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Far and Few Review on Blockchain Technology and Its Applications

Akoramurthy.B[*1], Dhivya.K [#2], Nandini.S[*3], Mala.B.M[@4], Balaraju.G[*5], Dr. T. Sivakumar[$6]

*Assistant Professor, School of Computing & Information Technology, REVA University, Bangalore.
[#]M. Tech Scholar, Department of Computer Science, Pondicherry University, Pondicherry.
[@]Assistant Professor, School of Computer Science & Engineering, REVA University, Bangalore.
[$]Assistant Professor, Department of Computer Science, Pondicherry University, Pondicherry.
akor.theanchor@gmail.com[*1]
dhivyaakoramurthy@reva.edu.in[#2]
nandinis1801@gmail.com[*3]
bm.malagowda@gmail.com[@4]
balaraju2346@gmail.com[*5]
tsivakumar72@gmail.com[$6]

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Abstract

The word "Fad" has become a contagious with the advent of Blockchain technology where new currencies are sprouting from it, which affords preferable characteristics and features such as no intermediators, decentralization and smart contracts in which everyone knows about it, alongside, autonomy, verification, etc. The work, first accomplished the review about Blockchain itself, mainly its origin, structure of blockchain, types of blockchain with comparison with other features, uses of blockchain application in various fields, blockchain interoperability, use cases of blockchain, energy consumption, in-depth comparison of the blockchain protocols and the complete list of Block use cases. Additionally, the Blockchain security in the network particularly in internet (Web Attacks) is focused. To be precise, we reviewed and categorized various real time attacks based upon the Blockchain ecosystem. Lastly, the challenges and research trends of the blockchain are discussed which helps to achieve more and efficient blockchain ecosystem. The work will also exhibit the future direction and recommendations which will help out the budding researcher.

Keywords: Blockchain; decentralization; risk; Blockchain security; attacks and bugs

1.Introduction

A block of chains that contains information, with which can be disseminated among the peers in the network where the distributed data is stored inside a block depends upon the types of blockchain and a transaction that can be replicated and distributed over the whole network of blockchain. Here all the transactions will be performed and shared with other peers, each transaction will be verified by the most of the network information. It contains every single

record of each other transactional information from the distributed system. Having a bulky list of records where each record can be called as blocks where the data inside blocks are encrypted using cryptographic algorithms which shows it is highly secured, and also inclusion of hash function makes the system to be data integrity. Its great potential leading the technology to apply for several applications [1] it is possible with the sole mixture of any of the blockchain characteristics such as, distributed, decentralization, immutability, transparency, unanimous and security. All those characteristics has already shown success for the system it was incorporated.

Almost all the characteristics of blockchain technology seeing its brighter side in any applications, it is used up and their growth are unstoppable. Because of the above reasons, Blockchain is considered to be as the fifth disruptive revolution along with the internet, mobile phones, social medias, Television [2]. Generally, the peers in the blockchain network follows the same rules and regulations in all transactions and same accord in the consensus algorithm, also implements the hash in the system, and generation of blocks will always be in sequential order, where which the system implemented the above will be enjoying the potentials of blockchain, which makes the network highly efficient and secured. Because of those reason, blockchain plays the backbone of digital currencies [3], financial transactions [4], smart and better homes [5], Blockchain based- Health care [6], Logistics & SCM [7,8], and so on. These Network of chains are typically a peer-to-peer network in which every node is connected with another node based upon a protocol that makes easier for communication, whereas addition and validation of new blocks in the network will be much easier. Also, the network of chains can be of open set distributed ledger for transactions. The structure of the blockchain system is immutable but mutable in terms of consensus algorithm. Talking in terms of computations, it is not feasible to trace back consensus algorithm and do modifications. Finally, a blockchain system can be exemplified as distributed systems and also its design system can be inspected securely and overall, the network can be of very much fault tolerant in nature.

