



Leveraging blockchain technology in Indian digital payment systems

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Abstract

The digital payments landscape is undergoing a fundamental transformation fueled by innovative technologies like blockchain. While often associated with cryptocurrencies, blockchain's potential extends far beyond mere transactional efficiency. This distributed ledger technology offers a unique blend of security, transparency, and immutability, making it a compelling avenue for reshaping the very nature of digital payments.

Purpose: The research paper will offer insights into the theoretical foundations, practical use cases, and potential challenges of integrating blockchain technology with existing systems in India.

Objective: This research paper aims to deliver a comprehensive conceptual understanding of blockchain technology, its potential applications in digital payments, and its relevance within the context of India Stack.

Research outcome: The study concluded that rising internet users and adoption of technology by the financial institutions and banking sector transformed the India as fastest growing economy in terms of digital payment systems.

Keywords: Blockchain technology, Digital payment systems, India stack

1. Introduction

A blockchain may be defined as a distributed database incorporating information or a book that marks all the events and transactions, executed and shared among concerned parties. The transactions are verified and information entered can never be erased (Priyadarshini, 2018) ^[12]. It is an advanced database mechanism with transparency and securely information is shared in the network in the form of blocks. All the information blocks are connected chronologically for every new information new block will be added. These blocks of information is secure because of the blockchain is a digital ledger system stored across on a different networks. In general blockchain technology is a system programmed to record and tract anything of value from records to transactions. The first phase of the blockchain technology is used in the crypto currencies, second phase in financial services and industries, and third phase used in areas like art, health, media and many government institutions as it is highly secure, scalable and sustainable (Simanta Shekhar Sarmah, 2018) ^[15]. Currently blockchain technology is used in application development environment like IoT (Internet of Things), smart contracts, distribution of the digital content, botnet, and P2P broadcast protocols (Jesse Yli-Huumo, 2016) ^[8].

2. Review of literature

Distributed ledger technologies (DLT) hold immense potential for recording events, medical records, and other sensitive data with enhanced security and transparency. These systems

facilitate efficient record management, identity verification, and transaction processing. Moreover, they enable large-scale collaboration in a decentralized and trustless manner, where participants cooperate without relying on a central authority (Siniša Franji, 2019) ^[16]. This technology has the potential to revolutionize specific banking services, particularly interbank transactions. DLT-based solutions could offer significant efficiency gains and cost reductions compared to traditional systems like SWIFT (Astrina Xhaferi, 2020) ^[2]. While decentralized protocols using shared ledgers offer exciting possibilities, limitations exist, particularly in parallel execution and compatibility with centralized environments. For seamless money transfer across disparate blockchains, alternative methods are needed (Mohanty, D.; Anand, D.; Aljahdali, H.M.; Villar, S.G., 2022) ^[11].

Blockchain technology has the potential to significantly improve security and efficiency in payment processing by minimizing information exposure and transaction costs. This technology allows encrypted data to reside directly on the card itself, minimizing data sharing and potential exposure. By acting as a single digital register numerous validation steps are reduced and stores the relevant information of the cardholder details (Godfrey-Welch et. al., 2018) ^[5]. (Haiss Peter, Andreas Moser, 2017) ^[6] pointed out that perceived advantages of DLT are reducing the cost, duration and simplified procedures and disadvantage is especially related to legal framework. Blockchain technology has been applied in financial services in the applications like cross border transactions, smart bonds,

point of sales system, lending and borrowing, securities trading, clearing and settlements, book keeping, auditing, hedge funds and reports (Chetna Laroia, 2020) ^[4].

In India states like Andhrapradesh and Telangana adopted blockchain technologies in land registry and digital certificates. Financial institutions, banking and startups are playing a key role in the development and application of blockchain technology (Bhuvana R, 2020) ^[3].

While distributed ledger technology (DLT) applications in banking hold promise for secure financial services, their adoption in rural areas raises unique cybersecurity concerns. While digital money storage reduces physical theft risks, it exposes users to online threats like phishing scams and malware. Research indicates that individuals with limited digital literacy and cybersecurity awareness are more vulnerable to online fraud. This puts rural populations at particular risk due to their potential lack of exposure to such threats. Therefore, the successful implementation of blockchain-based banking solutions in rural areas hinges on effectively mitigating cybersecurity risks. Without addressing these concerns, the security benefits offered by DLT might be overshadowed by the increased exposure to online threats (Schuetz, S.W. and Venkatesh, V, 2020) ^[14].

