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Bitrate Analysis of Satellite Television Transponders for Europe and Western Balkans

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Abstract— **This paper analyzes the bitrate of transponders for satellite television. The analysis was performed for the Eutelsat 16A satellite located at 16°E (east) using the DiviCatch device and the DiviSuite software package. This satellite broadcasts more than 80% of TV channels for the Western Balkans. The overview of transponders, technical parameters, and the number of SDTV and HDTV channels is shown in the tables. The results obtained are graphically presented for the average bitrate and individual bitrate of each TV channel. The results show that the largest number of SDTV and HDTV channels are broadcasted in the DVB-S2 standard using MPEG-4 compression and 8PSK modulation technique. The analysis shows that providers use 28% less bitrate than the suggested minimum when broadcasting HDTV channels, while for SDTV channels bitrate is 2% lower then suggested. In order to compare the parameters and the bitrate usage, the paper analyzes four more satellites as follows: BulgariaSat at 1.9°E, Hot Bird at 13°E, Astra at 19.2°E and Astra at 23.5°E. The results show the current bitrate usage of active transponders on these satellites as well as the applied parameters for their broadcasting (broadcasting standard, transponder bandwidth, channel resolutions, compression techniques and modulation schemes).**

Keywords- DVB-S; DVB-S2; satellite television; MPEG-2; MPEG-4; HEVC; HDTV; SDTV

I. INTRODUCTION

The advantage of satellite communications lies in the capacity they provide, the large signal area coverage and unnecessary construction of additional infrastructure on earth. Satellite television is a system of distribution of television signals via communication satellites to users. We are witnessing the rapid technological advancements that are coming with the increasing demands of users, so today we have a picture of 8K resolution. In order to transmit such a signal, large capacities and bitrates are required, even over 100 Mbit/s, which makes satellite TV a very suitable medium for this. Japanese television NHK experimentally began broadcasting TV signals in 4K and 8K format in 2016, to begin transmitting 8K signals and 22.2 sound system on December 1, 2018. The plan is to stream 2020 Tokyo Olympics in 8K resolution. Complete communication will take place via satellite transmission [1]. All this provides a great incentive to analyze the parameter and the bitrate required to transmit television channels via satellite. In this paper, the bitrate of transponder on the Eutelsat 16A satellite at the 16°E (east) satellite position is analyzed as well as BulgariaSat at 1.9°E, Hot Bird at 13°E, Astra at 19.2°E and Astra at 23.5°E.

The basic components in satellite TV systems are signal source, broadcast center (uplink antenna), satellite, downlink antenna and receiver (Fig. 1) [2].

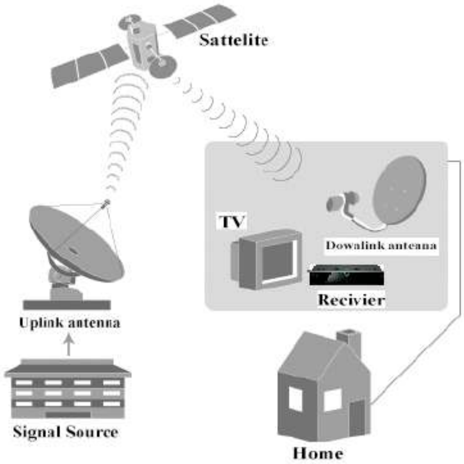


Figure 1. System of satellite transmission.

The signals from the Earth station are sent to the satellite via the uplink antennas of the broadcast facility. The satellites used to transmit TV signals are in geostationary orbit, 37000 km above the Earth's equator [2].

There are many transponders on one satellite that have a task to receive high frequency modulated signals emitted from the Earth broadcasting stations, amplify them, and transmit in

This paper is a revised and expanded version of the paper presented at the XIX International Symposium INFOTEH-JAHORINA 2020 [14] another frequency back to Earth. Today's transponders for TV transmissions are defined with the 36 MHz or 72 MHz band. In Europe, the Ku band (11.7 - 12.2 GHz) is used to distribute TV signals. Its characteristic gives a strong signal but in relatively small territory. This trait was used to promote the so-called smaller offset antennas (60 to 90 cm) that are quite easy to set up and use a combined universal LNB converter [2], [3].

Theoretically, if a satellite antenna could transmit equally in all directions, it would cover about 40% of the Earth's area. However, the transmitting antenna on the satellite does not transmit equally in all directions, but is directed at a narrower area, which is the so-called service area (footprint) of a particular transponder on a communication satellite. Using the directivity of the transmitter antenna on the satellite, it is achieved that the electromagnetic waves are not sent everywhere, even where they are unnecessary, but sent to the area for which the signal from the satellite is intended. This saves energy and, with the available transmitter power, achieves significantly better reception in the coverage area, at the expense of reception quality outside the coverage area. The receiving signal strength at the receiving point is most commonly given in dBW, for example 36 dBW, and is labeled with EIRP (Effective Isotropic Radiated Power). A single satellite can broadcast a signal to several frequency bands and footprint zones [4].

Multiplex (MUX) is a complex signal formed of several different signals, same or different formats, combined with specific information to contribute to the saving of the transmission medium capacity. The satellite multiplex can contain SDTV (Standard Definition Television), HDTV (High Definition Television) and UHDTV (Ultra High Definition Television) channels in MPEG-2 (Moving Picture Experts Group), MPEG-4 (H.264) or HEVC (High Efficiency Video Coding) i.e. H.265 compression format as well as radio channels [5], [6].

