

Blockchain Revolution in Banking Industry

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Abstract— today, banks are affected by economic and digital transformation, financial innovations and development of internet. Blockchain technology with cryptocurrency is underlying technology with promising application in the banking sector. Therefore, Aim of this paper is to do a research with the impact of Blockchain platform in the banking industry. To understand this technology, this research is to analyze technology functions with the model and anatomy of Blockchain architecture. Many researches for Blockchain technology are carried out consensus algorithms and four of them are discussed on this paper. How banking industry deal with this platform with advantages and limitations are mainly discussed in this paper.

Keywords—Blockchain; FinTech; Decentralization; Bitcoin; Banking industry; Cryptocurrency; P2P; Consensus;

I. INTRODUCTION

Today, banks are continuously exploring new ways to do transactions quicker for enhanced customer services by assuring transparency to customers and regulators while ensuring cost efficiency[5]. Blockchain is an essential technology with promising application scenarios in banking industry nowadays. It can transform banking industry and make process more democratic, transparent secure and efficient. Blockchain is a technology that combine several technologies like distributed data storage, consensus mechanism, point-to-point transmission and encryption algorithms. A Blockchain act as decentralized ledger that keeps track of transactions between two parties effectively. Although these parties have simultaneous access to update digital ledger constant and system virtually impossible to hack.

Blockchain will influence for end of money via bitcoin and other cryptocurrencies in Banking industry. More than 90 central banks involved in Blockchain globally and 80% of banks predicted to initiate Blockchain with distributed ledger technology[1]. So most of the banks on its way to establish blockchain use cases to create huge revolution in banking sector by giving signals of end of traditional banking.

This paper outlined as follows. Section I gives an introduction about how blockchain going to revolutionize the banking industry. Section II explain Blockchain architecture, model of Blockchain, how Blockchain works with consensus algorithm. Section III discusses performance and use cases in banking industry. Section IV discuss how impact of blockchain on FinTech and Cryptocurrency. Section V provides details about

limitations and future improvements of Blockchain System. Section VI provide a discussion on what are the challenges we have to faced when Blockchain adopt in Sri Lanka and what are the solutions to overcome that challenges. Section VII gives conclusion about this article, Blockchain revolution in banking industry.

II. BLOCKCHAIN ARCHITECTURE

A. Model of Blockchain

A blockchain is a digital, decentralized, immutable and distributed ledger that record transactions near real time. Blockchain is as a kind of ledger or spreadsheet, which power a peer-to-peer (P2P) network to validate and verify each transactions[1]. This blockchain system consist N number of nodes which are interconnected together on a commonly accepted protocol, thereby creating a continuous mechanism of control regarding errors, manipulation and data quality. This maintains continuously growing list of records called 'Blocks'.

Blocks in a blockchain can identified with the help of hash in the block header which is generated with the help of SHA256 algorithm (bitcoin)[3]. This hash function is developed using a mathematical algorithm that maps arbitrary size data into 32 byte string[2]. These blocks are data structures which helps to bring transactions to be included in the public ledger. The header of the block consists index, Hash, previous hash, timestamp and nonce. Complete summary of transactions stored as array in the body of the block. Figure 1 illustrate how hash value and previous block hash value link to each other.

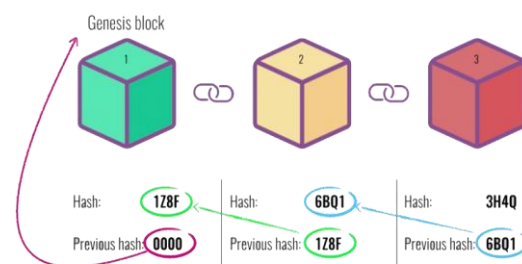


Figure 1: How hash value and previous block hash value link to each blocks in blockchain.

The first block of a blockchain is called as genesis block and it contains its transactions with a unique hash value. This hash and the all new transaction data are used in the next block in the chain. That means each block links to previous block through its hash. In this ways transactions can be added safely. They are secured from tampering and revision. Each block contains a timestamp and linked to the previous block by using secure Hash Algorithm [3]. So if someone change the data of a block, its hash value also changed. Then it's effected for the next block because it contains the hash of previous value. Therefore any one cannot change transaction data of block. The main advantage is that Blockchain uses cryptography, which allows users to modify the transactions on a secured network. If majority of nodes or participants agree that the transaction performed looks valid transaction information which matched with the blockchain's transaction history, then new block will be added to the chain. These configurations are divided depend on the type and the size of the network and the use case.

