

## OPPORTUNITIES FOR IMPLEMENTATION OF INTELLIGENT SYSTEMS FOR THE DEVELOPMENT OF THE SETTLEMENTS IN BULGARIA

Kamen Petrov<sup>1</sup>

<sup>1</sup>E-mail: kpetrov@unwe.bg

### **Abstract**

This report is dedicated to intelligent territorial management systems, which are increasingly used in urban governance with the introduction of the term "smart city". In this presentation, we present a new approach to implementing smart governance systems in the form of a smart region. The exhibition examines the possibilities for applying smart approaches to the development of the territory and improving the spatial development of the administrative-territorial units in Bulgaria. An attempt has been made to analyze and compare smart policies in the European area and their implementation in our country. The main trends and opportunities for smart management of the regions in Bulgaria are outlined.

**Key words:** smart region, regional development, governance, territory, system, city, space

### **Abstrakt**

Dieser Bericht ist intelligenten territorialen Verwaltungssystemen gewidmet, die mit der Einführung des Begriffs "Smart City" zunehmend in der städtischen Verwaltung eingesetzt werden. In dieser Präsentation stellen wir einen neuen Ansatz zur Umsetzung intelligenter Verwaltungssysteme in Form einer intelligenten Region vor. Die Ausstellung untersucht die Möglichkeiten für die Anwendung von smarten Ansätzen zur Entwicklung des Territoriums und zur Verbesserung der räumlichen Entwicklung der administrativ-territorialen Einheiten in Bulgarien. Es wurde der Versuch unternommen, intelligente Politiken im europäischen Raum und ihre Umsetzung in unserem Land zu analysieren und zu vergleichen. Die wichtigsten Trends und Möglichkeiten für eine intelligente Verwaltung der Regionen in Bulgarien werden skizziert.

**Stichworte:** intelligente region, regionale entwicklung, governance, gebiet, system, intelligente stadt, raum

### **Résumé**

Ce rapport est consacré aux systèmes intelligents de gestion territoriale, qui sont de plus en plus utilisés dans la gestion urbaine avec l'introduction du terme "ville intelligente". Dans cette présentation, nous introduisons une nouvelle approche de la mise en œuvre de systèmes administratifs intelligents sous la forme d'une région intelligente. L'exposition explore les possibilités d'application d'approches intelligentes au développement du territoire et à l'amélioration du développement spatial des unités administratives-territoriales en Bulgarie. Une tentative a été faite pour analyser et comparer les politiques intelligentes dans l'espace européen et leur mise en œuvre dans notre pays. Les principales tendances et opportunités de la gestion des régions intelligentes en Bulgarie sont décrites.

**Mots clés:** région intelligente, développement régional, gouvernance, territoire, système, ville intelligente, espace.

