Research_Proposal__1134987_Mohammad_Najm.pdf

by Mohammad Najm

Enhancing Banking Transactions with Blockchain Technology: From Traditional MVC/SOAP API to Hyperledger Fabric.

Mohammad Najm

Research Proposal

August 2024

Contents

Abstract

Blockchain technology is considered the future of banking and fintech. With advantages like centralized ledger, zero trust bookkeeping, and smart contracts, it aims to revolutionize the way we approach traditional banking and financial transactions. This research aims to compare blockchain-based transactions with modern banking transaction technology and to evaluate differences in speed, cost efficiency, security protocols, and compliance challenges. The findings will illuminate whether blockchain can mitigate existing inefficiencies in modern banking systems while identifying any limitations or challenges that may hinder its widespread adoption. In addition, it explores the integration of blockchain-based software applications into existing banking ecosystems without increasing migration tasks and costs.

1 Background

1.1 Current state of online banking systems

1.1.1 Technology

The current state of banking systems is quite sophisticated and has adopted technology for fast and robust transaction management. Database information systems have developed focus on database transactions and their ACID properties, whereas software engineering considers service transactions, which encompass the business logic layer and interact with multiple resource managers. However, the adoption of new technology occurs at a slower pace, due to the sensitive nature of the data flow, and only after a series of robust trials and audits is a new technology authorized to operate in the system.

1.1.2 Architecture

The architecture most commonly used today in enterprise banking applications is the MVC architecture[1]. It consists of three components:

1. **Model:** The model is the central component or module that deals with the data and business logic of an application including database operations, data validation and business rules.

2. **View:** The view is the part of the application that is visible to the customer and is generally served as a webpage in HTML/CSS or other front-end technologies.

3. **Controller:** The controller acts as a bridge between the model and the view and controls the flow of data according to what we interact with as a user in the view.

1.1.3 Challenges

The main challenges facing banking applications today are

1. Cybersecurity and data breaches
2. Regulatory Compliance
3. Customer Experience
4. Legacy Systems Integration
5. Fraud Detection and Prevention

1.2 Emergence of Blockchain Technology

1.2.1 Usecases

Blockchain technology exhibits extensive potential across numerous sectors due to its core features of decentralization, security, and transparency. Within the financial sector, blockchain is primarily employed for secure, cost-effective cross-border transactions and digital asset management, facilitating quicker settlements and minimizing dependence on intermediaries. In the realm of supply chain management, blockchain assures product traceability, allowing real-time tracking from origin to end-point, enhancing transparency, and curbing fraud. The healthcare sector adopts blockchain for the secure handling of patient data, ensuring that critical medical records remain immutable and are accessible only to authorized individuals. Moreover, blockchain's significance in identity verification is increasingly recognized, offering a decentralized, tamper-resistant method for managing digital identities, which can optimize processes in areas such as banking, online commerce, and governmental services. These varied applications highlight blockchain's potential to revolutionize traditional systems by boosting security, efficiency, and transparency across many industries.

1.2.2 Blockchain and Finance

In the finance industry, blockchain technology is ushering in major innovations through numerous applications. A major highlight is **cross-border payments**, where blockchain facilitates quicker and more cost-efficient transactions by removing intermediaries, thereby cutting costs and delays. **Digital asset management** is another crucial application, offering a secure framework for creating, trading, and managing digital assets like cryptocurrencies, tokenized assets, and NFTs, ensuring transparency and unchangeable ownership records. **Smart contracts** enable automated and trustworthy financial agreements, allowing the execution of complex transactions such as loans, insurance claims, and derivatives without relying on third parties. **Decentralized finance (DeFi)**[2] is transforming conventional banking by providing peer-to-peer financial services like lending, borrowing, and trading on blockchain platforms, all accessible with an Internet connection. Moreover, blockchain assists in fraud detection and prevention, offering advanced security measures that guard against identity theft, double-spending, and fraudulent transactions by maintaining an immutable and transparent record of all financial activities. These uses underline blockchain's potential to substantially boost the security, efficiency, and inclusivity of financial systems[3].

