A Review On Block-Chain Technology And Its Applications In Different Area

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Abstract:- Blockchain's underlying technology, block-chain, has recently drawn a lot of attention. Block-chain functions as a static ledger that allows transactions to be carried out over a wide region. A distributed site known as blockchain is shared by computer network nodes. Blockchain functions as a database that electronically saves data in a digital manner. What makes blockchains most well-known is the vital role they play in cryptocurrency systems like Bitcoin by preserving a safe and independent record of transactions. Over the next several decades, blockchain technology will have a tremendous impact and the ability to fundamentally alter the corporate environment. It may change how we view how businesses operate and how our economy functions. Blockchain is a widely used distributed ledger technology that aims to provide data security, integrity, and transparency by making it difficult for data to be stolen or changed. A significant portion of current blockchain technology research is concentrated on how it may be applied to digital currencies like bitcoin and a few others. Only one of the research's goals is to investigate how blockchain technology is used in various environments or regions. Blockchain technology has applications in finance, government, and a number of other sectors in addition to cryptocurrency. Accounting, business process management, and banking Therefore, the goal of this research is to assess and investigate the opportunities for current and potential blockchain technology applications.

Keywords: Block chain, Block chain Technology, Ledger, Applications, Business, Cryptocurrencies, Bitcoin, economy, Distributed, Cryptocurrency, Banking System, Healthcare, Voting System, Real Estate, BTC.

Introduction :- In a white paper for BTC, Satoshi Nakamoto, the pseudonymous creator of Bitcoin, described the blockchain as we know it at the same time that it was being debated in computer science circles. Thus, the Bitcoin network served as the foundation for blockchain technology. Although blockchain is today utilised in many different industries, it was first created to advance the goals of this particular digital currency as well as those of all other digital currencies. Although Bitcoins and other cryptocurrencies

were the first Blockchain applications to gain widespread adoption, they are not the only ones [4]. Due to the nature of blockchain technology, organisations, sectors, and businesspeople from across the world have been investigating its potential to bring about revolutionary changes in a variety of industries.

Introduction of Blockchain:

Blockchain is a system for storing data that makes it challenging or tough to alter, hack, or defraud the system. It is a distributed data collection that is split up among the PC organization's hubs. A blockchain saves data electronically and in a sophisticated form as knowledge set [3]. Blockchains are most well-known for their important role in preserving a secure and decentralised record of trades in digital currencies like Bitcoin. A blockchain's primary requirement is to organise data transactions in a reliable manner. However, how people utilise blockchain and delivered record technology varies according on the situation.

For instance, if we discuss Bitcoin, we can see how blockchain was portrayed in the standard. Bitcoin is a sophisticated kind of digital currency that is implemented using blockchain and DLT developments [8]. A public organisation, this type of blockchain network has existed since individuals from everywhere the world can turn into a hub; check other hub and exchange Bitcoins.

Then again, let us guess that a bank is utilizing a private blockchain network. It will be a confined organization where just the approved individuals from the bank can get to private data. Along these lines, nobody out of this shut organization can get to bank information. A private organization will have restricted and approved hubs checked by an organization manager. The data sent through such a private blockchain network stays inside the organization [5]. Any new hub that desires to get included a private organization needs consent from the organization administrator.

Kinds of Blockchains:-

Private and public blockchains are the two main categories of blockchains. In any case, there are a few variations, including blockchains that are comparable to Consortium and Half breed. Let's first recognise the similarities across the various blockchain types before delving into their specifics. Each blockchain consists of a collection of hubs that collaborate on a common (P2P) network architecture [11]. Every hub inside an organisation has a copy of the common record, which is constantly updated. Each hub has the ability to create blocks, start or get exchanges, and check exchanges.

1. Public Blockchain:-

A public blockchain is a non-prohibitive, authorization less circulated record framework. Any individual who web-based methods can join up on a blockchain platform to become an authorised hub and a part of the blockchain network. It is permitted for a hub or client, which is a component of the public blockchain, to access recent and old data, confirm

trades, complete evidence of work for upcoming squares, and engage in mining. The mining and trading of virtual currencies is the most crucial use of public blockchains [9]. Accordingly, Bitcoin and Litecoin blockchains are the most well-known public blockchains. Public blockchains are generally secure provided that users adhere strictly to security policies and procedures. Even yet, it is dangerous when the members don't actually adhere to the security protocols.

