

Scenarios for the Impact of GSM-5G Networks on the Economic Development

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Abstract

Communication through GSM-5G networks represents a new stage in its development, the communication speed being about 100 times higher than in the case of 4G networks, but the transmission distances are small. So, these 5G networks will be implemented mainly in urban areas due to high costs.

The paper aims to analyze scenarios for the impact of 5G networks on the background of accelerated technological development.

Key words: communication, 5G networks, scenarios

J.E.L. classification: O10, O18, A10

1. Introduction

Compared to 4G, GSM-5G technology can deliver up to 100 times higher bandwidth, greatly improved reliability and connection to a much higher density of devices.

Some characteristics of the 5G-technology are presented (ITU, 2018):

- Faster connections, higher throughput and greater capacity (up to 10 Gbps)- are used in cases: fixed wireless access service, enhanced in-building; broadband service, real-time augmented reality service; real-time virtual and mixed reality service, crowded or dense area service, enhanced digital signage, highdefinition cloud gaming, public protection and disaster; response services, massive content streaming services, remote surgery and examination.
- Reduced time for data from device to be uploaded and reach its target (1 ms compared to 50 ms for 4G) and Robust security properties, leading to high reliability and availability – are used in cases: autonomous vehicles, drones and robotic applications, health monitoring systems/telehealth, smart grid and metering, intelligent transportation, factory automation, remote operation, self-driving cars, mission-critical services (security and safety), high-definition real-time gaming.
- Increased spectral efficiency plus small cell deployment and Efficient power requirements for massive multipleinput, multiple-output (MIMO), small cell implementation – are used in cases: Asset tracking and predictive maintenance, smart cities/buildings/agriculture, internet of energy/utility management, industrial automation, smart logistics (advanced telematics), smart grid and metering, smart consumer wearables, environmental management, intelligent surveillance and video analytics, smart retail.

The impact of 5G-technology on the economy is given by its capacity to: create new industries and sub-industries, products and business models; improve the productivity; optimize the costs, improve the service quality. Each industry is influenced by the 5G-technology. So, 5G-technology has the potential to create or transform million jobs across all sectors of the economy.

5G-technology is based on the signals transmitted by the radio waves. This technology requires more the wave transmission points than the previous technologies. So, the construction of 5G networks requires the additional expenses. Thus, the 5G- technology is not profitable in rural areas.

Unfortunately, the 5G -technology can create the public health problems. The health effects of the radiofrequency radiation have been the subject of numerous studies. There are studies on the impact of 5G technology on people exposed to a high concentration of energy due to the large number of antennas used. In a study (Lennart Hardell, Rainer Nyberg, 2020) by Dr. Hardell, the effects on the skin, the gene and the systemic effects such as the immune function were reported.

2. Literature review

Larry Thompson and Warren Vande Stadt (Larry Thompson and Warren Vande Stadt, 2017) present both the technical and the economic reasons for which the 5G -networks will not be spread in the rural areas.

Edward J Oughton, Zoraida Frias and others (Edward J. Oughton, Zoraida Frias, Sietse van der Gaast, Rudolf van der Berg, 2019) present a detailed technical-economic analysis regarding the implementation of 5G -networks in the Netherlands. Also, an analysis is made at a geographical and demographic level (geotype) of their spread, dictated by the economic and the technical reasons.

The authors made an analysis of the potential traffic that could be covered by the 4G-GSM cells and an analysis of the 5G development costs compared to the other types of networks. The authors also try to answer the question: what are the costs generated by the implementation of 5G-networks per user ?

Augusta Riddy (Augusta Riddy, 2018) points out that despite the will of the British Government, between the localities, the fiber optic cables are chosen and only in the crowded areas will appear the 5G- networks.

Lacey Newlin (Lacey Newlin, 2020) points out the problems of the 5G implementation in the rural areas of the USA, the discrepancy between the desire to implement the 5G- tehnology and the technical-economic possibilities.

Roger Kauffman (Roger Kauffman, 2021) shows the attempts of telecommunications companies to connect the rural areas by trying to combine the 5G- technology with other transmission technologies.

3. Research methodology

The goal is to create scenarios based on the premises – there are necessary in the establishment of the future approaches for research on the impact of the development of GSM-5G networks.

Isolation and observation of current or past economic processes can be the basis of new research.

Thus, an economic system is decomposed into elements, each element having as few inputs and outputs as possible, so it can be approached almost independently. This decomposition is based on the observability of present or past economic systems – each element being as isolated as possible in relation to the others. With these sets of isolated elements we try to create the scenarios can be the future approaches in the research of the impact of GSM-5G networks on the economic development.

