

COMPARATIVE ANALYSIS OF INFLUENCE OF TV CHANNEL TRANSMISSION PROCESS TO QOE FOR DVB-T/H AND IPTV SERVICES

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Abstract

Digital television (TV) broadcasting offers the user an opportunity to watch higher quality television channels, compared with analog television. However, for the user, which chooses digital television instead of the analog television, the implementation of the longer channel zapping process negatively affects the user's perception of the attractiveness of service and his individual needs, so it is important for the television service provider to analyze the impact of the channel zapping process to service quality of experience (QoE). As nowadays the digital terrestrial/ handheld television (DVB-T/H) is most common TV service and digital IP television (IPTV) is considered as the most promising contender for the digital terrestrial/ handheld television, so the task of this paper is to analyze and compare the QoE of TV channel transmission process for DVB-T/H and IPTV services by TV channel zapping time.

1. INTRODUCTION

Currently actual problem for digital television is TV channel zapping time. This QoE parameter is very important for users of digital TV. Influence of channel zapping process of IPTV service to QoE is directly dependent on its main components, influencing digital television channel zapping time [1]. The main component - processing time of requests for TV channel change is reliant to the user's behaviour for TV channel searching and selection.

TV channel zapping time of DVB - T/H service is dependent on a number of components [2]. Correlation of components, that influences the TV channel zapping time, affects the transmission process of TV channel for DVB-T/H and IPTV services, so the experimental researches for TV channel zapping time of DVB-T/H and IPTV services are presented in this paper.

2. EXPERIMENTAL RESEARCHES FOR CHANNEL ZAPPING TIME OF DVB-T/H AND IPTV SERVICES

The aim of experimental researches - to measure the TV channel zapping time of DVB-T/H and IPTV services, using a different methods of TV channel searching and selection, and compare the

influence of TV channel transmission process by channel zapping time impact on the quality of experience.

The experiments were carried out in the networks of Lithuanian DVB-T/H (Fig. 1) and IPTV (Fig. 2) services' providers. During the experiments, the TV channel zapping time was recorded by assessing different behaviour of users for TV channel searching and selection to a fixed choice of selected TV channel:

- TV channel is selected sequentially;
- TV channel is selected random.

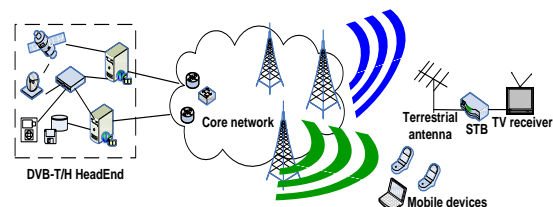


Figure 1. Experimental network for DVB-T/H service

When user selects TV channels sequentially, he/she switches one TV channel after another, recording the TV channel after the completion of the first request for channel change. When user selects TV channels random, he/she switches one TV channel after another at random, repeating the changing process not less than 2 times and not recording the selected TV channel after sending

request for its change. The transmission of selected TV channel begins when user fixes his choice for selected TV channel.

Experimental measurements was made in the hours of highest load – on Saturdays and on Sundays from 18 to 22 hours (p.m.). The duration of all experiments – 5 weeks.

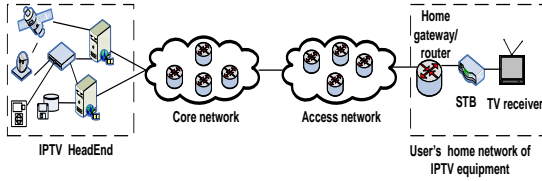


Figure 2. Experimental network for IPTV service

Total amount of TV channels: 57 IPTV channels and 14 DVB-T/H channels. The evaluation of QoE for different TV service was made by 10 respondents, who evaluated the subjective QoE using the method of Mean Opinion Score (MOS) and expressing the perceived quality of service on a scale from 1 (poor) to 5 (excellent).

3. RESULTS OF EXPERIMENTAL RESEARCHES FOR CHANNEL ZAPPING TIME OF IPTV SERVICE

Experimental results of IPTV service were processed by methods of statistical analysis. Results in Fig. 3 shows, that when TV channel is selected sequentially, only part times of TV channels changes exceed the limiting value for IPTV channel zapping time according ITU-T (2 seconds) [3].

