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FINANCIAL ANALYSIS OF THE BROADCASTING SERVICE OF DIGITAL TELEVISION, RADIO PROGRAMS AND DATA TRANSMISSION IN THE REPUBLIC OF SERBIA

Jelena Cerovina*, Ivana Milošević, Milan Simić

Faculty of Technical Sciences, University of Pristina in Kosovska Mitrovica, Kosovska Mitrovica, Serbia

Abstract:
Digitalization of radio and television programs as well as other multimedia content is a very complex process with many aspects and requires large financial investments in the infrastructure of the system and all supporting elements. This paper provides a concise description of the institutional and regulatory frameworks in the digitalization process in the Republic of Serbia, the important reasons related to the choice of compression standard and standard for the transmission of television signals, as well as a description of the role of JP Emisiona tehnika i veze in the digitalization process. The aim of this paper is the financial analysis of earnings on an annual basis for the services of broadcasting TV programs in the first and second multiplexes, broadcasting radio programs within the DVB-T2 network and data transmission services after the digitalization process. The method and data required for the preparation of the financial analysis were derived on the basis of the price list of services published by the JP Emisiona tehnika i veze published in August 2020. The results are presented tabular and graphically.

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INTRODUCTION

Digital television introduces a new era of broadcasting, many technical innovations that enable a significant increase in capacity and adaptability of networks, thereby opening numerous opportunities in terms of improving the quality of existing services and introducing new ones. (Shin & Song, 2012) Some of the many advantages of digital television compared to the analog one are: better image and sound quality, digital signal reception which is more resistant to the influence of various interferences, lower transmission costs, capability of transmitting a greater number of channels and services, more efficient use of radio frequency spectrum, etc. (Petrović, Jakšić, Spalević, Milošević & Lazić, 2014) Digital TV users are offered more diverse content through various transmission platforms and freedom to choose individual services in the form that suits them best. (Jakšić, Milošević, Jakšić, Maksimović & Todorović, 2022)

*E-mail: jelena.stojkovic@pr.ac.rs

In 2009, the Republic of Serbia started the process of digitalization radio and television programs by adopting the Strategy for Switchover from Analog to Digital Broadcasting of radio and television programs. The strategy establishes basic strategic guidelines for the introduction of digital and the shutdown of analog television and radio programs, which are in line with the conclusions of the Regional Conference on Radio Communications of the International Telecommunication Union held in Geneva in 2006, according to which it was determined that the introduction of digital and the complete shutdown of analog television in Europe will be completed by June 17, 2015 at the latest (Ministry of Trade, Tourism and Telecommunications, 2013).

The original deadline for the completion of the digitalization process in Serbia, set for 2012, was missed due to the lack of financial resources and insufficient number of free frequencies. The problem was solved by relinquishing part of the frequency of Avala television, after the channel was shut down, for broadcasting a digital signal. The new deadline was set for 2013. However, this deadline was also missed due to technical problems. The digitalization process was completed on June 7, 2015, which was concluded based on the official data from the relevant ministry on the coverage of the territory of Serbia with a digital signal, as well as the confirmation from the international organizations (EU and OSCE) that the process was completed.

According to the data of the JP Emisiona tehnika i veze the earnings were many times higher than the funds invested in the digitalization process, i.e., in the amount of 37.5 million euros including 13.5 million euros received as donations from the European Union within the project "Assistance for the transition to digital broadcasting in Serbia" implemented in 2009 by the Ministry of Telecommunications and Information Society. A total of 13.5 million euros was invested in the equipment necessary for the reconstruction of transmission system for transmitting digital TV signals through network of ground transmitters. This equipment included TV transmitters worth 3 million euros, multifunctional transmission network worth 1.5 million euros, terminal and network equipment worth 2 million euros, antenna systems worth 3.5 million euros, communication and control-measurement equipment worth 3.5 million euros. Earnings from digitalization are estimated at more than 100 million euros (Ilić *et al.*, 2017; Ministry of Telecommunication and Information Society, 2009).

In accordance with the provisions of the Law on Broadcasting, the former Radio Television of Serbia was divided into the national public broadcasting service and the public service of the province RTV Vojvodina (Ministry of Trade, Tourism and Telecommunications, 2002). Taking these provisions into account, this paper presents a financial analysis of TV program broadcasting services with unconditional access to Public Media Institutions (RTS and RTV), holders of licenses to broadcast TV programs in the entire territory of the Republic of Serbia, holders of licenses to broadcast TV programs in regional and local areas; as well as the service of broadcasting radio programs within the DVB T2 network and data transmission. The financial analysis was performed on the basis of the price list of services published by JP Emisiona tehnika i veze in August 2020 (JP Emisiona tehnika i veze, 2020).

INSTITUTIONAL AND REGULATORY FRAMEWORK FOR TELEVISION DIGITALIZATION IN THE REPUBLIC OF SERBIA

The process of switching from analog to digital TV broadcasting requires government intervention (Ariansyah & Yuniarti, 2021). In this process, a key role is played by the government, regulatory bodies, media public service, commercial broadcasters, network operators, equipment manufacturers, authorized persons for the installation and maintenance of common antenna systems and cable distribution systems (Trujillo, 2013). In order to adopt an appropriate regulatory policy, it is necessary to understand the environment in which the radio and television industry operates, given that with the expansion and technological progress of the Internet, users can access information and entertainment contents using other media apart from radio and television (Hauge, 2014).

The first goal of the Broadcasting Switchover Strategy from analog to digital TV broadcasting is to define legislative activities in order to create a legal framework for digital broadcasting development in accordance with the international and European standards. When creating the new regulatory framework, the specifics of the legal system of the Republic of Serbia were taken into account, as well as the existing rights and market position of the broadcasters, holders of licenses for broadcasting programs that were valid even after the scheduled date for turning off analog broadcasting. The regulatory framework in the Republic of Serbia consists of the Strategy for the Development of the Public Information System in the Republic of Serbia, the Strategy for the Development of Broadcasting in the Republic of Serbia, the Strategy for the Development of Electronic Communications in the Republic of Serbia, the Strategy for the Development of the Information Society in the Republic of Serbia, the Law on Electronic Communications, the Law on Broadcasting, the Law on Public informing (Ministry of Trade, Tourism and Telecommunications, 2013).