Bitrate represents the number of bits of audio and video signals (in this case TV signals) per unit of time (Kbit/s, Mbit/s). Symbol Rate (SR) is a change of symbols in a unit of time, that is, a signal change during transmission using different digital modulations or line coding. It is limited by the satellite frequency bandwidth. The unit is the Mega Symbol per second (MS/s) [5].

Depending on the applied compression, quality and the resolution, different bit rates are used. Table 1 provides the bitrate for signal transmission of different resolutions and compression formats [5].

TABLE I. REQUIRED BITRATE

Compression	*Resolution*	*Bitrate [Mbit/s]*
MPEG-2	SDTV	2 – 5
	HDTV	15 – 20
MPEG-4	SDTV	1.5 – 2
	HDTV	4 – 8
	UHDTV	25 – 35
HEVC	SDTV	0.5 – 0.75
	HDTV	1 – 3
	UHDTV	10 – 15

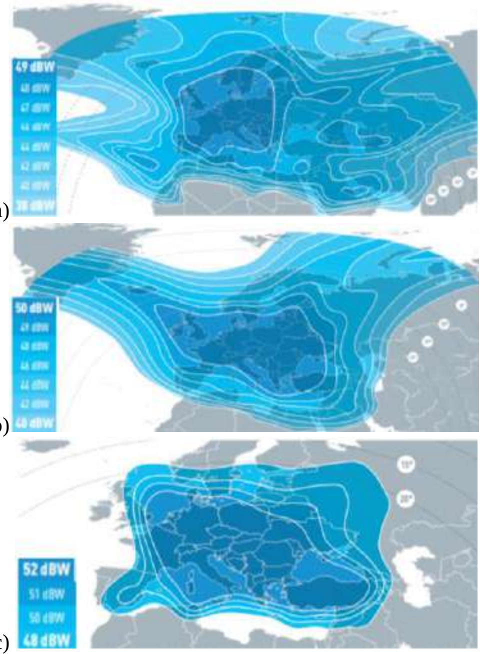
When a digital receiver receives information from a satellite, it cannot send feedback indicating whether the received signal is received with an error. For this reason, a Forward Error Correction (FEC) code has been implemented. A signal is transmitted from the satellite transponder, and during transmission a signal is corrupted by errors; if the receiver receives a signal with errors, it has the ability to correct this error in time [5].

DVB-S (Digital Video Broadcasting - Satellite) is the oldest DVB standard adopted in 1994 by the European Telecommunications Standards Institute (ETSI). It is a satellite transmission of digital audio and video content using a system of geostationary satellites and corresponding receivers. The second generation of this standard - the DVB-S2 has a higher capacity, uses more efficient modulation and compression. DVB-S2 delivers about 30% better performance than DVB-S, allowing the HDTV program to broadcast with the same bandwidth previously required for SDTV [2], [7], [8].

II. SYSTEM MODEL

In this paper, an analysis of the bitrate of the Eutelsat 16A satellite transponder located at the 16°E satellite position is given. This has been the most popular satellite position in the Western Balkans for the last 15 years (Serbia, Bosnia and Herzegovina, Northern Macedonia, Croatia, Slovenia and Albania). This satellite is used by many DTH (Direct to Home) platforms and providers to broadcast TV programs to end users: Total TV, Max TV, A1 Croatia, DigitAlb, Tring, Transmitters and Connections (OiV), Team Media and others [9], [10]. Other satellites were also analyzed for comparison: BulgariaSat at 1.9°E, Hot Bird at 13°E, Astra at 19.2°E and Astra at 23.5°E.

Fig. 2 shows the service area (footprint), coverage and signal strength for Ku band of Eutelsat 16A satellite.



a) b) c)

Figure 2. Footprint of a Eutelsat 16A satellite: a) Europe A, b) Europe B, c) Europe C.

This satellite has 509 SDTV channels, 199 HDTV channels, one 4K channel and 78 audio channels, of which more than 80% is for the Western Balkan countries. Table 2 gives an overview of the channels located on this satellite for each transponder, as well as its technical reception characteristics: frequency, polarization, standard, modulation, FEC and bitrate. From the given data it can be seen how the parameters affect the bitrate.

TABLE II. OVERVIEW OF TRANSPONDERS ON EUTELSAT 16A SATELLITE.

