PhD Oral Defense

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Thesis Title

Scalability Methods for Blockchain Systems

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Abstract

Despite the strength and benefits of blockchain technology, scalability issues, that is, low performances and huge storage data are the biggest but less researched challenges of blockchain. This thesis presents various scalability methods that we proposed for improving the scalability of blockchain systems. As many lightweight nodes depend and put much workload on blockchain servers, we propose an efficient high-performance FPGA In-NIC NoSQL caching system to reduce the workload on blockchain servers and improve its read-performance. The evaluation result of the system revealed a throughput performance improvement of 103x when a cache hit occurs on the FPGA. The design also offers small work area utilization and low power consumption. Furthermore, we propose an FPGA-Redis hybrid (multilevel) NoSQL caching system to further enhance the read-performance of the blockchain servers compared to when using the FPGA-only caching system. Our results revealed an improvement up to 4.09 times with the proposed FPGA-Redis system compared to the FPGA-only caching system. We also propose GlobeChain as a nationality-based sharding protocol that uses our proposed consensus delegate selection algorithm to scale the existing healthcare blockchains for cross-border healthcare applications. Our results revealed a remarkable improvement of existing systems such as Bitcoin and Ethereum.