Model: Bitcoin, Ethereum, Litecoin

2. Private Blockchain:-

A private blockchain is a restricted or authorised blockchain that may only be used within a closed organisation. When a blockchain network only has a select group of people as members, private blockchains are often used [10]. The level of security, authorizations, and transparency is in the having control of the dominant group. Private blockchains are therefore similar to being used as a public blockchain but have a small and expensive organisation. Voting, store network executives, enhanced character, resource ownership, and other uses are communicated using private blockchain networks.

The Multichain and Hyperledger projects (Texture, Sawtooth), Corda, and other examples of private blockchains

3. Consortium Blockchain:-

A consortium blockchain is a semi-decentralized sort where more than one association deals with a blockchain network. This is in opposition to what we found in a private blockchain, which is overseen by just a solitary association. Beyond what one association can go about as a hub in this kind of blockchain and trade data or do mining [12]. Consortium blockchains are ordinarily utilized by banks, government associations, and so forth.

Model: of consortium blockchain are; Energy Web Establishment, R3, and so on.

Possessed	Blockchain(Public)	Blockchain(Private)	Consortium Blockchain
Consensus determination	All of the Miners' Expensive Proof of Work	chosen nodes Only minimal evidence of work	Only One Organization Must Provide Proof of Work
Automation	High	High	High
Transparency	High	Low	Low
Efficiency of Speed	Low	High	High
Centralized	No	Half	Yes

Consensus Process	Permission less	Permissioned	Permissioned
Identity	Anonymous	Known Users	Known Users
Transaction Approval	Order of Minutes	Order of Milliseconds	Order of Milliseconds
Read permission	Public	Public/Restricted	Public/Restricted
Immutability	NO	Tampering(Low)	Tampering(Low)
Efficiency	Low	High	High

TABLE 1: Comparisons between Public Blockchain, Private Blockchain and Consortium Blockchai

Public Blockchain   Consortium Blockchain   Private Block Chain
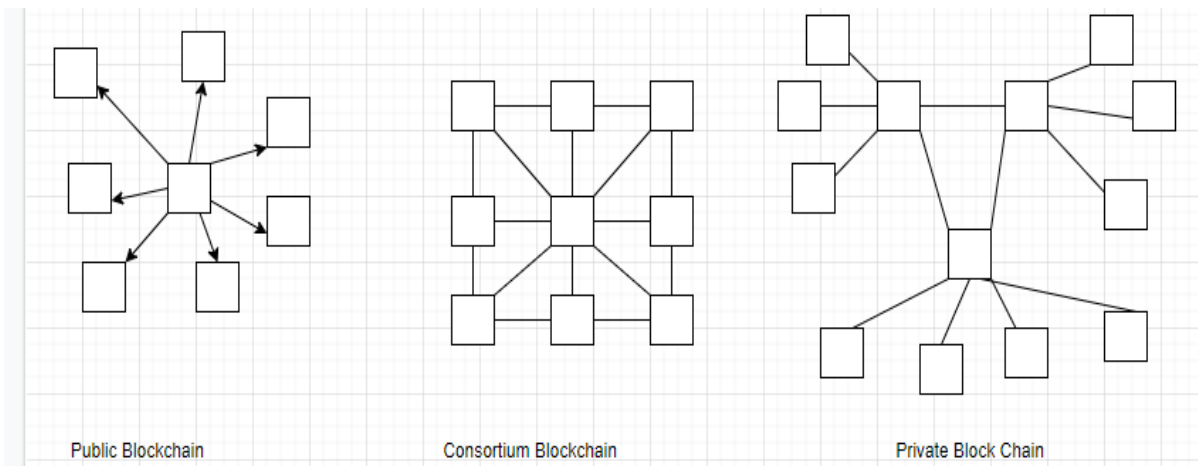
Figure 1: Illustrates the Types of Blockchain Technology

Application areas of Blockchain Technology:

   (i)   **Banking System.**
   (ii)   **Health care**
   (iii)   **Voting System**
   (iv)   **Real Estate.**

(i) Banking System: -

Blockchain Transformation of Banking Systems The great flexibility promised by blockchain technology makes it possible to overcome the challenges facing the banking sector. Blockchain innovation has a few application cases with advantages and restrictions.

