Distributed Ledger Technology and the Reserve Bank of India

PRITAM KUMAR

Pritam Kumar is currently a fifth year law student at National University of Study and Research in Law , Ranchi, Jharkhand

Abstract

The features and complexity of Distributed Ledger Technology have grown significantly to provide solutions to various industries, including the financial sector. Some central banks have launched pilot projects to study and comprehend DLT, as well as to investigate the potential benefits for their operations and financial systems. So far, most of these projects have been exploratory, examining the viability of conducting inter-bank settlements, settlement of digital assets and tokens, and cross-border payments across DLT platforms using existing system functionalities. In the Indian context, increasing support for innovations and emerging technologies from the Reserve Bank of India and the Government of India through regulatory spaces and other schemes would pave the way for the new economy, enriched with the momentum of technology-centric growth.

I.   Introduction

The broad term used to describe techniques for managing distributed ledgers over computer networks is "DLT." A purist (or perhaps a pedant) would point out that although "blockchain" is frequently used as a synonym for "DLT" , Blockchain is a form of distributed ledger technology which has distinct features among other types of DLTs. There are other types of DLT that are not based on blockchain technology, however many of the more well-known examples are. It is a digital document that is instantly distributed across a group of participants. It is distributed because every user (or node) in the network has a copy of the record, and each copy receives updates at the same time. Different distributed ledger platforms employ a variety of consensus techniques to ensure that all nodes concur on the record. One major benefit of DLT is that there is just one set of records, even though it is

maintained on various nodes, rather than several competing ones that need to be reconciled. This one record is a prime source of information[1].

A blockchain is a globally shared, transactional database. This means that everyone can read entries in the database just by participating in the network. If you want to change something in the database, you create a so-called transaction which is required to be accepted by all others. The word transaction implies that the change you want to make (assume you want to change two values at the same time) is either not done at all or completely applied. Furthermore, while your transaction is applied to the database, no other transaction can alter it. As an example, imagine a table that lists the balances of all accounts in an electronic currency. If a transfer from one account to another is requested, the transactional nature of the database ensures that if the amount is subtracted from one account, it is always added to the other account[2]. If due to whatever reason, adding the amount to the target account is not possible, the source account is also not modified. Furthermore, a transaction is always cryptographically signed by the sender (creator). This makes it straightforward to guard access to specific modifications of the database. In the example of the electronic currency, a simple check ensures that only the person holding the keys to the account can transfer money from it[3].

Out of the wreckage of the global financial crisis (GFC) arose a white paper titled 'Bitcoin: A Peer-To-Peer Electronic Cash System' (Nakamoto, 2008), which provided a roadmap for revolutionizing the financial system. Since then, the world has rapidly evolved from Bitcoin and early blockchain designs to customized blockchains tailored to the needs of various industries. There are currently over 2,000 cryptocurrencies1 listed on major cryptocurrency exchanges, as well as numerous blockchain startups around the world. Blockchain has become a buzzword, and no FinTech discussion is complete without mentioning it. Such growth in popularity over a decade reflects the inherent revolutionary features of blockchain and its appeal to technically insightful entrepreneurs.

II.   Why utilize DLTs?

FinTech companies that provide solutions for remittances and international payments based on blockchain technology are quickly upending and challenging market players. In order to lower risk, avoid fraud, and better implement monetary policy, central banks and other authorities are increasingly understanding that they could profit from this technology (De Meijer, 2018). As a result,

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[1] Nalin Priyaranjan, Dr. Mohua Roy and Dr. Sarat Dhal of the Department of Economic and Policy Research (DEPR), Reserve Bank of India, 'Distributed Ledger Technology, Blockchain and Central Banks' (2020) <https://rbidocs.rbi.org.in/rdocs/Bulletin/PDFs/03AR_11022020510886F328EB418FB8013FBB684BB5BC.PDF > accessed 23 October 2024
[2] Nalin Priyaranjan, Dr. Mohua Roy and Dr. Sarat Dhal of the Department of Economic and Policy Research (DEPR), Reserve Bank of India, 'Distributed Ledger Technology, Blockchain and Central Banks' (2020) <https://rbidocs.rbi.org.in/rdocs/Bulletin/PDFs/03AR_11022020510886F328EB418FB8013FBB684BB5BC.PDF> accessed 23 October 2024
[3] 'What is Blockchain?' (*McKinsey & Company*, 6 June 2024) <https://www.mckinsey.com/featured-insights/mckinsey-explainers/what-is-blockchain> accessed 21 October 2024