1.2.3 Cryptocurrencies

Cryptocurrencies signify a major advancement in digital finance, providing decentralized, peer-to-peer financial systems that function independently of traditional banking structures. Anchored on blockchain technology, cryptocurrencies employ cryptographic methods to ensure transaction security, manage the creation of new units, and authenticate asset transfers on a distributed ledger[2]. The most prominent example, Bitcoin, pioneered the idea of digital currency as a decentralized substitute to paper currency. Since its inception, many other cryptocurrencies like Ethereum, Litecoin, and Ripple have been developed, each offering distinct features and applications, including smart contracts and decentralized applications (dApps)[4]. The adoption of cryptocurrencies is growing for various purposes such as cross-border payments, investment media, and decentralized finance (DeFi) services, marking them as transformative forces in the global financial landscape. Although faced with regulatory issues and market instability, the increasing acceptance of cryptocurrencies indicates a movement towards more open, inclusive, and secure financial systems.

1.2.4 Decentralized Finance

Decentralized Finance (DeFi) signifies a revolutionary shift within the financial industry, leveraging blockchain technology to redefine conventional financial services in a decentralized, open framework. Unlike traditional financial systems that depend on central intermediaries such as banks and brokers, DeFi operates on decentralized networks, mainly employing smart contracts on blockchain platforms like Ethereum. This model enables users to participate directly in financial activities such as lending, borrowing, trading, and investing without middlemen, promoting financial inclusion and boosting transparency. DeFi platforms provide a wide range of services, including decentralized exchanges (DEXs), yield farming, and liquidity pools, giving users complete control over their assets[5]. The advancements in DeFi pose a significant challenge to the traditional banking system by offering permission-less, border-less, and open financial services, thereby altering how individuals and institutions interact with the global financial system. Despite facing regulatory issues and technical risks, the rapid growth of DeFi underscores its potential to democratize finance and influence the future direction of the decentralized economy.

2 Problem Statement

2.1 The Problem

The rapid advancement of financial technologies has exposed the limitations of traditional banking transaction systems, which are predominantly reliant on centralized architectures such as MVC frameworks and SOAP APIs. These systems, while effective in managing daily transactions[1], often suffer from scalability issues, higher transaction costs, and vulnerabilities to fraud. As the demand for faster, secure, and transparent financial operations grows, there is an increasing need for innovative solutions that can overcome the inefficiencies of conventional methods. Blockchain technology, with its decentralized ledger, promises to revolutionize banking by offering enhanced security, transparency, and reduced operational costs. However, the transition from traditional banking infrastructure to a blockchain-based model poses significant challenges, particularly in terms of system integration, regulatory compliance, and operational feasibility[6]. This research seeks to explore how the adoption of Web 3.0 Blockchain-as-a-Service , More specifically the framework known as *Hyperledger Fabric*, can enhance banking transactions by addressing these challenges and improving overall transaction efficiency, security and transparency[7].

2.2 Knowledge gaps

Research into Blockchain and its use cases in finance as it stands today has some knowledge gaps that can be addressed, and are mentioned below.

1. **Insufficient Comparative Research of Blockchain and Conventional Banking Systems:** Current research emphasizes the benefits of blockchain in financial operations, yet there is a scarcity of thorough comparative analysis between blockchain and traditional banking infrastructures, especially in terms of transaction speed, cost, and security. This research can fill this void by offering a detailed comparison between traditional MVC/SOAP API-driven banking systems and Hyperledger fabric applicationsWeb 3.0 Blockchain-as-a-Service (BaaS) models, with an emphasis on practical results in real-world banking scenarios.

2. **Operational Applicability and Integration Difficulties:** Although blockchain holds significant promise, much of the current research does not adequately assess the operational applicability of incorporating blockchain into established banking frameworks. There is a noticeable gap in studies that address the technical hurdles and organizational issues that banks face during the transition from centralized systems to decentralized blockchain-based infrastructures. This research can tackle these integration difficulties, with a focus on the architectural and operational dimensions, thereby clarifying the practical aspects of implementing blockchain in the banking sector.

3. **Research on Regulatory Compliance and Governance in Blockchain Usage:** While current studies acknowledge blockchain's capability to enhance transparency and security, few have thoroughly examined the regulatory obstacles and governance concerns linked to its adoption in the banking sector. Investigating the specific regulatory issues that surface with decentralized system implementation can help shed light on how banks can navigate the balance between innovation and regulatory compliance in a highly controlled industry[8].

