

# **O P I N I O N**

**of a dissertation**

**for the acquisition of the educational and scientific degree "Doctor" in**

**field of higher education – 5 Technical sciences**

**professional field – 5.3 Communication and computer technology**

**doctoral program – Communication networks and systems**

**Author: Eng. Boris Blagoy Arsov, MSc**

**Topic: Performance management and quality of service in mobile broadband networks**

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## **1. Topic and actuality of the dissertation**

The main topic of the dissertation work and set issue and related research are defined as significant and broad-spectrum in terms of the development of management efficiency and the quality of services in broadband mobile networks.

The topic provides an opportunity to analyze the ways to regulate and implement the main parameters and features of modern electronic communication network operators, in the direction of realizing the strategy itself and the requirements for broadband Internet and quality services through mobile cellular networks.

The analysis and practical experimentation of the researched processes of cellular radio coverage, the ways of regulation and implementation of parameters and features of modern electronic communication network operators provide an opportunity to synthesize and implement studies of broadband mobile network parameters and opportunities to improve the quality of services.

## **2. Literature review**

The literature review includes a list of 184 sources, of which 142 are papers and books, literary sources, and the rest are Internet addresses, which, according to the content of the topic, can be used, due to the continuous novelty and relevance necessary for the realization of the subject.

The cited literature works spans the period from 1980 to 2023, with nearly 45% of the total analyzed in the interval up to 2015. And in the next period, last 10 years, it covers about 55% of modern sources until 2023. From the assessment of the problem, which makes it possible to take into account the achievements to date related to the researched processes of cellular radio coverage and the capabilities of modern operators reflect the

importance and the usefulness of the quality of service of an electronic communication system, such as planning, construction, operation and management.

### **3. Research methodology**

The object of research is management of efficiency and quality of services in broadband mobile networks. Emphasis is placed on the evaluation of the channel parameters as well as the dependencies between them, which determine the quality of the signals and the efficiency of the network.

The research methods are mainly separated 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 place and method of research can be defined as exemplary and simulation, concerning practical studies of the communication channel in a certain part of a coverage area in a wireless network. Matlab/Simulink, TEMS Investment, Ariesso, etc. programming environments were used for several simulation studies. Exemplary models of radio coverage in a broadband mobile network using wireless channels are presented through simulation models demonstrating the mutual correlation and dependence of the parameters in them.

### **4. Contributions of Dissertation**

In view of the scientific and research work carried out, two categories of contributions are grouped, reflecting the qualities and new aspects when compiling the dissertation work:

❖ Scientific and applied contributions:

- An analytical methodology for designing and calculating the parameters of a broadband mobile network is presented. □ Mathematical dependencies 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 WCDMA End-to-End Physical Layer was synthesized, based on which research was done and graphical results were displayed for three different cases of the environment and the user's movement in it. Based on this, the effective BER values can be determined depending on the SNR, related to ensuring the quality of services under the different conditions.

❖ Applied Contributions:

- It is found that the Power Control Algorithm has limits and when the power regulation reserve resource is used up, it switches to channel switching (handover). Broadcasting with a very high power leads to a decrease in the sensitivity of the system, therefore the parameter BPC is introduced to regulate the power, the value of which is 0.7 at a speed of movement of the subscriber of 3km/h and 0 at a speed of movement of the subscriber of 50km/h h;

- 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. The signals from 2 operators in an urban environment in 2/3/4 and 5G modes of operation along certain routes were investigated by changing the speed of movement of the mobile measuring station. From the statistics and the analysis of the obtained results,

12 specific conclusions have been established, related to improving the efficiency of management and ensuring a better quality of services in an urban environment;

- The experimental setting was proposed and practical studies were carried out by the regulatory body for the Republic of S. Macedonia - the Electronic Communications Agency (AEC). Statistics, processing and analysis of the practical results for voice services and data transfer of the most important operators for the country of Macedonia have been carried out. 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 operational 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.

## **5. Publications and citations of publications on the dissertation work**

Regarding the coverage of the results of the dissertation work, five publications at international conferences and scientific publications are presented, fully covering the minimum requirements regarding the considered criterion. The first paper from the list was presented at the International Scientific Conference "EEPES 2023" and published in a publication ranked in Scopus. Two of the papers were presented at the "Unitech" International Scientific Conference and two at the "TechCo" national conference, which are independent, the other four were prepared in co-authorship with the scientific supervisor and author team. The publications were issued in peer-reviewed collections from international scientific conferences "EEPES 2023" and "Unitech" and national conference "TechCo" in the study period 2020-2022, actually representing nearly 2/3 of the content of the dissertation work.

In this regard, I can recommend the PhD student to continue to publish his results, both in similar and in publications with an Impact Factor and Scopus rank. The applied results have scientific and applied schedule in the provided direction.

## **6. 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 doctoral 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 the personal contribution of Eng. Boris Arsov. The orientation of the obtained results builds on the existing ones to date.

## **7. Abstract and author reference**

The content of the abstract corresponds to the content of the dissertation. The designations of the figures and formulas in the abstract match those of the dissertation. My assessment of the abstract is that it meets the generally accepted requirements and accurately reflects the content and contributions of the development. The abstract provides a clear idea of the essence of the problem, the purpose and tasks of the dissertation, as well as the way in which they are solved. The results of the analysis,

modeling and experiments, conclusions and contributions are briefly and clearly stated. It is laid out in 42 printed pages and has the same structure as a dissertation, ending with a short summary in English.

## **8. Opinions, recommendations and remarks on the dissertation work**

I believe that methodical, in-depth and variously focused sets of research have been done in simulated and real experimental environments regarding the issues raised in the dissertation work. The dissertation achieves the stated goal, as the defined tasks are performed at a high scientific level and the dissertation has a complete character. In the future, I recommend that the doctoral student continue his research work together with his colleagues from TU Gabrovo, and that the obtained results be presented and published in international conferences and in refereed journals with an "impact" factor (WoS) or Scopus rank.

## **9. Conclusion**

The topic of the dissertation is current and well developed. The problem set and the research related to it, as well as their justification, are satisfactorily significant and comprehensively described in the development.

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 to be acquired by mag. Eng. Boris Blagoi Arsov the educational and scientific degree of "doctor"

in the field of higher education - 5. "Technical sciences",  
professional field – 5.3. "Communication and computer technology",  
doctoral program - "Communication networks and systems"

21.03.2024

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