## Introduction

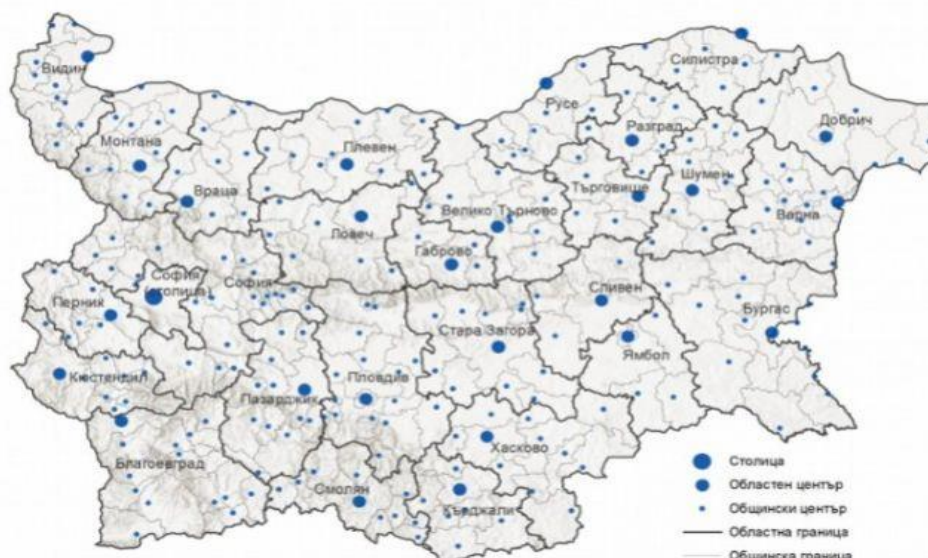
Modern technology is rapidly changing our lives. With the help of a computer you can do literally everything: to work, to buy goods and services, to communicate, to have fun. We can say that a new way of life is being formed today. In today's world, intelligent management systems focus on urban planning concept for the integration of many information for urban infrastructure management: transport, education, healthcare, housing and communal services, security and more. The aim is to create conditions for the creation of a "smart city" and then a smart region, which will provide a better quality of life for residents in different areas. The definition of a smart city is interpreted ambiguously by experts. However, their wording converges in one thing: the smart city is driven by data, and data management allows municipal services to improve the quality of life of the population (Batty, M. et al. 2012). The data cover such areas of citizens' lives as safety, transport, medical services, utilities, beautification, etc. The data sources are video cameras, various sensors, sensors and information systems. This model of change in humanity is related to the spatial development of our national territory and the need to introduce the concept of a "smart region". In practice, the smart region model goes beyond the innovative development of cities by adding to it the opportunity for innovative development of rural areas, post-urban spaces, suburban areas, holiday villages, resorts and villages in the Republic of Bulgaria. Thus, the intelligent system at the regional level is based on the introduction of information and communication technologies in various spheres of life, which can accelerate the economic development of the territories and improve the quality of life of citizens. In practice, the smart region is primarily a platform that applies the basic principle of smart development of the individual territory and especially the reuse of data and infrastructure (Correia, L.M. 2011). For example, thanks to an integrating system, the same surveillance camera can be used by different services and departments for their purposes such as traffic monitoring, public safety, quality control of street cleaning, etc. In the same way, different services can use data from the information systems of others for their own needs. This is what brings real efficiency, ensures the availability of information and reduces duplication of costs. The introduction of an innovative way of governing the territories of the country is caused by a continuing negative demographic trend.

## Results

In practice, the process of population decline and aging is deepening, regional imbalances are clearly outlined, the number of live births and the total birth rate are decreasing, the overall mortality rate is increasing, and the number of Bulgarians returning to Bulgaria continues to be much lower. who leave it. The men in Bulgaria are 3 369 646 (48.5%) and the women - 3 581 836 (51.5%). The aging process is more pronounced among women than among men. The relative share of women over the age of 65 is 25.1%, and of men - 17.9%. This difference is due to higher mortality among men and, as a consequence, lower life expectancy among them. The aging of the population leads to an increase in its average age, which increased from 40.4 years in 2001 to 43.9 years at the end of 2019. The aging process of the population is manifested both in the villages and in the cities, as in the cities the average age of the population is 43.0 years, and in the villages - 46.5 years. The aging trend of the population leads to changes in its basic age structure - below, in and above working age, and these sets are also affected by legislative changes on the retirement age (61 years and 4 months for women and 64 years and 2 months for men in

2019). This process greatly complicates the modernization of our territorial development.

Административни области в Република България към 31.12.2019 година<sup>1</sup>



**Figure 1.** Administrative map of Bulgaria with an image of the larger cities by 2019. Source: NSI, 2019

On the other hand, the global trends for the implementation of intelligent territorial management systems are one of the challenges that can create a condition for overcoming certain deficits in the regional development of our national territory. Thus, through the model of a smart region, the concept of scaling the technical solutions, management methods and social practices of a smart city for all municipalities in Bulgaria can be achieved. This is a concept for the development of the digital economy, the production and use of innovations within the regional specialization, which includes the creation of the necessary infrastructure for this and the cultivation of competencies required in the information society among residents of municipalities and settlements.