some central banks have set out on an ambitious journey to support and steer the sector in a non-disruptive manner, maintain financial stability, and guarantee the growth of financial market infrastructure using DLT[4].   There seems to be a substantial lack of knowledge regarding blockchain and DLT despite the public's intense interest in these new technologies. Due to the complexity of this technology and the numerous regulatory challenges it presents, including "the fast-moving vocabulary around blockchain technology and the challenges this unstable verbal terrain poses for regulators," several central banks and other regulatory authorities have been cautious in adopting it. Consider the adage of Charles Kettering that "a problem adequately expressed is half remedied" in this situation. This study is driven by the need to provide a clear knowledge of DLT, blockchain, and the applications of these technologies by central banks; the lessons learned from this study may also be applicable to the Indian context.

Legitimate ownership of items like homes, automobiles, and other possessions is established by a tangible document that is accepted by the general public and issued by an authorized institution. The verification procedure and the prevalence of fake certificates are two of the main problems with this type of ownership proof[5]. Every account in the distributed ledger technology (DLT) includes a digital public key and private key pair that are used to sign and encrypt blocks using hashing algorithms. The DLT structure's framework is composed of this mechanism. Here, the ownership information is recorded in a publicly accessible electronic ledger that uses cryptography to prevent tampering. The usage of a private key, which is used to sign transactions and so provide proof that it came from the owner and can be easily checked by using its public key pair, ensures the validity of transactions. Recent DLT Issues and Developments from Satoshi Nakamoto's paper from 2008, which served as the foundation for blockchain, it has come a long way. Although the first use of it was for cryptocurrencies, other uses have recently gained popularity. Limited uses, sluggish transaction confirmation, low throughput, lack of privacy, and high energy consumption are only a few of the initial drawbacks of the first generation of blockchains. These New approaches like sharing, alternative consensus mechanisms like Proof-of-Stake, and permissioned blockchains for specific applications, like wholesale interbank settlements (Proof-of-Concept projects by the Bank of Canada and Monetary Authority of Singapore), are being used to address shortcomings. Blockchain interoperability is being developed for cross-platform functionality. Other DLT systems, such as Quorum Corda, Hyperledger, etc., have been developed as a result of rising demand for various solutions[6].

III.   Permissioned versus Permissionless DLT

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[4] Rodrigo Mejia Ricart & Camilo Tellez, 'Distributed Ledger Technology: What is it and why Do we care' (*Better than cash Alliance*, 6 June 2019)<https://www.betterthancash.org/news/distributed-ledger-technology-what-is-it-and-why-do-we-care > accessed 18 October 2024
[5] Mohd Javaid, Abid Haleem & Ravi Pratap Singh, 'A review of Blockchain Technology applications for financial services' (July 2022) <https://www.sciencedirect.com/science/article/pii/S2772485922000606> accessed 20 October 2024
[6] Dr. Mushtaq Ahmed, 'Blockchain Technology' <https://egovstandards.gov.in/sites/default/files/2023-05/Blockchain%20Cryptographic%20Security%2C%20Hashing%20and%20Digital%20Signature.pdf> accessed 22 October 2024

A DLT can be categorized as permissioned (requiring prior authorization to join) or permissionless based on its capacity to authenticate transactions (anyone can participate). Most first-generation blockchains, including Bitcoin and Ethereum, lack permissions. Systems using permissionless DLT are extremely transparent since everyone can see every transaction recorded on the ledger. They take a long time to use, though, and are not appropriate for solutions that demand transaction privacy. Permissioned DLT platforms were launched for a controlled environment where participants trust each other and privacy is based on governance decisions. Select agents are given access to validate transactions by nature. DLT can be constructed so that an agent can only access its own transactions and not those of other agents, satisfying the privacy requirements. Business and financial agents have this as a key requirement[7].

IV. Smart Contracts

Smart Contracts are essentially self-executing pieces of business logics that mediates a specific transaction on the blockchain with pre-defined scripts contained within the code of the transaction[8]. This code autonomously controls the execution of the contract and ensures transactions are trackable and irreversible. These contracts are essentially DLT lines of code or logic that run on their own when certain prerequisites are satisfied. These can be thought of as digital contracts, and when the conditions are met, the smart contract verifies them and transfers the tokens in accordance with the conditions (Buterin, 2013). A straightforward smart contract would automatically split and send payments to the designated parties after being received. A smart contract's ability to communicate with other smart contracts allows it to become more complicated. In numerous central bank and other institution pilot programs, smart contracts have been used in services including trade financing, settlement of securities, etc[9].