The Strategy for the Development of the Information Society in the Republic of Serbia, together with the Strategy for the Development of Electronic Communications in the Republic of Serbia, defines the digital agenda of the Republic of Serbia. In accordance with the Strategy, the priorities in development of the information society are the transition to exclusively digital broadcasting of television and radio programs and the digital dividend (Šuput, 2014).

The Law on Electronic Communications resolves some of the issues that are very important for the functioning and development of electronic communications, such as: regulation of conditions and methods for performing activities in the field of electronic communications; design, construction or installation, use and maintenance of electronic communication networks, associated assets, electronic communication equipment and terminal equipment; management, use and control of the radio frequency spectrum; distribution and broadcasting of media content; protection of the rights of users and subscribers; security and integrity of electronic communication networks and services (Šuput, 2014).

The Law on Broadcasting regulates the conditions and manner of performing broadcasting activities, in accordance with the international conventions and standards, the establishment of RRA, as well as public broadcasting service institutions, determines conditions and the procedure for issuing licenses for broadcasting radio and television programs (Ljubojev & Dukić-Mijatović, 2018).

The Law on Public Information regulates the right to public information as the right to freedom of expression, as well as the rights and obligations of participants in the process of public information (Ministry of Trade, Tourism and Telecommunications, 2021).

THE CHOICE OF STANDARDS IN THE FIELD OF DIGITAL TELEVISION AND THE ROLE OF PUBLIC COMPANY ETV IN THE DIGITIZATION PROCESS

Digital Video Broadcasting-Terrestrial standard (DVB-T) has successfully replaced the analog terrestrial transmission for video broadcasting in Europe (Samo, Slimani, Barrufa & Rugini, 2015, p.35). DVB-T has brought a higher quality service to TV program and has reduced use of bandwidth (Ayat, Hardani, Mirzakuchaki & Haddadi, 2016, p.43). The ITU has presented a model of the digital television system that is the basis for all implementations of the DVB system. The model consists of 4 subsystems, and in some approaches of 3 subsystems. The source encoding and compression subsystem uses data compression methods and error protection techniques applied to video, audio, and auxiliary digital data streams. The multiplex service and transport subsystem enables division of the digital data stream into information packets, unique identification of each packet or packet type, and multiplexing of video, audio, and auxiliary data stream packets into a single data stream. The physical layer subsystem (adaptation) uses information about the digital data stream to modulate the transmitted signal (Antone & Arsinte, 2013, p.48).

The success of DVB-T and the development of technical innovations resulted into the definition of the second-generation standard for digital terrestrial video broadcasting (DVB-T2), which was approved as a European standard in June 2008 (Samo *et al*., 2015, p.35). By switching from DVB-T to DVB-T2 standard, it is possible to expand the capacity of the digital television system to about 25% which would enable greater competition among active broadcasters on the market (D'Andreagiovanni, Lakhlef & Nardin, 2020). DVB-T2 uses OFDM (orthogonal frequency division multiplex) modulation. DVB-T2 standard allows high flexibility in multiplex allocation, coding, modulation, and RF parameters (Eizmendi *et al*., 2014, p.259). OFDM is a powerful modulation technique that achieves a high bit rate. With this technique, it is possible to divide the stream of digital data into several streams that are then transmitted on several frequency subcarriers located close to each other in the spectrum and characterized by orthogonality, that is, there is no interference between them, even though there are no guard bands (Yu & Sadeghi, 2012). "OFDM technique enables the creation of broadband multiplex by generating a single multiplex covering multiple broadcasting frequency channels, without changing of the space between them, and keeping the symbol and guard interval duration unchanged compared to the one in single channel case" (Mišković & Reljin, 2015, p.70). In order to transmit more services within the frequency range of TV channels (TV program, radio program, teletext) through the DVB-T2 system, it is necessary to apply the technique of coding (compressing) audio-video content and its multiplexing (Iacob, Demciuc & Avram., 2020).

JP Emisiona tehnika i veze decided to choose the DVB-T2 standard for digital terrestrial broadcasting of television signals. The choice of this standard is based on the following facts: DVB-T2 offers extremely good signal protection; it is less sensitive to interference compared to DVB-T; within one multiplex a much larger number of TV programs in SD and HD resolution can be broadcast compared to the DVB-T standard, which increases the digital dividend (Oria, Lopez, Doblado, Perez Calderon & Baena, 2014). "SDTV is usually transmitted in resolution 720x576, while HDTV is using 1920x1080 resolution" (Galetic, 2020).

The DVB-T2 standard is based on the choice of the MPEG-4 version 10 (H.264/AVC) standard for video signal compression. Some of the characteristics of MPEG-4 version 10 (H.264/AVC) standard are: encoders based on this standard require twice the lower bit rate, and subjectively, the quality of the reconstructed video signal is almost the same compared to MPEG-2 (Erol, Kossentini, Joch, Sullivan &

Winger, 2009); the picture quality of MPEG-4 standard, according to the important international television associations, is equally good at low and high flows (both for SDTV and HDTV) (Jaksić, Petrović, Jaksić, Milošević & Marinković, 2016); MPEG-4 standard is compatible with IPTV (Al-Jobouri, Fleury & Ghanbari, 2014); it provides support for all the new multimedia services; providing this standard is important because it requires much less throughput compared to DVB-T2.

JP Emisiona tehnika i veze establishes and manages a network for distribution, broadcasting and multiplexing of digital television programs. In order to manage that network, JP Emisiona tehnika i veze issues individual licenses for the use of radio frequencies in accordance with the law regulating the field of electronic communications. JP Emisiona tehnika i veze provides access to the multiplex to institutions of the public broadcasting service and holders of valid licenses for broadcasting television programs that were issued on the basis of a previously held public competition in accordance with the regulations governing broadcasting. Technical and commercial conditions are governed by the contract that the JP Emisiona tehnika i veze concludes with public broadcasting service institutions and holders of valid licenses for broadcasting television programs (Ministry of Trade, Tourism and Telecommunications, 2013).