**European experience and the development of intelligent systems in the individual regions.** After 2015, the countries of the European Union are moving from a strategy for smart cities to a strategy for smart regions, which covers not only the municipal but also the regional and inter-municipal level of planning and policy. Globally, national and municipal strategies for the development of smart cities have been developed and are functioning. These are programs and initiatives for smart cities in the European Union and in the United States. At the same time, a number of departmental and interdepartmental initiatives standardizing the development of smart cities in the People's Republic of China have been implemented in recent years.

Also, nearly 100 smart city programs are implemented in India. As of 2020, there are several hundred smart cities around the world. It must be understood that the smart region is such a thing that, firstly, you cannot implement it "from above" and, secondly, you cannot implement it "in one". Without the participation of business and the population in the project, as well as without the cooperation of a large number of very different specialists, the project for a smart region will be doomed to failure.

It should also be borne in mind that rapid urbanization creates an excessive burden on services such as transport communications, emergency rescue and municipal services of cities and, above all, the

area of gravity of urban systems. To address these problems, the concept of a 'smart region' is becoming more widespread around the world. Its main goal is to increase the efficiency of all services through the use of information and communication technologies. It should be emphasized that all Smart Region projects involving video surveillance, public services, intelligent transport system and others should not be isolated. In intelligent systems, we must have interconnectedness within a single concept for the region. The main subsystems include the Intelligent Transport System (ITS), the Geographic Information System (GIS), the security system, e-education and e-health. Each project, as a rule, is a deeply integrated system consisting of many subsystems, which include different functional components, each of which can be used simultaneously in many subsystems (Santova, 2019).

Smart regions scale the practices of smart cities and determine their smart economic specialization. The main concept for the regional development of the Bulgarian regions should be the development of elements of e-government and the introduction of digital government mechanisms that use big data for management decisions in the system of state and municipal administration. In the field of regional economy achieving digitalization of sectors and clusters of the economy, as well as various spheres of public life at the level of district, region, municipality and settlement, the use of big data as a factor for economic development, social sphere, state and municipal management.

The application of smart city technology is evolving in order to improve the management of urban flows and respond quickly to complex tasks. Therefore, the "smart city" is better prepared to solve problems than with a simple "operational" connection with its citizens. Nevertheless, the term itself remains unclear in its specificity and therefore includes many interpretations and discussions. Thus, among the sectoral technologies that influence the development of smart cities, include those technologies that simultaneously cover several trends or industries, in this case from the point of view of city management. In Bulgaria in the last few years in the field of regional development began to implement partial projects to create a smart regional specialization. This is measured in the adoption of strategies for the development of a regional economy, based on the identification and selection of a limited number of priority areas for investment in research and innovation, which are the strengths and comparative advantages of the region (Shishmanova, 2015).

The first focus of this type of strategy rests on defining an urban environment to build a smart city. It is assumed that this should be a city that implements a number of technical solutions and organizational measures aimed at achieving the highest possible quality of management of urban resources and infrastructure and the provision of services in order to create sustainable favorable living conditions, stay and business activity in the city. But the city itself needs to have its own zone of gravity, which brings to the fore the need to develop the concept of a smart region. This concept should be based on the creation of a regional practice, which consists in scaling up intelligent urban technologies for urban agglomerations and areas with a low share of urban population, as well as for the formation of intelligent specialization of the region. This process is related to the need to achieve a high level of digitalization of the economy. As a regional economy should be a key factor in production are digital data, processing large volumes and the use of analytical results, which compared to traditional forms of management can significantly increase the efficiency of various types of production, technology, equipment, storage, sales, delivery of goods and services (Townsend, 2013).

