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THE ROLE AND IMPORTANCE OF THE “NATIONAL ROAMING” IN EMERGENCIES

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Abstract: After having analyzed recent catastrophic events that happened in the Republic of Serbia caused by flash flooding, at first glance the struggle with floods seemed to be lost. Yet, famous Serbian persistence or just a mere struggle for life of the citizens who showed extraordinary social solidarity in such difficult moments were crucial once again. The unity was expressed in many ways, by providing assistance to the most vulnerable people in the evacuation of flooded areas, delivering basic foodstuffs and medical assistance, as well as in the field of telecommunications whose scope of work was very important but publicly invisible in

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such critical moments. Without such “key hub” that connected all relevant state factors into a whole providing them constancy and continuity in communications, everything was pointless. This event, no matter how difficult and tedious, opened the subsequent analysis of many issues and spawned some great ideas. One of them is legally obliged introducing of “National roaming” at all telecommunication operators in our country, which is also discussed in this paper.

Keywords: national roaming, telecommunication operators, users’ networking, legal regulation of roaming

Introduction

Mobile phones and wireless communications in general are kinds of technologies that have been deeply involved into social life as its essential part. Nowadays, human life can hardly be imagined without cell phones. Also, everyday innovations in the field of wireless communications announce further radical improvement. Therefore, we can say that the development of these technologies has had an impact on the development of modern mankind. Access to the abundance of information enriched with multimedia content, slowly but surely becomes our lifestyle transforming the world into a “global village”. The possibility to access information easily and quickly from almost any place and at any time gives our lives a completely new dimension. The increasing flow rates of information and achievements implemented in the field of mobile and wireless communications open up completely new possibilities for interaction, not only with sources of information but also the people in general. Rapid development in this field has completely surpassed traditional fixed telephony for less than 30 years. Every day millions of citizens of Europe and the world rely on mobile phones to work, access various services, bill payment and various types of assistance, social life, leisure, but also, if necessary, *emergency services*. This is especially important in emergencies, when the security and stability of communication systems is of crucial importance for the security of life and property of citizens.

Mobile communications systems are very complex, especially sensitive and unstable during natural disasters (earthquakes, floods, etc.), so interruptions are part of everyday life. Therefore, mobile network’s breakdowns can have serious and major consequences on economy of a country. Studies have shown that the EU member states reported 79 significant incidents in the field of electronic communications in 2012. Most of these incidents have significantly affected the stability of the mobile telephony and mobile Internet.

This paper is demonstrating the seriousness and importance of the problem. At the same time, through analysis of the state of mobile and wireless communications but with practical examples and experiences of relevant subjects in recent emergencies, it was shown how roaming at national level – “national roaming” can be successfully used to improve the resistance of mobile communications networks and services in case of larger failures of the system, especially during emergencies.

1. The concept, types and manner of functioning of roaming

The term “**roaming**” in wireless telecommunications refers to mobile users’ ability to continually realize their voice calls, send and receive messages, or access other services including home ones, and while traveling outside the borders of the geographical area covering the national telecommunications network service to use service network of the visited country at the same time. In practice this means that roaming ensures the wireless telecommunication devices (mainly mobile phones) to maintain a persistent connection to the home network without any interruption. For example, if you travel abroad, your cell phone signal will not be interrupted at the moment of leaving the coverage area of the transmitter’s network bandwidth of your home mobile operator, but will automatically be taken over by visited mobile network operator that is available at that moment and that your home network has a roaming agreement signed with. In this way, the continuity and constant functionality of your mobile device are ensured, considering that nowadays a mobile device is not a luxury but an absolute necessity. This is of great significance especially in the case of providing emergency communications, such as emergencies.

In terms of telecommunications, roaming is divided into:⁴

- “**SIM- -based roaming**” - a roaming using SIM⁵ (mobile subscribers use a public wireless telecommunications network in a way that they can use the network of their mobile service provider they signed an agreement with, but also the network of another operator that their operator signed a roaming agreement with).

- “**Username/password-based roaming**” - roaming using username and password works on the same principle as the above mentioned. The only dif-

4 E. Sutherland, *The regulation of national roaming*, International Telecommunications Society, Budapest, 18-21 September 2011.

5 SIM - Subscriber identity module, is a smart card that stores data for GSM cellular telephone subscribers, <http://searchmobilecomputing.techtarget.com/definition/SIM-card>, accessed on January 24, 2017.

ference is in the access to the system, given that this one still requires the logging parameters using the user name and password.

