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Strategy for Testing Healthcare Applications on Blockchain Technology

Rakshith Amarnath[1], Sheela Ganesh Thorenoor [2]& Anil Kumar T G[3]

Student, Illinois Institute of Technology, Chicago, U.S.A., [1]

Independent Researcher, Bengaluru, India[2]

Principal Consultant, Architect Academy (TT), Wipro Ltd., No 72, Keonics Electronic City, Hosur Road, Bengaluru, India [3]

ABSTRACT: Blockchain is becoming important and disruptive technology and is getting adopted by multiple industry segments. Healthcare industry is also spearheading in this direction as it provides better and secured patient identity and all the benefits offered by blockchain technology such as transparency, speed and security are well suited to serve healthcare industry. Majority of healthcare applications built on the client server mode today as webservices can be redefined in a protected and secured way using blockchain technologies. However, there are multiple challenges the technology is facing in terms of scalability, implementation and governance. Smart contracts are becoming more prominent to define the business logic and testing the applications built on blockchain technology demands better strategies to provide the best customer experience along with maintaining patient data privacy. In this paper an attempt is made to discuss some important healthcare applications and the various testing types that need to be considered for testing these applications.

KEYWORDS: Block Chain, Testing Strategy, Health care, Electronic Health Record.

I.INTRODUCTION

Blockchain is a distributed ledger technology for transferring any type of information securely without the use of any central authority to control. The ledger of transactions is encrypted with cryptography with the peer nodes ordering and validating the transactions, which represent the transfer of information. Blockchains can be implemented as public, private or consortium blockchains, which can also be defined as permission less and permissioned. In permission less blockchains, identity of participants can be even anonymous, while in permissioned blockchains, the identity of users can be blacklisted using common methodologies of identity management. This technology enablesoperations which can be shared and decentralized with greater transparency for regulatory reporting with less complexity and better speed. Since the data is immutable, it provides better security and provides single source of information. There are various consensus mechanisms used such as proof of work, proof of stake, Practical Byzantine Fault Tolerance, generally used by permission less blockchains. Many more consensus mechanisms emerging such as round robin, federated consensus, voting etc. coming up for permissioned and enterprise blockchain applications. Bitcoin, ripple, Ethereum, Hyperledger, R3 are few examples of blockchain protocols and platforms.

II.OVERVIEW OF HEALTHCARE INDUSTRY APPLICATIONS USING BLOCKCHAIN TECHNOLOGY

Blockchain as a technology is foreseen by healthcare industry for developing applications which are personalized, secure, reliable consisting of real time clinical data of the patients. Regulation policies enforce data privacy and therefore demands more secured application development. The various healthcare industry use cases are getting developed in the fields of pharmaceuticals, medicine, e-health, tele-monitoring, neuroscience, biomedical to name a few, the most popular being the usage of blockchain in Electronic Health Record, EHR[1]. Data provenance, losing control over data and maintaining security, auditing, are some critical limitations for implementing EHR, which can be

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overcome using enterprise blockchain technologies, thereby providing better access to medical and health records. Immutability feature of blockchain helps in detecting fraud in the field of medicine, since it doesn't allow the duplication or modification of the data transaction, thereby maintaining data security and transparency. In pharmaceuticals, blockchain finds its application on pharmaceutical supply chain, used for keeping track of the origin of medicine, its ownership, compositions.

Usage of blockchain technology in healthcare, provides an advantage to the patients to send their data which will not be corrupted or tampered, which will be completely secure, providing them the authority to control on their data as how it can be used and shared. Extremely secured supply chain of pharma companies can be guaranteed through blockchain technology, thereby enabling more vigilant tracking of drugs from their origin to destination [2].

III.CHALLENGES IN TESTING BLOCKCHAIN APPLICATIONS

To test he blockchain applications, there are multiple points which need to be considered. Important among them are the layers of implementation. The bottom most layer is the infrastructure layer with the suitable protocol. This layer may not provide all the capabilities needed for developing blockchain application. Instead they may provide basic features of processing the transaction and data storage. In order to build an application or solution, there needs to be a suitable platform, which allows the execution of basic rules of business logic. However, healthcare industry applications need much more robust and private platforms which allow the implementation and execution of confidential business logics which much higher capabilities. The suitable integration layers with the respective application programmable interfaces need to be developed to provide a seamless functionality of various applications. There is also a need to consider how the data services, administration and other operational services are implemented.

All these complexities pose various challenges in terms of testing to deliver a defect free application. Since the technology is complex, testing the technical functionality demands the right skillset. Along with the scalability, performance might become an important aspect to be considered. Security would be the next challenge with redundant datasets. Integrating with existing application will be much more challenging because of the interoperability issues. Above all these there are not very well-defined standards yet. Hence testing blockchain applications would demand better testing knowledge and skills to ensure end to end functionality and enhance customer experience. The suitable knowledge of the blockchain protocol, underlying functionality complex need to be understood to ensure a defect free product.

IV.TESTING STRATEGY AND TYPES OF TESTING FOR BLOCKCHAIN APPLICATIONS

Testing blockchain applications therefor would demand better strategies to overcome the various challenges discussed in section 3. The testing strategy would involve testing which is specific to the blockchain technology used such as peer to peer or node testing and smart contract testing. In addition to this the functionality testing and integration testing are needed to test the blockchain applications. Equal amount of emphasis also is to be given to nonfunctional testing such as performance and specially securing testing. In addition, the infrastructure testing, UI, mobile app and integration testing also need to be performed.

The decentralized nature of blockchain demands the testing on transactional features such as hash and timestamping, verification, consensus aspect, various events or messages or notifications from the transaction processing perspective. API interaction and smart contract testing provide an additional testing to strategize. Since the smart contracts let the automatic execution of transaction based on business logic and pre-defined condition, testing the smart contract for every possible state of execution becomes very important. Since they may change dynamically, it provides an additional challenge in terms of testing.

Functional testing of blockchain demands testing for node consensus depending on the consensus mechanism, validating the smart contracts and the shared ledger. Non-functional testing demands platform performance with the scalability and stability along with load testing. The network latency block size, transaction size, the response time for the query are important points to be considered for performance testing. Security testing involves testing of access, various cryptographic and consensus algorithms used, assessing vulnerability, validation of the information etc. To detect the bug at the earlier phase, API testing could be a better choice and smart contract testing can be enabled with this. Blockchain specific testing involves peer to peer node testing based on blockchain protocol used in order to validate the nodes and their transactions. Nodes can be full node, which stores the entire blockchain and ensures that the transactions are valid, lightweight node which passes their transaction to the full node.

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All the above considerations would provide a better testing methodology for blockchain applications.

V. CONCLUSION

Through this paper, an attempt has been made to discuss on the various types testing used for testing applications and solutions built on blockchain technologies. The demanding healthcare industry applications in terms of security can be redefined through right business logic using blockchain technologies and therefore will find the large number of patient centric applications getting developed on blockchain technologies, specifically as enterprise solutions. Testing and ensuring quality of these products definitely demands better testing strategy and methodologies to be worked on at the early stage of implementation. A strategy for testing the infrastructure, platform, integration of services, performance and security are important aspects to be considered to order to ensure a defect free product.

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