***The needs of regional development to create an intelligent environment.*** In the intelligent management of the regional development it is necessary to use new terminology, which will fill with content the spatial development of the processes of innovative development of the separate territorial communities. In the first place, there is the concept of 'big data', which characterizes digital data sets, large size, the rate of increase or complexity of which requires significant processing power for processing and special software tools. Also for analysis and presentation in the form of human-perceived results. Another concept related to the development of regional technologies is the Internet of Things (IoT). It is a computer network that connects physical objects equipped with built-in information technology to interact with each other or with the external environment without human intervention. Another variety is cyberphysical systems (CPS), which are intelligent network systems with built-in sensors, processors and devices that are designed to interact with the physical environment and support the operation of computer information systems in real time. Cloud computing, which is a model of information technology for providing ubiquitous and convenient access via the Internet information and telecommunications network to a common set of configurable computing resources ("cloud"), storage devices, can also be important for supporting regional development. data, applications and services that can be immediately provided and released from the cargo with minimal operating costs or almost without the involvement of the supplier. Thus, in regional development, there is a need to create a network of open data. It creates conditions for the use of information created by state bodies, their territorial bodies, local self-government bodies or organizations subordinated to state bodies, local self-government bodies, or received by these bodies and organizations, which must be published in Internet in a format, providing its automatic processing for reuse without prior change by a person (machine readable format) and can be freely used by any person for any purpose in accordance with the law. In this way, conditions are created for the promotion of e-government at the regional level (Correia, 2011). The next step at the local level is to move to building an industrial Internet, (IIoT). This means building an information and communication infrastructure based on Internet connection of industrial devices, equipment, sensors, sensors, process management systems, as well as the integration of data from hardware and software with each other without human intervention. In recent years, the European Union has been implementing a "Strategy for Research and Innovation for Smart Specialization" (RIS3). Regional and national smart specialization strategies are supported through participation in the Smart Specialization Platform (S3). A similar example is the introduction of an electronic document management system that brings together regional authorities, district administrations and other institutions.

In Bulgaria, opportunities can be sought for building smart regions in the presence of a city with opportunities for effective implementation of smart systems. The formation of intelligent regions can be realized through the development of the following agglomeration areas such as Sofia-Pernik-Radomir, Veliko Tarnovo-Gorna Oryahovitsa-Lyaskovets, Varna-Devnya-Provadia, Burgas-Pomorie-Saint Vlas, Sliven-Yambol, Haskovo-Dimitrovgrad, Stara Zagora-Kazanlak, Lukovit-Cherven Bryag, Plovdiv-Asenovgrad, Vratsa-Mezdra, Montana-Lom and Ruse-Svishtov. In these areas it is necessary to create an opportunity to increase the number of services provided in electronic form. Next, it will be necessary to work on the provision of integrated services, as well as to reduce the time for the provision of public services. In addition, it will be necessary to significantly expand the list of information requested through inter-agency communication channels. This will outline the spatial profile of the respective agglomeration

area, and hence the project opportunities for intelligent specialization at the regional level. Based on the accumulated experience, three types and three ways of developing smart regions based on agglomeration areas can be identified. In the first place, such as the introduction of smart systems in the infrastructure of existing cities, the creation of smart infrastructure for large mass events, as well as the construction of new high-tech areas or residential cities ("green field" projects). The main problems in the implementation of the concept of a smart region is the presence of "smart cities", provided that a significant part of the country as of December 31, 2019 live in cities 5,125,407 people - 73.7 percent, and in villages - 1 826,075 people or 26.3 percent of the country's population.