The difference between home and visited mobile telecommunications network is technically defined by the way of access of mobile subscriber to a certain network. If user's data are not listed in the register of national telecommunications network, the required data should first be approved by the visited mobile telecommunications network, enabling thus a user to be authenticated and given permission to use any visited network services. Then, the data are entered into a network visitors' user base, and the user is approved to use the services of visited telecommunications network. Such roaming procedure in practice and the possibility of entering user's data are necessary for authentication, access for authorization and service charging by visited mobile telecommunications network.

In essence roaming is achieved as follows:⁶

1) User's mobile device finds the base station of the visited operator which is in range and sends the request for a connection (device sends the IMSI⁷ code of the SIM card to the base station of the mobile operator to be registered, but network selection is based on the different lists classified by priority);

2) The base transceiver station (BTS) forwards the request to the base station controller (BSC) and finally the mobile switching center (MSC) of the network which is accessed;

3) The last step has two possible ways:

a) The MSC network which is accessed tries to find the IMSI code of the SIM card of the mobile user in its own network, however, if it is not found, the reason is that the IMSI code has already been assigned by the local operator;

b) MSC uses the IMSI code in order to identify home network of the mobile user's SIM card through the mobile country code that tracks mobile network code. If there is a roaming agreement between MSC network's operator which can be accessed, it contacts home mobile network, authenticates the mobile device and takes appropriate parts of the user's profile stored in the VLR register (visiting location register) network which is accessed. VLR register keeps a temporary profile for the purpose of achieving roaming. All of this is done in the so-called idle mode of work before the user starts using the services and network services which he accessed.⁸

⁶ R. Mattioli, M. Dekker, *National Roaming for Resilience*, European Union Agency for Network and Information Security (ENISA), November 2013.

⁷ IMSI - The International Mobile Subscriber Identity (IMSI) is an internationally standardized unique number to identify a mobile subscriber, <http://www.telecomabc.com/i/imsi.html>, accessed on January 24, 2017.

⁸ European Parliament, *Technical Issues on Roaming: Transparency, Technical Aspects and Data – Overview related to the proposed regulation on Roaming*, Brussels, 2006.

A mobile device registered on a visited network periodically and automatically attempts to connect to its home operator network or any other high priority networks if on automatic mode. A period is configured in the SIM card to scan the available networks in a specific location. The default period used is usually 60 minutes but can be configured from 6 minutes to 8 hours in 6 minute steps in the SIM. If any higher priority networks are found, the mobile device stays on the visited network.⁹

2. The legal basis of roaming regulation in the Republic of Serbia

Legal regulations in force represent a basic postulates and guidelines of social behavior in a legally regulated and accountable country. Laws adopted by the Parliament shall always reflect social reality and are therefore always subject to change with the aim of adapting society to the emerging situation. The truth is that society usually reacts only when something happens, so the consequences of such events may be catastrophic. Therefore, a proactive approach in certain cases may be of crucial importance. Such situation happened in recent past when great flash flooding ever hit Serbia. An emergency situation was declared in the entire territory of the Republic of Serbia. All relevant state authorities engaged together with Serbian citizens gave their best. But, of course, there were some dysfunctionatities as a result of incomplete and defective legislation. For example, there were no adequate responses of the state authorities to a large number of malicious calls made to 112 number, which probably resulted in the lack of timely assistance to persons who really needed help, due to the absence, insufficiency or obsolescence of the existing legal rules.

A similar situation happened with the functioning of the roaming in the national telecommunications frameworks (*national roaming*). Due to the lack of regulations governing this area, base stations did not accept calls of other operators in case of problems caused by failures of the systems that subscribers signed the contract with. So, base stations of different official mobile telecommunications operators in the Republic of Serbia (MTS, Telenor and VIP mobile) had longer or shorter operation mode depending on the power supply interruption or disruption of connection lines. In this way, many mobile phone users were unable to make timely calls for help.

⁹ 3GPP Organisational Partners, 3rd Generation Partnership Project : Technical Specification Group Core Network Terminals; Non-Access-Stratum (NAS) functions related to Mobile Station (MS) in idle mode (release 9), 2009.

The analysis of legal framework regulating this area (the Law on Electronic Communications, the Law on Emergency Situations, etc.) has led to the conclusion that roaming and national roaming are not regulated by any laws. The only regulations governing this area are the agreements concluded between the individual mobile operators. So, roaming is regulated only by agreements, especially in terms of calculation of tariffs.

