# Blockchain: Recent Trends, Applications and Challenges in Intelligent Real-World Scenarios

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**Abstract -** The Blockchain Technology behind most of the connectivity into multidisciplinary areas with evolving to create new generation of opportunity for expanding new technologies based on their souls. In this review paper, we give an overview of this significant technology impact on various fields and how it can be useful for society and how the blockchain enhanced industrial operations transform into applications going from cryptocurrencies, banking and financial services, Internet of Things, and Web of Things to open and social administrations, Space industry, Government operations, healthcare, and medical industry operations, deep web, cyber security, and educational operations, etc.

**Keywords:** Blockchain, Cryptocurrencies, Smart Contracts, Digital Signature, Internet of Things; Smart Contract.

## • Introduction

Blockchain technology, as its name suggests, is a chain of blocks. Every one of these blocks contains a lot of exchanges that have been cryptographically verified to be exact, and these blocks are associated in a chain that regards the sequential request of the exchanges contained in each block – thus the name blockchain.

A blockchain speaks to a conveyed record those stores the occasions that happen in the framework. This record is unchanging, and its substance is confirmed by every one of the hubs in the framework – network checked. This straightforward thought gives the premise to a shockingly wide assortment of utilizations. The remainder of this paper audits the innovation behind blockchain and after that reviews its employments.As of late, cryptographic money has pulled in broad considerations from both the industry and the scholarly community. Bitcoin that is frequently called the main crypto money has delighted in an immense accomplishment with the capital market arriving at 10 billion dollars in 2016 (coin work area, 2016).

The blockchain is the central instrument for the Bitcoin. Blockchain was first proposed in 2008 and executed in 2009 (Nakamoto, 2008). Blockchain could be viewed as an open record, wherein every single submitted exchange are put away in a chain of blocks.

This chain ceaselessly develops when new blocks are attached to it. The blockchain innovation has the key attributes, for example, decentralization, constancy, secrecy, and discernability.

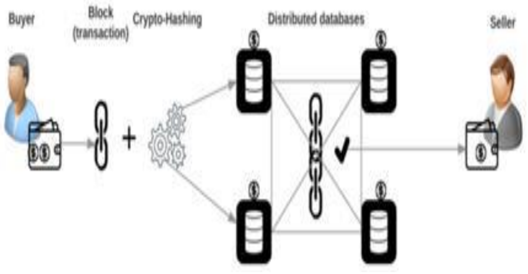


Figure.1: Blockchain Centralised process

Blockchain can work in a decentralized domain, which is empowered by coordinating a few centre advancements, for example, cryptographic hash, computerized signature (in light of halter kilter cryptography) and circulated accord instrument. With blockchain innovation [1], an exchange can occur in a decentralized manner. Therefore, blockchain can significantly spare the expense and improve the productivity.

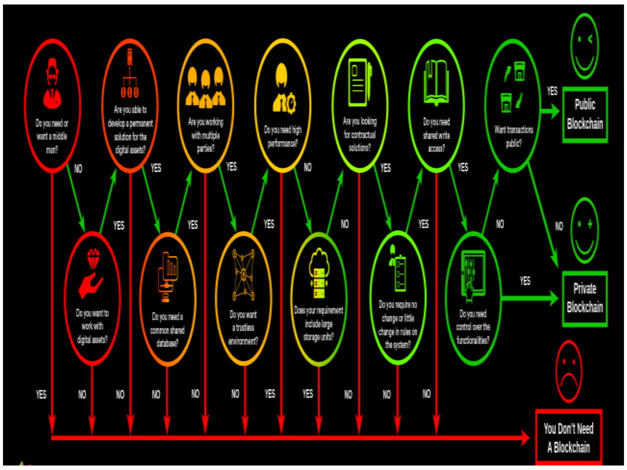

Do you need or want a middle man?
Are you able to develop a permanent solution for the digital assets?
Are you working with multiple parties?
Do you need high performance?
Are you looking for contractual solutions?
Do you need shared write access?
Want transactions public?
Do you want to work with digital assets?
Do you need a common shared database?
Do you want a trustless environment?
Does your requirement include large storage units?
Do you require no change or little change in rules on the system?
Do you need control over the functionalities?
YES
NO
Public Blockchain
Private Blockchain
You Don't Need A Blockchain

Figure.2: Blockchain working progress

## 1. Background and Related Work

In the accompanying segment, we detail the required blockchain foundation. In 2008 Satoshi Nakamoto made sense of how to actualize a computerized, dispersed, with the goals of cryptographic calculations, hashing strategies and discharged programming called blockchain innovation. Bitcoin is the soonest use of Blockchain Technology [2].

