

## Opinion

By Assoc. Prof. Dr. Denis Safidinov Chikurtev

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

Professional direction: **5.3. Communication and computer technology**

Scientific specialty: "**Communication networks and systems**"

Author of the dissertation: **Krasimir Zhivkov Terziev**

Dissertation topic: **Modern satellite communication systems and innovative methods for increasing their efficiency**

### 1. Timeliness of the problem

The problem addressed in the dissertation concerns improving communication and access between ground satellite stations and satellites located in low earth orbit. The topic is current and significant for society. Given the development of technology and the increase in population density, the need for such research is essential. Solving such problems is expected to lead to improved Internet communication, environmental monitoring, navigation support, investigation and scientific research and missions, rescue missions, military applications.

### 2. Degree of knowledge of the state of the problem and general characteristics of the work

The candidate shows in-depth knowledge of the subject and particulars regarding the device and the principle of operation of the ground satellite stations and the satellite systems located in different ground orbits. In addition, the PhD student demonstrates knowledge of the problems in these systems, methods and approaches for solving these problems, and analytical thinking. Solutions can be achieved through the use of advanced communication technologies and data analysis and traffic monitoring tools that can help optimize the routing of traffic between different stations, ensuring that available capacity is used to its full potential.

The dissertation work is structured in 4 chapters, in a volume of 172 pages. 34 figures, tables, mathematical equations and 100 literary sources are presented.

The aim of the dissertation is to design a ground subsystem for satellite communications for low- orbit satellites. The objective is primarily applied in nature and is expected to have a direct impact and application in the satellite communications sector. The tasks are clearly defined and their implementation is expected to lead to the achievement of the goal.

Chapter 1 provides a historical overview of the development of satellite and terrestrial communication systems. Next, the development of technologies in this field is briefly described. In this chapter, too much attention is given to historical events in terms of individuals and companies that build the systems and sell services. Technological development is expected to be presented in more depth by examining scientific works on the subject.

In Chapter 2 satellite communication and its main elements are presented in detail. The PhD student has described the process of data transmission, parameters on which transmission depends, devices and techniques to improve systems. In addition, computational methods for calculating frequency bands and signals are presented, as well as the main elements in designing a satellite link.

Chapter 3 describes the design of the antenna part of a low earth orbit satellite communication system. The cloud-based platform "Network" technology is used Cloud Engine". The ground antenna "OC LEO 1" is used in the development. The device and technical specifications of the antenna are described in detail. Good practices and techniques are described for installing and preparing the antenna for operation so as to achieve maximum performance. To improve the factory parameters of the antenna, a modified reflector is applied, which was calculated according to the parabolic reflector theorem.

In Chapter 4, the performance of the designed system is evaluated. The obtained results show an increase in the performance of the system, clearly presenting comparisons of the parameters of OC LEO 1 compared to conventional ground stations. Finally, ideas for future research are presented.

### **3. Correspondence of the proposed research methodology and the set goals and objectives of the dissertation work**

A standard methodology for solving scientific and applied problems is applied. The structure of the dissertation is arranged meaningfully, starting with defining the problems on the subject and the need for research in this area. Then it goes to a detailed description of the characteristics and methods for solving these problems. A solution for the design of an improved system for a ground satellite station is proposed, and finally research and tests are carried out for the verification of the resulting system.

### **4. Contributions**

The doctoral student presented 4 contributions to the dissertation, which were not categorized. I define the type of contributions as follows:

Scientific and applied contributions:

- An analytical survey of satellite communications was made, through which the utility of using low-orbit satellites was determined and the technological functions that must be performed by ground stations were determined.
- An antenna system has been developed for the ground station, which allows to achieve higher communication speed, greater signal gain for reception and transmission, greater overall functionality.

Applied Contributions:

- A satellite communications ground station for low-orbit satellites has been designed to support information services via low-orbit satellites.



- The antenna part has been evaluated through experiments, achieving higher technological parameters than an existing prototype and its use in a real satellite communication system.

## 5. Dissertation Publications

The candidate has presented 7 scientific publications in the dissertation. One of the publications is referenced in Scopus. The other six publications are in non-refereed publications, five of which are in international conferences and one is in a journal. In two of the publications, the doctoral student is an independent author, and in the other five he is a co-author with his supervisor. The obtained publication points significantly exceed the minimum for ICT and indicate that the scientometric indicators are met.

## 6. Opinions, recommendations and notes

It makes a good impression that the candidate's work and the presented systems and technologies find direct and real application in the field of communications systems and services. The results achieved can directly have a positive impact on the sector.

I have some notes regarding the layout and technical requirements of the thesis.

On page 72, Kepler's third law is presented in figure form. The equation must be written in normal format. All presented tables in the dissertation do not have a number or title. A non-standard format was used for the layout of the bibliographic data of the used literary sources. It is recommended that they be formatted in a standardized format: APA, MLA, Chicago or IEEE.

## Conclusion

The presented dissertation meets the set of criteria and indicators for the acquisition of the educational and scientific degree "doctor", according to the Law on the Development of the Academic Staff in the Republic of Bulgaria (ZRASRB), the Rules of the Bulgarian Academy of Sciences for the Implementation of the ZRASRB, the Rules of the Specific Conditions for Acquiring scientific degrees and for holding academic positions at IIKT-BAS. In conclusion, I give a **positive assessment** of dissertation work.

Strongly recommended to the scientific jury to award **Krasimir Zhivkov Terziev** the educational and scientific degree "doctor" in professional field **5.3. Communication and computer technology**.

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