

OPINION

**On the dissertation work
for the acquisition of the educational and scientific degree "doctor" in**

**area of higher education – 5 Technical sciences
professional field – 5.3 Communication and Computer Engineering
doctoral program - Communication networks and systems**

Author: Mag. Eng. Boris Blagoj Arsov

Topic: Management of the performance and quality of service in mobile broadband networks

Member of the scientific jury: Prof. Dr. Eng. Emiliya Andonova Dimitrova

1. Topic and actuality of the dissertation

In contemporary everyday life, broadband Internet through mobile cellular networks provides the creation and use of new rich media content, applications, new innovative services, adaptable to different platforms, accessible to everyone, regardless of location or time, and customized according to the user, according to his priorities or needs. Broadband Internet enables the reorganization of production and work processes both in the business sector and in administration, i.e. for the development of the network economy and the transition to knowledge-based societies.

For this, it is necessary to build a quality telecommunication infrastructure of the mobile network through modern technologies, which every mobile operator of an electronic communication network must own and build during its development.

The subject of the dissertation work is the management of efficiency and quality of services in broadband mobile networks, where the main emphasis is on the evaluation of the channel parameters and the dependencies between them, determining the quality of the signals and the efficiency of the network.

2. Research methodology

The subject of research are the various processes at the physical level related to the communication channel, as well as the dependencies concerning the parameters determining the efficiency of information transmission in specific conditions.

The research methods are mainly identified in the separate chapters, such as analytical, simulation and practical, and cover the dependences of the parameters characterizing the implementation of the individual models. The study site is an example of practical studies of the communication channel in a certain part of a coverage area in a wireless network. Exemplary models of radio coverage in a broadband mobile network using wireless channels are presented through simulation and experimental models, demonstrating the mutual correlation and dependence of the parameters in them.

The purpose of the research is related to the creation of methodologies from procedures related to correct approaches in modeling, selection and implementation of architecture, the necessary equipment and the correct configuration, by monitoring and evaluating the parameters of signals in broadband mobile networks, related to improving the efficiency of communication and the quality of services in them.

3. Dissertation Contributions

I accept the contributions formulated and declared by the PhD student and their scientifically applied and applied nature. Contributions have the significance of novelty in the considered issue and are an extension of existing knowledge.

The dissertation presents an analytical methodology for designing and calculating the parameters of a broadband mobile network. Mathematical dependences related to network load factors in the forward and reverse direction, with determination of radio coverage, radio propagation losses, antenna gain are derived. A simulation model of the physical layer was synthesized, on the basis of which research was done and graphical results were displayed for three different cases of the environment and the user's movement in it. Experimental results of the parameters of a broadband mobile network in urban conditions are presented, by using specialized software applications installed on a mobile station. From the statistics and the analysis of the obtained results, specific conclusions have been established related to improving the efficiency of management and ensuring a better quality of services in an urban environment. An experimental setup was proposed and practical studies were carried out by the regulatory body for the Republic of N. Macedonia - the Electronic Communications Agency (AEC). A process has been developed that includes network monitoring, measurements of key performance parameters and cell optimization to improve efficiency and quality of service. Real measurements were made related to the emission of non-ionizing radiation from the base stations of the mobile operators related to the commissioning of the new 5G technology. Diagnostics and evaluation of the operating characteristics related to ensuring the quality of service in urban areas have been carried out, problem areas have been localized and basic technical and technological solutions for its improvement have been defined.

4. Publications and citations of publications on the dissertation work

Regarding the reflection of the results of the dissertation work, five publications have been presented at international and national conferences, fully meeting the minimum requirements regarding the considered criterion. Two of the papers were presented at the International Scientific Conference "Unitech" and two at the national conference "TechCo", and they are independent. The publications have been published in peer-reviewed collections from the international scientific conference "Unitech" and the national conference "TechCo" in the study period 2022-2023, actually representing nearly 2/3 of the content of the dissertation work. One of the publications was presented at an international scientific conference and published in the AIP journal, which has an impact rank. The publications present a large part of the conducted research and present the main conclusions of the dissertation work.

5. Authorship of the results obtained

In the presentation of the dissertation work, a significant amount of research and experimental activity has been carried out by the PhD student under the guidance of his supervisor. I believe that a huge share of the conducted research and compiled analyzes in connection with summarizing the results are entirely personal contributions of Eng. B. Arsov. The orientation of the obtained results greatly enhances the currently existing studies of signal processes and parameters in broadband mobile networks, by synthesizing analytical and simulation models and conducting practical experimental results.

From the author reference made, I did not find any plagiarism by the author in the presented dissertation and the published works related to it. I believe that the content and layout of the dissertation and the abstract meet the requirements of the Law on the Development of the Academic

Staff in the Republic of Bulgaria (LDASRB) and the Regulations for the Acquisition of Scientific Degrees and the Occupancy of Academic Positions at TU-Gabrovo.

6. Opinions, recommendations and remarks on the dissertation work

I believe that methodical, in-depth and with different focus sets of researches have been done in software and real experimental environment regarding the issues raised in the dissertation work. In connection with the described research, analyzed results, synthesized model and implemented practical experiments, the following remarks and recommendations can be defined:

- In separate places in the work, stylistic and grammatical errors regarding the speech when presenting the information are noticeable, which do not detract from the work of the PhD student;
- It would be good to have a list of the symbols and notations used in the formulas and the text;
- The reported results in the form of working screens in Chapter IV are too many, and some of them could be presented in an Appendix.

I recommend that in the future the doctoral student continue the cooperation in his research work with colleagues from the Technical University - Gabrovo and participate together with them in international projects, as well as publish the achieved results in conferences and journals indexed in the Scopus / WoS databases with impact factor or impact rank.

7. Conclusion

I believe that the submitted dissertation **meets** the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria. The achieved results give me reason **to propose** that the educational and scientific degree "doctor" be acquired by **Eng. Boris Blagoj Arsov** in the field of higher education 5. Technical sciences, professional field 5.3. Communication and Computer Engineering, Doctoral Program "Communication Networks and Systems".

20.03.2024

Scientific Jury member: /signature/

/Prof. Dr. Eng. Emiliya Dimitrova/