From the above review of literature it is evident that blockchain technology applications are there in all the fields especially in the financial sector usage and application is high. Majority of the studies are positive in the application of technology and highest concern is there from the legal framework. In this regard the following objectives are framed to study.

3. Objectives and Methodology

- Analyze the theoretical foundations of blockchain technology and present digital payment and settlement systems in India.

- Investigate the real-world applications of blockchain technology through relevant use cases.
- Evaluate the purpose and use of India Stack in relation to these systems and technologies.

3.1 Research methodology

- Literature review:** Conduct a comprehensive review of existing academic literature, industry reports, and government publications for exploring the landscape of digital payments in India.
- Comparative analysis:** Compare and contrast the features, functionalities, and potential benefits of block chain technology with existing digital payment and settlement systems in India.
- Use case analysis:** Selected representative use cases of block chain technology in the financial sector and conduct an in-depth analysis of their implementation, challenges, and potential impact.

4. Existing digital payment system in India

In India payment system is largely bank centric and majority of the payment gateways are operated by Reserve Bank of India (RBI) and National Payments Corporation of India (NPCI). As payment and settlement system considered as the back bone of the financial system in any country. Over the period number of payment and settlement system evolved which transformed from manual to electronic processing. Payment and Settlement Systems Act, 2007 ensured the RBI to commence and operate payment system in India. Through the Payment and Settlement system Regulations, 2008 RBI started regulating the payment system operators. For the development of the payment system institutional mechanisms like Clearing Corporation of India Limited (CCIL) and National Payments Corporation of India (NPCI) brought in place (Loksabha Secretariat, 2017) ^[10].

