

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: Prof. Eng. Grigor Mihaylov, PhD

1. Topic and relevance of the dissertation work

The problems of modern passive optical networks, and in particular the methods and algorithms for studying multiplexed signals, are the subject of constant research and improvement.

Despite the intensive scientific and research activity that has been developing in the world in recent years in this area, there are still unresolved issues, which is why the relevance of the dissertation problem stands out very clearly.

In this sense, it can be assumed that the dissertation paper examines current problems related to the development and application of the fundamental theory and practice of communication systems.

I accept the justification for the relevance made by the doctoral student and I believe that the considerations presented are correct and well-founded.

2. Research methodology

The purpose of the dissertation is formulated on the basis of a thorough and reasoned analysis of the current state of the problems of ensuring the efficiency and quality of services provided through passive optical networks.

For the analyses and research conducted in the main part of the dissertation, modern mathematical tools are applied, i.e. appropriate methods for analysis and synthesis and modeling of processes in communication optical networks. These methods can be attributed to the theory and practice of information transmission systems, digital signal processing, computer modeling, etc. Simulation studies, which have high evidentiary value, are implemented in an appropriate programming environment, confirm the correctness of the methods, algorithms and mathematical proofs developed in the dissertation work. The results are presented in tabular and graphical form, with a thorough analysis of the same. A summary and conclusions from the main results obtained are made for each chapter.

The tasks set in the dissertation are adequate to the problem and are solved in the required volume and at a high scientific level.

3. Contributions of the dissertation work

In the process of work and in the preparation of the dissertation, a number of contributions have been achieved, which can be qualified as:

Contributions of a scientific and applied nature:

1. A methodology and algorithm for optimal planning, sizing, modeling and research of passive optical networks with spectral multiplexing of signals is proposed.
2. Simulation models have been synthesized for research, analysis, performance evaluation and solving optimization problems in high-speed (10Gbps) multi-channel optical networks using different optical modulation formats (NRZ and RZ) of the signals and various complex configuration parameters.
3. The degree of influence of the high optical density in the fiber core on the occurrence of nonlinear effects (FWM, SPM and XPM) in different formats of optical signal modulation (RZ and NRZ) has been studied. It has been established that RZ pulses have a higher peak power and as such are more susceptible to FWM, SPM and XPM. However, in the presence of SPM, these pulses can undergo compression (solitons) and be more efficient than NRZ pulses.
4. Dependencies related to determining the boundary conditions and the maximum value of the Q-factor for different input parameters and network range, determining the losses during radio propagation, the eye diagrams of the channel optical signals and the optimal value of the input optical power have been derived.

Contributions of an applied nature:

1. Simulation models of multi-channel high-speed optical communication networks have been developed and studied to solve optimization problems according to criteria of achieving a minimum BER value (Min. BER) or maximum Q factor and ensuring maximum network performance and efficiency for various input signal parameters.
2. A practical model / experimental setup of a passive optical network (PON) with spectral multiplexing of signals for the delivery of interactive services has been developed and studied, designed to perform three main tasks: to allow a wide variety of practical research (traffic processing, introduction of new services and modules for management and communication, etc.); to be a platform for conducting general research in the field of passive optical networks; to provide convenient and easy training for personnel.
3. Experimental research steps are defined and experimental results are presented for a comprehensive determination and evaluation of the energy balance and model parameters for studying multiplexed optical signals in a passive optical network, using specialized measurement equipment.

4. Publications and citations of publications on the dissertation work

From the publications of the doctoral student, presented and discussed at various scientific forums, it is evident that as a result of the work on the dissertation, the relevant conclusions were obtained, which are the work of the doctoral student Eng. Emanuel Kypreos and have value for the theory and practice of communication networks and systems at the present time. No information is presented about the author's citations.

5. Authorship of the obtained results

Judging by the publications, it is clear that the doctoral student has been working hard on this topic. The authorship of the contributions to the dissertation is also indicated by the fact that two of the publications are independent, and in another the doctoral student is the lead author in the team. This, as well as the specific style of presentation of the author, give me reason to have no doubt about the leading role of Eng. Kypreos in the preparation of the publications.

6. Comments, recommendations and remarks on the dissertation work

As for certain weaknesses and critical remarks, they can be indicated. In places, minor grammatical errors have been made. The style of presentation needs refinement. It is necessary for the doctoral student to continue working to improve the style of presentation in scientific articles, reports, accounts, etc.

The weaknesses indicated above can be easily eliminated in the future scientific research work of Eng. Emanuel Kypreos.

These remarks do not reduce the value of the dissertation.

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”.

17.02.2026

Member of the scientific jury: /signature/

/Prof. Eng. Grigor Mihaylov, PhD/