

**STRATEGY OF BROADBAND NETWORK AND
SERVICE DEVELOPMENT IN THE REPUBLIC OF
SERBIA BY 2016**

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ABBREVIATIONS

Abbreviations	Full form	Meaning
AD SS	All Dielectric Self-Supporting	Nemetalni samonosivi kablovi
ADSL	Asymmetric Digital Subscribers Line	Asimetrična digitalna pretplatnička linija
AMRES	Information – communication institution “Academic Network of Serbia - AMRES”	Akadska naučnoistraživačka i obrazovna mreža
xDSL	Digital Subscribers Line	Digitalna pretplatnička linija
CATV	Cable Television	Kablovska televizija
DAE	Digital Agenda for Europe	Digitalna agenda za Evropu
DVB	Digital Video Broadcasting	Digitalna radiodifuzija televizijskog signala
DVB-C2	Digital Video Broadcasting – Cable 2nd Generation	DVB Cable po optičkim sistemima
DVB-H	Digital Video Broadcasting - Handheld	Digitalna radiodifuzija televizijskog signala za prijem mobilnim prijemnikom
DVB-T2	Digital Video Broadcasting Terrestrial 2nd Generation	Digitalno terestričko emitovanje televizijskog signala
EU	European Union	Evropska unija
EPS	PE “Elektroprivreda Srbije” (Electric Power Industry of Serbia)	
EMS	PE “Elektromreza Srbije”	
PE ETV	PE “Emisiona tehnika i veze” (Broadcasting Technique and Connections)	PE for managing broadcasting infrastructure
FP7	7th Framework Programme for Research and Technological Development	Sedmi okvirni program za istraživanje i tehnološki razvoj
FTTB	Fibre to the Building	Optički završetak u razvodnom oramiruću zgrade
FTTC	Fibre to the Curb	Optički završetak u uličnom izvodu optičke mreže
FTTH	Fibre to the Home	Optički završetak do krajnjeg korisnika
FTTN	Fibre to the Network	Optički završetak u optičkom čvoru
HDSL	High Data Rate Digital Subscriber Line	Digitalna pretplatnička linija visokog protoka
HFC	Hybrid Fibre-Coaxial	Hibridni optičko-koaksijalni
HORIZON 2020	The EU Framework Programme for Research and Innovation 2014-2020	

HSDPA	High Speed Downlink Packet Access	Paketski pristup visokim protokom na downlink-u
HSPA	High Speed Packet Access	Paketski pristup visokim protokom
HSUPA	High Speed Uplink Packet Access	Paketski pristup visokim protokom na uplinku-i
IaaS	Infrastructure as a Service	Infrastuktura kao servis
ICT PSP	ICT Policy Support Programme	Razvoj regulatornog okvira za IKT
ICT	Information-communication technologies	
IOE	Internet of Everything	Internet svega
IOT	Internet of Things	Internet stvari
IP	Internet Protocol	Internet protokol
IPA	Instrument for Pre-Accession Assistance	Pretpristupni fond
IPTV	Internet Protocol Television	Televizija po Internet protokolu
ISDN	Integrated Services for Digital Network	Digitalna mreža integrisanih usluga
ITU	International Telecommunication Union	Međunarodna telekomunikaciona unija
LAN	Local Area Network	Lokalna mreža
LLU	Local Loop Unbundling	Raščlanjavanje lokalne petlje
LTE	Long Term Evolution	Mobilni sistemi četvrte generacije
M2M	Machine to Machine	Mašina – mašina
MHP	Multimedia Home Platform	Multimedijalna kućna platforma
NGAN	Next Generation Access Networks	Mreže za pristup nove generacije
NGN	Next Generation Networks	Mreže nove generacije
OECD	Organisation for Economic Co-operation and Development	Organizacija za ekonomsku saradnju i razvoj
OPGW	Optical Ground Wire	Optička vlakna u zemljovodnom užetu
P2M	People to Machine	Korisnik-mašina
P2P	People to People	Korisnik-korisnik
PaaS	Platform as a Service	Platforma kao servis
SP	Special purposes	
PDSL	Power-Line Digital Subscriber Line	DSL preko energetske kablova
PPP	Public Private Partnership	Javno-privatno partnerstvo
Agency	Regulatory Agency for Electronic Communications and Postal Services	
QoS	Quality of Service	Kvalitet servisa

SaaS	Software as a Service	Softver kao servis
SDN	Software Defined Networking	Softverski definisano umrežavanje
Телеком Србија	Telecommunications Company “Telekom Srbija” a.d.	
UHF	Ultra High Frequency	Ultra visoke frekvencije
UMTS	Universal Mobile Telecommunications System	Univerzalni mobilni telekomunikacioni sistem
VoIP	Voice over Internet Protocol	Prenos govora IP mrežom
VPN	Virtual private network	Virtuelna privatna mreža
WLAN	Wireless Local Area Network	Bežična lokalna mreža
WiMAX	Worldwide Interoperability for Microwave Access	Široko rasprostranjena interoperabilnost za mikrotalasni pristup

DEFINITIONS

Term	Definition
Leased line	a non-switched telecommunications line between termination points of a fixed public telecommunications network, not including switching controlled by the user
Information society	a human society at a level of cultural civilization development where information is easily accessible
Interconnection	a specific type of access implemented between public communications network operators used to provide physical or logical connection of public telecommunications networks used by the same or a different operator in order to allow the users of one network to communicate with the users of the same or another networks, or to access the services provided by other telecommunications operators
Internet	global electronic communications system of interconnected computer networks and devices, intended for exchange of all types of information through a set of communication protocols
Interoperability	ability of two or more systems or components to exchange information and to use the information that has been exchanged
Public fixed telecommunications network	a telecommunications network which is used in part or in whole for providing different public telecommunications services between stationary termination network points, including also access infrastructure and infrastructure connecting public telecommunications networks within a certain territory and outside it
Public mobile telecommunications network	a telecommunications network which in part or in whole operates through public mobile telecommunications network at specific radio frequencies
Cable distribution network	a cable telecommunications network intended primarily for the distribution of radio and/or television programs and for the provision of other telecommunications services
User	a physical or legal person that employs or requires publically available electronic communications service
Electronic communications operator	a physical or legal person that builds, owns or uses telecommunications network, or provides telecommunications service
Last mile	a physical wire between termination point at the operator's network (local exchange) to end-user
Private telecommunications network	a telecommunications network that is built, maintained and operated by a physical or legal person for own needs, through which no public telecommunications services are provided. A private telecommunications network may be connected with a public

	telecommunications network
Access network	network which enables the transmission of telecommunication services between the locations from which telecommunication services are provided to end users and the network on users' premises
Broadcasting network	a telecommunications network used for broadcasting and distributing radio and television signals intended for direct public reception by an unlimited number of users in an open area
Local loop unbundling	access to network resources from the local exchange to the user's premises owned by the incumbent operator, for providing services to end-user
Telecommunications	any transmission, emission or reception of messages (speech, sound, text, image or data) in the form of signals by using wire, radio, optical or other electromagnetic systems
Telecommunications network	a network of telecommunications systems and equipment enabling the transmission of data in accordance with users' requests
Telecommunications equipment	equipment and devices for emission, transmission, and reception of signals, and the corresponding software used in telecommunications
Triple-play	a set of services that provides voice, data and video simultaneously
Telecommunications service	a service whose provision consists wholly or partly of the transmission or routing of signals over a telecommunications network in accordance with the requests of users and telecommunications process
Universal Service	a set of basic telecommunications services of specified scope and quality which shall be available to all users of the public telecommunication network in the Republic of Serbia, at reasonable prices
Broadband (access)	provides fast Internet access, through telephone lines or cables, through wireless technologies or satellite

Pursuant to Article 45(1) of the Law on Government (“Official Gazette of the RS”, no. 55/05, 71/05-correction, 101/07, 65/08, 16/11, 68/12-CC, 72/12, 7/14-CC and 44/14),

the Government hereby adopts

STRATEGY OF BROADBAND NETWORK AND SERVICE DEVELOPMENT IN THE REPUBLIC OF SERBIA BY 2016

1. INTRODUCTION

Economic progress and its sustainable growth, in addition to the accession of Serbia to the European Union, is one of the main challenges our country currently faces. Development of basic infrastructure (roads, railroads, power system) was crucial for economic growth in Serbia in previous periods. Today, broadband networks and information communication technology (ICT) have become an integral part of basic infrastructure.

The 2010 UN Declaration set a millennium goal for all modern countries – to provide broadband Internet access to every citizen. Besides telecommunication, Internet and TV, this service provides many other modern amenities: e-business, e-banking, e-commerce, e-education, e-health. All this results in a considerable increase of business efficiency on an individual level, and significantly impacts the development degree in manufacturing, industry and banking sectors. Accelerated development of broadband networks is a challenge for the development of a modern local ICT industry in terms of production of specific hardware for use by individuals at home, or in private companies, as well as measurements, control and management of large public systems (smart grid network). On the other hand, high quality of telecommunication infrastructure is one of the main parameters for defining competitiveness of an economy, as well as attracting foreign investors.

The European Union defined in the strategy "Europe 2020: A strategy for smart, sustainable and inclusive growth", which was adopted 2010, strategic goals for sustainable growth and employment. The Europe 2020 Strategy is not designed only for the member states, but also provides certain guides for stepping up the reforms to candidate countries. Policy support as implemented to date has become obsolete, and new broadband development policy is needed, with a clear focus closely tied to the market. It is important to emphasize that the EU financial instruments for the member states and those on their way to membership will be in the function of achieving the EU 2020 Strategy goals. Achievement of these goals will, in a sense, affect the IPA instrument (*Instrument for Pre-Accession Assistance*), cross-border cooperation programmes of the Republic Serbia with the EU member states, as well as the participation of the Republic of Serbia in EU programmes, such as HORIZON 2020 which will replace the current programmes, in which the Republic of Serbia yielded good results, such as FP7 (*7th Framework Programme for Research and Technological Development*) and ICT PSP (*ICT Policy Support Programme*).

The rapid development of electronic communications, in particular broadband, as well as the increasing share of this sector in the overall economy, nationally as well as worldwide, is one of the few trends which managed to sustain positive results in the face of the global economic crisis. By stimulating economic growth through new services and being open for investments, telecommunications create conditions necessary for generating new jobs, increase productivity in existing businesses, and boost income and the speed of return on investment. Broadband networks are a platform for providing services which require faster exchange of

information. Investing into broadband directly impacts GDP growth, competitiveness in all economic sectors and improves the quality of life.