Table 1: Showing modes of digital payment and service offerings

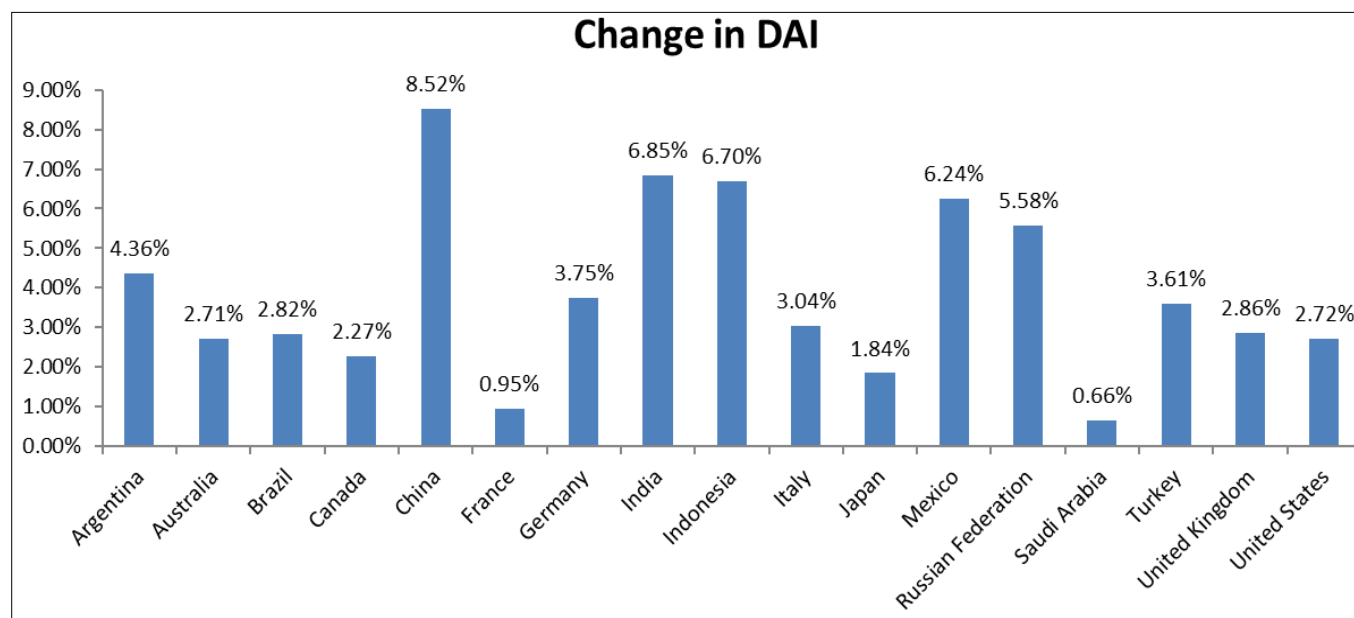
Sl. No	Mode	Services Offered
1	Banking Cards	- Used at PoS (Point of Sale) machines, ATMs, microATMs, Shops, wallets, online transactions, and for e-commerce websites. - International cards can be used across globe for multiple currencies
2	Unstructured Supplementary Service Data (USSD)	Balance enquiry, Mini-statement, Funds transfer, MMID, A/c no., Aadhaar, Know MMID, Change M-PIN and Generate OTP
3	Aadhar Enabled Payment Systems (AEPS)	Balance enquiry, Cash withdrawal, Cash deposit, Aadhaar to Aadhaar funds transfer and Payment Transactions (C2B, C2G Transactions)
4	Unified Payments Interface (UPI)	Balance enquiry, Transaction history, Send / Pay Money, Add bank account, Change / Set MPIN, Notifications, A/c management
5	Mobile Wallets	Balance enquiry, Passbook/Transaction history, add money, accept money, pay money, Manage profile and Notifications
6	Prepaid Cards	Balance enquiry, Passbook/ Transaction history, add money, accept money, pay money, Manage profile and Notifications
7	Point of Sale (POS)	Any card, Resident for bio-metric auth (AEPS) for registered device, Wallet account, Scanner for reading QR Code and Bar code
8	Internet Banking	One-to-one funds transfer, Funds transfers individually on an order by order basis, Payment transaction, Fund transfer service through mobile phones
9	Mobile Banking	Financial transactions remotely using a mobile device
10	Micro ATMs	Low cost device for Business Correspondents (BCs) to deliver basic banking services

