Detailed Human Capital Indicators

Lithuania performs best in digital skills. Its scores (58% and 32%) are much higher than the relevant regional averages (45% and 21%) The score of software skills (58%) is also higher than the relevant regional average. ICT graduates only account for 2.7% of all graduates in Lithuania, which is below the regional value of 4.2%.

Use of internet services

Lithuania has improved its overall score for the Use of internet services, but progress was rather modest. Lithuania, with its score of 57 points, ranks 2nd among the Central and Eastern European countries and 13th among the EU member countries.

		2016	2020	EU11 2020
3a1 People who have never used the internet	% individuals	24.57 %	15.11%	15.42%
3a2 Internet users	% individuals	69.01 %	80.69%	77.55%
3b1 News	% internet users	93.63 %	91.03%	74.42%
3b2 Music, videos and games	% internet users		83.82%	72.61%
3b3 Video on demand	% internet users		15.05%	13.12%
3b4 Video calls	% internet users	71.37 %	74.83%	64.41%
3b5 Social networks	% internet users	64.82 %	74.25%	72.80%
3b6 Doing an online course	% internet users	7.55%	9.07%	6.14%
3c1 Banking	% internet users	70.28 %	79.34%	50.34%
3c2 Shopping	% internet users	43.85 %	58.84%	56.26%
3c3 Selling online	% internet users	4.80%	10.90%	14.34%

Illustration 66 Lithuania Detailed Use of Internet Serivces Indicators

Overall, the Use of internet services in Lithuania has higher scores than in other regional countries. The number of internet users is still increasing and has now reached 81%, higher than the regional average of 77%.

Compared to the regional average, Lithuanians' online activities rank higher for news, banking, video calls, social networking, as well as for music, videos, and games. Lithuanians are below the EU average in using the internet for video-on-demand and shopping. The proportion of people who have never used the internet is decreasing; the share of 15% is equal to the regional average.

Integration of technology

The Integration of digital technology by businesses is a bright spot in Lithuania's digital economy. It ranks second among the Central and Eastern European counts and ranks 10th among the EU member countries. Its score in 2019 was 20 points higher than the regional average. At the same time the progress was also relatively faster than in the region.

		2016	2020	EU11 2020
4a1 Electronic information sharing	% enterprises	40.10 %	48.26%	27.55%
4a2 Social media	% enterprises	16.67 %	24.05%	14.27%
4a3 Big data	% enterprises		13.67%	8.69%
4a4 Cloud	% enterprises	11.73 %	17.03%	9.92%
4b1 SMEs selling online	% SMEs	17.57 %	23.91%	14.42%
4b2 e-Commerce turnover	% SME turnover	11.04 %	12.38%	6.07%
4b3 Selling online cross-border	% SMEs	9.71%	12.85%	6.97%

Illustration 67 Lithuania Detailed Integration of Technology Indicators

Lithuania excels in electronic information sharing (48% of Lithuanian enterprises share information electronically compared to the regional average of 28%). Lithuania also performs exceptionally well in SMEs selling online, selling online across borders to other EU countries, and in e-Commerce turnover. All of these indicators exceed the regional average by a big margin. Lithuania's performance is also above the regional average in corporate use of social media, cloud services, and big data.

In 2019, the government drew up the Lithuanian Industry Digitisation Roadmap for 2019-2030. Work on this roadmap was helped by the efforts of thematic working groups on digital manufacturing, digitization services, human resources, cybersecurity, standardization, and legal regulation.

"The AI strategy was launched in March 2019. It gives an overview of emerging AI ecosystems in research, industry, agriculture, health, transportation, energy, finance, and society more broadly. The strategy plans the roll-out of AI in both the private and public sectors. The strategy pays particular attention to developing necessary skills, encouraging research and experimentation, the ethics of AI, transparency, and security."[26]

[26] DESI 2020 Lithuania country profile

Digital public services

Lithuania ranks 2nd in the region and 6th in the EU in the Digital public services dimension. Their score is 72,0 points, 19 points higher than the regional average.

		2016	2020	EU11 2020
5a1 e-Government users	% internet users needing to submit forms	78.35 %	80.94%	61.92%
5a2 Pre-filled forms	Score (0 to 100)	74	88.25	45.02
5a3 Online service completion	Score (0 to 100)	87.86	96.13	82.66
5a4 Digital public services for businesses	Score (0 to 100) - including domestic cross-border	87.30	93.21	74.95
5a5 Open data	% of maximum score		52.99%	63.03%

Illustration 68 Lithuania Detailed Digital Public Service Indicators

Lithuania scores well above the regional average for most components of digital public services. The only exception is open data, where Lithuania is ranked 24th in the EU.

1.3.7. Czechia country profile

Overall DESI

Based on the GDP per capita, Czechia is the most developed country in Central and Eastern European region. Taking into account its economic level, the country's overall DESI score seems slightly low. The country is only in 4th place in regional and 17th in EU ranking. Its score of 51 points is only 6 points above the regional average.

	Czechia	EU11	EU
Connectivity	44.9	51.0	50.1
Human Capital	48.6	39.3	49.3
Use of internet	54.1	48.2	58.0
Integration of technology	49.6	29.9	41.4
Digital public services	62.4	62.0	72.0
DESI	**50.8**	**45.1**	**52.6**

Illustration 69 Czechia Comparison of DESI

Czechia's strongest dimension is the Integration of digital technologies where the country scores 20 points higher than the regional and 9 points higher than the EU average. The score is high, thanks to a solid performance in e-commerce. The connectivity score is below the regional average by 6 points.

Czech authorities are starting to deliver the steps planned in the national strategy for digitization - Digital Czechia. The implementation plans adopted in 2019 included 808 actions. The majority of these actions related to the digitization of public administration and public services.

"The country has introduced a new national strategy for artificial intelligence (AI). It is intended to support research, stimulate international cooperation, help

industry, businesses, and public administration to integrate AI solutions, provide relevant skills to people and assess the impact of AI on the economy and society. The overall objective is to make Czechia a model European country for AI."[27]

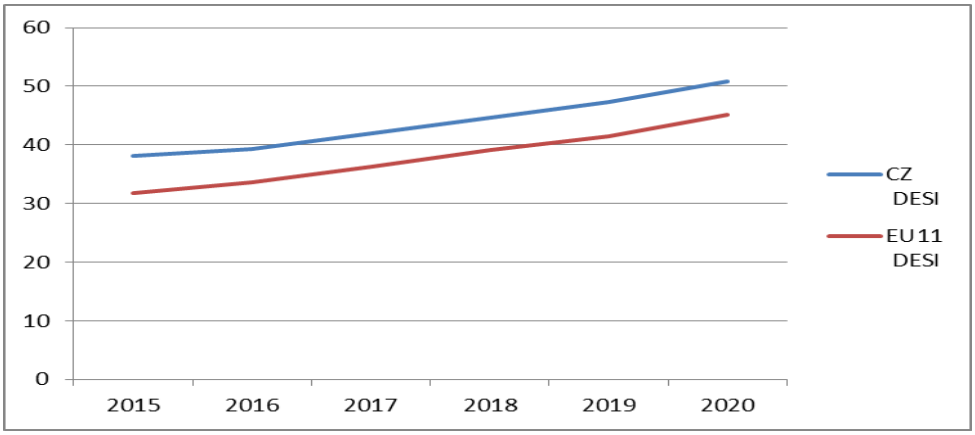


Illustration 70 Czechia Comparison of DESI

The development of the digital economy was relatively fast in recent years, but it did not exceed that of the other regional countries. The difference in points remained unchanged.

Connectivity

As we have mentioned above, the Connectivity dimension is the weak link in Czechia's digital economy. For some reason, the progress in this regard has slowed down substantially in recent years.

		2016	2020	EU11 2020
1a1 Overall fixed broadband take-up	% households	76.04 %	74.08 %	67.42%
1a2 At least 100 Mbps fixed broadband take-up	% households	6.63%	20.37 %	30.38%

[27] DESI 2020 Czechia country profile

1b1 Fast broadband (NGA) coverage	% households	72.86 %	92.06 %	80.99%
1b2 Fixed Very High Capacity Network (VHCN) coverage	% households	17.31 %	29.27 %	54.84%
1c1 4G coverage	% households (average of operators)		99.57 %	94.52%
1c2 Mobile broadband take-up	Subscriptions per 100 people	69.52	96.32	122.55
1c3 5G readiness	Assigned spectrum as a % of total 5G spectrum		16.67 %	13.99%
1d1 Broadband price index	Score (0 to 100)		57.13	75.87

Illustration 71 Czechia Detailed Connectivity Indicators

Overall fixed broadband take-up (74%) did not increase in recent years, although it is slightly above the regional average. Czechia's fast broadband (NGA) coverage is high (reaching 92% in 2019). Fixed VHCN coverage (covering 29% of households in 2018) is significantly below the regional average of 55%. The share of households having at least 100 Mbps fixed broadband (20%) is also quite low compared to regional counterparts.

The country shows complete average 4G coverage (100% of households in Czechia are now covered by the technology). Mobile broadband take-up (96 subscriptions per 100 people) has also seen progress although it is behind the regional average.

The retail prices in Czechia are higher than in other regional countries. Czechia scored 57 on the broadband price index against the regional average of 76. Despite relatively high prices, particularly in the mobile segment, the broadband take-up in Czechia is still higher than in other countries of the region.

Czechia scores are rather high in the 5G readiness indicator. 42% of the spectrum harmonized at EU level for wireless broadband in the country has been assigned.

Following the '5G for 5 Cities' contest supported by the Czech government, five Czech cities were selected for the earliest 5G tests in the country.

"In January 2020, the Czech government decided to take a different approach to the original auction design that the national regulatory authority (NRA) put forward for public consultation the previous year. As a consequence, while the launch of the 5G auction is planned for 2020, it risks being delayed beyond 30 June 2020."[28]

Human capital

As regards the Human capital dimension, Czechia has a relatively high ranking: 3rd place in the region and 14th place in the EU.

		2016	2020	EU11 2020
2a1 At least basic digital skills	% individuals	56.89 %	62.10 %	44.69%
2a2 Above basic digital skills	% individuals	22.93 %	25.79 %	21.01%
2a3 At least basic software skills	% individuals	60.07 %	64.17 %	46.93%
2b1 ICT specialists	% total employment	3.40%	4.10%	3.08%
2b2 Female ICT specialists	% female employment	0.80%	0.92%	1.05%
2b3 ICT graduates	% graduates	4.70%	4.50%	4.22%

Illustration 72 Czechia Detailed Human Capital Indicators

The proportions of the population with at least basic (62%) and above basic (26%) digital skills have just slightly increased in recent years, but they are well above

[28] DESI 2020 Czechia country profile

the regional average. The proportion of people employed as ICT specialists has increased to 4.1%, well above the regional average (3%)

The national digitization strategy, Digital Czechia, adopted in 2018, focuses on the need to develop relevant digital skills and knowledge among people and to create a modern labor market. The related implementation plan lists eight objectives, covering basic and supplementary digital education, support for the adaptation of the labor market, and the improvement of teachers' digital skills.

Use of internet services

In the Use of internet services, Czechia's score is 54 points 6 points higher than the regional average. The county is now on 5th place in regional and on 17th place in EU ranking.

		2016	2020	EU11 2020
3a1 People who have never used the internet	% individuals	13.37 %	9.28%	15.42%
3a2 Internet users	% individuals	77.19 %	84.74 %	77.55%
3b1 News	% internet users	86.09 %	92.07 %	74.42%
3b2 Music, videos and games	% internet users		69.51 %	72.61%
3b3 Video on demand	% internet users		5.06%	13.12%
3b4 Video calls	% internet users	40.30 %	52.05 %	64.41%
3b5 Social networks	% internet users	49.99 %	67.73 %	72.80%
3b6 Doing an online course	% internet users	3.44%	7.08%	6.14%
3c1 Banking	% internet users	59.59 %	78.09 %	50.34%
3c2 Shopping	% internet users	54.88 %	73.13 %	56.26%
3c3 Selling online	% internet users	16.63 %	14.26 %	14.34%

Illustration 73 Czechia Detailed Useof Internet Serivces Indicators

The proportion of people who have never used the internet has fallen to 9% (much lower than the regional average of 15%). 92% of Czech internet users read newspapers and news magazines online. This is the highest score in the whole of the EU. Czechs are also above the EU average for online shopping, social networks, and the use of online banking.

Integration of technology

In the Integration of digital technology, Czechia is in first place in the region and in the 9th place in the EU. The progress in this regard has even accelerated in recent years.

		2016	2020	EU11 2020
4a1 Electronic information sharing	% enterprises	30.25 %	38.00 %	27.55%
4a2 Social media	% enterprises	10.28 %	20.40 %	14.27%
4a3 Big data	% enterprises		8.09%	8.69%
4a4 Cloud	% enterprises		15.53 %	9.92%
4b1 SMEs selling online	% SMEs	22.79 %	28.35 %	14.42%
4b2 e-Commerce turnover	% SME turnover	16.78 %	20.92 %	6.07%
4b3 Selling online cross-border	% SMEs	11.77 %	15.30 %	6.97%

Illustration 74 Czechia Detailed Integration of Technology Indicators

E-commerce continues to be the main driver in this dimension. 28% of Czech SMEs sell online, and the turnover from e-commerce already represents more than a fifth of their revenue. This is the second-highest score in the EU. Czechia also has the third-highest percentage share of SMEs that sell online across borders to other EU countries, In terms of the adoption of concrete digital technologies such as big data analysis or cloud, Czech companies are more restrained.

In 2019, the Czech government announced a new innovation strategy to widen the use of digital technologies among companies. "The document is built around nine pillars and incorporates the existing strategy for digital transformation – Digital Czechia. The actions range from reforming education, protecting intellectual property, supporting innovation hubs, and digitizing the economy and society. Among the first concrete actions, the government launched a new funding program with three pillars: support of high-tech start-ups, development of infrastructure, and delivery of digital services with a focus on artificial intelligence and finally implementation of innovative solutions in the economy."[29]

Digital public services

Czechia's score in Digital public services is 62 points, equal to the regional average but 10 points below the EU average. The country is in 6th place in regional and on the 22nd place in EU ranking.

		2016	2020	EU11 2020
5a1 e-Government users	% internet users needing to submit forms	23.98 %	50.83 %	61.92%
5a2 Pre-filled forms	Score (0 to 100)	29.14	52.50	45.02
5a3 Online service completion	Score (0 to 100)	70.29	82.13	82.66
5a4 Digital public services for businesses	Score (0 to 100) - including domestic cross-border	66.92	79.81	74.95
5a5 Open data	% of maximum score		63.58 %	63.03%

Illustration 75 Czechia Detailed Digital Public Service Indicators

[29] DESI 2020 Czechia country profile

The share of e-government users increased very fast in recent years, from 24% in 2015 to 51% in 2019. All the other indicators, although their progress was also fast, they are only around the regional average.

The country is pursuing its e-government plan included in the Digital Czechia strategy. “Since February 2020, Czechia has a new ‘digital constitution’. This law introduces the right for citizens to access nearly all public services electronically.”[30]

[30] DESI 2020 Czechia country profile

1.3.8. Croatia country profile

Overall DESI

In 2019 Croatia had an overall DESI score of 48 points. The country is on 5th place in regional, and on the 20th in EU ranking. Taking into account the country's lower than the average economic development level, and also that Croatia become the European Union's member state only on 1 July 2013, this is a good result.

	Croatia	EU11	EU
Connectivity	41.2	51.0	50.1
Human Capital	49.2	39.3	49.3
Use of internet	55.5	48.2	58.0
Integration of technology	41.5	29.9	41.4
Digital public services	55.8	62.0	72.0
DESI	**47.6**	**45.1**	**52.6**

Illustration 76 Croatia Comparison of DESI

In two dimensions, Human capital and Integration of technology, Croatia reaches the average EU level. In the Connectivity dimension, it lags behind the regional average by 10 points.

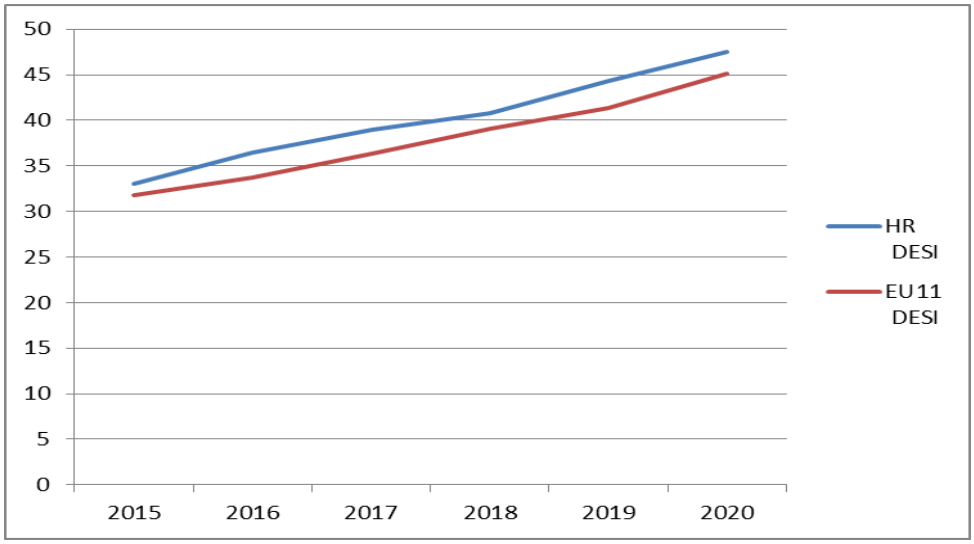


Illustration 77 Croatia Development of DESI

In the last years, the development of the digital economy was rather fast. In the previous five years, the country‘s DESI score was always higher than that of the region.

Connectivity

In the Connectivity dimension, Croatia’s ranking is relatively low. It is on 10th place in regional, and on the 20th place in EU ranking. The progress was rather fast in recent years, but the starting point compared to other regional countries was somewhat low.

		2016	2020	EU11 2020
1a1 Overall fixed broadband take-up	% households	70.35 %	70.35 %	67.42%
1a2 At least 100 Mbps fixed broadband take-up	% households	0.13%	6.21%	30.38%

1b1 Fast broadband (NGA) coverage	% households	51.97 %	85.63 %	80.99%
1b2 Fixed Very High Capacity Network (VHCN) coverage	% households	10.05 %	43.22 %	54.84%
1c1 4G coverage	% households (average of operators)		98.23 %	94.52%
1c2 Mobile broadband take-up	Subscriptions per 100 people	68.14	89.02	122.55
1c3 5G readiness	Assigned spectrum as a % of total 5G spectrum		0.00%	13.99%
1d1 Broadband price index	Score (0 to 100)		61.03	75.87

Illustration 78 Croatia Detailed Connectivity Indicators

On fixed NGA broadband coverage, Croatia's score of 86% is 5 points higher than the regional average. Croatia significantly improved VHCN coverage from 10 % in 2018 to 43% in 2019. Take-up of mobile broadband subscriptions improved but remains 30 percentage points below the EU average. On 100 Mbps and above broadband take-up, Croatia continues to lag significantly, with only 6%, compared with a regional average of 26%. Croatia scores 61, much lower than the regional average of 75, on the broadband price index, mainly due to high prices of fixed and converged baskets.

"Croatia scores 0% in the 5G readiness indicator. The country still lacks a dedicated comprehensive strategy for 5G deployment, which is a prerequisite for future assignment procedures. Having already delayed the adoption of a national roadmap, including detailed steps to enable the 700 MHz frequency band to be used for mobile broadband by 30 June 2020, Croatia placed the roadmap draft in public consultation."[31]

[31] DESI 2020 Croatia country profile

Human capital

Human capital is a bright spot in Croatia's digital economy. It is on the 2nd place in regional and 13th place in EU ranking. The progress in this regard was faster than in the other regional countries.

		2016	2020	EU11 2020
2a1 At least basic digital skills	% individuals	50.91 %	53.35 %	44.69%
2a2 Above basic digital skills	% individuals	30.28 %	35.34 %	21.01%
2a3 At least basic software skills	% individuals	54.60 %	56.02 %	46.93%
2b1 ICT specialists	% total employment	2.70%	3.50%	3.08%
2b2 Female ICT specialists	% female employment	0.84%	1.08%	1.05%
2b3 ICT graduates	% graduates	3.90%	5.50%	4.22%

Illustration 79 Croatia Detailed Human Capital Indicators

Levels of basic digital skills increased at a moderate pace; only 53% of people between 16 and 74 years have at least basic digital skills. However, for the above basic digital skills, Croatia has positioned significantly higher than the regional EU average. ICT specialists account for a higher percentage of the workforce in Croatia than the regional average (3.5% compared to 3.1% in the region). Conversely, the number of ICT graduates continues to grow, and Croatian ICT graduates currently account for 5.5% of all graduates in Croatia.

In 2019, the reform of the education curricula (the 'School for life' program) was rolled out after a pilot in 2018. The reform aims to introduce a learning-outcomes approach, increasing the quality of education and teaching. The reform is now being implemented in all primary and secondary schools and is scheduled to be completed in all grades by 2022. [32]

[32] DESI 2020 Croatia country profile

Use of internet services

In the Use of internet services, Croatia's score is 56 points, 8 points higher than the regional average. The county is now on 5th place in regional and on 15th place in EU ranking.

		2016	2020	EU11 2020
3a1 People who have never used the internet	% individuals	26.25 %	18.31 %	15.42%
3a2 Internet users	% individuals	65.75 %	77.12 %	77.55%
3b1 News	% internet users	89.26 %	90.52 %	74.42%
3b2 Music, videos and games	% internet users		87.73 %	72.61%
3b3 Video on demand	% internet users		26.25 %	13.12%
3b4 Video calls	% internet users	42.31 %	60.11 %	64.41%
3b5 Social networks	% internet users	63.89 %	73.19 %	72.80%
3b6 Doing an online course	% internet users	4.01%	6.41%	6.14%
3c1 Banking	% internet users	47.13 %	58.75 %	50.34%
3c2 Shopping	% internet users	44.11 %	56.55 %	56.26%
3c3 Selling online	% internet users	50.05 %	27.35 %	14.34%

Illustration 80 Croatia Detailed Use of Internet Serivces Indicators

Croatian internet users are active in a variety of online activities, such as reading news, listening to music, watching videos, playing games, and using social networks. 91% of Croatian internet users read news online (compared with 74% in the region). The number of people who have never used the internet is steadily declining, although it is higher than the regional average. Croats are also active users of social networks, and they widely use the internet for banking (59% against a regional average of 50%) and shopping (57% against a regional average of 56%).

Integration of technology

In the Integration of digital technology in businesses dimension, Croatia ranks 3rd among the regional countries and 12th among the EU countries. Its score of 42 points is 12 points higher than the regional average. The progress was rather fast due to the high priority in government programs.

		2016	2020	EU11 2020
4a1 Electronic information sharing	% enterprises	28.67 %	25.95 %	27.55%
4a2 Social media	% enterprises	14.50 %	22.39 %	14.27%
4a3 Big data	% enterprises		10.33 %	8.69%
4a4 Cloud	% enterprises	15.20 %	21.69 %	9.92%
4b1 SMEs selling online	% SMEs	18.85 %	21.33 %	14.42%
4b2 e-Commerce turnover	% SME turnover	7.07%	9.03%	6.07%
4b3 Selling online cross-border	% SMEs	8.94%	10.24 %	6.97%

Illustration 81 Croatia Detailed Integration of Technology Indicators

Croatian enterprises are taking increasing advantage of the opportunities offered by online commerce, with 21% of SMEs selling online, 10% selling across borders to other EU countries, and 22% using cloud solutions. 22% of enterprises actively use social media, while 1 in 4 enterprises (26%) share information electronically. All these indicators are much higher than in the other Central and Eastern European countries.

At present, Croatia is preparing both a national plan for the digital transformation of the economy and a national platform for the digitization of industry. The platform aims to: provide supporting conditions for networking opportunities; help businesses to prepare for Industry 4.0; digitize public administration, and develop technical and security standards. The national plan for the development of AI is in the draft stage.

Digital public services

On Digital public services, Croatia's score is 56 points, 8 points lower than the regional average. The country ranks 9th among the regional and 25th among the EU countries.

		2016	2020	EU11 2020
5a1 e-Government users	% internet users needing to submit forms	58.01 %	65.28 %	61.92%
5a2 Pre-filled forms	Score (0 to 100)	20.57	33.13	45.02
5a3 Online service completion	Score (0 to 100)	60.57	72.88	82.66
5a4 Digital public services for businesses	Score (0 to 100) - including domestic cross-border	60.48	65.28	74.95
5a5 Open data	% of maximum score		68.98 %	63.03%

Illustration 82 Croatia Detailed Digital Public Service Indicators

Croatia has a high level of online interaction between public authorities and members of the public. 65% of online users actively use e-government services in 2019, 3 percentage points higher than the regional average. The availability of e-government services for business is on the rise, although it is still lower than the regional average. Croatia scores above the regional average for open data.