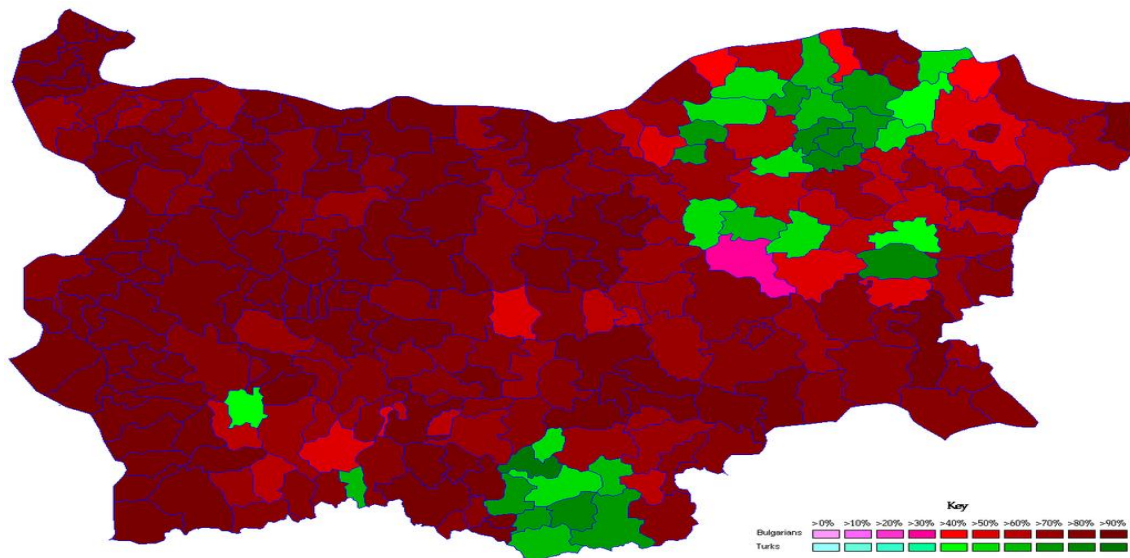


Figure 2. The population in Bulgaria by 2019. Source: NSI, 2019

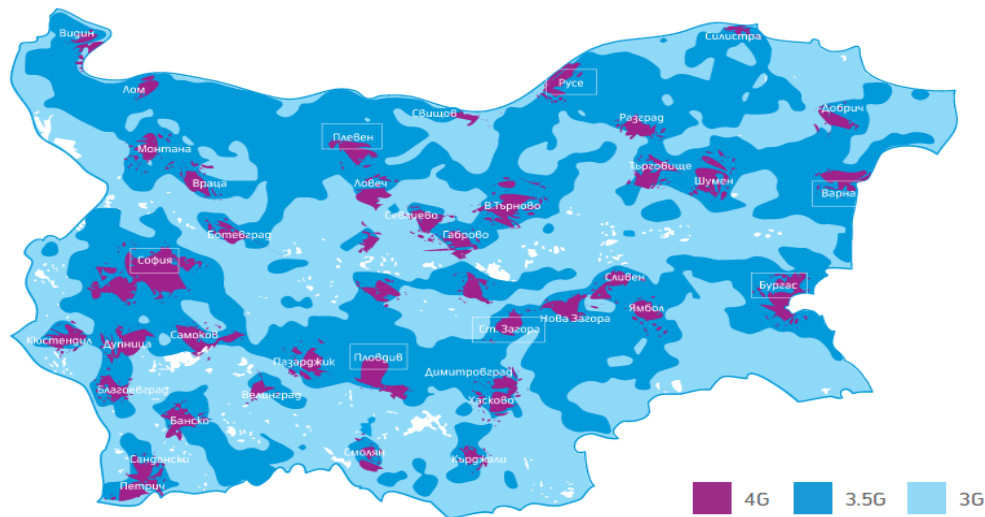
At the end of 2019, the settlements in Bulgaria are 5,257, of which 257 are cities and 5,000 – villages. There are 171 settlements without population. The largest number is in the districts of Gabrovo, Veliko Tarnovo and Kardzhali - 63, 58 and 11, respectively. By 2020, the country is divided into 6 statistical regions, 28 districts and 265 municipalities. Half of the country's population (50.4 percent) lives in the Southwest and South Central regions, and the smallest in population is the Northwest region - 728 thousand people, or 10.5 percent of the country's population. According to data from the National Register of Settlements of the NSI for the number of inhabitants by settlements as of December 31, 2019, it also shows that a total of 1,753 settlements, including Klisura and Rila Monasteries, which have the status of settlements, have a population below 100 souls. If the villages with zero population are added to them - 171, the total number of settlements with less than 100 inhabitants become 1,924 or more than one third of all settlements in the country, including cities. On the other hand, the ten largest villages start with the village of Lozen / region. Sofia-city / with a population of 6168 people. The report shows that Lozen is larger than 145 cities, or in other words, more than half of the cities in the country. The next largest village is Aydemir / region. Silistra / with a population of 5465 people. The list in the ten largest villages is from Bistritsa / region. Sofia-city / with 5116 people, Draginovo / region Pazardzhik / with 4667 inhabitants, Kazichene / region Sofia-city / with its 4545 inhabitants, Rosino / region Plovdiv / with 4233