Source: Researcher compiled from <http://cashlessindia.gov.in/>

4.1 Digitization

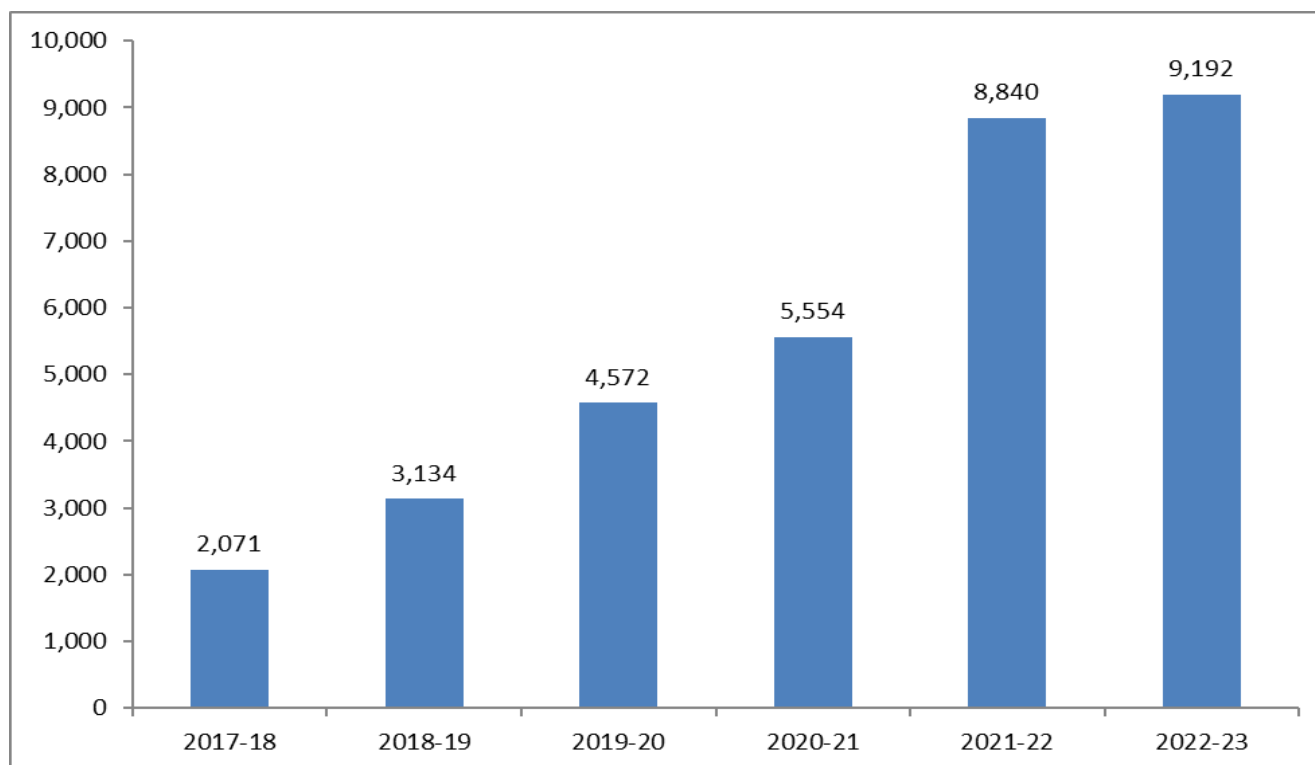
Reserve Bank of India has been designated as regulator and supervisor of payment systems in India through the Payment and Settlement Systems (PSS) Act 2007. The act has boosted the growth of the digital payments and played a vital role in the transformation of economy into cashless economy. In the traditional banking challenges exists like time consuming process, high transaction cost, paper work, timings of operations and transparency. Currently the banking sector has drastically changed due to the technology.

Digitalization has increased among the global economies but stagnant in terms of growth. In the developing economies the usage of digital payments among the adults has increased. India's digital consumer base is the second largest and growing rapidly. According to the Internet and Mobile Association of India (IAMAI) report, in 2022, comprising rural and urban areas there were a total of 759 million active internet users exist. Even in the digital adoption index from the year 2014 to 2016 China in the first place with 8.52 percent growth in the adoption and India in the second place with 6.85 percent growth in the adoption (refer chart 01).



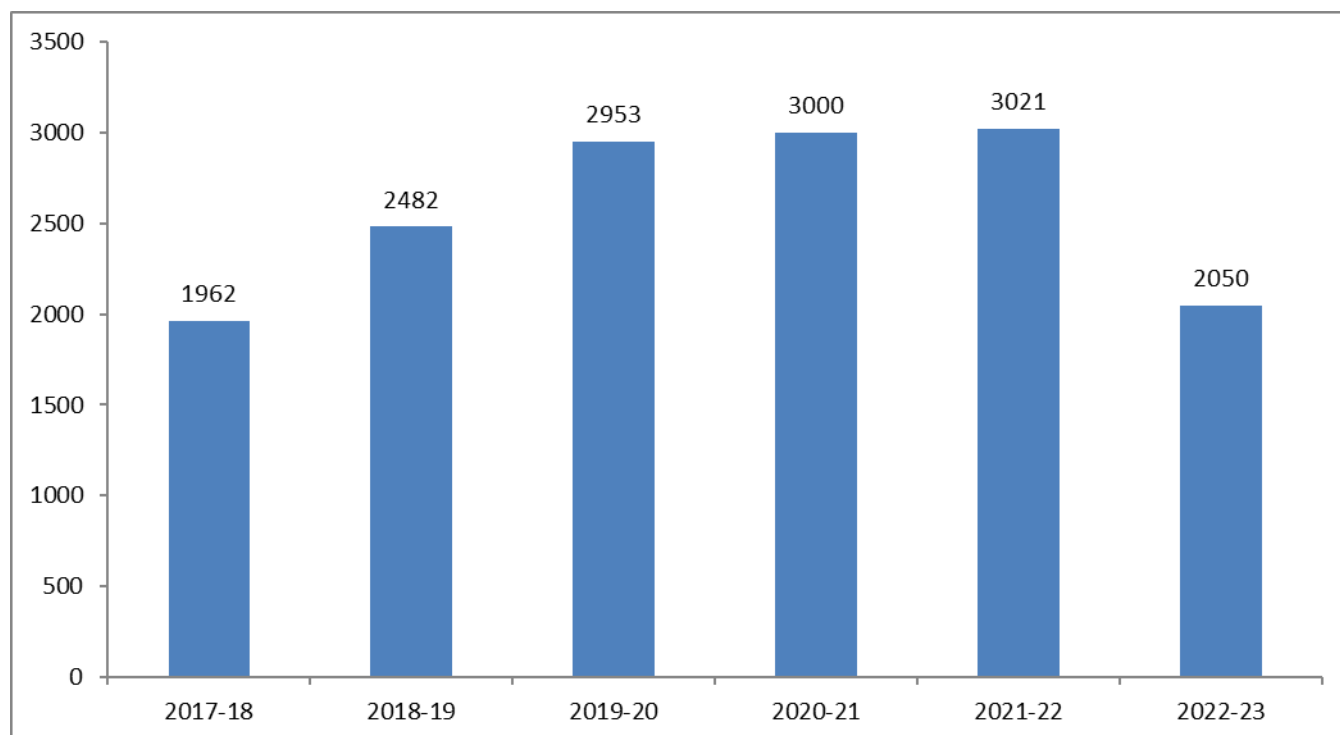
Source: Researcher calculations based on Digital Adoption Index 2014 and 2016, World Bank

