

# OPINION

**From Assoc. Prof. Eng. Ivelina Stefanova Balabanova,  
Professional direction 5.3. Communication and computer equipment,  
Technical University-Gabrovo**

**Subject:** dissertation work for the acquisition of the educational and scientific degree "**DOCTOR**" in professional direction 5.3. "Communication and Computer Engineering".

**Author:** Teodora Ivanova Pasarelska, doctoral student of self-study in doctoral program "Telecommunications" - NBU.

**Topic of the dissertation:** "Investigation of methods for planning and distribution of the radio frequency spectrum in the Republic of Bulgaria".

**Scientific supervisor:** Prof. Dr. Plamen Marinov Tsvetkov.

**Grounds for presenting the review: member of the Scientific Jury, according to Order No. 3-RK-27/17.10.2024 of the Rector of the NBU.**

The review was prepared in accordance with the Law on the Development of the Academic Staff of the Republic of Bulgaria, the Regulations for the Implementation of this Law and the Ordinance on the Development of the Academic Staff at the NBU.

## **1. Significance of the researched problem in scientific and scientific-applied terms**

Dissertation work on the topic "Investigation of the methods for planning and distribution of the radio frequency spectrum in the Republic of Bulgaria", with the author Teodora Ivanova Pasarelska, a doctoral student of independent training in the doctoral program "Telecommunications" of the New Bulgarian University (NBU) represents a comprehensive and significant study in the field of the methods for planning and distribution of the radio frequency spectrum in the Republic of Bulgaria. The investigated problem is relevant and important, both for the ICT sector and for the country's economy as a whole.

The doctoral work is structured in 5 main chapters, including a conclusion, and the text is placed in a total volume of 214 typewritten pages together with tables and figures. A list of the used bibliography and sources of information - a total of 212 in number and a list of used abbreviations and definitions - are attached to the dissertation work.

The literature used is in large volume and in harmony with the subject of the dissertation work, as it relates to the basic principles of the management and distribution of the radio frequency spectrum.

The extensive research and in-depth analysis done underline the significance of the doctoral work, as well as the author's erudition and detailed knowledge of the problem under study.

The dissertation is of a scientific and scientifically applied nature, which is evidenced by the contributions of the doctoral student in the studies and analyses, as well as the prepared methodology for conducting a simulation study to determine the mutual influence between radio electronic equipment of the users of a radio frequency resource for mixed use.

## **2. Justification of the objectives and tasks in the dissertation work**

The dissertation work has scientifically based and clearly defined goals and objectives. The main objectives of the dissertation are defined as:

- 1) Study of the methods of distribution, planning and management of the radio frequency spectrum to ensure the implementation of modern wireless broadband electronic communication services and achieve efficient, shared, dynamic and loyal use of this resource;
- 2) Allocation of sufficient and appropriate radio frequency spectrum for the provision of telecommunication services;
- 3) Provision of conditions for coordinated and harmonized use of the radio frequency spectrum.

In order to realize the goals set in the doctoral thesis, the following tasks have been defined:

**Task 1:** Analysis of the current state of the methods, approaches and strategies for planning and management of the radio frequency spectrum in the Republic of Bulgaria and their harmonization with European and world trends.

**Task 2:** Research and analysis of the basic principles and current trends in the management and allocation of the radio frequency spectrum.

**Task 3:** Exploring the possibilities and planning the necessary technical, regulatory and organizational procedures to ensure the implementation of modern wireless broadband electronic communication services.

**Task 4:** Development of approaches and methodology for radio frequency spectrum management. Development of computer models, conducting simulation and real field studies of objects.

As a summary, we can emphasize the fact that the goals and tasks set in the dissertation work have been fully fulfilled.

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

In the dissertation work, a methodology and research methodology were chosen, which are in full accordance with the set goals and objectives.

The doctoral candidate has opted for a research methodology related to defined basic steps, which include:

- analytical review of the current state of the radio frequency spectrum in the Republic of Bulgaria and harmonization with European and world trends.



