

A Comprehensive Study on Serverless Computing: Design Principles, Implementation Challenges, and Emerging Trends

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Abstract: Serverless computing represents a major advancement in cloud technology by abstracting infrastructure management and enabling developers to focus solely on application logic. It follows an on-demand trigger-based execution in which functions are automatically executed in response to specific triggers, whereas cloud providers handle the provisioning, scaling, and maintenance. This architecture promotes rapid development, dynamic scalability, and cost efficiency through cost model that charges per execution. Core technologies such as function-as-a-service (FaaS) and backend-as-a-service (BaaS) have become fundamental to this paradigm, supporting applications across domains, including web development, IoT, artificial intelligence, and large-scale data processing. Despite its benefits, serverless computing faces persistent challenges, such as initial-execution delay, provider dependency, limited control over runtime environments, and difficulty in monitoring stateless distributed functions. Ongoing research is directed toward enhancing portability, optimizing performance, and integrating serverless computing with emerging paradigms such as edge computing and quantum computing.

Keywords: Serverless Computing, Cloud Computing, Function-as-a-Service (FaaS), Edge Computing, Resource Optimization, Event-Driven Architecture, Hybrid Cloud, Performance Evaluation

