QUALITY OF SERVICE IN DIGITAL VIDEO BROADCASTING IN CZECH REPUBLIC

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Abstract: The aim of this paper is to explore the quality of services in Digital Video Broadcasting (DVB). This work is focused on long-term measurement of individual DVB standards. Program ČT 24 is selected for more detailed analysis. There is monitored bitrate and video quality on this program. Measurement is made on the DVB-T/S/S2 standards. The study of quality in DVB systems, which are available in the Czech Republic until 1. March 2017, was the motivation for this research. After this date broadcasting will start in DVB-T2.

Keywords: DVB-T, DVB-S, DVB-T2, DVB-S2, Video Quality

1 INTRODUCTION

Nowadays, the research and development in multimedia systems can be divided into several areas, video broadcasting and unicasting. Systems DVB-T/S/C are used for broadcasting and now already their second generation. This generation is labeled as: DVB-T2/S2/C2. For unicast and IPTV (Internet Protocol Television) there can be used the classical IP internet networks, peer to peer networks (P2P) or cellular networks (LTE). Description of DVB-T and DVB-T2 performance in fixed terrestrial TV channels can be found in [1]. Article [2] is focused on the measurement of DVB-S and DVB-S2 parameters. To provide cost effective and profitable broadband services, next generations of DVB systems must apply new technologies in equipment and design of communication payload.

At present, there is the boom of watching online videos, but watching traditional TV is not on the decline. As it can be seen in Table 1, time of watching TV has grown up in recent 5 years by 18 minutes [4].

Year	Time of watching TV
1/2017	4:20 / per day
1/2016	4:17 / per day
1/2012	4:02 / per day

Table 1: Average time of watching television per day [4].

Penetration of distribution platforms in the households in the Czech Republic is presented by Figure 1. Digital Terrestrial Television (DTT), which consist DVB-T and DVB-T2, has the highest penetration. Satellite television (SAT) DVB-S/S2 and television over cable (CATV) or Internet Protocol television (IPTV) has similar penetration. Analog television (ATV) was disabled in the end of 2012.

In these days (1. march 2017) it was officially launched broadcasting in standard DVB-T2. This broadcast is now available only from two transmitters nearby the Prague. Penetration of DVB-T2 signal since first march 2017 has been 25 % of people [4]. Coverage of landscape to this date can be seen in Figure 2.

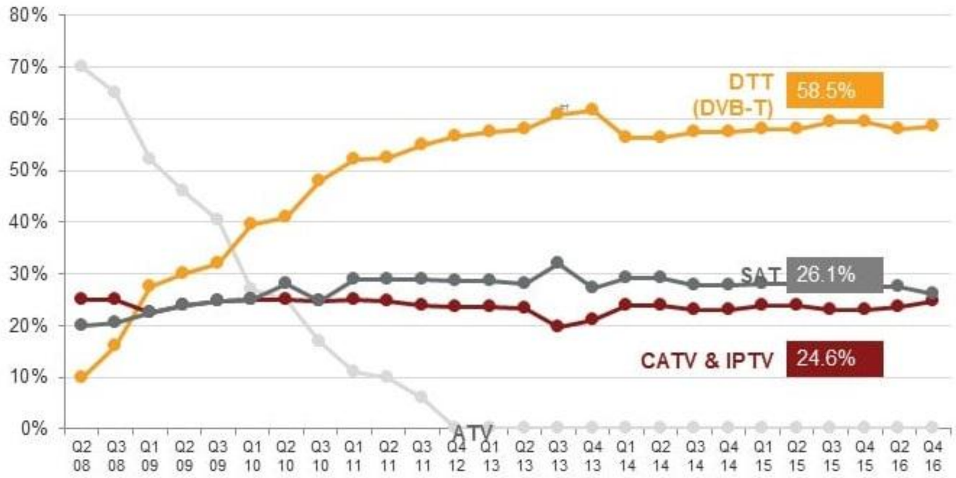


Figure 1: Penetration of distribution platforms on all TV receivers in the households [4].

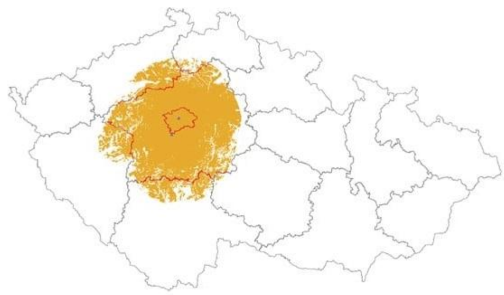


Figure 2: Current coverage of the DVB-T2 network [4].