4. **Scalability and Performance in High-Volume Banking Scenarios:** Although blockchain's scalability challenges are well-known[9], there is a lack of research on its efficiency in high-transaction environments characteristic of major banks and payment gateways like Paytm or UPIfinancial entities[3]. This research can add value by assessing the scalability and performance of blockchain-based banking applications under stress tests and contrasting these results with those of traditional banking systems.

5. **Long-Term Sustainability of Blockchain-Based Financial Services:** Current studies often emphasize the immediate advantages of blockchain implementation in banking[10], but they do not adequately address its long-term sustainability, especially in terms of energy usage, infrastructure upkeep, and advancing technological standards. This research could bridge this gap by exploring the durability of blockchain systems in the banking sector over the long term, taking into account future advancements in both blockchain and conventional technologies.

3 Objective and research questions

Objective

Blockchain technology presents a unique opportunity to transform banking by offering a decentralized approach to transactions, which challenges the efficiency and security of traditional banking systems. This research proposal aims to compare blockchain-based transactions with conventional banking setups, evaluating differences in speed, cost, and fraud prevention. By examining the inherent strengths and weaknesses of both systems, this research will provide insight into how blockchain technology can improve transaction reliability and transparency while highlighting the limitations of traditional infrastructures. The goal is to assess the potential of blockchain to revolutionize financial operations in a modern banking context.

RQ 1. *Is blockchain technology in its current state a viable alternative for the modern banking ecosystem?*

RQ 2. *In what areas is the technology lacking when it comes to mainstream adoptions?*

RQ 3. *What steps can we take to mitigate the disadvantages of this technology and prepare for its mainstream adoption*

4 Significance and scope of the research

4.1 Significance

The significance of comparing blockchain and traditional banking transaction systems is important in the current financial landscape. As blockchain technology continues to evolve and gain traction in various sectors, the banking industry is at a critical juncture. The evaluation of the potential of blockchain to improve efficiency, security and operational processes is of paramount importance, as financial institutions are under increasing pressure to modernize systems, reduce transaction costs, and improve transparency. This research is particularly relevant as customers demand faster and more secure services, and the banking sector is faced with the challenge of meeting these expectations[11].

4.2 Scope

The scope of this research is broad, encompassing not only the operational differences between blockchain and traditional systems, but also the broader economic and regulatory implications. By examining transaction speed, cost efficiency, security protocols, and compliance challenges, this research addresses key areas where blockchain can have a competitive advantage over legacy systems[12]. In addition, it explores the integration of blockchain technology into existing infrastructures, particularly in domains such as cross-border payments, fraud detection, and digital asset management.

4.3 Relevance

In the context of increasing decentralized finance (DeFi) applications, cryptocurrencies, and global trends toward digitalization, this research is of substantial contemporary relevance. It contributes to ongoing discussions about the future of banking and financial technologies, offering valuable insights to banks, policymakers, and technologists[13]. The findings will illuminate whether blockchain can mitigate existing inefficiencies in traditional banking systems while identifying any limitations or challenges that may hinder its widespread adoption.

5 Research Methodology

5.1 Methods tackling the first research question

RQ 1. *Is blockchain technology in its current state a viable alternative for the modern banking ecosystem?*

a. Methodology

1. **Generate some synthetic data for transaction purposed that would be used as input for our tests.**
2. **Develop an example banking ecosystem using the Hyperledger Fabric framework.**
3. **Demonstrate load testing and performance benchmarks using tools that are commonly used for these purposes.**
4. **Repeat the same process with an ecosystem built using SpringBoot MVC architecture using Microservices Methodology since it is the current latest trend in the field.**
5. **Compare the results and draw conclusions based upon the results in both scenarios.**

b. Risks and feasibility

There is no risk as such because both scenarios will involve banking ecosystems developed using openly available architectures, and the data being used would be synthetically generated just for this particular scenario/usecase. The hosting and deployment of the apps can be done using aws/azure or some other cloud provider using academic research credits or borrowed for academic research.

c. Expected Outcomes

1. When we will compare the metrics we can formulate our answer to the research question and have some input ready for the other research questions we need to tackle in this research.