V. Blockchain Interoperability

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[7] Toshendra Kumar Sharma, 'Permissioned and Permissionless Blockchains: A Comprehensive Guide' (10 May 2024) <https://www.blockchain-council.org/blockchain/permissioned-and-permissionless-blockchains-a-comprehensive-guide/ > accessed 26 October 2024
[8] <https://www.ibm.com/topics/smart-contracts> accessed on 25 October 2024
[9] Shafaq Naheed Khan, 'Blockchain Smart Contracts: Applications, challenges and future trends'(18 April 2021) <https://link.springer.com/article/10.1007/s12083-021-01127-0> accessed 24 October 2024

There are numerous active blockchain and DLT platforms worldwide. These DLT platforms can communicate with one another to deliver required services and are designed for certain use cases. This DLT property is sometimes contrasted with the Internet, a network of networks. According to interoperability, if one transaction takes place on one DLT platform, another transaction will presumably follow on a separate DLT platform. Project Jasper and Project Ubin from the Monetary Authority of Singapore and the Bank of Canada respectively show the value of such interoperability in cross-border payment operations (Bank of Canada et al, 2018)[10].

VI.   DLT and Blockchain Platforms

DLT and blockchains should be seen as platforms for creating more complex applications rather than just ways to move currency. By design, every DLT platform is distinct, with a distinct set of capabilities, benefits, and drawbacks. Choosing the appropriate platform for the application at hand is crucial. The timeline shows the evolution of these platforms beginning with Bitcoin.

VII.   DLT in Central Banks

Blockchain became well-known thanks to the cryptocurrency Bitcoin. Central banks all over the world started to keep an eye on the threats posed by cryptocurrencies since it was encroaching on the territory of the central bank, which is the sole issuer of currency in an economy. Central banks showed confidence and interest in blockchain-based applications other than cryptocurrencies while keeping an eye on these developments. The World Economic Forum (WEF) released a paper titled "The future of financial infrastructure" in August 2016 that included information on the potential ways that blockchain technology could transform financial services with uses spanning from payments to equity settlements.

Central banks realized they could support innovations in a quickly changing digital context after being given the task of creating financial infrastructure. It was also recognized that central bank participation might increase the security and stability of these platforms and boost the efficiency of the financial industry as a result. Bank of Canada and the Monetary Authority of Singapore recently tested cross-border payments on their respective blockchain networks as part of their programs. As Facebook's

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[10] Nalin Priyaranjan, Dr. Mohua Roy and Dr. Sarat Dhal of the Department of Economic and Policy Research (DEPR), Reserve Bank of India,
'Distributed Ledger Technology, Blockchain and Central Banks' (2020)
<https://rbidocs.rbi.org.in/rdocs/Bulletin/PDFs/03AR_11022020510886F328EB418FB8013FBB684BB5BC.PDF> accessed 23 October 2024

intended launch of Libra was revealed in a white paper in June 2019, the interest of central banks in DLT increased further in the second half of 2019.

Several central banks have started projects (Annex) over the past five years to research and test DLT technology in order to evaluate its potential for use in financial infrastructure. The majority of the initiatives have an exploratory goal rather than a replacement goal for the current financial infrastructure, which is to examine whether current systems are still viable on a new decentralized platform. These initiatives are largely designed to increase central banks' awareness of DLT and investigate the viability of gradually integrating CBDC into the financial system.

Applications of DLT in India Following Bitcoin, several cryptocurrency firms have emerged in India, including Uno coin in 2013 and Zebpay in 2014. (Tracxn, 2019). However, the price volatility of Bitcoin and the fraud cases have highlighted regulatory worries about the dangers of cryptocurrencies. Both the Reserve Bank and the Government of India have said that they have not authorized or issued regulations for any institution to deal with cryptocurrencies. As a result, individuals dealing with cryptocurrencies have no legal protection and are responsible for any associated risks.

In truth, the Reserve Bank has warned against trading in cryptocurrencies in a number of news statements (Dec 24, 2013, Feb 1, 2017, Dec 5, 2017). The Reserve Bank forbade its regulated entities from providing their services to businesses dealing with cryptocurrencies or virtual currencies in April 2018 through a circular dated 6th april,2018 in order to protect domestic depositors and financial institutions from the rising risks brought on by speculative dealings in cryptocurrencies. But In the case of *Internet And Mobile Association of India v. Reserve Bank Of India, MANU/SC/0264/2020,* The Supreme Court of India declared the said circular unenforceable.