Tr.	*Freq./Pol.*	*St.*	*Mod.*	*SR*	*FEC*	*BP*	*SD*	*HD*
A01	10721 H	S	QPSK	27500	3/4	34.9	4	0
A03	10762 H	S2	8PSK	30000	3/5	52.2	11	8
A05	10804 H	S2	8PSK	29950	2/3	58.0	14	3
A07	10845 H	S2	8PSK	30000	3/5	52.2	10	9
A09	10887 H	S2	8PSK	30000	3/5	58.0	14	11
A11	10928 H	S2	8PSK	30000	3/5	52.2	10	4
B02	10972 V	S2	8PSK	27500	3/5	48.9	16	3
B02	11011 V	S2	8PSK	27500	3/5	48.9	8	1
B04	11055 V	S2	8PSK	27500	4/5	43.6	4	8
B04	11094 V	S2	8PSK	27500	4/5	43.6	18	10
B06	11131 V	S2	8PSK	16593	2/3	32.1	6	1
B06	11151 V	S2	8PSK	14375	3/5	43.6	16	0
B06	11178 V	S2	8PSK	30000	3/5	53.4	30	0
C01	11221 H	S2	8PSK	30000	3/5	53.4	4	9
C02	11231 V	S2	8PSK	42000	4/5	66.7	22	2
C03	11262 H	S2	8PSK	30000	2/3	58.1	2	3
C04	11283 V	S2	8PSK	30000	2/3	59.4	13	15
C05	11303 H	S2	8PSK	30000	2/3	58.1	12	4
C06	11324 V	S2	8PSK	30000	2/3	59.4	4	9
C07	11345 H	S2	8PSK	30000	3/4	41.5	4	0
C08	11366 V	S2	8PSK	30000	2/3	59.4	9	8
C09	11387 H	S2	8PSK	30000	3/5	53.4	20	1
C10	11400 V	S2	8PSK	13846	3/4	30.9	16	2
C10	11427 V	S2	8PSK	27500	2/3	54.5	18	10
D01	11471 H	S2	8PSK	30000	3/4	66.8	19	6
D02	11471 V	S2	8PSK	30000	5/6	74.4	20	10
D03	11512 H	S2	8PSK	30000	3/4	65.3	18	4
D04	11512 V	S2	8PSK	39950	2/3	58.0	5	2
D05	11554 H	S2	8PSK	30000	3/4	66.8	14	6
D06	11554 V	S2	8PSK	30000	5/6	74.4	33	6
D07	11595 H	S2	8PSK	30000	3/4	65.3	16	4
D08	11595 V	S2	8PSK	30000	5/6	74.4	0	1
D9	11637 V	S2	8PSK	30000	2/3	58.1	7	0
D09	11637 H	S2	8PSK	30000	5/6	74.4	18	12
D11	11678 H	S2	8PSK	30000	3/4	65.3	24	2
F02	12541 V	S2	QPSK	19970	3/4	29.7	4	5
F02	12564 V	S	QPSK	3617	3/4	5.0	1	0
F04	12593 V	S	QPSK	2500	3/4	3.07	1	0
F03	12604 H	S2	QPSK	30000	3/4	43.6	19	4
F03	12640 H	S2	8PSK	10833	3/5	19.3	4	2
F04	12643 V	S2	8PSK	27500	2/3	53.2	16	0
F03	12654 H	S	QPSK	11111	2/3	13.7	3	0
F03	12660 H	S2	QPSK	2222	5/6	3.6	0	2
F05	12694 H	S2	QPSK	2220	5/6	3.2	1	0
F05	12699 H	S	QPSK	9880	2/3	12.1	4	2
F05	12717 H	S2	QPSK	7500	3/4	11.2	4	0
F05	12739 H	S	QPSK	2255	3/4	3.1	1	0

Tr. – Transponder, Freq. – Frequency, Pol. – Polarization, St. Standard, Mod. – Modulation, BP – Bitrate.

Most transponders use the DVB-S2 standard, while significantly less transponders use the DVB-S standard, which can be expected to switch to DVB-S2 broadcasting in the near future. This would further save the transponder's bitrate capacity by 30%, thereby increasing the number of TV channels in SDTV and HDTV format and would allow more space for 4K format broadcast channels.

The analysis of the parameters and bitrate of the transponder was performed using the DiviCatch RF-S/S2 device and the DiviSuite software tool [11].

III. RESULTS AND DISCUSSIONS

Table 3 gives an overview of the number of TV channels on transponders for a particular standard, modulation and compression. Also, average bitrate for SDTV and HDTV channels is presented. From Table 3 it can be seen that the more prominent is DVB-S2 standard and MPEG-4 compression and that the largest number of channels use the 8PSK modulation technique. The DVB-S standard does not broadcast HDTV channels on this satellite. Comparing the average bitrate of Table 3 and the required bitrate of Table 1, it can be seen that, in general, the average bitrate fits within defined limits. However, the shown average bitrate is not always an objective parameter for representation, because the DVB-S2 standard generally uses variable bitrate that depends on the content of the image, i.e. its complexity.

In order to represent the bitrate of each channel more accurately and how much they deviate from their average values, in Fig. 3, Fig. 4, Fig. 5, Fig. 6, Fig. 7, Fig. 8, Fig. 9, Fig. 10, Fig. 11 and Fig.12 the bitrate values of the individual SDTV and HDTV channels for different standards, modulation techniques and compression standards are shown. The transponder frequencies and the number of channels are indicated on the x-axis, while the red line indicates the average bitrate of these channels.

TABLE III. NUMBER OF SDTV AND HDTV CHANNELS AND AVERAGE BITRATE FOR EUTELSAT 16A.

St.	Mod.	Comp.	SDTV		HDTV	
			No. Ch.	Avg. Bitrate	No. Ch.	Avg. Bitrate
S	QPSK	MPEG-2	14	3.38	0	0
		MPEG-4	5	1.81	0	0
S2	QPSK	MPEG-2	0	0	0	0
		MPEG-4	31	1.98	17	3.58
		HEVC	2	0.75	0	0
	8PSK	MPEG-2	2	4.29	0	0
		MPEG-4	437	1.94	172	4.67
		HEVC	18	0.99	10	1.72

St. Standard, Mod. – Modulation, Comp. – Compression, Ch –Channel.

Since only SDTV channels exist in the DVB-S standard, the MPEG-2 compression standard is used for a most of these channels, as can be seen in Fig. 3. It can also be seen that MPEG-2 compression for SDTV channels uses a lot of bitrate and compared to Fig. 4, it can be seen that by using the MPEG-4 compression standard, much lower bitrate can be used for the same resolution.