METHODOLOGY

The financial analysis of the services of broadcasting TV programs, radio programs within the DVB T2 network and data transmission was carried out based on the price list of services published by the Emisiona tehnika i veze in August 2020.

Method 1: According to the Rulebook on the switchover from analog to digital broadcasting of television programs and access to the multiplex, the first multiplex is filled with programs from public media services in the Republic of Serbia and holders of licenses for broadcasting television programs throughout the Republic of Serbia. The second multiplex is filled with television broadcasting services for which a license has been issued to broadcast television programs in regional and local areas in accordance with the law (Ministry of Trade, Tourism and Telecommunications, 2015).

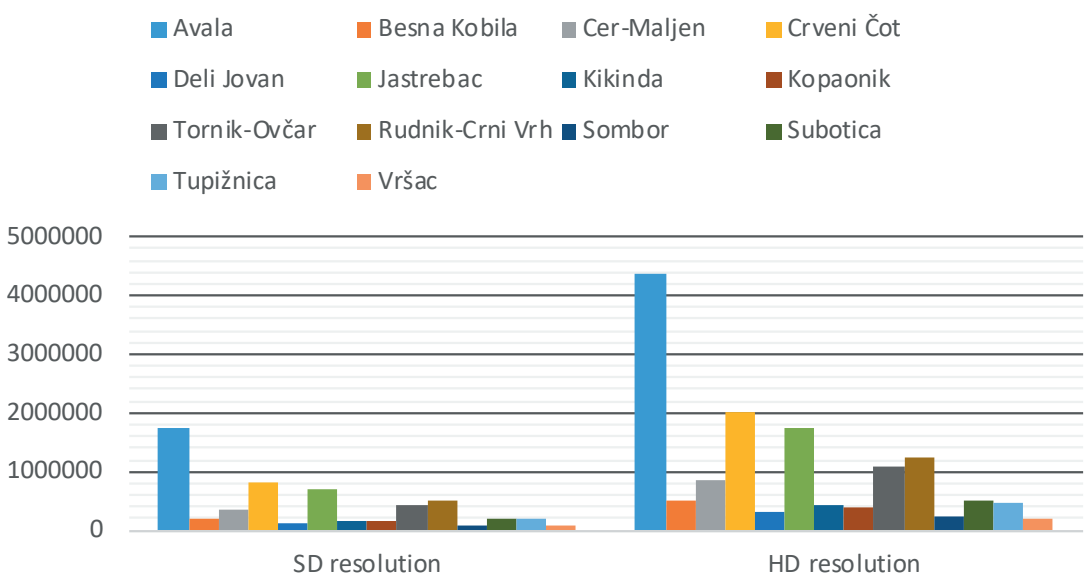
According to the data in the register of medical service providers on the website of the Regulatory Body for Electronic Media and based on the list of TV programs by distribution zones on the website of JP Emisiona tehnika i veze, 8 TV programs in SD resolution are broadcast in the distribution zones of Sombor, Subotica, Kikinda and Vršac within the first multiplex. In distribution zones Avala, Cer-Maljen, Deli Jovan, Rudnik-Crni Vrh, Ovčar-Tornik, Tupižnica, Jastrebac, Kopaonik, Besna Kobila, 7 TV programs in SD resolution, 1 TV program in HD resolution and 3 radio programs in DVB-T2 networks in the first multiplex (Regulatory body for electronic media, 2022; JP Emisiona tehnika i veze, 2022).

In accordance with the above-mentioned data, the total monthly price of TV program broadcasting services for Public Media Institutions (RTS and RTV) and license holders for broadcasting TV programs throughout the Republic of Serbia is obtained as the sum of individual TV program prices for each distribution zone from Table 1 multiplied by a commercial correction factor, which is 0.73 for SD resolution and 0.45 for HD resolution. The prices in Table 1 are taken from the price list of services published by JP Emisiona tehnika i veze for the service for which the salary calculation is made.

Table 1. Individual prices of TV programs for the service of broadcasting TV programs for Public Media Institutions (RTS and RTV) and holders of licenses for broadcasting TV programs in the entire territory of the Republic of Serbia for each distribution zone in SD and HD resolution.

Distribution zones	SD resolution Price (dinars)	HD resolution Price (dinars)
Avala	1.748.291,71	4.370.729,28
Besna Kobila	205.198,56	512.996,39
Cer – Maljen	340.629,61	851.574,01
Crveni Čot	800.274,38	2.000.685,94
Deli Jovan	131.327,08	328.317,69
Jastrebac	693.571,13	1.733.927,81
Kikinda	168.262,82	420.657,04
Kopaonik	155.950,90	389.877,26
Tornik – Ovčar	439.124,91	1.097.812,28
Rudnik – Crni Vrh	496.580,51	1.241.451,27
Sombor	94.391,34	235.978,34
Subotica	201.094,59	502.736,47
Tupižnica	180.574,73	451.436,83
Vršac	82.079,42	205.198,56

Figure 1. Graphic display of individual TV program prices for TV program broadcasting services for Public Media Institutions (RTS and RTV) and license holders for broadcasting TV programs in the entire territory of the Republic of Serbia for each distribution zone in SD and HD resolution