1. Installments: These are the crucial applications for any financial and banking systems. This blockchain invention will be used for the instalment procedure by commercial and

national banks alike. These are crucial for cross-guest payments; otherwise, incredibly quick payments should be feasible. Changes in return rates may result in a few complications with the conversion of bitcoin to local currency [6].

2. Computer controlled confirmation:

3. Loans: Traditional banks offer a variety of loans, but they demand an investing cycle. Block chain technology may be used for these lending the money systems to facilitate simple and incredibly quick transfers. The KYC (Know Your Client) and BSA (Bank Secrecy Act) are handed to banks, and each is connected to a single buyer block [1]. This structure helps with budgeting and time management for delaying the normal lengthy discussion.

4. Accounting, Bookkeeping, and Examining:

The majority of conventional banks really rely on back-and-forth section exchanges for administrative labour before increasingly digitising the finer details. Banks can easily submit their exchange details into the public record system [7]. When using blockchain, all of the records are transparent and irrevocable. This structure includes clever agreements that can pay requests for proposals organically. The need that bank employees have prior knowledge of blockchain technology is a significant restriction.

5. Crowd funding: This is an online fundraising component that uses a large number of people with little money to subsidise it. Starting Coin Contributions (ICOs) can use blockchain technology to sell their tokens decentralizedly over the internet. Given the legal concerns with ICOs, there is risk in this.

6. Smart Contacts: Code for smart contracts is stored in the blockchain. When the necessary prerequisites are satisfied, these projects proceed accordingly. Due to the decentralised record on the blockchain, they are conducting easy cryptographic exchanges without the need for delegates.

7. KYC (Know Your Client):

All banks and other financial institutions utilise a portion of their time to execute the standard KYC procedure independently. Blockchain enables independent checks of each client of one bank for other banks [6]. This contact helps eliminate duplication, save administrative effort, and save time.

(ii) Health Care:

By creating a health documents provincial clinical data stage and utilising the most cutting-edge Internet of Things technology, clever medical care recognises the collaboration between patients and clinical staff, clinical organisations, and clinical devices, enabling the clinical business to gradually complete data. In order to improve the clinical framework and focus on the specifics of clinical benefit, sharing clinical

information is an important step [15]. However, patient data exchange between foundations isn't currently commonplace.

fully acknowledged [16], and the blockchain is currently a fantastic way to address this issue. Blockchain, a developing innovation for decentralised and conditional information splitting across sizable organisations of untrusted individuals, is communicated information frameworks containing several free hubs [17]. It features timestamps, aggregate support, programmability, sealing, and decentralisation[18]. The present body of study focuses on fusing blockchain technology with a specific data innovation to create a single application stage, such as utilising blockchain technology to create a clinical exchange sheet confirmation framework or using blockchain to create a clinical data sharing stage. Blockchain clinical medicinal applications are few. MedRec, which merges a blockchain with a tonne of information, creates a robust environment for healthcare data archiving and study by integrating blockchain technology and the OPAL/Enigma encryption platform [19]. However, a thorough examination of blockchain technology's application to all facets of smart clinical research is required.

1. Interior and External Regulation:

interior oversight essentially refers to the continual administration of drugs, equipment, and the manufacturing network by healthcare organisations. The administrative body is the main body, and the outside guidelines include three measures: clinical production network guidelines, clinical whole cycle guidelines, and clinical waste treatment process guidelines. A structure known as the application chain covers the exchange of goods or Customers get services from sources made up of individuals, groups, activities, information, and resources. Its objective is to keep the delicate items' quality intact while in transit. The industry of materials and goods distribution depends on the data frameworks board. Furthermore, pharmaceutical store networking the board is essential for tracing the origin of the components used in assembling, the steps involved in assembly, and the delivery of final items [21]. Frameworks developed by store network executives for exposing stockpile chains to devaluation, deceit, and manipulation have been combined [22]. In the therapeutic environment, where a flawed inventory network has an immediate negative impact on patient outcomes, a healthy store network is particularly important. The blockchain innovation [13] is one possible solution for work on the security, integrity, information sources, and utility of a sound inventory network. Blockchain technology exchanges are safe, simple, and can be continuously verified and recorded in the stock network, thereby reducing the amount of time required and the possibility of human error [23]. Additionally, the security of medical equipment and supplies may be increased through the use of blockchain technology. Blockchain innovation is possible by storing unique device identifiers for each medical device and by tracking and delivering firmware updates using clever agreements. Invariance can be used in blockchain-based clinical device tracking to prevent device loss, theft, and malicious alteration [21].