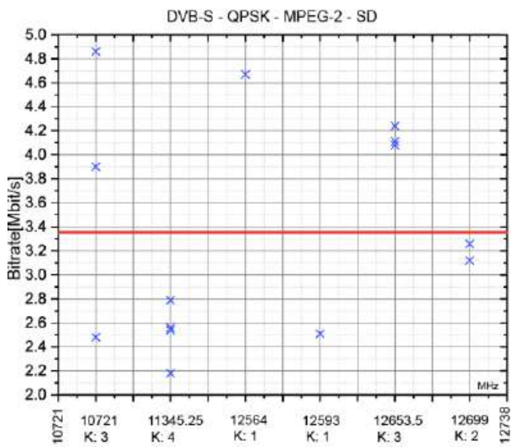


Figure 3. Bitrate for SDTV channel for DVB-S standard, QPSK modulation and MPEG-2 compression.

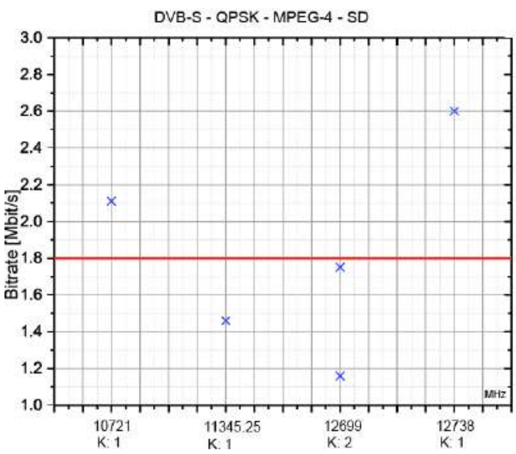


Figure 4. Bitrate for SDTV channel for DVB-S standard, QPSK modulation and MPEG-4 compression.

Fig. 5, Fig. 6 and Fig. 7 show the bitrate of TV channels when using DVB-S2 standard, QPSK modulation and MPEG-4 compression technique for SDTV and HDTV formats and HEVC for SDTV format, respectively. Using QPSK modulation in DVB-S2, HEVC compression is used by only two SDTV channels. In Fig. 7 it can be seen that their average bitrate is only about 0.75 Mbit/s.

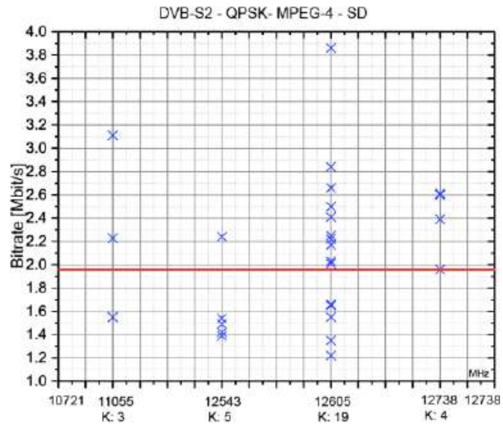


Figure 5. Bitrate for SDTV channel for a DVB-S2 standard, QPSK modulation and MPEG-4 compression.

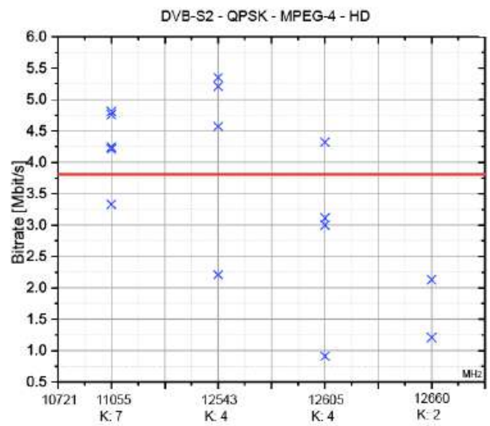


Figure 6. Bitrate for HDTV channel for DVB-S2 standard, QPSK modulation and MPEG-4 compression.

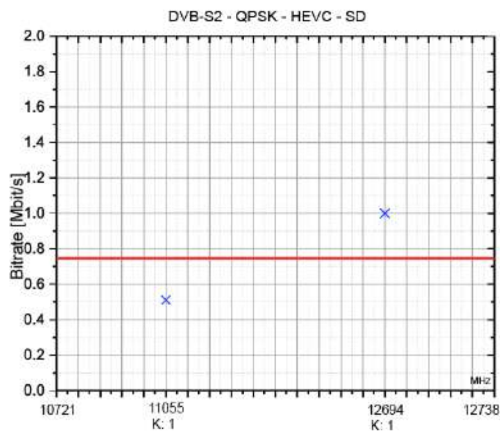


Figure 7. Bitrate for SDTV channel for DVB-S2 standard, QPSK modulation and HEVC compression.

Fig. 8, Fig. 9, Fig. 10, Fig. 11 and Fig. 12 show the bitrate when 8PSK modulation was used. In Fig. 8 it can be seen that only two TV channels use MPEG-2 compression for SDTV channels. In Fig. 11 and Fig. 12 HEVC compression was used for SDTV and HDTV channels, however, it can be seen that these channels are located on only one transponder. Also, the advantage of HEVC compression and 8PSK is seen in low bitrate if compared with the examples when QPSK modulation was used (Fig. 7).

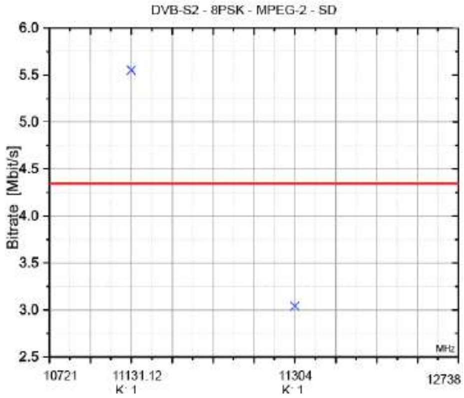


Figure 8. Bitrate for SDTV channel for DVB-S2 standard, 8PSK modulation and MPEG-2 compression.