It fills in as a convention for trading cryptographic forms of money, for example, Bitcoins. It illuminates a very outstanding software engineering issue analyzing Generals Problem‖ which scrutinized the accord of a dispersed framework by giving an answer.

### 2.1. Blockchain Ledgers

Authorization blockchain Mining makes the blockchain to be Permission and permission less. The authorization block is mined by the known excavators who have expert. The specialist of a digger can be controlled in the consent block. Each segment permissioned block can be altered for a permissioned stage. Confirmation of transaction is finished by approved individuals. Along these lines, for all intents and purposes [3], the record does not require an accord plan to guarantee to alter strength.

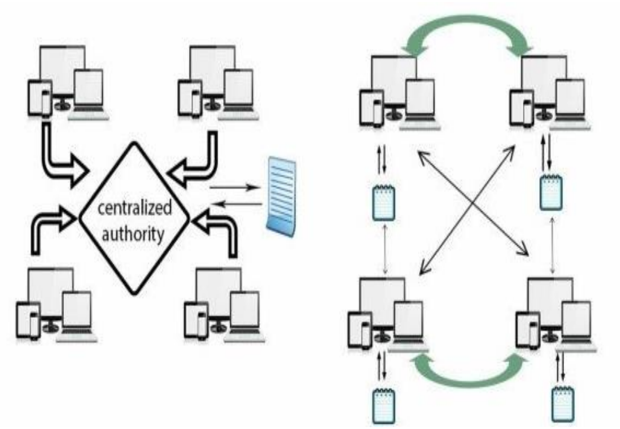


Figure.2: Centralized and Distributed Ledger

To just approved and constrained arrangement of individuals in the system are offered rights to see the substance of the block alleged perusers and approved scholars to refresh the exchange, this idea in blockchain can called as permissioned blockchain. To actualize a permissioned record structure to be considered as pursues:

- Identifying the members of the Network and their job
- The structure of each sort of exchange to be utilized in the system, and the fitting calculations to confirm every exchange in the system.
- Designing the structure to control the system with specific standards for choosing who has approved a client to access control and the activities in the system to be performed by their individuals for each sort of exchange.
- Designing the control structure for approved excavator in order to control who can mine a block and which exchanges can be incorporated into the system
- Designing the structure for every individual from the system that characterizes
- Rights of a survey the substance of the blocks, and to confirm the block.
- Designing a proper agreement calculation and a motivator plan or reward to guarantee the genuineness of the individuals in the system, is required to make it misrepresentation free.
- The structure decisions can be made dependent on the kind of uses. Instances of consent blockchain are Hyper ledger Fabric and R3 Corda.