In our experimental measurement, there was measured average bit rate for the TV program ČT 24 continuously 24 hours. Multiplex throughput is determined by various parameters of the physical layer. On the other hand, provider adjusts a number of streams (TV programs). Each program in the multiplex has a different bit rate, according to the requirements of the provider. He can offer more programs in poorer quality or fewer programs in the better quality. Table 2 shows the parameters of the individual standards which were measured.

Implementation	DVB-S	DVB-S2	DVB-T
Modulation scheme	QPSK	8PSK	OFDM 8K
Transmission capacity of the multiplex [Mb/s]	38.0	51.0	19.9
Code rate	7/8	3/4	2/3
Average bitrate of the ČT 24 program [Mb/s]	2	4	3

Table 2: Parameters of used DVB standards.

2 EXPERIMENTAL SETUP

The connection of measuring equipment is shown in Figure 3. In the first stage there is received DVB-S signal amplified by LNA (Low Noise Amplifier). Thereafter signal is transferred in first satellite inter-frequency to DVB-S receiver "Katrein MSK-33". In the next stage, there is signal transferred via TS parallel to the Digital Video Measurement System "R&S DVM 400". The DVB-T signal is received by the second "R&S DVM 400". In the final stage of the diagram, there is "R&S DVQ", which measures the video quality of decoded video signal. Description of the video metrics used by "R&S DVQ" is in chapter III. Measurement was carried for all platforms successively. It means three consecutive days. The reason was that we have available only one quality analyzer.

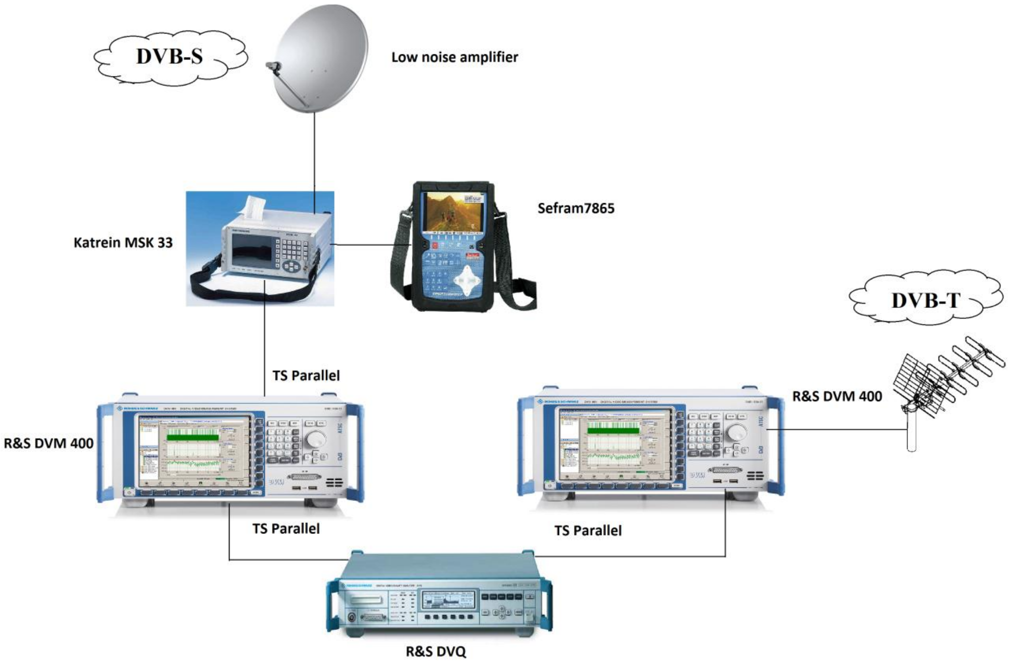


Figure 3: Block diagram of measuring instruments.

The physical layer of DVB-S and DVB-S2, illustrated by constellation diagrams, is shown in Figure 4. As it can be seen in this picture, DVB-S uses QPSK (Quadrature Phase-Shift Keying) modulation. Current standard DVB-S2 uses 8PSK modulation. These constellation diagrams are from the device “Sefram 7865”.