2.Emergence of Blockchain Technology:

1982 was the year where the term was first used which gave rise to existence of the disruptive technology by the person David Chaum who used or coined a Blockchain technology in his PhD thesis [10]. Haber and Stornetta during the year 1992 described about securing data in blockchains using cryptography algorithms [11]. Later 1992, Bayer, Haber and Stornetta introduced Merkle trees (graphical Structure) for the design purpose [12]. In 1998, there was an effort to create virtually decentralized [13]. In 2008, Bitcoin were introduced by Satoshi Nakamoto, which is the decentralized digital currency that can be travel on the end-to-end network of bitcoins. Also, transactions can be verified by any node on the network over cryptographic algorithms and can be chronicled in a public distributed ledger network. [14]. Also, in the year 2009 the name Blockchain which is currently hot was first termed as the disseminated or distributed ledger other than the transactions of Bitcoin [15]. Around the year 2013, Ethereum came into its existence or field in the form of research [16]. Later in 2014, in order to progress Ethereum crowdsourcing was made, and followed by the year 2015 Ethereum went on to action. The incipient of the Ethereum oblique that Blockchain technology new or next version was innate, which is completely different from other projects that engrossed on

the developing alternative digital coins (same as Bitcoin), also Ethereum allows anyone to communicate with each other on the most efficient distributed applications which comes under on Blockchain ecosystem. Technically speaking, Bitcoins, Ethereum and smart contracts are developed as a distributed- ledger, data storing unit and piece of code respectively. The Ethereum network was upgraded, in which it exhibits, the design supports more new additions, operates in high speed, along with advanced security features, which shows the system much more efficient than the previous network, which included three new phases over the period of two years. During the year 2015, Hyperledger was introduced as open-source software by the Linux Foundation for the blockchain systems. In order to take the Blockchain to the industry level, several frameworks were introduced based on the Ethereum, Bitcoins. Hyperledger, here are eight types of Blockchain which including Hyperledger. There are five Hyperledger tools and four libraries [17]. The emergence of the Blockchain technology is illustrated in Figure.1. The main concept of blockchain was comes into an existence in the year 1982, which was simply a chain of blocks (like linked lists) and security in blocks has been introduced in 1991. After that famous Merkle tree blockchain has been introduced in 1993. Bit Gold with digital currency is introduced in 1998 and bitcoin were introduced with blockchain with public blockchain networks can be made public or private depends upon the need of the system, if anyone can be made participate in the network, then the network can be of permissionless blockchain network, whereas if proper authentication is followed up, then the network can be permissioned block chain network. To enhance the efficiency, they upgraded the Ethereum 2.0 in 2020 and worldwide crypto lottery of smart blockchain in Feb 2022.

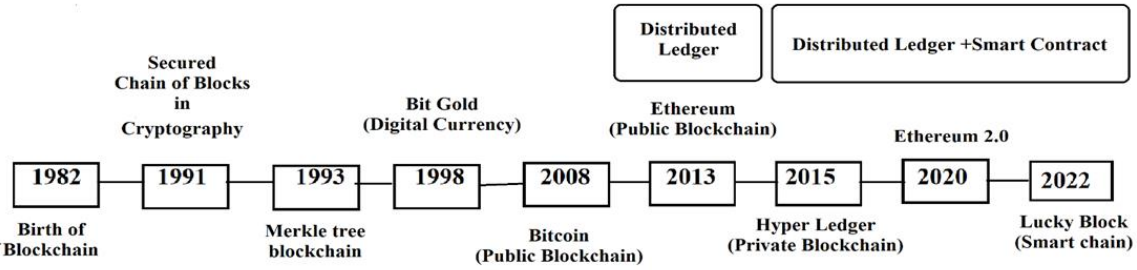

Figure. 1. Emergence of Blockchain

3. Structure, Types and Mechanism of blockchain technology

A. Structure of Blockchain: It is a series chain of blocks which consist of set of all transactions and other important details required for transactions. Blocks are linearly connected and cryptographically secure (i.e.) we are using encryption concept. Here is the structure(design) of Blockchain Fig.2 is shown below

Figure. 2. Structure of Blockchain

B. Types of Blockchain:

Classical Blockchain could be implemented as permissioned and permissionless are

Permissioned blockchain (Private): In this, networks will not be open to all the participants but participants are pre-approved by a designated authority.