1.3.9. Slovakia country profile

Overall DESI

On overall DESI, Slovakia ranks 7th in the region and 22nd among the EU member states. Its score of 45 points is equal to the regional average. Taking into account its high economic development level, a better result would be expected.

	Slovakia	EU11	EU
Connectivity	47.5	51.0	50.1
Human Capital	41.8	39.3	49.3
Use of internet	53.4	48.2	58.0
Integration of technology	32.6	29.9	41.4
Digital public services	55.6	62.0	72.0
DESI	**45.2**	**45.1**	**52.6**

Illustration 83 Slovakia Comparison of DESI

Slovakia is very close to the regional average of all dimensions. There are no weak links in its digital economy.

"In 2019, the Slovak government adopted a new Strategy for the digital transformation of Slovakia 2030. This document lays down a long-term vision and aims to guide the economy, society, and public administration through technological change. Its goals are also to stimulate smart regional development and help researchers and innovators to keep the pace with global trends.

The strategy aims to reach its objectives through the related Action Plans. The first one for the years 2019-2022 lists four main objectives: digital transformation of schools, conditions for a data-based economy, innovating public administration, and support for the development of Artificial Intelligence (AI)."[33]

[33] DESI 2020 Slovakia country profile

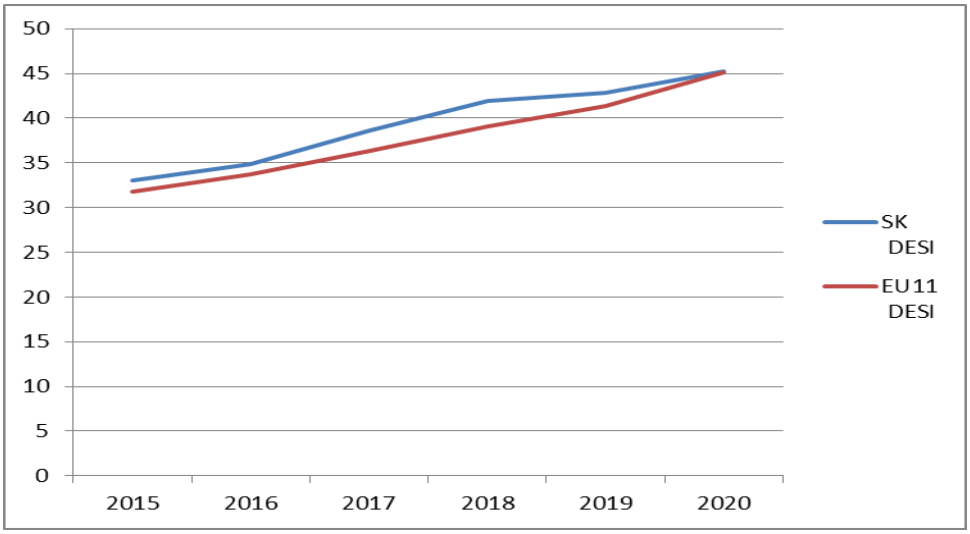


Illustration 84 Slovakia Development of DESI

The development of the digital economy in Slovakia was rather moderate in recent years, but it corresponds to the regional trend.

Connectivity

On the Connectivity dimension, Slovakia lags the other Central and Eastern European countries. Its score of 48 points is 3 points below the regional average.

		2016	2020	EU11 2020
1a1 Overall fixed broadband take-up	% households	71.53 %	71.73%	67.42%
1a2 At least 100 Mbps fixed broadband take-up	% households	7.20%	14.56%	30.38%
1b1 Fast broadband (NGA) coverage	% households	54.44 %	75.97%	80.99%
1b2 Fixed Very High Capacity Network (VHCN) coverage	% households	36.12 %	46.50%	54.84%

1c1 4G coverage	% households (average of operators)		88.75%	94.52%
1c2 Mobile broadband take-up	Subscriptions per 100 people	63.36	94.69	122.55
1c3 5G readiness	Assigned spectrum as a % of total 5G spectrum		33.33%	13.99%
1d1 Broadband price index	Score (0 to 100)		60.31	75.87

Illustration 85 Slovakia Detailed Connectivity Indicators

Overall fixed broadband take-up has seen progress with 72% of households subscribing to any kind of fixed internet offer and lies slightly above the regional average. While the number of households subscribing to at least 100 Mbps fixed broadband has also seen some progress (15%), it ranks relatively low compared to other regional countries. Slovakia's fast broadband (NGA) coverage has reached 76% but is still below the regional average of 81%. Slovakia had good progress in VHCN coverage, which has reached 47%.

The number of households covered by 4G (average coverage) stands at 89% but still lies below the regional average of 94%. Mobile broadband take-up (95 subscriptions per 100 people) has also seen slight progress. The broadband prices in Slovakia are high compared to the regional average – the country scored 60 in the broadband price index compared to the regional average of 75.

"Slovakia scores 33% in the 5G readiness indicator. In Slovakia, 46% of the spectrum harmonized at the EU level for wireless broadband has been assigned. The assignment of frequencies in the 3.4-3.6 GHz band was completed in 2016, and nationwide licenses were assigned to four operators (O2 Slovakia, SWAN, Orange, Slovanet) until August 2025.

The Slovak national regulatory authority for electronic communications (Regulatory Authority for Electronic Communications and Postal Services, RÚ) published a call for tender in the form of a national consultation for the award of

frequencies in the 700, 900, and 1800 MHz bands on 31 March 2020. The procedure was later postponed because of the pandemic."[34]

Human capital

In the Human capital dimension, Slovakia's score of 42 points is 3 points higher than the regional average. The country is in 6th place in regional and on 20th place in EU ranking. The progress in recent years was rather moderate.

		2016	2020	EU11 2020
2a1 At least basic digital skills	% individuals	53.15 %	53.87%	44.69%
2a2 Above basic digital skills	% individuals	26.07 %	27.07%	21.01%
2a3 At least basic software skills	% individuals	56.54 %	55.56%	46.93%
2b1 ICT specialists	% total employment	2.80%	3.20%	3.08%
2b2 Female ICT specialists	% female employment	0.75%	0.87%	1.05%
2b3 ICT graduates	% graduates	2.60%	3.30%	4.22%

Illustration 86 Slovakia Deatailed Human Capital Indictors

The proportion of Slovaks who declare to have basic digital skills (54%) did not increase in recent years, but still remains 10 points higher than the regional average. 27% of Slovaks have above basic digital skills, which is also a good score, much higher than the regional average (21%). The proportion of ICT specialists in total employment grew to 3.2%. It is slightly above the regional average (3.0%). The share of ICT graduates is slowly growing (3.3%) but remains below the regional average (4.2%).

[34] DESI 2020 Slovakia country profile

Improving digital skills is one of the priorities of the Slovak Digital Transformation strategy 2030 and the related action plan for 2019-2022.[35] The aim is to adapt the education system and focus on skills for jobs. The strategy also mentions the need to develop soft skills and competencies for participating in a digital society (digital citizenship).

Use of internet services

In the Use of internet services, Slovakia's score is 54 points, 6 points higher than the regional average. The county is now on 7th place in regional and on 20th place in EU ranking.

		2016	2020	EU11 2020
3a1 People who have never used the internet	% individuals	16.26 %	11.71%	15.42%
3a2 Internet users	% individuals	74.18 %	81.97%	77.55%
3b1 News	% internet users	65.25 %	72.13%	74.42%
3b2 Music, videos and games	% internet users		66.43%	72.61%
3b3 Video on demand	% internet users		16.51%	13.12%
3b4 Video calls	% internet users	54.51 %	65.91%	64.41%
3b5 Social networks	% internet users	69.09 %	71.51%	72.80%
3b6 Doing an online course	% internet users	3.81%	6.07%	6.14%
3c1 Banking	% internet users	48.01 %	66.11%	50.34%
3c2 Shopping	% internet users	61.50 %	70.74%	56.26%
3c3 Selling online	% internet users	11.63 %	26.52%	14.34%

Illustration 87 Slovakia Detailed Use of Internet Serivces Indicators

[35] DESI 2020 Slovakia country profile

The proportion of people who have never used the internet has decreased to 12% below the regional average by 3 percentage points. More Slovaks are using the internet (82%, up from 74% in 2015) and banking online (66%, up from 48% in 2015). There was a significant increase compared to 2015 both in online shopping and the share of internet users who sell online. In online transactions, Slovakia's score is well above the regional average.

Integration of technology

On the Integration of digital technology in businesses, Slovakia ranks 5th among the regional countries and 21st among the EU countries. Its score of 32 points is 2 points higher than the regional average.

		2016	2020	EU11 2020
4a1 Electronic information sharing	% enterprises	30.40 %	31.12%	27.55%
4a2 Social media	% enterprises	12.06 %	17.59%	14.27%
4a3 Big data	% enterprises		9.35%	8.69%
4a4 Cloud	% enterprises	13.24 %	13.93%	9.92%
4b1 SMEs selling online	% SMEs	12.46 %	11.37%	14.42%
4b2 e-Commerce turnover	% SME turnover	10.92 %	11.25%	6.07%
4b3 Selling online cross-border	% SMEs	6.34%	6.54%	6.97%

Illustration 88 Slovakia Detailed Integration of Technology Indicators

The proportion of companies that share electronic information at 31% is higher than the regional average of 27%. Slovakia is slightly better than the other regional countries in the use of big data analysis by companies (9.3% vs. 8.7%) and in the use of cloud technology (14% vs. 10%).

The country's e-commerce scores have not improved in the last five years; only 11% of SMEs sell online. The share of SME turnover from e-commerce at 11% and the proportion of SMEs that sell online across borders at 7% also remained stagnant in the last five years.

Slovakia has a national digitization strategy that supports the integration of innovative technologies in companies. It aims to introduce legislation that will enable new business models, particularly ones built on digital platforms and AI.

Digital public services

In Digital public services, Slovakia's score is 56 points 6 points lower than the regional average. The county is now on 9th place in regional and on 26th place in EU ranking.

		2016	2020	EU11 2020
5a1 e-Government users	% internet users needing to submit forms	53.07 %	52.16%	61.92%
5a2 Pre-filled forms	Score (0 to 100)	19.14	37.63	45.02
5a3 Online service completion	Score (0 to 100)	58.86	85.00	82.66
5a4 Digital public services for businesses	Score (0 to 100) - including domestic cross-border	50.79	84.11	74.95
5a5 Open data	% of maximum score		33.14%	63.03%

Illustration 89 Slovakia Detailed Digital Public Service Indicators

Although there was a significant increase in all indicators of digital public services, Slovakia's scores are relatively low. Only 52% of Slovak internet users who need to submit forms to public institutions do so online. Slovakia also scores 7 percentage points less on pre-filled forms than the regional average.

1.3.10. Slovenia country profile

Overall DESI

Slovenia is 3rd place in regional and 17th in EU ranking. Its score of 51 points is 6 points above the regional average

	Slovenia	EU11	EU
Connectivity	50.2	51.0	50.1
Human Capital	48.3	39.3	49.3
Use of internet	51.7	48.2	58.0
Integration of technology	40.9	29.9	41.4
Digital public services	70.8	62.0	72.0
DESI	**51.2**	**45.1**	**52.6**

Illustration 90 Slovenia Comparison of DESI

Slovenia has a relatively high score in all five dimensions but advanced in ranking only in the integration of digital technology dimension.

"Slovenia is implementing the Digital Slovenia 2020 strategy adopted in March 2016. Together with the Slovenian Industrial Policy, Digital Slovenia is one of the three key sectoral strategies with guidelines for the creation of an innovative knowledge society. The strategy covers all areas of life and development: public services, entrepreneurship, households, and education. Slovenia is currently drafting an all-inclusive artificial intelligence strategy and updating the strategy Digital Slovenia."[3637]

[36] DESI 2020 Slovenia country profile

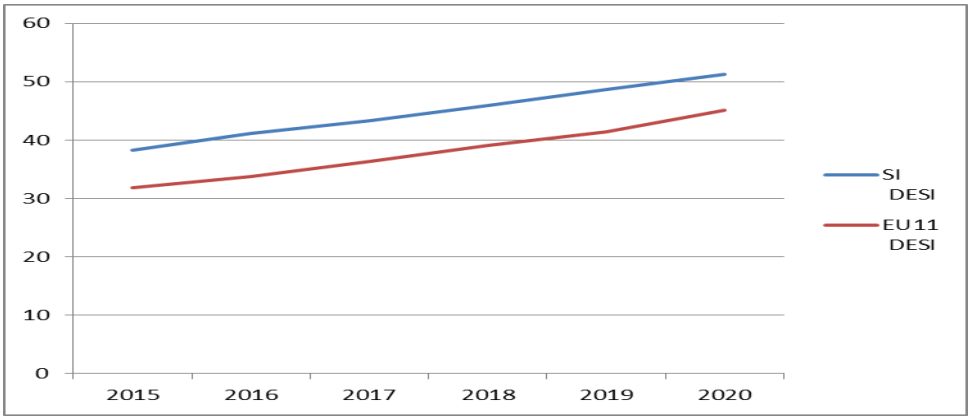


Illustration 91 Slovenia Development of DESI

In Slovenia, the development of the digital economy was moderate in recent years, but it corresponds to the regional trend.

Connectivity

In the Connectivity dimension, Slovenia progressed slower than the other regional countries last year and ranked only 6th among the Central and Eastern European countries and 16th among EU countries. It is the only dimension where Slovenia's score of 50 points was lower than the regional average.

		2016	2020	EU11 2020
1a1 Overall fixed broadband take-up	% households	74.63 %	83.45 %	67.42%
1a2 At least 100 Mbps fixed broadband take-up	% households	5.33%	20.54 %	30.38%
1b1 Fast broadband (NGA) coverage	% households	80.82 %	86.91 %	80.99%
1b2 Fixed Very High Capacity Network (VHCN) coverage	% households	44.99 %	66.45 %	54.84%
1c1 4G coverage	% households (average of operators)		98.80 %	94.52%
1c2 Mobile broadband take-up	Subscriptions per 100 people	48.03	81.31	122.55
1c3 5G readiness	Assigned spectrum as a % of total 5G spectrum		0.00%	13.99%
1d1 Broadband price index	Score (0 to 100)		63.50	75.87

Illustration 92 Slovenia Detailed Connectivity Indicators

Overall, fixed broadband take-up (83%) is rather high and above the regional average by 16 percentage points. In the last five years, Slovenia increased its take-up of at least 100 Mbps fixed broadband by 16 percentage points, but it is still lower than the regional average. Fast NGA and VHCN coverage also improved, and they are ahead of the regional average of 80% and 55%.

4G coverage is ubiquitous, covering 99% of households. Slovenia increased its mobile broadband take-up to 81 subscriptions per 100 people but remained far below the regional average of 123. The country scored 63 in the broadband price index what places it slightly higher than an average regional country. Slovenia still lacks a dedicated, comprehensive strategy for the timely assignment of the 5G pioneer spectrum bands (700 MHz, 3.6 GHz, and 26 GHz), and for 5G deployment. The adoption of a strategy draft, which provided for a multi-frequency auction by 30 June 2020, has again been temporarily suspended.

Human capital

Slovenia's score in the Human capital dimension is 48 points, 9 points higher than the regional average. The country ranks 4th in the region and 15th among the EU member countries. The progress in the last five years was in line with the other regional countries.

		2016	2020	EU11 2020
2a1 At least basic digital skills	% individuals	50.90 %	55.13 %	44.69%
2a2 Above basic digital skills	% individuals	25.62 %	31.07 %	21.01%
2a3 At least basic software skills	% individuals	54.31 %	58.65 %	46.93%
2b1 ICT specialists	% total employment	3.50%	4.00%	3.08%
2b2 Female ICT specialists	% female employment	1.04%	1.40%	1.05%
2b3 ICT graduates	% graduates	3.70%	3.70%	4.22%

Illustration 93 Slovenia Detailed Human Capital Indicators

Basic digital skills levels are higher than the relevant regional averages. 55% of people between the ages of 16 and 74 years have at least basic digital skills (44% in the region). The proportion of ICT specialists is well above the EU average (4%

compared to 3% in the region). ICT graduates in Slovenia account for only 3.7% of the total. It is below the regional average of 4.2%.

"One of the biggest strengths of Slovenia is its human capital. The knowledge needed for digital transformation is concentrated in the country. It is reflected in the high number of ICT start-ups (above the EU average) and a high proportion of STEM graduates. Digital infrastructure is good and stable. Slovenia has the potential to serve as a reference model for the introduction of new digital technologies and new niche business models."[38]

Use of internet services

In the Use of internet services, Slovenia's score is 52 points 4 points higher than the regional average. The county is now on 8th place in regional and on 22nd place in EU ranking.

		2016	2020	EU11 2020
3a1 People who have never used the internet	% individuals	22.13 %	13.00 %	15.42%
3a2 Internet users	% individuals	70.51 %	80.96 %	77.55%
3b1 News	% internet users	76.66 %	76.35 %	74.42%
3b2 Music, videos and games	% internet users		84.12 %	72.61%
3b3 Video on demand	% internet users		16.15 %	13.12%
3b4 Video calls	% internet users	36.05 %	50.42 %	64.41%
3b5 Social networks	% internet users	51.13 %	62.67 %	72.80%

[38] DESI 2020 Slovenia country profile

3b6 Doing an online course	% internet users	4.33%	6.55%	6.14%
3c1 Banking	% internet users	46.05 %	56.71 %	50.34%
3c2 Shopping	% internet users	51.61 %	66.26 %	56.26%
3c3 Selling online	% internet users	24.67 %	21.85 %	14.34%

Illustration 94 Slovenia Detailed Useof Internet Serivces Indicators

The proportion of people who have never used the internet decreased (from 2% in 2015 to 13% in 2019). It is slightly below the regional average (15%). The proportion of internet users increased from 70% to 81%. It is higher than the regional average of 78%. People in Slovenia are keen to engage in a variety of online activities in line with the rest of the region. Compared to the region, the higher-ranking activities are reading the news (76% compared to the regional average of 74%) and consumption of music, videos, and games (84% of internet users, as against the regional average of 72%). In 2019, the use of online banking (57% of internet users) was higher than the regional average (50%).

Integration of technology

On the Integration of digital technology in businesses, Slovenia ranks 5th among the regional countries and 15th among the EU countries. Its score of 41 points is 10 points higher than the regional average. In the last five years, the progress in this dimension was substantially higher than in the other regional countries.

		2016	2020	EU11 2020
4a1 Electronic information sharing	% enterprises	32.90 %	32.75 %	27.55%
4a2 Social media	% enterprises	16.49 %	23.85 %	14.27%
4a3 Big data	% enterprises		10.21 %	8.69%
4a4 Cloud	% enterprises	10.94 %	17.11 %	9.92%
4b1 SMEs selling online	% SMEs	15.48 %	16.97 %	14.42%
4b2 e-Commerce turnover	% SME turnover	8.45%	10.78 %	6.07%
4b3 Selling online cross-border	% SMEs	10.46 %	12.14 %	6.97%

Illustration 95 Slovenia Detailed Integration of Technology Indicators

Slovenian enterprises are taking advantage of the opportunities presented by electronic information sharing (used by 33% of enterprises compared to the regional average of 28%) and the use of social media (used by 24% of enterprises, against 14% in the region). Slovenia also has higher scores than the regional average in the use of big data, cloud services, SMEs selling online, and e-Commerce turnover.

“Slovenia continues to implement its Digital Slovenia 2020 strategy, the Research and Innovation Strategy of Slovenia, as well as the Smart Specialization Strategy. Some of the concrete actions based on these strategies are the Strategic Research

and Innovation Partnerships (SRIPs), the Digital Innovation Hubs, and the FabLabs. However, the uptake in companies, especially SMEs, which lack capacity and resources (both financial and skills) remains a challenge."[39]

Digital public services

On Digital public services, Slovenia's score is 71 points, 9 points lower than the regional average. The country ranks 4th among the regional and 17th among the EU countries.

		2016	2020	EU11 2020
5a1 e-Government users	% internet users needing to submit forms	55.02 %	58.57 %	61.92%
5a2 Pre-filled forms	Score (0 to 100)	43.29	64.00	45.02
5a3 Online service completion	Score (0 to 100)	84.00	91.25	82.66
5a4 Digital public services for businesses	Score (0 to 100) - including domestic cross-border	67.87	76.67	74.95
5a5 Open data	% of maximum score		74.95 %	63.03%

Illustration 96 Slovenia Detailed Digital Public Service Indicators

The country performs well in the open data indicator for which its score of 75% is 12 percentage points higher than the regional average. Only 59% of Slovenian internet users actively engage with e-government services compared to a regional average of 62%. A wide range of basic online services for businesses is available in Slovenia. Slovenia's digital public services score for business is 77 compared to 75 for the region.

[39] DESI 2020 Slovenia country profile

2. National Initiatives in Central and Eastern Europe

2.1. National Broadband Plans

The Digital Agenda for Europe (hereinafter: DAE),[40] a flagship initiative of the Europe 2020 strategy adopted in 2010,[41] set three overarching broadband targets to be met by the European Union by 2013 and 2020 (commonly referred to as the DAE I-III targets):

I. **Basic broadband by 2013**: coverage (at 2 Mbps) for 100% of EU citizens by 2013
II. **Fast broadband by 2020**: coverage at 30Mbps or more for 100% of EU citizens by 2020
III. **Ultra-fast broadband by 2020**: 50% of European households should have subscriptions above 100Mbps

According to the DAE, the European Commission should "report annually on progress as part of the Digital Agenda governance", and the DAE targets have been incorporated into the Connectivity dimension of the DESI. On the other hand, member states were to adopt operational National Broadband Plans (NBPs) to meet these coverage and take-up targets, using (national and EU) public financing in line with EU competition and state aid rules, and taking other measures, including legal provisions to facilitate broadband investments. Most member states have gradually adopted NBPs, and while "[s]ome countries [still] do not have a single document that can be regarded as an NBP", "all countries have an overall strategic approach for the deployment of NGA networks that is implemented in practice". [42]

The national targets specified by these NBPs in the EU11 were mostly in line with the DAE targets (for Croatia, Czechia, Latvia, Lithuania and Poland, they were perfectly aligned), but some member states opted for adopting slightly more

[40] COM(2010) 245
[41] COM(2010) 2020
[42] https://ec.europa.eu/digital-single-market/en/broadband-member-states

ambitious targets (Bulgaria and Estonia) or timelines (Hungary); less ambitious targets (Romania), or have not adopted any ultrafast take-up target (Slovakia and Slovenia). Although the bandwidths in the DAE II-III targets are usually understood to refer to advertised *download* speeds, some Western European countries (e.g. Ireland) also specified additional targets for upload speeds, but no CEE country has followed suit.

According to a Study on NBPs, commissioned by the European Commission and conducted between November 2015 and September 2016,[43] the broadband development of the EU11 countries shared a common approach towards organizational steering in that they were all steered top-down (in contrast to some Western or Northern European countries like Austria or Finland with bottom-up steering). The funding of national broadband projects relied heavily on EU funds such as the ERDF (European Regional Development Fund) and the EAFRD (European Agricultural Fund for Rural Development). The CEF (Connecting Europe Facility), the EFSI (European Fund for Strategic Investment) and ESIFs (European Structural and Investment Funds) were to provide additional financial instruments (e.g. guarantees, loans, equity) to support innovative business models and broadband deployment. According to the Commission's conclusions based on the Study on NBPs, "[d]espite ambitious national broadband plans, only few [sic] Member States are close to reaching the DAE targets or their national targets respectively. Only few [sic] countries will possibly reach their targets by 2020."