2. Clinical Record Management:

The board keeps clinical records online. Classical document clinical records contain remarkably sensitive information that must be shared among peers in order to stay up to date on the most recent patient history [25], and electronic health records offer a useful health history file server that synchronises with online electronic access to these records [24]. Current electronic medical records cannot ensure the privacy, security, or accessibility of sensitive information, and patient treatment and conclusion data are still dispersed throughout multiple clinical foundational data sets [24, 25]. As a consequence, people may find it difficult to comprehend information about the many medical therapies that are offered, while clinical foundations frequently maintain the required administration. When exchanging electronic health records via blockchain technology, patients retain control over their electronic clinical record. The secure storage and transfer of healthcare records is ensured by the blockchain's decentralised, self-trusted, and change-safe design, which also dramatically cuts throughput for sharing and other expenses [26]. If they have access to their own medical records, they will also concentrate more on their own medical care [27].

3. Treatment Optimization:

The integration of targeted therapy and telemedicine constitutes treatment streamlining. In many nations, the number of clinical patients has substantially grown, making it more challenging for patients to receive prompt medical attention from doctors or nursing staff [28]. Innovation in telemedicine is viewed as a way to deliver reasonable and equitable clinical treatment [29]. Security issues in the transmission and recording of information exchanges have been brought up by the development and marketing of Internet of Things hardware and other remote persistent observation frameworks. The smart agreement of the blockchain may be applied to improve the security examination and the board of clinical sensors due to the blockchain's skillfully produced, mysterious, and simple features [30].For instance, Medical Chain has sent out a clever contract that patients may use to let doctors to review clinical situations from a distance and provide thoughts or other hypotheses [23]. The data may also be ordered by the foundations for medication-designated innovative work after receiving client clearance and transferred securely using blockchain uneven cryptographic encryption [17] in order to lead drug-designated innovative effort.

4. Specialist Management:

Three factors are included on the board of specialists: client assessment, staff evaluation, and differentiating proof. For data interchange, patient tracking, character validation, and verification, block chain technology takes a wide spectrum of interoperability between doctors, patients, and experts into consideration [31]. Additionally, by working with clinical groups to choose top physicians, the blockchain may be used to track doctors' treatments, obviating clinical issues and supporting patients in making the best medical decisions. Medico Health is one blockchain-based initiative that provides entirely private

and secure patient contact with the top doctors in the world. While data on the validity of doctor endorsements and licences is maintained in a static decentralised data set, a licensed doctor just stores patient records and accesses it secretly at a certain time [23].

5. Clinical Insurance:

The blockchain may provide customers a high level of dependability due to its Practical Byzantine Fault Tolerance and multinode comaintenance features [2]. The fizzyTM Ethereum platform from the French auto insurance company AXA now provides defined flight delay insurance. This platform uses clever agreements connected to the global air traffic data set to securely start paying out once flight delays are identified without the need for additional administrative work. Similar arrangements might be created for health insurance, removing the need to review medical information while greatly enhancing the user interface [27]. Clinical protection using blockchain technology may be made simpler and less expensive [32], while also safeguarding patient rights, reducing emergency clinics' uncollected assets, and cutting costs associated with running insurance companies.

(iii) Voting System:

According to the current social atmosphere, a fair and unambiguous political choice is required for the modern society. The existing democratic system does not allow for an easy vote-counting process. Polling may be dangerous because of things like false voters, misrepresentation in the voting booths, and other things. Along these lines, the need for a false democratic decentralised structure with a weaker base emerged. All of the problems with traditional democratic frameworks may be resolved by the decentralised democratic framework employing blockchain. Due to its decentralised record innovation, blockchain provides unique features. Blockchain is a decentralised system for exchanging information. a setting that allows many viewpoints to coexist while maintaining their independence from one another and working together to coordinate certain dynamic cycles.. Blockchain employs the additional just process. Existing information on the blockchain cannot be removed. Blockchain makes use of established organisational structures. Blockchain is a chain made up of squares that holds all of the client's data using communicated record technology. Ralph Merkle examined the concept of square connectivity using the Merkle tree. A square data encryption hash is written on each hub's label. As a result, a cryptographic label hash of child hubs is added to a non-leaf hub. As all squares are connected, any alteration in the blockchain can be effectively identified. A specific electronic voting system must satisfy the majority of the security requirements in order to conduct a public political vote. They can be classified as lacking a democratic foundation. The clear democratic framework should ensure that the electorate's votes are counted and that a vote's veracity is provided. The democratic system shouldn't allow one person or group to dominate the frameworks. Only eligible individuals are allowed to vote. The optional framework shouldn't be expensive. Depending on the situationthe members should only be granted limited access under the choice framework. The