In this sense, qualitative variables were established as follows:

- Input variables described qualitatively (independent variables) - represented by investments in the communications infrastructure, communication needs resulting from the emergence of new services;
- Output variables described qualitatively (dependent variables) – represented by the volume of data and their transmission speed, the services quality, a new infrastructure in services;
- Intermediate variables (state - dependent variables) - represented by the chain of intermediate implications (for example: energy consumption difficult to quantify depending on the data transmitted, environmental variables).

All these variables are reflected in the diagrams that were made.

Methods of data collection - The data were taken by searching the internet and observing the demands and offers on the market. The evolution of the possibility of teleworking by categories of activities and types of geographical areas was followed. Information on intermediate variables was also collected by observing their citation in articles on the Internet.

Methods of analysis - Qualitative methods, based on language and observations, were used to identify the elements involved. The identified elements were put together in diagrams. Arrows were used to highlight the relationship between the elements and the cause-effect direction.

Justification of the chosen methodology - These methods were chosen due to the type of problem treated. The advantage of the approach is the possibility of adaptation and development as new data appear. As statistics appear, quantitative variables may be added. After identifying the model structure; it can be completed either by classical methods or by non-standard methods in the area of expert systems.

4. Findings

4.1. Influence of the appearance of GSM- 5G networks on the services sector

In the field of services, the most significant transformation given by the use of 5G networks is the one given by the possibility of large transfers of data which extends the services provided remotely.

Increasing the possibilities of remote control of the services leads to an increase of both their volume and their variety. Transfers of large volumes of the data lead to an increase in the share of work at home. Increasing in the volume of services leads to a decrease in their costs in the urban areas (the rural areas do not benefit from the GSM networks with 5G technology).

Working from home leads to a decrease of the time needed to carry out the activities, and implicitly to an increase in the number of people who can perform the activities in the services area.

Increasing the availability of people in the services area leads to the appearance of new jobs in this area because the service sector needs small investments and small places to carry out the activities.

Implementation of the remote services leads to new directions for the development of services such as: use of virtual reality and use of augmented reality in the promotion of tourism; improving and expanding the distribution networks - for example: increasing the frequency of information/ reporting of the product distribution; medical services provided. The appearance of new types of the remote services leads to the appearance of some new occupations. The occupations involving the use of remotely controlled equipment lead an increase in the volume of the maintenance services - for example the maintenance of robots in the service units.

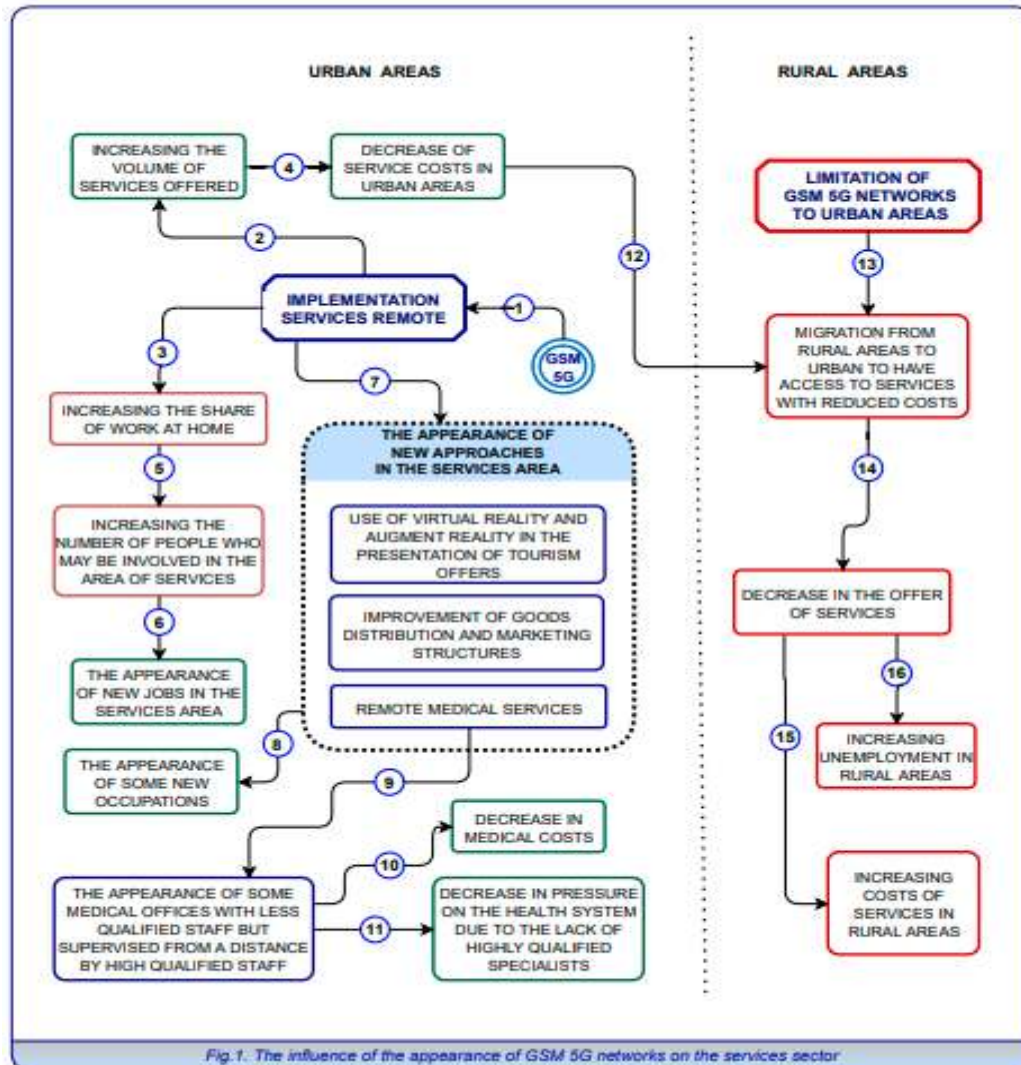
The appearance of remote medical services can create the medical units for patients served by the nurses, the specialist doctors supervising the medical activities remotely. The appearance of some medical offices with less qualified staff but supervised from a distance by the high qualified staff leads to a decrease in the medical costs. Also, the involvement of less qualified medical staff leads to reduce the crisis of specialists. A decrease in the costs of medical services in the urban areas leads to a migration of the rural population to the cities.