Permissionless blockchain (Public): In this blockchain, networks will be open to all.

Features	Permissioned Blockchain	Permissionless Blockchain
Real life applications	Logistics, Land buying & Selling and Property proprietorship	Internet of Things applications & validation of documentation
Access	Access with Full control	No Dependency, Complete Trust & Transparency is possible
Auditability	Lack of Auditability	Yes
Security	Yes	Lack of Security

Table.1 Comparison of blockchain types with other features

C. Mechanisms of Block Chain

	PoW (Proof of Work)	**PoS (Proof of Stake)**	**DPoS (Delegated Proof of Stake)**	**PoET (Proof of Elapsed Time)**	**PBFT (Practical Byzantine Fault Tolerance)**	**DAG (Directed Acyclic Graph)**
Definition	Mostly used in mining cryptocurrency, Mines New Tokens and validate new transactions.	Substitute to PoW that validates block transactions randomly and create new block too.	More democratic process and provides features such as voting and delegation mechanism	Decides the Bloc winners or Mining Rights.	Handles well malevolent nodes are in the system.	Modelling tools used for cryptocurrencies.
Types	Permissionless Public	Permissionless Public/	Public/Private	Permissionless	Permissioned Private Blockchain	Permissioned Public

	/Private Blockchain	Private Blockchain	Blockchain	Blockchain		Non-Blockchain
Cost Effective	Costly	Low Cost	Slightly higher cost	Cheaper	low consensus efficiency	medium to high value.
Perk	New coins + Transaction Fees	Only TF	No Perk	No	dynamic adjustment credit	token-economic incentive mechanism
Mathematical model	Yes	Yes	Yes	Yes	Yes	Graph Based
Network Flexibility	A guaranteed flexible PoW	degree of flexibility	Highly Flexible	Changes on demand	a poor node scalability	scarifies Network flexibility
Power consumption	Higher orders of magnitude	several orders of magnitude lower than that of PoW	Lower energy consumption	High resource utilization and energy consumption	Lower Side based on Algorithm	More Validating Power
Vulnerability to various attack (51% and syble)	Highly Vulnerable	Not at stake	vulnerable to the 51% attack	Vulnerable	guaranteed security	Vulnerable to attacks due to low volume of transactions
examples	Bitcoin#1BTC, Dogecoin#10 DOGE	Terra, Avalanche, polka dot	Cardano, EOS, and TRON	Hyperledger Sawtooth	Zilliqa	IOTA, Obyte,
Number of transacti	7 Transactions per second	4.6 transactio	EOSIO has surpassed 5.0 billion	465 transacti	10,000 transactions	10,000 transactions

ons per seconds		ns per second.	transaction s	ons per seconds	required per second	required per second
Final block validatio n per seconds	Varies depends upon cons	14 sec for Ethereum	0.5 – 3 Sec	Not Defined	Not Defined	120 seconds

4. Blockchain - Use cases and Applications

A. Transactions- Blockchain Based

Blockchain being an open and distributed ledger uses a data structure which is append- able. That is, only newer transactions can be added to the network, but already made transactions cannot be deleted from the network. This makes record of money transferred in the blockchain network are verifiable and holds the transferred record permanently. Comparatively, transactions done in the blockchain system is less cost with existing services and also fast enough even in cross-border transactions.

B. Monetary interactions

It means interactions between the companies involves immutable records, instant payment processing, transparent pricing and buying, new digital financial exchange or market. Due to the advent of various cryptocurrencies, investment in stocks becomes much easier.

C. Loaning

Blockchain avoids the middle men concepts, which makes processing of loans faster and simultaneously reduces the growing cost of the loan applications. Both the loan seekers and lenders are coming under the viable agreement that regards payment, principal or loan amount, tenure of repayment etc. which is technically called smart contract.