The development of broadband networks and services must be market-regulated, while the role of the state is to ensure beneficial and conducive conditions for business are available countrywide. In order to provide conditions necessary for provision of services and create an environment for more investment into broadband across the country, this Government's Strategy proposes and defines various activities in several areas. These activities, among other things, entail providing more competition on the market, efficient management, and promoting investments into broadband infrastructure in remote areas of the country. The goal is to reduce the gap between urban and rural areas in the country and to create conditions for equal regional development by accelerated broadband development.

Broadband improves production and service processes, enhances the operation and management of companies. This is the reason why companies around the world develop new ways to organize and use knowledge of their employees. Today's economy is driven by creating intangible assets such as knowledge and information. The new economy and new technology are inextricably linked and form one whole, making the basis of successful functioning and development of all participants in business activities. By connecting people, institutions and businesses, flexibility and dynamism of the economy are achieved, which directly affects the competitiveness of the market.

2. REGULATORY FRAMEWORK AND ANALYSIS OF THE CURRENT STATE IN THE TELECOMMUNICATIONS IN THE REPUBLIC OF SERBIA

Regulatory framework relevant for the development of broadband networks and services in the Republic of Serbia includes the following regulations:

- Law on Electronic Communications ("Official Gazette of the RS", No. 44/10, 60/13 – CC and 62/14);
- Law on Ratification of the Final Acts of the Regional Radio- Communications Conference for planning of the digital terrestrial broadcasting service in parts of Regions 1 and 3, in the frequency bands 174-230 MHz and 470-862 MHz (RRC-06) ("Official Gazette of the RS – International Treaties", No. 4/10);
- Law on Ratification of the Protocol amending the Regional Agreement for the European Broadcasting Area (Stockholm, 1961) with Resolutions (RRC-06- Rev. ST61) ("Official Gazette of the RS – International Treaties", No. 1/10);
- Law on Ratification of the Final Acts of the World Radio-Communications Conference (WRC-07) ("Official Gazette of the RS – International Treaties", No. 2/11);
- Regulation Stipulating the Frequency Allocation Plan ("Official Gazette of the RS", No. 99/12);
- National Sustainable Development Strategy ("Official Gazette of the RS", No. 57/08)
- Strategy of Electronic Communications Development in the Republic of Serbia for the period 2010-2020 ("Official Gazette of the RS", No. 68/10);
- Government's Conclusion adopting the Action Plan (2013-2014) for Implementing the Strategy of Electronic Communication Development in the Republic of Serbia for the period 2010-2020, 05 No: 090-2125/2013 dated 14 March 2014
- Strategy of Information Society Development in the Republic of Serbia by 2020 ("Official Gazette of the RS", No. 51/10);

- Strategy for Transition from Analogue to Digital Broadcasting in the Republic of Serbia (“Official Gazette of the RS”, No. 52/09, 18/12 and 26/13);
- Rulebook on Transition from Analogue to Digital Broadcasting and Multiplex Access in Terrestrial Digital Broadcasting (“Official Gazette of the RS”, No. 55/12);
- Rulebook determining Frequency/Location/Allotment Allocation Plan for terrestrial digital TV broadcasting stations in the UHF band for the territory of the Republic of Serbia (“Official Gazette of the RS”, No. 73/13);
- Rulebook determining Frequency/Location Allotment Plan for terrestrial analogue FM and TV broadcasting stations for the territory of the Republic of Serbia (“Official Gazette of the RS”, No. 9/12, 30/12, 93/13 and 10/14);
- Rulebook on the manner of monitoring the radio frequency spectrum usage, technical inspection procedure and protection from harmful interference (“Official Gazette of the RS”, No. 60/11 and 35/13);
- Rulebook on the manner of radio frequency usage under general authorization regime (“Official Gazette of the RS”, No. 28/13).

Analysis of the current state of telecommunications in the Republic of Serbia

For the purposes of the Strategy of Broadband Network and Service Development in the Republic of Serbia by 2016 (hereinafter referred to as: the Strategy), a brief analysis of the state of telecommunications in the Republic of Serbia was conducted from the aspect of implementation of the following strategies: Strategy of Broadband Development in the Republic of Serbia by 2012, Strategy of Electronic Communications Development in the Republic of Serbia for the period 2010-2020 and Strategy of Information Society Development for the period 2010-2020.

Analysis of the state of telecommunications in the Republic of Serbia, from the aspect of implementation of the Strategy of Broadband Development in the Republic of Serbia by 2012:

The Government in 2009 adopted the Strategy of Broadband Development in the Republic of Serbia by 2012. This strategy defined the basis of broadband development and the conditions which were needed to increase the level of broadband penetration and expand the set of services to be available to the end user. Also, it defined measures enabling the governing authorities to implement new broadband technologies and their more rapid development by ensuring free market and infrastructure competition. The use of new access technologies improves the quality of life by simplifying the communication, easier and faster access to information, access to new forms of entertainment and by enhancing the cultural life. The integral part of the Strategy of Broadband Development in the Republic of Serbia by 2012 is the Action Plan for its implementation. The Action Plan provided for the activities for further infrastructure development, drawing up of relevant regulations, improvement of the protection of customers’ rights and increase in broadband availability, where five out of nineteen activities remain to be implemented. The activities proposed for under the Action Plan but not yet completed: telecom ducts cadastre, rules regulating installation and development of telecommunications infrastructure, as well as promotion of broadband network and service development in local self-government, need to be implemented to facilitate numerous procedures for electronic communications operators, as well as various investors. It is necessary

to predict pre appropriate measures to make up for lost time. Appropriate measures need to be proposed as soon as possible to make up for lost time. In addition, collection of accurate data on the infrastructure possessed by different electronic communications operators, which has not been available until now, is highly important. Accordingly, the Ministry of Trade, Tourism and Telecommunications drafted Law on amendments to the Law on Electronic Communications proposing for amendments that will allow for easier access to information about the directions and capacities of electronic communications networks. Also, it is necessary to draw up Action Plans for implementing the Strategy of Electronic Communications Development in the Republic of Serbia for the period 2010-2020 and the Strategy of Information Society Development in the Republic of Serbia for the period 2010-2020, align allotments plan with Frequency Allocation Plan, allocate the digital dividend, draw up broadband availability maps in the Republic of Serbia and draft model for stimulating private initiative for broadband development.

Analysis of the state of telecommunications in the Republic of Serbia, from the aspect of implementation of the Strategy of Electronic Communications Development in the Republic of Serbia for the period 2010-2020:

The Government in 2010 adopted the Strategy of Electronic Communications Development in the Republic of Serbia for the period 2010-2020. This strategy sets out a framework for promoting electronic communications, as well as the main directions and goals of the successful electronic communications development in the Republic of Serbia by 2020. The strategy also proposes the adoption of two-year action plans for implementing the set goals. In March 2013 the Government, on a proposal of the Ministry of Foreign and Internal Trade and Telecommunications, adopted an Action Plan (2013-2014) for implementing the Strategy of Electronic Communications Development in the Republic of Serbia for the period 2010-2020, recognizing its importance in creating a predictable telecommunications market for entrepreneurs and investors. The implementation of the activities proposed for in the Action Plan will create conditions for a more intensive use of ICT in various industries, and economic and institutional environment in which the business sector will invest more in ICT, which will result in rapid economic growth and the development of society as a whole. This Action Plan is the first Action Plan which was adopted on the basis of the Strategy of Electronic Communications Development, although the strategy was adopted more than two years ago. As the Action Plan did not exist until March 2013, there is no reliable method to fairly assess the degree of implementation success of this strategy for the period 2010-2012, i.e. there was no a possibility for the expert and general public to follow the progress in the field of electronic communications in accordance with the adopted strategy.

Analysis of the state of telecommunications in the Republic of Serbia, from the aspect of implementation of the Strategy of Information Society Development in the Republic of Serbia for the period 2010-20:

In analysing the state of telecommunications in Serbia, it should be mentioned that besides the Strategy of Electronic Communications Development in the Republic of Serbia for the period 2010-2020, there is a Strategy of Information Society Development for the period 2010-2020 ("Official Gazette of the RS", No. 51/10), and these two strategies together make the Digital agenda for the Republic of Serbia. The Strategy of Information Society Development in

the Republic of Serbia for the period 2010 -2020 defines the main goals, principles and priorities for the development of information society and determines the actions to be taken in this period. In August 2013 the Government adopted the Action Plan (2013-2014) for implementing the Strategy of Information Society Development in the Republic of Serbia by 2020. This is the first Action Plan since the adoption of the Strategy in 2010 which stipulates the obligation of the Government to adopt two-year action plans for its implementation; therefore it is impossible to conduct an objective analysis of the degree of implementation of this strategy.

3. GUIDES TO BROADBAND DEVELOPMENT IN THE EUROPEAN UNION

The effort of the Republic of Serbia to join the EU obliges it to implement the EU legal framework, as soon as possible, as well as to implement appropriate recommendations given by the EU. In 2010 the European Union adopted the Strategy "Europe 2020: A strategy for smart, sustainable and inclusive growth" which sets out the goals and instruments for ensuring competitiveness and improving the standards of its citizens. This strategy also has a short-term priority, to ensure a successful exit from the current economic and financial crisis; whereas a long-term goal is to enable a sustainable future with more jobs and better living standards.

In preparing the Europe 2020 Strategy, the EU took as starting points: the exit strategy from the economic crisis; dealing with global challenges; continuity in the implementation – continuity of the Lisbon Strategy; stronger financial support; better coordination with other EU policies; better division of labour between the EU institutions and member states; new implementation mechanisms; stronger instruments of European economic governance and strengthening of Europe's competitiveness.

In order to achieve the goals defined in the document "Europe 2020: A strategy for smart, sustainable and inclusive growth", the EU defined Initiative - the European Digital Agenda as one of the flagship initiatives. This initiative is focused on creating a single digital market and promoting its benefits to companies and households, supports the development of fast Internet and broadband Internet access for all.

Europe is faced with reduced productivity mainly due to: less investment in research, development and innovation; insufficient use of information and communication technologies and the difficulties in accessing innovation of particular sections of the society. The new economy, which is also called digital economy, is based on knowledge and use of human knowledge. Innovation is the key driver of the economy and business success in the 21st century and employees are expected to continuously improve new skills. In the case of the digital economy physical presence ceases to be important, leading to a single global economy. Recent analyses have shown that the digital economy is growing at seven times the rate of the rest of the economy.

The digital single market is one of the most challenging and promising areas of progress. The single digital market opens up new opportunities to boost the economy through e-commerce, while at the same time facilitating administrative and financial compliance for businesses and empowering customers through e-government. Market and government services developed within the digital market are evolving from electronic to mobile platforms and becoming ubiquitous, offering access to information and content at anytime, anywhere and on any device. This progress calls for a regulatory framework that is conducive to the development of cloud computing, overall mobile data connectivity and simplified access to information and content.