**Permission less Blockchain:**

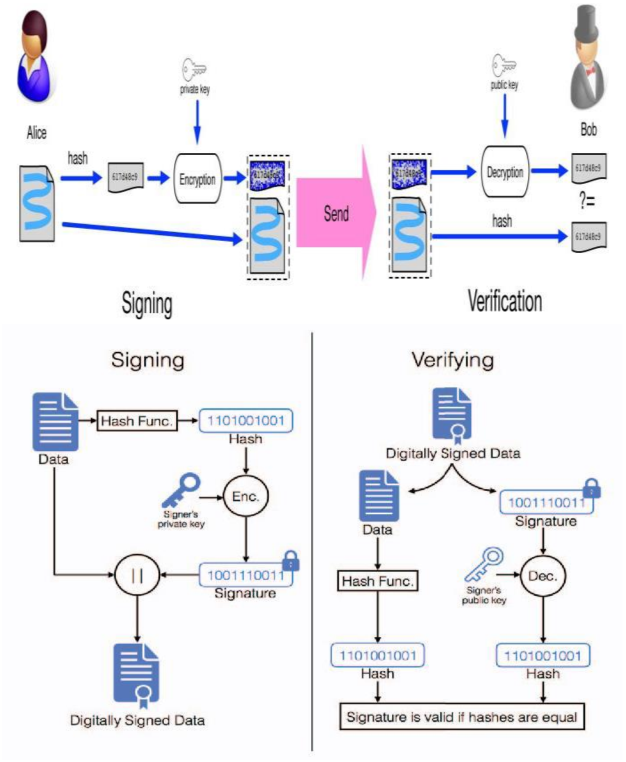


Figure.3: Crypto signature used in Blockchain

They are decentralized Network and open to all individuals in the system. Any hub can join and leave the system. There is no control for getting to the block to see the exchanges anybody in the system has the option to peruse [4]. The privilege to refresh the exchange is given to all in the system ie. anybody can be an essayist whenever.

There is no focal substance which deals with the participation, or which could choose the perusers or scholars. The utilization of cryptographic calculations will plan the structure of such permission less blockchain, which ensures the system to be secure.

## 2.2. Requirements for implementation of Blockchain Technology

### Software

a) A Software program which comprises of following capacities
b) Create possess Hash work
c) A work that produces an open key and a private key.

**Transaction ledger:** Each block should comprise of Block Number and each block ought to contain a number of exchanges. Every exchange ought to contain exceptional exchange ID. Exchange subtleties containing Public key of the sender, the open key of the collector called as a message.

The info the sum and the charges for the exchange. Yield the all-out parity accessible.

**Example:** Sender wants to send 10 BTC to receiver
Input = 10 BTC to receiver
Miner/ transaction fee = 1 BTC
(10 BTC – 1BTC) = 9 BTC

Output is 9btc which receiver can have in his Bitcoin wallet.

**Cryptographic algorithms for Hashing:** Method or procedure utilized for Hashing. SHA 256 is utilized. The hash starts with a number of zero bits. The SHA (Secure Hash Algorithm) is one of the various cryptographic hash capacities. A cryptographic hash resembles a mark for content or an information document.

SHA-256 calculation creates a nearly one of a kind, fixed-size 256-piece (32-byte) hash. Hash is a single direction work, it can't be decoded back.

**Verifying the transaction:** Proof of work: (One CPU is one vote) PoW is the accord calculation utilized in Bitcoin. Its center thought is to designate the bookkeeping rights and rewards through the hashing power rivalry among the hubs. This relies upon the measure of preparing force gave to the system [3]

**Proof of stake:** In PoS the advanced money has the idea of coinage. Coinage of a coin is it's worth increased when the period after it is made. The more one hub holds the coins, the more rights it can get in the system.

**Network:** Decentralized Network: Steps to run the Network are as per the following:

a) New exchange are communicated to all hubs
b) Each hub gathers new exchange into another block.
c) Each hub takes a shot at finding a troublesome confirmation of-work for its block.
d) When a hub finds a proof-of-work, it communicates the block to all hubs.
e) Nodes acknowledge the block just if all exchanges in it are substantial and not effectively spent.
f) Nodes express their acknowledgment of the block by taking a shot at making the following block in the chain, utilizing the hash of the acknowledged block as the past hash.[1]

## 2.3. Blockchain Architecture

The blockchain is a succession of blocks, which holds a total rundown of exchange records like an ordinary open record (Lee Kuo Chuen, 2015). Figure 1 delineates a case of a blockchain. Each block indicates the promptly past block by means of a reference that is basically a hash estimation of the past block called parent block.

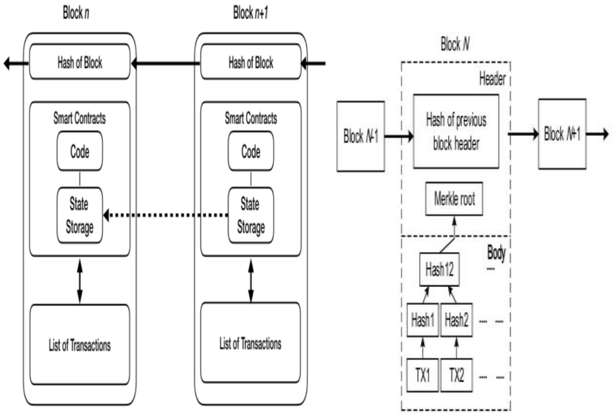


Figure.4: Block internal operational Structure

It is important those uncle blocks (offspring of the block's predecessors) hashes would likewise be put away in Ethereum blockchain (Buterin, 2014). The primary block of a blockchain is called beginning block which has no parent block [5].