D. Blockchain Based Insurance Industry

It provides transparency on standing polices or past policy of the customers which makes the claims easier. Also, every third-party document involved in the claiming process can be accessed on the shared interface provided by blockchain itself. On the basis of digital smart contract, every obligation between the customer and the company can be bended easily.

E. Blockchain based Real estate applications

Any level of the transactions involved in real estate are empowered by the blockchain technology and its problems will be much more simplified by the way data has been transmitted in the system.

F. Digitizing personal information

Blockchain with its e- keys, 0-knowledge data storage system, and decentralized ledger concepts, leads to store personal information such as Security Pin, any bank account information on the blockchain system has become the safest way for storing data online.

G. Blockchain powers Voting System

Blockchain Technology is not for doing only financial transactions, but the kind of infrastructure it provides makes the system to do any data to be transmitted. Voting system being a smaller one but having a big value of data. A blockchain-oriented voting system have no concern about the security of Internet, though hacker with entree to one terminal will not be able to disturb remaining nodes of the network. Citizens with Voting rights can efficiently consent their vote getting disturbed by any other externals factors. Also counting votes can be done in out-and-out certainty, because of the trust created by blockchain technology in which one person has attributed to only one vote to its name, which completely denies the fake votes, where tampering is absolutely not possible.

H. Orchestration and Supply Chain Management

Blockchain technology increases traceability of supply chain which makes sure industrial standards are achieved. It also promises reduced losses from unofficial/gray market. Exhibits transparency and acquiescence over contracted projects or manufacturing. Since ledger and everything was made digital which completely avoids any paperwork and management costs will be also reduced. The above mentioned are considered as primary potential advantages of the blockchain whereas the following are the added benefits when one can enjoy by incorporating in the given applications.

- ✔ Engaging all the participants actively(stakeholders)
- ✔ Sensitive data can also be shared among the public which shows the trustily of the system
- ✔ supply chain derelictions can be avoided at most.
- ✔ Transparency of resources maintained in every product strengthens the company reputations in the market.

I. 5th Generation Network

5G is the new wireless technology with the power of five generations of network. As previous 4G wireless technology it increases the speed of cell phone and tablets since adding additional speed with reduces the latency and higher capacity. In addition to security enhancement is requesting. In new features of 5G technology it connects vastly number of devices which includes smaller, less expensive, Subordinate devices has the potential to survive in most conditions just like the humans. Blockchain is a framework in the business conducted and runs this technology in 5G. All 5G Networks, will be delivering the first-time yields, that will rebuild the challenging rewards that network needs which will redesign any business.

Amalgamation of 5G with Blockchain Technology

The most celebrated edifice of Blockchain is decentralization, which has a capability of trailing the assets along with its movement and applications in the mobile network scenario. If the network structure is incorporated with blockchain, the system will become ubiquitous, as any needed data can be assessed anywhere at any time, which shows up the readiness of the network.

If only network service providers reconnoitre this technology integration with 5G, they will enjoy the following identified benefits over traditional way of managing assets in network.

✔ Avoids Centralised network structure

As every block in the chain contains their own identity and its authentication, there won't be any need for centralised system for any real time data sharing. Then the network structure is called as Decentralization.

✔ Transparency & Tracking

Any assets in any Blockchain applications can be able to track easily and the system will be flexible enough to conduct auditing at any time, which reflects the transparency in the structure.

✔ Enhanced Privacy & Security

Data in the blocks cannot be changed, it provides the utmost security along with the trust to the system itself.

✔ Digital Asset Tokens

Every asset detail will be digitized as a token, which will then be added to the blockchain system. This digitization of assets is actually a mystification in the form of not damageable. Also, data in the chain which is encrypted, can be recovered back through the token means.

By all means, another edifice immutability leads the way that the technology stands first in "do nothing" for the data whatever is given to it. In other words, no textual reaction will be taken place in the blockchain system, where the data will become "Mummies" (Unchanged). As the data deployed is being the same all the way, there creates a trust between the nodes in the system as the data is valid enough. As the industry is multi-functional, every asset is easily accessible by everyone.