3. The term “national roaming” and its importance in emergency situations

In European and global terms, international roaming is the most common type of roaming, but **national roaming** is increasingly gaining in importance. National roaming is a term referring to the concept when the user's signal of one operator's mobile network is transmitted through the network of another operator in the same country, with the aim to ensure *communication continuity* of mobile signals. In practice, this means that the user of national operator's mobile telecommunications network is having *continuity* of mobile signal, even in case when he is out of the area covered by the user's mobile operator base station, through taking over the user's signal by the base station of another national operator which provides regular signal coverage in that area. The only condition for the exercise of these activities is the national roaming agreement signed between the operators, as well as the provision of technical resources and capacities for their functioning.

In some countries, national roaming is imposed by the National Regulatory Authority with the objective to promote and stimulate competition by facilitating the entrance of new actors in the market. Sometimes national roaming is implemented on a voluntary basis between operators without intervention or request from the National Regulatory Authority for commercial purposes.

Bearing in mind the emergencies declared in the territory of the Republic of Serbia during the floods in 2014, it should be noted that all users of different telecommunications services were enabled to call (calls were forwarded to emergency number 112 free of charge), even in cases when phone user did not have a SIM card in his mobile phone. Considering the fact that there was no adequate legal framework governing this specific situation, the citizens were still able to dial 112 at any time and from any place, thus obtaining the necessary help. Yet it was not enough. They were able to contact the 112 operators, inform the authorities on their location

and their condition, to obtain help. At the same time, they did not have the opportunity to contact their relatives and get information about them due to disruptions in work of many base stations. It was paradoxical bearing in mind that the solution was within reach. Adequate legislation and agreements signed on national roaming among home telecommunications operators would have played a crucial role in the rescue of human life, in a way that mobile phone signals would automatically be accepted by the base stations of different operators that have been in operation, thus ensuring communication continuity.

Amazing though is the fact that during floods a total of 460,615 calls were received to 112 number not only by SIM cards of all mobile operators (MTS, Telenor, and VIP) but also from devices having no SIM card. Even more surprising, as well as concerning, is the fact that only 36,272 (about 8%) calls were made on a realistic basis, while even 92% of all calls were **malicious**.¹⁰ This fact is a clear signal to the relevant state authorities that this field of work needs to be improved in the future by adopting legislation which would provide adequate penalties to perpetrators of such acts, and also a variety of mechanisms for their effective enforcement.

4. Analysis of the operation of base stations of mobile telecommunications operators MTS, Telenor and VIP during emergency situations in the Republic of Serbia in May 2014

Functioning of the base stations of official telecommunications operators in the Republic of Serbia (MTS, Telenor and VIP mobile doo) during the emergencies in May 2014, was analyzed in order to properly take stock of the issue and understand the importance, necessity and urgency of prescribing regulations. The analysis was done on a sample of three representative town areas (Obrenovac, Svilajnac and Paracin) that were the most affected by floods in the period. The parameters that were used for analysis and comparisons refer to the following characteristics of functioning of mobile base stations:

- Availability of base stations per day.

For the purpose of objective overview of the functioning of mobile base stations, a comparative analysis of the above parameters was carried out for: (1) a seven-day period before the emergency was declared, and (2) duration of the emergency.

¹⁰ Official data of the *Department of Telecommunications and Encryption, Ministry of Interior of the Republic of Serbia*, <http://arhiva.mup.gov.rs/>, 2014.

This comparative analysis uses the official statistical data on communication statistics obtained by MTS, Telenor d.o.o and VIP mobile d.o.o. which are given by written demand of the authors.

Analysis of data (shown in Figures 1, 2, 3 respectively) on the availability of mobile base stations of telecommunications operator MTS in the areas of Obrenovac, Svilajnac and Paracin for the period 8-23 May 2014, has led to the conclusion that there were interruptions in availability of individual base stations in the mentioned period in given cities. Hence, critical periods of interruptions in the functioning of base stations of telecommunications operator MTS in the area of Obrenovac were as follows: 13-16 May and 18-20 May; in the area of Svilajnac 11-13 May and 14-15 May; and in the area of Paracin 11-13 May and 5-18 May.