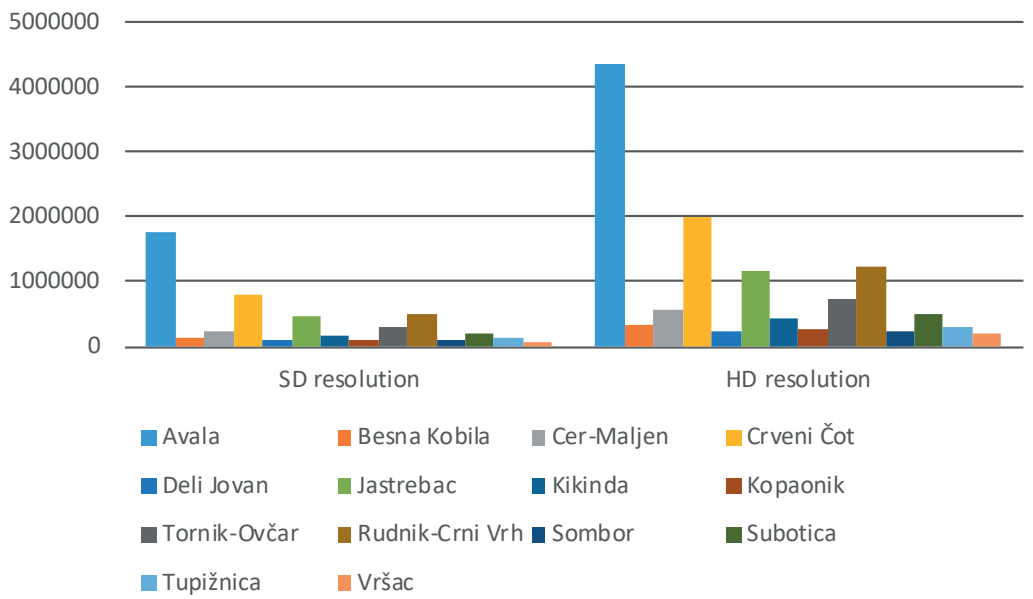
Method 2: In the second multiplex, the following number of TV and radio programs are broadcast by distribution zone: in Sombor and Subotica, 5 TV programs in SD resolution, 1 TV program in HD resolution and 3 radio programs within the DVB-T2 network; in Kikinda, 4 TV programs in SD resolution, 1 TV program in HD resolution and 3 radio programs within the DVB-T2 network; in Crveni Čot, 10 TV programs in SD resolution, 1 TV program in HD and 3 radio programs; in Vršac, 8 TV programs in SD resolution, 1 TV program in HD and 3 radio programs; in the Avala zone, 3 TV programs are broadcast in SD resolution; in Cer-Maljen and Besna Kobila zones, 7 TV programs in SD resolution; in Deli Jovan zone, 10 TV programs in SD resolution; in the area Rudnik-Crni Vrh, 11 TV programs in SD resolution; in Ovčar-Tornik zone, 14 TV programs in SD resolution; in Tupižnica zone, 8 TV programs in SD resolution; in Jastrebac zone 13 TV programs in SD resolution; in Kopaonik zone 12 TV programs in SD resolution (Regulatory body for electronic media, 2022; JP Emisiona tehnika i veze, 2022).

In accordance with the above-mentioned data, the total monthly price of the TV program broadcasting service by distribution zone, for holders of licenses for broadcasting TV programs in regional and local areas, is obtained as the sum of the individual prices of TV programs for the desired distribution zone from Table 2 multiplied by the commercial corrective by a factor that is 0.2 for both SD and HD resolution. The prices of TV programs by distribution zones in Table 2 are taken from the price list of services published by JP Emisiona tehnika i veze.

Table 2. Individual prices of TV programs by distribution zone of the TV program broadcasting service, for holders of licenses for broadcasting TV programs in regional and local areas.

Distribution zones	SD resolution Price (dinars)	HD resolution Price (dinars)
Avala	1.748.291,71	4.370.729,28
Besna Kobila	136.799,04	341.997,60
Cer – Maljen	227.086,40	567.716,00
Crveni Čot	800.274,38	2.000.685,94
Deli Jovan	87.551,38	218.878,45
Jastrebac	462.380,75	1.155.951,88
Kikinda	168.262,82	420.657,04
Kopaonik	103.967,27	259.918,18
Tornik – Ovčar	292.749,94	731.874,85
Rudnik – Crni Vrh	496.580,51	1.241.451,27
Sombor	94.391,34	235.978,34
Subotica	201.094,59	502.736,47
Tupižnica	120.383,15	300.957,88
Vršac	82.079,42	205.198,56

Figure 2. Graphic display of individual prices of TV programs by distribution zones of TV program broadcasting service, for holders of licenses for TV program broadcasting in regional and local areas.



Method 3: The broadcasting service of radio programs within the DVB T2 network includes reception of the modulation signal, coding, multiplexing, distribution, and broadcasting through a network of digital, terrestrial transmitters and repeaters. The total monthly price of the service is obtained as the sum of the price per radio program multiplied by the commercial correction factor given in Table 3. The price per radio program is taken from the price list of services published by JP Emisiona tehnika i veze. In the first and second multiplex in all distribution zones, 3 radio programs are broadcast each within the DVB-T2 network.

Table 3. The price per radio program of the broadcasting service of radio programs in the DVB T2 network by all distribution zones

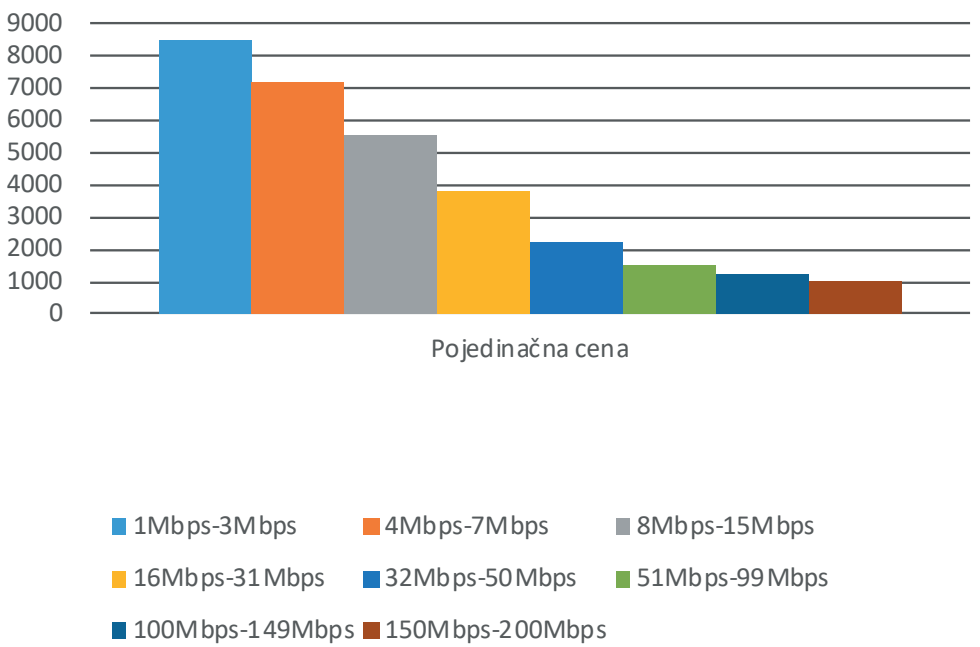
Service	Type of signal	Price (dinars)	Commercial correction factor
Broadcasting of radio programs in the DVB T2 network	Stereo audio signal	320.664	0,5