Country	**National Broadband Plan (NBP)[44]**	**National targets (by 2020 and as a % of households, unless otherwise specified)**	**Fixed broadband coverage and take-up data (2019; % of households)**

[43] https://ec.europa.eu/digital-single-market/en/news/study-national-broadband-plans-eu-28-connectivity-targets-and-measures

[44] Some countries (e.g. Romania) have not adopted a single document that could be regarded as an NBP. In these cases, we tried to select the strategic document that established key national broadband targets from the documents referenced by the European Commission's website: https://ec.europa.eu/digital-single-market/en/broadband-member-states

Bulgaria (2014)	Bulgarian National Broadband Infrastructure Plan for Next Generation Access (2014-2020)	100 % coverage of 30 Mbps; 50 % take-up of 100 Mbps; 80 % business take-up of 100 Mbps	77.1% coverage of 30 Mbps; 11.0% take-up of 100 Mbps
Croatia (2016)	Broadband development strategy 2016-2020	100 % coverage of 30 Mbps; 50 % take-up of 100 Mbps	85.6% coverage of 30 Mbps; 6.2% take-up of 100 Mbps;
Czechia (2016)	National Plan for the Development of Next Generation Networks	100 % coverage of 30 Mbps; 50 % take-up of 100 Mbps	92.1% coverage of 30 Mbps; 20.4% take-up of 100 Mbps
Estonia (2014)	Digital Agenda 2020 for Estonia	100 % coverage of 30 Mbps; 60 % take-up of 100 Mbps	83.7% coverage of 30 Mbps; 14.1% take-up of 100 Mbps
Hungary (2014)	National Infocommunication Strategy 2014-2020	by 2018: 100 % coverage of 30 Mbps; 50 % take-up of 100 Mbps	89.6% coverage of 30 Mbps; 50.9% take-up of 100 Mbps
Latvia (2013)	The conception of next generation broadband electronic communication network development 2013-2020	100 % coverage of 30 Mbps; 50 % take-up of 100 Mbps	93.1% coverage of 30 Mbps; 38.1% take-up of 100 Mbps
Lithuania (2014)	Plan for the Next Generation of Internet Development for 2014-2020	100 % coverage of 30 Mbps; 50 % take-up of 100 Mbps	69.4% coverage of 30 Mbps 32.0% take-up of 100 Mbps
Poland (2014)	Polish National Broadband Plan	100 % coverage of 30 Mbps; 50 % take-up of 100 Mbps	75.9% coverage of 30 Mbps 27.6% take-up of 100 Mbps
Romania (2015)	National Strategy on the Digital Agenda for Romania 2020	80 % coverage of 30 Mbps; 45 % take-up of 100 Mbps	82.0% coverage of 30 Mbps 48.7% take-up of 100 Mbps
Slovakia (2014)	Strategic document for Digital Growth and Next Generation Access Infrastructure 2014-2020	100 % coverage of 30 Mbps; No take-up target	76.0 % coverage of 30 Mbps 14.6% take-up of 100 Mbps
Slovenia (2016)	Plan for the development of next generation broadband networks until 2020	100 % coverage of 30+ Mbps (with 96 % coverage of 100 Mbps) No take-up target	86.9% coverage of 30 Mbps 20.5% take-up of 100 Mbps

Legend (colour codes)	Teal: More ambitious than DAE Black: In line with DAE	Green: National target achieved (even if only fixed networks are considered)

	Orange: Less ambitious than DAE Purple: Target not specified	Black: Yet to achieve national target (if only fixed networks are considered)

Illustration 97 Comparison of National Broadband Plans

Although NBPs mostly focus on fixed broadband networks, the DAE I-II targets can be interpreted to encompass coverage by *any* broadband technology, including mobile and satellite networks. Indeed, the European Commission considered the first DAE target to have been achieved on the basis of ubiquitous coverage by satellite broadband,[45] in spite of the fact that standard fixed broadband coverage is still only at 97% at the EU level (as of 2019) and considerably lower in some CEE countries (under 90% in Slovakia, Romania, Lithuania and Poland).

[45] "Basic broadband for all citizens by 2013: this target is met, as satellite broadband is available (coverage 100%) in every Member State." https://ec.europa.eu/digital-single-market/en/broadband-strategy-policy;
"The European Union's aim is to maximise broadband connectivity for all citizens regardless of their location throughout the EU. Satellite broadband is often the only broadband solution for those who live in areas with no or very poor connectivity." https://ec.europa.eu/digital-single-market/en/content/broadband-all

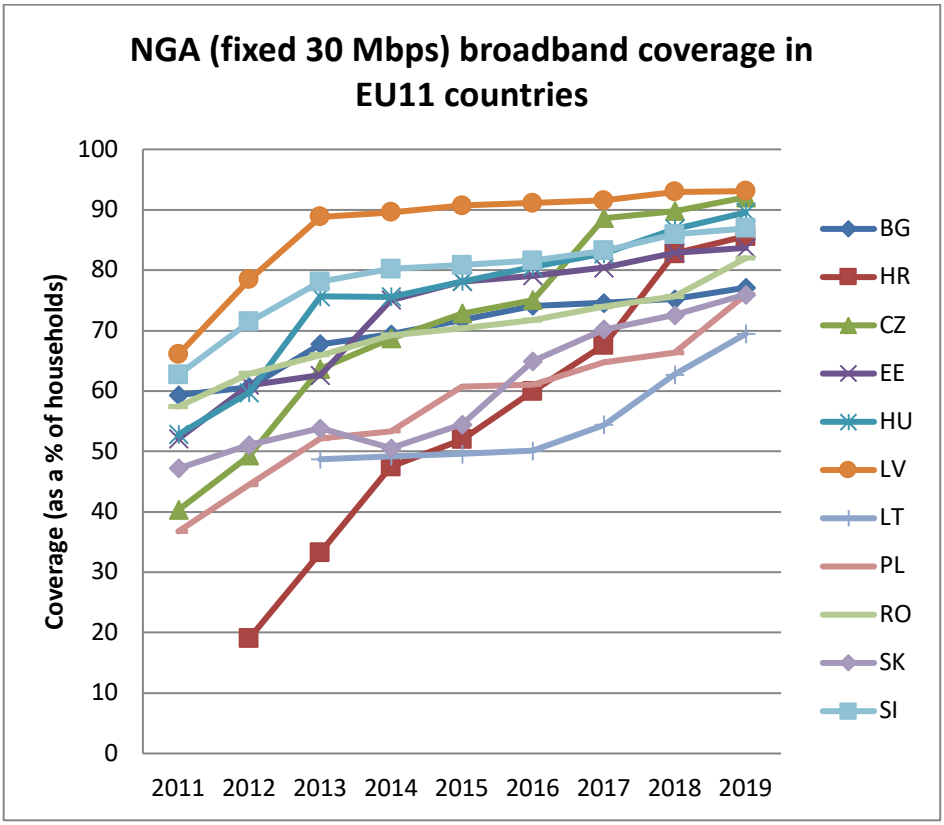


Illustration 98 Fixed 30Mbp Broadband Coverage in EU11 Countries

As regards the DAE II (fast broadband coverage) target, the Commission required member states to "[i]mplement the European Spectrum Policy Programme, so as to ensure the coordinated allocation of the spectrum needed to meet the target of 100% coverage of 30 Mbps internet by 2020", indicating that 4G mobile networks (capable of providing upload speeds in excess of 30 Mbps) should be taken into account when evaluating the results. For most CEE countries, this may spell the difference between success and failure, since 4G coverage exceeds 98% for all EU11 countries (and 99% for all except Slovakia),[46] while only Latvia and the Czech Republic have achieved at least 90% NGA (fixed 30 Mbps) coverage.[47] The most striking discrepancy between the mobile and fixed fast broadband coverage figures was a 30.6% difference between the two in Lithuania (4G mobile

[46] Digital Agenda Scoreboard: 4G (LTE) mobile broadband coverage/availability
[47] Digital Agenda Scoreboard: NGA broadband coverage/availability

broadband coverage: 100%; and NGA fixed broadband coverage: 69.4%), but similarly large gaps could be observed for Poland (99.9% vs 75.9%), Bulgaria (99.5% vs 77.1%) and Slovakia (98.4% vs 76.0%). If only fixed networks were considered, Romania would be the only EU11 country that had already met its less ambitious national fast broadband coverage target of 80% by 2019, while Hungary had (technically) already failed to meet its more ambitious target (100% coverage) by 2018.

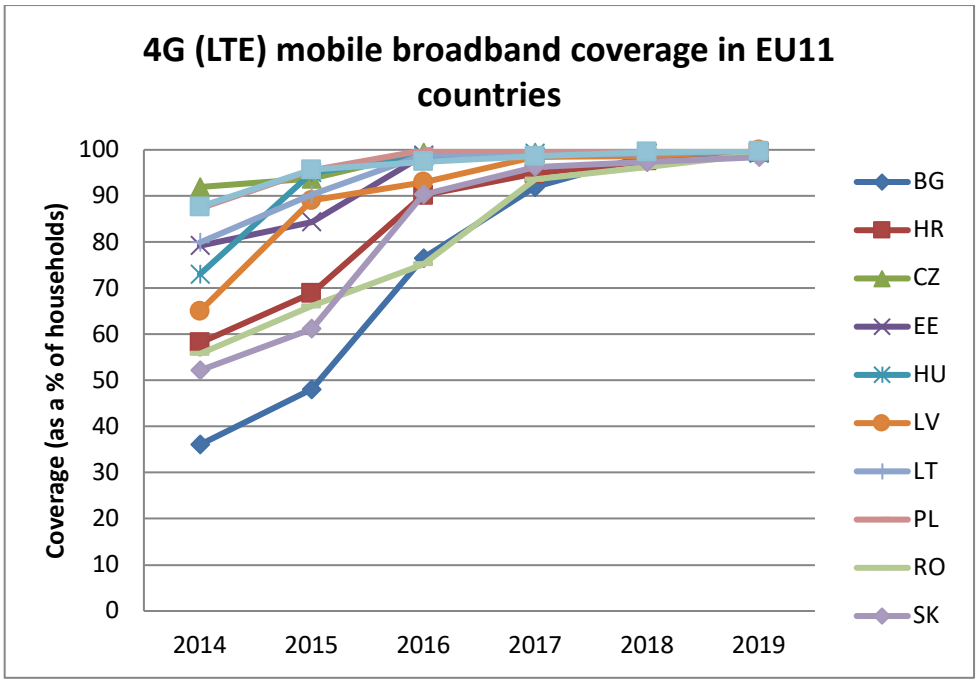


Illustration 99 4G Mobile Broadband Coverage in EU11 Countries

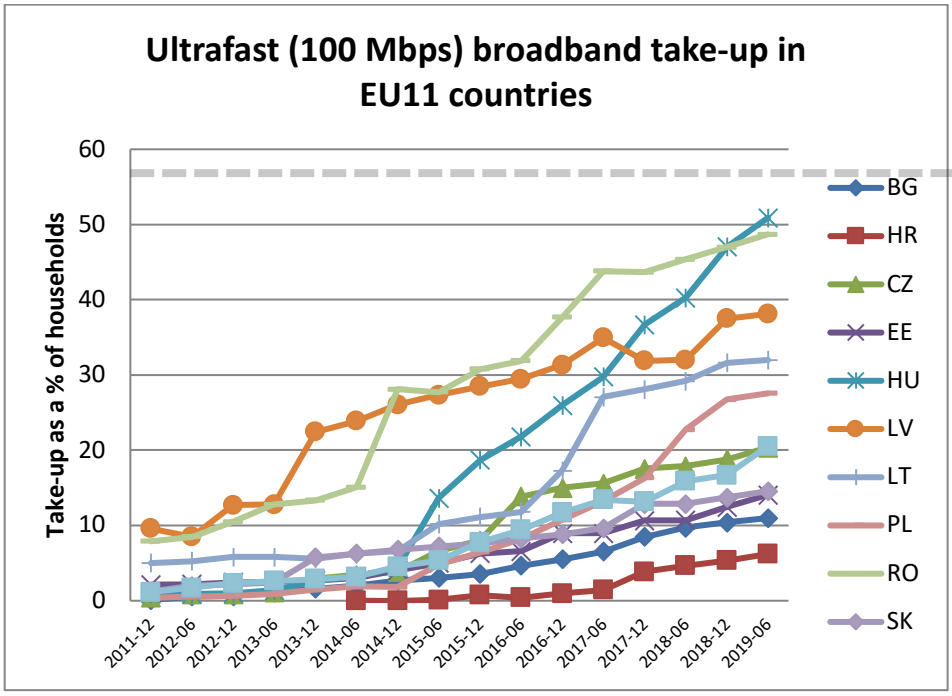


Illustration 100 Ultra Broadband Coverage in EU11 Countries

There is less ambiguity concerning the interpretation of the DAE III (ultrafast broadband take-up) target, but there are stark disparities between the performances of different CEE countries.[48] According to official EU statistics from June 2019, Hungary (50.9%) and Romania (48.7%) have already met their national targets,[49] but some other countries in the region (Croatia [6.2%], Bulgaria [11%], Estonia [14.1%], Slovakia [14.6%], Czechia [20.4%] and Slovenia [20.5%]) have not even achieved take-up rates of 25%, which means that they are unlikely to achieve the DAE III target by December 2020 (although it is worth noting that Slovakia and Slovenia had not even adopted this target in the first place).

[48] Digital Agenda Scoreboard: Households with ultrafast fixed broadband connection
[49] Although Romania has set a less ambitious target take-up rate in their NBP (45%), the country is well on course to also meet the original DAE III target (50%) by 2020.

In September 2016, the European Commission set out its new vision and "strategic objectives" for 2025 in a communication entitled Connectivity for a Competitive Digital Single Market – Towards a European Gigabit Society (hereinafter: GSC).[50] Unlike the DAE, the GSC specified separate targets for fixed and mobile broadband networks that should be achieved by 2025:

I. **Gigabit connectivity** for all main socio-economic drivers such as schools, transport hubs and main providers of public services as well as digitally intensive enterprises
II. All urban areas and all major terrestrial transport paths to have uninterrupted **5G coverage**
III. All European households, rural or urban, should have access to Internet connectivity offering a downlink of at least **100 Mbps, upgradable to Gigabit speed**

The Commission required "Member States to review and update National Broadband Plans [by the end of 2017] with a time horizon of 2025", "in line with the strategic objectives" set in the GSC, but as of 2019, most EU11 countries have still not published an updated NBP reflecting these new targets. According to a survey conducted by the European Commission in 2019 (published in April 2020),[51] among the CEE countries, only Lithuania made a reference to the 2025 Gigabit society targets in the context of their NBPs.[52] On the other hand, almost all of these countries plan to adopt a new or updated plan by the end of 2020 (and Poland has already done so in March 2020).

[50] COM(2016) 587
[51] https://ec.europa.eu/digital-single-market/en/news/summary-results-questionnaire-national-broadband-plans-and-reaching-2020-and-2025-broadband
[52] However, the Commission's thematic website on national broadband plans also states that "Latvia supports the Gigabit society targets in the policy plan for the electronic communications sector 2018-2020 (approved in March 2018)". https://ec.europa.eu/digital-single-market/en/country-information-latvia

Country	**Status of updated NBPs reflecting GSC targets in the EU11, according to the European Commission** (page numbers refer to the DESI SWD[53] unless otherwise specified)
Bulgaria	*Bulgaria **has delayed the adoption** of its new broadband plan. Nevertheless, the development and deployment of high-speed networks is set as a priority in Bulgaria's National Development Programme (NDP) Bulgaria 2030.* (p. 22)
Croatia	*Croatian authorities **are drawing up** a national plan for broadband development for 2021-2027, which should be aligned with the gigabit society targets.* (p. 122)
Czechia	*Czechia also **intends to adopt** a new national plan for developing VHCNs, and studies are under way to inform the plan.* (p. 35)
Estonia	*Estonia's new digital strategy for 2020+ **has been in preparation since the end of 2019**. This strategy will align its connectivity targets to those of the Gigabit Society, including the availability of speeds of 100 Mbps upgradeable to 1 Gbps to all residents.* (p. 70)
Hungary	*A new gigabit Hungary strategy was **drafted in 2019** and the Government **plans to adopt it in 2020**, which would, on the one hand, reflect the Gigabit Society targets for 2025 and on the other, establish longer-term targets for 2030 in Hungary.* (Telecoms Chapters: HU)
Latvia	*Latvia has made good progress on the national broadband strategy goals for 2013-2020, which **include the Digital Agenda for Europe targets and the Gigabit society objectives**.* (p. 171)
Lithuania	According to the Commission's survey, Lithuania **already makes a reference** to GSC targets. *"Lithuania's digital strategy, the Information Society Development Programme for 2014-2020, was adopted in 2014 and **amended in 2017**.(…) "The strategy covers all areas of the digital economy and society: digital skills; digital content in the Lithuanian language; investments in **high-speed broadband**; e-government; use of open public data and innovative e-service creation; security; reliability; and interoperability"*. (p. 180)
Poland	*Poland **has also finally adopted** an updated national broadband plan (on March 10th 2020), which reflects the gigabit society goals and includes actions regarding 5G implementation, foreseen in the '5G Strategy for Poland'*. (p. 256)
Romania	*The Romanian national broadband plan adopted in 2015 **has not yet been updated** to reflect the gigabit society targets*. (p. 279)
Slovakia	*While the 2011 national broadband strategy is still in place, the Deputy Prime Minister's Office for Investments and Informatisation is **currently finalising** the new national broadband plan for 2021-2025. The new plan*

[53] SWD(2020) 111 PART 3/6: https://ec.europa.eu/transparency/regdoc/rep/10102/2020/EN/SWD-2020-111-F1-EN-MAIN-PART-3.PDF

	is expected to align Slovakia's broadband strategy with the 2025 gigabit society targets. (p. 303)
Slovenia	*Slovenia **is preparing** a National Broadband Plan 2025, which would be aligned with the gigabit objectives for 2025. It includes plans for 5G coverage for urban areas and the main terrestrial transport routes, gigabit connectivity for schools, transport hubs, public service providers and digital industry, and networks of at least 100 Mbps, upgradable to 1 Gbps, covering all citizens.* (p. 291)

Illustration 101 Ongoing National Broadband Plans in EI11 Countries

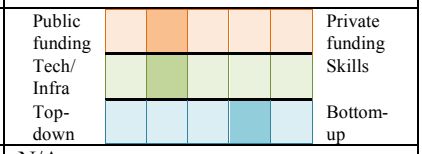
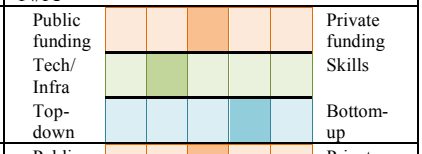
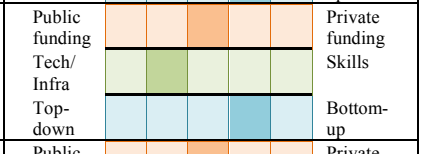
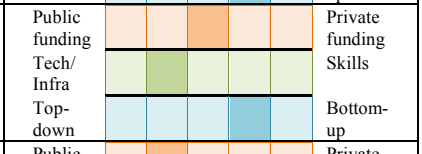
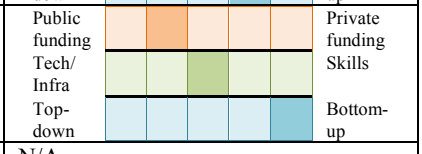
2.2. **National initiatives for digitalizing industry**

The European Commission adopted its Digitising European Industry (DEI) strategy in April 2016 to "reinforce the EU's competitiveness in digital technologies and to ensure that every industry in Europe, in whichever sector, wherever situated, and no matter of what size can fully benefit from digital innovations."[54]

The European Platform of National Initiatives was then launched in March 2017 to "jointly build a critical mass of initiatives and investments for digitizing industry, and to ensure the commitment of Member States, Regions and private sector to achieving the Digitising European Industry goals."[55] Member States were expected to adopt large-scale policies and national initiatives for digitizing industry "to increase productivity and competitiveness and improve the digital skills of their workforce."

Furthermore, the Digital Transformation Monitor (DTM) was set up to foster the knowledge base on the state of play and evolution of digital transformation in Europe and to evaluate national digital transformation policies and programs.[56] According to the DTM, although they could identify similar goals and many commonalities, the national initiatives they reviewed showed a great deal of variety and differed in many aspects, including "policy, design, funding approach, financial size and implementation strategies".

[54] COM(2016) 180
[55] https://ec.europa.eu/digital-single-market/en/coordination-european-national-regional-initiatives
[56] https://ec.europa.eu/growth/tools-databases/dem/monitor/category/national-initiatives

Country	National initiative	Status	Policy levers according to the Digital Transformation Scoreboard (DSB)[57]
Bulgaria	*Plan for Digital Transformation of Bulgarian Industry (Industry 4.0)*	Under preparation	N/A
Croatia	*Digitizing impulse 2020*	Under preparation	N/A
Czechia (2016)	Průmysl 4.0 (Industry 4.0)	Launched	
Estonia	N/A[58]	N/A	N/A
Hungary (2016)	IPAR 4.0 National Technology Platform (Industry 4.0)	Launched	
Latvia (2012)	National Industrial Policy Guidelines 2014 -2020	Launched	
Lithuania (2017)	Pramonė 4.0 (Industry 4.0)	Launched	
Poland (2016)	Initiative for Polish Industry 4.0 – The Future Industry Platform	Launched	
Romania (2016)	*Manifesto for a Digital Romania*	N/A[59]	N/A

[57] https://ec.europa.eu/growth/tools-databases/dem/monitor/scoreboard (page 13)

[58] Estonia does have an overarching digital strategy entitled Digital Agenda 2020 for Estonia, but that document explicitly states that it does intend to cover "the use of ICT in various areas of life and policy, such as ICT in health care or business". Furthermore, the country's DESI report suggest that in order to "boost the digital transformation of the Estonian economy, it is important that Estonia continues and strengthens its efforts to raise awareness of the benefit of better integrating digital technologies, particularly for SMEs. This objective could be achieved through a cross-sectoral initiative and with an extended focus, not limited to high-growth industries or those that already use digital technologies very intensely, including in the start-up ecosystem."

[59] Although the European Commission's catalogue of Digitising European Industry initiatives lists the *Manifesto* as an initiative, the country's latest DESI report states that "Romania does not have a national digital transformation strategy for enterprises", suggesting that the initiative was aborted.

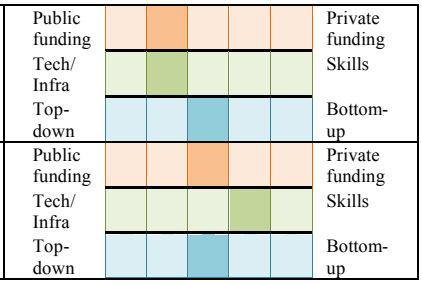
Slovakia (2016)	Smart Industry	Launched	
Slovenia (2016)	The Slovenian Digital Coalition / Digital Slovenia 2020	Launched	

Illustration 102 Assessment of Ongoing National Broadband Plans in EI11 Countries

2.2.1. Czechia: Průmysl 4.0 (Industry 4.0)

Průmysl 4.0 (Industry 4.0) is "a national initiative aiming to maintain and enhance the competitiveness of the Czech Republic in the wake of the Fourth Industrial Revolution."[60] According to the DSB, this initiative follows a rather bottom-up approach with largely public financing (its funding model being based on "already existing orientational programs of the involved ministries and the Technological Agency of the Czech Republic"). Its goal is to "prepare not only industry but the whole society for the economic and societal changes related to the fourth industrial revolution."

Průmysl 4.0 is characterized by the DTM as having a "wide focus on the creation of business and the social environment, in which the Czech economy can reach its full potential." They note that the initiative can build on the country's solid tradition in industrial manufacturing and its "strong industrial ties to Germany," as "Czech companies heavily participate in the supply of industrial components to its neighboring country, thus integrating into the German industrial supply chain."

The DTM's analysis praised the initiative for its multidisciplinary approach actively involving key stakeholders but identified the lack of a clear model for private financing as a weakness.

2.2.2. Latvia: National Industrial Policy Guidelines 2014 -2020

According to the DTM, Latvia "does not have a specific strategy for digitizing industry in place." Nevertheless, it adopted its National Industrial Policy Guidelines 2014-2020 in 2012, aiming to "promote structural economic changes that favor a higher added value production of goods and services" by "increasing the role of a more modernized industry and by expanding exports".[61] It is characterized by DSB as a bottom-up initiative financed by both the public and

[60] https://ec.europa.eu/growth/tools-databases/dem/monitor/content/czech-republic-%E2%80%9Cpr%C5%AFmysl-40%E2%80%9D
[61] https://ec.europa.eu/growth/tools-databases/dem/monitor/content/latvia-%E2%80%9Cnational-industrial-policy-guidelines-2014-2020

private sector (hereinafter referred to as *mixed financing*) with a focus on infrastructure development as well as on training the workforce.

This national initiative focuses on six key areas: on improving education systems and skills of the workforce, encouraging industrial development, increasing financing, fostering innovation, stimulating exports and reducing energy costs. Its three main targets are "1) the elimination of market failures and the improvement of competitiveness, 2) the development of particular sectors, and 3) the activation of regional advantages".

According to the DTM, thanks to a thorough micro-level analysis of industry carried out during the first implementation phases of the initiative, "policy makers were able to gain a better understanding of the Latvian state of play in digitization"; but a "relatively low degree of business culture", "poorly developed" clusters and capital market, and "insufficient innovation performance" could be key barriers towards realizing the initiative's goals.