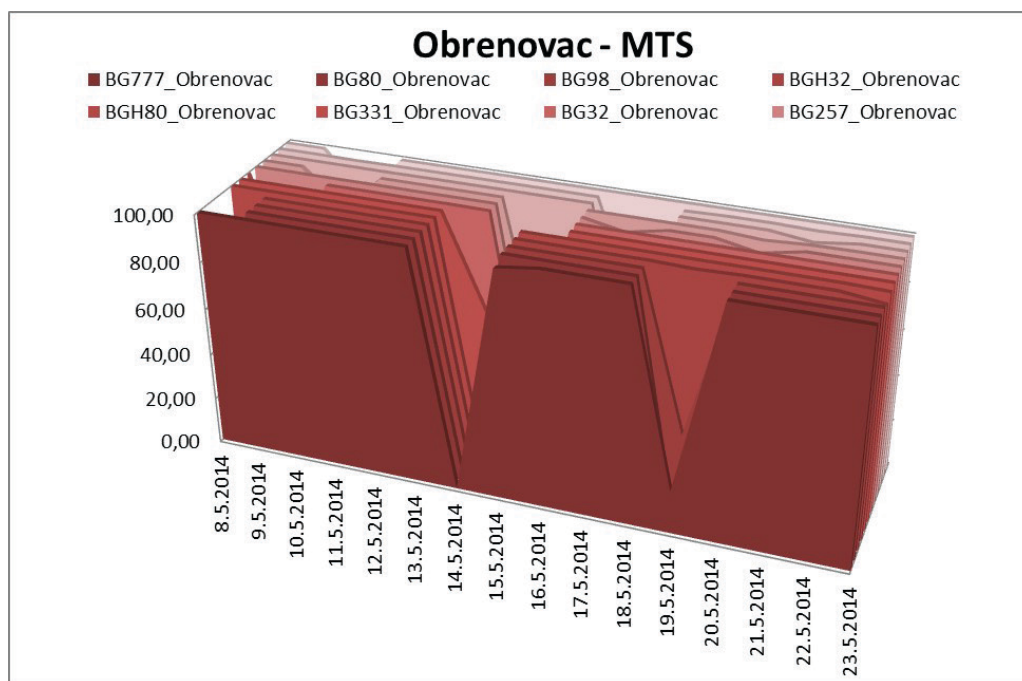


Figure 1. *The availability of mobile base stations of telecommunications operator MTS in the area of Obrenovac in the period 8-23 May 2014*

Source: Official statistical report provided by telecommunication operator MTS, written report on demand, 2014

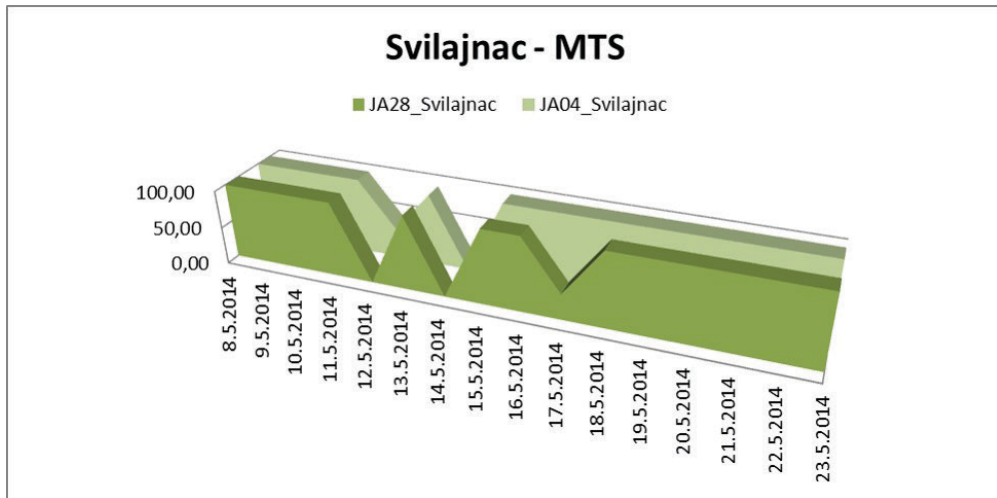


Figure 2. The availability of mobile base stations of telecommunications operator MTS in the area of Svilajnac in the period 8-23 May 2014

Source: Official statistical report provided by telecommunication operator MTS , written report on demand, 2014