**Block:** A block comprises of the block header and the block body as appeared in

- **Block version**: demonstrates which set of block approval principles to pursue.
- **Parent blocks hash:** 256-piece hash esteem that focuses on the past block.
- **Merkle Tree root hash:** the hash estimation of the considerable number of exchanges in the block.
- **Timestamp:** a 4-byte field, which more often than not begins with 0 and increments for each hash calculations.

**Nonce:** a 4-byte field, which usually starts with 0 and increases for every hash calculation.

The block body is made out of an exchange counter and exchanges. The most extreme number of exchanges that a block can contain relies upon the block size and the size of every exchange. Blockchain utilizes an unbalanced cryptography system to approve the validation of exchanges (NRI, 2015) [8]. A crypto signature based on asymmetric cryptography is used in an untrustworthy environment. We next briefly illustrate digital signature.

### 2.4. Digital Signature

Every client possesses a couple of private keys and open key. The private key is utilized to sign the exchanges. The carefully marked exchanges are spread all through the entire system and afterward are gotten to by open keys, which are unmistakable to everybody in the system.

Figure 4 demonstrates a case of an advanced mark utilized in the blockchain. The run of the mill advanced mark is engaged with two stages: the marking stage and the check stage. Take Figure 3 for instance once more. At the point when a client Alice needs to sign an exchange, the first creates a hash worth got from the exchange [6].

At that point encodes this hash an incentive by utilizing her private key and sends to another client Bob the scrambled hash with the first information. Bounce checks they got exchange through the correlation between the decoded hash (by utilizing Alice's open key) and the hash worth got from the got information by a similar hash work as Alice's.

The typical crypto signature algorithms used in blockchain include elliptic curve crypto signature algorithm (ECDSA) (Johnson et al., 2001).

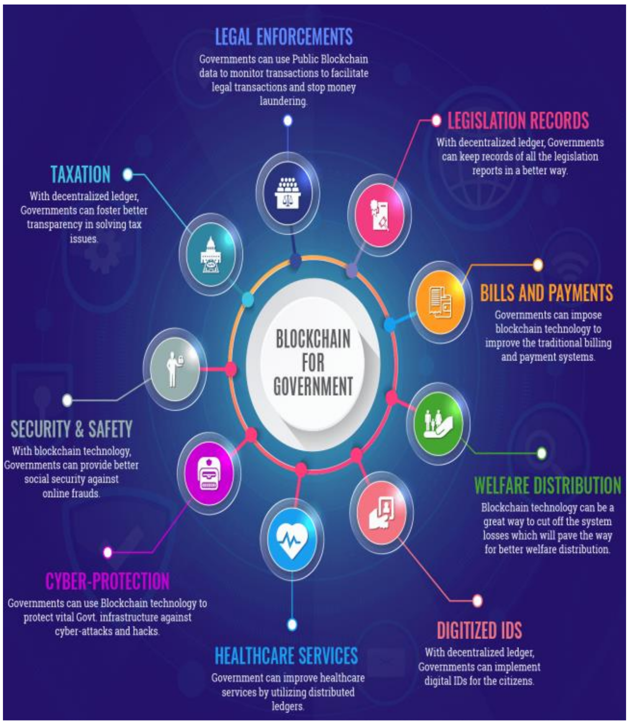

LEGAL ENFORCEMENTS
Governments can use Public Blockchain data to monitor transactions to facilitate legal transactions and stop money laundering.
LEGISLATION RECORDS
With decentralized ledger, Governments can keep records of all the legislation reports in a better way.
TAXATION
With decentralized ledger, Governments can foster better transparency in solving tax issues.
BILLS AND PAYMENTS
Governments can impose blockchain technology to improve the traditional billing and payment systems.
BLOCKCHAIN FOR GOVERNMENT
SECURITY & SAFETY
With blockchain technology, Governments can provide better social security against online frauds.
WELFARE DISTRIBUTION
Blockchain technology can be a great way to cut off the system losses which will pave the way for better welfare distribution.
CYBER-PROTECTION
Governments can use Blockchain technology to protect vital Govt. infrastructure against cyber-attacks and hacks.
DIGITIZED IDS
With decentralized ledger, Governments can implement digital IDs for the citizens.
HEALTHCARE SERVICES
Government can improve healthcare services by utilizing distributed ledgers.