2.2.3. Lithuania: Pramonė 4.0 (Industry 4.0)

In 2017, the Lithuanian Government officially launched the Pramonė 4.0 platform "aiming to increase and strengthen the competitiveness and productivity of the Lithuanian industry and to promote the integration of digital solutions and new technologies".[62] According to the DSB, its policy levers are similar to Latvia's initiative, with bottom-up design and implementation, mixed financing and focusing on the integration of digital solutions, new technologies as well as skills.

The platform aims to "serve as the main venue for the dialogue between the industry, public authorities and the academic community to find the most efficient solutions for the digitalization of industry at national level" and "help ensure timely involvement in the processes of the Fourth Industrial Revolution".[63] In addition to the platform, the country has also established a "Digital Innovation Hub" to help companies, especially small and medium sized enterprises (SMEs) and "non-tech industry", "to become more competitive by improving their business and production processes as well as products and services by means of digital technologies". It is also expected to "serve as an information source by providing all necessary data on the latest digital and manufacturing technologies at national and global level".

The DTM praises the initiative for the "establishment of thematic groups with members from the public and private sector ensuring a wide involvement of stakeholders with diverse backgrounds", but identifies the lack of a "coherent strategy for raising awareness of the platform" and "low participation of SMEs" as weaknesses.

[62] https://ec.europa.eu/growth/tools-databases/dem/monitor/content/lithuania-%E2%80%9Cpramon%C4%97-40%E2%80%9D
[63] https://industrie40.lt/national-industry-digitalisation-platform-pramone-4-0-in-operation/

2.2.4. Poland: Initiative for Polish Industry 4.0 – The Future Industry Platform

Announced in 2016 as part of the "Responsible Development Plan," the platform aims to "act as an integrator of all stakeholders interested in Industry 4.0 as well as an accelerator of the digital transformation of Polish industry".[64] Its goals include a contribution to "knowledge transfer and awareness raising, as well as the development and application of digital transformation support measures." The DSB classifies the platform as a bottom-up initiative that is largely publicly financed and is equally orientated towards the integration of digital solutions (new technologies) and skills.

"The initiative is expected to respond to a series of challenges defined in the Responsible Development Plan: enhancing the current low productivity level; improving the competitiveness of domestically produced machines, devices and software; consolidating supply chains to remain competitive at global scale; and improving the attractiveness of the labor market."

According to the DTM, key barriers towards realizing the initiative's goals include "low SME awareness," "delays in the legislative process before implementation" and "the complexity of establishing a mechanism supporting SMEs financially in implementing new technologies." However, they commend the initiative for combining "regulatory activities with practical business approach" and for encouraging the involvement of "all interested stakeholders (e.g., business, universities, regional governments, etc.)".

2.2.5. Romania: Manifesto for a Digital Romania

Announced in November 2016 by then prime minister Dacian Ciolos, the Manifesto for Digital Romania was established "around three main objectives": "On the one hand, a better coordination of investment and public money spending

[64] https://ec.europa.eu/growth/tools-databases/dem/monitor/content/poland-%E2%80%9Cinitiative-polish-industry-40-%E2%80%93-future-industry-platform%E2%80%9D

in the IT field, with citizens oriented results, to reflect in the administration performance. Secondly, supporting innovation, research & development and entrepreneurship and thirdly, measures to draw specialized professionals in the public sector and to ensure them a stable employment, to encourage them to come and work in administration [sic] in this sector."[65]

According to the Commission, the Manifesto "commits to a set of principles aligned with the vision for a digital future," and was expected to "bring together decision-makers, the ITC, and creative industries, communities of programmers and entrepreneurs, civic and professional associations" to "support projects, services, and data that are open by default, agile, adaptable and flexible solutions, cutting-edge technology, and continuous innovation in the field of digital technologies."[66]

Nevertheless, little information is available on the implementation or the results of this initiative, with Romania's DESI 2020 country report suggesting that "Romania would benefit from a national strategy focusing on the digital transformation of enterprises."[67] Furthermore, the report recommends targeted measures "to support the digitization of SMEs and raise awareness on the relevance and benefits of adopting digital technologies."

2.2.6. Slovakia: Smart Industry

Inspired by similar initiatives implemented in Germany and the Netherlands, Slovakia's Smart Industry Initiative was adopted in 2016 to "address the low levels of digital awareness amongst Slovak companies, and to bring the nation's business community – particularly industrial companies – closer to the principles of Industry 4.0", with a focus "on collaborative R&D cooperation with industry, and eventually the deployment of more advanced technologies throughout the

[65] https://www.gov.ro/en/news/address-by-prime-minister-dacian-ciolos-at-the-international-digital-romania-4-0-industry-forum
[66] https://ec.europa.eu/futurium/en/system/files/ged/romania_211117.pdf
[67] https://ec.europa.eu/newsroom/dae/document.cfm?doc_id=66928

economy".[68] The Smart Industry Platform was established to coordinate the various efforts, and is comprised of a working group of multidisciplinary experts from industry, the academic community and government.

The DSB characterizes the initiative as being a technology oriented with public financing and an approach close to the midpoint of the top-down/bottom-up scale. Nevertheless, the DTM suggests that the "approach of the initiative leans more towards a top-down than bottom-up, despite the involvement of key industry and academic stakeholders, in that the concept was fully prepared by the Slovak Ministry of Economy, which is also responsible for the development of the action plan".

According to the DTM, the initiative is "mainly aimed at transforming companies and wider industry specifically by increasing the uptake of state-of-the-art technologies with a longer term view toward their use in digitising full production and operational processes", and identifies a "slow start, tight timeframe and no clear funding scheme" as key barriers towards realizing the initiative's goals, noting that in February 2018, Smart Industry was "still in the early implementation stages" and that there was "no additional budget earmarked for the purposes of this initiative".

2.2.7. Slovenia: The Slovenian Digital Coalition

Slovenia's Digital Coalition was established in November 2016 to accelerate the digital transformation in the country, bringing together key stakeholders from trade, industry, research and development, civil society and the public sector.[69] It is expected to serve "as a coordinated and consultative non-discriminatory open forum with the objective to foster the development of the digital economy, the creation of digital jobs as well as the exploitation of opportunities closely linked to the development of ICT and the internet". The Slovenian Digital Coalition was formed to ensure the successful implementation of the Digital Slovenia 2020

[68] https://ec.europa.eu/growth/tools-databases/dem/monitor/content/slovakia-smart-city
[69] https://ec.europa.eu/growth/tools-databases/dem/monitor/content/slovenia-slovenian-digital-coalition

strategic framework that "aims at speeding up the country's transformation towards a digital society and making Slovenia a reference for innovative digital solutions".

According to the DTM, the initiative has a focus on digital skills and awareness-raising with mixed public/private financing. As regards the initiative's position on the top-down/bottom-up scale, it notes that "though the Coalition was established with the adoption of the Digital Strategy 2020 prepared by the Slovenian Ministries, the Slovenian Digital Coalition leans more towards a bottom-up approach, since platform members are given an important role in the initiative's implementation".

The DTM notes that the Digital Coalition "started off with widespread support from a range of different stakeholders", but suggests that the "absence of a balanced funding model, resilience and overall lengthy process of implementing the changes in the legal and regulatory framework" could be key barriers.

3. Cooperation between China and Central and Eastern European countries in the digital economy

3.1. Chinese Government Initiatives and the Participation of CEE Countries

3.1.1. Belt and Road Initiative and the digital economy

The idea of incorporating topics from digital economy sectors into Belt and Road Initiative comes from five years ago. The first time it was mentioned in the White Paper issued by the National Development and Reform Commission, Ministry of Foreign Affairs, and Ministry of Commerce in March 2015[70].

In connection with increasing connectivity, the document proposes: "We should jointly advance the construction of cross-border optical cables and other communications trunk line networks, improve international communications connectivity, and create an Information Silk Road. We should build bilateral cross-border optical cable networks at a quicker pace, plan transcontinental submarine optical cable projects, and improve spatial (satellite) information passageways to expand information exchanges and cooperation."[71]

As we can see from the above quotation, the emphasis was limited on building communications infrastructures. After two years, the concept was broadened significantly. There were already several references to digital economy issues in the joint communique of Leaders Roundtable of Belt and Road Forum in May 2017[72]

- "Strengthening cooperation on innovation, by supporting innovation action plans for e-commerce, digital economy, smart cities, and science and technology parks and by encouraging greater exchanges on

[70] Vision and Actions on Jointly Building Silk Road Economic Belt and 21st-Century Maritime Silk Road
2015/03/28
[71] Footnote 1
[72] Joint communique of Leaders Roundtable of Belt and Road Forum Xinhua| 2017-05-15

innovation and business start-up models in the Internet age in respect of intellectual property rights.[73]"

- "Promoting practical cooperation on roads, railways, ports, maritime and inland water transport, aviation, energy pipelines, electricity, fiber optic including trans-oceanic cable, telecommunications, and information and communication technology, and welcoming the development of interconnected multimodal corridors, such us a new Eurasian Land Bridge, Northern Sea Route, the East-West Middle Corridor, etc., and major trunk lines to put in place an international infrastructure network over time.[74]"

- "Expanding trade by nurturing new areas of trade growth, promoting trade balance and promoting e-commerce and digital economy, welcoming the development of free trade areas and signing of free trade agreements by interested countries.[75]"

As we can see from the above quotations, the document identifies three major areas which should be covered by Belt and Road Initiative projects:

- Innovation for digital economies
- Telecommunications networks
- E-commerce

In December, China and seven other countries co-launched a Digital Economy Cooperation Initiative at the ongoing 4th World Internet Conference (WIC). China, Egypt, Laos, Saudi Arabia, Serbia, Thailand, Turkey and United Arab Emirates (UAE) agreed to extend their cooperation in the digital economy in order to build an interconnected Digital Silk Road and create a community of shared interests and a shared future with win-win cooperation and common prosperity

The eight countries agreed, "to expand broadband access and improve quality, promote a digital transformation, encourage e-commerce cooperation, support

[73] Footnote 3
[74] Footnote 3
[75] Footnote 3

internet-based entrepreneurship, and innovation. In addition, they want to encourage the establishment of a multi-level exchange mechanism to promote exchanges and share views among governments, enterprises, scientific institutions, industry organizations, and relevant interested parties to promote cooperation in the digital economy."[76]

As we can see from the above quotation, the Digital Economy Cooperation Initiative has foreseen much deeper cooperation than the official Belt and Road documents.

The official documents approved by the 2nd Belt and Road Forum 2019 went even one step further. In the report of the Office of the Leading Group for Promoting the Belt and Road Initiative titled "The Belt and Road Initiative Progress, Contributions and Prospects,"[77]there are two important new elements.

The document says: "Digital Silk Road has become an important part of the Belt and Road Initiative. It has signed cooperation agreements with 16 countries to strengthen the construction of the Digital Silk Road." [78] This is a clear acknowledgment that the Digital Silk Road became one of the priorities of the BRI.

The document also says: "The world is experiencing a revolution in technology and industrial reform on a larger scale and at a deeper level. As modern information technology makes continuous breakthroughs and the digital economy thrives, all countries have seen their interests more closely connected. All parties involved in the Belt and Road Initiative should pursue innovation-driven development, intensify cooperation in frontier areas such as artificial intelligence, nanotechnology and quantum computing, and promote big data, cloud computing, and smart cities, so as to turn them into a digital Silk Road of the 21st century." [79] By concretely referring to such digital economy services like artificial intelligence, big data, and cloud computing, the document substantially extends the scope of international cooperation covered by Digital Silk Road.

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[76] Digital economy cooperation to empower Belt, Road 2017/12/3
[77]The Belt and Road Initiative Progress, Contributions and Prospects Office of the Leading Group for Promoting the Belt and Road Initiative 2019-04-25
[78] Document in footnote 8
[79] Document in footnote 8

3.1.2. China – CEE cooperation in the framework of Digital Silk Road

Returning to our topic of cooperation between China and Central and Eastern European countries in the digital economy, although nearly Central and Eastern European countries used to be active participants of Belt and Road Forums and other events linked to this initiative, however we are not aware of any major digital economy projects which were organized or implemented under the BRI framework.

Without going into the details, we have selected two areas where significant development potential exists, but neither the Chinese nor the Central and Eastern European parties (both the governments and interested companies) paid serious attention to them.

With regard to smart city development, in recent years, Chinese telecommunications companies ZTE and Huawei, in particular, have expanded their efforts to supply smart city projects in Belt and Road countries such as Malaysia, Singapore, and the Philippines[80]. It is remarkable that although Huawei and ZTE are very active in the CEE countries, they have not initiated any major smart city projects in the region. In my opinion, the lack of interest from Chinese companies can be explained by two factors:

- Both Huawei and ZTE have separate business units responsible for software development, system integration, and government services, but compared to the carrier business line, these units are relatively new, and they lack high-level skilled professionals.

- In the European countries, the incumbent telecom companies have already set-up their own system-integration units[81] , and they concentrate significant attention and resources to the domestic smart city projects. The Chinese telecom companies also have to compete with multinational IT

[80] Beijing's Silk Road Goes Digital Blog Post by Guest Blogger for Elizabeth C. Economy June 06, 2017

[81] Like the T-System the subsidiary of Deutsche Telekom

companies like IBM or HP, which have strong system integration business units in every EU member country.

According to a report from global consultancy Deloitte, the China Chamber of International Commerce and AliResearch, in China, the consumption of imported goods through cross-border e-commerce reached a compound annual growth rate of 76% between 2015 and 2018[82].

In recent years Alibaba, the leading e-commerce service provider on the Chinese market, has launched several new initiatives to expand its cross-border activities. In February 2014, Alibaba launched Tmall Global, a platform where overseas brands and merchants can sell their products to Chinese online consumers. By the end of 2016, Tmall Global had attracted more than 14500 foreign brands of over 3700 product categories from 63 countries to open shops on it[83].

Alibaba rival JD.com has followed the same pattern. By 2016, JD.com opened 256 major warehouses across the country, covering most of the domestic key cities along the Belt and Road Initiative, including Shanghai, Xi'an, and Chengdu. The further opening up to overseas markets has brought the number of product brands available at JD Worldwide Service to over 20,000, covering more than 70 countries and regions [84].

Cross-border e-commerce is in the same development stage as the smart cities. In Central and Eastern European countries, the activities of Chinese e-commerce companies are not visible. The possible reasons are the following:

- The services of Chinese e-commerce companies became available only in the last 4-5 years. For them, the Central and Eastern Europe is not a priority region

[82] China's demand for imported consumer goods remains strong, bolstered by digital upgrades in cross border e-commerce 5 November 2019
[83] Cross-border shopping surged on Alibaba's Tmall Global in 2016 Adan Najberg December 22, 2016
[84] Xinhua Insight: Belt and Road Initiative boosts China's ecommerce Xinhua 2017-04-29

- Small and medium-sized companies from the Central and Eastern European countries are keen to enter Chinese consumer markets. Still, they lack both brand name recognition and basic market knowledge.

Besides publications on particular projects, it is not easy to find a document with a comprehensive overview on the implementation of Digital Silk Road projects. Mercator Institute of Chinese Studies regularly posts its Belt and Road Initiative Tracker. In 2019 the Institute published a special edition targeted on Digital Silk Road[85].

According to their database, Chinese entities have provided more than USD 17 billion for Digital Silk Road projects completed since 2013:

- at least USD 7 billion in loans and FDI for fiber-optic cable and telecommunication network projects completed since 2013
- more than USD 10 billion for e-commerce and mobile payment deals
- for smart and safe city-related projects, at least several hundred million USD
- for data and research centers, the available information is too limited to make an estimate.

Three big Western-European countries (United Kingdom, France, Germany) were involved in these projects, but the CEE counties did not participate in them

We can conclude that the cooperation in the digital economy between China and Central and Eastern European countries is in an initial development stage. Except for the telecommunication equipment vendors (Huawei, ZTE), no other major player in the Chinese digital market has expressed an interest in entering this market.

[85] MERICS Networking the "Belt and Road" – The future is digital August28, 2019

3.1.3. The 17+1 cooperation

The above statement is also valid for 17+1 Cooperation between China and the Central and Eastern European countries. Some topics related to the digital economy are mentioned in the official documents, but in most of the cases without going into details and without setting up concrete implementation measures.

In the following, we refer to three official documents approved by the different 16+1Summits.

The Medium-Term Agenda for Cooperation between China and Central and Eastern European Countries passed on Suzhou Summit on November 24, 2015, has only two points referring to the digital economy.

In the chapter with the title "Cooperation on Connectivity," the document says: "The Participants will step up cooperation in infrastructure development, including roads, railways, ports, airports, telecommunications and oil and gas pipeline networks, taking into account existing policy commitments and priorities at the EU level."[86]. In the chapter with the title: "Cooperation in Science, Technology, Research, Innovation, and Environmental Protection," the document says: "The Participants will strengthen cooperation in communications technology and its application while ensuring adherence to globally recognized international standards in this sector. Participants will discuss the possibility of establishing a cooperation mechanism on communications."

These points only identify certain issues without making any commitment to some projects. Interesting to note also that any reference to smart cities and e-commerce is missing from this document, although the BRI documents published earlier had already mentioned them.

In the Sofia Guidelines for Cooperation between China and Central and Eastern European Countries approved on the 7th Summit of China in July 2019, there is

[86] The Medium-Term Agenda for Cooperation between China and Central and Eastern European Countries November 24, 2015,

already a specific reference saying: ".Participants will examine possibilities of practical cooperation in trade in services and e-commerce."[87]

The Dubrovnik Guidelines passed on the 8th Summit in April was the first official 17+1 document that paid serious attention to the topic of e-commerce and the smart city development.

The document says: "The Participants are aware of the importance of new trade formats, such as e-commerce, especially in the context of the development of the global economy, and support progress on WTO e-commerce negotiations. The Participants support the strengthening of trade relations between China and CEECs and will conduct further cooperation through an e-commerce platform and encourage enterprises in China and CEECs to promote the import and export of high-quality local products through e-commerce. CEECs welcome Chinese e-commerce enterprises to consider the establishment of online regional, sub-regional, or country pavilions to enhance the visibility of quality goods from CEECs." [88]In our opinion, this guidance was issued with a delay of 3-4 years, but it is very important because it provides clear government support for Chinese internet companies to promote cross-border e-commerce activities with the Central and Eastern European countries.

As regards to smart city development, the document mentions: "The Participants will explore the possibility of launching the China-CEEC Smart City Coordination Center in Romania."

We can conclude the analysis of official documents of BRI and 17-1 cooperation that they correctly identify those areas which have the highest potential for future development. Business digitization and e-commerce are those issues where the digital economies of Central and Eastern European countries are lagging the other EU member countries, and the cooperation with Chinese companies could deliver substantial benefits for both parties.

[87]The Sofia Guidelines for Cooperation between China and Central and Eastern European Countries
[88] The Dubrovnik Guidelines for Cooperation between China and Central and Eastern European Countries

3.2. Regulation of digital markets in the European Union

Unfortunately, government support is only one of the preconditions for successful business transactions. Chinese companies like Alibaba, Ant Financial, Tencent, Baidu, JD.com, Didi Chuxing were quite active in promoting smart city projects, setting up data centers, making investments in local e-commerce or fintech unicorns, but they concentrated on Central and Southeast Asia, in some instances Africa[89].

The European digital markets, including Central and Eastern European countries, are less attractive for the Chinese internet companies than the Asian markets because:

- On average they have higher development levels and less growth potential
- They are dominated by the big American companies (Amazon, Google, Microsoft) with a high market share
- They have well-elaborated but sometimes too sophisticated regulatory systems covering topics that are crucial in the operation of digital markets like consumer protection, privacy, market reviews, data protection, cybersecurity, etc.

On the other hand, the Central and Eastern European countries have certain advantages compared to the Western European markets:

- Business internet and e-commerce has more development potential than in the more advanced Western European countries
- The big American multinationals like Amazon, Microsoft and others pay less attention to this region

[89] The Digital Silk Road: Expanding China's Digital Footprint PREPARED BY EURASIA GROUP
8 APRIL 2020

- The above mentioned regulatory systems are harmonized on the EU level, which means Chinese companies can enter a smaller country's market learn the regulatory rules here and based on his experience can expand their service coverage later

In this chapter, we want to provide an overview of the EU regulatory framework of digital industries. It is targeted on the Chinese audience: on Chinese infocommunications companies as potential entrants to the EU market and policymakers responsible for the China-EU strategic cooperation. Digital globalization makes it necessary that international parties have to understand the regulation of each other's digital markets. Companies aiming to enter new markets, have to assess the regulatory risks coming with it. Simultaneously if the governments want to promote cooperation between China and Central and Eastern European countries, they have to develop common regulatory principles and regulatory standards. In the following, we will present three crucial EU level regulatory documents:

- EU Directive on European Electronic Communications Code
- EU Directive on Security of Network and Information Systems
- EU Cybersecurity Act

3.2.1. The new European Electronic Communications Code[90]

The Code will modernize the current EU telecoms rules, which were last updated in 2009. It entered into force on December 20, 2018, and needs to be transposed[91] into the national laws of the member countries by December 21, 2020.

The Code aims to provide:

- "Clear and inclusive rules: the same rules will apply all over Europe with a vision of an inclusive single market;
- Higher quality of services: the Code will foster competition for investments, in particular in next-generation networks - 5G, meaning higher connection speeds and higher coverage;
- Consumer protection: the Code proposes a regulatory approach that allows all actors, from traditional telecom operators to online players, to provide interpersonal communication services with the same level of protection for the end-user. That means that 'electronic communications services' will also cover services provided over the internet, such as messaging apps and email (also known as 'over-the-top' or 'OTT' services."[92]

The new Electronic Communications Code will:

- Facilitate the roll-out of new, very high capacity fixed networks by making rules for coinvestment more predictable and promoting risk-sharing in the deployment of very high capacity networks;

[90] DIRECTIVE (EU) 2018/1972 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 11 December 2018 establishing the European Electronic Communications Code
[91] Transposition means that although the regulatory framework of the different member states is harmonized on the EU-level, but the legislation and the enforcement is still the responsibility of the relevant national bodies. The national acts are passed by the Parliaments and the enforcement is conducted by the National Regulatory Authorities
[92] European Commission – Press release Digital Single Market: EU negotiators reach a political agreement to update the EU's telecoms rules Brussels June 2018

- Benefit and protect consumers, promoting better tariff transparency and comparison of contractual offers; guaranteeing better security against hacking, malware; better protecting consumers subscribing to bundled service packages; making it easier to change service provider and keep the same phone number.

3.2.2. EU Directive on Security of Network and Information Systems[93]

The Directive on Security of Network and Information Systems[94] ('NIS Directive') represents the first EU-wide rules on cybersecurity[95]. It aims to ensure that EU countries are well-prepared and are ready to handle and respond to cyberattacks through:

- the designation of competent authorities;
- the set-up of computer-security incident response teams (CSIRTs);
- the adoption of national cybersecurity strategies;

The provisions of the Directive aim to serve three major objectives:

- improved cybersecurity capabilities at the national level

[93] DIRECTIVE (EU) 2016/1148 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 6 July 2016 concerning measures for a high common level of security of network and information systems across the Union

[94] According to the Directive, the Network and Information System is an electronic communications network, or any device or group of interconnected devices which process digital data, as well as the digital data stored, processed, retrieved or transmitted.

[95] According to the Directive, the Cybersecurity is the ability of network and information systems to resist action that compromises the availability, authenticity, integrity or confidentiality of digital data or the services those systems provide.

- increased EU-level cooperation[96]
- risk management and incident reporting obligations for operators of essential services and digital service providers

For operators of essential services and the digital service providers the directive prescribes risk management and incident reporting obligations.

Security measures cover the following:

- Preventing risks: Technical and organisational measures that are appropriate and appropriate to the risk.
- Ensuring security of network and information systems: The measures should ensure a level of security of network and information systems appropriate to the risks.
- Handling incidents: The measures should prevent and minimize the impact of incidents on the IT

Each Member State has to identify operators of essential services by applying these criteria:

- The entity provides a service which is essential for the maintenance of critical societal/economic activities;
- The provision of that service depends on network and information systems; and
- A security incident would have significant disruptive effects on the provision of the essential service.

The Directive covers such operators in the following sectors: energy, transport, banking, health, water, digital infrastructure.