So, the 5G networks are implemented more in the urban areas than in the rural ones and this leads to a migration of population to the city.

Decreasing the rural population leads to a decrease in the number of services in that area. Decreasing the services in rural areas leads to an increase in the service costs. Also, declining the services in rural areas leads to an increase in the unemployment.

In Figure 1 we present a scenario on influence of the appearance of GSM- 5G networks on the services sector.

Figure no. 1. The influence of the appearance of GSM-5G networks on the services sector



Source: Own sources

4.2. Influence of the appearance of GSM- 5G networks on the industrial units

The existence of 5G-GSM networks in the urban areas can lead to the spread of work from home in the industrial units.

The high speed of communication allows the management of various industrial processes from a distance. The remote industrial process management involves the existence of automation equipment can be controlled remotely. So, the demand for such automation equipments increases.

Working from home offers the possibility to employ part-time the highly qualified specialists from other urban areas. Also, working from home decreases the administrative expenses. There will be fewer offices and less utility costs.

The transmission of large volumes of data leads to the extension of remote control.

Finally, a consequence of the automation of different processes is the decrease of production costs. The automation requires the highly qualified staff. The expansion of automation leads to increase the demand for the highly qualified staff.

The local 5G- GSM networks can be created for the rural areas. They can be made with the fiber optic cables. This also allows in the rural areas, the existence of fast communication with the cities and the remote management of industrial processes through the GSM 5G networks. This fact leads

to the lower costs for the rural areas, especially since in the rural area there is a much larger workspace.