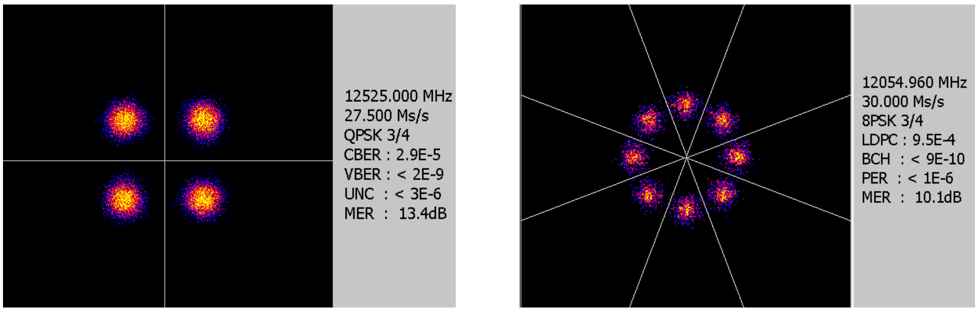


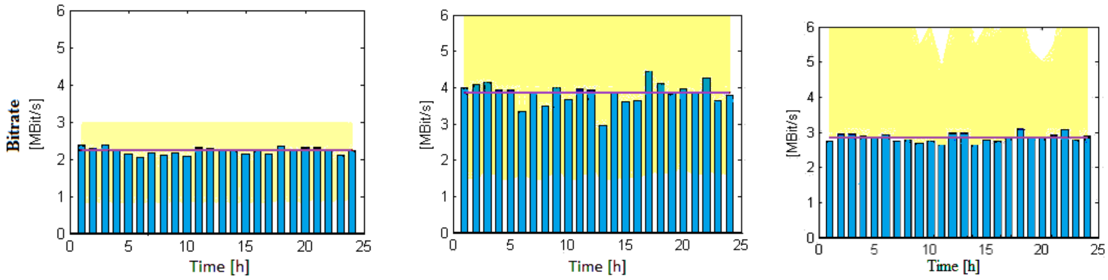
Figure 4: Constellation diagrams of DVB-S and DVB-S2.

3 USED VIDEO QUALITY METRIC

The basic metric of a Digital Video Quality Analyzer for calculating the quality of coded video sequences is the quality DVQL-U (Digital Video Quality Level - Unweighted). DVQL-U is used as the absolute value for the existence of blocking type interference patterns within an original frame. In contrast to DVQL-W (Digital Video Quality Level - Weighted), DVQL-U is a direct measure of these blocking types of interference. Depending on the original frame, however, the test value is not always correlated with the impression of the quality of a subjective test. To bring the objective quality closer to the subjective quality, other quantities in the video must also be taken into consideration. These are the Spatial Activity (SA) and the Temporal Activity (TA). This is because SA, TA can make blocking structures invisible, they can mask them. These artifacts are then not seen by the human eye [3]. The DVQL-W metric was chosen because of the best corresponding to a subjective test.

4 EXPERIMENTAL RESULTS

The measurements were carried the entire day, i.e. 24 hours. The measurement was performed on program ČT 24. It is unencrypted and there can be measured video quality. Figure 5 shows the data flow of bit rate for TV program ČT 24 during twenty-four hours. The violet line is the average value of bit rate for 24 hours. Blue line indicates average values per hour. The yellow bar graph shows the maximum and minimum of the bitrate. The same description is for the video quality in Figure 7-9. As it can be seen in Figure 5, bitrate of one video stream is variable. The difference is about 10 %. The maximum bit rate is approximately 80 % higher than the average value of bitrate. The maximum bitrate is constant for DVB-S. In DVB-T, it is changing over the time.



a) DVB-S b) DVB-S2 c) DVB-T

Figure 5: Average bitrate for program ČT 24 in standards: a) DVB-S, b) DVB-S2, c) DVB-T.

As it can be seen in Figure 6, it is possible to transmit several video streams in one multiplex. These diagrams are from the device "R&S DVM 400". For DVB-T, it is four to five programs in the SD resolution. For the satellite version of DVB, it is more than ten programs. The number of streams would be roughly half if there are used programs in Full HD resolution. The number of programs in one multiplex depends on the provider. It must be mentioned that the sum of all data flows must be less or equal to the total throughput of the multiplex.

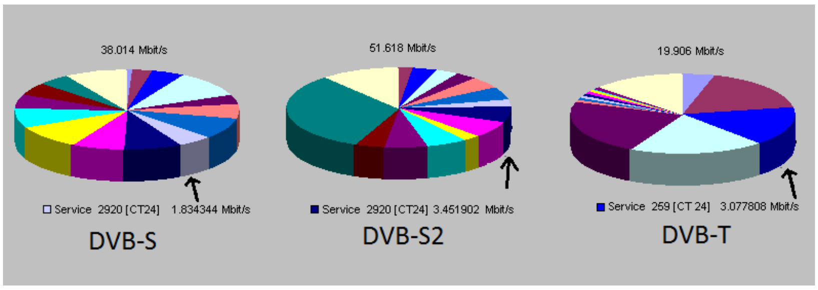


Figure 6: Allocation of bitrates for each program in standards DVB-S, DVB-S2 and DVB-T.

As it can be seen from figure 7-9, video quality is changing over the time. When figures 5a and 7 are considered it can be concluded that quality responds to bitrate. Distribution of DVQL-W quality over the duration is in figure 7b. From the histograms of the time of occurrence of the video quality, it is obvious that the most common value of the quality is 89 % for DVB-S2, 84 % in case of DVB-T and 80 % for DVB-S.