The Digital Service Providers which are covered by the Directive are:

[96] NIS is also a EU directive which was later transposed to national laws, meaning that there are separate network security laws and national regulatory authorities in each EU member country

- Online marketplaces (which allow businesses to set up shops on the marketplace in order to make their products and services available online)
- Cloud computing services
- Search engines

The Directive had established the NIS Cooperation Group which is the key institution to ensure strategic cooperation and the exchange of information among EU Member States in cybersecurity. On the operational side, the NIS Cooperation Group is supported by the work of the CSIRT s network, in the same time the group provides strategic guidance for the activities of the CSIRT s network.[97]

3.2.3. The EU Cybersecurity Act[98]

On June 27, 2019, the European Cybersecurity Act entered into force, setting the new mandate of ENISA, the EU Agency for Cybersecurity, and establishing the European cybersecurity certification framework. It is important to note that the legal form of the Cybersecurity Act is EU regulation. A regulation is a binding legislative act which must be applied in its entirety across the European Union. It differs from the directives[99] where it is up to the individual countries to devise their own laws.

The Cybersecurity Act introduces for the first time EU-wide rules for cybersecurity certification. Companies in the EU will be able to certify their products, processes, and services only once and see their certificates recognized across the Union[100].

[97] Shaping Europe's digital future NIS Cooperation Group
[98] Regulation (EU) 2019/881 of the European Parliament and of the Council of 17 April 2019 on ENISA (the European Union Agency for Cybersecurity) and on information and communications technology cybersecurity certification and repealing Regulation (EU) No 526/2013 (Cybersecurity Act) (Text with EEA relevance)
Accessed 29 September 2019
[99] Like European Electronic Communications Code or the NIS Directive presented above.
[100]European Commission - Questions and answers - EU Cybersecurity Brussels, 26 June 2019

- Under the framework, multiple schemes will be created for different categories of ICT products, processes, and services. Each scheme will specify, among the others, the type or categories of ICT products, services, and processes covered, the purpose, the security standards that shall be met, and the evaluation methods. ENISA, upon request from the Commission or the European Cybersecurity Certification Group (composed by the Member States), will prepare the certification schemes that will then be adopted by the Commission through implementing acts.

- Alongside third-party certification, conformity self-attestation by the manufacturer is allowed for the products that present a low level of risk.

- While the certification will remain voluntary, the Commission will assess whether mandatory certification is required for certain categories of products and services.

Until 2019 EU Agency for Cybersecurity (ENISA) had a temporary mandate, which was set to expire in 2020. The Cybersecurity Act gave the Agency a permanent mandate, thus putting it on a stable footing for the future. The current tasks of the EU Agency for Cybersecurity, such as supporting policy development and implementation as well as cyber capacity building, have been strengthened and refocused. New tasks have been added, most prominently regarding cybersecurity certification:

- Support for policy implementation in the area of cybersecurity, especially the NIS Directive, as well as to other policy initiatives with cybersecurity elements in different sectors (e.g. energy, transport, finance).

- Cybersecurity capacity building, for example, with training to help improve EU and national public authorities' capabilities and expertise, including on incident response and on the supervision of cybersecurity-related regulatory measures.

- Market-related tasks (standardization, cybersecurity certification), such as analysis of relevant trends in the cybersecurity market.

- Operational cooperation and crisis management aimed at strengthening the existing preventive operational capabilities and supporting operational cooperation as the secretariat of the CSIRTs Network.

- Coordinated vulnerability disclosure: The EU Agency for Cybersecurity will assist Member States and Union institutions, agencies, and bodies in establishing and implementing vulnerability disclosure policies on a voluntary basis.

3.2.4. The presence of the Chinese telecom companies on the Central and Eastern European markets

As we have mentioned in point 1.1.2, except for the telecommunication equipment vendors (Huawei, ZTE) no other major players of the Chinese digital market are present on Central and Eastern European markets. Interestingly this statement is true, not only for the digital platform providers like Baidu, Ali Baba, and Tencent but also for the leading telecom service providers, like China Telecom, China Mobile, or China Unicom.

This business policy is in contrast to the practice of large multinational telecommunications companies (Orange, Deutsche Telekom, BT), which follow their large domestic business partners to foreign markets as well. Large Chinese banks (Bank of China, ICBC) or manufacturing companies (Huawei, ZTE, Wanhua) are present in many countries of the region, but their telecom services are not provided by their usual domestic partners, but by the leading multinational firms.

Examining the website of the above mentioned three Chinese telecom companies, they are already capable of providing sophisticated business services like secure Virtual Private Network (VPN) datacommunications services, cloud services, or data center services, but in most regional countries, they have no network coverage or they did not register their services at the local telecom authorities.

We conducted an online survey on the local presence of China Telecom, China Mobile, and China Unicom. All three companies have European headquarters, and we used the information obtained from their European website.

Among the three companies, China Telecom has the most advanced service portfolio and the widest regional coverage. China Telecom global network covers 42 countries, 18 countries from the Asia Pacific, and 16 from the European region. Unfortunately, they have registered their services only in two countries (Czechia, Hungary) from 11 countries covered by our study[101].

China Mobile provides Global Business Support in 36 countries, but the Central and Easterns European countries are not among them[102]. The situation is similar in the case of China Unicom[103].

The lack of presence of Chinese telecom service providers in the region has a substantial negative impact on the development potential of China-CEE cooperation in the digital economy:

- The business datacommunications services are crucial elements of digital service packages (cloud, data, centers, encryption) provided for the corporate sector. The Chinese e-commerce and fintech companies (JD.com, Ant Financial, and others) are forced to cooperate with Western multinational carriers and have to accept their technical standards
- As we have pointed out in this chapter, the regulation of electronic communications markets, network and information systems and cybersecurity is based on EU-level directives. On the other hand, the implementation of these directives to local laws and regulations differs in each EU member country. The interpretation and understanding of these local rules is a long and complicated process. It may seem that the registration of a new service in a new country is a simple procedure. Still, the operations of these services need a lot of resources and local representation.

3.3. Regulation of Cybersecurity of 5G networks and its implementation in the Central and Eastern European countries

[101] Source: China Telecom website
[102] Source. China Mobile website
[103] Source: China Unicom website

3.3.1. The EU Commission Recommendation on Cybersecurity of 5G networks[104]

Compared to the other three regulatory tools this document has created a lot of publicity, although EU recommendations usually do not prescribe any binding rules, it depends on the member states how to interpret and implement them. The Commission avoided issuing centralized community level rules on purpose, although it did not exclude that if necessary, such rules will be passed in the future.

At the beginning of 2019, the EU Commission was under great pressure to approve stricter rules and to ban Chinese equipment vendors from participating in the implementation of the 5G networks. On March 12, 2019, the European Parliament passed a resolution on security threats connected with the rising Chinese technological presence in the EU and possible action on the EU level to reduce them.[105]

In this resolution the Parliament raised concerns "about third-country equipment vendors that might present a security risk for the EU due to the laws of their country of origin, especially after the enactment of the Chinese State Security Laws, which impose obligations on all citizens, enterprises and other entities to cooperate with the state to safeguard state security, in connection with a very broad definition of national security; whereas there is no guarantee that these obligations are not applied extraterritorially."[106] They have also expressed "deep concern about the recent allegations that 5G equipment developed by Chinese companies may have embedded backdoors that would allow manufacturers and authorities to have unauthorized access to private and personal data and telecommunications from the EU;"[107]

Defying these expectations, the recommendation set up three objectives:

[104] COMMISSION RECOMMENDATION of 26.3.2019 C(2019) 2335 final Cybersecurity of 5G networks
[105] European Parliament resolution of 12 March 2019 on security threats connected with the rising Chinese technological presence in the EU and possible action on the EU level to reduce them (2019/2575(RSP))
[106] See document in footnote 32
[107] See document in footnote 32

- "Member States to assess the cybersecurity risks affecting 5G networks at national level and take necessary security measures.

- Member States and relevant Union institutions, agencies, and other bodies to develop jointly a coordinated Union risk assessment that builds on the national risk assessment.

- The Cooperation Group set up under Directive (EU) 2016/1148 (NIS Cooperation Group) to identify a possible common set of measures to be taken to mitigate cybersecurity risks related to infrastructures underpinning the digital ecosystem, in particular, 5G networks"[108].

The recommendation authorized the National Regulatory Authorities to take concrete measures like:

- update the relevant obligations imposed on undertakings providing public communications networks or publicly available electronic communications services

- ask for commitments from the undertakings participating in any upcoming procedures for granting rights of use for radio frequencies in 5G bands as regards compliance with security requirements for networks

At EU level, two tasks were defined:

- By October 1, 2019, the Member States with the support of the Commission and together with the European Agency for Cybersecurity (ENISA) should complete a joint review of the Union-wide exposure to risks related to infrastructures underpinning the digital ecosystem, in particular 5G networks.

- The Member States and EU Commission representatives' parties should be agreed by December 31, 2019, for advising the Commission on developing minimum common requirements to further ensure a high level of cybersecurity of 5G networks across the Union.

[108] See document in footnote 31

The NIS Cooperation followed this time-table: on October 9, 2019, it issued its risk assessment report[109]. In this document although no country was mentioned by name, but among the supplier-specific vulnerabilities, point 2.37 has a rather clear reference to China.

"The likelihood of the supplier being subject to interference from a non-EU country is one of the key aspects in the assessment of non-technical vulnerabilities related to 5G networks. Such interference may be facilitated by, but not limited to, the presence of the following factors:

- a strong link between the supplier and a government of a given third country;
- the third country's legislation, especially where there are no legislative or democratic checks and balances in place, or in the absence of security or data protection agreements between the EU and the given third country;"[110]

At the end of 2019, the EU Member States, acting through NIS Cooperation Group, has adopted the toolbox. In January, the EU Commission endorsed the joint toolbox[111] and published a communication document[112] interpreting the conclusions of the toolbox.

The main message of the Communications document is that "all Member States should ensure that they have measures in place (including powers for national authorities) to respond appropriately and proportionately to the presently identified and future risks"[113] They should in particular:

[109] EU coordinated risk assessment of the cybersecurity of 5G networks NIS Coordination Group Report October 9 2019
[110] See document in footnote 36
[111] Cybersecurity of 5G networks EU Toolbox of risk mitigating measures NIS Coordination Group 29 January 2020
[112] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions Secure 5G deployment in the EU - Implementing the EU toolbox 29.1.2020 COM(2020) 50 final
[113] See document in footnote 38

- "Strengthen security requirements for mobile network operators (e.g. strict access controls, rules on secure operation and monitoring, limitations on outsourcing of specific functions, etc.);

- Assess the risk profile of suppliers; as a consequence, apply relevant restrictions for suppliers considered to be high risk - including necessary exclusions to effectively mitigate risks - for key assets defined as critical and sensitive in the EU coordinated risk assessment(e.g., core network functions, network management, and orchestration functions, and access network functions);

- Ensure that each operator has an appropriate multi-vendor strategy to avoid or limit any major dependency on a single supplier (or suppliers with a similar risk profile), ensure an adequate balance of suppliers at national level and avoid dependency on suppliers considered to be high risk; this also requires avoiding any situations of lock-in with a single supplier, including by promoting greater interoperability of equipment."

Although the Commission was very clear in announcing its objectives, but it also admitted that the decision on specific security measures remains the responsibility of Member States.

Concluding the assessment of the Recommendation on Cybersecurity of 5G networks and its impact on Chinese-CEEC cooperation we can state:

- There are no EU level regulatory rules on 5G network security; the recommendation and the toolbox, although provide some guidance, but also ensures substantial room for national governments to make their own choice between security and economic aspects of network implementation.

- The Commission carefully avoided the country- and vendor-specific statements. This provides certain relief for such Chinese vendors like Huawei and ZTE. However, the 2.37 point of Risk Assessment Report by NIS Coordination Group provides an argument [114] for anti-China

[114] See the quotation above

interpretation and can be used as a reference by national political decision-makers who favor an anti-China policy.

- The EU regulation of 5G network security is an ongoing process. On July 24, the EU Member States, with the support of the European Commission and ENISA published a report[115] on the progress made in implementing the joint EU toolbox of mitigating measures. "As part of the implementation of the Commission Recommendation adopted last year, by October 1 2020, Member States, in cooperation with the Commission, should assess the effects of the Recommendation and determine whether there is need for further action."[116]

3.3.2. The regulation of Cybersecurity of 5G networks in Central and Eastern European countries

As we have written in the previous point, the EU Recommendation and Toolbox on Cybersecurity of 5G networks do not provide binding rules. Members countries have the right to interpret these recommendations; it is up to them to decide whether to restrict the participation of Chinese vendors (Huawei. ZTE) in the implementation of 5G mobile networks.

The governments of Central and Eastern European countries were active players in the debates on Cybersecurity of 5G networks. It is well known that they were under continuous pressure from US government to take sides in the "US-China technological war."

As I have proven in point 1.3.1. the EU Commission and the leading EU member countries (France, Germany) have avoided qualifying the Chinese vendors as security threats for the 5G mobile networks. In contrast, in the last two years, eight among the eleven Central and Eastern European countries covered by this study have signed a government-level Joint Declaration on 5G Security with the US.

[115] Report on Member States' Progress in Implementing the EU Toolbox on 5G Cybersecurity July 2020

[116] Press release by the European Commission and the German Presidency of the Council of the EU 5G security: Member States report on progress on implementing the EU toolbox and strengthening safety measures

Country	Date of Signature
Czech Republic[117]	May 6 2020
Estonia[118]	November 1, 2019
Latvia[119]	February 27, 2020
Poland[120]	September 5, 2019
Republic of Bulgaria[121]	October 23, 2020
Romania[122]	August 22, 2019
Slovak Republic [123]	October 23, 2020
Slovenia[124]	August 13, 2020

Illustration 103 Joint Declaration on 5G Security with the US

In the above table, we indicate the name of the country and date of signature of the Joint Declarations. The text of those declarations, which were signed in this year, is exactly the same. There are no direct references to China and the Chinese vendors, but the message is obvious. These declarations will serve as a basis for later concrete government decisions officially prohibiting Chinese vendors from taking part in the implementation of 5G mobile networks.

As a clear example of the intention of the signatories, I provide a quotation from the text below:

The parties "believe that a rigorous evaluation of suppliers and supply chains should take into account the rule of law, the security environment; ethical supplier

[117] Joint Statement on United States – Czech Republic Joint Declaration on 5G Security
[118] United States–Estonia Joint Declaration on 5G Security
[119] Joint Statement on United States-Latvia Joint Declaration on 5G Security
[120] U.S.-Poland Joint Declaration on 5G
[121] United States – Republic of Bulgaria Joint Declaration on 5G Security
[122] Memorandum of Understanding between the governments of Romania and the US on 5G technology
[123] United States – Slovak Republic Joint Declaration on 5G Security
[124] Joint Statement on United States – Slovenia Joint Declaration on 5G Security

practices; and a supplier's compliance with security standards and best practices. Specifically, evaluations should include especially the following elements:

- Whether the network hardware and software suppliers are subject, without independent judicial review, to control by a foreign government;"

The above declarations relate to the security of the 5G networks. Still, since August this year, the US government has introduced a new broad concept regarding the secure telecommunications infrastructures, the so-called "Clean Network." On September 23 this year, the US and Estonia have released a new Joint Statement on Secure Telecommunications Infrastructure. In this document, the two parties have "emphasized the United States´ and Estonia´s strong commitment to shared principles on 5G security and internationally accepted digital trust standards that are rooted in the Clean Network. They discussed ways for further advancing their cooperation in securing critical telecommunications infrastructure and ensuring clean technology supply chains."

3.4. Prospects of cooperation between China and Central and Eastern European countries in the digital economy

Considering the analysis provided in the first two chapters of this study, we could evaluate the prospects of cooperation between China and Central and Eastern European countries in the digital economy as promising. Business digitization and e-commerce are those areas where the digital economies of Central and Eastern European countries lag behind the other EU member countries, and the cooperation with Chinese companies could deliver substantial benefits for both parties.

The new developments in this year have also provided arguments for strengthening cooperation in "digital economy". Under the epidemic situation, the electronic information technology industry and e-commerce not only suffered the least impact, but also developed rapidly. The explosion of "blowout" huge demand in digital economy also highlights the contradiction between supply and demand. Increasing investment in digital infrastructure has been listed as an important agenda of central and Eastern European countries. In many countries the governments have identified digital transition as one of the priority development

projects of the European Union recovery fund;, and will submit a subsidy plan within the framework of the EU recovery fund to provide funds for enterprises' digital infrastructure. In recent years, China has developed rapidly in the fields of 5g, industrial Internet, data center and other new digital infrastructure fields, and the digital economy has also shown strong strength and potential in the fight against the epidemic. Strengthening digital cooperation between the two sides can help the central and Eastern European economies recover rapidly in the post epidemic era, and become a new driving force for China CEE cooperation

In this chapter, we have also demonstrated that there are significant obstacles to achieve progress in this cooperation:

- Neither the Chinese digital platform providers nor the Chinese telecom service providers have shown any interest in entering the CEE digital markets. Business development is a time-consuming, complicated process. Without a local presence and lack of local partners, they have no chances to win on the corporate or government tenders.

- Business digitization is subject to complex and evolving domestic and international laws and regulations regarding data security and privacy. The EU directives and the local laws and regulations are complex and stringent, and many are subject to change and uncertain interpretation. Lack of experience results in difficulties in adapting the service portfolio of Chinese companies to the local requirements.

- The two most successful Chinese companies in the region were the telecom equipment vendors Huawei and ZTE. Unfortunately, they were negatively impacted by the new 5G network security regulation, which affects their non-5G businesses too. These two companies have the most serious problems in those eight Central and Eastern European countries which have signed Joint Declaration with the US government effectively prohibiting Huawei and ZTE to take part in the implementation of 5G networks.

Combined with political, economic and technological factors, the main challenge of "China CEE" digital economic cooperation comes from the influence of the United States and the European Union on central and Eastern European countries.

On the one hand, the US government regards Central and Eastern Europe as a strategic foothold to deal with the competition among big powers and intervene in the cooperation between China and Central and Eastern European countries. On the other hand, the EU has repeatedly questioned the motives of China CEEC cooperation, strengthened its intervention, and introduced an investment security review mechanism. Digital economic cooperation between countries will inevitably involve data security issues. As the Central and Eastern European countries are becoming more and more consistent with the European Union in legislation, strict control of data security will become normalization, data protection related user information collection, data localization storage and cross-border transmission. The problem is likely to become the "red line" or major risk point of "China Central and Eastern Europe" digital economic cooperation in the next few years.

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4. National Digital Programs in Hungary and Hungary Compared to Other EU and EU11 Countries in DESI

Introduction

In 2014, the Hungarian State prepared the National Infocommunication Strategy[125] (NIS) for the period 2014-2020, in accordance with the Digital Agenda[126] initiative adopted by the European Union in 2010.

Based on this, the Hungarian Government set the goal of making the development of telecommunications infrastructure a top priority.

Specific objectives related to the development of broadband infrastructure:

- Provide local access with at least 30 Mbps bandwidth in uncovered areas by 2018.
- By 2020, 50% of households should have an Internet connection with a bandwidth of 100 Mbps or more

Most of the market participants joined the above program through strategic agreements with the government.

In order to achieve its objectives, the Hungarian government used all the means at its disposal, be it a political, regulatory or public policy tool for development.

The basic pillar of the resources needed to achieve this goal was the European Union support, for which a specific program was launched, the Superfast Internet Access Program[127] (SIP).

At the same time, for the sake of completeness, the area of Central Hungary, for which it was not possible to use EU development funds, was allocated a corresponding amount from domestic resources. In March 2014, the government created the Digital National Development Program (DNDP)[128], which no longer

[125] https://2010-2014.kormany.hu/download/b/fd/21000/Nemzeti%20Infokommunik%C3%A1ci%C3%B3s%20Strat%C3%A9gia%202014-2020.pdf (in Hungarian)
[126] https://eur-lex.europa.eu/legal-content/HU/TXT/PDF/?uri=CELEX:52010DC0245&from=hu (in Hungarian)
[127] https://kifu.gov.hu/szip (In Hungarian)
[128] http://njt.hu/cgi_bin/njt_doc.cgi?docid=172387.275675 (in Hungarian)

included only the development of infrastructure, but was built on the following three pillars.

- Digital Competencies
  - residents
  - SMEs
  - public administration
  - e-Inclusion
- Digital Economy
  - ICT industry
  - e-Services
  - Company IT
  - R&D&I
- Digital State
  - Government IT
  - e-Public administration
  - e-Public services
  - Security

In order to implement the strategy operationally, the Hungarian Government has established the Digital Welfare Program[129] (DWP), which will be explained in details later.

One of the main indicators of the effectiveness of the period 2014-2020 by the European Union was the recent update of DESI[130], based on which it can be stated that Hungary in terms of infrastructure development has definitely made progress.

In the first half of 2020, the Hungarian government drew up an industry strategy for 2021-2030, called the National Digitization Strategy (NDS). According to the status of the NDS, it has passed the stage of public discussion, after processing the comments, the Hungarian government plans to adopt it during the autumn period of this year.

NDS is covered in detail later in this material.

[129] https://digitalisjoletprogram.hu/ (in Hungarian)
[130] https://ec.europa.eu/digital-single-market/en/news/digital-economy-and-society-index-desi-2020

4.1. Digital Infrastructure

4.1.1. Digital Infrastructure in Hungary in light of DESI's Connectivity Dimension

Overall the state of digital infrastructure and the use of this infrastructure by consumers is a success story in Hungary thanks to the Superfast Internet Program. This is also reflected in the Connectivity dimension of the DESI index which shows that Hungary has an advantage over not just the EU11 but over the EU average as well in this area as shown on the graph and tables below.

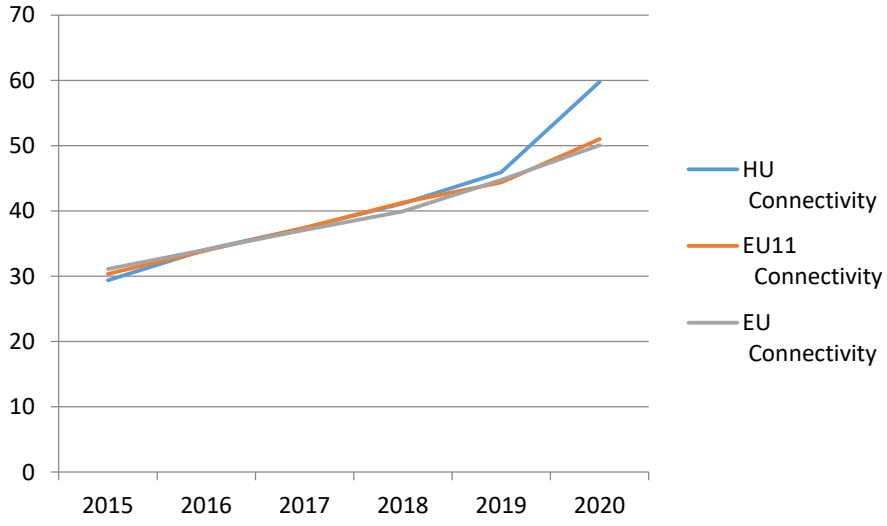

Illustration 104 Comparison of Connectivity Dimension of DESI

		HUN		EU11		EU	
	Sub-Dimensions	**2016**	**2020**	**2016**	**2020**	**2016**	**2020**
Connectivity	Overall fixed broadband take-up	68,71%	81,82%	62,86%	67,42%	71,75%	77,63%
	At least 100 Mbps fixed broadband take-up	13,64%	50,90%	10,64%	30,38%	7,72%	25,86%
	Fast broadband (NGA) coverage	78,15%	89,55%	66,45%	80,99%	69,35%	85,85%
	Fixed Very High Capacity Network (VHCN) coverage	21,48%	42,57%	27,38%	54,84%	19,25%	44,03%
	4G coverage	n/a	96,83%	n/a	94,52%	n/a	96,47%
	Mobile broadband take-up (subscription per 100 people)	34,44	69,56	72,54%	122,55	75,80	100,16
	5G readiness	n/a	61,11%	n/a	13,99%	n/a	20,52%
	Broadband price index	n/a	63,44	n/a	75,87	n/a	64,24

Illustration 105 Comparison of Connectivity Sub-Dimensions of DESI

In terms of connectivity, Hungary ranks 7th in the EU, showing significant improvement in the past four years. Fast broadband coverage improved further with 3 percentage points to 90% of households, above by 4 percentage points the EU average of 86%.

Connection speeds has improved in a big way. This is the result of the fact that 51% of Hungarian subscribers has at least 100 Mbps fixed broadband as opposed to the EU average of 26%. This is partially the result of the wide spread Hungarian cable network– which is atypical in most EU countries – which can achieve a bandwidth of 100 Mbps, as opposed to the copper-based DSL[131] network. This means a big improvement over last year's 40%. Very High Capacity Network (VHCN) coverage stands at 43%, just below the EU average of 44%. The average mobile broadband coverage of 97% is practically the same as the EU average of 96%, it is just 1 percentage point below it.