inhabitants, Gradets / region Sliven / with 4153 inhabitants, Trud / region Plovdiv / - 3961, Malo Konare / region Pazardzhik / with 3849 people and Bukovlak / region. Pleven /, which with its 3763 inhabitants is ahead of Kalipetrovo / region. Silistra / - 3709 inhabitants.

Provided that we see the serious decline of the Bulgarian village, we can deduce that the most numerous is the group of villages in which live between 101 and 200 people inclusive - 713. Next is the group of villages with a population of between 201 and 300 people, which include 509 settlements. The third largest group is the villages with inhabitants between 301 and 400 people, which includes 406 villages. In 266 villages the number of inhabitants is between 401 and 500 people, and in 211 - between 501 and 600. In 177 villages the population is between 601 and 700 inhabitants. Between 701 and 800 inhabitants have 132 villages. In 113 villages the population is between 801 and 900 inhabitants, and in 77 live between 901 and 1000 people, as one settlement - the village of Bliznatsi, municipality. Avren, Varna region has exactly 1000 inhabitants. In 374 settlements the permanent inhabitants are between 1001 and 2000. A total of 75 villages fall into the group with a population between 2001 and 3000 inhabitants. In another 18 villages live between 3001 and 4000 people. In 4 villages the population is between 4001 and 5000 people. Two villages fall into the group between 5001 and 6000 inhabitants and another into the group of over 6000 inhabitants. Also, 34 cities are between 10 and 20 thousand people, and 169 cities are less than 10 thousand people. This whole picture shows that we have a contrast in the development of the national territory and in order to overcome the regional imbalances it is necessary to rely on the model of a smart region. This means making efforts for the intelligent development of nearly 200 cities, grouped as regions, so as to create opportunities to form at least 20,000 urbanized people. In practice, the experience gained in the construction of intelligent systems can form the first group of 27 large cities in Bulgaria and apply the experience in the construction of intelligent systems in Sofia, Plovdiv, Varna and Burgas. Of course, an important step in this direction is to develop and implement strategies for the development of smart cities and regions. Although a good example may be the formation of agglomerations of a lower class. This can be done by transforming areas with low urbanization into a smart region (example Dulovo-Alfatar-Silistra, Chernoochene-Kardzhali-Momchilgrad, Sandanski-Petrich-Parvomay, Dupnitsa-Sapareva Banya-Samokov, Kostenets-Ihtiman-Vakarel, Nikolae -Tvarditsa, Karlovo-Sopot-Kalofer and others.) In practice, the individual regions can have opportunities in this direction by encouraging the development of small and medium enterprises that are actively involved in the development of "smart cities". This process can be encouraged by the state through the implementation of programs, implementation of ideas and solutions, as well as the provision of grant schemes for the preparation and implementation of a national strategy for smart cities. Another solution is the implementation of corporate projects to provide free support for small and medium enterprises, building business incubators, open innovation centers and parks and identify "champions" working in the segment of smart city development. It is important to note that integrated solutions are often needed in regional development. This involves solving several problems simultaneously or providing services throughout the life cycle of the city's construction, including infrastructure, industrial and partial solutions. Moreover, partial solutions are technological solutions within any narrow specialization (ICT, telecommunications, energy, security, automation and building management systems, etc.). In this regard, at the regional level it is necessary to increase the role of public, expert and research organizations, as well as companies, is to create various ratings and partnerships for the development of smart cities and regions. An effective