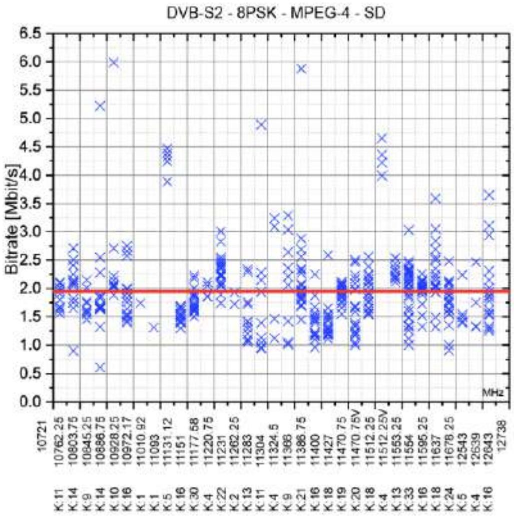


Figure 9. Bitrate for SDTV channel for DVB-S2 standard, 8PSK modulation and MPEG-4 compression.

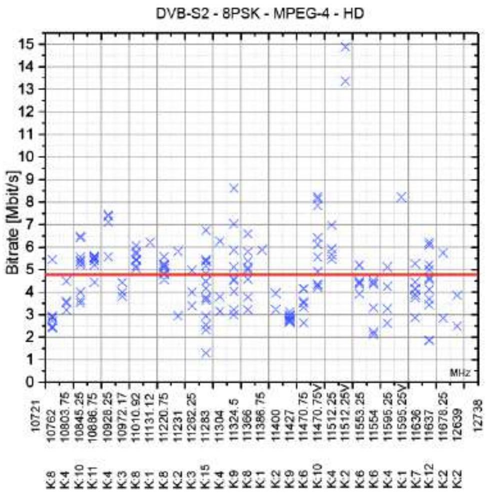


Figure 10. Bitrate for HDTV channel for DVB-S2 standard, 8PSK modulation and MPEG-4 compression.

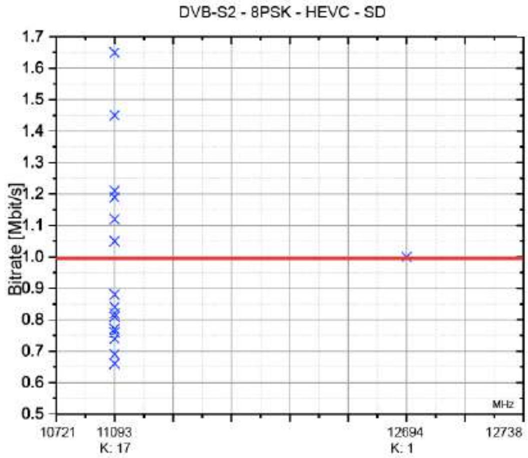


Figure 11. Bitrate for SDTV channel for DVB-S2 standard, 8PSK modulation and HEVC compression.

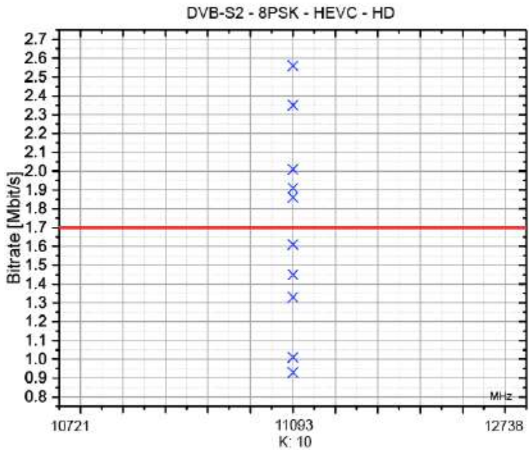


Figure 12. Bitrate for HDTV channel for DVB-S2 standard, 8PSK modulation and HEVC compression.

The most common are 8PSK modulation and MPEG-4 compression, for both SDTV and HDTV channels (Fig. 9 and Fig. 10).

The average bitrate does not always represent a reliable parameter for estimating the consumed bitrate. For this reason, individual bitrate of each TV channel is presented. How many TV channels deviate from the average bitrate value (Fig. 9 and Fig. 10) when using 8PSK modulation and MPEG-4 compression for SDTV and HDTV channels is shown in Fig. 13 and Fig. 14, respectively. Three limits were formed for the SDTV and HDTV formats to represent number of TV channels that are close to the average value (medium limit), that exceed that value (high limit), and that are below (low limit).

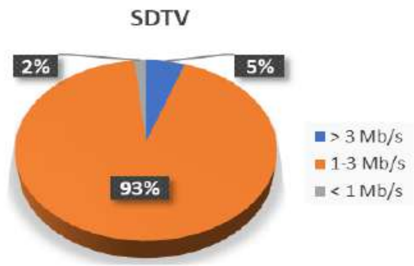


Figure 13. Deviation ratio of TV channels versus average bitrate for SDTV formats.

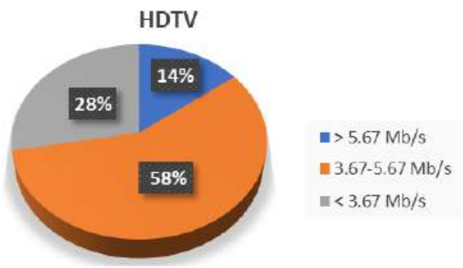


Figure 14. Deviation ratio of TV channels versus average bitrate for HDTV formats.