[131] A copper-line based broadband technology capable of reaching speed of up to 50 Mbps

However, mobile broadband take-up in Hungary is well below the EU and EU11 averages. So the reason why Hungary has the highest growth rate in this sub-dimension is because it has a lot of catching-up to do, since it is not only below the EU and EU11 averages, but it is the last among all the EU member states. It is also interesting to see that in this sub-dimension the EU11 average is well above the EU average. This situation can be attributed to the fact that Poland has the highest mobile broadband take-up in the EU with 175,7 mobile broadband subscription per 100 people.

Hungary is below the EU and EU11 averages in mobile broadband take-up may be because prices for mobile phone users are persistently among the highest in Europe. Hungary ranks 16th in the EU in terms of broadband prices when analysing all product baskets (fixed, mobile, converged).

The biggest part of the projects under the Superfast Internet Programme deployed FTTH[132], enabling speeds envisaged in the gigabit range. The project has had the intention to cover all Hungarian households – the connectivity of close to half a million households has been financed by EU funds. For areas that are not economically viable, a state aid scheme of almost HUF 60 bn has been developed to ensure broadband roll-out. The success of the project is reflected in the increase of rural FTTP coverage from 4% in 2015 to 29% in 2019. [133]

[132] Fibre to the Home, a broadband technology capable of reaching speed of 1 Gbps
[133] Digital Economy and Society Index (DESI) 2020; Hungary

	Sub-Dimensions Rate of Change (2020/2016)	HUN	EU11	EU
Connectivity	Overall fixed broadband take-up	19%	7%	8%
	At least 100 Mbps fixed broadband take-up	273%	185%	235%
	Fast broadband (NGA) coverage	15%	22%	24%
	Fixed Very High Capacity Network (VHCN) coverage	98%	100%	129%
	4G coverage	n/a	n/a	n/a
	Mobile broadband take-up (subscription per 100 people)	102%	69%	32%
	5G readiness	n/a	n/a	n/a
	Broadband price index	n/a	n/a	n/a

Illustration 106 Comparison of the Development of Connectivity Sub-Dimensions of DESI

It is also worth considering that in Hungary the rate of increase of all but two sub-dimensions within the Connectivity dimension is higher than the average growth rate of either the EU11 or the EU28. This is illustrated in the table showing the rate of change in the Connectivity dimension.

In case of at least 100 Mbps fixed broadband take-up Hungary has the highest growth rate between 2016 and 2020, it is a much more positive situation than with mobile broadband take-up, Hungary outgrowing the EU and EU11 averages from an already reasonably good situation in 2016.

The only sub-dimension where Hungary's rate of increase is below the EU and EU 11 averages is the Fixed Very High Capacity Network Coverage. In this area Hungary is a little bit below the EU average but well below the EU11 average. In this case we have a similar situation compared to the one above (mobile broadband take-up), meaning that the EU11 average is above the EU average of all the member states. This can be the result of the following situation:

In EU11 countries between 2000 and 2015 there was a lower DSL and broadband coverage compared to the Western European countries, which was the result of

lower demand for broadband services. As a result, there was less incentive for telecom operators in Western Europe to build fibre optic networks after 2015, since they already had a big part of these countries covered by DSL, a slower version of broadband technology. Whereas in Eastern Europe where broadband deployment started later, telecom operators there had the opportunity to realize that fibre optics will be a much more future proof technology than DSL or even high speed coax[134] networks. (Hungary is a special case in this situation because it has had a traditionally wide spread coax network, which is capable of higher bandwidth than the DSL network as already mentioned above.)

The other possible reason for this situation is that Eastern European countries have a better access to EU funds since they are less developed than Western European ones, and a lot of these fibre optic investment is financed by these EU funds. (Better access to EU funds means that bigger part of their GDP is financed by these funds, so in Western Europe it is more difficult to allocate money from these EU funds to even such important goals as broadband network deployment.)

4.1.2. Superfast Internet Program

The Origins of and Goal of SIP

The Digital Agenda of the EU set three goals in the area of digital infrastructure:

1. Basic broadband internet for all by 2013: basic broadband coverage for the entire EU population (100%). (Benchmark determined in December 2008, the DSL coverage rate for the total EU population was 93%.)
2. High-speed broadband internet connection by 2020: internet connection with at least 30 Mbps bandwidth for the entire EU population (100%). (Benchmark determined in January 2010, 23% of broadband subscriptions had a bandwidth of 10 Mbps or more.)
3. Extremely fast broadband internet by 2020: 50% of European households must have an internet connection with a bandwidth of more than 100 Mbps. (no benchmark adopted)

The NIS, adopted in February 2014 in Hungary on the basis of Digital Agenda of the EU, dealt with the domestic development directions of the info-

[134] broadband technology capable of reaching speed above DSL but below fibre optic technology

communication sector for the period of 2014-2020, and already talked about the need for at least 30 Mbps Internet access for all Hungarian citizens. Furthermore, in the same spirit, the Hungarian Government adopted Government Decree 1631/2014[135] which sets out the framework and goal of the SIP.

The target group of the project has been uncovered households, meaning. business and residential customers, as well as local and central public administrations. Public administrations can be municipalities, government or public institutions (police, fire brigade, health care institutions, educational bodies, etc.).

The most directly involved stakeholders of the project have been government bodies, departments and authorities which have been involved in the preparation phase of the project implementation. It also affects the general public and all institutions and companies that use a broadband network but do not currently have access to 30 Mbps. In addition, market players (small, medium and large enterprise service providers), public players capable of providing electronic communications services, passive infrastructure builders and NGN equipment delivery companies were also involved in the implementation phase of the project.

SIP and the Most Important Factors Necessary for its Implementation

As mentioned earlier, the priority goal of SIP has been for all Hungarian households to have access to an Internet connection with a bandwidth of at least 30 Mps. In order to achieve this objective, a working group responsible for coordination has been created, and an organization has been set up within the framework of the Government Informatics Development Agency.

Accordingly, in order to ensure and coordinate the state tasks required to ensure full coverage of Internet connection with a bandwidth of at least 30 Mps the Superfast Internet Program has been set up within the Government Informatics Development Agency under the supervision of the Ministry of National Development.

The main goal of SIP is to implement the Superfast Internet Program and to perform the related operational tasks. All tasks and steps directly related to this

[135] https://net.jogtar.hu/jogszabaly?docid=A14H1162.KOR&txtreferer=A1400392.KOR

goal are carried out within the framework of the SIP, and can be considered as a part of the project of SIP.

According to the Decree 1631/2014, the most important steps required for the launch and implementation of SIP were the following:

- Infrastructure mapping: the development of a nationwide database and basic mapping of next-generation and lower-bandwidth network coverage, and the development of a nationwide, continuously updated geographic information system-based electronic communications register that is suitable to fully support the planning and monitoring tasks of Superfast Internet Program. Before the first call for proposals in 2015, all telecommunication service providers were asked about their future plans for NGN network deployment in the next three years. SIP aimed to cover only those areas where there was no coverage of NGN and no service provider wanted to deploy NGN in the next three years.
- Preparation of a detailed feasibility study: includes the development of a tender framework for the deployment of next-generation broadband network infrastructure, modifying the regulatory environment so that it simplifies administrative rules for network deployment, the coordination of technology-neutral network developments and the development of a service, business and operational model called Dynamic Business Model;
- Preparation and implementation of EU tenders: preparation of a call for proposals for the development of next generation networks (taking into account the possibilities of utilization and use of governmental networks), as well as announcement and implementation of these tender constructions in the 3rd and 8th priorities of GINOP[136];
- preparation of legislative amendments: on the one hand, to simplify construction legislation, to make procedures work as a one-stop shop system and to reduce construction procedural fees, and on the other hand, to review the regulatory environment in order to further increase competitiveness;
- consultations with stakeholders: consultations with professional interest groups through the National Communications and Informatics Council,

[136] GINOP is a set of development programs funded in a bigger part by the EU and in a smaller part by the Hungarian Government

with the involvement of the Electronic Communications Reconciliation Council.

In accordance with the above, the tender GINOP 3.4.1-2015 was announced in the autumn of 2015. In this tender, more than 140 districts could be tendered for broadband development. Each district could be applied for separately and with different conditions for each district, which meant different CAPEX needed for each district with different amount grants granted. Grants are determined as a percentage of the CAPEX needed to implement a project, with different districts allocated different grant percentages. This call for proposals has been followed to date by three more, one of which was non-EU funded and therefore not published under the GINOP 3.4.1 code, but followed the same logic and the call for proposals itself was almost the same as for the other tenders.

The main technological and financial results of the SIP project are the following so far[137]:

- Construction of 19,000 km of optical cable
- 3,000 km of new underground network infrastructure
- 87% of access points funded in a project implemented with FTTH technology
- 67% of access points funded by solely service providers implemented with FTTC (Fibre To The Cabinet) technology
- State aid of HUF 59 billion (€ 178 million) given
- Total project cost of HUF 152 billion (€ 460 million)
- Within the framework of the SIP, 4 tenders have been announced so far, the fifth tender will be announced soon, although there has been a little delay because of the Corona Virus.

[137] https://kifu.gov.hu/szip (in Hungarian)

4.1.3. Other aspects of Digital Infrastructure

The most important other aspect of Digital Infrastructure is the mobile infrastructure. This includes the current 4G infrastructure as well as the roll-out of 5G infrastructure. Currently 4G coverage in Hungary is 97% which is around the EU average. Mobile broadband takes up (mobile broadband subscriptions per 100 people) however is only 70%, which is well below the EU average of 100%.

In telecommunications, 5G is the fifth generation technology standard for mobile telecommunication networks, which cellular phone companies began deploying worldwide in 2019. It is the planned successor to the 4G networks which provide connectivity to most current cellphones. The main advantage of the new networks is that they will have greater bandwidth, giving higher download speeds, eventually up to 10 gigabits per second (Gbps). Due to the increased bandwidth, it is expected that the new networks will not just serve cellphones like existing cellular networks, but also be used as general internet service providers for laptops and desktop computers, competing with existing fixed internet service providers such as cable internet, and will also make possible new applications in internet of things (IoT) and machine to machine areas. Current 4G cellphones will not be able to use the new networks, which will require new 5G enabled wireless devices.[138]

5G, its Future and its place among the DESI indicators

Although 5G will probably be a very important part of Connectivity in the field of DESI indicators, so far the deployment of 5G networks has just started in recent years. Not only in Europe, but everywhere else this technology is only marginal compared to the already established 4G, which was launched more than 10 years ago. The 5G readiness indicator in Connectivity dimension of DESI shows the portion of the spectrum assigned for 5G purposes in each Member State in the 5G bands. The percentage score of the 5G readiness indicator is based on the amount

[138] https://en.wikipedia.org/wiki/5G

of spectrum assigned in a specific Member State and ready for 5G use by the end of 2020 within the 5G bands identified in Europe.

This score is calculated based on the portion of spectrum assigned in each 5G band in comparison with the maximum feasible amounts, which are as follows:

- 700 MHz band: 60 MHz (703-733 & 758-788 MHz)
- 3.6 GHz band: 400 MHz (3 400-3 800 MHz)
- 26 GHz band: 1000 MHz within 24 250-27 500 MHz.

All three spectrum bands have an equal weight, so having the maximum feasible amount assigned –and ready for 5G use – in the range of one of these bands will result in a score of 33.33%. So to put it simply 5G readiness measures the percentage of all allocated frequency bands compared to all frequency bands harmonized for 5G network deployment.[139]

Hungary also wants to be at the forefront of 5G development and as a result the 5G Coalition was founded in the summer of 2017 as a professional collaboration forum that currently has 83 member organizations. The goal of the organization consisting of representatives of the market, academia and the state has been for Hungary to become one of the centres of European 5G developments, and for Hungary to be at the forefront of the world in the field of 5G introduction, dissemination and practical application.

The process of 5G deployment has already started in most European countries as well as in many other parts of the world. The spectrums used for 5G services has been allocated in Hungary to the three major mobile operators in the country (Magyar Telekom, Telenor and Vodafone).

Vodafone was the first operator to launch its 5G service in Hungary in 2019. This took place in the 9th district in Budapest, close to Vodafone's Hungarian head office, by the installation of 33 permanent, live 5G base stations.[140] In 2020 Telekom has also launched its commercial 5G service. At the time of launch, the service was available in certain parts of central Budapest, the downtown of

[139] https://data.consilium.europa.eu/doc/document/ST-10211-2019-ADD-2/en/pdf
[140] Vodafone has launched Hungary's first 5G network (in Hungarian) Vodafone Hungary press release October 18 2019

Zalaegerszeg (town in Western Hungary), and at the Zalaegerszeg ZalaZone automotive test track.[141]

According to the latest DESI report Hungary is 3rd regarding the 5G readiness indicator with 61%. The 5G Coalition aims to make Hungary a major European centre of 5G developments. It should also take the leading role in the region in testing 5G applications. The 5G strategy elaborated on the basis of the proposals of the 5G Coalition has not been adopted by the Hungarian government yet.

The total costs of 5G deployment in Hungary is expected to be around HUF 800 billions (€ 2,3 billions). About HUF 300 bn (€ 860 millions) is expected to be financed by either the Hungarian state or EU funds.[142] The timeline of this big investment is expected to be extended to several years.

[141] Telekom launches commercial 5G service Telekom press releases April 9, 2020
[142] GIGABIT HUNGARY STRATÉGIA 31. Digitális Jólét Fórum (in Hungarian)

4.2. Digital Competencies

4.2.1. Digital Competency in Hungary in light of DESI's Human Capital and Use of Internet Services Dimension

The two indicators of DESI - Human Capital and Use of Internet Services - are, in a sense, about the digital skills of European citizens, and how they can apply those skills. Hungary ranks 19th in the field of Human Capital according to the latest DESI report among the 28 EU countries. In terms of Use of Internet Services Hungary ranks 14th in the latest DESI comparison.

Human Capital

It is a problem in Hungary that only little progress has been made in digital skills and in advanced specialist skills in recent years. At least basic digital skills remained well below the EU average (49% compared to 58% in the EU) and at least basic software skills are also modest. Both are indicators in which Hungary could not improve on, but has actually got worse in the past four years. In both indicators Hungary is better than the EU11 average by about 4 percentage points in case of both at least basic software skills and at least basic digital skills. However, in both cases the EU 11 average has improved over the past 5 years as opposed to Hungary, as can be seen in the illustration showing the rate of change in the sub-dimensions of DESI'S Human Capital dimension.

Only a quarter of the population aged between 16 and 74 has above basic digital skills, below the EU average of 33%. While slightly more than fifth of the EU11 countries have above basic digital skills which is 4 percentage points less than in Hungary.

The ratio of female ICT specialists is very low at only 0.7% of all the female workforce, which is close to half of this same ratio in the EU. Central Eastern European members of the EU have a ratio of 1,05% of ICT specialists among the female workforce, which is 50% higher than this same figure in Hungary. The rate of growth in Hungary is negative in this subdimension -unlike in case of the EU and EU11 averages -, which means that there is less women working as an ICT specialist now than 5 years ago.

		HUN		EU11		EU	
	Sub-Dimensions	**2016**	**2020**	**2016**	**2020**	**2016**	**2020**
Human Capital	At least basic digital skills	49,52%	48,68%	41,55%	44,69%	55,33%	58,32%
	Above basic digital skills	22,42%	25,36%	17,56%	21,01%	28,23%	33,31%
	At least basic software skills	52,12%	50,62%	44,30%	46,93%	58,69%	60,57%
	ICT specialists	3,50%	3,70%	2,54%	3,08%	3,40%	3,90%
	Female ICT specialists	0,89%	0,70%	0,85%	1,05%	1,19%	1,39%
	ICT graduates	2,90%	4,30%	1,52%	4,22%		3,60%

Illustration 107 Comparison of Human Capital Sub-Dimensions of DESI

ICT specialists account for a slightly lower ratio of the workforce as in the rest of the EU (3.7% compared to 3.9% in the EU). Hungary is above the EU11's average in terms of ICT specialists where this figure is only 3,08% of the total employees.

In Hungary 4.3% of graduates study ICT, which exceeds the EU average by 20%, where the percentage of ICT graduates among the total graduates is only 3.6%. This sub-dimension is only slightly higher in Hungary than in EU11 countries where the ratio of ICT graduates is 4,22%, which is also higher than in the whole of the EU.

	Sub-Dimensions Rate of Change (2020/2016)	**HUN**	**EU11**	**EU**
Human Capital	At least basic digital skills	-2%	8%	5%
	Above basic digital skills	13%	20%	18%
	At least basic software skills	-3%	6%	3%
	ICT specialists	6%	21%	15%
	Female ICT specialists	-22%	23%	16%
	ICT graduates	48%	179%	n/a

Illustration 108 Comparison of the Development of Human Capital Sub-Dimensions of DESI

Use of Internet Services

This year's DESI report shows that Hungary is at 14th place in the field of Internet use, lagging behind the EU average (almost 80% of individuals are Internet users in the examined age group of 16-74 used by this DESI sub-dimension). The reasons for the 14th place are, among other things, the higher proportion of those who have never used the Internet compared to the EU average. In Hungary those who have never used the Internet in their entire life make up around 14% of the population, which is significantly higher than in the EU states, where slightly less than 10% of people have never used the Internet. In this subdimension Hungary is slightly better than the EU11 countries' average, where a bit more than 15% of the population has never used the Internet. Comparing these three figures – the EU average, EU11 average and Hungary – the EU average has the fastest rate of decrease, even though the EU average has started from the lowest level of all the figures examined. The rate of change is the slowest in Hungary with a figure of -33% during the last four years.

According to the dimension of Use of Internet services Hungary and the EU11 countries are below the EU average when it comes to banking, shopping, selling online or doing online courses. In all these sub-dimensions Hungary is above the EU11 average but below the EU average of all member states. The growth rate in these subdimensions are more varied, and does not show any pattern, for example the sub-dimension of selling online has decreased in each three examined cases: by 35% in Hungary, while in case of the EU and EU11 average by 13% and 3% respectively.

		HUN		EU11		EU	
	Sub-Dimensions	**2016**	**2020**	**2016**	**2020**	**2016**	**2020**
Use of internet services	People who have never used the internet	21,17%	14,25%	25,39%	15,42%	16,44%	9,45%
	Internet users	71,59%	79,91%	64,73%	77,55%	76,43%	85,26%
	News	85,72%	83,53%	74,00%	74,42%	68,26%	72,16%
	Music, videos and games	n/a	82,37%	n/a	72,61%	n/a	80,60%
	Video on demand	n/a	11,01%	n/a	13,12%	n/a	31,08%
	Video calls	54,72%	75,47%	47,05%	64,41%	36,72%	59,78%
	Social networks	83,40%	85,67%	66,92%	72,80%	62,94%	64,91%
	Doing an online course	3,92%	6,96%	4,77%	6,14%	7,29%	11,17%
	Banking	46,41%	58,11%	39,92%	50,34%	57,32%	65,99%
	Shopping	47,16%	59,46%	44,07%	56,26%	65,26%	71,46%
	Selling online	25,28%	16,46%	16,39%	14,34%	23,37%	22,60%

Illustration 109 Comparison of Use of Internet Services Sub-Dimensions of DESI

While a group of sub-dimensions show an EU11 advantage over the EU as a whole, and within the EU11 Hungary even has an advantage over these newly joined 11 European Union member states. These sub-dimensions are the usage of social networks, video calls, and consuming news on the Internet. In all these three areas Hungary has the advantage both over the EU11 and the EU averages. The growth rate is more varied in this case as well. Hungary actually has a negative growth rate in case of the online news consumption, while the EU average shows the highest, if still modest growth rate of 6% over the last four years. The usage of video calls is dynamically increasing in the EU11 countries (an EU11 average of 37% is almost equals Hungary's 38%), however the growth of the EU average (63%) is almost the double of the Hungarian and EU11 figures.

	Sub-Dimensions Rate of Change (2020/2016)	HUN	EU11	EU
Use of internet services	People who have never used the internet	-33%	-39%	-43%
	Internet users	12%	20%	12%
	News	-3%	1%	6%
	Music, videos and games	n/a	n/a	n/a
	Video on demand	n/a	n/a	n/a
	Video calls	38%	37%	63%
	Social networks	3%	9%	3%
	Doing an online course	78%	29%	53%
	Banking	25%	26%	15%
	Shopping	26%	28%	10%
	Selling online	-35%	-13%	-3%

Illustration 110 Comparison of Development of Use of Internet Services Sub-Dimensions of DESI

4.2.2. Digital Education Strategy

The Digital Education Strategy, which was launchedin 2016 by a Government decision[143], and has covered all levels of the education system, including public education, vocational training, higher education and lifelong learning.

Digital Education Strategy has aimed to improve the digital infrastructure of the schools in Hungary. The major goal in this area has been the digital upgrade in state schools to ensure at least 100 Mbps broadband for schools with less than 500 students. More than 75% of this project has been completed so far.The rest of the schools - with more than 500 students - has been designated to receive 1 Gbps connectivity , and almost 25% of these schools has already been installed with such a fast connection.[144] The improvement of broadband infrastructure indirectly also helps improve digital competence in the education system, since it means faster access to Internet in more schools, and pupils can receive a better education in ICT skills as a result.

Other important goals of the Digital Education Strategy include:

- Vocational training institutions should have the required modern IT tools to support the education (not just digital education)
- Teachers and vocational instructors should have necessary technical knowledge and methodological competencies for digital education.
- Teachers and vocational instructors must become committed towards the direction of digital education.

4.2.3. Digital Workforce Program

The Digital Workforce Programme was launched[145] in 2018. The need for this program was justified by the fact that lack of digitally prepared employees is becoming increasingly critical for the competitiveness of the Hungarian economy and enterprises. For a long time now, it has been necessary to replace the missing

[143] http://njt.hu/cgi_bin/njt_doc.cgi?docid=197804.327718
[144] Digital Economy and Society Index (DESI) 2020; Hungary
[145] Government decision 1456/2016 (VII.19)
https://net.jogtar.hu/jogszabaly?docid=A17H1456.KOR&txtreferer=0000 (in Hungarian)

22 thousand IT professionals[146]. Without this the technological development of Hungarian small and medium enterprises (SME), the attraction of new investors to Hungary, or even the retention of existing ones can be a growing problem.

The strategic goal of creating the labour market conditions for the digital economy is to introduce lifelong learning. In order to significantly increase the proportion of employees with high-level digital competencies in non-IT professions as well, the number and output of other vocational trainings based on the use of IT solutions must be increased by a significant amount. To achieve this the following measures have to be taken:

- In order to remain competitive, at least the EU average (10%) in knowledge renewal must be reached, which presupposes the annual retraining or further training of at least 500,000 people, compared to the current 165,000;
- It is necessary to strengthen the emergence of technology-intensive, digitalisation-related professions, training forms and channels in the adult education structure by all available means;
- It is important to address the retraining and further training of the inactive and the employed, which emphasizes the training that can be carried out in addition to work.

The Digital Workforce Program aims to contribute both to alleviating the chronic IT gap and to increase the proportion of non-IT workers with high digital skills.

First the emphasis should be on short-cycle, non-traditional IT training programs. In order to solve the problems described above, in order to preserve the competitiveness of Hungary's national economy and to meet the IT labour needs of foreign enterprises and bigger domestic companies as well as SMEs, at least another 20,000 IT specialists must be trained within 3 years.

In parallel, the capacity and content of traditional training systems need to be expanded. In addition to significantly increasing the capacity of traditional training systems, there is a need to develop alternative training pathways that provide the digital economy with a workforce with IT and digital skills.

[146] http://ivsz.hu/projektek/kutatas-az-informatikus-munkaerohianyrol/ (in Hungarian)

Other important goals of the Digital Workforce Program[147] are the following:

- short-cycle general IT training programs should be launched for those who want to complete IT training in addition to their existing job or for reasons other than employment;
- the range of applicants for IT trainings should be expanded by developing a co-financed, employment-embedded training program;
- a program should be launched that links short-cycle training directly to employment, so it can help those who have dropped out of higher education for various reasons or have changed careers;
- development of parallel models for demand-driven training content development is needed, recognition and certification models should also be created for these;
- the development of regulations ensuring the increased volume of trainings in 'e-learning' is needed, which allows for simplified accreditation for short-term, labor market-relevant trainings
- a state scholarship system for students admitted to the field of ICT education should be developed and implemented and the number of students in IT courses dropping out must be reduced.