mechanism for open innovation is "living laboratories" ("living laboratories"), which allow companies, start-ups and proactive citizens to test different solutions for smart cities in practice in a real urban environment. Crowdsourcing and hackathon projects are used to attract a wide range of citizens. In countries such as Bulgaria, the problems of regional development are integral and so far many policies and projects related to targeted impact have been implemented, but high-tech projects with smart governance systems are not perceived as a possible factor to promote regional development (Marinov, R 2009).

**Policies for development of information infrastructure in the regions.** The construction of intelligent management systems undoubtedly goes through the development of the information infrastructure in the regions of Bulgaria. These are the development of new model communication networks, data centers, the introduction of digital data platforms to meet the needs of data collection and transmission and the provision of data storage and processing services. The main objectives of the development of the information infrastructure within the implementation of the concept of a smart region are the development and implementation of a plan for providing broadband Internet access to the population. Modernization of the material and technical base and information infrastructure of the institutions and organizations of education, healthcare, culture, social services, public transport, as well as public authorities and local authorities is a necessary condition for the revival of the country's regions. This can be done by creating a single situational center at the settlement level by integrating a large number of information systems based on a single information platform for the situational center (usually in a settlement of 5 to 10 thousand people). Also the degeneration of an information panel (board) at the municipal level on the Internet, which shows real-time information about the situation in the respective municipality and the settlements in it.



**Figure 3.** Coverage with 3G and 4G of the space in Bulgaria. Sources: The Communications Regulation Commission (CRC)

Another possibility is the introduction of an electronic card of a citizen at the level of municipalities and settlements in them with the possibility of personal identification with it, access to services to premises, loyalty programs, payment for travel in public transport and others. Another novelty is the use



of citizens' smartphones as devices on the Internet of things for collecting information in a single regional geographic information system and subsequent analysis of the obtained large data.

This should go hand in hand with increasing the amount of open state and municipal data available to the public, companies and stakeholders. Another important part is the creation at the municipal level of a narrowband network using LPWAN technology for the collection and processing of telematic information. All this should encourage the process of attracting investors to less developed areas and creating conditions for the development of industries specializing in the creation of cyberphysical systems. This will provide support for pilot projects for investors to test solutions for urban areas in rural areas of Bulgaria.

Also creating a connection between all schools in each municipality to the unified information system in the field of education "Network City". By introducing an electronic system for admission to educational organizations and services to inform parents about their children who are in class, which will lead to the development of the infrastructure of further education through the creation of new platforms for self-realization of representatives of educational and scientific organizations (children's technology parks, centers for youth innovative creativity, coworking, incubators). The key to improving competitiveness and increasing the share of the digital economy, as well as training qualified staff for it. The main goals of this direction: improvement of the educational system, which should provide the digital economy with competent staff, development of a career guidance system, additional education for children and youth and identification of talents in the field of information technologies. The main objectives of the training within the application of the concept of "smart region" are the introduction of a system of competencies that reflects the digital reality of the activities of citizens, including the competencies of teachers. Creating opportunities to ensure an increase in the number of graduates of schools and organizations of secondary vocational education who have passed the exam in computer science. The purpose of this direction is to achieve a state of security of the individual, society and the state from internal and external information threats by ensuring the unity, stability and security of the information and telecommunications infrastructure. The main tasks for ensuring information security in the framework of the implementation of the concept of smart region are raising the awareness and literacy of the population and organizations on information security issues as part of the open programs for informing the citizens about the risks of information security. The main goal of the introduction of digital intelligent technologies in the field of construction and housing and communal services is to increase the efficiency of design, construction and operation of real estate, to ensure high quality planning of settlements, housing and services provided in the housing and communal services sector. The aim is to increase the transparency of the housing and communal services market for end-users of services (Nikolova and Klisurova 2015). The tasks for the introduction of digital intelligent technologies in the field of construction and housing and communal services within the concept of "Smart Region" are to create conditions for the transition of the regional construction complex to the technology for information modeling of buildings and structures (BIM). technologies). The transition to the mandatory use of information modeling technology in the construction of buildings and structures commissioned by government agencies and organizations, as well as companies with state participation. Creating conditions for equipping systems for monitoring, analysis and forecasting of damages in the infrastructure of the house (elevators, pipelines, etc.) of residential projects under construction with the help of information