foregoing requirements are set in stone and will never change as a prerequisite for blockchain innovation in the e-Voting framework.

(iv) Real Estate:

1. Smart agreements: Using "smart contracts" is a second area where Square Chain can have an impact. These are computer programmes that authorise the execution of commercial agreements when specific requirements are satisfied. A lease or utility agreement in which one party pays another party an agreed-upon sum dependent upon certain circumstances would be considered a representation. Similar to how your bank automatically pays your energy bill every month, regardless of how expensive it may be, this section might be automated. Smart agreements would make the certification area more simple and liquid while reducing the contact of doing the commerce.

2. Trust and straightforwardness:

Blockchain can provide a conviction of information that permits a more pronounced degree of conviction and straightforwardness by maintaining a permanent record of property proprietorship, blockage, and transit [13]. Each piece of real estate might have its own electronic address where all matters relating to the property may be handled [2]. By combining financial data, leases, charges, easements, building execution, actual attributes, and the trade history relating to the property, this might possibly eliminate the requirement for an expensive top to bottom title search. A blockchain-based, passed-on record might provide the basis for a more extensive structure across numerous geographic locations when examining a long-standing operation. . This might provide a standard method of record-keeping and a practical, potentially national framework for obtaining and maintaining property information and documents. Computerized characters can aid in converting the existing conversation to an online setting and provide a significant increase in security [14]. Any previous exchange that is verified by the diggers and uploaded to the hub in a distributed organisation may be located in the square chain since blockchain exchanges are non-changing. The decision to proceed at an arbitrary time interval fosters openness and trust between the partners. Additionally, the square chain's hashing process, in which a new hash is put to the created square together with the value of the previous block's hash, creates a strong got structure that makes it very difficult to hack a blockchain. These hashes are generated using various formulas, such as SHA (got hashing calculation).

3. Financing: There is also a fundamental potential advantage to the company region in funding from the Square network. Starting with credit, block chain enables precise record keeping and chronicle documentation. After reserving a development, the structure may be used to track borrower sections, contract consistency, and other development developments. Adroit agreements may therefore be employed to maintain duties and detect defaults, potentially lowering agreement altering costs, in addition to assisting in partnerships, securitization, and revamping. Neighborhood title recorders are now considering how to upgrade their record-keeping systems, which are still based on

nineteenth-century "tech" in various ways. In one scenario, the Cook County Recorder of Deeds collaborated with blockchain startup velox.RE to create a method to impact title trades on the square chain. Sweden, the Republic of Georgia, and India have all expressed interest in incorporating square chain into their vault structures. When states embrace the square chain for record keeping, building on that will be a common development to satisfy all land opinions. Although the potential for blockchain improvement in the business sector is enormous, it may take a significant portion of the day to fully develop the framework (Eden, 2008). Huge efforts are being made to handle fundamental issues such as stage planning, neighbourhood country level determination, managing optimal trade volumes, and data security and limit requirements. As we have seen in numerous parts, unsettling impact through mechanical advancements might arrive much faster than people imagine, and now is an excellent time to focus on future prospective outcomes.

4. Tokenization: Tokenization of fungible assets, acquiring property in the real world and converting it into a token, can make transferring resources more beneficial, faster, and less difficult. Tokenization aids in the digitalization of confirmations, optional sources, and monetary units in the land. With Ethereum blockchain advancement, updated sources may be altered to include ownership liberties, alternative records, and regulations to assure critical resource issuance, dissipation, and exercises.