The Digital Agenda for Europe (DAE) contains 13 specific goals set by the EU in the field of telecommunications and ICT:

- the entire EU to be covered by broadband by 2013
- the entire EU to be covered by broadband above 30 Mbps by 2020
- 50 % of the EU to subscribe to broadband above 100 Mbps by 2020
- 50 % of the population to buy online by 2015
- 20 % of the population to buy online cross-border by 2015
- 33 % of small and medium-sized companies (SMEs) to make online sales/purchases by 2015
- the difference between roaming and national tariffs to approach zero by 2015
- to increase regular internet usage from 60 % to 75 % by 2015, and from 41 % to 60 % among disadvantaged people
- to halve the proportion of the population that has never used the internet from 30 % to 15 % by 2015
- 50 % of citizens to use e-Government by 2015
- all key cross-border public services, to be agreed by Member States in 2011, to be available online by 2015
- to double public investment in ICT Research & Development to € 11 bn by 2020
- to reduce energy use of lighting by 20% by 2020.

3.1. Economic and social impact of broadband

The most common way to access the Internet in Serbia is mostly based on the first generation broadband. Thus, in the Republic of Serbia, over 80% of the population has broadband Internet access via xDSL systems. Given the existing copper infrastructure, this technique has been the best way of ensuring its maximum utilization. Lately, Internet access via 3G data cellular networks becomes more frequent, which is based on the technology that in mobile systems permits speed up to 42 Mbps, but lacks good coverage inside buildings and divided the capacity to larger number of simultaneous users. Deployment of LTE technology, operating in parallel with 3G, similar to having today the coexistence of GSM and 3G technology in the network, would provide much better rates.

The standard definition of broadband does not exist, although the term “broadband access” generally refers to high-speed Internet access. The International Telecommunication Union (ITU) defines a broadband network as a technology providing access to networks with data rates faster than primary rate ISDN (at 1.5 or 2 Mbps), while the OECD defines it as a technology providing downstream speed more than 256 kbps, and upstream access speed more than 128 kbps. In this Strategy, the definition of broadband is compliant with the definition of the EU Digital Agenda, i.e. fast Internet access provides a rate of 30Mbps and, and ultra-fast of 100Mbps.

Broadband should not be considered only in terms of access speed. The attention must be primarily paid to the conditions enabling intelligent connectivity and synchronization of different units that can be separately distributed over the network and combined with other services to create more complex applications. This will in the future allow for the management of buildings, power grids, transportation systems, roads, bridges, vehicles and workplaces, as well as how the development of broadband can improve the working and living conditions of the population.

Internet technologies are the most effective support to the development of the information society, as well as the crucial factor for economic growth and prosperity of a country. According to various studies that have been conducted in recent years in the world, it was found that an increase in the number of broadband connections directly increases GDP. In

addition to that, the fact that GDP and employment grow in parallel indicates that broadband has a significant impact on the growth of business and generates highly stable economic development. According to various analyses, when the economy of a country relies on broadband Internet access, an increase of GDP from over 4.1% up to 10% can be generally expected.

Table 3.1 Overview of technologies and required rates for the use of different services

Technologies	Bit rate	Time to download 1GB photo album	Time to download 4.7GB standard video	Services
FTTH	1 Gbps download 1 Gbps upload	9 sec	39 sec	Development services, telepresence, live streams, digital cinema and remote access to networks for different type services, regardless of location
FTTH	100 Mbps download 100 Mbps upload	1min 23sec	6min 31sec	Telemedicine, high resolutions, virtual video games, IPTV
CATV	50 Mbps download 10 Mbps upload	2min 46sec 13min 52sec	13min 2sec 1hr 5min	Telemedicine, broadcast video, HDTV, smart building management
DSL	8 Mbps download 1 Mbps upload	19min 0sec 2hr 32min	1hr 29min 11hr 54min	VoIP, e-mail, transmission of sound, transmission of files and monitoring from remote locations, video on demand

Table 3.1 shows the overview of required transmission rates necessary for the use of different applications and services by end-users and companies.

Positive economic growth generated by the increase in broadband penetration can be of great importance for both developed societies and developing societies. In combination with a variety of ICT services, broadband can significantly impact the economy by strengthening the value added and creating new jobs. Because of its nature, broadband technologies are defined as general-purpose technologies, such as in the past the transport networks and power grids were, that influenced the development of new products and different innovations.

According to the data of the Agency, which were submitted by operators of electronic communications networks and services, within the 2012 annual reports, distribution of broadband connections is shown in Table 3.2.

Table 3.2: Broadband Internet connections by data rates

Data rate in Mb/s	Share (%)	Number of connections (including mobile subscribers)
1-2	36.36	1 718 699
2-10	61.4	2 902 314
> 10	2.24	105 882

According to a recent OECD study, the economic impact of broadband networks increases exponentially with the penetration of the technology. The idea that ICTs are general-purpose technologies is based primarily on the concept associated with ICT investments going beyond conventional concept of capital investment in equipment. This is confirmed by the fact that knowledge has become qualitatively and quantitatively more important to economic activity. The application of ICT facilitates the communication and the creation of new knowledge through more efficient process of collaboration and data processing.

Table 3.3: Effects of an increase in broadband penetration

Effects	Impact	Explanation
Direct effects	Direct fostering value added	Direct investments in development and deployment of networks and technologies
	Multiplied effects	Impact of broadband to equipment suppliers and content providers
Indirect effects	Direct foreign investments	Direct foreign investments as a result of well-deployed ICT infrastructure
	Productivity growth	More efficient business processes thanks to connectivity
	Development of human resources	Acquiring new knowledge and skills, as well as developing services through broadband

Broadband impacts directly or indirectly various segments of society. Direct effects of broadband are reflected through the impact of investment in the development of technology and infrastructure, to fostering value added. As the broadband access networks further grow and deploy, demand and supply mutually influence each other and cause a significant increase in demands for higher rates.

As one of the solutions for the effects of the financial crisis, the EU Member States emphasize the central role of investments in communications technology within the economic stimulus package. Stimulating these investments they stop the emerging trend of falling demand, while laying the foundation for future innovation and productivity growth. All these factors cause a significant increase in demands for investment in next generation networks.

In addition to direct effects, the broadband has also significant indirect multiplied effects. On the one hand, broadband access affects the efficiency of the ICT sector, while on the other

hand, affects the creation of new products and services within the ICT sector, where providers of different services have the greatest benefit.

As broadband access networks are more available, the economy is more dependent on their continuous and constant operation. Sustainable and modern infrastructure may affect other factors of competitiveness and an increase in foreign direct investments. Broadband access increases productivity by reducing the costs of certain processes, providing access to big markets, raising capital and fostering labor productivity.

As it further develops, the broadband access becomes the main infrastructure support to the economy a country. Currently it is in its 2nd stage of development, having evolved from a data network connecting PCs with wires to a much broader network of new portable devices from mobile phones to tablet computers. Broadband networks make feasible for manufacturers and customers to freely trade even though they are in different locations. Another important impact of broadband is the development of human resources through better access to education and training, and improvement of health care.

3.2. Global trends in broadband Internet access development

ICT access is considered vital to the success of individuals and communities. The spread of broadband, and its related digital services and content, directly reduces the digital divide. Equally important for our country, in addition to provide what we see as traditional resources and services, is to reduce the digital divide between the citizens of the Republic of Serbia – in order to strengthen the whole society, both economically and socially.

There is a direct relationship between regular use of the Internet and broadband connectivity rates. Those regions with a higher proportion of broadband connections tend to have a higher share of regular Internet users. The graph below shows the level of broadband Internet access and use of the Internet.

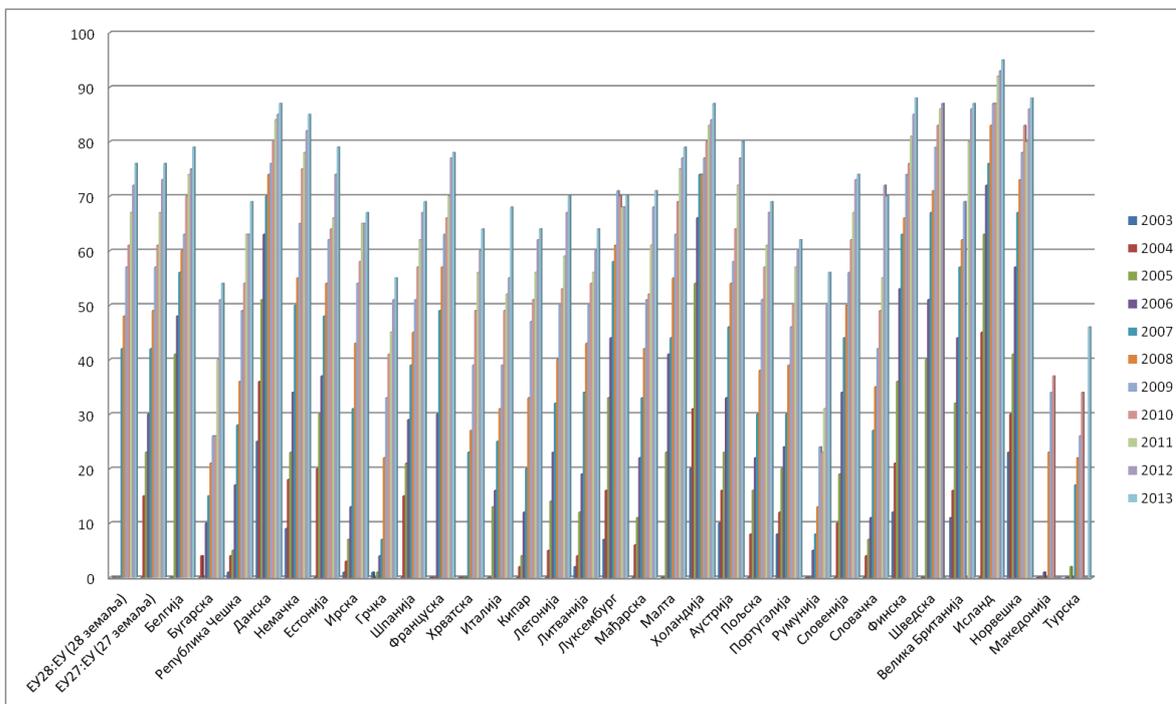


Figure 3.1: Percentage share of the population having broadband Internet access (source: Eurostat)

Efforts have been made to expand both the geographical reach and the speed of broadband Internet across the EU. Analyses show that in 2011 around two-thirds of all households in the EU-27 (67%) had broadband Internet access, a share that rose to 72% in 2012.