Method 4: According to the Article 8 of the Rulebook on switchover from analog to digital broadcasting of television programs and access to the multiplex, the data flow within the multiplex is at least 2Mb/s per individual television program broadcast in SD resolution and at least 5Mb/s in HD resolution (Ministry of Trade, Tourism and Telecommunications, 2015). Table 4 gives the prices for individual capacity that falls within the corresponding range of capacities taken from the price list of services published by JP Emisiona tehnika i veze. The total monthly price of the data transmission service by distribution zones in Table 8 is obtained when the leased capacity expressed in Mbps (megabits per second) is multiplied by the price for the capacity range in Table 4. The price of the data transmission service refers to the data flow per individual TV program in SD and HD resolution.

Table 4. Price of individual capacity in the corresponding capacity range of the data transmission service.

Capacity	Price (dinars)
1Mbps-3Mbps	8.474,58
4Mbps-7Mbps	7.203,39
8Mbps-15Mbps	5.508,48
16Mbps-31Mbps	3.813,56
32Mbps-50Mbps	2.254,37
51Mbps-99Mbps	1.525,42
100Mbps-149Mbps	1.186,44
150Mbps-200Mbps	1.016,95
Tornik – Ovčar	292.749,94
Rudnik – Crni Vrh	496.580,51

Figure 3. Graphic display of individual prices of the leased capacity in the corresponding capacity range of the data transmission service.



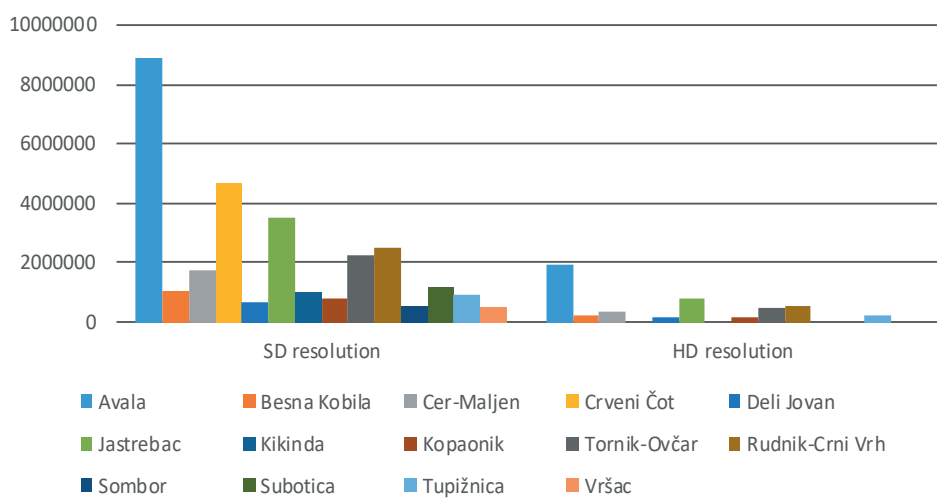
RESULTS AND DISCUSSION

Using method 1 and using prices based on the data from Table 1, the following results were obtained, presented tabular and graphically (Table 5 and Figure 4).

Table 5. Total prices on a monthly basis for broadcasting TV programs for Public Media Institutions (RTS and RTV) and licensees for broadcasting TV programs throughout the Republic of Serbia for each distribution zone in SD and HD resolution

Distribution zones	SD resolution Price (dinars)	HD resolution Price (dinars)
Avala	8.933.770,64	1.966.828,18
Besna Kobila	1.048.564,64	230.848,376
Cer – Maljen	1.740.617,31	383.208,305
Crveni Čot	4.673.602,38	/
Deli Jovan	671.081,379	147.742,961
Jastrebac	3.544.148,47	780.267,515
Kikinda	982.654,869	/
Kopaonik	796.909,099	175.444,767
Tornik – Ovčar	2.243.928,29	494.015,526
Rudnik – Crni Vrh	2.537.526,41	558.653,072
Sombor	551.245,426	/
Subotica	1.174.392,41	/
Tupižnica	922.736,87	203.146,574
Vršac	479.343,813	/

Figure 4. Graphic display of total prices for monthly TV programs for Public Media Institutions (RTS and RTV) and license holders for broadcasting TV programs throughout the Republic of Serbia for each distribution zone in SD and HD resolution