- Analysis of terrestrial networks and radio frequency bands 900 MHz and 1800 MHz. 2 GHz, 2.3 GHz, 2.6 GHz and 3.6 GHz radio frequency bands, 700 MHz and 800 MHz bands are considered.
- Survey of the radio frequency spectrum for the fourth generation (LTE), for terrestrial digital radio broadcasting - DVB-T, the frequency ranges suitable for point-to-point and point-to-multipoint networks, as well as satellite telecommunication networks for provision of mobile services, radio frequency spectrum for devices with a short range of action, frequency ranges intended for "Machine-to-Machine" (M2M) communication and others.
- Study of the methods of allocation, planning and management of radio frequency spectrum, emphasizing the method of use of spectrum that is not individually assigned, the method of individually assigned limited resource, the method of licensed joint access to radio frequency spectrum and the method of determining the right for the use of radio frequency spectrum.
- Research and planning of technical, regulatory and organizational procedures in the implementation of modern wireless broadband electronic communication services.
- Investigating the deployment of modern wireless broadband electronic communications services. Emphasis is placed on innovations such as 5G technology and IoT integration.
- Analyze spectrum management and the regulatory framework, noting spectrum licensing and allocation, public-private partnerships, organizational strategies and infrastructure development, as well as operational management.
- Implementation of a methodology for conducting a simulation study to determine the mutual influence between radio electronic equipment of the users of a radio frequency resource for mixed use. Scenarios and an exposition of a simulation research method are presented. Data is collected and analyzed.
- Mathematical analysis and interference models in emerging systems and technology such as 5G base stations. Mathematical concepts and approaches to the study of base station interference are defined, surveying signal propagation, interference modeling, and interference mitigation techniques.
- Tests and studies ending with concrete results and evaluation of the validation of the mutual influence between the radio-electronic equipment of the users of the radio-frequency resource for mixed use.

#### **4. Scientific and applied scientific contributions of the dissertation work**

Scientific and scientific-applied contributions by the candidate are visible in the dissertation work. Rich and specific terminology is used in the doctoral thesis, which shows the understanding of the research problem by the doctoral student, as well as her competence on the subject. A methodical and consistent approach is evident in the studies and analyses, as well as precision and scientific correctness in the citations.

Own contributions and results of a scientific and scientifically applied nature can be noted based on the prepared studies, analyzes and implemented methodology for conducting simulation research in the dissertation work.

I am of the opinion that the contributions declared by the doctoral student Teodora Pasarelska in the dissertation work are her own work.

In summary, it can be said that the doctoral work, as well as the presented own contributions by the candidate, are significant in a scientific and applied scientific aspect.

## 5. Publications on the dissertation work

A total of 5 scientific publications are attached as materials deposited for the defense of the dissertation. A predominant number of the publications are scientific articles in peer-reviewed and refereed scientific journals and collections from the NACID reference list. One publication reflected in the world-renowned referenced and peer-reviewed database SCOPUS is also presented.

The candidate has prominent participation in national and international conferences and symposia, at which numerous scientific reports have been presented, which speaks of her scientific competence.

## 6. Quoting from other authors

Some of the presented scientific publications related to the defense of the dissertation show good citation by other authors.

## 7. Opinions, recommendations and notes

I am of the opinion that the dissertation work is significant and the candidate's contributions are of a scientific and scientifically applied nature. The doctoral work fully complies with the mandatory legal requirements of the RSARB, the Regulations for its implementation, as well as the regulations of the NBU.

I will make several recommendations regarding the dissertation work and the candidate's future activities:

- I recommend the doctoral student to develop and upgrade his research activity in the specific direction to improve the possibilities of implementing modern wireless broadband electronic communication services and to participate in national and international projects.
- I recommend the candidate to publish more and more scientific articles in English in specialized journals with a high impact factor and world-renowned refereed and peer-reviewed databases such as Scopus, Web of Science and others.
- I recommend more active participation in international scientific conferences and forums, with the aim of achieving world fame and citation of the candidate's scientific works, as well as useful international contacts and future fruitful collaborations in a scientific and educational aspect.

## CONCLUSION

Dissertation work on the topic "Research of the methods for planning and distribution of the radio frequency spectrum in the Republic of Bulgaria", authored by Teodora Ivanova Pasarelska, fully complies with the mandatory legal requirements of ЗПАСРБ and the Regulations for its implementation, as well as with the Normative Regulations of the New Bulgarian University.

The doctoral work can be distinguished as a significant and in-depth study with high scientific and scientific applied value.

Based on all of the above, I give my **high and positive assessment** regarding the presented dissertation work on the topic "Research of the methods for planning and distribution of the radio frequency spectrum in the Republic of Bulgaria" and **I support** the awarding of Teodora Ivanova Pasarelska with the educational and scientific degree "**DOCTOR**" in a



scientific specialty "Telecommunications" by professional direction 5.3. "Communication and Computer Engineering".

**Date: 24.10.2024r.**

**Signature:**

A handwritten signature in blue ink, appearing to be 'Iyelina', written over a vertical line.

**/ Assoc. Prog. Eng. Iyelina Stefanova Balabanova/**