SCALABILITY ANALYSIS OF BLOCK-CHAIN BASED SYSTEMS

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Dedication

I dedicate this thesis to my parents and my whole family who have supported me all the way as without their support this would not be possible. I would also like to dedicate this thesis to my respected teachers and especially my supervisor Dr. Osama Rehman for the guidance and countless meetings which led to the completion of this work. I dedicate my degree to my dearest Parents, Family, Friends, and respected Teachers who motivated, supported and encouraged me in every aspect of my life.

ABSTRACT

In recent years, block-chain technologies have gained massive momentum over different application domains. Block-chain is a decentralized data management technology which is speculated to be a disruptive technology that can have a drastic impact on people's lives as the Internet did. As different block-chain platforms are emerging rapidly, a firm understanding of the offerings by the adopted platform for the underlying technology along with its performance analysis is both important and challenging. Many organizations have shown interest in adopting the block-chain technology in their core systems, but scalability becomes a main concern in existing block-chain platforms. The block-chain application is stepping from its inception to full maturity and establishing itself as a part of the internet of future *(such as in the Internet of Things)*, thus scalability is one of the technical challenges while having billions of devices installed worldwide with the passage over time.

In this work, a comprehensive overview is presented of a major and a popular block-chain platform, known as the Hyperledger-Fabric. The work proposes a prototype while using Docker containers as the experimental setup for deploying Hyperledger-Fabric nodes and chain-code. The work also evaluates performance of the Hyperledger-Fabric based block-chain technologies in-terms of system scalability while considering different use cases and scenarios. Performance evaluation can help in identifying system bottlenecks that can be further utilized to develop better solutions or optimize existing ones. A methodology is presented for evaluating performance of the block-chain platform. While using this methodology, performance analysis is done along with presenting the obtained results. The experimental results are based on varying numbers of transactions and number of nodes which reflects a detailed study of the Hyperledger-Fabric platform that may also help Hyperledger-Fabric foundation to further improve the performance of their platform.

The experiments mainly consist of two cases. In Case#1, the transactions are performed by only a single node within the block-chain group of nodes depicting a low load over the block-chain network. In Case#1, nodes are varied from 3 to 25 nodes and the selected node performs up to 2000 transactions. Whereas in Case#2, we consider a worst case scenario in which all the nodes are performing transactions on the network. For Case#2, nodes are varied from 3 to 13 nodes and transactions up to 1000. While evaluating

performance, two performance parameters, namely Consensus Time and Ledger Size, are mainly assessed while executing the experiments. For Case#1, over 25 nodes and while having 2000 transactions, it is observed that Ledger Size consumes a disk space of 5.3 MB and for that it takes 80.18 Minutes to complete the execution of all transactions. For Case#2, over 13 nodes and while having 1000 transactions, the Ledger Size consumes 57001.9 MB of disk space and takes 270.06 Minutes to complete the execution of all transaction.

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