OPINION

by Assoc. Prof. Vassil Guliashki, PhD
Institute of Information and Communication Technologies - BAS
on a dissertation thesis for awarding the educational and scientific degree **"Doctor"**
in professional direction **4.6 "Informatics and Computer Science"**
doctoral program **"Computer Sciences"** – *Software architectures*

titled: *"Development of Hierarchical Taxonomy that Incorporates Patterns for Improving Security in Information Systems Based on Microservice Architecture"*

by TIHOMIR DIMITROV TENEV

By order No RD 38-187/14.05.2020 of the Rector of Sofia University "St. Kliment Ohridski" Prof. Anastas Gerdzhikov on the grounds of Art. 5, paragraphs 1, 2 and 3 of the Regulations on the terms and conditions for acquiring scientific degrees and holding academic positions at Sofia University "St. Kliment Ohridski" and with a decision of the Faculty Council of Faculty of Mathematics and Informatics, Record of proceedings № 7 / 27-29.04.2020 in connection with the procedure for acquiring the educational and scientific degree "Doctor" in the professional field 4.6 Informatics and Computer Science, doctoral program „Computer Sciences" – *Software Architectures* by Tihomir Dimitrov Tenev with a dissertation thesis titled "Development of hierarchical taxonomy of models that incorporates patterns for improving Security in information systems based on microservice architecture" I have been included in the Scientific Jury as a member.

As a member of the scientific jury I received:
1. order No RD 38-187/14.05.2020 of the Rector of Sofia University "St. Kliment Ohridski" Prof. Anastas Gerdzhikov
2. Dissertation thesis for awarding the educational and scientific degree „Doctor".
3. Abstracts in Bulgarian and in English.
4. Copies of the papers, published on the dissertation thesis.

When evaluating the dissertation, the terms of the Law for development of the academic staff in the Republic of Bulgaria (LDASRB), the Regulations for Implementation of LDASRB (Decree No. 26 of February 13, 2019) and the Regulations for the conditions and procedure for acquiring scientific degrees and holding academic positions at Sofia University "St. Kliment Ohridski" are decisive.

1. According to Art. 27 (1) of LDASRB "the dissertation work shall contain scientific or applied research results that represent an original contribution to science. The dissertation shall show that the candidate has profound

theoretical knowledge in the respective subject, as well as their abilities of independent scientific research."

2. According to Art. 27 (2) of LDASRB the dissertation work should be presented in a form and volume corresponding to the specific requirements of the primary unit. The dissertation work should contain: title page; contents; introduction; presentation; conclusion − summary of the obtained results, accompanied by declaration of originality; bibliography.

The scientific supervisors of the dissertation thesis are Assoc. Prof. Simeon Emilov Tsvetanov, PhD and Assoc. Prof. Dimitar Birov, PhD.

GENERAL CHARACTERISTICS OF THE DISSERTATION THESIS

Dissertation thesis is in a volume of 151 pages with 39 figures, and includes: introduction, eight chapters, conclusion, contributions, declaration for originality of the results, appendixes, bibliography of 111 sources and list with publications on the dissertation thesis.

The goal of the dissertation is to "develop a hierarchical taxonomy of models designed to improve security in information systems.". The proposed taxonomy in the dissertation is focused on a new generation of software architecture "Microservice Architecture", which allows developers to create flexible applications covering large loads in a short time without affecting their normal operation. To achieve this goal, the **following tasks** have been formulated and completed:

1. To categorize and granulate new generation software architecture, also called Microservice Architecture, with aim its presentation in different forms.

2. To analyze the threats for each of the presented categories of microservice architecture, allowing more precise positioning the respective security models.

3. Identifying appropriate security patterns that fall into distinct categories, relying on vulnerability analysis.

4. To transform the justifications and solutions provided by the various security patterns into the context of a microservice architecture.

5. To make a hierarchical model of all categories of microservice architecture, to serve as a skeleton in the construction of a detailed hierarchical taxonomy.

6. Identifying and using appropriate object-oriented modeling language, in which the Interface Definition Language (IDL) or the so-called Managed Object Format (MOF) is applied in order to bring the selected security patterns in a readable form, respecting the hierarchy of the individual categories.

7. To transform the modeling language so that it can be represented graphically.

8. To find new products that can create a sustainable environment for microservice applications.

9. To study which of the presented security patterns can be applied through the selected modern products for management of microservice applications and to propose solutions for use, following the good practices of the selected security patterns from the hierarchical taxonomy of such patterns.

The formulated aim and tasks have scientific and scientific-applicational potential for research and application in the field of hierarchical taxonomy of patterns for improving security in information systems based on microservice architecture.

The dissertation includes 5 publications in conference proceedings, four of which are co-authored and one has a single author - the PhD student himself. The presented publications give grounds to assume that the dissertation thesis has the necessary publicity. There aren't found citations.

CONTRIBUTIONS

The **results** obtained can be summarized in the following **contributions**:
- Research and analysis of architectures based on microservices is made for security purposes.
- A conceptual model using microservice architecture has been proposed, which helps in defining the vulnerable areas.
- Threat analysis was performed toward the defined microservice areas. Lists of appropriate Security Patterns as well as adapted solutions are proposed.
- A hierarchical model is presented, and a hierarchical taxonomy of security patterns is developed using object-oriented modeling.
- A graphical interface has been made to illustrate the links between vulnerable areas in microservice architecture and selected security patterns.
- The architecture of a platform implementing the proposed patterns is presented using modern microservice management technologies.

It can be assumed that the presented results sufficiently cover the scope of the set goal and tasks.

The **abstracts** are in Bulgarian and English, respectively in the volume of 40 pages and 37 pages and present the dissertation thesis.

CRITICAL NOTE

Numerous spelling errors can be noticed in the text of the dissertation. Even in the contributions there is an unfinished sentence (see the second contribution). Obviously, the PhD student has put a lot of work and efforts into the developments of the dissertation itself, but he did not have enough patience to eliminate the spelling errors in the final text.

FINAL COMPLEX ASSESSMENT

I believe that the presented dissertation **meets** the requirements of the Law for development of academic staff in the Republic of Bulgaria. The achieved results give me grounds to propose to the respected Scientific Jury to award to **Tihomir Dimitrov Tenev** the educational and scientific degree "Doctor" (PhD) in the professional field − 4.6 "Informatics and Computer Science", doctoral program "Computer Science" - *Software Architectures*.

03.07.2020.   ....

Sofia city   /Assoc. Prof. Vassil Guliashki/