5.2 Methods tackling the second research question

RQ 2. *In what areas is the technology lacking when it comes to main- stream adoptions?*

a. Methodology

1. Analyze the results from the first experiments and draw up a table of metrics.
2. Study the issues and points that would be potential issues for banking use-cases.
3. Suggest potential fixes or workarounds if possible and then repeat the experiment to see if it gives a different outcome.

b. Expected Outcomes

The outcome of the steps would highlight any shortcomings or pain points of application of blockchain to the banking use-case and would also provide ideas to mitigate those problems.

5.3 Methods tackling the third research question

RQ 3. *What steps can we take to mitigate the disadvantages of this technology and prepare for its mainstream adoption?*

a. Methodology

1. Identify the disadvantages of using blockchains from the experiment.
2. Elaborate the complexity of the disadvantage.
3. Suggest a workaround or mitigation for the disadvantage.

b. Expected Outcomes

We have a clear picture of the current state of technology and how well it integrates into the traditional banking system, along with potential disadvantages and problems.

6 Requirements and Resources

6.1 Requirements

- AWS/Azure Account with credits
- Synthetic Dataset which will mimic bank transactional data.
- Macbook Pro With M3 Pro Series Chip and 18GB RAM
- Server PC with atleast 64GB RAM (Can Be Hosted via VMs Online)
- EC2/Azure VM Instances on AWS Cloud or Azure to act as clients
- IDE's and licenses for software

6.2 Resources

- 1 MacBook / Personal Computer to write and design code
- 1 Azure/AWS Account (1 of each to keep redundancy) with educational access/credits
- 100-150 EC2/VM Instances for client loads (Virtual)
- 2-6 Server Instances for server loads (Virtual)
- Jetbrains IntelliJ IDE with educational liscence
- Matlab with educational liscence
- Github/Bitbucket reposirotry for Version Control
- CI/CD Pipelines

7 Research Plan

Master's Thesis Plan

Each period is considered as a bi-weekly sprint as per agile methodology. A legend describing the charting follows.

ACTIVITY	PLAN START	PLAN DURATION	ACTUAL START	ACTUAL DURATION	PERCENT COMPLETE
Literature Search	1	1	1	1	90%
Literature Review	1	2	1	2	90%
Design of MVC Application	3	4	3		25%
Coding and Implementation of MVC Application	6	6			0%
Design of Hyperledger Application	10	4			0%
Coding and Implementation of Hyperledger Application	13	6			0%
Synthetic Data Generation	17	1			0%
Interim Report	19	2			0%
Benchmarking Applications	20	2			0%
Inferring Results	22	2			0%
Review Conclusions	24	4			0%
Analyze & Evaluate	27	1			0%
Final Report	34	6			0%

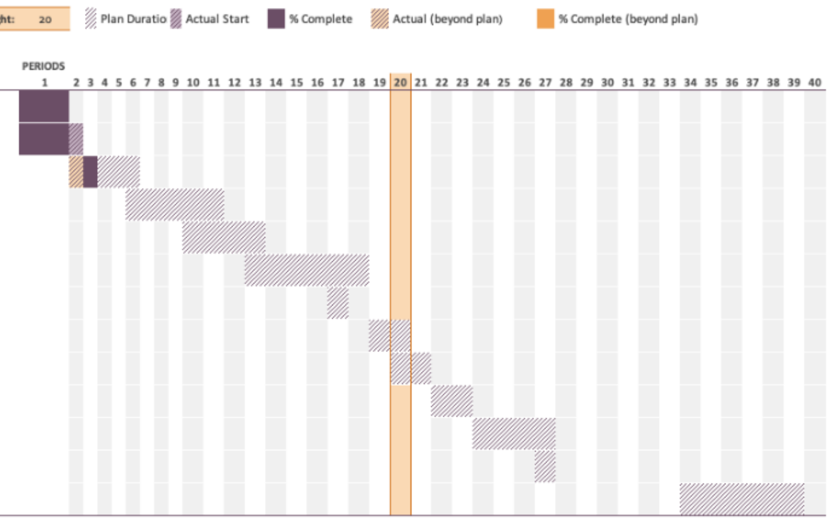

Figure 1. *Gantt chart of the Master's Thesis.*

References

[1] Navarro, A. Fundamentals of transaction management in enterprise application architectures. *IEEE Access* **10**, 124305–124332 (2022).