In Fig. 13 it can be seen that 93% is in the medium limit and only 2% is below the low limit. Compared to the values in Table 1, the provider used recommended bitrate for most of TV channels. For the HDTV format, the situation is significantly different. The 58% of TV channels are in the medium limit, while 28% are below the limit. Considering the values in Table 1, where 4-8 Mbit/s is foreseen for these parameters, the provider consumed less bitrate of 3.67 Mbit/s for 28% of TV channels, although a minimum bitrate of 4 Mbit/s was recommended.

In addition to the Eutelsat 16A satellites, which broadcast as much as 80% of the channels in the Western Balkans, the satellites that are most popular in Europe and which have services for the Western Balkans are: BulgariaSat at 1.9°E, Hot Bird at 13°E, Astra at 19.2°E and Astra at 23.5°E. Table 4 gives an overview of these satellites, their frequency range, the number of transponders, and the positions of the satellites.

TABLE IV. OVERVIEW OF THE MOST POPULAR SATELITTES FOR EUROPE

Name	No. transponder			Bandwidth [MHz]			Position
	C	Ku	Ka	C	Ku	Ka	
Bulgaria Sat	-	30	-	-	77	-	1.9°E (2017 -)
Hot Bird 13E	-	38	-	-	33	-	13°E (2006-2009) 9°E (2006-2009) 13°E (2016 -)
Hot Bird 13B	-	64	-	-	-	-	13°E (2006 -)
Hot Bird 13C	-	64	--	-	24,33, 36, 50	-	13°E (2008 -)
Eutelsat 16A	-	53	3	-	36,54, 72,108	-	16°E (2011 -)
Astra 1KR	-	32	-	-	77	-	19.2°E (2017 -)
Astra 1L	-	29	-	-	26	-	19.2°E (2006 -)
Astra 1M	-	36	2	-	26,33	500	19.2°E (2007 -)
Astra 3B	-	60	-	-	26,33	-	19.2°E (2008 -)
Astra 1N	-	52	4	-	36,33	-	23.5°E (2010 -)

Table 4 also shows when satellites were launched and their positions over a 15-year lifespan. It is mentioned that the satellites analyzed are the most popular in Europe, however, Eutelsat 16A is a satellite that has a part of transponders directed to South Africa.

In Fig. 15, Fig. 16, Fig. 17 and Fig. 18, beam for Bulgaria Sat at 1.9°E, Hot Bird at 13°E, Astra at 19.2°E and Astra at 23.5°E can be seen [12]. Based on the beams, the power and area of coverage of these satellites can be seen, that is, the broadcasting of services from these satellites.

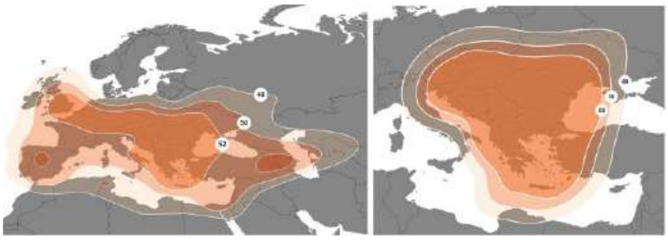


Figure 15. BulgariaSat 1.9° beams (Service area).

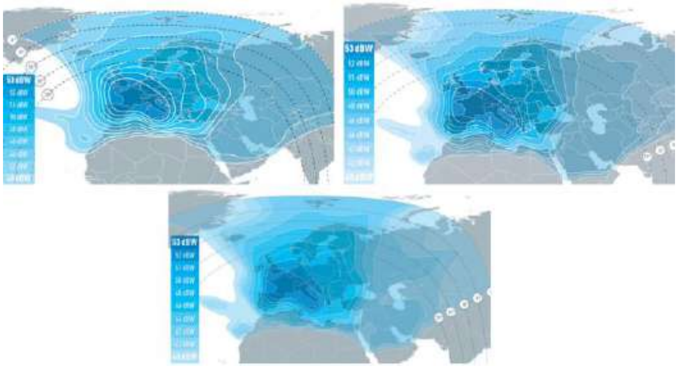


Figure 16. Hot Bird 13° beams (Service area).

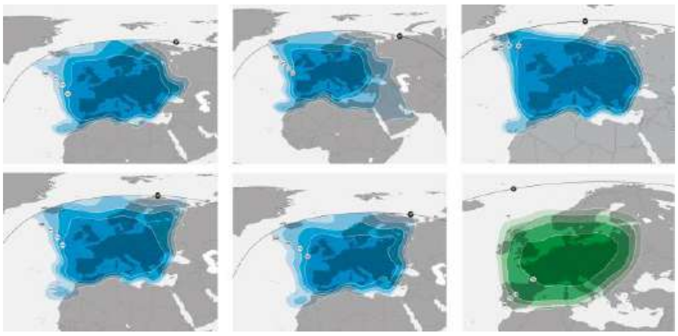


Figure 17. Astra 19.2° beams (Service area).