Chart 1: Showing the change in the digitalization adoption index (2014-2016)



Source: Compiled by researcher from Ministry of Electronics & IT, Digital Transactions in India as on 08 Feb 2023

Chart 2: Showing number of digital transactions² (in crore)



Source: Compiled by researcher from Ministry of Electronics & IT, Digital Transactions in India as on 08 Feb 2023

Chart 3: Showing value of digital transactions (in lakh crore)

From the above chart it is clearly evident that internet, raising awareness, digital literacy, raising middle income population has increased the volume and value of digital transactions in India. The growth in the past five years from 2017-18 to 2022-23 is drastic and this growth made India as third largest country in the adoption.

5. Blockchain implementation in Indian payment systems (Use cases)

Letter of Credit (LC)

In the current system buyers and sellers use paper based LCs where physical documents were sent to both the party's. Time and cost involved in processing the physical documents has become an hindrance for the exporters. To overcome this Citi India using blockchain technology enabled the LC transaction for Cummins India Limited on Contour. This has simplified the trade processes, reduced the transaction time and provided access to trade finance and working capital solutions to the clients using digital platform. By creating a paperless solution for the LC transaction for the banking clients of Citi helped to improve the efficiency across the value chain. Another use case HSBC facilitated blockchain-based trade finance transaction for Reliance Industries' export to Tricon Energy enabled the transaction in a transparent environment, securely, simple and faster way (Kalpana Pathak, 2018) ^[9].

e-KYC (Know Your Customer)

Existing KYC process is lengthy, complex and with inadequate transparency in the data collection. Protection of the customer data, unauthorized usage of the data and fraudulent usage are the challenges that exists in the current financial system. To overcome this challenge TCS (Tata Consultancy Services)

came with blockchain solution named as 'Quartz' innovative solution leverages a private, permissioned blockchain to securely store and share KYC data with authorized entities, based on explicit customer consent. It streamlines the entire KYC process, from onboarding and periodic reviews to remediation and lifecycle management, through standardized and efficient data collection. Designed for versatility, it caters to the diverse KYC needs of institutions across various industries, combining the strengths of both off-chain and on-chain functionalities (TCS).