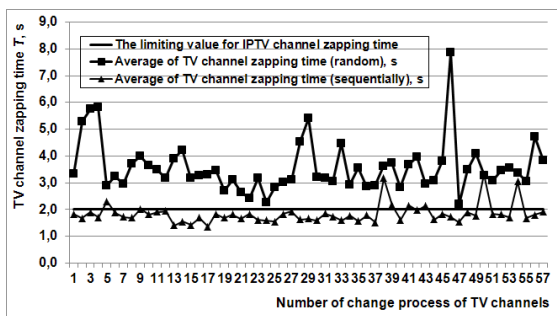


Figure 3. IPTV channel zapping time

Differentially is when IPTV channel is selected random. In this case all IPTV channel zapping times exceed the limiting value of 2 s.

However, the perceived quality of IPTV service respondents are assessing not only by the main criterion – the channel zapping time, but also on other, visible or audible factors: TV channel video

and audio desynchronization or video distortion, and et al. In order to eliminate possible errors of IPTV QoE, authors approximate results of experimental researches of IPTV service (Fig. 4). Due to this approximation, authors proposed the objective method for IPTV QoE evaluation by TV channel zapping time, when TV channel is selected

– sequentially:

$$\begin{aligned} ob_MOS = & -0,665 \cdot T^5 + 7,8222 \cdot T^4 - \\ & - 34,952 \cdot T^3 + 73,913 \cdot T^2 - \\ & - 75,812 \cdot T + 34,935 \end{aligned} \quad ; (1)$$

– random:

$$\begin{aligned} ob_MOS = & -0,0319 \cdot T^3 + 0,6273 \cdot T^2 - \\ & - 4,0203 \cdot T + 9,3723 \end{aligned} \quad ; (2)$$

here T – TV channel zapping time in IPTV service.

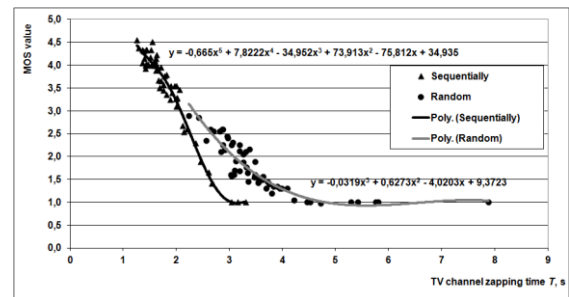


Figure 4. Approximation of results of experimental researches of IPTV

Comparision of IPTV subjective and objective QoE, when TV channel is selected sequentially and random is presented in Fig. 5 and Fig. 6. The correlation between subjective and objective QoE is 0,82 (for sequentially) and 0,87 (for random).

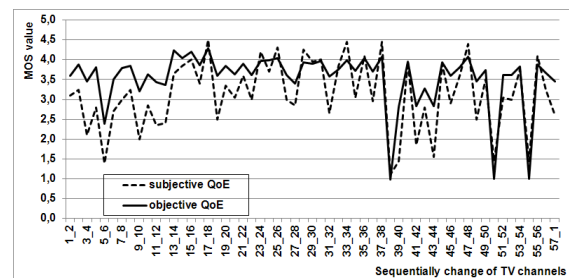


Figure 5. IPTV QoE (sequentially)

These coefficients indicate a strong correlation between the subjective QoE evaluation by respondents and proposed an objective QoE assessment.

According to the results of quality of experience evaluations, is seen that, when TV channel zapping

time exceeds the limit of 2 s, respondents of IPTV service consider this as a very long duration for change of TV channel. This duration is unacceptable for respondents and forms a negative attitude to the transmission of IPTV channels. Also it affects the negative approach to the attractiveness of IPTV service.

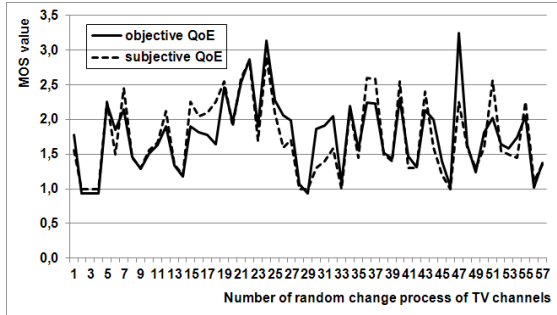


Figure 6. IPTV QoE (random)

4. RESULTS OF EXPERIMENTAL RESEARCHES FOR CHANNEL ZAPPING TIME OF DVB-T/H SERVICE

Experimental results of DVB-T/H service were processed by methods of statistical analysis are presented in illustrations below.