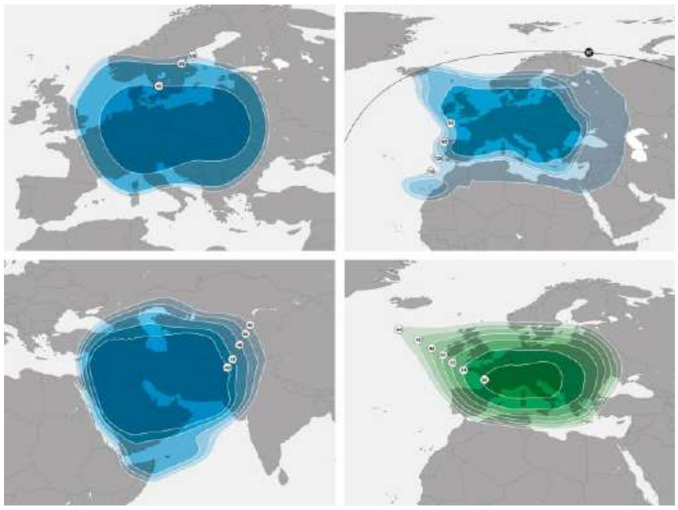


Figure 18. Astra 23.5° beams (Service area).

Fig. 19 shows the total bitrate of the analyzed satellites. It can be seen that the lowest bitrate is on BulgariaSat. However, it is a satellite launched in 2017 and it is very important to note that at the time of analysis only 4 transponders were active on this satellite, while 6 were for channels which are occasionally broadcasted. It can be seen from Table 4 that 30 transponders are stationed on this satellite, however, as mentioned, not all of them are active and part of the transponders is used for tests, reserved and dedicated transmissions of both TV channels and data. The bitrate depends directly on the number of transponders, so Fig. 19 shows the bitrate for the active transponders. Also, important fact is that even active transponders are not always fully used, as can best be seen from a more detailed analysis of the Eutelsat 16A satellite. The reason is that providers also transmit occasional TV signals, data, as well as a reserved program for exchange or live coverage transmissions and tests, but also for renting.

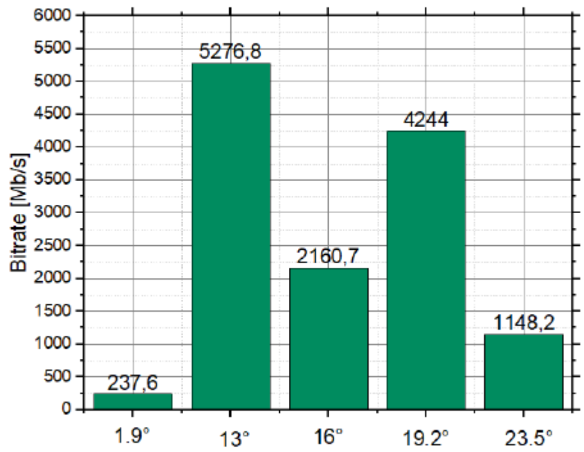


Figure 19. Total bitrate on analyzed satellites.

Fig. 20 shows the number of TV channels for mentioned satellites for DVB-S standard and QPSK modulation for SDTV and HDTV channels, as well as the compression used over those channels. From Fig. 20 it can be seen that in DVB-S standard, BulgariaSat does not broadcast its channels, while many channels using MPEG2 compression can be found on Hot Bird 13°E and Astra 19.2°E satellites. Also, Eutelsat 16°E and Astra 23.5°E broadcast a small number of TV channels in this standard. It is noticeable that the number of HDTV channels is very low even when using the MPEG4 compression technique.

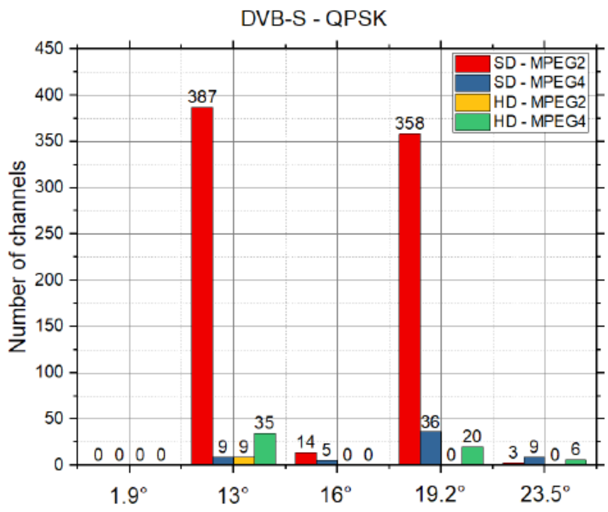


Figure 20. Number of TV channels for DVB-S standard and QPSK modulation.

As can be seen from Fig. 20, there is a small number of HDTV channels and the use of more efficient compression techniques is insignificant in DVB-S standard. In this type of cases, HDTV channels use a lot of bitrate, and for that reason some satellites no longer have DVB-S channels, even those with a lower resolution. The DVB-S2 standard delivers about 30% better performance than the DVB-S standard as well as new modulation schemes. Fig. 21 shows the number of TV channels for DVB-S2 standard and QPSK modulation technique. As can be seen from Fig. 21, there is a small number of TV channels that broadcast with this modulation technique. It can also be seen that the MPEG2 compression technique is less in use in favor of MPEG4 compression technique. This is a small number of TV channels in terms of satellite capacity, so these channels tend to switch to other modulation techniques for better efficiency. Interestingly, Hot Bird broadcasts one UHDTV channel using these techniques and HEVC compression.