B. Classification of Blockchain system.

There are three types of Blockchain systems. They are as follows:

1) Public Blockchain

This provides an open platform for people from various financial organizations like banks and backgrounds to join, transact and mine by decentralized consensus mechanisms. There are no restrictions. So they are called as 'Permission less' blockchains[2]. Blockchain is specific to the user without specific validator nodes. All the participants have power to write and read transactions, and perform auditing and view transactions of the blockchain.

2) Private Blockchain

These systems facilitate exchange of data and private sharing and among a group of individuals or selected people or multiple organizations controlled by selective individuals or one organization. These blockchain systems are called as permissioned Blockchain.[2] Therefore unauthorized access can't do, without any special permission. Each and every node maintaining a copy of the ledger to reach a consensus, but unlike public blockchain the writes are restricted.

3) Consortium Blockchain

This blockchain system can be considered as partially private and permissioned blockchain, not a single organization or person but a set of pre-determined nodes are[2] responsible for consensus and block validation. Nodes decide who can join the network and mine data. . This is not a fully centralized system, but it has the ability to control some selected validator participants or peers. There are some limited ability to read and write transactions. These nodes does not guarantee immutability and irreversibility.

C. How blockchain works

Figure 2 explains how a blockchain works in a transaction below:

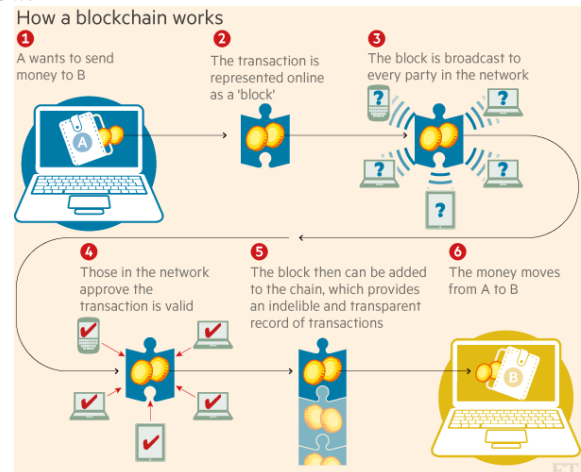


Figure 2: How a Blockchain works [1]

1. A node of the network start a transaction by creating and then digitally sign with its private key.
2. The transaction is represented as a block.
3. The block is broadcast to the every participants in the P2P network.
4. The transaction is propagated by using Gossip protocol, to participants to validate the transaction based on data and history of transaction. More than 50% of nodes are required to verify the transaction[6].
5. When the transaction is verified and validated block can be added to the blockchain.
6. Newly created block now becomes a part of the ledger and money (cryptography like bitcoin) moves to the other party.

D. Anatomy of a Blockchain Transaction

Below diagram shows how a transaction between two parties occurs algorithmically through distributed ledger technology.

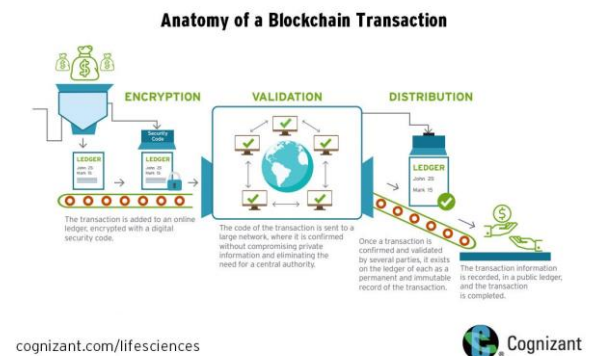


Figure 3: Anatomy of a blockchain Transaction [1]

4) Practical Byzantine Fault Tolerance (PBFT)

This algorithm was proposed as a solution of Byzantine Generals problem. This algorithm can apply only for public blockchain system or the permissioned systems. The purpose of this algorithm is to eliminate failures by influencing malicious participants by manipulating messages from special participants in the network. PBFT was designed for asynchronous systems [24]. All participants (node) have the ability to communicate each other and create an agreement using majority [10]. Messages which are sent from the specific node should verify by the participant that they are not modified during the transaction period. Below diagram simply shows how Practical Byzantine Fault Tolerance Algorithm count messages.