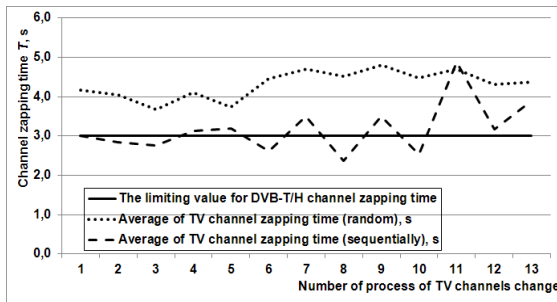


Figure 7. DVB-T/H channel zapping time

According to the Fig. 7, it is obviously, that when TV channel is selected random, in contrast to sequentially changes, all times of TV channels changes exceed the limiting value of 3 seconds [4] for DVB-T/H channel zapping time. Such TV channel zapping time respondents grade less than 3.5 in MOS scale as long duration for change of TV channel.

However, as given evaluations of the subjective QoE was scattered, the authors proposed to approximate these evaluations (Fig. 8).

In this case, the authors proposed an objective method for QoE assessment of the DVB-T/H service according TV channel zapping time, when TV channel is selected

– sequentially:

$$ob_MOS = 0,1296 \cdot T^5 - 2,8156 \cdot T^4 + 23,762 \cdot T^3 - 96,972 \cdot T^2 + 189,69 \cdot T - 138,09 \quad ; (3)$$

– random:

$$ob_MOS = 0,3315 \cdot T^4 - 6,2355 \cdot T^3 + 43,392 \cdot T^2 - 132,91 \cdot T + 153,62 \quad . (4)$$

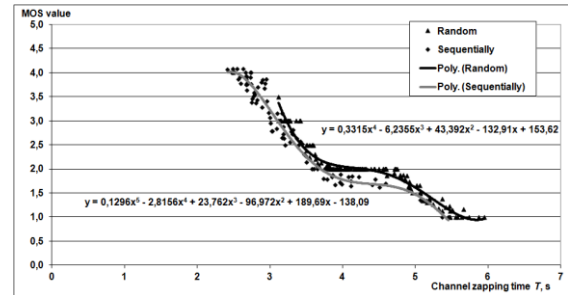


Figure 8. Approximation of results of experimental researches of DVB-T/H

Comparison of DVB-T/H subjective and objective QoE is presented in Fig.9. In this case, when IPTV channel is selected sequentially, correlation between the subjective and objective QoE is equal to 0.98; and when IPTV channel is selected random correlation is 0.93. That shows a very strong correlation between the subjective QoE evaluation and proposed an objective QoE assessment.

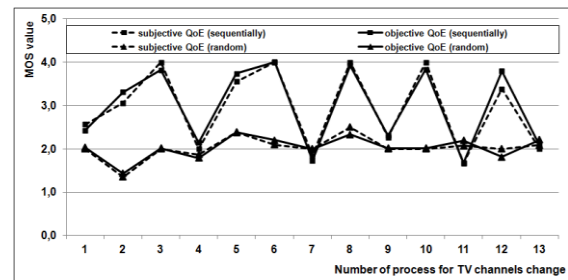


Figure 9. DVB-T/H QoE

According to the results (Fig. 9) the request for change of TV channel, when respondent is selecting a channel sequentially, was processed shorter than in a case of random selection. This results the assessment of QoE for DVB-T/H service greater than 3.5 in MOS scale as acceptable TV channel zapping time by respondents.

4. CONCLUSIONS

According to the results of experimental researches it can be stated that:

1. IPTV channel zapping time is 1 second shorter when TV channel is selected sequentially and 1 second longer when the TV channel is selected random, compared with DVB-T/H.

2. Due to this time, subjective QoE evaluation of IPTV service is 0,5 greater (for sequentially and random) in MOS scale than for DVB-T/H service.

In this paper according to the influence of TV channel transmission process for subjective QoE, authors proposed objective methods for QoE evaluation, which correlations are close to 1.

References

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