

OPINION

**of a dissertation
for awarding an educational and scientific degree of "Doctor" in**

**in the field of higher education – 5. Technical Sciences
the professional field – 5.3 “Communication and Computer Engineering”
doctoral program – "Communication Networks and Systems"**

Author: M.Eng. Seyhan Sadak Myumyunali

Topic of the dissertation: “Research and Improvement of the Quality of Service in Satellite Communication Channels”

Member of the scientific jury: Assoc. Prof. Krasen Kirov Angelov, PhD

1. Topic and relevance of the dissertation work

The dissertation work of M.Eng. Seyhan Myumyunali is dedicated to the mechanisms, methods and means of improving the quality of service in satellite communication channels, which is a process with continuous development, a definite guarantee of the relevance of the work and a real challenge for in-depth dissertation research.

The object of research in the dissertation is the wireless transmission environment with its features and influence, as well as the processes of signal processing and transmission in satellite communication channels, in particular in satellite television systems according to the DVB-S/S2 standard, in satellite data transmission systems and in satellite communications systems operating in low Earth orbit.

The structure of the dissertation includes an introduction, five chapters, a conclusion, a list of abbreviations used, a list of publications on the dissertation, and a reference list. The dissertation, with a volume of 128 pages, was developed on the basis of an analytical review of 158 literary sources, including 12 in Bulgarian, 124 in English and 22 Internet-based sources. Not all listed sources are cited in the dissertation. The introduction in the first chapter of the dissertation shows a good knowledge of the features and parameters of satellite communication systems, as well as the international standards regulating their characteristics and requirements. This knowledge has allowed the author to correctly assess the current state of the problem and formulate research goals in the dissertation work.

2. Research methodology

The research methods in the dissertation work are analytical, simulation and practical. The Matlab/Simulink and Free Space Propagation Simulator programming environments were used as a tool for the simulation studies. The chosen research methodology is adequate.

The purpose of the research is to create methodologies of procedures related to correct approaches in configuration, monitoring and control of satellite communication systems for digital television and data transmission, by determining optimal ranges of changes of specific

technical parameters and criteria related to effective operation and setting up the satellite communication channels.

3. Contributions of the dissertation work

The contributions of the dissertation work can be classified as scientific-applied and applied, which can generally be summarized as follows:

A) Scientific-applied contributions:

– A complete model of a DVB-S2 system has been created in a virtual environment for research and evaluation of the degree of influence of individual configuration parameters and signal processing stages on the quality of service by evaluating the bit error rate (BER), the signal-to-noise ratio (SNR) in the transmission channel and the signal vector diagram in scenarios with different modulation formats and transmission power.

– A simulation model was created and investigated to evaluate the performance of BCH and LDPC signal coding in a satellite DVB-S2 link channel. The signal-to-noise ratio (SNR) threshold levels for various combinations of encoder configuration parameters and coding depth, respectively, have been established in order to ensure quasi-error-free signal reception for QPSK and 8-PSK modulation formats.

– A simulation model of a DVB-RCS satellite communication system for broadband data transmission with MF-TDMA (Multi-Frequency Time Division Multiple Access) and mesh topology has been developed. Continuous Resource Assignment (CRA), Rate-Based Dynamic Capacity (RBDC), and Volume-Based Dynamic Capacity (VBDC) mechanisms were evaluated. In order to efficiently use the frequency and maintain the quality of services. Research and comparative analysis of the performance (according to the network throughput criterion) of the DVB-RCS satellite communication system for broadband data transmission has been made in 3 different scenarios regarding the delivered services: for delay-tolerant services; for delay-sensitive services; performance evaluation depending on the number of users.

– A comprehensive model for the analysis of the effectiveness of the application of polarization modulation (PM) has been developed and investigated in order to more optimally use the available frequency resources and accelerate the synchronization time in high-frequency narrowband or high-dynamic satellite communication. Research has been carried out to evaluate the quality of service by determining the SER coefficient and its limit values under different formats of PM and DBPSK modulation and comparative analysis with Monte Carlo simulation in satellite AWGN channel

B) Applied contributions:

– An experimental set-up of a „satellite-earth“ link communication channel for low-Earth orbit satellites with hardware transceiver modules and a satellite communication channel simulator module has been developed and studied.

– Practical experiments have been conducted and an approach has been proposed for optimal selection of operating frequency range, altitude and orbit parameters, transmission power, parameters of the receiving-transmitting antenna, as well as for evaluating the influence of the complex combination of these parameters.

4. Publications and citations of publications on the dissertation work

The results of the dissertation have been published in 6 publications in Bulgarian language. One of the publications is independent. The remaining 5 are co-authored with the scientific supervisor and colleagues from the university. The presented publications are reports at scientific conferences, referenced in the National reference list of modern Bulgarian scientific publications with scientific peer review – 3 of them were presented at the international scientific conference UNITECH in 2020 and 2021 and 3 of them – at the national scientific conference TechCo in 2021 and 2022. The publications promulgate the research carried out and present the main conclusions of the dissertation work. There is no information about known citations of the dissertation's publications.

The publication activity of the PhD student covers the minimum national requirements and the requirements of the regulations for awarding of the educational and scientific degree “Doctor”.

5. Authorship of the obtained results

From the presented publications, as well as from the dissertation work, it can be seen that a significant amount of research and experimental activity was carried out by the PhD student under the guidance of his scientific supervisor. The presented results build on existing research on quality-of-service improvement processes in satellite digital television and data transmission systems based on satellite signal parameters and characteristics, signal processing, and provided radio coverage. I believe that the main part of the conducted research and compiled analyzes of the results are entirely the personal contribution of the PhD student.

6. Comments, recommendations and remarks on the dissertation work

The topic of the dissertation is relevant and interesting. My personal opinion is that the work has a sufficient volume and the necessary depth of research. The obtained results are significant enough for the educational and scientific degree “doctor”. The publicity of the work is ensured and proven by publications at refereed scientific conferences.

I have the following important remarks and recommendations regarding the dissertation work:

- 1) In the future, the doctoral student must approach with greater care and precision when formulating the goals, tasks and achieved results when conducting and documenting scientific and scientific-applied research.
- 2) There is some minimal divergence from the objective given in the introduction and that at the end of the first chapter.
- 3) There is a different type of presentation of the same variables in the different analytical dependencies in the individual chapters of the dissertation.
- 4) Tables 2.1 to 2.4 should be presented in a more optimal form. Table 3.1 would be better placed in an appendix.
- 5) I recommend the doctoral student to publicize his research and achieved results not only at scientific conferences in Bulgaria, but also in prestigious scientific journals and international scientific conferences indexed in the world-famous Scopus and Web of Science databases.

The presented remarks and recommendations do not detract from the results achieved by the PhD student on the scientific subject in the dissertation

7. Conclusion

My personal opinion is that the submitted dissertation work meets the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria. The achieved results give me grounds to obtain the educational and scientific degree "Doctor" from M.Eng. Seyhan Sadak Myumyunali in the field of higher education – 5. Technical Sciences, the professional field – 5.3 “Communication and Computer Engineering”, doctoral program – “Communication Networks and Systems”.

17.01.2023

Member of the scientific jury: /signature/
/Assoc. Prof. Krasen Angelov, PhD/