Apart from the specific goals set out in the Digital Workforce Program, it also includes a plan[148] to set up a

- Measurement, monitoring and forecasting system which should be able to forecast and monitor the needs of the Hungarian Workforce in the area of digital competencies. Based on efficient monitoring and forecasting system the necessary measures should be determined as a result.
- Incentive scheme that creates opportunities for a significant number of disadvantaged citizens to participate in trainings that provide skills needed for high-income jobs

[147] https://digitalisjoletprogram.hu/files/2e/86/2e865bc650f57539da2dbccf7b169eda.pdf (Page 9 in Hungarian)
[148] https://digitalisjoletprogram.hu/files/2e/86/2e865bc650f57539da2dbccf7b169eda.pdf (page 17-18 in Hungarian)

4.3. Digital Economy

4.3.1. Digital Economy in Hungary in light of DESI's Integration of Technology Dimension

Hungary remained one of the worst performing EU countries in the Integration of Technology in businesses, as it ranks 26th in the latest DESi report. ICT adoption is low across all indicators measured in this area.

Only 6% of companies rely on big data solutions (12% in the EU and 9% in the EU11) and 11% use cloud computing (18% in the EU and 10% in the EU11).

Domestic SMEs do not take advantage of e-commerce to sell their products online either at home or in foreign markets. In 2020, only 12% of SMEs sold online, a proportion that has increased only 24% in the last four years. As a result Hungary is behind both the EU 11 and the EU average as well in this sub-dimension.

Among the five DESI dimensions examined this is the one where Hungary performed the worst. In all but two sub-dimensions (cloud computing and e-commerce turnover) Hungary is way below the EU average, and even below the EU11 average.

		HUN		EU11		EU	
		2016	**2020**	**2016**	**2020**	**2016**	**2020**
Integration of Technology	Electronic information sharing	16,02%	14,33%	23,38%	27,55%	n/a	34,41%
	Social media	11,35%	11,76%	9,37%	14,27%	17,75%	25,17%
	Big data	n/a	6,17%	n/a	8,69%	n/a	12,26%
	Cloud	6,12%	11,47%	5,55%	9,92%	n/a	17,85%
	SMEs selling online	10,03%	12,46%	11,17%	14,42%	16,16%	17,53%
	e-Commerce turnover	7,01%	10,93%	4,97%	6,07%	9,36%	11,09%
	Selling online cross-border	4,46%	5,22%	4,91%	6,97%	7,52%	8,38%

Illustration 111 Comparison of Integration of Technology Sub-Dimensions of DESI

Selling cross-border is also a sub-dimension where Hungary is not just well below the EU average, but is even below the EU11 average. It may be an even bigger cause for concern that among all the five sub-dimensions where Hungary performed the poorest, the country's growth rate over the last four years has been quite low compared to the EU11 especially. In four cases of these five sub-dimensions Hungary's growth rate is lower than the EU 11 averages (there is no data for the fifth sub-dimension of big data usage)

	Sub-Dimensions Rate of Change (2020/2016)	HUN	EU11	EU
Integration of Technology	Electronic information sharing	-11%	18%	n/a
	Social media	4%	52%	42%
	Big data	n/a	n/a	n/a
	Cloud	87%	79%	n/a
	SMEs selling online	24%	29%	8%
	e-Commerce turnover	56%	22%	18%
	Selling online cross-border	17%	42%	11%

Illustration 112 Comparison of the Development Integration of Technology Sub-Dimensions of DESI

Most businesses, especially SMEs, still do not take advantage of digital technologies. It is, therefore, essential to continue to raise awareness and further develop funding programmes.

Digitization brings tangible results for businesses in terms of competitiveness, efficiency and growth potential, but to achieve this, businesses must first recognize the need for change. However, this has clearly not happened so far in Hungary: the DESI index is the weakest in the dimensions that would be needed for the digital transformation of enterprises, so the Hungarian lag is significant in terms of both employees' digital competencies and the integration of digital technology.

Unfortunately, among the DESI indicators, Hungary is one of the worst EU countries in the field of business integration of digital technologies. The low level

of digital development of enterprises poses an increasing threat to Hungarian competitiveness.

4.3.2. Digital commerce and accessibility

Within the framework of the EU Digital Single Market initiative, the increase of domestic and cross-border trade has been formulated as a political goal, which poses opportunities, but also a danger for Hungarian companies. Internet commerce and online sales of services on the supply side allow for more efficient, competitive operation while providing access to a larger market. On the demand side, it primarily means convenience, affordable and home-delivered products, and a larger supply, so its widespread use increases the quality of life.

In 2015, the net turnover of Hungarian online trade was HUF 319 billion, and the share of turnover in total trade was 4.1%[149]. In 2019 it was HUF 625 billion, and its share of the total trade was 6,3%. The yearly growth rate of online trade was 18%.[150]

The DWP suggests the following steps in relation to digital commerce and accessibility[151]

- Already operating digital trade and service transactions which favorable for the Hungarian economy, as well as the development of trade / service units operated from Hungary at the international level should be strengthened and supported
- Administrative burdens on digital commerce should be reduced
- The justification for the surcharge applied by many service providers for electronically supplied services (justified by convenience by the service providers) should be examined

[149] https://digitalisjoletprogram.hu/files/58/f4/58f45e44c4ebd9e53f82f56d5f44c824.pdf (page 93 in Hungarian)
[150] https://minner.hu/e-kereskedelem-statisztikak-2019/ (in Hungarian)
[151] https://digitalisjoletprogram.hu/files/58/f4/58f45e44c4ebd9e53f82f56d5f44c824.pdf (page 94 in Hungarian)

4.3.3. Sharing Economy

Sharing-based businesses already existed in the second half of the ’90s, and over the course of a few years, they significantly changed entire industries and consumer habits. The sharing of consumer goods through internet applications has become a symbolic element of the whole digital transformation as it creates new forms of employment and new value chains. The essence of the sharing economy is that users share with each other:

- their unused capacities and resources (eg tangible assets, services, money);
- on-demand (immediately as demand arises), usually via an IT platform;
- on a trust basis, attaching special importance to personal interaction and community experience;

In Hungary it affects the same industries as it does around the world: transport, distribution of durable goods, accommodation, real estate market , labour and intellectual capital, financial services, copyright. 22% of Hungarian Internet users participate in the sharing economy, which means approximately one million people.[152]

In connection with the sharing economy, the DWP has set the following general goals[153]:

- International good practices and examples and their applicability in Hungary should be followed up and examined.
- Employees should be prepared for the digital transformation (and possible involvement in sharing economy).
- Domestic enterprises, especially SMEs, must be helped to prepare for the digital transformation (and possible involvement in sharing economy).
- The creation and encouragement of innovative business and technological solutions should be supported.

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152 152
https://digitalisjoletprogram.hu/files/58/f4/58f45e44c4ebd9e53f82f56d5f44c824.pdf (page 92 in Hungarian)

153 https://digitalisjoletprogram.hu/files/58/f4/58f45e44c4ebd9e53f82f56d5f44c824.pdf (page 91 in Hungarian)

4.3.4. Industry 4.0

Industry 4.0 describes the organization of production processes in which devices communicate independently with each other along a value chain: creating a "smart" factory of the future in which computer-controlled systems monitor physical processes, create virtual replicas of physical reality and make decentralized decisions based on self-organizing mechanisms.[154]

An effective digital restructuring of Hungarian industry has a potential to contribute to digitization of enterprises in the country. Against this background, the Hungarian government and manufacturing industry identified the following objectives[155]:

- increase the level of R&D expenditures to 1.8% of the GDP
- increase the industrial output-to GDP ratio from the current 23.5% to 30%
- decrease standardized low-skill activities
- increase high-skill activities, embracing planning, control and IT related tasks
- reinforce the growth, export and innovation potential of the domestic companies

4.3.5. Digital Health

Although there has been a significant improvement in life expectancy in recent years, the health outlook remains unfavorable, making Hungary one of the countries in the EU with the worst health status and the highest avoidable mortality rate.

Unfortunately, despite the tremendous technological and scientific development of the last decades, there has been little change in the lifestyle of the population.

[154] https://www.ipar4.hu/page/ipari-forradalmak-ipar-4-0 (in Hungarian)
[155] https://ec.europa.eu/growth/tools-databases/dem/monitor/sites/default/files/DTM_IPAR_HU_v4.pdf

Although most people are aware of a lifestyle that is detrimental to their health, they do little about it.

The DWP[156] has set out the following goals for the area of Digital Health

- Today, body weight, body composition, daily physical activity, heart rate, blood pressure and blood sugar, proper posture, blood alcohol level can all be measured with smart devices that use wireless technologies to transmit data to mobile phones or Internet databases. The use of these smart soultions should be supported among all segments of the population.
- In order to carry out a data-based systematic quality review of the health care system, a quality control and accountability system needs to be developed that harmonizes with funding and regulatory systems.
- Digital solutions should be introduced to support the social care of elderly people

4.3.6. Supporting the Digital Developments of SMEs Operating in the Central Hungarian Region

The concept of small and medium-sized enterprises which account for 99.8% of Hungarian companies, covers a very wide range, but at the same time includes enterprises at a great distance from each other in terms of organization, capital strength, number of employees and turnover. Statistically (and in terms of EU development funds / aids), a small commercial enterprise with a few employees and a turnover of HUF 10 million is an SME, as is a manufacturing company with 200 employees and a turnover of over HUF 10 billion. The average Hungarian entrepreneur is the founder and at the same time the leader of a company that employs less than 10 people and has an expected turnover of around HUF 70 million.[157]

[156] https://digitalisjoletprogram.hu/files/58/f4/58f45e44c4ebd9e53f82f56d5f44c824.pdf (page 80 in Hungarian)
[157] https://digitalisjoletprogram.hu/files/58/f4/58f45e44c4ebd9e53f82f56d5f44c824.pdf (page 74 in Hungarian)

Even though more than 99% of Hungarian companies are SMEs they only employ 69% of the workforce and account for 54% of the value added created.[158]

Special attention should be paid to supporting the digital developments of SMEs operating in the Central Hungarian Region, which is regularly excluded from EU-funded developments. In order to increase the digital awareness of SMEs operating in the Central Hungarian Region and to support ICT developments it is necessary to develop targeted programs from domestic sources. The DWP[159] suggests the following steps:

- Awareness and the openness of company managers should be raised concerning digitization of the economy
- The development and publishing of relevant online content on digitization is needed for micro-enterprises

158 https://www.kormany.hu/download/5/f7/b1000/KKV_Strategia.pdf#!DocumentBrowse (page 26 in Hungarian)

159 https://digitalisjoletprogram.hu/files/58/f4/58f45e44c4ebd9e53f82f56d5f44c824.pdf (page 77 in Hungarian)

4.4. Digital State

4.4.1. Digital State in Hungary in light of DESI's Digital Public Service Dimension

DESI indicators show that Hungary still lags behind the EU average, even the EU11 average in terms of Digital Public Services. Hungary still ranks as low as 24th.

		HUN		EU11		EU	
		2016	**2020**	**2016**	**2020**	**2016**	**2020**
Digital Public Service	e-Government users	41,01%	55,16%	55,83%	61,92%	57,05%	67,31%
	Pre-filled forms	19	41,75	37,55693	45,02377	48,6922	59,375
	Online service completion	54,7143	86,75	69,1493	82,66497	80,7466	89,75
	Digital public services for businesses	57,568	85,31	62,04816	74,95029	76,8313	87,6315
	Open data	n/a	32%	2%	63%	n/a	66%

Illustration 113 Comparison of Digital Publis Services Sub-Dimensions of DESI

Digital Public Services have been one of the most challenging areas of the digital economy and society in Hungary. In three of the five sub-dimensions (e-government users, pre-filled forms and. open data) Hungary is ranked not only below the EU, but also below the EU11 average. The scores for online service completion and for digital public services for businesses are above the EU11 average and just below the EU average.

It is an encouraging sign that in all four sub-dimensions where data is available Hungary has had a faster growth rate than the EU and the EU11 averages. Hungary especially achieved high growth rates over the last four years in the areas of pre-filled forms (120%), online service completion (59%) and digital public services for businesses (48%). This shows that Hungary may have started a catching up process in these sub-dimensions.

	Sub-Dimensions Rate of Change (2020/2016)	HUN	EU11	EU
Digital Public Service	e-Government users	34%	11%	18%
	Pre-filled forms	120%	20%	22%
	Online service completion	59%	20%	11%
	Digital public services for businesses	48%	21%	14%
	Open data	n/a	3762%	n/a

Illustration 114 Comparison of of the Dewvelopment of Digital Publis Services Sub-Dimensions of DESI

4.4.2. Digital Administration

Under the digital state pillar, the DWP [160] cannot undertake the digital transformation of the entire administration, but seeks to formulate proposals in some areas that make the digital accessibility of public services tangible in terms of digital welfare.

The importance of digital administration is twofold:

1. Cost-effective development of public administration is inconceivable without the development of digital public administration processes and services.
2. The digitalisation of public administration has repercussions for society: those with digital competences will be able to manage their affairs more efficiently, thus further increasing their advantage over digitally under-educated or unskilled groups in society.

Current digital public administration developments typically focus on streamlining processes, simplifying processes, and the technical improvements, software, and hardware that serve them. In the case of projects, the aspects of two actors are essential: that of the citizen for whom the system is available and that of the clerk who has to work with the system.

Hungarian public administration development - primarily organizational transformation - does not necessarily follow the directions set out in the strategies. This is particularly evident in the field of digital administration, where there are

[160] https://digitalisjoletprogram.hu/hu/tartalom/djp20-strategiai-tanulmany (page 99, in Hungarian)

only general directions set out in certain documents and strategies, but there is no document that can be followed with action plans broken down by years. As a result, in the case of implementation institutional strategies, particular interests or individual ideas come to the fore.
The content of e-government strategies is quite general: nor the National Infocommunication Strategy nor any other strategic document contains a specific action plan for e-government. It is also a problem that in the current governmental structure, the area has several owners at the same time.
In practice, the launch of e-government projects was also hindered by the reorganization of the entire state administration and the termination, transformation and merging of potential or previously specifically designated project owners. The reorganization of background institutions has not yet made implementation more efficient. E-government has not become an initiator of change, but a clear follower, continuing to follow the notion that the development of digital public administration can take place as part of the development of the whole public administration.
The government decision defines a specific action plan for the dissemination of open source and open source software within the Hungarian public administration. In order to achieve the goals, another task is to provide support to the software development for SMEs involved in this market.

The major goals defined in DWP[161] for the more efficient operation of the digital state and public administration are the following:

- In the future, the directions of digital public administration development should determine the new models and strategy of public administration development, not the other way around.
- A unified and integrated institutional framework for digital public administration research and development and supervision needs to be established.
- An adult training program should be launched to develop digital administration competence.
- A national campaign should be launched to raise the profile of digital public administration services.

[161] https://digitalisjoletprogram.hu/hu/tartalom/djp20-strategiai-tanulmany (page 100, in Hungarian)

- One of the cornerstones of achieving the IT independence of Hungary, and especially of the government, is that the government should have the appropriate IT competence to introduce, support, further develop and customize open solutions that are also accessible to Hungarian developers.
- An organization should be set up to monitor electronic administration, e-government front office and back office processes, taking into account the current competencies
- Development and launch a digital public education training program is needed

4.5. Conclusions

4.5.1. DESI Indicators and their Progress Over the Last four Years

Among all the DESI dimensions both Hungary and the EU11 countries performed the best in the area of Connectivity. In ths dimension both Hungary and the EU11 countries were on a similar level with the EU in 2016, but over the last four years the EU11 countries got slightly ahead of the EU, and Hungary got ahead of it significantly. This is probably thanks to the large infrastructure deployment programs used to build and upgrade broadband infrstructure financed by EU funds, which are easier to have access to in EU11 countries since their less developed status.

	HUN		EU11		EU		Ranking in the EU	
DESi Dimensions	**2016**	**2020**	**2016**	**2020**	**2016**	**2020**	**2016**	**2020**
Connectivity	34,1	59,8	33,9	51,0	34,1	50,1	17	7
Human Capital	39,5	41,8	34,4	39,3	45,4	49,3	17	19
Use of internet	47,2	55,9	36,6	48,2	46,7	58,0	12	14
Integration of technology	20,1	25,3	22,7	29,9	33,1	41,4	26	26
Digital public services	28,9	57,8	43,9	62,0	54,2	72,0	25	24
DESI (all dimensions)	33,8	47,5	33,7	45,1	41,6	52,6	20	21

Illustration 115 Comparison of DESI-Dimensions

In the dimensions of Human Capital and Use of Internet, Hungary slightly performed poorer than four years ago in 2016, and rcontinously ranked between the 10th and 20th among EU countries. This shows that the Hungarian state

initiatives aimed at improving this dimensions could not achive better results than similar programs in other EU countries, so Hungary has remainned on a similar level to the one it was on in 2016. It is a cause for concern however that in both these dimensions Hungary's growth rate has been lagging behind both the EU11 and the EU countries.

Dimensions Rate of Change (2020/2016)	HUN	EU11	EU
Connectivity	75%	50%	47%
Human Capital	6%	14%	9%
Use of Internet	18%	32%	24%
Integration of Technology	26%	32%	25%
Digital Public Services	100%	41%	33%
DESI	40%	34%	26%

Illustration 116 Comparison of Development of Desi Dimension

The area of Integration of Technology and Digital Public Services where Hungary performs the poorest. In both dimensions Hungary has remained among the most poorly performing 3-4 countries within the EU over the last four years. Encouriging sign in the area of Digital Public Services however that the rate of improvement is well over the EU and EU11 countries.

4.5.2. SWOT Analysis and Goals for the Future

Broad Goals for the Future

The digital transformation will inevitably reach almost all subsystems of the economy and society. In the 21st century, digitalisation is a prerequisite for adapting to changing conditions and recognizing new opportunities. It is no longer a question today that digitalisation is the engine of the economy, with its positive impact in all sectors. Digitalisation increases efficiency, increases prosperity and productivity, and improves competitiveness.

Recognizing the need for digital transformation the NDS[162] strives to make Hungary put the digital economy, digital education, e-government and digital

[162] https://www.kormany.hu/download/f/58/d1000/NDS.pdf (page 104, in Hungarian)

public services at the center of its competitiveness and modernization efforts. In order to support digitization efforts, the Government needs to seek a broad partnership with the European Union, domestic economic actors, non-governmental organizations, education and research actors. The Government also needs to place special emphasis on ensuring that state actors involved in digitization are coordinated and pursue common goals, contribute to the improvement of the country 's digital prosperity by exploiting the synergies on offer. If this attitude is represented by the Government in the long run and consistently and it displays this strategic decision in government communication, operation, resource allocation, economics, research and education, Hungary will be able to catch up in the areas of digitization (especially in case of digital state and digital economy) where it has the biggest lags.

The overall goal of the NDS is for Hungary to make a concerted effort to promote digitalisation in the fields of economy, education, research and development, innovation, and public administration, which will make a significant contribution to improving the country's competitiveness and the well-being of its citizens. It is also important to strengthen the supportive nature of the state and to consistently represent this attitude in the measures needed to be taken.

Specific goals and SWOT analysis

Based on the latest DESI report the NDS has made a SWOT analysis[163] to determine the weaknesses, dangers on the one hand, and the strengths and opportunities on the other hand. This SWOT analysis was made separately for each five DESI dimensions. As well as making a SWOT analys the NDS has also set out some specific goals for each of the specific four pillars of digitaziation.

Digital Infrastructure	
Strengths	**Weaknesses**
• Above-EU average NGA coverage • Ongoing developments of NGA networks • Efficient communications and competition authority • Significant improvement in 4G coverage, increasing amount of data consumed • 5G test networks at mobile operators • Commitment from government and market participants • Further developing existing infrastructure relating to Supercomputing (HPC)	• Low rate of subscriptions with guaranteed bandwidth between 30 and 100 Mbps • Significant lag in mobile broadband penetration • Slow implementation of supported broadband development projects • Legal and other barriers to the telecommunications market remain unresolved (eg use of power lines) • The proportion of settlements that can only be reached by a single optical network is high, so its owner is in a monopol position. • Lagging behind the EU average in terms of 5G commercial service
Opportunities	**Dangers**
• Widespread national infrastructure reduces territorial inequalities, thus promoting equal opportunities • Cheap accessibility for low-download Internet-only subscriptions • High NGA coverage helps the spread of modern technologies, it can lead to increased investments • Facilitating network sharing solutions by domestic mobile operators can accelerate the deployment of 5G, and reduces the network CAPEX and OPEX. • Strengthening cooperation (state, universities, market participants) can lead to coordinated infrastructure developments • Possibility to build (additional) test networks	• Intensive infrastructure developmentcan cause a shortage of specialists (eg suppliers, network designers) • Lack of cooperation (state, universities, market participants) can have a negative impact on developments • Retail demand does not follow supply, network capacity remains unused • CAPEX of 5G networks is high, therefore the initial, investments of the service providers have a high risk • Lack of regulation reduces the incentive to invest in new technologies • • Public distrust of new technology (eg fear of health risks of 5G)

[163] https://www.kormany.hu/download/f/58/d1000/NDS.pdf (page 99, in Hungarian)

The NDS has also suggested several goals that should be reached within the next 5-10 years[164]. In case of the Digital infrastructure dimension these suggestions are the following:

- The proportion of households covered by a gigabit network will reach 95% by 2030 (base indicator is 59,8%)
- The proportion of households covered by the 5G network should reach 75% by 2023, covering the main transport routes and cities (base indicator is 0%)
- Provision of National Telecommunications Backbone endpoints for all district headquarters by 2025 (base indicator is 20%)
- The proportion of public educational institutions with a network connection of at least 1 Gbps bandwidth should be 100% by the end of 2025 (base indicator is 1,3%)
- The national HPC capacity should be 15 Pflops[165] by 2030 (base indicator is 0,45 Pflops)

[164] https://www.kormany.hu/download/f/58/d1000/NDS.pdf (page 106, in Hungarian)
[165] Measurement of computing capacity (FLOPS meaning floating point operations per second; and peta is a number meaning 10^{15}, eg: peta-byte is equal to onemillion gigy-bytes)

Digital Competences	
Strengths	**Weaknesses**
• Full Internet coverage, • High number of Internet users among people aged 16-50 • There are well-functioning digital competency development projects • Number of e-learning based trainings is increasing in all segments (corporate, education, public administration) • NAT [166] contains the knowledge needed to acquire high-level digital skills • The digital infrastructure has improved and the digital equipment of domestic schools has increased • DWP Network coordinated by the Digital Welfare Coordination Center with nationwide coverage of 1681 DWP Points with nearly 2000 DWP Mentors can reach 1 Million citizens	• Digital illiteracy is well above the EU average • Awareness of adult education programs is low • The number of users of digital competence development programs is low • The number of modern digital devices is low in educational institutions, the replacement of oudtated devices is incidental • The awareness and use of teleworking and distance learning opportunities is low • In public education, digital competence is not sufficiently developed in subjects other than digital culture, the expertise of teachers and the equipment are not sufficient, the proportion of independent IT sessions is low.
Opportunities	**Dangers**
• Extending existing good digital education and competency development programs • Greater involvement of the market sector to increase digital competence (private-public cooperation programs) • Extending free labor market entry programs, especially for those over 50 • Increase the number of participants in IT training / vocational training • Digital competence development across the whole spectrum of education can lead to significant capacity building in the labor market • Clearly laid out roles and effective government coordination can help ensure the better use of development resources • With the coordination of the Digital Welfare Coordination Center, the DWP Network can provide thematic digital training for thousands of citizens	• With a lack of support (eg insufficient equipment), the transition to digital education will be delayed • Low willingness to switch due to resistance of teachers / students (low digital competence) • The large number of digitally illiterate people imposes economic burdens on society: (declining employment opportunities, further need to maintain hybrid solutions, slow down the spread of digitally based, cost-effective solutions) • people over 50 will be permanently digitally illiterate, thus reducing their employment prospects • The digitalisation of jobs is faster than digital workforce training • Due to lack of resources (few tools needed for education, incomplete modern knowledge transfer), the labor market value of professionals remains low • The lack of ICT developments in public and higher education institutions causes labor market disadvantages and competitiveness problems

[166] National Core Curriculum

The NDS's suggests the following goals in case of Digital Competences for the future:

- Proportion of those (aged between 16 and 74) without digital skills should fall below 2% by 2030 (base indicator is 14,2%)
- The proportion of regular internet users between the ages of 16-74 should be 100% by 2030 (base indicator is 87%)
- The proportion of graduates in IT higher education on the Bachelor[167] level should be 14% by 2030 (base indicator is 7,56%)

[167] University education in Hungary is divided into Bachelor (3 or 4 years) and Masters level (5 or more years)

