Modern architectures and approaches to software design and development

Yaroslav Michkivskyi
student of the Department of Software Engineering,
Kharkiv National University of Radio Electronics, Kharkiv, Ukraine,
e-mail: yaroslav.michkivskyi@nure.ua
Illya Vysochyn
student of the Department of Software Engineering,
Kharkiv National University of Radion Electronics, Kharkiv, Ukraine,
e-mail: illia.vysochyn@nure.ua
Sergey Michkivskyy
PhD of Economic Sciences, Associate Professor,
Head of the Department of Computer Science,
Director of the Educational and Research Institute
of Information and Communication Technologies,
University of Economics and Law «KROK», Kyiv, Ukraine,
e-mail: michkivskyysm@krok.edu.ua
ORCID: 0000-0002-9343-2317

The rapid increase in the complexity of software systems and the growing requirements for product time-to-market demand methods that allow organizing the development process as efficiently as possible. At the current stage of software engineering development, the choice of architectural style becomes the key point. It determines the way components are structured, the level of coupling between them, and the possibility of parallel development. Software architecture affects not only technological aspects but also economic factors: maintenance costs, the speed of making changes, scalability, and adaptation to market requirements.

One of the main problems of classical development is that, at early stages of project structure organization, the desire to quickly obtain working functionality often prevails. This leads to the use of monolithic architectures or informal structures, which later complicate testing and make quick changes impossible. A monolithic architecture provides significant advantages in the first months of the project — low integration complexity, a single development environment, and minimal overhead. However, as the system grows, the monolith becomes a source of technical debt: any update affects all code, test duration and compilation time increase, and interdependencies between modules create risks of system malfunction even with minor changes.

In contrast to monoliths, microservice and modular architectures [1] allow significantly increasing development and testing speed by splitting the system into independent modules that interact according to clearly defined contracts. This approach enables different teams to work in parallel, conduct isolated testing, implement independent releases, and quickly experiment with parts of the system, for example, in implementing the graphical interface using different technologies [2], without jeopardizing overall functionality. However, microservices come at a cost: increased infrastructure expenses, orchestration complexity, the emergence of inter-service delays, and the need for additional monitoring, logging, and load-balancing

tools.

To achieve a balance between development speed, system stability, and security measures, it is important to correctly assess the scale of the project, information security [3], performance requirements, and expected load. In small systems, using microservices may be excessive, while for large-scale solutions, transitioning to a service-oriented architecture helps avoid performance degradation and technical debt. An additional tool is the use of Clean Architecture and Hexagonal Architecture, which ensure the isolation of business logic from infrastructural components. Thanks to such separation, testing business rules becomes significantly faster and less dependent on external services, which reduces the time needed to develop new features and simplifies their verification.

An important component of optimization is automation. Integrating architectural approaches with CI/CD processes allows significantly accelerating the testing and deployment cycle. Automated tests, containerization, and orchestration ensure system stability during frequent updates, minimizing the risk of critical errors in the production environment. Properly designed architecture not only speeds up test execution but also reduces their number, as modules have clear boundaries of responsibility and a limited area of influence.

Overall, the problem of optimizing software development and testing speed lies in achieving a balance between two interconnected goals: increasing the pace of development and maintaining high quality and system operability. Excessive optimization toward speed can lead to loss of architectural control, which ultimately reduces product stability. Meanwhile, prioritizing reliability alone slows down the response to market changes.

Thus, the use of modern architectural approaches - modularity, microservices, Clean Architecture, and event-driven solutions - allows significantly reducing the time required for software development and testing. However, the effectiveness of these approaches depends on a properly chosen balance between architectural complexity and development requirements. The best results can be achieved by combining architectural strategies with DevOps automation, carefully separating responsibilities between components, and applying principles of low coupling and high modularity. Such an approach ensures not only accelerated development but also long-term stability, scalability, and efficiency of the system amid constantly changing requirements.

Ключові слова: monoliths, microservice, modular, architectures, development process.

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