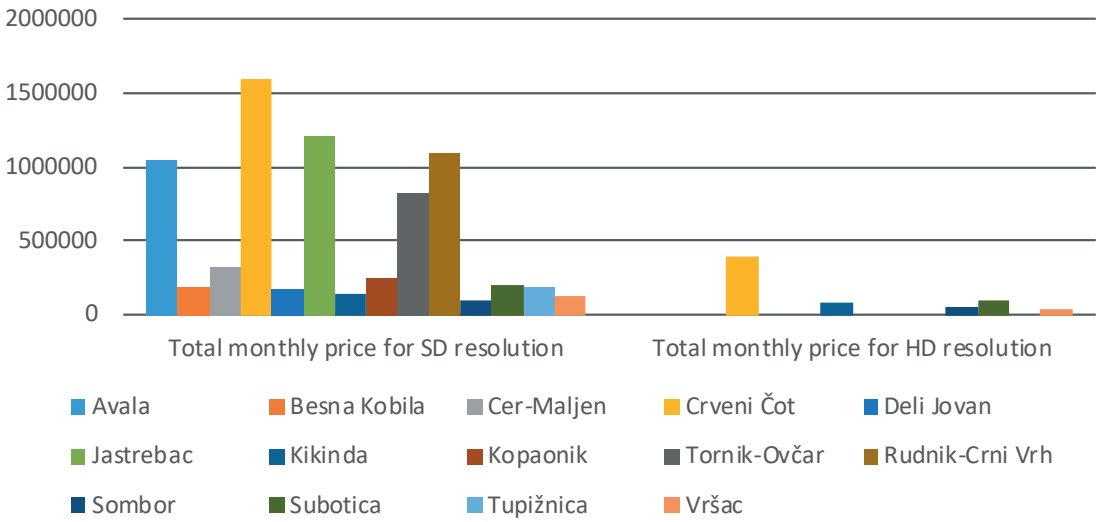
Earnings on a monthly basis for the service of broadcasting TV programs for public media services RTS and RTV in the entire territory of the Republic of Serbia and other holders of licenses for broadcasting TV programs in the entire territory of the Republic of Serbia in SD resolution in total for all distribution zones is 30,300,522 dinars, and for broadcasting in HD resolution amounts to 4,940,155 dinars. For the same broadcasting service, the annual earnings are 363,606,264 dinars for broadcasting in SD resolution, and 59,281,860 dinars for broadcasting in HD resolution.

Using method 2 and using prices based on the data from Table 2, the following results were obtained, presented tabular and graphically (Table 6 and Figure 5).

Table 6. The total price on a monthly basis for broadcasting TV programs in SD and HD resolution by distribution zone, for holders of licenses for broadcasting TV programs in regional and local areas

Distribution zones	SD resolution Price (dinars)	HD resolution Price (dinars)
Avala	1.048.975,03	/
Besna Kobila	191.518,656	/
Cer – Maljen	317.920,96	/
Crveni Čot	1.600.548,76	400.137,188
Deli Jovan	175.102,76	/
Jastrebac	1.202.189,95	/
Kikinda	134.610,256	84.131,408
Kopaonik	249.521,448	/
Tornik – Ovčar	819.699,832	/
Rudnik – Crni Vrh	1.092.477,12	/
Sombor	94.391,34	47.195,668
Subotica	201.094,59	100.547,294
Tupižnica	192.613,04	/
Vršac	131.327,072	41.039,712

Figure 5. Graphical representation of the total price on a monthly basis for the service of broadcasting TV programs in SD and HD resolution with unconditional access by distribution zone, for holders of licenses for broadcasting TV programs in regional and local areas



Earnings on a monthly basis for the service of broadcasting TV programs for license holders in regional and local areas in total for all distribu tion zones in SD resolution is 7,451,990 dinars and in HD resolution it is 673,051 dinars. For the same broadcasting service in SD resolution for all distribution zones, the annual income is 89,423,880 dinars, and for broadcasting in HD resolution it is 8,076,612 dinars.

Using method 3 and prices accordingly, in Table 3, the total monthly price for broadcasting radio programs by distribution zone is given in Table 7.

Table 7. Total price on a monthly basis of the broadcasting service of radio programs in the DVB T2 network by all distribution zones

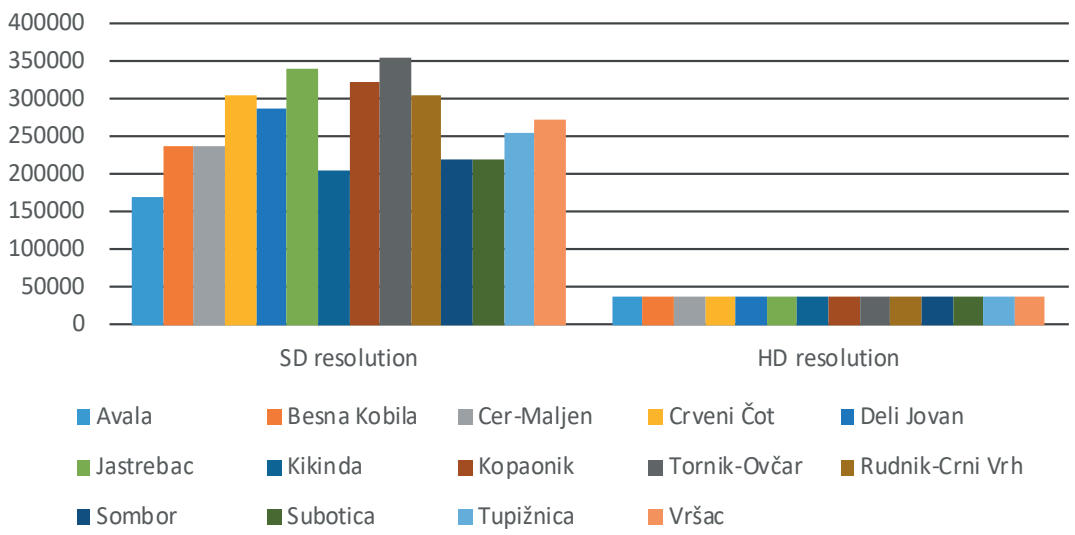
Service	**Type of signal**	**Price (dinars)**	Commercial correction factor	Total monthly price (dinars)
Broadcasting of radio programs in the DVB T2 network	Stereo audio signal	320.664	0,5	480.996

Using method 4 and prices accordingly, in Table 4, the total monthly price for broadcasting radio programs by distribution zone is given tabular and graphically (Table 8 and Figure 6).

Table 8. The total monthly price for data transmission service by distribution zone in SD and HD resolution

Distribution zones	SD resolution Price (dinars)	HD resolution Price (dinars)
Avala	169.491,6	36.016,95
Besna Kobila	237.288,24	36.016,95
Cer – Maljen	237.288,24	36.016,95
Crveni Čot	305.084,88	36.016,95
Deli Jovan	288.135,72	36.016,95
Jastrebac	338.983,2	36.016,95
Kikinda	203.389,92	36.016,95
Kopaonik	322.034,04	36.016,95
Tornik – Ovčar	355.932,36	36.016,95
Rudnik – Crni Vrh	305.084,88	36.016,95
Sombor	220.339,08	36.016,95
Subotica	220.339,08	36.016,95
Tupižnica	254.237,4	36.016,95
Vršac	271.186,56	36.016,95

Figure 6. The total monthly price of the leased capacities in the corresponding data transmission service capacity range.