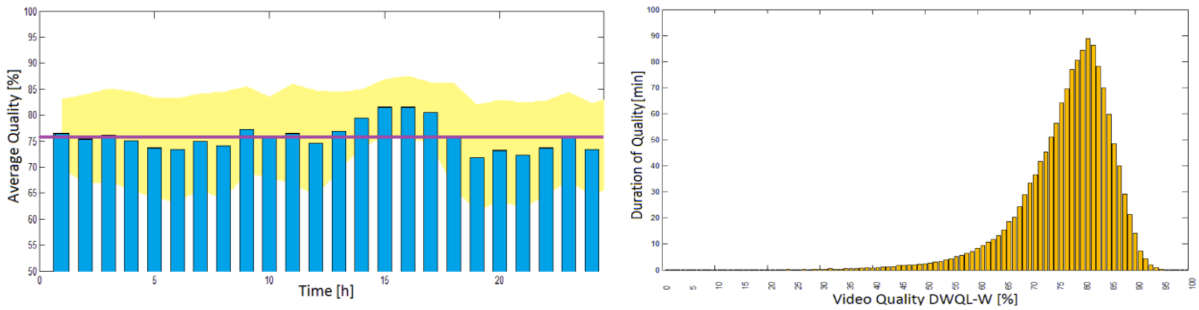


Figure 7: Standard DVB-S a) Average quality in 24 hours b) Duration of video quality.

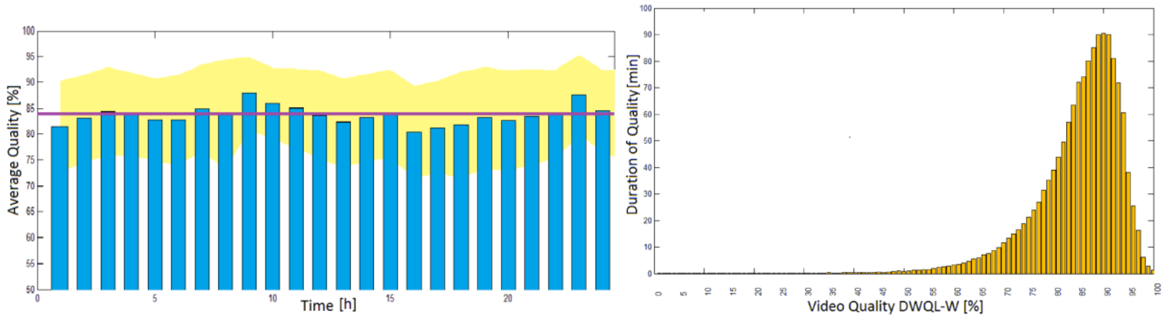


Figure 8: Standard DVB-S2 a) Average quality in 24 hours b) Duration of video quality.

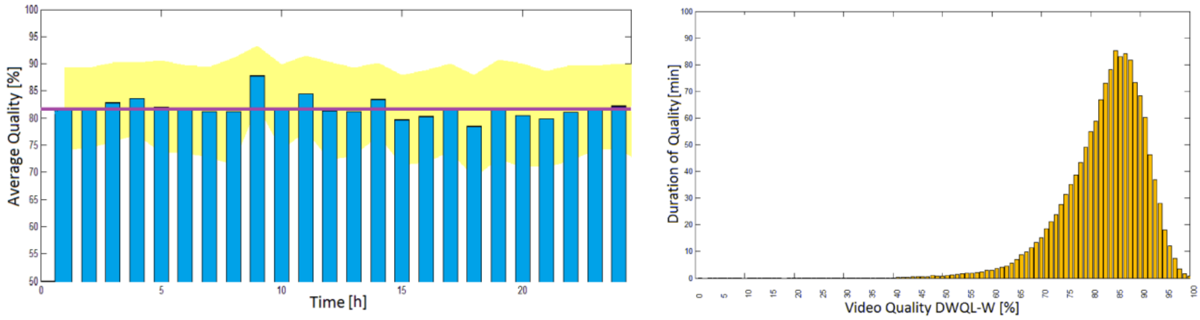


Figure 9: Standard DVB-T a) Average quality in 24 hours b) Duration of video quality.

5 CONCLUSION

In this work, there is explored the current quality of services in DVB systems in the Czech Republic. From the results, it is possible to determine, that the highest transmission rate is in the DVB-S2. This corresponds to the highest video quality in this system. The provider has allocated a certain bandwidth that is used according to his requirements. The provider may have a lot of programs in poor quality, or a few programs with higher quality.

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