REVIEW

of a dissertation submitted for the award of the educational and scientific degree "Doctor"

Administrative details

Topic: “Platforms for Smart Contracts.”

Author: Zhivko Stefchev Zhelyazkov, Section “Mathematical Foundations of Informatics,” Institute of Mathematics and Informatics at the Bulgarian Academy of Sciences.

Supervisor: Prof. Hristo Nikolov Kostadinov, PhD.

Field: 4. Natural sciences, mathematics and informatics.

Professional area: 4.6 Informatics and Computer Science.

Reviewer: Assoc. Prof. Yuri Lyubchov Borissov, PhD – Institute of Mathematics and Informatics, Bulgarian Academy of Sciences.

Procedure

By Order No. 91/18.11.2025 of the Director of the Institute of Mathematics and Informatics (IMI) at the Bulgarian Academy of Sciences (BAS), I was appointed to the Academic Board for this procedure, and at its first meeting I was selected to prepare the present review. All materials were provided in accordance with the relevant regulations and comply with the Law on the Development of Academic Staff in the Republic of Bulgaria and its implementing rules. I am not aware of any procedural violations, nor of any plagiarism in the dissertation.

Candidate

Zhivko Stefchev Zhelyazkov received a Master’s degree from Sofia University “St. Kliment Ohridski” in the program “Probability and Statistics” in 1998. The CV provided in the materials indicates participation in projects as a programmer, team leader, and project manager in the companies where he has worked and is currently working.

Doctoral enrollment

The doctoral student was enrolled part-time as of 01.07.2019 for a period of four years and was cleared for defense by decision of the Scientific Council of IMI (Minutes No. 14/21.12.2023). The preliminary discussion of the dissertation, which I attended, took place on 07.11.2025 at an extended meeting of the MOI Section in the IMI-BAS building. By order of the Director of IMI an Academic Board and a defense date were set. I consider the procedure regular and without violations.

Dissertation and abstract

The dissertation submitted for review is written in English and consists of: an introduction (5 pages) and a main text (118 pages) in six chapters, divided into sections. The dissertation includes a list of contributions, a bibliography of 56 entries, lists of figures (48 in total), three tables, and appendices with two glossaries: a glossary of abbreviations and a glossary of terms. The work complies with the Law on the Development of Academic Staff in the Republic of Bulgaria and its implementing regulations, as well as with the Rules of BAS. The abstract (in Bulgarian, 40 pages) adequately reflects the core ideas and the essential final results described in the dissertation.

General description of the dissertation

Profile and positioning of the work

The dissertation focuses on the design and assessment of DLT/blockchain-based architectures addressing three practical challenges:

1. decentralized incentivization of scientific research through tokenized rewards and transparent rules;
2. management of software deployment and maintenance (SDM) with full traceability of responsibilities and key performance indicators (KPIs), using IPFS for low-cost, hash-addressed data storage and controlled access;
3. a publicly verifiable random number generator (RNG) with a prototype on a public chain from the EOSIO/Antelope/Vaulta ecosystem.

The topic is relevant, as in recent years European requirements for digital operational resilience and transparency in the sphere of digital services have intensified and deepened, placing emphasis on traceability, auditability, and process automation. This, in turn, necessitates the development of new architectural solutions and practices for building trustworthy, verifiable, and resilient decentralized services.

Content overview

- Chapter 1 systematizes fundamentals of DLT and blockchain: network types, consensus mechanisms (PoW, PoS, DPoS, BFT), cryptographic primitives, applicability across industries, and a comparative review of Ethereum, EOSIO/Antelope/Vaulta, Hyperledger Fabric, and Corda.
- Chapter 2 defines a decentralized system for incentivizing research—roles (framework providers, reward providers/contributors, researchers), reward structures, cases for private submissions, and protections against denial-of-service (DoS).
- Chapter 3 develops a DLT-based SDM architecture: five smart contracts (participant management, process engine, secured notifications, "software marketplace," lifecycle/KPI tracking), local agents and oracle flows to IPFS and the chain.
- Chapter 4 proposes a publicly verifiable RNG with block-hash-based strategies (current/delayed/random block hash, multi-hash accumulation, commit-reveal), together with a prototype ("get_random/rngstart") on the Jungle test network.
- Chapters 5–6 contain tests, conclusions, and the contributions.