Digital Economy	
Strengths	**Weaknesses**
• Existence of long-term overlapping corporate digital development programs • Coverage of broadband infrastructure • Nearly 100% of businesses have an Internet connection • Office IT tools are available • Among entrepreneurs and business employees the use of smartphones and, in the case of the latter, social media is also widespread. • The digital economy accounts for at least 20% of GDP • The "Information and Communication" sector accounted for 8.1% of total R&D expenditures in Hungary in 2018	• Business leaders aren't often open to new solutions • Digital preparedness of companies are very varied, the situation is worst in case of micro-enterprises • Lack of application of new technologies • Low level of online presence and e-commerce • Significant lag in digitization in some sectors (tourism, construction, food industry, retail) • Most ICT enterprises, operate in the Central Hungarian region, however, EU funding sources are typically available outside of this region. • There are too few micro, small and medium-sized enterprises that manufacture hardware and theirr exports are low • During the 2014-2020 EU budgetary period ICT based R&D projects were not a priority in case of EU financed tenders
Opportunities	**Dangers**
• Generational change in businesses helps digitization • As a result of the coronavirus crisis, more and more companies are turning to digitization • Further development and strengthening of the existing digital infrastructure • Continuation of well-functioning development policy programs • Increased and specific support for the digitization of certain sectors • Application of new types of development policy solutions (eg voucher) • Access to direct EU funding (eg. Digital Europe Program[168]) • Greater use of eGovernment opportunities by businesses • Supporting domesticly owned ICT equipment manufacturing	• Business leaders, especially of micro-enterprises, will still not be open to new ICT solutions • As a result of the corona crisis, companies are reluctant to invest resources into digitalisation developments. • The lack of integration of application of new technologies will continue for SMEs • Most companies in Budapest are expected to continue to have difficulty accessing tenders, since Central Hungary recieves very little EU funds • Lagging behind international trends in infocommunication R & D & I • Lack of integration of the Hungarian ICT sphere into the international R & D & I ecosystem

[168] https://ec.europa.eu/digital-single-market/en/europe-investing-digital-digital-europe-programme

The NDS's goals for the future in the area of Digital Economy are the following:

- Proportion of enterprises with integrated (digitized) business processes should exceed 40% by 2030 (base indicator is 13%)
- The proportion of businesses using big data analysis should reach 20% by 2030 (base indicator is 6,17%)
- The share of R&D expenditures in the "Information and Communication" sector as a percentage of total domestic spending should exceed 12% by 2030 (base indicator is 8,1%)

Digital State	
Strengths	**Weaknesses**
• Uniform legal framework • Exisiting, working central services, good practices • Centrally maintained public records • Widely available digital administration options • Skilled workforce - high number of college graduates • Development of e-public services on the customer side • A training system has been established • The foundation of a cross-sectoral e-Health institutional system has been established • High-quality solutions are available in the field of smart city • The information security system of the public administration sector has been established • The implementation of EU regulations has been implemented, the legal environment has been renewed • IT developments receiving government support are tied to security standards	• Outdated local infrastructure and systems • There are a number of obsolete services that do not integrate new building blocks • Low rate of online, structured, data-preloadable forms • Lack of communication in the field of e-government - people are not informed about the existing services and there is no proper education, training • The use of unique, non-standardized developments and island-like solutions is also typical. • High fluctuation in some segments in public administration causes a burden in terms of training; • Low motivation - lack of real career paths, low wages for government employees • Uneven development in both territorial and functional (organizational) terms; • Lack of extension of central services • The utilization of e-Health developments is not sufficient • Cybersecurity capacity building and competence development are needed for publicly used infocommunication systems

Opportunities	Dangers
• With structured online forms, data connections, there would be more opportunities for automation • Applying artificial Intelligence and new technologies • Additional resources for digital public development (eg from the resources of the Digital Europe Program) • Customer demand for expanding e-public services is growing • Experience from previous projects is available • High-level services can also be built on public registers • Utilization of innovative technologies in healthcare is a need supported by all actors affected in E-Health • The basics of data-driven healthcare are in place • Modern intelligent solutions will be applicable in many areas of settlement operation • Development of state-supported cyber security service packages for the SME	• By ongoing paper-based administrative logic, the real benefits of electronicization cannot be reaped • Ignoring EU directions could lead to further lags in an already fast-growing area • In the 2021-2027 EU budgetary period, there not be as much resource for this area as in the previous one • Public services based on outdated technology increase data and information security risk; • Few specialists in public administration due to low wages • Settlements and local governments continue to pursue their own, unified, uncoordinated policy in relation to their digital public services • Gaps in digital literacy for the majority of the population persist and reduce confidence in digital services • The growing backwardness of the SME sector in the field of information security has a negative impact on Hungary's competitiveness

The NDS's suggests the following goals in case of Digital State for the future:

- Users of eGovernment (users submitting formsonline) should reach 90% by 2030 (base indicator is 55%)
- The proportion of individuals using e-health services should exceed 50% by 2030 (base indicator is 7%)

[169]CSIRT: computer security incident response team. CERT: computer emergency response (or readiness) team.

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5. China Hungary cooperation in digital industries

In the Central and Eastern European region, Hungary's bilateral relations to China have been unique in several ways[170]:

- Hungarian government started re-establish relations with China already in 2003, well before the other regional countries.
- Hungarian governments, regardless of political orientation, have been working on developing relations with China for nearly two decades. The change of government in 2010 did not have any negative impact on bilateral ties.
- With 4 billion USD[171], Hungary is the largest recipient of Chinese FDI investment in the region and also serves as a regional hub for some big Chinese companies like Wanhua, Bank of China or Huawei

We will prove that this high-level mature relationship played a significant role in promoting the bilateral cooperation in the telecommunications industry and provides a good starting point to extend the bilateral cooperation to those new areas of digital industries like e-commerce or business digitization which are lagging in Hungary and also to 5G which is a controversial issue in the EU politics and regulation[172], but the Hungarian government sets high priority to it.

We will concentrate on bilateral initiatives and projects for two reasons

- Past experiences show that bilateral cooperation is more effective than multilateral forms like 17+1 cooperation. In multilateral institutions sometimes takes too much time to agree on a common agenda, and there is a risk to invoke the intervention of EU institutions.[173]
- The mature economic and political relationship means that both the Chinese and the Hungarian governments are open to new initiatives coming from the business sector. This setup ensures that the new projects

[170] Ágnes Szunomár, Tamás Peragovics (2019) Hungary: An Assessment of Chinese-Hungarian Economic Relations
[171] Hungarian government estimate
[172] See the chapter on EU regulation of 5G network security
[173] Typical case for that is the Budapest-Beograd railway line

are coming from interested companies, and because of this, they have a higher probability of succeeding.

We will conduct the analysis of the development potential and the possible scenarios of bilateral relations in digital industries in three points:

- Lessons from the development of bilateral cooperation in the telecommunication industry in the period 2003-2019
- Managing 5G network security issues by the Hungarian government
- Future development potential of cooperation in digital industries based on the interviews with market players and observers

5.1. Lessons from the development of bilateral cooperation in the telecommunication industry in the period 2003-2019

The starting point of re-establishing political and economic relations with China was the visit of the Hungarian Prime Minister, Peter Medgyessy, in 2003, one year before Hungary entered the European Union. This visit was a breakthrough and has created interest in the bilateral relations among the business companies as well.

Around 2003 the leading Chinese telecommunication equipment vendors Huawei and ZTE have already established their European representative offices, and they also had the first commercial contacts with pan-European companies like British telecom or Telefonica. Although they have got very little information on the Central European markets, the publicity around the Prime Minister's visit has raised their interest in Hungary.

In the next two years, the Hungarian and Chinese government ministries played a major role in organizing visits, business forums and exchange of information for business companies[174]

[174] Between 2004 and 2010 the author as a government official personally took part in the organisation of these events.

- In October 2004 a Hungarian-Chinese Telecommunications Business Forum was organized with the participation of all important market player from both countries
- In January 2005 the Minister responsible for information and communication industry headed a big industrial delegation visiting among others the headquarters of Huawei and ZTE in Shenzhen
- In September 2005 the new prime Minister Ferenc Gyurcsány visited China strengthening the political relations and reconfirming the Hungarian government's interest in developing business cooperation in the infocommunications industry
- In October 2005, a Hungarian Information Technology Center (HTEC) was opened [175] in Shenzhen. The facility, located in Shenzhen, was intended to give a boost to bilateral cooperation, and familiarize the Chinese partners with the Hungarian infocommunications industry.

Huawei immediately responded and quickly benefited from these new business opportunities:

- **2005** Setting up a local office in Hungary
- **2007** Exclusive mobile network equipment supplier for Vodafone Hungary the third mobile operator in the country with three million subscribers
- **2009** Exclusive optical fiber network supplier for Magyar Telekom the leader on the telecom services market
- **2010** Starting of trial operations for Huawei's Europe Supply Center in Hungary
- **2013** Strategic Partnership Agreement between the Hungarian government and Huawei
- **2013** Opening of Huawei's Logistic Center in Hungary

[175] Hungary to open technology center in China Budapest Business Journal, October 7, 2005,

At present, Huawei employs 330 people directly and over 2000 outsourced employees, mainly working at its European Supply Center and European Logistics Center in the country.[176] The sales revenue of Huawei Hungary in 2018 amounted to 280 million USD, an 40% increase compared to the previous year.[177]

ZTE has got similar business development:

- **2005** Setting up a local office in Hungary
- **2005** Exclusive equipment supplier to ACTEL a small business communications service provider
- **2010** Exclusive mobile network equipment supplier for Telenor Hungary[178] the second mobile operator in the country with three million subscribers

According to the latest information,[179] ZTE Hungary employs 120 people in its local office in Budapest.

As we can see from the above time-table, both Huawei's and ZTE's growth in the Hungarian market was gradual but fast. Quite unexpectedly, in 3-5 years, they achieved a breakthrough; they have signed an exclusive supplier's agreement with the leading mobile operators in Hungary.

According to the author, there is an essential lesson from the above development, which is worth considering by the other Chinese digital companies as well.

- Hungary was an excellent entry point for Chinese telecom companies to the EU markets. In 2004 Huawei had got only the first contracts in European countries (Telfort in Holland, British Telecom in the United Kingdom). Still, because of a lack of brand names, they had got competitive disadvantage compared to the leading EU vendors like Ericsson or Nokia. Other pan-European EU telecom service suppliers,

[176] A European hub in Hungary
[177] Huawei blog February 2 2019
[178] Telenor Hungary selects ZTE to build LTE network
[179] Data from 2016

like Deutsche Telekom or Vodafone,[180] were interested in Huawei's products, but they were afraid to use them in their core Western European markets. A Central European market like Hungary was a testing ground for them to gather some experience with this vendor without taking too much risk. After these successful trials in the following years, both Telekom and Vodafone were happy to use Huawei's equipment in the more developed and demanding markets. Telenor's choice of selecting of ZTE's 3G and 4G mobile network systems followed the same pattern. Telenor Group is present in many EU countries, but Hungary was the first member country where it started to use ZTE equipment.

Chinese fintech companies, IoT companies, or cloud service companies can follow the example of Huawei or ZTE. They can also take Hungary as an entry and reference point for the European markets. This business plan can be implemented in two alternative scenarios

- They can approach and sign a contract with a pan-European company's Hungarian subsidiary. The Hungarian manufacturing and banking sector is also dominated by big European multinationals (for instance, Volkswagen, Mercedes or Bosch in manufacturing, Unicredit, Erste, Aegon in the financial industry) like the telecommunications sector. A successful reference project with these big firms can serve as a first step in the European expansion plans, with or without the original partner.

- Another potential business partner for them can be a Chinese multinational company located in Hungary. As I have mentioned before, in 2003, the Bank of China has set up its regional hub in Hungary. In 2010 Wanhua has acquired a prominent local firm, and since then, it operates its European headquarters in Hungary. Delivering digital solutions for these firms can serve not only as a reference but also as a learning project on how to accommodate the sophisticated data protection and network security rules of the European Union.[181]

[180] Since the late nineties the Hungarian telecom service market is dominated by three pan-European companies Deutsche Telekom,,Telenor and Vodafone

[181] As I have mention in the chapter on this topic the same rules apply to all EU member country.

A good example of the second option is the strategic cooperation agreement signed on July 29, 2016, by Wanhua-BorsodChem and Huawei. According to the agreement, "Wanhua will be establishing its regional infocommunications center in Hungary. Cooperation between the two Chinese companies will introduce state-of-the-art production technology based on big-data, cloud-based technology, and communication between machines, the so-called fourth industrial revolution, in the region."[182]

5.2. Managing 5G network security issues by the Hungarian government

For the Hungarian Government, the implementation of a 5G mobile network was always a strategic priority. In its "Digital Welfare Programme 2.0" [183] the government identified three major objectives for 5G development:

- Hungary to become a European hub for 5G developments by 2018
- Hungary to play a leading regional role in testing applications based on 5G technology
- Hungary to be among the first to adopt 5G technology after 2020.

The 5G coalition with up to 50 Hungarian government institutions, companies, business chambers, universities, research institutes, and professional and civic organizations was also formed mid-June 2017. The 5G Coalition set goals, including drawing up a 5G development strategy and creating a testing environment to give Hungary a say in setting global 5G standards, aiming for the nation to become an early 5G adopter from 2020.[184]

Since two of the three existing mobile networks in Hungary were delivered by Chinese vendors, the Hungarian government was always open to the participation of Chinese companies in the implementation of its 5G strategy.

[182] Huawei and Wanhua-BorsodChem conclude strategic cooperation agreement in Hungary
July 29, 2016
[183]Digital Welfare Programme 2.0. Strategic Study

[184] 5G Observatory – Quarterly Report on Hungary April 14 2020

The implementation of 5G development strategy started in 2019:

- In May 2019, on the occasion of the opening ceremony of the Zala ZONE Automotive Proving Ground, on the test track, Vodafone launched Hungary's first live and permanent 5G base station connected to its network and using its own licensed frequency. As a sole supplier for Vodafone Hungary, the 5G equipment was delivered by Huawei.

- On June 17, the National Media and Infocommunications Authority (NMHH) issued a public consultation[185] on its plans to auction frequency bands[186] for the purpose of supporting the introduction of fifth-generation (5G) mobile technology. The auction was expected late in 2019. All three existing mobile network operators (Magyar Telecom, Telenor, and Vodafone) applied to participate in the auction, but because of legal problems, the procedure was postponed to early 2020.

- On October 17, Vodafone Hungary launched the country's first commercial 5G network. The service was initially available in the inner districts of Budapest and along the Danube. The service provider had a total of 33 permanent, live 5G base stations in the capital.[187]

- The 5G spectrum auction scheduled for the end of March 2020. Despite Covid-19, the process was upheld due to the heavy market interests observed. Magyar Telecom, Vodafone Hungary, and Telenor Hungary won 15-year in the 700 MHz, 2100 MHz, and 3600 MHz bands and acquired usage rights for 128.49 billion HUF (368 million EUR). Magyar Telecom acquired 2×10 MHz in the 700 and 2100 MHz bands and 120 MHz in the 3600 MHz frequencies. Telenor got 2×5 MHz of spectrum in the 700 MHz frequencies and 140 MHz in the 3600 MHz band. Vodafone obtained 2×10 MHz of spectrum in the 700 MHz band, 2×5 MHz in the 2100 MHz band and 50 MHz in the 3600 MHz frequencies.[188]

[185] The gate opens before selling 5G frequencies NMHH press release 17 June 2019
[186] These frequency bands are: 700 MHz, 2.1 GHz, 2.6 GHz and 3.6 GHz
[187] Vodafone has launched Hungary's first 5G network (in Hungarian) Vodafone Hungary press release October 18 2019
[188] 5G Observatory – Quarterly Report on Hungary April 14 2020

- On April 9, Telekom has launched their commercial 5G service. At the time of launch, the service was available in certain parts of downtown Budapest, downtown Zalaegerszeg, and at the Zalaegerszeg ZalaZone automotive test track. Telekom's commercial 5G service is operating within the 3.6 GHz frequency range. Similarly to the 2G, 3G, 4G technologies, Ericsson Hungary was Magyar Telekom's partner in constructing the 5G stations operational upon commercial launch.[189]

Regarding the participation of Chinese suppliers in the implementation of the 5G network, there are two ministerial statements which are worth to analyze:

On November 5, 2019, at the 2nd Hongqiao International Economic Forum in Shanghai, Minister of Foreign Affairs and Trade Péter Szijjártó said: "The fifth-generation (5G) network is being established in Hungary with the involvement of Chinese telecommunications giant Huawei". He also highlighted: "Hungary does not differentiate between enterprises based on nationality; the only condition it sets is that they must conform to our country's laws and regulations."[190]

Two months after the publication of EU's Regulatory Toolbox on 5G Network Security in March 2019, Minister of Innovation and Technology László Palkovics and several senior executives of the Hungarian subsidiary of Huawei Technologies in China discussed the introduction and development of 5G networks in Hungary. On this meeting, the Minister reaffirmed, Hungary is counting on Huawei Technologies to build 5G networks in the future, although the final decision on procurement is obviously not in the hands of the government, but in the hands of the telecommunications operators concerned. In connection with the EU regulation on the 5G network security ha said: "We see and maintain our position so far, which treats cybersecurity, not as a political but as a technology issue. The domestic market remains open to the company's full participation in the domestic deployment of 5G technology."[191]

[189] Telekom launches commercial 5G service Telekom press releases April 9, 2020
[190] The 5G network is being established in Hungary with the involvement of Huawei November 5, 2019,
[191] Hungary relies on Huawei in everything (in Hungarian) March 4 2020

In our opinion, Mr. Palkovics statement fully corresponds to the principles elaborated in the EU toolbox[192]. This document does not name any country or supplier as a target for the regulation. It concentrates on risk assessment methods and provides the choice for the Member States to decide on necessary actions.

Mr. Palkovics's opinion has another interesting aspect. He emphasized that it is up to the mobile service companies to decide whether they employ Chinese equipment or not. Hungary is a special case in the sense that all the local mobile companies are members of a bigger pan-European group. Certain business decisions like large scale purchasing contracts are decided by the international headquarters, not by the management at the local level.

Vodafone Group has 111 million customers across Europe. On February 5, 2020, Nick Read, Vodafone's chief executive has announced that the group is to remove Huawei equipment from the sensitive core parts of its mobile networks across Europe at a cost of €200m (£169m) over the next five years.[193] If implemented, this decision will have a serious negative on Hungary's 5G network development.

In 2018, PPF Group, a Czech conglomerate, agreed to purchase Telenor's assets in Central and Eastern Europe. Following the closing of the transaction, PPF Group became the sole owner of Telenor's assets in Hungary, Bulgaria, Montenegro, and Serbia.[194]

As we mentioned before, at the moment, ZTE is the exclusive network supplier of Telenor Hungary, but after the change of shareholding, the purchasing contract for 5G equipment will be decided at PPF Prague headquarters.

Concluding the analysis of 5G network security issues on the Hungarian market we can state:

- Compared to other central European countries, like Poland and the Czech Republic, the Hungarian government tries to avoid geopolitical

[192] Cybersecurity of 5G networks EU Toolbox of risk mitigating measures NIS Coordination Group 29 January 2020
[193] Vodafone to remove Huawei from core European networks Guardian February 5 2020
[194] PPF Group completes its acquisition of Telenor's telecommunications assets in CEE countries July 31 2018

considerations. Its approach is based on the objective criteria of risk assessment. This opinion enjoys wide-ranging political support; even the opposition parties accept it.

- The government has ambitious development goals. It wants Hungary to be among the first in the EU to adopt 5G technology after 2020. The Chinese vendors like Huawei and ZTE have a strong market position, being the exclusive suppliers of the second and the third mobile service companies on the Hungarian market. This situation provides excellent opportunities for the above two Chinese companies.

- The Hungarian mobile market is dominated by pan-European like Deutsche Telekom, Vodafone od PPF. Their business plans take into account the local conditions, but certain decisions are taken by the international headquarters.

5.3. Future development potential of bilateral cooperation in digital industries based on the interviews with market players and observers

2020 will be an important year in Chinese Hungarian cooperation in digital industries. This year both the EU Commission and the Hungarian government will publish their new digital strategies:

- The new EU program was not published yet, but the Commission has already announced its aim to become a global role model for the digital economy. Europe as a global leader wants to develop digital standards and promote them internationally. This program will be important guidance for the distribution of EU Structural Funds supporting the development of different Member States.

- The experts are already working on the new National Digital Strategy of the Hungarian government[195], which will be approved and published in September 2020. This document also uses the EU's DESI methodology, and even the quantitative targets for 2030 are set according to the DESI dimensions.

[195] National Digital Strategy 2021-2030 Draft for public consultation

In our previous analysis, we have already identified those areas of the Hungarian digital markets, which need the support of, and cooperation with the Chinese digital companies: the development of the 5g mobile networks and the digitization of the business sector. We asked our interviewees what they think about the possibilities of bilateral cooperation in these topics. Seven personal interviews were completed, six with the representatives of Hungarian market players, and one with the former Ambassador of Hungary to the People's Republic of China.

From the Ambassador, we have asked two questions:

- China is ahead of the world in the development of the digital economy. However, the Digital Silk Road has not been given priority neither in Belt Road Initiative nor in 17 + 1 cooperation. Is it expected that this situation will change?
- The EU Commission issued a recommendation in January this year to address 5G network security issues. This regulation is based on different principles than the US approach it reflects the softer position of German political leadership. In the light of political developments in recent months, is it expected that the tougher American position will prevail again?

According to the Ambassador, cooperation with China in the digital economy is a politically sensitive issue, which should be handled with care. The Hungarian decision-makers have to understand this, and instead of multilateral platforms like BRI or 17+1 cooperation, they should concentrate on bilateral cooperation.

Answering on the second question he expects that US pressure on Central and Eastern European countries will continue. US's objective is to completely exclude the Chinese vendors from the implementation of 5G networks. Because of this pressure, the Hungarian need not change our present position. We can cooperate with Chinese vendors if we implement the necessary security measures.

From the representatives of the mobile service companies (Vodafone Hungary, Telenor Hungary) we asked:

- What were their experiences working with Chinese suppliers in the past? Were they satisfied with their technical level and the cooperation attitude?

- Do they intend to continue the cooperation with Chinese vendors in implementing their 5G network too?

Both companies have a positive experience working with Chinese vendors: they were quick in addressing problems; their technical level did not cause any problem. Regarding the 5G network, Telenor did not select its supplier yet. They asked for proposals from the two Chinese vendors too, and the decision can be expected in the near future. Vodafone Hungary has a very good relationship with Huawei; its 5G commercial service is based on Huawei's equipment. They are aware of EU's recommendation on 5G network security; if the Vodafone Group headquarters request any change, they will follow their guidance.

We have also met with the representative of Huawei Hungary and asked them about their expectations on the perspectives of 5G development in Hungary. They have frequent consultations both with the government and mobile companies, and based on these meetings, they are optimistic about the future.

Both Huawei and ZTE are market leaders not only on mobile network equipment but also on fixed network equipment markets (optical fibers etc.) We also interviewed the representatives of two small fixed network service providers (MVM-NET, Invitech) about their experience with the Chinese vendors. In recent years both Hungarian companies have completed big investment projects financed partly by EU Structural Funds partly by their own financial resources. They relied on the supplies of Chinese vendors, and they were very satisfied with their services. They expressed concerns about a new EU network security regulation of critical infrastructures. [196] Any restriction on the Chinese equipment in their networks could cause a big increase of their investment costs.

Finally, we also selected a typical Hungarian digital company for an in-depth interview. "E-Group's product range offers innovative data management, data security, cryptographic and transactional solutions for various industries, like the health, financial, and energy and government sectors."[197]

E-Group worked with major Chinese companies and has opened a representative office in the region. Their experience with Chinese partners was mixed. They had

[196] EU Commission is working on the amendment of Cybersecurity Act.
[197] E-Group's website

some very successful projects in Hungary, like the China UnionPay Gateway[198]. In this project, E-Group was the strategic partner of China UnionPay to operate a regional payment gateway to cover Central Europe and the Balkans area. The negative experience comes from some recent ongoing projects, where the Chinese partners were too cautious, tried to avoid business risks, and as a consequence, the progress is slow, below expectations.

We can conclude the results of personal interviews as

- Huawei and ZTE, the two Chinese companies that are present in the Hungarian market for many years, have very good reputations among their Hungarian partners. The Hungarian companies are afraid of some potential EU restrictions, which can negatively impact their operations.
- Vodafone and Telenor, the two Hungarian mobile companies who use Chinese equipment in their present mobile networks, are keen to preserve this relationship and want to rely on these Chinese companies to implement their 5g network too. Some decisions are still under review; the final contracts can be signed by the end of 2020
- Unfortunately were not able to conduct many interviews with companies specialized on data management, data security or fintech services. This market has a huge development potential, but it was not decided whether the Chinese digital companies will play a significant role in it.

[198] E-Group Transactions and Records China UnionPay Gateway

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