Availability and speed on broadband Internet are key drivers for achieving general economic goals. The relative importance of broadband Internet access in achieving economic goals grew at an average annual rate of 11.4% within the EU-27 from 2007 to 2012, which was slower than during the preceding 5 years, reflecting the fact that broadband connection rates were approaching saturation in some regions.

According to the data of the Statistical Office of the Republic of Serbia, 43.4% of the households in the Republic of Serbia have broadband Internet connection, which is an increase of 5.4% compared to 2012.

Mobile broadband penetration has grown to 68.4% in the OECD area, meaning there are now more than two mobile broadband subscriptions for every three inhabitants. Wireless broadband subscriptions in the 34-country group were up 16.63% from a year earlier to a total of 851 million, driven by continuing strong demand for smartphones and tablets. Six countries (Australia, Denmark, Finland, South Korea, Japan and Sweden) lie above the 100% penetration threshold, while Australia has edged into first place after a 13% surge in smartphone subscriptions in the first half of 2013.

Fixed wired broadband subscriptions in the OECD area reached 332 million as of June 2013, making an average penetration of 26.7%. Switzerland, the Netherlands and Denmark remained at the top of the table with 43.8%, 40.0% and 39.7% respectively.

The predominant type of broadband Internet access is through technologies using the existing infrastructure of copper wires (DSL, ADSL and ADSL2+), accounting for 57.9% in the share of fixed broadband Internet access. However, during 2013 a fall of these subscriptions was recorded, having in mind that fiber continued to gradually replace this technique (22%). The remaining market share is occupied by subscribers using a cable modem for Internet access (19%).

At the end of 2012 we reported the first drop in subscriber numbers for copper based technologies as 415 000 subscribers were lost in Q4. In 2013, the number of subscribers for copper continued to increasingly decay, as 2.77 million subscribers were lost. On the other hand, broadband Internet based on optic networks continues to dominate the overall trends in growth, experiencing a growth of 9.8% in the last quarter.

Double-digit annual growth in fixed wired broadband subscriptions was sustained thanks to increases in large OECD economies with low penetration levels such as France (32% in six months), Spain (34%), Turkey (33%) and the UK (47%). Japan and Korea remain the leaders in deploying optical networks, with fibre making up 68.45% and 62.76% of fixed broadband connections.

4. PRIORITIES AND PRINCIPLES OF BROADBAND DEVELOPMENT IN THE REPUBLIC OF SERBIA

4.1. Key challenges

Five key goals, consistent with with the National Sustainable Development Strategy, need to be defined to ensure sustainable development in the Republic of Serbia, as follows: EU membership, sustainable economic development through promoting innovation, social

development (development of human resources, employment and inclusion), regional development and environmental protection. Key development indicators are reflected through the following areas:

1. strong institutions promoting rule of law and harmonization with the EU acquis;
2. development of competitive market based on knowledge and innovations;
3. investment in people through education;
4. investment in infrastructure development, in both urban and rural areas;
5. rational use of resources and environmental protection.

Actual key challenges the economy of the Republic of Serbia faces, which need to be considered and dealt with:

1. Increase in competitiveness to fully benefit from the economic recovery;
2. Gradual transition to economy based on knowledge, research and development, which will enable efficient functioning of the country;
3. Increase in employment opportunities by becoming part of the European and world economy, by stimulating investment, and the stability of financial system.

Six areas have been identified in which appropriate changes need to be performed in order to achieve long-term goals:

1. Social inclusion;
2. Harmonization with the EU acquis;
3. Innovation;
4. Social development;
5. Development of smart grids;
6. Modern public administration.

Social inclusion: It is necessary to strengthen social inclusion and encourage youth employment. The economic growth reduces the digital divide between rich and poor regions, and the Government can, through a variety of programs, influence the development of innovative solutions for solving social problems.

Harmonization with the EU acquis: The Republic of Serbia must carry out and complete the process of harmonization with the EU acquis, given that it is one of the main requirements for EU membership. Goals and priorities of the RS must be aligned with the goals of the Europe 2020 Strategy and the Digital Agenda initiative.

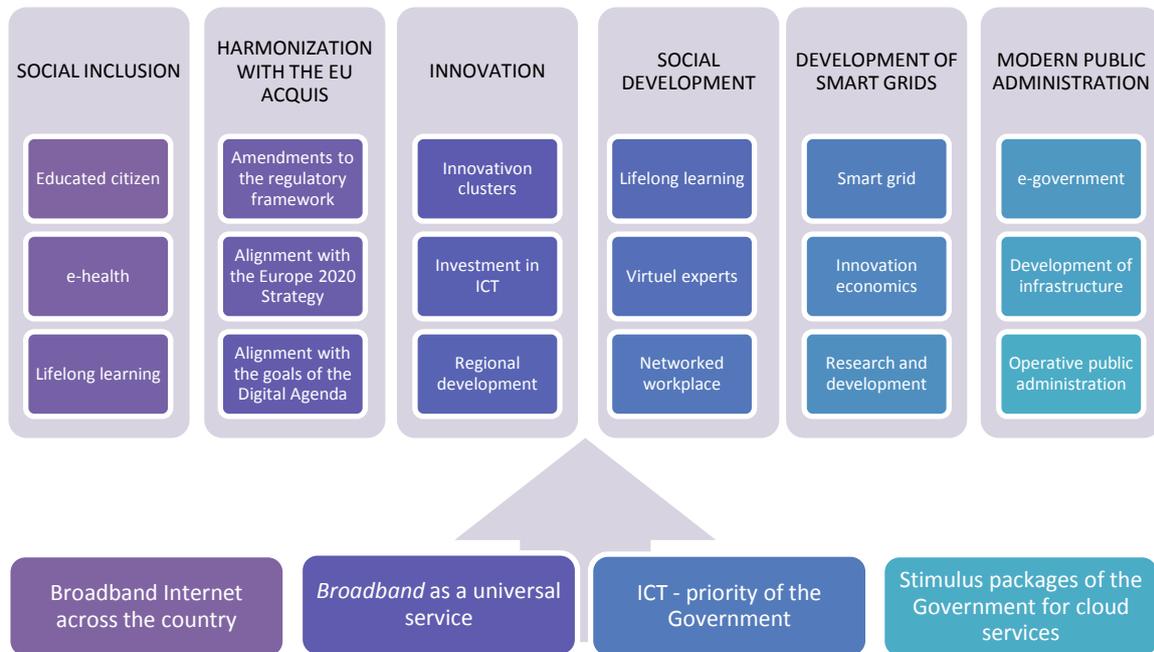


Figure 4.1.: Goals and areas affecting the overall economic development in the RS

Innovation: One of the instruments for the development of a competitive market in the Republic of Serbia is the transition to economy based on knowledge, research and development. Increase in investment in research and development (e.g. smart cities) and improvement of the quality of the education system (e.g. form innovation clusters between universities, government and private sector) are crucial for getting to innovation.

Social development: Regarding social development, it should focus on developing human resources, education and increasing employment rates. The main goals in this context are retaining experts, improving the quality and availability of labour and achieving a more flexible labour market. Lifelong learning, preventive health care, telemedicine and e-health available in rural areas directly affect the Republic of Serbia’s competitiveness. ICT solutions and services serve to reduce social inequalities in education, health care and basic needs of the population.

Development of smart grids: Sophisticated cooperation based on modern technological solutions is a decisive factor for the future economic growth. Smart grids are a major component of modern infrastructure. The economy of the Republic of Serbia has great potential for rapid and sustainable development if it focuses on investing in the development of broadband access networks.

Modern public administration: One of the main tasks is to make the work of the Government more transparent, to increase the interaction between citizens and facilitate decision making within the governing authorities, by using a variety of technological solutions. Creation of modern public administration aims at rationalizing the bureaucracy, transitioning to cloud technology, introducing electronic public procurement and promoting small and medium-sized enterprises.

4.2 Main principles of broadband network development in the Republic of Serbia

In the field of telecommunications and information technologies, five areas have been identified, linked by cause and effect, which are defined as priorities, and which will be implemented in line with the above mentioned principles:

1. Infrastructure
2. E-government
3. Education
4. Employment
5. Cyber safety

To narrow the digital divide among different regions of the Republic of Serbia, as well as within the municipalities themselves, it is necessary to encourage investment in broadband infrastructure, independent of access technology, with special emphasis on underdeveloped municipalities where the construction of fibre optic network would enable the development and inter-municipal connection to the city network as well.

In developing broadband services, the importance is primarily given to the free market. In areas where there is no sufficient commercial interest in investing in broadband infrastructure, it is necessary to provide state incentives, remove legal barriers and provide adequate administrative capacities. All the goals to be implemented by the Republic of Serbia for the development of broadband Internet access will be based on the following principles:

- Technological neutrality of networks and services
- Broadband access as a universal service
- Development of next-generation networks

Technological neutrality: This principle is based on the concept that the next generation networks may be based on different technology platforms. This will ensure interoperability in networks, devices and services, and will enable intensive development of applications and services that would be delivered on different platforms. The Government should, in particular, consider the adoption and implementation of new legislation on open and neutral character of the Internet, which protects the rights of users to access and distributes information online and ensures traffic transparency.

Broadband as a universal service: Bearing in mind that this-type networks require large start-up costs, the state needs to play a key role in encouraging investment in new technology solutions and wireless technologies. Achieving full digital inclusion and maximum benefit from universal fast broadband access is only possible with the support of local authorities and their impact on the supply and demand of broadband infrastructure. The impact of the Government also matters in the way of implementing broadband Internet plans that effectively coordinate large benefits achieved by investing in infrastructure in densely populated areas on the one hand, and much less financially attractive investments in underdeveloped areas on the other hand. The competent authorities shall influence the public sector to facilitate construction conditions for installations, broadband networks and the right to trespass on to somebody else's property or the right to use someone else's property (easement), where it is necessary for construction or installation of telecommunications networks, and maps of available passive infrastructure suitable for cabling. Wireless (terrestrial and satellite) broadband Internet may have a key role in covering of all areas, both rural and urban areas.

Development of next-generation networks: Today, Internet access in Europe is mainly based on first generation broadband. However, citizens and businesses around the world are demanding much faster Internet, i.e. Next Generation Access (NGA) networks. In this context, Europe is lagging behind some of the major international partners, therefore it adopted the DAE to narrow this gap. Significant development indicator of next generation networks is the development level of broadband networks whose architecture is based on fibre – Fibre to Home, which is quite underdeveloped in Europe, in particular in Serbia.