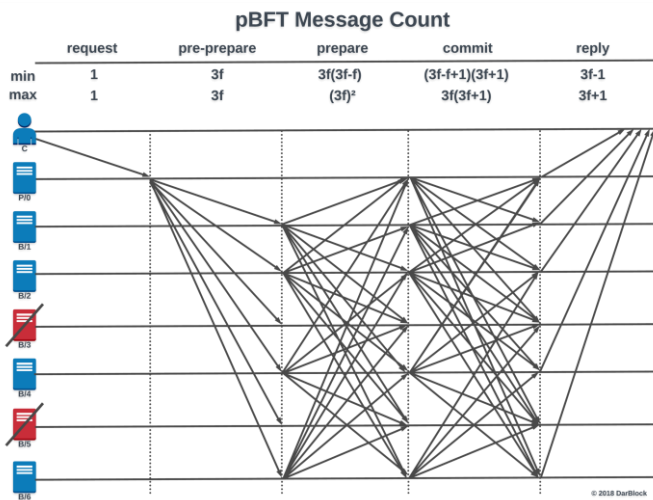


Figure 5: How pBFT message count

III. PERFORMANCE AND USE CASES IN BANKING INDUSTRY

Today Banking industry faced with issues like rising cost of operations, fraudulent attacks on centralized servers and ensuring transparency of the transactions. Most of the banking transactions depend on manual processing and documentation, involve with intermediaries and time consuming. Blockchain provides solutions for banks as it helps to eliminate intermediaries' transactions and facilitates real-time cryptography transactions. So most of the banks adopted this technology and increased their profit. Following evaluation factors uncovers a pain point in the current state process, which could be resolved by a feature of the Blockchain solution. Impact of block chain technology summarized as below:

Table 1: Impact of the Blockchain technology

Features	Assessment Framework	Impact of Blockchain Fit
Intermediary	<ul style="list-style-type: none"> High fees for intermediary? Latency due to processing through intermediary? Does the intermediary exist due to lack of trust? 	Blockchain's distributed ledger technology facilitates disintermediation, thereby reducing costs and lowering latency.
Transparency	<ul style="list-style-type: none"> Are multiple participants involved? Does increase in transparency into the transaction help the participants 	The hash/ pointers of the records written on the Blockchain are immutable and irreversible, not allowing modifications and eliminating risk of fraud.
Information Storage	<ul style="list-style-type: none"> Is the same information being stored in multiple locations? Is data consistency an issue? 	Blockchain's distributed ledger and consensus mechanism allows data consistency across multiple participants
Manual Processing	<ul style="list-style-type: none"> Does the process involve manual operations? Is the cost of Reconciliation high? 	Blockchain maintains automated audit trail of transactions, thereby reducing manual processing for data validations and reconciliations
Trust	<ul style="list-style-type: none"> Is there trust among participants? Do multiple participants have the right to modify transactions? Is there a risk of fraudulent transactions? 	Smart contracts allow codification of business rules, validations and reconciliation, thereby reducing manual processing.
Documentation	<ul style="list-style-type: none"> Is the documentation paper-based? Is there a large number of documents / reports required to be generated? 	Smart contracts allow business validations and automated reconciliation for straight through processing.
Time Sensitivity	<ul style="list-style-type: none"> Will the transactions benefit from being real-time or synchronous? 	Blockchain enables the near real-time settlement of recorded transactions, reducing risk and providing an enhanced customer experience.

A. Blockchain Transformation of Banking services

Blockchain technology promises huge opportunity to recover the challenges in banking industry. There are several use cases with advantages and limitations with blockchain technology.

1. Payments : These are the important usecase of any financial and banking systems. Both commercial and central banks are going to use this blockchain technology for payment process. These are important for cross boarder payments, without third party payments can be done very quick. Some problems related to the cryptocurrency exchange to the local money can be happened because of changes in exchange rates[6].
2. Digital verification: This can be done by removing all traditional verification systems like identity, face checking and proof of client intension by using blockchain. Blockchain provides ways to choose user can identify them and others who like to share their identity without repeating registration for each banking services. Because of the shared ledger system, any participant can access information without permission. Therefore private information should not added to the blockchain.
3. Lending: Traditional banks provide different kind of loans. But it take long time process. Blockchain can use for this lending systems with superfast transactions with transparent way. Banks are provide loans, KYC (Know Your Customer) and BSA (Bank Secrecy Act) and link all of them to a single consumer block[1]. This system helps to save money and time for waiting the traditional long process.
4. Bookkeeping, Accounting and Auditing: Most of the traditional banks still depend on paperwork like double entry transactions and after a long process they are digitalized the details slowly. Banks can directly enter their transaction details into the shared ledger system [7]. All the records are transparent and irreversible when using blockchain. This system has a feature of smart contracts which can pay invoices automatically. People who work in banks should have prior knowledge about blockchain is a considerable limitation.
5. Crowdfunding: This is an online raise funding mechanism by involving large number of people with small amount of money. Initial Coin Offerings (ICOs) have the ability to sell their tokens via internet, with the decentralization advantage by using blockchain technology. This have a risk because of the legal issues in ICOs.