Where Blockchain Fits in 5G?

✔ As it is not possible to establish a greater number of towers for 5G, small depositors take the advantage of available Cell towers, which can be the part of their overall signal distribution.

✔ These smaller network providers need to be registered, should have certified, it has to managed, and also automatically paid for the use of their towers.

- ✔ A simulated blockchain can be used to create thousands of nodes virtually, that ultimately supports the concept of network slicing in 5G.
- ✔ As already it is proved that blockchain is applicable successfully for Data or Information sharing, based on the agreement (Smart Contracts) made with, and which can also be validated by the network too subsequently. Infrastructure sharing can be also done without involving third party.
- ✔ Blockchain eliminates parts of the present process' expensive exchange mechanism, often given via clearing authority, and establishes a “data from sole source” for across-the-board control information amongst roaming partners.
- ✔ The initial phase of 5G deployment in India is not going to be full 5G , instead deployments will be based upon existing 4G systems , wherewhich operations will be done in joint network based.During the Full 5G implementation, several subsets has to be introduced for scheduling, data transfer mechanism etc which will be requiring the blockchain to be incorporated for its better efficiency.
- ✔ The widespread use of the blockchain might significantly advance the communication sector and all other monetary sectors from the standpoint of utilising it in 5G.

Other benefits linked with the blockchain in the Future Telecommunications systems include

- ✔ The clearance of all transactions taking place between any carriers
- ✔ Management of Service provider and clients on the basis of written agreement.
- ✔ Generalization of itinerant terms and contracts among various different operators;
- ✔ Easier Money Transfers within and outside borders;
- ✔ Effective management of user’s identity and increased level of authentication process;
- ✔ Handling Authorized Shared Spectrum Access (ASSA) through the blockchain-oriented carrier souk.

5. Security and risks in Blockchain

Hot Web oriented security risks are listed here which is analysed and evaluated on the basis of Blockchain technology, and Table III exhibits the valuation results which are potted in of the success of blockchain in business in the year 2008 to May 2018 & also has 9 types of blockchain risks of security in Table IV.

Security Risks (Hot Web Applications)	**Blockchain System Evaluation**	**Cause & Effects**
Cross Ste Scripting (XSS)	Possibility of various effects	May exhibit private keys and Transactional data of the user account
XML External Entities (XXE)	No Assess	Not Applied
Broken Access Control	Smart contracts will be affected	Multi signature will be affected
Injection	Poor input cleansing	Possibility of malevolent smart contract Execution
Invalid Authentication	Poor Implementation leads to large surface attacks	LISK
Exposing complex Data	Highly probable to this vulnerability	Susceptible to all Transactions

Table. 3 Risks Security in Blockchain

S.No	**Security Categories of BCT**
1	Smart contract's exposures
2	Illicit smart contracts
3	Under-optimized smart contract
4	Privacy on Transaction
5	Double spending
6	Illicit activities
7	Under/over -priced operations

8	51% vulnerability or sybil attacks
9	Private key security issues

Table. 4 blockchain risks of security

6. Conclusion:

This work has steered the cavernous survey on the Blockchain which focused primarily on summary and its procedures. Likewise, it offered the past of Blockchain, along with the comparison of consensus algorithms and mechanisms in as many niceties and as good as quantifiable as likely. Also enlisted the all-inclusive Blockchain few Use cases & it's far applications. Hot web-oriented application security risks have been defined which describes the blockchain security application categories along with cause and effects. We believe that this work will help bourgeoning researchers to easy understand the Blockchain technology Applications and its security issues.

7. Recommendations

- ✔ Governments will accept/endorse blockchain technology very sooner.
- ✔ A greener blockchain -greener planet.
- ✔ Sooner many countries will accept cryptocurrencies as a legal tender.
- ✔ The NFT market will continue to grow nevertheless with an admonition.
- ✔ Blockchain can be the most in-demand and on demand skill too.

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