Declared contributions and their assessment

The author formulates several contributions that the reviewer considers real and verifiable:

- A detailed analysis of existing solutions for smart-contract platforms based on blockchain and distributed-ledger technologies (DLT).
- A review of popular distributed storage technologies, together with their strengths and weaknesses when used as a foundation for smart-contract platforms. EOSIO is chosen for subsequent applications.
- A distributed system for incentivizing research and development, where rewards are defined for finding the unique or the best solution to a given problem.
- A detailed analysis of a distributed system for managing the lifecycle of corporate software, using EOSIO as the smart-contract platform.
- A distributed system using a set of algorithms for generating verifiable random numbers, built on a smart-contract platform based on EOSIO as the underlying blockchain.
- A working prototype on Vaulta/EOSIO for generating provable random numbers, with a detailed description of its environment: interfaces, smart contracts, data models, and communication protocols.
- Summaries of results from the development of new systems based on smart-contract platforms, along with analyses for various scenarios successfully addressed by the proposed architecture.
- Demonstrated advantages of the chosen approaches in traceability, security, and clear definition of responsibilities.

Assessment: the contributions are practice-oriented, with clear interfaces and demonstrations. Of particular value are the SDM modules (with potential for real-world deployments), as well as the RNG prototype, which operationalizes verifiability on a public blockchain.

Critical notes, inaccuracies, and corrections

- Specification of PoW using "number of zeros": the statement about "~20 zeros" as a typical requirement for block signing is an intuitive oversimplification; in Bitcoin the difficulty is defined via a target that is adjusted periodically (≈ every 2016 blocks) and is not expressed as a fixed count of leading zeros.
- The bibliography and historical review suggest that 1998 is the year of publication of the article "A Digital Signature Based on a Conventional Encryption Function." The correct year is 1987 (published in LNCS in 1988).
- IPFS References: A misspelling ("ipsf.io") was found in the bibliography. Recommendation: correction to ipfs.tech (official materials/documentation) and ipfs.io (gateway).

Style, language, and technical editing

The author writes clearly and structurally, with appropriate diagrams. An automated scan found a limited number of minor spelling inconsistencies in English terms: "3-dimentional/dimentional" (instead of 3-dimensional/dimensional), "decease" (instead of disease) in the context of prion disorders, "Gibb's" (instead of Gibbs, e.g., Gibbs free energy), and a likely typographical slip "Wen (IDE)" (instead of Web IDE).

Publications and participation in scientific forums

The list of publications includes two papers published in Springer's reputable series "Studies in Computational Intelligence," with SJR 0.190, indexed in Scopus. The papers are co-authored with the supervisor Prof. Hristo Kostadinov. I consider the candidate's contribution to be equal to that of his co-author, and that their number meets the requirements of the applicable rules.

The list of conference participation records two talks at the Annual Meetings of the Bulgarian Section of SIAM (2019 and 2022). It is also noteworthy that the candidate has delivered talks at national seminars on coding theory "Professor Stefan Dodunekov."

Conclusion

Zhivko Zhelyazkov's dissertation presents a systematic, engineeringly argued approach to three distinct but related domains: incentivization of research, management of deployment and maintenance of enterprise systems, and a publicly verifiable RNG. The strength of the work lies in carefully modeled interfaces and roles, clear modularity (especially in SDM), and the transition to an executable prototype on a public test network with operational traceability.

The candidate clearly demonstrates deep theoretical and practical knowledge in blockchain technologies and smart-contract platforms, alongside the capacity for independent research-applied and development work. I am convinced he fully meets the requirements established by the national and institutional regulations, and I recommend that the Academic Board vote:

Zhivko Stefchev Zhelyazkov be awarded the educational and scientific degree "Doctor" in the professional field 4.6 "Informatics and Computer Science."

18 December 2025 Reviewer: …….

Sofia / Assoc. Prof. Yuri Borissov /