TECHNOLOGICAL FRAMEWORK

5.1. Networks

Modern electronic communication networks should secure data transmission using high data rates through buses and in the whole transport network, as well as broadband Internet access to every user. Transmission of information by high data rate ensures accelerated development of interactive and multimedia services, which the user accesses independently of his location. Therefore broadband access became an important link in developing rural and remote areas, as well as in developing industrial zones, and in interconnecting economic regions in a country. The use of new access technologies improves the quality of life by simplifying communication, easier and quicker access to information, access to new forms of entertainment and by enhancing the cultural life.

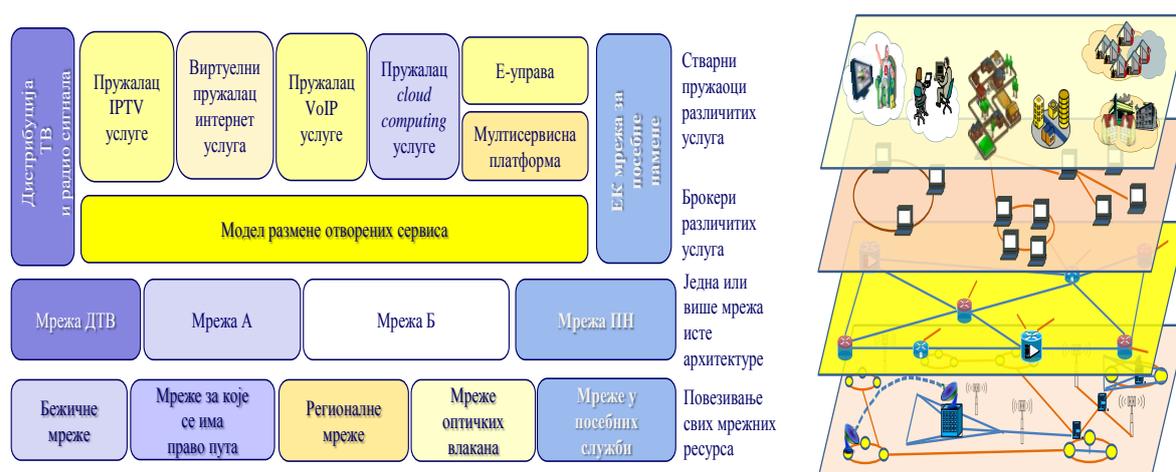


Image 5.1.: Model of exchanging open services in open electronic communications networks

*(Distribution of TV and radio signal, IPTV service provider, Virtual Internet services provider
VoIP service provider, Cloud computing service provider, E-government, Multiservice platform
Special purposes EC network
Open services' exchange model*

DTV network A network B network PN network

Wireless networks, Networks with pathway rights, Regional networks, Fiber optical networks, Special services' networks

*Real providers of different services, Different services' brokers, One or several networks with the same architecture
Connecting all network resources)*

According to the Strategy of Electronic Communications Development in the Republic of Serbia for the period 2010-2020, the open electronic communication networks' model based on which open services' exchange shall be implemented, i.e. resources shall be secured for distributing different services is shown in Figure 5.1. The model envisages an optical fibre network generated by merging available network infrastructure, enriched by networking with wireless capacities, where they are available and where it is necessary. Different operators can find their interest in merging parts of their capacities, thus forming a complex, ramified passive network which they can lease unused optical fibres (dark fibre), or other network resources. A service provider of passive capacities can be one or several operators.

Modern electronic communications' networks have been based on IP platform, so the network architecture that will be implemented in the future is of that type. Peculiarities of individual technologies exist, and they mainly refer to distribution of different contents to end users.

Open services exchange level provides complete network protection, as well as automatic operating control of all model components. This level contains interfaces towards end users, i.e. is responsible for the end users' market, but also interfaces towards virtual providers of certain services on upper level. The collection system is organized on this level. So, the exchange level connects virtual service providers with the end-users.

Virtual service providers can use all their resources in developing the service on IP platform, without an obligation to provide control, maintenance, even without marketing engagement.

In the complex network, however, it is possible to have different scenarios related to purpose of the network and desired services. Therefore special purpose networks (PN), functional systems or some other distributive systems can be separated already at passive fibre optical networks level, with defining competencies and obligations between operators.

5.1.1. Wired Networks

The concept of wired networks pertains to all network technologies which as a transmission medium use optical fibres or some hybrid combination of optical and copper ones. In accessing the end users hybrid networks use available copper cables. By using DSL (Digital Subscriber Line) technique, existing copper cables are used for introducing broadband Internet access, i.e. as a cable platform for transmitting television signals. Besides the opportunity to use DSL technique to enable access with relatively high data rates, we should stress out that this is an old technology, providing temporary solutions. Analysis of broadband networks' progress in Korea and Japan showed that the DSL technique achieves quick progress (case of Korea), but that this is still a temporary solution. In many cases copper cables have poor characteristics, disabling high data rates. Strategically, it must count on introducing optical fibres (as Japan opted).

This part presents a survey of broadband technologies, based on wired networks, achieving significant market presence.

Having in mind that the electronic communications systems are built in long term, as well that they develop by evolving, the final goal of establishing the networks is technological neutrality. On the other hand, the Internet technique has been widely accepted primarily due to flexibility and scalability. Thus, passive networks are connected on the physical layer, over which IP technology is established. The operators use available passive networks, by joining their forces based on their own interests, thus enabling formation of a complex IP network, optimized in such a way as to simultaneously meet the expectations of residential and business users, where they secure traffic control and other IP operator's functions. The advantage of forming an open, merged network is the creation of a services exchange base. Its architecture can be of ring type, increasing robustness and resistance to interruptions on optical fibre cables, or a star, where individual fibres are allocated to end users to whom division of bigger capacities FTTx (FTTN, FTTC, FTTB, FTTH) makes sense. In that regard, the network can be scalable, which is an indisputable advantage. On this level, one or several merged operators can be engaged.

As a good example of constructing local FTTH networks in municipalities, one can quote interconnecting optical network of Novi Sad Town, as well as setting basic infrastructure for building optical networks in towns like Sabac. Such optical systems development will lead to creating regional networks, resulting in fund savings in local public companies, schools, kindergartens, libraries, hospitals, healthcare institutions and other services and institutions of interest for municipalities and the need to outsource certain services from other

telecommunication operators will be decreased. The mentioned will lead to raising quality of public utility services to a higher level, securing the purpose and cost-effectiveness of investing in those municipalities, and the citizens will have available different advanced services through optical networks, like e-government services (e-health, e-education, e-banking, e-judiciary, etc.), video surveillance, wireless Internet, etc.

On the other hand, the demand for introducing broadband access for every citizen by 2020, which is the goal of ITU, European Union (EU Digital Agenda), and also of the Republic of Serbia (Digital Agenda of the RS), quotes as necessary introducing optical systems for electronic communications FTTx.

5.1.2. Wireless Networks

The wireless networks can be terrestrial and satellite based, or a combination thereof. Besides that, more usual classification of these networks is done according to the fact if users are at a fixed location or are mobile. With accelerated development of mobile electronic communication systems, the mobile networks become increasingly interesting, and in some circumstances, even dominant. New technologies in wireless electronic communications systems have converged and so significantly approached broadcasting mobile systems. The latest solutions, for instance of a television standard, DVB-T2 (Digital Video Broadcasting Terrestrial), as well as the fourth generation mobile systems LTE, have in common: multiplex access, modulation procedures, protection coding and IP technology basis. That infers that in the near future a solution for their joint work will be found, at least in a part of offered services, like television broadcasting.

In electronic communications technologies often overlap; new, much more efficient ones are introduced, simultaneously keeping the old, still profitable ones. Therefore, evolutionary approach is emerging. However, one should not insist on spreading the old technologies, because that can have quite a detrimental effect on the market, and introducing new ones should be left to the operator, who will exactly there see the opportunity to expand its own users' base, i.e. to increase profit thanks to new attractive services.

Because the radiofrequency spectrum is a limited natural resource, constrained by its limiting frequencies from 9 kHz to 3000 GHz¹, special attention must be paid to spectrum management. By introducing new efficient technologies, certain parts of the spectrum will be freed up. The freed up spectrum will be used whether for expanding services that freed the spectrum, or for introducing some other modern services. The freed up spectrum is considered to make a digital dividend, which as well as the spectrum, as a common good, belongs to the citizens. The most frequently mentioned dividend occurs during transition from analog to digital broadcasting. The freed up band is the most desired part of the spectrum – interferences and attenuations within it are acceptable, i.e. it is possible to build a network with the smallest investments, and within it antennas (primarily receiving ones) are of sufficiently small dimensions. Thus the UHF (Ultra High Frequency) band is called “sweet spot”. By choosing efficient standards for video signal transmission and compression, network type and architecture, it is possible to optimize the digital dividend.

The freed up band and mobile systems' demands have resulted in countries massively opting for allocating the dividend to mobile broadband services. The wish of all administrations is to thus enable Internet access in rural areas, and from the funds received by selling the dividend to enable further development of electronic communications.

¹ The EU has adopted a new Allocation Plan, ERC Report 25, using frequencies within the 8.3 kHz-9 kHz band for meteorological services, thus expanding the definition of radio-frequency spectrum to frequencies below 9 kHz.

In conclusion of discussing network technologies and standards for transmitting various signals one should point out to the fact that, besides convergence of techniques and technologies in the wireless systems, convergence is expanding also to the optical systems, like in case of standard DVB-C2 (Digital Video Broadcasting - Cable) for transmitting digital television signal in cable distribution systems. Thus the second television standards' generation for different platforms (for cable, satellite, terrestrial systems) and the fourth generation of mobile systems, like LTE, are close regarding applied technologies. Also, they all use the same - IP platform, and based on that ground, they are also close to IPTV systems. We should note that it is planned for 5G systems (fifth generation mobile systems) to operate on high frequencies, using similar solutions as 4G. High frequencies (28GHz or 60GHz) imply coverage at short distances. Therefore 5G systems shall be used in parallel with 4G. Let's underline that one of the reasons for accelerated introduction of new technologies and expansion of the broadband systems, is exactly such convergence of technologies.

5.2 Network Status in the Republic of Serbia

In the Republic of Serbia there are underutilized optical systems' networks. Therefore it is necessary in the next period to provide conditions for their interconnection, according to the adopted open network model.

By observing the existing state-owned capacities, primarily of "Telekom Srbija" a.d. (Joint Stock Company), "Elektroprivreda Srbije" (EPS), "Elektromreža Srbije" (EMS), "Pošta Srbije" (PTT), "Emisiona tehnika i veze" (ETV) and the level of necessary capacities for providing services and public administration services in the Republic of Serbia, a need for more efficient use of those capacities imposes itself, for their maintenance and further development.