Figure.5: Block Chain for Government services

### 2.5. Key Characteristics of Blockchain

In summary, blockchain has following key characteristics.

**Decentralization:** In ordinary concentrated exchange a framework, every exchange should be approved through the focal confided in office (e.g., the national bank) definitely coming about the expense and the exhibition bottlenecks at the focal servers.

In an unexpected way, an exchange in the blockchain system can be directed between any two friends (P2P) without the confirmation by the focal organization. As such, blockchain can essentially decrease the server costs (counting the advancement cost and the activity cost) and moderate the exhibition bottlenecks at the central server [7].

**Auditability:** Since every one of the exchanges on the blockchain is approved and recorded with a timestamp, clients can without much of a stretch check and follow the past records through getting to any hub in the disseminated system. In Bitcoin blockchain, every exchange could be followed to past exchanges iteratively.

It improves the delectability and the straightforwardness of the information put away in the blockchain.

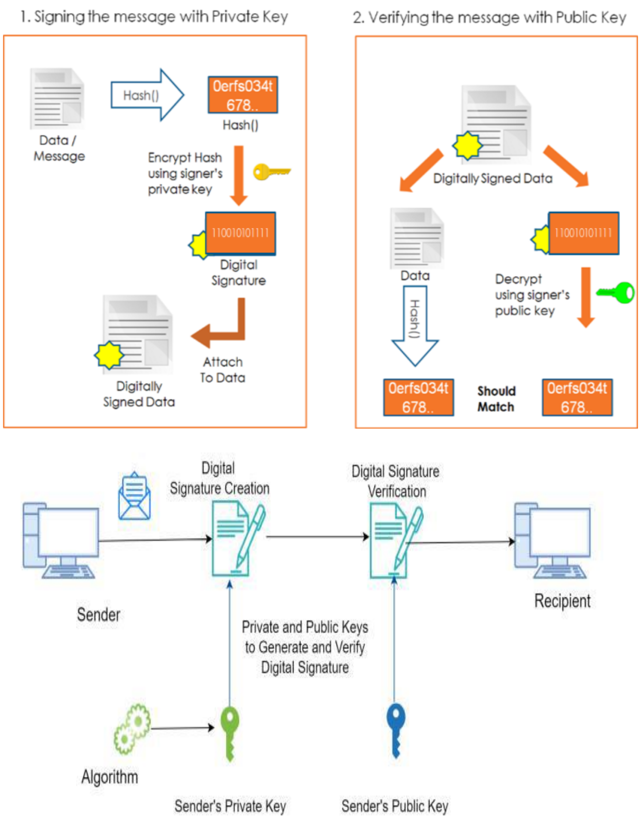

1. Signing the message with Private Key
Data / Message
Hash()
0erfs034t 678..
Hash()
Encrypt Hash using signer's private key
11001010111
Digital Signature
Attach To Data
Digitally Signed Data
2. Verifying the message with Public Key
Digitally Signed Data
Data
Hash()
Decrypt using signer's public key
11001010111
0erfs034t 678..
Should Match
0erfs034t 678..
Digital Signature Creation
Digital Signature Verification
Sender
Recipient
Private and Public Keys to Generate and Verify Digital Signature
Algorithm
Sender's Private Key
Sender's Public Key

Figure.6: Crypto signature used in blockchain

**Persistency:** Since every one of the exchanges spreading over the system should be affirmed and recorded in blocks appropriated in the entire system, it is almost difficult to alter. Also, each communicated block would be approved by different hubs and exchanges would be checked. So any adulteration could be identified effectively.