6. Smart contracts: Smart contracts are set of code which stored in Blockchain. These programs execute automatically when conditions are met. They are perform cryptographic transactions, transparency without intermediaries because of the decentralized ledger in blockchain.
7. KYC (Know Your Customer): Traditional KYC process use lot of time to perform individually in all banks and other financial institutions. Using Blockchain, independent verification of each customer of one bank can be accessible for other banks[6]. This process helps to eliminate duplication, reduction of administrative effort and save time.

Table 2: Summary of functions (use cases) with the impact of the blockchain

Function	Blockchain impact	Stakeholders
Authenticating Identity and Value	Verifiable and robust identities, cryptographically assured	Retail banking, payment card networks, regulators
Moving Value – make a payment, transfer money, and purchase goods and services	Transfer of value in very large and very small increments without intermediary will dramatically reduce cost and speed up the payment	Retail banking, Wholesale banking, Money transfer services, payment card networks
Storing Value – commodities, currencies and financial assets are stores of value etc.	Payment mechanism with a reliable and safe store of value reduces needs for financial services; ban savings and checking accounts will become obsolete	Retail banking, investment banking
Lending value – credit card debt, municipal bonds, corporate bonds, government bonds, mortgages, asset backed securities,	Debt can be traded, issued, and settled on the blockchain; reduces friction, increases efficiency, improves systemic errors. Customers can use reputation to access loans	retail banking
Exchanging Value	Increasing speed dramatically	All the banks
Investing and Funding	New models	Investment banking
Management Risk	Lowering risk	Wholesale bank

B. Trade finance platforms in Blockchain

Blockchain is widely expand in Europe, America and China banking industry. We.Trade was the first blockchain based transaction and now there are many transaction platforms like One Pay, Batavia, Marco Polo, Voltron, BBVA and Indra.

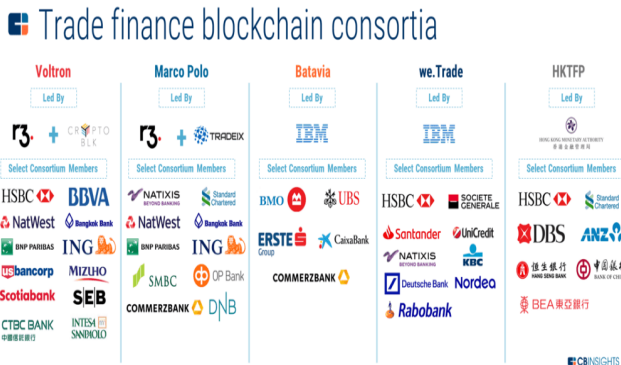


Figure 6: Trade Finance platforms in Blockchain

1. We.Trade: This was established in 2017 with nine banks including Deutsche Bank, KBC, Nordea, HSBC, Robobank, Natixis, UnitCredit and Societe Generale[12]. Purpose of this platform is to do strong cross border transactions. This is realtime unique, smart contract based platform which provides Know Your Customer interface.
2. Batavia: This was developed by 5 banks including Commerzbank, UBS, CaixaBank, BankofMontreal with the use of Blockchain technology[12]. This provides securable transactions within small time period. Therefore Batavia eliminate invoice payments and saved the time by using decentralized shared ledger.
3. BBVA and Indra: This was the very first platform which corporate loans. All the transactions have transparency with the combination of private and public blockchain. So they have the ability to trace transaction details.
4. One Pay: This allows to do international transactions real time with different currencies. Customer can check whether they will receive the exact amount before the transaction. These transactions fast and cost friendly.
5. Voltron: This is a finance trade platform based on blockchain to exchange credit. Voltron is an open platform, anyone can join easily and exchange documents to the network. This platform enables financial industries and banks to give low cost faster services to the customers.