Cross border Transactions

In the cross border transactions funds are sent via the corresponding banking network created a delay and carries significant risk. For the cross border bond settlement Asian Development Bank (ADB) examined the usage of Distributed Ledger Technology (DLT) and blockchain came with a novel project 'Project Tridecagon' connecting ASEAN + 3 Countries (+3 representing China, Japan & Korea) central banks' real-time gross settlement systems (RTGS) and Central Security Depository (CSD) book-entry systems. Project Tridecagon divided the process into two distinct legs: foreign exchange (payment versus payment or PvP) and domestic security settlement. This aimed to improve efficiency by leveraging distributed ledger technology (DLT) in each stage. This two-part system aimed to address the inefficiencies of traditional cross-border transactions, which often involve complex intermediaries and extended settlement times. However, it's important to note that Project Tridecagon is still in its developmental stages, and challenges such as regulatory alignment, scalability, and integration with existing financial systems need to be addressed before widespread adoption can occur (ADB, 2023) ^[1].

Digital currency

The Reserve Bank of India's Digital Rupee marks a significant advancement in the country's payment ecosystem. This central bank digital currency (CBDC) functions as an electronic alternative to physical cash, enabling seamlessly secure and instant digital transactions (IBA). RBI, announced plans to equip its Digital Rupee with two game-changing features:

programmability and *offline functionality*. These additions promise to significantly enhance the utility and inclusivity of this innovative currency (RBI, 2024) ^[13].

6. Comparison of block chain with traditional payment system

Table 2: Showing potential cost savings and efficiency gains

Potential cost savings	Potential efficiency gains
In the traditional payment system due to multiple intermediaries (banks, payment gateways) charging fees whereas blockchain is eliminating and saving the significant costs.	As in the traditional system delay in the settlement is observed. Real time processing transactions in blockchain improved the speed.
Quick access to funds due to faster settlements leading cost saving.	Transactions are visible on blockchain helps in improving the transparency and reduces disputes.
Due to automation of the processes like reconciliation and paperwork reduces the operational cost.	In the cross border transaction blockchain eliminates the third party which lead to faster settlement at low cost
Fraud attempts and its costs are minimized due to tamper proof technology.	Simplified compliance process of KYC helps in secure, store and sharing of information.

Source: Compiled by researcher from various studies

7. Leveraging India Stack for digital payments

Digital infrastructure playing a catalytic role in India poised the evolution of ecosystem by leveraging technology. India stack a technology which is acting as a link in combining the Application Programming Interface (API) with another software program allows the stake holders like governments, businesses, start-up companies and developers for providing

the financial services. Due to this innovation, transformation is highly visible in the growth of the fintech solutions in India. India stack enabled the private companies and start-ups to build applications integrated with the state services to provide seamless access to various financial services. The success of the India Stack is based on the three parameters identity layer, payments layer and data layer (refer the table 03).

Table 3: Showing the India Stack parameters and purpose

Sl. No.	Parameter	Initiative	Purpose	Operating body
1	Identity Layer	e-auth	e-verification of identify through UIDAI database	UIDAI
		QR Code Scan	verification of identify through UIDAI database	UIDAI
		Offline XML	Official document generated by UIDAI can be shared	UIDAI
		e-Aadhar	Signed PDF copy	UIDAI
		e-KYC	Electronically instant verification for individual	UIDAI
		Digi locker	Authenticated digital documents can be stored and sharable	MeitY
		e-sign	Legal digital signatures on any document	CCA
2	Payments Layer	Unified Payment Interface	Money transfers digitally through virtual payment address	NPCI
		Aadhar payments bridge	Channeling the subsidies in their Aadhar enabled bank account	NPCI
		Aadhar enabled payment system	Access to basic banking services through Aadhar enabled account	NPCI
3	Data Layer	Account aggregator	Using technology exchange of data between the institutions	RBI
		Consent artefact	Digital document with user consent for data sharing	RBI

Source: Researcher compiled from IMF³ March 2023 and IBEF⁴

8. Conclusion

This research paper has delved into the complex interactions between blockchain technology, the existing digital payment and settlement systems in India, and India Stack initiative. Through examination of theoretical framework and practical use cases highlighted the potentials and challenges in the India's evolving landscape. The major finding of this study is, blockchain technology is offering security, transparency and reduced frauds. Through the use cases found that how in real world blockchain is streamlining the processes and improving the cross- border transactions. From the perspective of the regulatory framework also found that India stack is serving as foundational infrastructure for integration of blockchain based

solutions. The study identified that still hurdles exist in terms of regulatory clarity, user awareness and wider adoption.

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