modeling technology (Nikolova, 2017). As well as for the installation of devices for remote measurement of heat, energy and water resources consumption during the construction of new buildings and structures and the replacement of old measuring devices. Ensuring the integration of capital construction projects by entrepreneurs with the existing regional and / or municipal solutions of System-112 and the Complex Emergency Warning System for the population for the threat of emergencies or emergencies (KSEON). Also expanding the opportunities for citizens and organizations for remote and electronic documents related to the construction, operation, rental and cool sale of real estate. The main objectives of this area are to improve the quality of state and municipal services, the efficiency of the performance of state functions, including control and supervision, as well as to ensure the effective functioning of state bodies and local self-government. The tasks for introduction of intelligent digital technologies in the field of state and municipal government are to increase the share of residents receiving state and municipal services in electronic form to over 70%, to increase the number of regional and municipal services and provided in electronic form. Introduction of a mechanism for public-private partnership in the development of digital governance, in particular in the field of the functioning of the state information systems. The main goals of this area are to improve the quality of information of citizens and their participation in management processes at the municipal level. The tasks for the introduction of intelligent digital technologies in the field of interaction between the authorities and the citizens are to create a special regional portal and a pilot city portal for discussing proposals and voting on the most important issues in the life of the region. Including creating an opportunity to make proposals to the development strategy of the region and municipalities. Regular monitoring of the satisfaction of the inhabitants of the municipalities with the quality of life, taking into account the use of digital channels for interaction with the citizens and the use of digital services for monitoring the public opinion.

### **Conclusion**

In the modern regional development the necessity of the application of innovations becomes more and more necessary. In this direction, the search for solutions to promote regional development with the implementation of the concept of "Smart Region" will create conditions in spatial terms throughout the national territory of Bulgaria to develop the digital economy. Of course, the introduction of smart systems as a factor in promoting regional development needs to be conceptualized and developed by developing a three-year plan for the implementation of the concept and roadmaps in certain areas, projects and areas to be included as various government agencies and local self-government, and business and citizens. The interaction of the authorities and local self-government, as well as the institutions for the development of the region will play an important role in the realization of the concept of "smart region". In the planning, implementation, monitoring and evaluation of results, the views of all stakeholders must be taken into account when implementing the concept of a smart region.. The financing of projects within the concept of "Smart Region" should be included in the state budget and municipal budgets. Also, investments, funds of companies and residents at the level of municipalities and districts related on a voluntary basis and within the framework of public-private partnership will be attracted for the implementation of projects. It is necessary to implement the concept of "smart region", which should be developed in accordance with municipal plans and strategies for regional development. Roadmaps will be developed in some municipalities and districts for the implementation of the concept. As part of the concept, both existing and new priority projects of regional development will be implemented. It is

necessary to apply a project approach to implement the concept of a smart region. In order to manage the implementation of the Smart Region concept, a system of indicators and methodology should be developed to assess the effectiveness of the development of the digital economy and smart regions in Bulgaria.

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