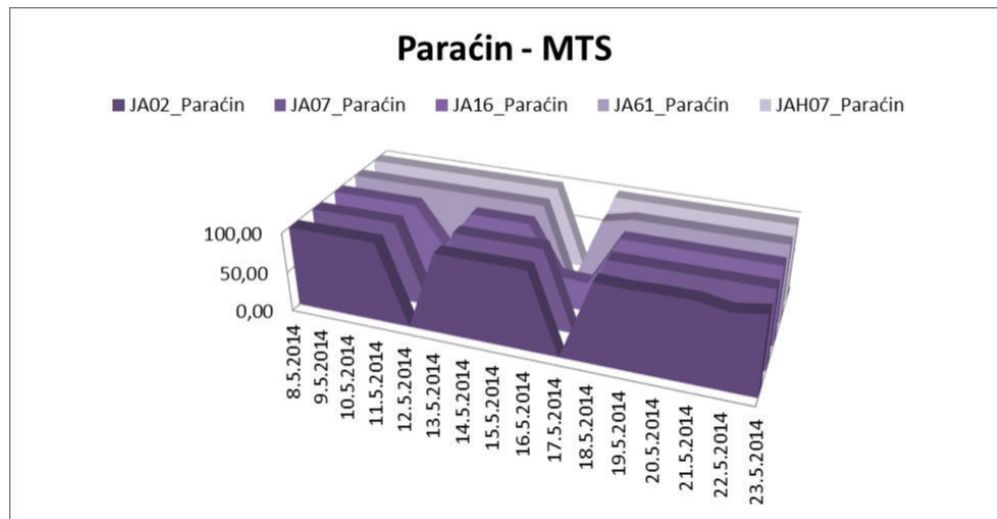


Figure 3. The availability of mobile base stations of telecommunications operator MTS in the area of Paraćin in the period 8-23 May 2014

Source: Official statistical report provided by telecommunication operator MTS , written report on demand, 2014

The data (Figures 4, 5 and 6) referring to the availability of cellular base stations of the telecommunication operator VIP mobile d.o.o. in the areas of Obrenovac, Svilajnac and Paracin, for the period 8-23 May 2014, have confirmed the similar situation as with MTS operator, and led to the same conclusion that there were interruptions in availability of individual base stations in the mentioned period in all these cities. For example, most mobile base stations in the town of Obrenovac did not work at all in the period 15-23, which means that they were out of function for almost the entire period of the emergency situation. As for Svilajnac, which had only one mobile base station for the whole territory of the city, the station was out of function from 15-19 May. The situation with Paracin was better since the base stations were out of function only in the period from 15-17 May.

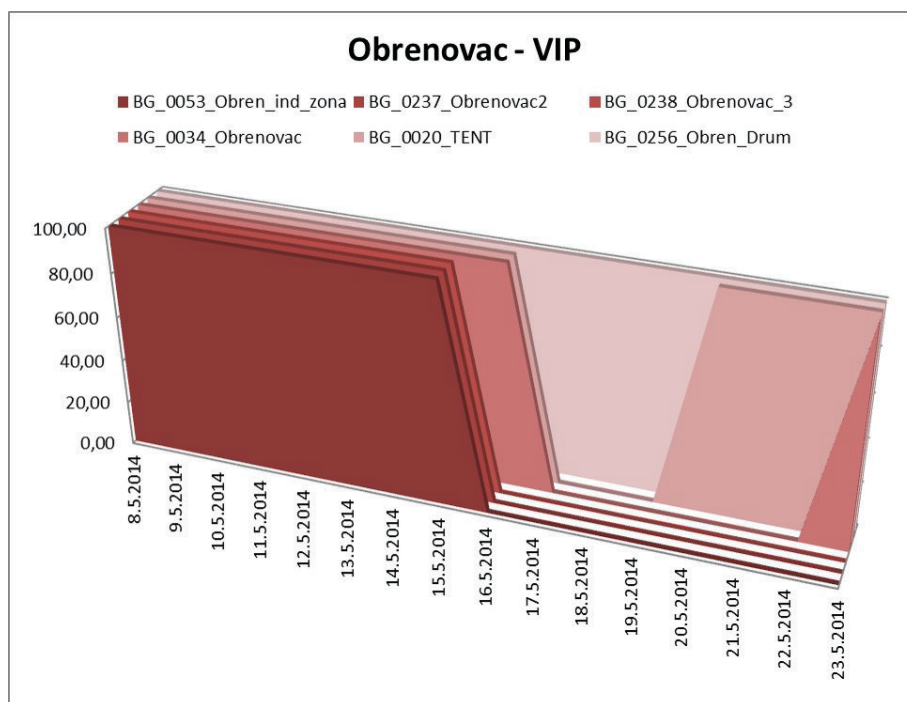


Figure 4. *The availability of mobile base stations of telecommunications operator VIP mobile d.o.o. in the area of Paracin for the period 8-23 May 2014*