Furthermore, tokenization lowers costs and increases renting, buying and selling sources, developing new characteristics, monitoring pay, and handling distinctive association demands. All around customisation and short issuances let guarantors to modify overpowering sources as shown by method for money related expert demands, essentially decreasing counter-party risk. Wider commercial opportunities and greater development of liquidity are made possible by increased availability among unrelated associations and sources. These advantages for financial professionals and money-related experts demonstrate the real certainty of square chain in the sector of land. A tokenized asset resembles a Real Estate Investment Trust (REIT) [15]. A tokenized asset has significantly more flexibility and does not incur the expenditures of multiple specialists, which are the major noteworthy distinctions. The level of advantages can be shared in proportion to the tokens after contributing to the property, which is then divided into tokens, according to every investment. This is possible because to shrewd agreements, which may include a clause that causes comparatively falling earnings [15].

Conclusion:

According to a hypothetical viewpoint, based on the writing survey, Blockchain Innovation has high worth and great potential in resolving issues of information respectability, further developing straightforwardness, improving security, preventing misrepresentation, and establishing trust and protection. Blockchain innovation has the potential to revolutionise the fields of money, bookkeeping, e-government, BPM, security, diversion, exchanging stages, medical services, the internet of things, and legal offices,

among others. Thus, Blockchain Innovation has enormous potential in providing inventive arrangements, contingent on the space or area of its execution, because monetary efficiency and social advantages may be achieved through specialised development and applications. Nonetheless, implementing Blockchain Innovation at organisations in many industries might be costly. Moving or relocating inheritance frameworks necessitates a great deal of thought from organisations. Taking on Blockchain Innovation, organisations should communicate a13 joined together stage at this early level to support such crossover application engineering, merging Blockchain and legacy frameworks. As a result, they must broaden their understanding of Blockchain Innovation, its value, opportunities, and risks. As a result, there are just a few instances when the invention has been used with these frameworks. As a result, Blockchain Innovation may not be able to replace inherited frameworks or legacy applications very soon. However, blockchain may undoubtedly be a complementary application to existing frameworks and may possibly spur the creation of new frameworks in the near future. In conclusion, more focused research into this area of blockchain innovation is necessary to advance the growth of this industry because it is still in the exploratory stage and there are many legal and specialist difficulties that need to be resolved. In order to assist professionals and scientists, this audit provides a useful starting point for potential future research topics for the development of Blockchain applications.

References:

[1] "State of blockchain q1 2016: Blockchain funding overtakes bitcoin," 2016. [Online]. Available: http://www.coindesk.com/ state-of-blockchain-q1-2016/
[2] S. Nakamoto, "Bitcoin: A peer-to-peer electronic cash system," 2008. [Online]. Available: https://bitcoin.org/bitcoin.pdf
[3] G. W. Peters, E. Panayi, and A. Chapelle, "Trends in crypto-currencies and blockchain technologies: A monetary theory and regulation perspective," 2015. [Online]. Available: http://dx.doi.org/10.2139/ssrn. 2646618

[4] G. Foroglou and A.-L.Tsilidou, "Further applications of the blockchain," 2015.
[5] A. Kosba, A. Miller, E. Shi, Z. Wen, and C. Papamanthou, "Hawk: The blockchain model of cryptography and privacy-preserving smart contracts," in Proceedings of IEEE Symposium on Security and Privacy (SP), San Jose, CA, USA, 2016, pp. 839–858.
[6] B. W. Akins, J. L. Chapman, and J. M. Gordon, "A whole new world: Income tax considerations of the bitcoin economy," 2013. [Online]. Available: https://ssrn.com/abstract=2394738
[7] Y. Zhang and J. Wen, "An iot electric business model based on the protocol of bitcoin," in Proceedings of 18th International Conference on Intelligence in Next Generation Networks (ICIN), Paris, France, 2015,

pp. 184–191.

[8] M. Sharples and J. Domingue, "The blockchain and kudos: A distributed system for educational record, reputation and reward," in Proceedings of 11th European Conference on Technology Enhanced Learning (EC-TEL 2015), Lyon, France, 2015, pp. 490–496.

[9] C. Noyes, "Bitav: Fast anti-malware by distributed blockchain consensus and feedforward scanning," arXiv preprint arXiv:1601.01405, 2016.

[10] I. Eyal and E. G. Sirer, "Majority is not enough: Bitcoin mining is vulnerable," in Proceedings of International Conference on Financial Cryptography and Data Security, Berlin, Heidelberg, 2014, pp. 436–454.