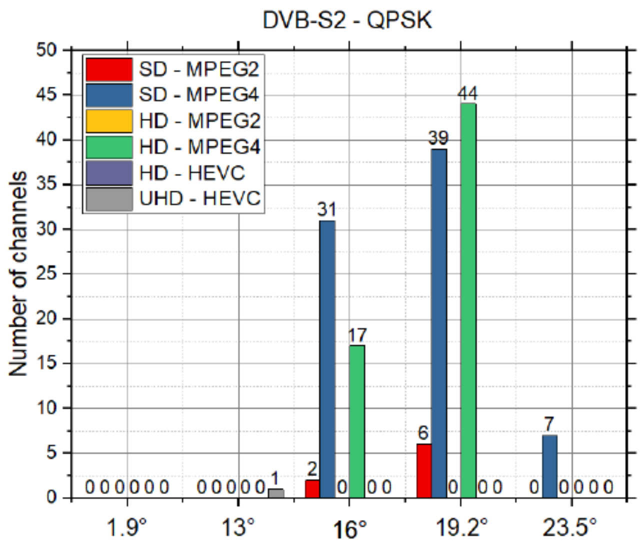


Figure 21. Number of TV channel for DVB-S2 standard and QPSK modulation.

In the analysis so far and in practice, the DVB-S2 standard clearly yields better results. In Fig. 20 and Fig. 21 it can be seen that some satellites almost do not broadcast channels with these parameters, but that most TV channels are broadcast in DVB-S2 standard using the 8PSK modulation technique. Fig. 22 shows the number of TV channels for each satellite broadcasting TV channels in SDTV, HDTV and UHDTV resolution and the application of different compression techniques. It can be seen from Fig. 22 that the BulgariaSat only broadcasts SDTV channels using the MPEG 4 compression technique. The HDTV channels on the Hot Bird satellite are mostly using MPEG4 compression technique, but there are also 17 UHDTV channels that use the new HEVC compression technique.

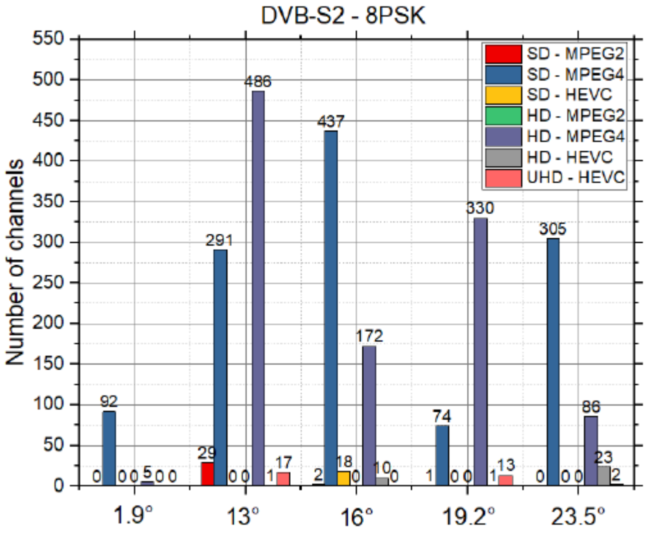


Figure 22. Number of TV channel for DVB-S2 standard and 8PSK modulation.

Comparing the results from Fig.20, Fig. 21 and Fig. 22, one can see the current status of the number of TV channels and the parameters with which they are broadcast. The most common modulation scheme is the 8PSK and MPEG4 compression technique. However, in comparison with the previous years, it is clear that there is a tendency of gradual transition to newer modulation schemes and more efficient compression techniques.

IV. Conclusions

In this paper, an analysis of the transponder bitrate located on Eutelsat 16A is made. Based on the results obtained, shown in tables and graphs, it can be seen that DVB-S standard is used only for SDTV channels using MPEG-2 and MPEG-4 compression, while there are no HDTV channels. The QPSK modulation technique has been used in a small number of TV channels in the DVB-S2 standard, while the 8PSK modulation is the most common. Using this modulation and MPEG-4 compression, this satellite is broadcasting 437 SDTV and 172 HDTV channels for a total of 609 TV channels. The analysis shows that 80% of the TV channels is intended for the Western Balkan countries. Also, four more satellites were analyzed: BulgariaSat at 1.9°E, Hot Bird at 13°E, Astra at 19.2°E and Astra at 23.5°E. These satellites are the most popular in Europe and a large number of services are intended for Western Balkan countries. Based on the results obtained, it can be seen that the number of active transponders on the satellites varies as well as the bitrate used. Part of the transponders is used for renting, exchanging channels, data and for tests. On satellites, there are transponders that experimentally broadcast TV channels with modulation techniques such as 16PSK and HEVC compression techniques whose resolutions are 4K or 8K. However, these channels are not intended for the end users.

In March 2014, the DVB-S2X standard was introduced as an extension of the DVB-S2 standard to improve spectral usage from 20% to 51% compared to DVB-S2 for DTH networks. The new standard also brings new improvements that are reflected in larger combinations of different FEC values and modulation schemes such as 64, 128 and 256 APSK (Amplitude Phase Shift Keying), which can achieve up to 51% better efficiency compared to DVB-S2 [7], [13]. Since individual transponders are used for testing purposes, these satellites also include S2X standard during transponder analysis, but these channels are not intended for the end users, too. The results clearly show the tendency of gradual transition from DVB-S to DVB-S2 standard, so in the next period a gradual transition from DVB-S2 to DVB-S2X standard is expected.

This paper provides a good basis for analysis, based on it, it is possible to calculate and investigate how much bitrate will be saved if a DVB-S channels move to DVB-S2, as well as DVB-S2X, all using the HEVC compression technique.

Acknowledgement

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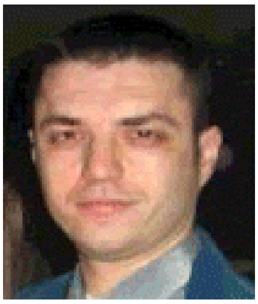

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