A. Financial Technology (FinTech)

FinTech describe large variety of emerging technologies and innovative business models to transform financial services in an efficient way. Nowadays FinTech become an integral part of Banking and it started to compete with non-financial institutes which provide services to consumers. Rapid increase of FinTech changed the business model of banking by providing innovative solutions. FinTech banks attract their customers by providing financial services more efficient, transparent, user friendly and automated than traditional banks. Today FinTech includes Blockchain and cryptocurrencies, Artificial Intelligence, Machine learning, Digital advisory and training system, Mobile payment systems and Crowd funding[16]. Among them this research will discuss impact of Blockchain and Cryptocurrencies on FinTech. It is hard to quantify the growth and the size of FinTech in banking industry. As a result of the growth of FinTech, it is a new wave of digital banking startups.

a) Benefits of FinTech in Banking

There are many opportunities related to FinTech in banking Industry.

1. Offer better banking services- FinTech banks provide financial services in cost effective and flexible way.
2. Greater Access to Capital- FinTech appears in Peer-to Peer network by providing credits to users who cannot get bank loans.
3. Cost Advantage- This provide transactions and services in lower cost and fast. FinTech helps to cutoff costs like cross-border transfers and make fast payment methods.
4. Helps to increase financial stability.
5. Enhancement in Security-most of the banks use Blockchain to enhance their transaction security through the hash encryption and linkages between blocks[16]. FinTech helps to prevent these risks and information leakage.

b) Threats of FinTech in Banking

There are many variety of risks that can influenced in various sectors as both strategic and tactical ways.

1. Competition on market share- existing banks loss their market share and profit margin.
2. High operational risk- use of FinTech for banking industry increase the complexity of the systems and limited expertise and experience in managing risks.
3. Cyber risks- cloud computing, AI and other technologies facilitated to increase interconnectivity potentially make more vulnerable to cyber-attacks [16].
4. Risk of fraud or malpractice
5. Compliance risk regard to data privacy.

B. Blockchain on Cryptocurrencies

There are over one thousand cryptocurrencies in the world among them Bitcoin is the best cryptocurrency which blockchain technology invented. Cryptocurrency has been influence for people, busines and organizations. Blockchain technology is the backbone of crypto invention. Cryptocurrency is a digital medium of exchange, create and store electronically in the Blockchain. Encryption techniques are used to control monetary units and to verify the transfer of funds in cryptocurrency [15]. Blocks in the Blockchain which encrypted information stored in a ledger, on steroids are linked using cryptography. Blockchain technology has decentralized network which are interconnected nodes/participants which are not rely on central server, and they are based on P2P system.

Crypto is the first application of Blockchain technology [17]. Mathematical concepts and consensus algorithms are combined with features of blockchain which create platform to regulate and transfer ownership can be identified without central authority or third party [17]. Bitcoin and Ethereum networks are based on Blockchain. Bitcoin revolutionized electronic currencies because of its simple characteristic, anyone cannot change values without fulfilling conditions. There is a specific mechanism to rule these crypto. When transaction approved, it cannot changed/deleted and it becomes immutable record in blockchain. Ethereum is one of the cryptocurrency which used to Smart Contracts in Blockchain technology.

Figure 7 shows that how Blockchain and Bitcoin deals with investments from 2012-2016.

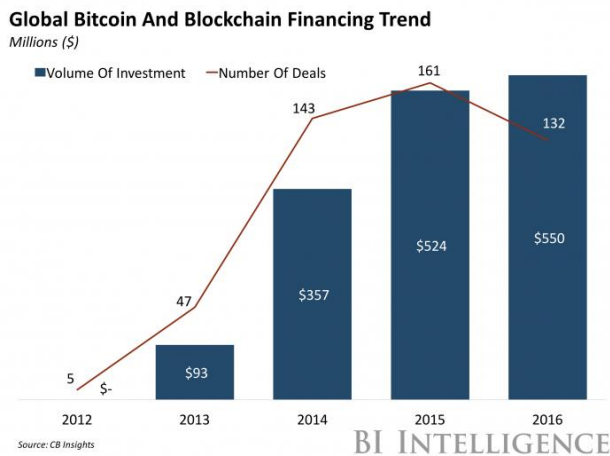


Figure 7: Relationship between number of deals and volume of interests using Blockchain and Bitcoin

V. LIMITATIONS AND FUTURE IMPROVEMENTS

In the above sections we discussed about blockchain architecture, how blockchain works, what are the algorithms we used, how we used blockchain for banking industry and how blockchain impact for the banking revolution. Blockchain

applications offer solutions for that require significant changes or complete replacement of existing systems in banking industry [11]. Despite its benefits and capabilities, the blockchain have some limitations too.