According to the data published by the Agency, "Telekom Srbija a.d." has during the last year rendered services through public fixed telecommunications network and public fixed wireless telecommunications network (FWA). As the biggest active public fixed telecommunications network operator in 2012, its operations represented the most important segment in the fixed telephony market, both in the financial and in the technical sense. In 2012 "Telekom Srbija a.d." built 351 new base stations. "Telekom Srbija a.d." is the incumbent operator - the operator with significant market power, so it is obliged to render services under certain conditions.

EPS and EMS: A few years ago new telecommunication system implementation started for the needs of power engineering companies in our country, which has been finalized. All designed bus level networks have been completed. "Overview of Telecomm Market in the Republic of Serbia in 2012", quotes that the project of installing optical cables at the bus network layer has been completed and, due to a clear need for new telecommunications connections in lower levels, both regional and local, the network is currently expanding in this direction. Thus current implementation and immediate plans are focused on covering the entire 110 kV power transmission network. In that way, optical cables connect all important power supply facilities in the Republic of Serbia. At the end of 2011, the already rolled out network reached the total length of over 6,000 km of OPGW (Optical Ground Wire), ADSS (All Dielectric Self-Supporting) and connecting underground optical cables. The network reaches nearly all important facilities in the power supply system of the Republic of Serbia. With further development, it will practically cover all significant points in the country, which is very important, both in terms of the power supply and telecommunications. Further development towards regional and local layers will surely make it most widely distributed optical transfer medium, with multiple usage capabilities.

PE ETV has more than 260 broadcasting stations with transmitters and repeaters, among which is Avala Tower. The most important task of the company is creating the conditions for

transition to digital broadcasting of radio and television programmes over terrestrial transmitters, and its main obligations are: to ensure conditions for unhindered functioning of broadcasting infrastructure serving for broadcasting radio and television programmes; to regularly maintain and develop broadcasting infrastructure capacities and interconnection systems, to enhance their technical-technological interconnecting into a single system and to contribute to harmonization of the broadcasting system of the Republic of Serbia with broadcasting and interconnection systems of the other countries. PE ETV owns the following equipment: radio and television transmitters, microwave connections and antenna systems.

Telecommunications networks in “Železnice Srbije” a.d. (Serbian Railways) use the following types of transfer media:

- transmission over cable lines,
- transmission by radio.

Optical cables were laid within the Belgrade railway node, in the total length of 21 km. Optical cables were laid along Pozega-Kraljevo route in the total length of 65.7 km (source: RATEL).

Radio link systems are a single technical and technological unity in terms of their operation and usage. Radio-links are increasingly being employed in the railway system, specifically due to their flexibility, availability and quality of service, which is of great important for the operation of railways.

The network infrastructure of AJSRO (“UZZPRO”) connects the governing authorities in Belgrade into a single computing-communication network through optical cables – dark fibre. AJSRO leased, based on Dark Fibre Lease Agreement, concluded through public procurement, from PE PTT Serbia, around 200 kilometres of optical fibres by 2015, in the territory of Belgrade, for the needs of operations of the governing authorities. AJSRO also concluded with “Telekom Srbija” the Agreement on Telecommunication Service - High Speed Internet Access 400Mbs and the Agreement on providing L3 VPN Telecommunication Service, which are shared through mentioned optical cables between the governing authorities.

The network infrastructure of AMRES connects academic, scientific-research and educational institutions of the Republic of Serbia into a single computing-communication network. AMRES infrastructure network consists of access network, backbone and external links. The access technology mainly used for connecting the institutions to AMRES network is fibre-optics (FTTB), and xDSL VPN and analogous links to a lesser extent. The Dark Fibre Lease Agreement made between “Telekom Srbija a.d.” and AMRES enabled leasing around 3800 kilometres of optical fibres by 2026.

According to the Law on Electronic Communications, during applying for registration with the Register of Public Network and Service Operators, the network and service operators deliver to the Agency a short description of their network and services, but not their relevant projects. Out of that reason this Strategy has just the relevant data about infrastructure, available to the network and services operators, which are available to the Agency. Because there are no data about other operators, based on this, it can be concluded that it is necessary to urgently compile Infrastructure Atlas, in order to create equal conditions for operation in the electronic communications market and in order to secure operational predictability.

5.2.1. Infrastructure

Infrastructure that supports different network technologies should, above all, facilitate the spread of optical systems in urban areas, as well as in parallel to main roads. Infrastructure development could be supported by passing regulations that would provide transparent and relatively flexible licensing for the construction of electronic communications. It should be borne in mind that wired network technologies and networks cannot be regarded as limited resources. It is, therefore, in the interest of the population, to lay more optical fibres, thus increasing competition in the market and reducing the cost of leasing passive network resources. The point of market regulation is to ensure equal conditions for all market participants.

One of the good ways to improve working conditions would be transparent notification of interested parties so they, in building roads, can share the cost, or lay pipes for optical cables by themselves. It should be seen as a resource for the development of new systems in the future.

Defining infrastructure atlas is also crucial to the efficient development of telecommunications infrastructure, which would accelerate the development of new infrastructure, on the one hand, but on the other hand, it would be a good guide to potential investors. The Infrastructure Atlas will involve an analysis of broadband availability and deployment. This will identify the current state and create conditions for drafting measures and models to support the development of broadband networks, especially in rural and less economically developed areas. Optimal solution will be proposed for each considered area, depending on its structure, and construction cost estimates per broadband connection in urban and rural areas.

5.2.2. National network of the Republic of Serbia

Large companies, especially public companies that perform main activities within complex systems must provide network resources to perform management, control, maintenance or transfer of data between many locations where parts of these systems are located. If it is the case of a large number of remote locations, a simple analysis shows that the cost-effectiveness of optical communication systems is significantly higher than wireless ones. In addition, electronic communication systems using optic cables are less sensitive to the environment with electromagnetic interference, which is the reason of their widespread application. It is therefore understandable why in such cases optical networks for the systems themselves have been developed. On the other hand, the capacity of optical fibers is far greater than what is necessary for the operation of the system. It should be borne in mind that the cost of fibers accounts for the smallest part of the cost for building fiber optic networks. Difference in the costs of cables carrying small number of fibers, and those carrying tens of them, is relatively small. It is, therefore, realistic, and economically and technically sound, to build networks of relatively high capacities. In this way, the state through its public enterprises, joint stock companies and organizations possesses large and high quality telecommunication systems for performing services and providing services necessary primarily for these institutions. The unused portion of these capacities may be used to provide services to the state authorities. The above capacities are not merged, they were developed separately, with the aim to meet the needs of institutions that built them, therefore they need to be consolidated. In addition to the developed and relatively high-quality network of "Telekom Srbija"^a, modern technology (optical communication systems) enabled during planning and rolling out special purpose systems such as of EPS, EMS, Železnice Srbije, PE PTT - a (and other smaller but not negligible capacity of the National Bank of Serbia, Ministry of Finance - Tax Administration, Customs Administration, Srbijavode, PE

Srbijašume, Republic Health Insurance Fund, AMRES) building of additional capacities, which can be used for more rapid development of broadband networks and services in the Republic of Serbia.

Merging the remaining available capacity may be, according to Figure 5.1, performed at the level of basic network resources, on the IP level, or on the level which integrates support to various services. This procedure should be performed by the network operator to whom all resources are available and who would ensure proper utilization of the same for all state authorities.

The mentioned operator would be entrusted to merge network resources, since uncoordinated usage of the above mentioned resources is a permanent loss, especially for citizens whom many electronic government services need to be provided as soon as possible, i.e. services whose introduction would improve the quality of life by providing information about traffic, weather conditions, cultural events and many others. Supply of these services would be a good basis for promoting the introduction of broadband networks and access, which would further also encourage private initiatives in this area.

5.3. Services

Strong contribution to the introduction of new services comes from video applications, as well as a variety of electronic services (e-payment, e-health, e-...). It is evident that network resources are not sufficient, services are also necessary. Full benefit from ICT can be achieved only in the synergy of developing networks and services. The conclusion is that we should introduce open networks (contents are transferred by different ways of networking of different transmission systems) on which open services develop (from which it continues to develop innovative solutions for a variety of mostly interactive services).

In current networks hardware devices or their components are increasingly being replaced by software solutions. Many features in modern production systems are being left to software solutions that are executed at remote sites. Due to the fact that very different processes take place on remote locations, to which software solutions cannot be individually fully customized, offered services are commonly planned as open, and the user has an opportunity to develop own-specific applications. This is the reason for introducing open services as non-linear services.

5.3.1. Software defined networking

Starting from the described model of an electronic communications network as an open network supporting open services, it is possible to introduce a new architecture based on IP technology.

Software Defined Networking (SDN) is an approach where computer network and software separate the data plane from the control plane. This kind of networking allows the network administrators to manage the network through abstraction of lower level functionality. Thus, decisions about where to traffic is sent (which is the role of the control plane) from forwarding traffic to a selected destination (the data plane) are made separately. This kind of networking allows flexible changes of network architecture and is a good basis for, among other things, introducing cloud technology.

5.3.2. Internet of Things (IOT)

Due to the rapid development of the Internet and services that are offered through IP networks, as well as a trend known as the "Internet of Things" (IOT), it is easy to imagine the daily life which would provide every citizen with a simple and efficient communication in all areas of business and entertainment. It is necessary, for this purpose, to provide support to various types of networks.



Figure 5.2 Coverage and capacity affect quality of service / customer satisfaction

The first question that arises in planning the present scenario is related to the required network resources where optical electronic communications systems are unavoidable, due to the high capacity provided. On the other hand, demands for services that do not restrict the mobility of users are increasing. Therefore, the range, or territory coverage of the signal of a wireless transmission system is placed in the foreground.

5.3.3. Internet of Everything (IOE)

Adopting growing trend of the Internet of Everything (IOE) companies can benefit from higher operational efficiency, enhanced customer service, and more innovations. Over the next decade, the competition will be based on how well companies will understand and adopt the Internet of Everything – not only through technology and business, but through the way of connecting with clients and partners. More and more smart factories with automated systems, robots and sensors monitoring energy consumption, supply chain and quality, will be seen in production.

