OPINION

of a dissertation
for the acquisition of the educational and scientific degree "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: Eng. Emmanouil Themistoklis Kypraios
Topic: Methods and Algorithms for Research on Multiplexed Signals in Passive Optical Communication Networks
Member of the scientific jury: Assoc. Prof. Eng. Boyan Dimitrov Karapenev, PhD

1. Topic and relevance of the dissertation work

The growth of information flows and the speeds with which they are transmitted in recent years, as well as their globalization, place extremely high demands on world-leading information and communication networks and systems.

The subject of the dissertation is the methods for modeling and researching the parameters and characteristics of WDM-PON networks in order to ensure, manage and improve the efficiency and quality of services in this type of optical broadband communication systems, where the main emphasis is on the evaluation of the channel parameters as well as the dependencies between them, determining the quality of the signals and the efficiency.

The development of simulation models of WDM-PON optical networks and their research are essential to increase the efficiency, reliability and scalability of modern broadband infrastructures. WDM-PON is a complex technology that integrates wavelength management, optical propagation, passive components used and end-user specific channel isolation. Simulation methods and tools allow experimentation with new architectures, algorithms, and technologies, such as dynamic wavelength distribution, advanced modulation formats, and AWG-based routing strategies. This accelerates innovation and supports the development of next-generation WDM-PON designs capable of meeting rapidly increasing bandwidth requirements. The research also helps assess the impact of emerging applications – such as 5G/6G fronthaul, IoT ecosystems, cloud services and edge computing – ensuring that WDM-PON networks can evolve to meet future communications requirements. Simulation studies has a key role in enhancing network security and resilience. By modeling and investigating different failure scenarios, interference sources and cyber threats, designers can develop strategies to increase the resilience and stability of WDM-PON infrastructures. This is especially important for applications that require high reliability, such as industrial automation, healthcare systems and government networks. The creation of adequate simulation models of WDM-PON systems and their investigation are critical to establish their behavior, reduce deployment risks, promote innovation, and ensure that WDM-PON technology remains the leading solution for high-performance intelligent and adaptive optical access networks.

2. Research methodology

The purpose of the research in the dissertation work is related to the development of methodologies related to correct approaches in modeling, selection and implementation of architecture, the necessary equipment and the correct configuration, through monitoring and evaluation of signal parameters in passive optical networks with spectral multiplexing of signals, related to improving the reliability and efficiency of communication and the quality of services in them.

The subject of the study are the different processes at the physical level related to the processing of signals in the optical link channel, as well as the dependencies concerning the parameters determining the performance and efficiency of information transmission under different combinations of initial conditions.

The research methodology includes analytical, simulation and practical studies and covers the dependences of the parameters characterizing the implementation of individual models. The object is the synthesis of simulation models and the implementation of an experimental model for studying the processes of spectral multiplexing and signal transmission in a passive optical communication network. The OptySystem and MATLAB/Simulink software environments were used to perform the simulation studies. Example models of optical link lines in a passive test network with spectral multiplexing are presented, which demonstrate the mutual correlation and dependence between the parameters in them.

3. Contributions of the dissertation work

In the dissertation, 4 scientific-applied and 3 applied contributions are presented and well-organized, which I accept as clear, precise and concrete without the need for additional reformulation. I appreciate the author's contributions with the necessary scientific and scientific-applied value and significance, and it can be noted that they expand the knowledge in the field of WDM-PON optical networks and systems.

4. Publications and citations of publications on the dissertation work

In connection with the dissertation, 6 published reports were presented at the scientific conferences UNITECH'2025, TechCo'2024 and 2025 (2 number) and the Student Scientific Session 2024 (2 number), 3 of which are independent. No information provided on availability of citations.

5. Authorship of the obtained results

The dissertation, the abstract and the published publications show undoubtedly that their author, Eng. Emmanuel Themistoklis Kypreos, has acquired the ability to perform literary and theoretical analysis and research in the field of WDM-PON optical networks and systems. This characterizes the dissertation student as a well-established specialist in this field.

The abstract has a volume of 50 pages and clearly, precisely and concretely presents the content of the overall development in the dissertation work.

6. Comments, recommendations and remarks on the dissertation work

The topic in the dissertation work is considered and presented in great depth of research and summarizes and offers specialized work and development in the field of WDM-PON optical networks and systems, and I recommend the dissertation student to continue and deepen his work on it.

An impression is made by the well summarized, defined and presented conclusions to the individual chapters, as well as the conclusion, which also contains guidelines for the future development of the subject and the application of the obtained results in the dissertation work.

I would also make the following general recommendations regarding the future work and activity of the dissertation student: to continue and deepen his scientific and research work in PN 5.3; to actively participate in the learning process of learners; to join and work in collectives of international, national and university research and educational projects and the like and to seek to publish the results reached in reputable and refereed journals with Scopus/WoS databases.

7. Conclusion

I consider that the presented dissertation **meets** the requirements of the Law on the Development of 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. Emmanouil Themistoklis Kypraios in the field of higher education - 5. Technical Sciences, professional field - 5.3 Communication and Computer Engineering, doctoral program – “Communication Networks and Systems”.

16.02.2026 **Member of the scientific jury: /signature/**

/Assoc. Prof. Boyan Karapenev, PhD/