ABSTRACT

This explanatory report comprises 128 pages and includes 24 figures, 20 tables, 2 appendices, and 36 references.

Relevance of the topic. In modern distributed architectures operating at ultra-large scales and serving millions of devices, efficient node discovery and interaction are critically important. Traditional logically centralized registries have significant limitations: they introduce a single point of failure, create a bottleneck, and require continuous scaling as the number of computing nodes grows, which reduces the system's elasticity. A failure or degradation of such a registry may lead to the unavailability of the entire system, which is unacceptable for global services.

Research aim. To increase the availability and fault tolerance of distributed systems by implementing a decentralized mechanism for discovering computing nodes, thereby enabling a failure-resistant architecture that supports efficient scaling and high service availability at ultra-large scales.

Object of the study. The process of service discovery in distributed systems.

Subject of the study. Methods and software tools for service discovery in distributed systems, ensuring fault tolerance, availability, and scalability.

To achieve the stated aim, the following tasks were formulated:

− conduct a review of existing approaches to service discovery in distributed architectures and evaluate their scalability;

− analyze alternative approaches to implementing service discovery in distributed systems;

− develop an architectural solution based on a decentralized discovery mechanism;

− implement a prototype of the system;

− perform testing under real workload conditions.

Scientific novelty. The scientific novelty of the master's thesis lies in improving the method of service discovery in distributed architectures (microservice and service-oriented), which eliminates centralized points of failure and enhances the fault tolerance and availability of distributed systems.

Practical significance. The developed mechanism can be used to improve the reliability and scalability of microservice and service-oriented systems, particularly in cloud environments.

Relation to scientific programs, plans, and topics. The work was carried out at the Department of Computer Science and Software Engineering of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute."

Approbation. The scientific results of the thesis were presented at the IX International Scientific and Practical Conference of Young Scientists and Students "Software Engineering and Advanced Information Technologies (SoftTech-2025)."

Publications. The scientific results of the dissertation are published in:

– Lavrov A.O., Rodionov P.Yu. Software for Decentralized Service Discovery in Ultra-Large Distributed Systems. Proceedings of the IX International Scientific and Practical Conference of Young Scientists and Students "Software Engineering and Advanced Information Technologies (SoftTech-2025)." Section of the Department of Computer Science and Software Engineering. November 26–28, 2025, Kyiv.

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