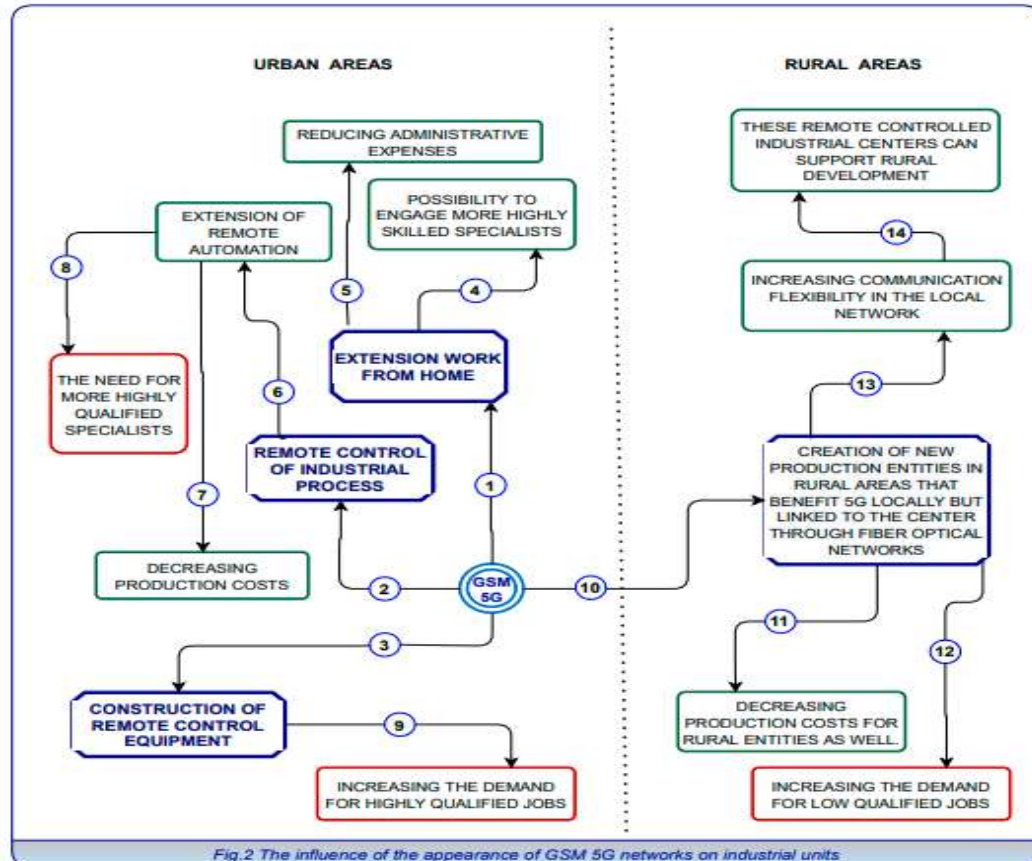
The coordination centers are in the urban areas and therefore the staff with low qualifications can be employed in the coordinated centers, in the rural area.

The GSM-5G local networks allow a high flexibility compared to the wired ones.

Finally, the existence of these coordinated regional centers leads to the development of the rural regions involved.

In Figure 2 we present a scenario on influence of the appearance of GSM- 5G networks on the industrial units.

Figure no. 2. The influence of the appearance of GSM-5G networks on the industrial units



Source: Own sources

4.3. Influence of the appearance of GSM-5G on the vocational education and the training

Unlike other technological generations, the 5G is designed as a "breakthrough" technology, different from the consumer internet and the entertainment industry. The 5G is designed to serve the innovative industrial uses.

The 5G networks impose the cities to become "smart". They need to invest in the Big Data solutions, the Machine Learning applications and the automation to facilitate the real-time interactions with citizens. Thus, the evolution on the labor market is dynamic.

The automation of the industry does not mean the elimination of the human factor, but its evolution, by improving the skills.

Two of the biggest challenges for companies are the allocation of staff and the exploitation of real capacity of the equipment.

The highly qualified people are wanted in the urban areas to design and to implement the remote control. In the urban areas, persons with the qualification of operator are also sought to ensure the service and the operation of the involved equipments.

In the rural areas, there are also sought operators for the remote control.

The highly qualified people in the field of telecommunications are sought in order to expand and to connect GSM 5G networks. The specialists in automation are sought to design and to expansion of the automation equipments controlled by GSM networks.

The higher schools are needed to train the automation specialists.

Also, for the training of telecommunications specialists, the higher schools in the field are needed.

Training in high schools requires a long time. The long periods of study lead to the specialists crises. At the time of request for the specialists, then we find their lack.

Reducing the number of specialists through the possibility of working from home tends to compensate for the lack of specialists.

Telecommunications operators are needed. Also, operators in the field of automation are also needed.

The training of operators in the field of automation can be done by the vocational schools or by the reconversion to the workplace. Also, the telecommunications operators can be obtained in the same way. The demand for operators is partially covered by the vocational schools and the economic entities that requalify them.

In the rural areas, we have a demand for the telecommunications operators to ensure the communications between the remote equipments and the control center. In the rural areas we have a demand for the automation operators to serve the remote controlled entities.

The training of operators in automation can be done both in the urban areas and the rural areas- in rural areas there may be small schools if there is demand for this or directly through professional retraining. Also, the training of telecommunications operators in the rural areas can be done in the same way.

The demand for operators in the rural areas can also be met by the specialized personnel from the urban areas. Operators can also come from rural areas if there is a sufficiently high demand in rural areas.