A. Limitations of blockchain technology

1. High initial cost: Blockchain save transaction cost and time but it need high initial capital cost.
2. Complexity: This technology involves with entirely new vocabulary. Participants should have specialized knowledge about the technology.
3. Network size: Blockchain requires a large network of participants. If it is not widely distributed grid of network, it becomes more difficult to achieve the benefits.
4. Transaction cost: Transaction cost of first few years is free. But after that it rising transaction cost in the network.
5. Limited scalability and storage issues: Blockchain have consensus mechanism to verify the transactions. This limits the number of transactions that can be made in a given time period. Blockchain has an immutable distributed chain of blocks grows at a very rapid space, then this can course for storage issues.
6. Unavoidable security flaw: If more than half of participant nodes to service the network a lie, it will become a truth.
7. Energy and resource consumption: A blockchain network consume heavy resources. When blockchain network grows, miners need to validate the blocks also get increased. So it increased heavy energy consumption.

B. Future improvements of blockchain technology

1. Blockchain and bitcoin are really hard to those who are not worked with technology and software development. So one of the future improvement is build tools to make the transactions easier.
2. Storing data in the Blockchain is quite expensive so make a solution for store the data off the chain and send them to the blockchain periodically.
3. Make laws for adopt blockchain technology for the industry is necessary for revolution of banking industry.
4. Blockchain will hope to reduce their prices and improve their quality of services with new features in near future.

VI. DISCUSSION

Today, Sri Lanka warmly welcome Blockchain technology because of its massive collection of benefits. Central Bank of Sri Lanka have appointed two committees to research about potential suitability and practicality of blockchain and FinTech in Sri Lanka in 2017. ICTA also recommend that blockchain is a disruptive technology which provide security of data.

Therefore Sri Lankan government should seriously concern about this technology and make rules and regulations for adopt them. Most of the countries have experimenting this but unfortunately still Sri Lanka taken 'wait and watch' approach. Sampath Bank announced that they become the first bank to introduce and develop blockchain based banking solutions in Sri Lanka. HSBC bank also announced that they successfully executed first scalable trade finance transaction using blockchain.

To adopt Blockchain in banking in srilanka, first bankers should have prior knowledge about what is blockchain? ; What are the advantages of blockchain among traditional banking transactions? And how blockchain can adopt to their banks. Therefore now, there are some courses beginning related to blockchain technology to teach about these things. Most of the IT companies and Banks combine together and doing meetups and discussions about this technology to adopt it in Sri Lanka.

A. Challenges occur to adopt Blockchain in Sri Lanka

Most of the protagonists think that blockchain revolutionized financial sector not only banking sector but also in other sectors like healthcare, trade, law etc. However every new technology takes long time to solve all challenges and use it as a powerful technology in world. There are some more challenges which occur when Blockchain adopt in Sri Lanka.

1. Financial Regulations: There are no any specific regulations or rules when it comes to the blockchain. Then no one has sure that they will be safe in using blockchain transactions. Therefore Government and other responsible sectors need to create rule related to blockchain. There are no enough rules for banks to adopt blockchain for their digital transactions.
2. Consumer Protection: There are no customer protection systems in Sri Lanka to motivate customers to use disruptive technologies in their day to day lives. Therefore consumers are not tend to use applications in blockchain.
3. Taxation: There are many issues related to taxation of cryptocurrency in Sri Lanka.

B. Solutions to overcome challenges for adopting blockchain in Sri Lanka

Government, Central Bank of Sri Lanka and other responsible parties should create the foundation of adopting disruptive technologies like Blockchain which is the next best revolution after the internet. Therefore they should do researches related to blockchain and provide facilities to do research for banking sector to gain the technological knowledge. As an example conduct trainings, meetups about the upcoming technologies and their advantages using experts for each and every banks. Government should give freedom to do experiments using new technologies but responsible parties should track their improvements and performance time to time. Knowledge and training is not enough to adopt a new technology. Government should established rules and regulations to protect customers

and financial institutes as well. Because both of them must have confidence to use and involve with new technologies. Government should establish financial regulatory systems to control blockchain based applications. Responsible authorities need regulators to govern abuse practices and legal prohibitions in applications based on blockchain. Still Sri Lanka does not have regulation and taxation system to overcome taxation of cryptocurrency. Therefore government should establish good taxation system, laws and acts to adopt Blockchain technology in Sri Lanka.