The authorities have, however, acknowledged the value of DLT and blockchain. In light of this, it is essential for Indian institutions to comprehend the potential advantages and risks of DLT in order to benefit from technological progress. The adoption of DLT and blockchain in India has advanced recently in both the public and private sectors, despite the fact that the majority of the initiatives are still in the proof-of-concept stage. In actuality, blockchain-based solutions are becoming increasingly popular in the public sector. In the fields of property registry, digital certificates, electronic health records, and other sectors, certain state governments, including those of Andhra Pradesh and Telangana, have begun implementing blockchain-related solutions (Government of Andhra Pradesh September 2018).

The private sector's adoption of blockchain-based solutions is being led by the banking and financial services industry. These initiatives serve as examples, with some of them being Yes Bank's implementation of the issuance of commercial papers on blockchain (Yes Bank, July 2019), Axis Bank's launch of an international payment service using Ripple's enterprise blockchain technology (Axis Bank, November 2017), and the execution of a blockchain-based trade finance transaction by HSBC India and Reliance Industries Ltd. (HSBC India, November 2018). Startups are using blockchain technology to

offer solutions in a variety of sectors, including healthcare, retail, government services, and human resources. Around US$ 8.5 million has reportedly been invested by venture capitalists in blockchain-based firms in India (NASSCOM, 2019).

However, according to this analysis, Indian start-ups were only able to secure 0.2% of the surge in venture capital investments in blockchain startups around the world. Through its new regulatory sandbox environment, the Reserve Bank of India has been proactive in offering advice for the development of blockchain-based applications. Startups and financial institutions that use blockchain-based applications may be added to regulatory sandbox cohorts to test their products for a predetermined amount of time. Recently, the Government of India announced a number of initiatives in the Union Budget 2020–21, focusing on the new economy built on cutting-edge technologies like artificial intelligence, machine learning, the Internet of things, etc.

The National Mission on Quantum Technologies and Applications was given 8,000 crores over a five-year period, and 6,000 crores for improving digital connectivity at the grass-root level by connecting 1 lakh Gram Panchayats under the Bharatnet program. It was also proposed to release a policy allowing the private sector to build Data Center parks across the nation. Additionally, it was suggested to postpone paying taxes on shares distributed by startups to their employees under employee stock option schemes (ESOPs). These initiatives would therefore create new investment and employment opportunities in addition to opening up new pathways for start-ups to develop and thrive. More start-ups and investments are anticipated as the regulatory framework surrounding DLT and blockchain technology develops with the introduction of a regulatory sandbox[11].

VIII.   Conclusion

DLT and blockchain have grown significantly in features and complexity over the past ten years to provide solutions for many industries, including the financial sector. Due to their intricacy, DLT was initially only understood by computer scientists and a select few other curious people. However, there is a lot of interest in DLT since it has uses in finance and other industries. Pilot initiatives to research, comprehend, and investigate the possible advantages of DLT for their operations and the financial systems have been performed by some central banks in partnership with other organizations.

The majority of these initiatives are currently experimental in nature and study whether it is feasible to carry out cross-border payments using DLT platforms, inter-bank settlements, and the settlement of digital assets and tokens using the functions of the current system. It's crucial to keep in mind that the majority of these central banks haven't yet stated that they intend to launch DLT-based applications

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[11] 'Budget 2020 announces Rs 8000 cr National Mission on Quantum Technologies & Applications'
<https://dst.gov.in/budget-2020-announces-rs-8000-cr-national-mission-quantum-technologies-applications> accessed 26 October 2024

in production. The Riksbank, among other things, has indicated that DLT in its current form is too immature to be used for the deployment of e-krona, even in the case of CBDC. The Riksbank, has expressed concerns about DLT for the deployment of its e-krona, even though DLT has potential applications in central bank digital currencies (CBDCs) due to its scalability, performance limitations, regulatory uncertainty, energy consumptions and interoperability issues.

However, these initiatives and the benefits they provide strengthen the power of central banks and regulators to direct the construction of a DLT-based financial market infrastructure. As institutions and start-ups embark on adopting new technology to provide effective and efficient answers to business problems, this also enables central banks to offer helpful counsel.

In the Indian context, growing support for innovations and emerging technologies from the Reserve Bank of India and the Government of India through regulatory sandbox and several other initiatives will pave the way for a new economy enhanced with impetus for technology-centric growth.