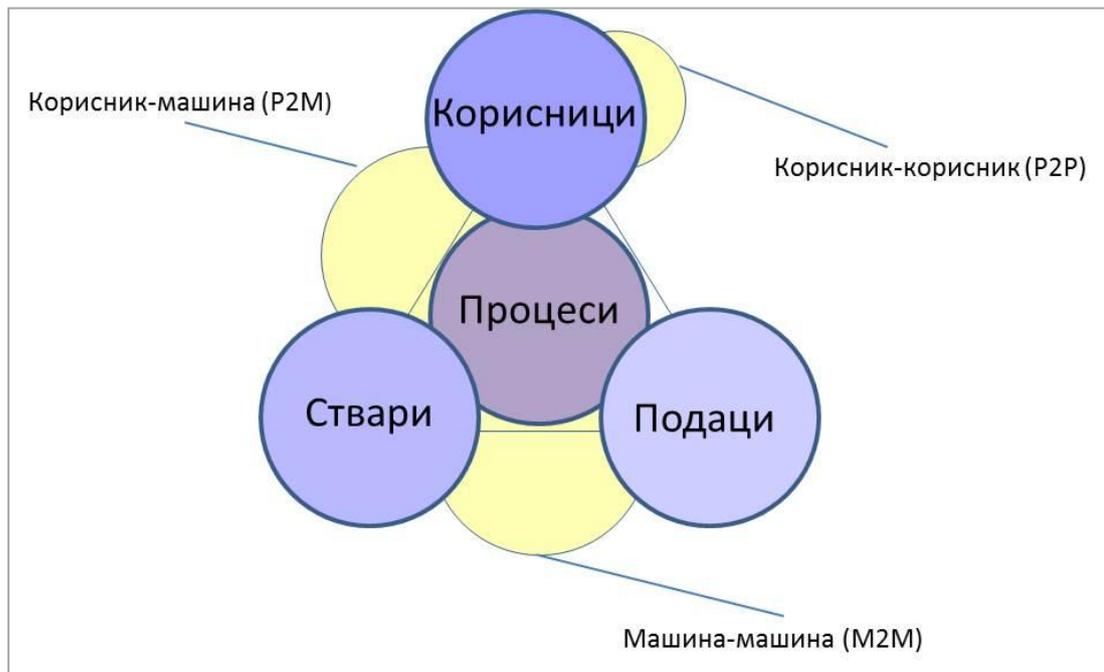


Figure 5.3.: Internet of Everything

*People to Machine (P2M) People to People (P2)
 People, Processes, Things, Data
 Machine to Machine (M2M)*

The Internet of Everything refers to the networked connection of people, data, process and things (sensors) and increased value that occurs as “everything” joins the network. Several technology trends, including the Internet of things, increased mobility, the emergence of cloud computing and the growing importance of big data, are all helping to enable IoE.

5.3.4. Cloud Computing

Although the SDN way of connecting is very efficient from the point of utilization of computing resources, it should be noted that the current development trend of networks is such that cloud computing is increasingly being used (use of the network regardless of location of the access to different-type service network).

Generally speaking, cloud computing offers three types of services:

- Infrastructure as a Service (**IaaS**), provides provision processing, storage, networks, and other fundamental resources where the user is able to deploy own software (including operating systems and applications). This service is very interesting for companies to remotely access demanding materials (videos, databases, etc.). For example, a video can be set on the cloud from a laptop. Only those who possess necessary codes can access it through the network of mobile electronic communications systems.
- Platform as a Service (**PaaS**), this model is introduced so as developers could prepare a platform where they could continue to develop end users’ software. PaaS provides basic protection, scalability, operating system patches. PaaS providers usually use **infrastructure** of other IaaS providers. In this way, they are engaged in systematic programming and provide a base for developing services and programming on SaaS level.

- Software as a Service (**SaaS**), pertains to services run on the cloud. Applications can be accessed through different interfaces and browsers.

Services are classified according to the layers where they are virtualized. The introduction of cloud computing simplifies network architecture, particularly for high-demanding services that are based on the use of video and other signals, based on large databases. It could be said that the introduction of cloud computing has greatly changed the architecture of future television and radio stations. Many operations and devices that were considered indispensable in the production have now been replaced by the cloud.

Cloud services provide many benefits to small and medium sized enterprises, as they eliminate the need for jobs which do not require, by their nature, full-time work. Also, private initiative for starting small-sized businesses is significantly encouraged. Employers do not have the fear, in the event of beginning failure or similar problems, to be burdened with unrealistic payments.

Cloud can be successfully applied to all applications that require access to applications from a large number of remote locations, for example: in traffic control, collecting payments, control of fire or other disasters, creating an museum electronic archive or electronic library funds and similar.

So, the introduction of cloud can reduce investments and operational costs. Therefore, the described technology is suitable for developing countries. It should be stressed that cloud technology introduces the possibility of a more efficient development of PPP (Public Private Partnership), i.e. association of private and public networks.

The existence of broadband networks with secure high-rate access is necessary to enable end-users to use any of the above function. Investment in broadband networks is again actual, because software, infrastructure and different platforms are accessed over a network, wireless or wired one.

5.3.5. Telemedicine

According to the World Health Organization, e-Health is understood to mean the integration of telecommunications systems into the practice of protecting and promoting health, while telemedicine is the incorporation of these systems into curative medicine. E-health covers education, public and community health, health systems' development and control of epidemiology, whereas telemedicine is oriented more towards the clinical aspect. E-health would mean the use of information-communication technologies (ICT) for the transmission of health care information for clinical, administrative and educational purposes. In addition, there is one more important area of ICT in medicine, and this is telecare. It deals with delivering clinical care to remote patients. Boundaries between these terms are blurring by time leading to the common term "e-health" which will cover all aspects of telemedicine and telecare.

Telehealth (e-health) implies that the health care is provided over the Internet and includes a variety of informational, educational, commercial and the service provided by both professional and non-professional staff, business people, and even the users themselves.

It is often said that e-health services encompasses "6 Cs":

- content,
- connectivity,

- commerce,
- community,
- clinical care and
- computer applications.

5.3.6. TV service in IP network environment

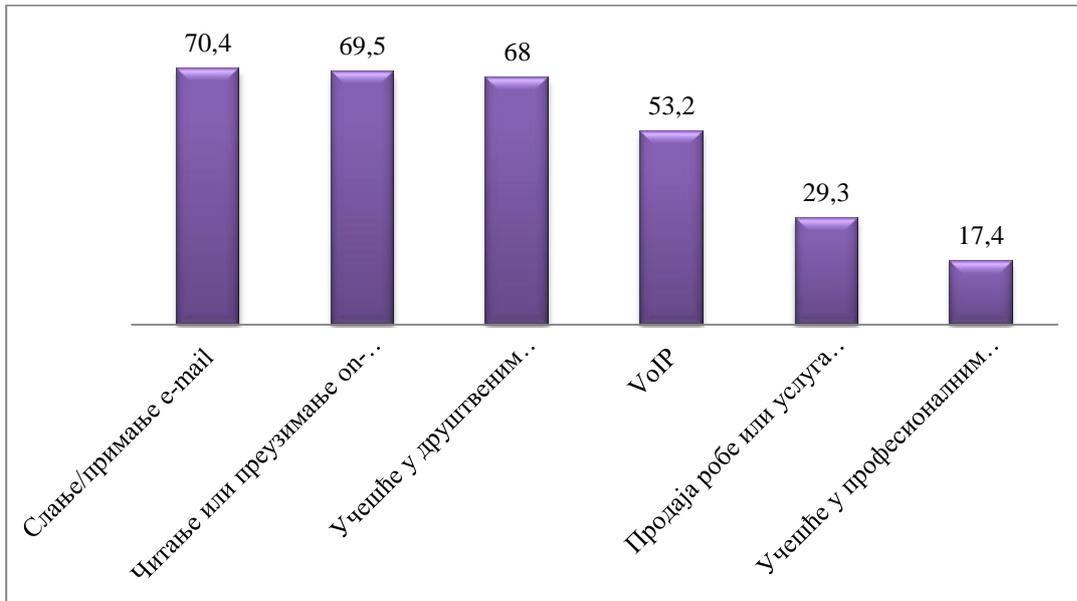
Along with the intensive development of television standards using classical media (satellite, cable and terrestrial transmission), IPTV also develops. This is a technology that allows TV service to be transmitted over IP-based networks. It provides two-way communication and quality of service is pretty unified. Communication in IPTV, comparing to broadcast (one-to-all communication), so far common in TV, is multicast (from one-to-many users over IP network). Users access a multicast group on demand. The signal source is at the operator, and TV signal is efficiently transferred over the network to all users who demanded connection to multicast group. As this technology features an integrated return channel, a variety of benefits such as "video on demand", quality control, watching statistics and similar, are available in IPTV broadcasting. The number of IPTV subscribers is growing in many countries, and its popularity, as well as in traditional cable distribution systems offering audio-visual services, depends on offered content.

In addition to IPTV services, television programs can be watched over the Internet, which is very popular with young people. This resulted in developing connected TV (or smart TV) standards, which provide viewers unprecedented possibilities in the choice of content. It is particularly interesting that set-top-box devices for terrestrial television systems have the ability to connect to the Internet. Such service is beyond the ability of other standards such as MHP (multimedia home platform) which was developed within the DVB project, which was expected to be widely used.

5.4. Situation in the Republic of Serbia – Services

According to the data of the Statistical Office of the Republic of Serbia, over 2 400 000 persons used the Internet every day in the Republic of Serbia, which is an increase of over 300 000 compared with 2012. Conducted analysis showed that the Internet in Serbia is most commonly used for: sending/receiving e-mails, reading or downloading on-line journals, participating in social networks, searching (web browsing), playing video games, downloading movies or music, listening to radio or watching TV, VoIP, e-banking, selling goods or services over the Internet.

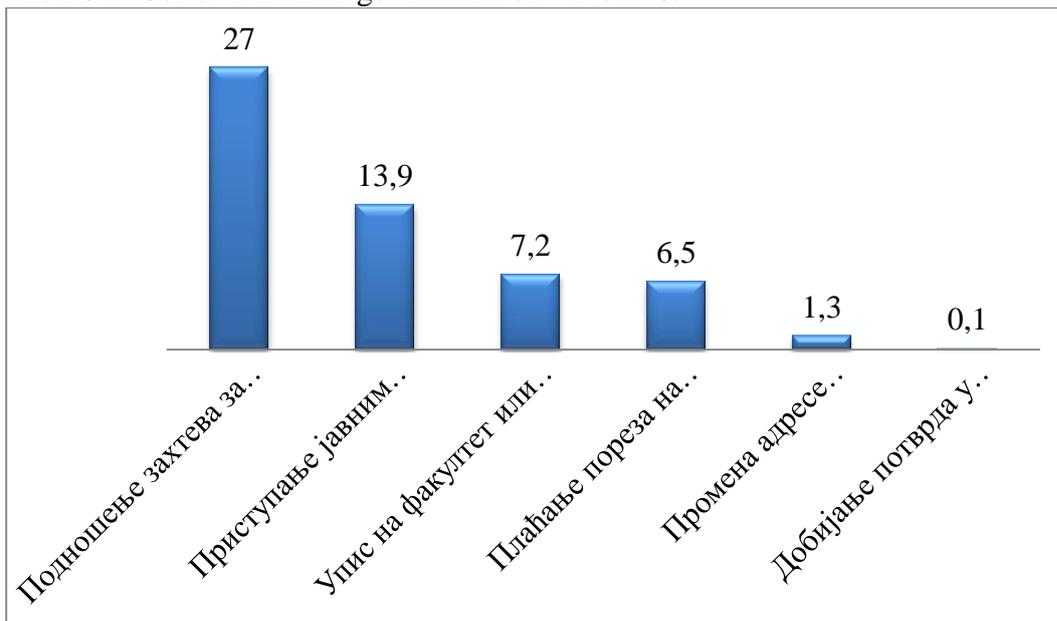
Table 5.1: Use of services over the Internet in %



Over 806,000 individuals in the Republic of Serbia use the electronic services of the public administration (electronic government services). Surveys showed that during 2013 electronic government services were mainly used to apply for issuance of personal documents (27%), access to the public libraries (13.9%), admit to a university or other educational institution (7.2%), pay income tax (6.5%). During the first three months of 2013, 19.6% of respondents used the Internet and e-Government to inform about the work and services provided by public institutions, 13.9% of the respondents downloaded official forms, and 10.6% of them sent completed forms.