C. Comparison between consensus algorithms with banking services.

Below diagram shows a comparison between main four consensus algorithms.

Table 3 : Comparison between consensus algorithms

Consensus Algorithm	Security	Network Scale	Resource Consumption	Transition Time	Decentralization
PoW	High	Large	High	Long	Little High
PoS	Little High	Large	Medium	Medium	Little High
DPoS	General	Large	Low	Short	Low
PBFT	General	Small	Low	Short	Low

When we discussed about blockchain revolution in banking industry, we used blockchain for many banking services. In this section I am going to emphasize which consensus algorithms are more suitable for each banking services.

- Banks use blockchain for their payments specially cross-border payments. Cross border payments are faster and less expensive and need decentralized ledger without intermediaries. Therefore PBFT is the best consensus algorithms because PBFT requires low energy cost and decentralized ledger with low transaction time. POW, POS takes more transaction time than PBFT.
- Online transactions are impossible without identity verification. Blockchain create it possible securely reuse identity verification. In this case we need consensus algorithm which provide more secure than others. Therefore POW is best for providing more secure with digital identity.
- Banks use blockchain for syndicated lending, with more transparent. This helps to save cost and time by reducing regulatory meetups. PBFT is more relevant algorithm for syndicated lending. It requires small

network scale, decentralized ledger with good transparent features. POW and POS can also use.

- Blockchain technology used for crowdfunding in banking industry. Crowdfunding involves raise funds by ask large number of people for a small amount of money. Crowdfunding requires decentralization of funding and more transparent. POW, POS and DPoS are more suitable for crowdfunding because of their features.
- Banks used blockchain to smart contracts. These are perform cryptographic transactions, transparency without intermediaries because of the decentralized ledger in blockchain. If the cryptocurrency is Bitcoin for smart contracts most of the time we use POW. If the cryptocurrency is Ethereum for smart contracts most of the time we use POS because of their features.
- An Ethereum blockchain uses POW algorithm for KYC in banking industry. POW helps to independent verification of each customer of one bank, help to eliminate duplication and save time rather than other algorithms.

VII. CONCLUSION

Blockchain is decentralized digital ledger which cannot achieve hacker's objectives. Therefore Security wise, it is very important technology to adopt in Sri Lankan Financial industries like banks. This also helps to enhance the efficiency of the banking industry. There are lot of opportunities with Blockchain technology with immeasurable values. This provides a unique way to establish cryptography transactions, by enabling simplification of money in the world. Giants in the banking industry started to search possible new use cases to expand their services by using Blockchain. This technology revolutionize the underlying sectors in credit information systems, payment clearing, lending systems, digital verification, audit keeping systems, crowdfunding, smart contract and KYC in banking. PBFT is the best consensus algorithm for payments and transactions. Banks used POW for digital verification because it is the best algorithm which provide better security. PBFT or BFT mostly used for syndicated lending in banking industry. Both PoW, Pos and DPoS are used for crowdfunding in banking sector. Based on the type of cryptocurrency algorithms will changed in smart contracts. If the cryptocurrency is Bitcoin for smart contracts most of the time we use POW. If the cryptocurrency is Ethereum for smart contracts most of the time we use POS. Most of the banks used PoW for KYC. Prospect of this technology into the banking industry will occur in the near future.

When using Blockchain, there are some challenges occur in. To solve these challenges we should provide facilities to reduce initial cost to adopt blockchain in banking sector. System usage complexity is high. Therefore developers should reduce complexity and give prior knowledge for the users. Then we can minimize adoption and usage problems related to

blockchain technology. Blockchain should develop for small scale networks as well in future. According to the consensus algorithm power consumption can be changed. Therefore we should select best algorithm for relevant banking service. Developers should reduce unwanted security flows and make simpler to use.

This paper gives a comprehensive review of blockchain revolution in banking industry. Blockchain is the next best invention after the internet. Therefore my opinion is blockchain is a great disruptive technology which revolutionized banking sector better way in near future.