Digital tools and immersive experiences, bolstered by augmented reality and virtual reality as well as at-a-distance collaboration tools, are gaining rapid adoption while accelerating us along the path to Industry 5.0.

In Figure 3 we present a scenario on influence of the appearance of GSM- 5G networks on the vocational education and the training.

Figure no. 3 The influence of the appearance of GSM-5G networks on education and on professional training

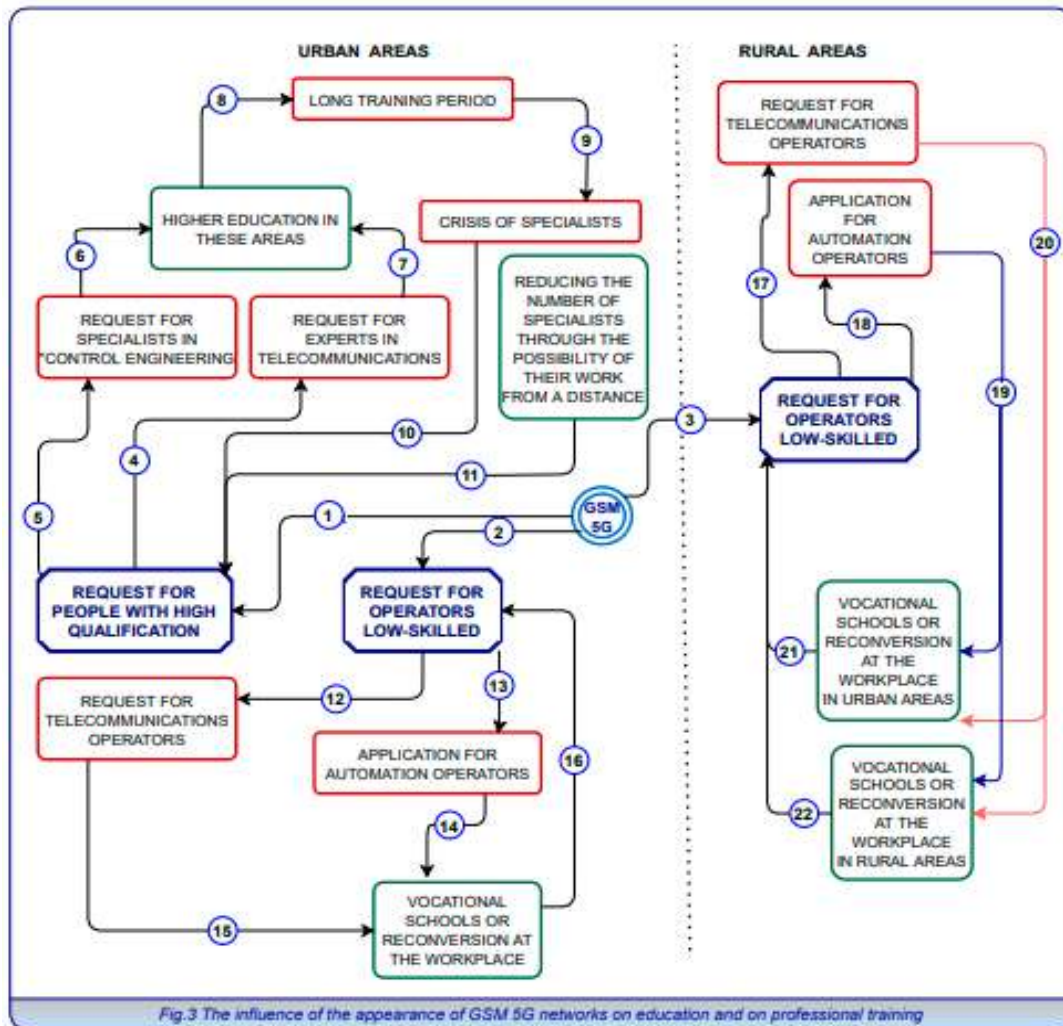


Fig.3 The influence of the appearance of GSM 5G networks on education and on professional training

Source: Own sources

5. Conclusions

The 5G networks develop more and more in crowded urban areas. The cost of implementing 5G networks is high, and the area of signal transmission is small at the transmission point level. Thus, the probability of implementation in the rural areas is low.

Increasing the communication speed in the crowded areas leads to a change of the whole macroeconomic structure. This change is achieved through the emergence of the new types of services are cheaper than the remote uncontrolled services.

At the rural level, the services remain on the initial structure with high costs. So, the rural population will use the infrastructure of services in the urban area. In the rural areas, the demand for services decreases and their cost increases. Therefore, the economic gap between urban and rural areas increases.

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