Source: Official statistical report provided by telecommunication operator VIP mobile d.o.o., written report on demand, 2014

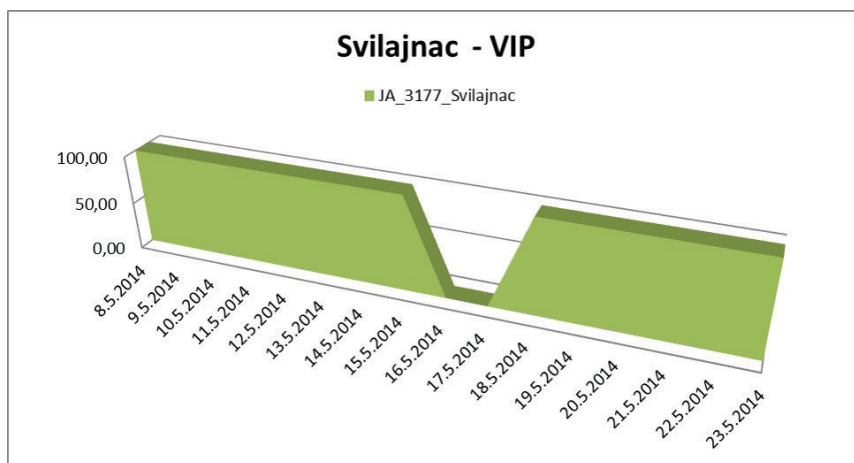


Figure 5. The availability of mobile base stations of telecommunications operator VIP mobile d.o.o. in the area of Svilajnac for the period 8-23 May 2014

Source: Official statistical report provided by telecommunication operator VIP mobile d.o.o., written report on demand, 2014

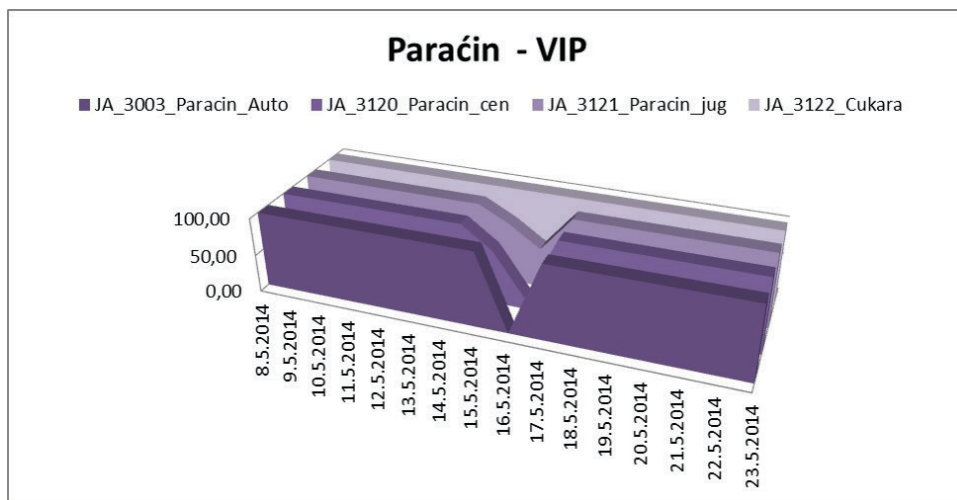


Figure 6. The availability of mobile base stations of telecommunications operator VIP mobile d.o.o. in the area of Paraćin for the period 8-23 May 2014

Source: Official statistical report provided by telecommunication operator VIP mobile d.o.o., written report on demand, 2014

The analysis of data (presented in Figures 7, 8, 9) referring to the availability of mobile base stations of telecommunication operator Telenor d. o. o. in the areas of Obrenovac, Svilajnac and Paracin, for the period 8-23 May 2014, led to similar conclusion as in previous cases. Individual base stations of the operator Telenor d. o. o. also had interruptions in communication availability. As for Obrenovac, most interruptions happened in the period from 16-18 May, which in some cases lasted longer, up to 22 May. As for Svilajnac, the interruptions happened in the period from 15-18 May, while Paracin had periodical interruptions, mainly in the period from 15-17 May.