In the Republic of Serbia 87.6% of companies with Internet connection use electronic government services, out of which 81.1% use e-government services for obtaining information, 80.8% for obtaining forms and 59.9% for returning completed forms.

Table 5.2: Use of electronic government services in %



Regarding e-business, over 900 000 individuals in the Republic of Serbia purchased or ordered goods or services over the Internet over the last year, which is an increase of 300 000 users compared to 2012. Clothes and sporting goods, household goods, electronic equipment, books, magazines, newspaper and tickets for cultural events were mainly bought.

In the course of 2012, 38.6% of companies used the Internet to access the tender documents in the electronic public procurement system, while 29.2% of companies used the Internet to offer goods and services through the same system.

6. CONCLUSION

Considering the impact that the implementation of modern telecommunication systems brings in terms of development – economic, technological, industrial, and the overall progress of society, while applying positive practices of developed and developing countries, the implementation of this Strategy should provide conditions required for more comprehensive application of the Internet, and consequently, modern services and features. Their use will result in a considerable increase in business efficiency, of large systems as well as individuals, and also significantly impact the degree of development in manufacturing, industrial, banking and commercial sectors.

In spite of the global economic crisis, the increase in broadband market share is one of the few trends which managed to sustain positive results. The increase of broadband penetration rates creates positive economic impacts, which are very important for further development of society. Broadband networks are a platform for providing services which require faster exchange of information. Provision of a variety of ICT services boosts value added in terms of economy, and facilitates the creation of new jobs. Various studies show that the development of broadband directly impacts GDP growth. Areas which also experience substantial positive impact are reduction in public administration costs, creation of new jobs, and increase in productivity.

Taking necessary steps for broadband development requires detailed analysis of accessibility of these systems in certain regions of the Republic of Serbia. It is therefore expected that the ministry responsible for electronic communication, using data from all operators, will compile maps indicating presence of broadband networks, particularly access networks, to be developed in each region. This is extremely important for the efficient application of selected types of technology.

The Republic of Serbia aims to develop fibre optic lines along major traffic routes, wherever absent, and in urban areas, wherever not yet developed. Rapid deployment of broadband is a major opportunity for the Republic of Serbia to speed up its overall development and overcome its current economic difficulties.

A good way to inform investors interested in developing fibre optic networks would be to publicly announce opportunities for financing or co-financing installation of tubes carrying cables and/or optic cables during construction of roads and types of traffic routes. However, in order to speed up infrastructure development, the existing legal framework should be improved, as well as more consistently implemented.

Keeping in mind the context of the global economic crisis, and the fact that it is not easy for any administration to set aside major funds for infrastructure projects, such as the broadband network, investors should be encouraged by expediting permits required for network development. We should also keep in mind that this issue will increasingly be present in EU

funded projects, and clear and precise documentation should be compiled in order to facilitate quick future application for various programs.

The state must define mechanisms for efficient use of radio frequency spectrum in order to get ready for introducing new broadband wireless technologies. The part of the spectrum released in the process of replacing technologies, in all transmission techniques, is called the digital dividend. Due to the great interest of mobile operators for freed up spectrum, it is expected to be allocated for mobile broadband systems, and broadband introduction. This would, to some extent, reduce the gap compared to the developed countries. The digital dividend is regarded as one of the most important links in the process of exit from the current economic crisis. Analysis showed that the sale of capacity, based on the digital dividend, could achieve a twofold benefit: development of broadband access for all citizens, as well as financial gains for the state. Both lead to economic prosperity because the broadband provides a way to increase the standard of not only ordinary citizens, but also the development of small and medium-sized enterprises, and thus a significant impact on the economy of the country.

It is necessary to implement the project of consolidation of the public sector network, clearly define policies and standards for networking state institutions, and coordinate further development. A prerequisite for efficient and consolidated development of the national network is the adoption of effective and appropriate institutional framework for the development of ICT in public administration based on openness and interoperability. One must take into account that different institutions have different needs and standards in the field of security of access to infrastructure. The consolidated national network should be decentralized but well-coordinated. Consolidation should be made within the respective networks. The network shall be established by using both its own and leased fibers and contracting partnerships with the private service operators. A prerequisite for the implementation of this solution certainly implies the existence of political decisions to direct the public administration to use and provide common ICT services.

Creating conditions for the introduction of functional e-administration is also crucial for further development of broadband. Faster development of e-administration and expanding the number of online services offered to users will result in an increase in the quantity of transmitted data, and generate user demand for better performance of telecommunication infrastructure. This can speed up investments on the one hand, as well as provide a higher quality network on the other. Development of e-commerce should under no circumstances be overlooked, primarily the development of payment via mobile phones (m-payment), as this service stimulates broadband development and increases data traffic, as well as making the country's economy even more competitive. Global trends show that the Internet economy will grow 8% annually, while in developing markets, it will grow more than twice as fast. The legal framework in our country is not entirely conducive for the development of online trade, but consumer habits also play a role in the development of this type of commercial activity, as well as inadequate computer literacy. This is why particular attention should be paid to education and continuous improvement of digital literacy.

Without investing into education and raising the level of digital literacy, we cannot expect to see rapid progress in the country, i.e. economic development. Our country was always rich in human resources, but the pace of technological development in the 21st century is so rapid, that our need for a workforce with ICT knowledge grows daily. Unless we urgently implement concrete measures in this area, we may find ourselves without quality staff, and implementation of new technologies will subsequently slowdown, which may result in withdrawal of investors or reduction in investment rates.

7. ACTION PLAN FOR IMPLEMENTING THE STRATEGY

The Action Plan is enclosed with the Strategy and forms its integral part.

8. FINAL PROVISION

This Strategy shall be published in the “Official Gazette of the Republic of Serbia”.

05 Number:
In Belgrade, 2014

GOVERNMENT

PRESIDENT

Aleksandar Vucic

**ACTION PLAN FOR IMPLEMENTING THE STRATEGY
OF BROADBAND NETWORK AND SERVICE
DEVELOPMENT IN THE REPUBLIC OF SERBIA BY 2016**

Description of Activity	Implementation deadline	Indicator	Responsible authority	Partners
1. Legislation				
Improve regulatory framework for standards and deployment of telecommunications infrastructure	2 nd quarter of 2014	Law on Planning, Design and Construction	MCTI	MTTT
Draw up Draft Law on Information Security	2 nd quarter of 2015	Draft Law on Information Security adopted by the Government	MTTT	OCNSCIP, MoJ, MPALS, MoI, MoD, SIA, AJSRO
Develop Study on Digital Dividend Exploitation 2	1 st quarter of 2015	Study on Digital Dividend Exploitation 2	MTTT	
2. Radio-frequency spectrum				
Draw up a Plan for releasing parts of radio-frequency spectrum	4 th quarter of 2014	Plan for released parts of radio-frequency spectrum for digital TV broadcasting and mobile telephony in line with the Frequency Allocation Plan	MTTT	RATEL, MoI, MD, SIA, MoF
Draw up Allotment Plans in order to align them with the Frequency Allocation Plan	4 th quarter of 2014	Allotments plans and Allocation Plan aligned.	MTTT	RATEL, MoI, MoD, SIA

Description of Activity	Implementation deadline	Indicator	Responsible authority	Partners
Release digital dividend spectrum	In accordance with adopted stages of the Transition Plan, not later than the completion of the transition to digital broadcasting	Digital dividend spectrum released.	MTTT	Users of spectrum
Decision on allocation of the digital dividend	In accordance with adopted stages of the Transition Plan, not later than the completion of the transition to digital broadcasting	Public Consultation on the digital dividend, Decision on allocation of the digital dividend made	MTTT, Government	
Conduct the digital dividend auction	In accordance with adopted stages of the Transition Plan, not later than the completion of the transition to digital broadcasting	Auction launched, the digital dividend allocated	RATEL	

Description of Activity	Implementation deadline	Indicator	Responsible authority	Partners
3. Infrastructure				
Develop Design of National communications network	3 rd quarter of 2014	Design of National communications network developed	MTTT	AJSRO, SIA, MoI, MoD
Develop broadband (availability) maps	4 th quarter of 2014	Available maps	MTTT	Operators, RATEL
Technical-economic analysis of broadband availability	4 th quarter of 2014	Availability analysis conducted	MTTT	RATEL, operators
Drawn up draft model for stimulating private initiative for broadband development	1 st quarter of 2016	Draft model drawn up	MTTT	SCC, Serbian Association of Employers
Promote development of broadband networks and services in local self-governments	2 nd quarter of 2016	Broadband network of local self-government authorities	MTTT	SCC, MPALS
4. Services				
Promote demand and usage of new services based on broadband by citizens and businesses	2 nd quarter of 2015	promotional material in electronic and hard copy prepared, promotional campaign conducted	MTTT	SCTM, operators, DeG

ABBREVIATIONS:

AMRES – Information – communication institution “Academic Network of Serbia”

SIA – Security Information Agency

DeG- Directorate for eGovernment

OCNSCIP - Office of the Council on National Security and Classified Information Protection

MCTI – Ministry of Construction, Transportation and Infrastructure

MPALS – Ministry of Public Administration and Local Self-government

MoD – Ministry of Defence

MoJ – Ministry of Justice

MTTT – Ministry of Trade, Tourism and Telecommunications

MoI – Ministry of Interiors

MF – Ministry of Finance

SCC – Serbian Chamber of Commerce

RATEL – Regulatory Agency for Electronic Communications and Postal Services

SCTM – Standing Conference of Towns and Municipalities

AJSRO – Administration for Joint Services of the Republic Bodies