[11] A. Biryukov, D. Khovratovich, and I. Pustogarov, "Deanonymisation of clients in bitcoin p2p network," in Proceedings of the 2014 ACM SIGSAC Conference on Computer and Communications Security, New York, NY, USA, 2014, pp. 15–29.

[12] F. Tschorsch and B. Scheuermann, "Bitcoin and beyond: A technical survey on decentralized digital currencies," IEEE Communications Surveys Tutorials, vol. 18, no. 3, pp. 2084–2123, 2016.

[13] NRI, "Survey on blockchain technologies and related services," Tech. Rep., 2015. [Online]. Available: http://www.meti.go.jp/english/press/2016/pdf/0531 01f.pdf

[14] D. Lee KuoChuen, Ed., Handbook of Digital Currency, 1st ed. Elsevier, 2015. [Online]. Available: http://EconPapers.repec.org/RePEc:eee:monogr:9780128021170

[15] V. Buterin, "A next-generation smart contract and decentralized application platform," white paper, 2014.

[16] D. Johnson, A. Menezes, and S. Vanstone, "The elliptic curve digital signature algorithm (ecdsa)," International Journal of Information Security, vol. 1, no. 1, pp. 36–63, 2001.

[17] V. Buterin, "On public and private blockchains," 2015.[Online]. Available: https://blog.ethereum.org/2015/08/07/on-public-and-private-blockchains/

[18] "Hyperledger project," 2015. [Online]. Available: https://www.hyperledger.org/

[19] "Consortium chain development." [Online]. Available: https://github.com/ethereum/wiki/wiki/Consortium-Chain-Development

[20] L. Lamport, R. Shostak, and M. Pease, "The byzantine generals problem," ACM Transactions on Programming Languages and Systems (TOPLAS), vol. 4, no. 3, pp. 382–401, 1982.

[21] S. King and S. Nadal, "Ppcoin: Peer-to-peer crypto-currency with proofof-stake," Self-Published Paper, August, vol. 19, 2012.

[22] "Bitshares - your share in the decentralized exchange." [Online]. Available: https://bitshares.org/

[23] D. Schwartz, N. Youngs, and A. Britto, "The ripple protocol consensus algorithm," Ripple Labs Inc White Paper, vol. 5, 2014.

[24] J. Kwon, "Tendermint: Consensus without mining," URL http://tendermint. com/docs/tendermint { } v04. pdf, 2014.

[25] S. King, "Primecoin: Cryptocurrency with prime number proof-ofwork," July 7th, 2013.

[26] P. Vasin, "Blackcoins proof-of-stake protocol v2," 2014. [Online]. Available: https://blackcoin.co/blackcoin-pos-protocol-v2-whitepaper.pdf

[27] G. Wood, "Ethereum: A secure decentralised generalised transaction ledger," Ethereum Project Yellow Paper, 2014.

[28] V. Zamfir, "Introducing casper the friendly ghost," Ethereum Blog URL: https://blog. ethereum. org/2015/08/01/introducing-casperfriendly-ghost, 2015.

[29] C. Miguel and L. Barbara, "Practical byzantine fault tolerance," in Proceedings of the Third Symposium on Operating Systems Design and Implementation, vol. 99, New Orleans, USA, 1999, pp. 173–186.

[30] D. Mazieres, "The stellar consensus protocol: A federated model for internet-level consensus," Stellar Development Foundation, 2015.

[31] "Antshares digital assets for everyone," 2016. [Online]. Available: https://www.antshares.org

[32] M. Vukolic, "The quest for scalable blockchain fabric: Proof-of-work ´ vs. bft replication," in International Workshop on Open Problems in Network Security, Zurich, Switzerland, 2015, pp. 112–125.

[33] C. Decker, J. Seidel, and R. Wattenhofer, "Bitcoin meets strong consistency," in Proceedings of the 17th International Conference on Distributed Computing and Networking (ICDCN). Singapore, Singapore: ACM, 2016, p. 13.

[34] D. Kraft, "Difficulty control for blockchain-based consensus systems," Peer-to-Peer Networking and Applications, vol. 9, no. 2, pp. 397–413, 2016.

[35] Y. Sompolinsky and A. Zohar, "Accelerating bitcoin's transaction processing.fast money grows on trees, not chains." IACR Cryptology ePrint Archive, vol. 2013, no. 881, 2013.