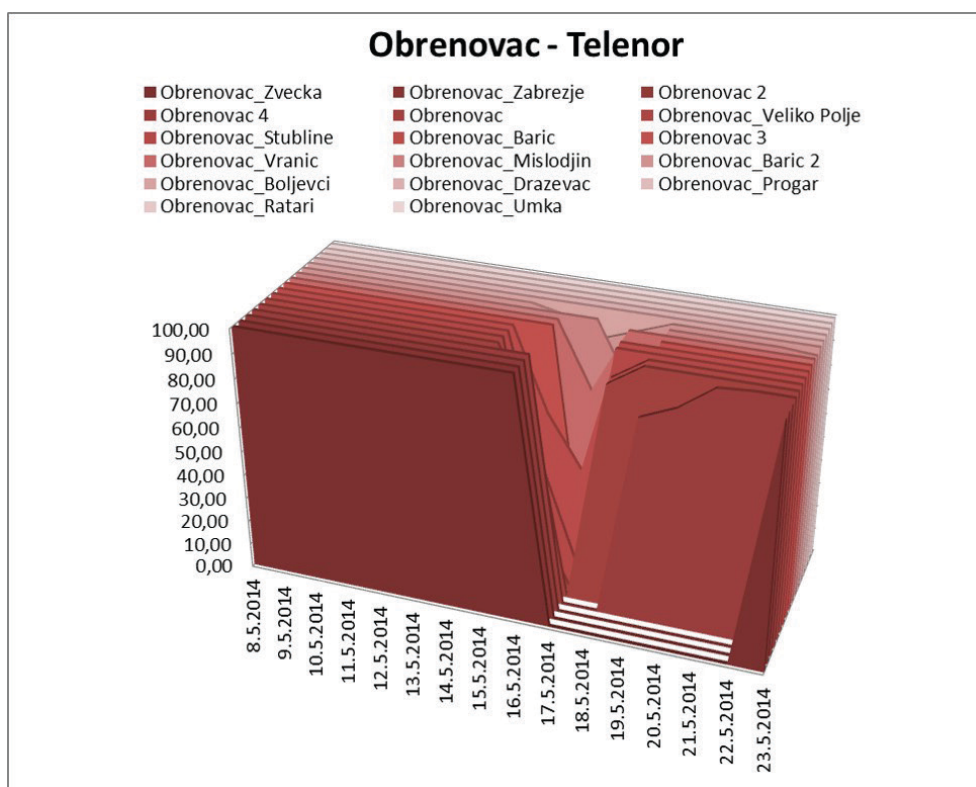


Figure 7. The availability of mobile base stations of telecommunications operator Telenor d.o.o. in the area of Obrenovac for the period 8-23 May 2014

Source: Official statistical report provided by telecommunication operator Telenor d.o.o., written report on demand, 2014



Figure 8. *The availability of mobile base stations of telecommunications operator Telenor d.o.o. in the area of Svilajnac for the period 8-23 May 2014*

Source: Official statistical report provided by telecommunication operator *Telenor d.o.o.*, written report on demand, 2014

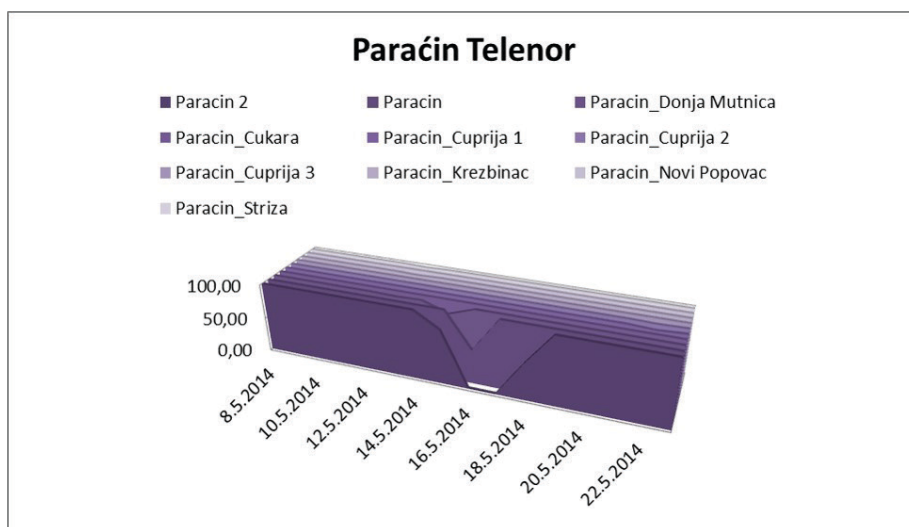


Figure 9. *The availability of mobile base stations of telecommunications operator Telenor d.o.o. in the area of Paraćin for the period 8-23 May 2014*

Source: Official statistical report provided by telecommunication operator *Telenor d.o.o.*, written report on demand, 2014

It was obvious that all three mobile telecommunications operators had evident problems in the functioning and availability of their base stations, but it was also evident that all these problems would have been easily resolved by simply downloading the mobile signal by the base station of the currently active telecommunication operator. Thus, complete telecommunication traffic through mobile networks would have been realized and there would have been no downtime.