CONCLUSION

Based on the analysis, it can be concluded that the monthly earnings for broadcasting TV programs for public media services RTS and RTV in the entire territory of the Republic of Serbia and other holders of licenses for broadcasting TV programs in the entire territory of the Republic of Serbia in total for all distribution zones are 35.240.677 dinars in SD and HD resolution. For the same broadcasting service, the annual earnings are 422.888.124 dinars for broadcasting in SD and HD resolution. Earnings on a monthly basis for the service of broadcasting TV programs for license holders in regional and local areas in total for all distribution zones in SD and HD resolution amount to 8.125.041 dinars. For the same broadcast service in SD and HD resolution for all distribution zones, the annual income is 97.500.492 dinars. Earnings for broadcasting radio programs within the DVB-T2 network in total for all distribution zones on a monthly basis are 7.214.940 dinars, and at the annual level 86.579.280 dinars. Earnings on a monthly basis for the data transmission service amount to 4.269.069 dinars, and on the annual basis to 51.228.828 dinars. We conclude that the total annual income brought by the service of broadcasting digital television, digital radio programs within the DVB-T2 network and digital data transmission is 658.196.724 dinars. From 2015 to 2022, earnings for broadcasting TV programs, radio programs within the DVB T2 network and digital data transmission have amounted to 4.607.377.070 dinars, and in euro equivalent 38.394.808. Based on the results of the financial analysis and data on the invested financial resources in the amount of 37.5 million euros, we can conclude that the invested funds have paid off and that the earnings are certainly higher than predicted, given that the financial analysis does not include the earnings from the service of broadcasting TV programs in the third multiplex, nor the earnings from the service of broadcasting radio programs within the DAB+ network.

REFERENCES

Al-Jobouri, L., Fleury, M. & Ghanbari, M. (2014). Engineering wireless broadband access to IPTV. *Journal of Visual Communication and Image Representation, 25* (7), 1493-1506. https://doi.org/10.1016/j.jvcir.2014.06.013

Antone, A. F. & Arsinte, R. (2013). Advanced methods and tools for online evaluation of multiplexing services and encoding parameters in digital video broadcasting. Acta Technica Napocensis. Electronica-Telecomunicatii, 54(2), 48-53. https://users.utcluj.ro/~atn/papers/ATN_2_2013_8.pdf

Ariansyah, K. & Yuniarti, D. (2021). Understanding the adoption of digital terrestrial, cable-based, and satellite-based television to speed up the analogue switch-off in Indonesia. *Telematics and Informatics, 62*,101633. https://doi.org/10.1016/j.tele.2021.101633

Ayat, M., Hardani H., Mirzakuchaki, S. & Haddadi, F. (2016). Design and implementation of high throughput FPGA-based DVB-T system. *Computers and Electrical Engineering, 51*, 43-57. https://doi.org/10.1016/j.compeleceng.2016.03.006

D'Andreagiovanni, F., Lakhlef, H. & Nardin, A. (2020). A matheuristic for joint optimal power and scheduling assignment in DVB-T2 networks. *Algorithms, 13*(1), 27. https://doi.org/10.3390/a13010027

Eizmendi, I., Velez, M., Morgade, J., Gomez-Barquero, D., Baena-Lecuyer, V., Slimani, M., & Zoellner. (2014). DVB-T2: The second generation of terrestrial digital video broadcasting system. *IEEE Transactions on Broadcasting, 60*(2), 258-271. https://doi.org/10.1109/TBC.2014.2312811

Erol, B., Kossentini, F., Joch, A., Sullivan, G. J. & Winger, L. (2009). MPEG-4 Visual and H.264/AVC: Standards for modern digital video. In Bovik A. C. (Ed.) *The Essential Guide to Video Processing* (2nd ed.) (pp.295-330). Austin, Texas, USA: Elsevier Inc.

Galetic, F. (2020). Technological progress in terrestrial transmitting – efficiency and rentability of introducing DVB-T2 HEVC system in Germany and Croatia. *WSEAS Transactions on Business and Economics, 17*, 940-946. https://doi.org/10.37394/23207.2020.17.92

Hauge, J.A. (2014). Mergers and acquisitions in radio and television broadcasting: Consistent goals and adaptive regulation. *Utilities Policy, 31*, 133-142. https://doi.org/10.1016/j.jup.2014.10.006

Iacob, M., Demciuc, Y. & Avram, I. (2020). Particularities of the implementation of terrestrial digital television in the Republic of Moldova. *Journal of Engineering Science (Chişinău), 27*(4), 55-64. https://doi.org/10.5281/zenodo.4288265

Ilić, S., Petrović, M., Jakšić, B., Bojanić, S., Spalević, P. & Babić, R. (2017). Implementing master program on digital broadcasting and broadband technologies. *Electronics, 21*(2), 100-107. https://doi.org/10.7251/ELS1721100I

Jaksić, K., Milosević, I., Jaksić, B., Maksimović, V. & Todorović, J. (2022). Structure and share of satellite TV channels and DTH platforms in Europe. *Acta Scientiarum Technology, 44*(1), e59237. https://doi.org/10.4025/actascitechnol.v44i1.59237

Jaksić, B., Petrović, M., Jaksić, K., Milošević, I. & Marinković, I. (2016). Development of satellite high-definition television in Europe. *Current Science, 111*(6), 1037-1044. https://doi.org/10.18520/cs/v111/i6/1036-1044

JP Emisiona tehnika i veze. (2022). *DVB T2 Serbia*. Retrieved July 21, 2022 from https://www.google.com/maps/d/u/0/viewer?mid=1Of9Gfe9poAg2WGBtpX6tl3v0ZiE&ll= 43.090069417741596%2C20.74533959612875&z=8

JP Emisiona tehnika i veze, (2020). *Price list of services.* Retrieved July 21, 2022 from http://212.200.255.168/wp- content/uploads/2022/07/Cenovnik-usluga-2.pdf

Ljubojev, N. & Dukić-Mijatović, M. (2018). The right of broadcasting organiyations in the serbian law. *Kultura Polisa, 15*(35), 371-382. https://kpolisa.com/index.php/kp/article/view/444

Mišković, B. & Reljin, I. (2015). Broadband DVB-T2 channels at a physical level-simulation analysis. *Elektronika ir Elektrotechnika, 21*(1), 70-75. https://doi.org/10.5755/j01.eee.21.1.5584

Ministry of Trade, Tourism and Telecommunications. (2015). *Rulebook on the transition from analog to digital broadcasting of television programs and access to the multiplex*. Belgrade: Official Gazette of the Republic of Serbia, No. 44/10, 60/13 – CC and 62/14.