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REFERENCES

- [1] "(PDF) Applications of Blockchain Technology in Banking & Finance." Available: https://www.researchgate.net/publication/327230927_Applications_of_Blockchain_Technology_in_Banking_Finance. [Accessed: 03-Mar-2019].
- [2] D. Puthal, N. Malik, S. P. Mohanty, E. Kougianos, and G. Das, "Everything You Wanted to Know About the Blockchain: Its Promise, Components, Processes, and Problems," *IEEE Consum. Electron. Mag.*, vol. 7, no. 4, pp. 6–14, Jul. 2018. [Accessed: 13-Mar-2019]
- [3] "(PDF) Impact of Blockchain Technology Platform in Changing the Financial Sector and Other Industries," *ResearchGate*. Available: https://www.researchgate.net/publication/324158510_Impact_of_Blockchain_Technology_Platform_in_Changing_the_Financial_Sector_and_Other_Industries. [Accessed: 15-Mar-2019].
- [4] "(PDF) Blockchain application and outlook in the banking industry," *ResearchGate*. [Online]. Available: https://www.researchgate.net/publication/311549710_Blockchain_application_and_outlook_in_the_banking_industry. [Accessed: 24-Mar-2019].
- [5] "(PDF) An Overview of Blockchain Technology: Architecture, Consensus, and Future Trends." Available: https://www.researchgate.net/publication/318131748_An_Overview_of_Blockchain_Technology_Architecture_Consensus_and_Future_Trends. [Accessed: 07-apr-2019].
- [6] "Blockchain-in-Banking-Finance.pdf." [Accessed: 07-Apr-2019].

- [7] "banking-on-blockchain.pdf." [Accessed: 12-Apr-2019].
- [8] J. Oh and I. Shong, "A case study on business model innovations using Blockchain: focusing on financial institutions," *Asia Pac. J. Innov. Entrep.*, vol. 11, no. 3, pp. 335–344, Dec. 2017. [Accessed: 03-Mar-2019]
- [9] A. Tandulwadikar and C. T. Solutions, "Blockchain in Banking: A Measured Approach," p. 10. [Accessed: 26-Apr-2019]
- [10] N. Hassan, "Blockchain banking system," p. 3, 2018. [Accessed: 02-May-2019]
- [11] S. Dhar and I. Bose, "Smarter banking: Blockchain technology in the Indian banking system," p. 5.
- [12] F. G. Rega, N. Riccardi, J. Li, and F. D. Carlo, "Blockchain in the banking industry: an Overview," *Unpublished*, 2018. [Accessed: 03-Mar-2019]
- [13] "Blockchain_Distributed_Ledger_Technology.pdf." [Accessed: 11-May-2019].
- [14] O. Shy, "Cashless Stores and Cash Users," *Fed. Reserve Bank Atlanta Work. Pap.*, 2019. [Accessed: 11-May-2019]
- [15] D. R. Houben and A. Snyers, "Cryptocurrencies and blockchain," p. 103. [Accessed: 16-May-2019]
- [16] D. Varga, "Fintech, the new era of financial services," *Vesztud. Bp. Manag. Rev.*, vol. 48, no. 11, pp. 22–32, Nov. 2017. [Accessed: 21-May-2019]
- [17] J. Pawluk, "Blockchain and Cryptocurrency," p. 45. [Accessed: 28-May-2019]
- [18] N. K. Ls, "Blockchian: 3rd Generation Internet," p. 5. [Accessed: 01-jun-2019]
- [19] W. A. Wijewardena, "Banking Sector, Disruptive Technology and the Blockchain." [Accessed: 03-Jun-2019]
- [21] F. DCosta, "Blockchain for Digital Transformation in Banking." [Accessed: 10-Jun-2019]
- [22] J. of C. S. Ijcsis, "Privacy Protection Issues in Blockchain Technology," *IJCSIS Vol 17 No 2*. [Accessed: 12-Jun-2019]
- [23] A. Mocambique, "Blockchain: Background and Policy Issues." [Accessed: 29-Jun-2019]
- [24] C. Gong, "An Overview of Blockchain Technology: Architecture, Consensus, and Future Trends." [Accessed: 04-Jul-2019]
- [25] C. Holotescu, "UNDERSTANDING BLOCKCHAIN TECHNOLOGY AND HOW TO GET INVOLVED." [Accessed: 05-Jul-2019]