Most notably the fact is that, during floods, a mobile base station at the location of Mislodín was set up and put into operation by VIP mobile operator, which greatly improved mobile signal coverage on the most of the territory of Obrenovac, solely thanks to efficient work and full commitment of all relevant state authorities, particularly the Ministry of Interior. Given that the base stations had power supply problems due to a power failure, together with the aggregates they were transported by the boats of the Ministry of Interior to safe locations and put into operation.

Conclusion

Mobile communication networks and services have become an integral part of everyday life. People are now more and more reliant on their mobile phone and expect to be connected anywhere at any time.

The *importance of national roaming* in mobile telecommunications has already been recognized. Therefore, implemented solutions or experiences of neighboring countries, including European and international framework in this area are crucial for understanding what benefits are offered by this solution.

Previously presented facts and their comparisons and comparative analysis led to an unambiguous conclusion that during floods in the abovementioned cities each telecommunication operator obviously had problems in the functioning of its respective base stations (interruption in electricity supply and connection failures) and in providing necessary services to users of mobile telephony services. The question arises whether it is possible, on the basis of the past experience and comprehensive analysis of the events during the emergencies in the Republic of Serbia, to find an adequate and final solution to this problem so that similar things would not happen again in the future. The answer is definitely positive and the solution is relatively simple, highly useful and economic. And that is **national roaming**.

By adopting adequate legislation in this field and signing national roaming agreements between mobile telecommunication operators in the Republic of Serbia, as well as by developing technical conditions for their implementation

and by adopting policies and regulations on activating national roaming, then by defining the temporal and spatial frame (depending on whether it governs only a part or the whole territory of the Republic of Serbia), etc., all these problems which we have dealt with in this paper will remain behind us and will be seen as a page in history.

The solution that emerged from previous experiences suggests that in future every town should have at least one base station (of one or more operators) with alternative power source in the form of battery or aggregate which will work 20, 30 or more days in continuity without traditional power supply, and that solution should be regulated by law, i.e. the operator will be obliged to apply it.

We truly believe that this paper will stimulate the relevant national authorities to take this issue into consideration, open a mutual constructive dialogue that will break the deadlock, contribute to the problem solution in the future, which is of crucial interest of the state as well.

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ZNAČAJ I ULOGA „NACIONALNOG ROMINGA“ U VANREDNIM SITUACIJAMA

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Sažetak: Posle analiziranja nedavnih katastrofalnih događaja koje su u Republici Srbiji izazvale velike poplave, na prvi pogled se činilo da je borba s poplavama izgubljena. Ipak, čuvena srpska upornost ili jednostavna borba za život građana, koji su u takvim teškim trenucima pokazali izuzetnu društvenu solidarnost, bile su još jednom od krucijalnog značaja. Jedinstvo je bilo izraženo na mnogo načina: pružanjem pomoći najranjivijim ljudima u evakuaciji poplavljenih područja i dostavljanjem osnovnih prehrambenih proizvoda i medicinske pomoći, kao i u oblasti telekomunikacija, čije je polje delovanja bilo veoma važno, ali javno nevidljivo u takvim kritičnim momentima. Bez takvog „ključnog čvorišta“ koje je povežalo sve relevantne državne faktore u celinu, pružajući im konstantnost i kontinuitet u komunikacijama, sve bi bilo besmisleno. Ovaj događaj, bez obzira koliko je težak i monoton, otvorio je naknadnu analizu mnogih pitanja i pokrenuo neke sjajne ideje. Jedna od njih je zakonska obaveza uvođenja „nacionalnog rominga“ kod svih telekomunikacionih operatera u našoj zemlji, o čemu se takođe govori u ovom radu.

Ključne reči: nacionalni roming, telekomunikacioni operateri, umrežavanje korisnika, zakonsko regulisanje rominga.