Ministry of Trade, Tourism and Telecommunications. (2013). Strategy for the transition from analog to digital broadcasting of radio and television programs in the Republic of Serbia. Belgrade: Official Gazette of the Republic of Serbia, No. 52/2009, 18/2012 and 26/2013.

Ministry of Trade, Tourism and Telecommunications. (2021). *Strategy for the development of the information society and information security in the Republic of Serbia for the period from 2021. to 2026*. Belgrade: Government of the Republic of Serbia, No. 86/2021-5.

Ministry of Trade, Tourism and Telecommunications. (2021). *The law on free access to information of public importance*. Belgrade: Official Gazette of the Republic of Serbia, No. 120/2004, 54/2007, 104/2009, 36/2010 and 105/2021.

Ministry of Telecommunication and Information Society. (2009). Assistence to the digital broadcasting switchover in Serbia. Retrieved September 5, 2022 from: https://www.itu.int/en/ITU-D/Regional-Presence/Europe/Documents/EU%20Assistance%20to%20the%20digital% 20broadcasting%20switchover%20in%20Serbia%20-%20IPA%20Project%20Fiche.pdf

Ministry of Trade, Tourism and Telecommunications. (2002). *Law on Broadcasting*. Belgrade: Official Gazette of the Republic of Serbia, No. 42/2002, 97/2004, 76/2005, 62/2006, 85/2006, 86/2006 and 41/2009.

Oria, A. C., Lopez P., Doblado, J. G., Perez Calderon, D. & Baena, V. (2014). L1 signaling mobility performance in the DVB-T2 receivers intercarrier interference cancellation method applied to L1 signaling. *Microelectronics Journal. 45*(10), 1304-1310. https://doi.org/10.1016/j.mejo.2013.11.004

Petrović, M., Jakšić, B., Spalević, P., Milošević, I. & Lazić, Lj. (2014). The development of digital satellite television in countries of the former Yugoslavia, *Tehnički vjesnik - Technical Gazette, 21*(4), 881-887. UDC/UDK 621.397.743:629.783(497.1)

Regulatory body for electronic media. (2022). *Register of media services*. Retrieved July 20, 2022 from http://www.rem.rs/sr/registar-pruzalaca-medijskih-usluga?utf8=%E2%9C%93&q%5Btip_id_in%5D%5B%5D=4&q%5Btip_id_in%5D%5B%5D=6&q%5Bpretraga%5D=&q%5Bzona%5D=&q%5Bd ozvola_prestala_da_vazi_eq%5D=

Samo, D.A., Slimani, M., Barrufa, G. & Rugini, L. (2015). A performance study of DVB-T2 and DVB-T2-Lite for mobile reception. *Digital Signal Processing, 37*. 35-42. https://doi.org/10.1016/j.dsp.2014.11.002

Shin, D.H. & Song, H.R. (2012). The switchover to digital broadcasting in Korea. *Technological Forecasting* & *Social Change, 79*(8), 1447-1461. https://doi.org/10.1016/j.techfore.2012.04.017

Trujillo, M., (2013). An overview on the standard of digital video broadcasting – terrestrial. *Ingeniería y Competitividad 15*(1), 37-47. http:// www.scielo.org.co/pdf/inco/v15n1/v15n1a04.pdf

Yu, M. & Sadeghi, P. (2012). A study of pilot-assisted OFDM channel estimation methods with improvements for DVB-T2. *IEEE Transactions on Vehicular Technology. 61*(5), 2400-2405. https://doi.org/10.1109/TVT.2012.2195041

Šuput, D. (2014). Pravno uređivanje elektronskih komunikacija – Regulatorni okvir EU i propisi država zapadnog Balkana. *Strani pravni život, 58*(2). 175-189. https://www.stranipravnizivot.rs/index.php/SPZ/article/view/249/248

FINANSIJSKA ANALIZA SERVISA EMITOVANJA DIGITALNE TELEVIZIJE, RADIO PROGRAMA I PRENOSA PODATAKA U REPUBLICI SRBIJI

Rezime:

Digitalizacija radio i televizijskih programa, kao i drugih multimedijalnih sadržaja, veoma je složen proces sa više aspekata i zahteva velika finansijska ulaganja u infrastrukturu sistema i svih pratećih elemenata. U ovom radu dat je sažet opis institucionalnih i regulativnih okvira u procesu digitalizacije u Republici Srbiji. Navedeni su bitni razlozi vezani za izbor kompresionog standarda i standarda za prenos televizijskih signala, kao i opis uloge JP Emisiona tehnika i veze u procesu digitalizacije. Cilj ovog rada je finansijska analiza zarade na godišnjem nivou za usluge emitovanja TV programa u prvom i drugom multipleksu, emitovanja radio programa u okviru DVB-T2 mreže i usluge prenosa podataka nakon procesa digitalizacije. Metod i podaci potrebni za izradu finansijske analize izvedeni su na osnovu cenovnika usluga objavljenog od strane JP Emisiona tehnika i veze objavljenog avgusta 2020. godine. Rezultati su prikazani tabelarno i grafički.

Ključne reči:

Digitalizacija,
Digitalna televizija,
Digitalni prenos podataka,
DVB T2,
Finansijska analiza.