[2] Mihai, R. *et al.* Blockchain-enabled economic transactions: Recurring financial accruals and payments. In *2022 IEEE 1st Global Emerging Technology Blockchain Forum: Blockchain and Beyond, iGETblockchain 2022* (Institute of Electrical and Electronics Engineers Inc., 2022).

[3] Khaldy, M. A., Alshdifat, G., Almalahmeh, T. & Aldweesh, A. Blockchain as a resilient infrastructure for e-business transactions. In *2nd International Conference on Cyber Resilience, ICCR 2024* (Institute of Electrical and Electronics Engineers Inc., 2024).

[4] Frauenthaler, P., Sigwart, M., Spanring, C., Sober, M. & Schulte, S. Eth relay: A cost-efficient relay for ethereum-based blockchains. In *Proceedings - 2020 IEEE International Conference on Blockchain, Blockchain 2020*, 204–213 (Institute of Electrical and Electronics Engineers Inc., 2020).

[5] Raman, R., V, A. M. R., Viswanathan, C., Shrirvastava, A. & Ganesh, E. N. Blockchain based future banking by decentralized exchanges. In *3rd International Mobile, Intelligent, and Ubiquitous Computing Conference, MIUCC 2023*, 367–372 (Institute of Electrical and Electronics Engineers Inc., 2023).

[6] Kruglova, I. A. Objective barriers to the implementation of blockchain technology in the financial sector. In *2018 International Conference on Artificial Intelligence Applications and Innovations*, 47–50 (2018).

[7] Attia, M. & Abed, A. H. A comprehensive investigation for quantifying and assessing the advantages of blockchain adoption in banking industry. In *6th International Conference on Computing and Informatics, ICCI 2024*, 322–331 (Institute of Electrical and Electronics Engineers Inc., 2024).

[8] Patil, K., Pramod, D. & S, V. B. Examining the intention to adopt blockchain in the banking industry by combining task-technology-fit and technology acceptance theory. In *2022 ASU International Conference in Emerging Technologies for Sustainability and Intelligent Systems, ICETSIS 2022*, 217–224 (Institute of Electrical and Electronics Engineers Inc., 2022).

[9] Sinha, S., Kumkum & Bathla, R. Implementation of blockchain in financial sector to improve scalability. In *2019 4th International Conference on Information Systems and Computer Networks (ISCON).* (IEEE, 2019).

[10] Zhang, J., Zhong, S., Wang, J. & Wang, L. An systematic study on blockchain transaction databases storage and optimization. In *2020 IEEE Intl Conf on Parallel Distributed Processing with Applications, Big Data Cloud Computing, Sustainable Computing Communications, Social Computing Networking (ISPA/BDCloud/SocialCom/SustainCom)*, 298–304 (IEEE, 2020). URL https://ieeexplore.ieee.org/document/9443832/.

[11] Tressa, N. & Priya, C. Blockchain based upi technology for secured peer-to-peer cryptocurrency transactions. In *2023 Global Conference on Information Technologies and Communications, GCITC 2023* (Institute of Electrical and Electronics Engineers Inc., 2023).

[12] Idris, N. F. B., Suhaimi, M. A. B., Zakaria, M. S. B. & Ismail, A. Z. B. Performance analysis of hyperledger fabric on multiple infrastructure setup. In *2023 International Conference on Digital Applications, Transformation and Economy, ICDATE 2023* (Institute of Electrical and Electronics Engineers Inc., 2023).

[13] Sakho, S., Jianbiao, Z., Essaf, F. & Badiss, K. Improving banking transactions using blockchain technology. In *2019 IEEE 5th International Conference on Computer and Communications* (IEEE, 2019).

Research_Proposal__1134987_Mohammad_Najm.pdf

ORIGINALITY REPORT

1%	0%	0%	1%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to Avans Plus Student Paper	1%
2	Submitted to Sunway Education Group Student Paper	1%

Exclude quotes	Off	Exclude matches	< 1%
Exclude bibliography	On		