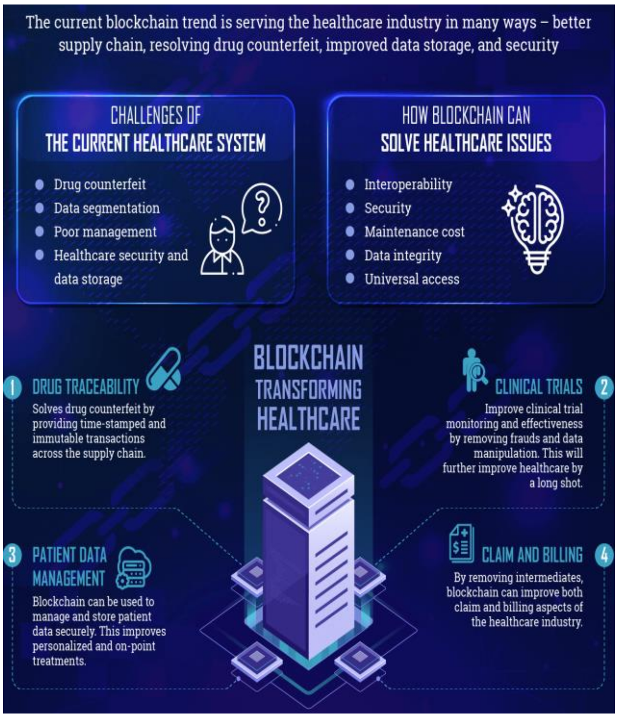
**Anonymity:** Every client can associate with the blockchain connect with a created location. Further, a client could produce numerous delivers to keep away from character presentation. There is never again any focal gathering keeping clients' private data. This system saves a specific measure of security on the exchanges incorporated into the blockchain. Note that blockchain can't ensure the ideal protection conservation because of the characteristic imperative.

### 2.6. Uses of Blockchain

Blockchain can be utilized for various applications other than advanced cash. Likewise, the presentation of keen contracts in Ethereum opened the entryway for some monetary applications using blockchain. In this area, we will talk about the absolute most unmistakable use-instances of blockchain [3].

**Financial Contracts:** Acquainting savvy contracts with blockchain enables plenty of money related contracts to be mechanized on blockchain. Financial contracts known as subordinates are standard particularly appropriate for blockchain execution. This is because of the way that they are contracts based on a fundamental resource. The conduct of the underlying resource gives the activating occasion that makes the agreement be executed. Subsequently, it is effectively expertly gram as if at that point (accomplish something different).

Keep in mind that blockchain offers network verification; this implies the particulars of the agreement is known to everybody and can't be reneged on. In this manner, giving security to counterparties taking part in money related contracts.



The current blockchain trend is serving the healthcare industry in many ways – better supply chain, resolving drug counterfeit, improved data storage, and security

CHALLENGES OF THE CURRENT HEALTHCARE SYSTEM

- Drug counterfeit
- Data segmentation
- Poor management
- Healthcare security and data storage

HOW BLOCKCHAIN CAN SOLVE HEALTHCARE ISSUES

- Interoperability
- Security
- Maintenance cost
- Data integrity
- Universal access

BLOCKCHAIN TRANSFORMING HEALTHCARE

1 DRUG TRACEABILITY

Solves drug counterfeit by providing time-stamped and immutable transactions across the supply chain.

2 CLINICAL TRIALS

Improve clinical trial monitoring and effectiveness by removing frauds and data manipulation. This will further improve healthcare by a long shot.

3 PATIENT DATA MANAGEMENT

Blockchain can be used to manage and store patient data securely. This improves personalized and on-point treatments.

4 CLAIM AND BILLING

By removing intermediates, blockchain can improve both claim and billing aspects of the healthcare industry.

Figure.7: Block Chain for Healthcare applications

It is additionally, in principle at any rate, changeless, hence giving a perpetual and open record of the considerable number of agreements and what occurred in them that can be utilized by administrative associations to comprehend the occasions in the market to put it plainly, it has straightforwardness inherent. Via computerizing monetary subsidiaries, it is conceivable to improve productivity, increment deceivability of market activity for administrative associations, and decrease exchange costs [6].

Most budgetary derivates today are exchanged over the counter (OTC) which implies that their evaluating is untransparent and may permit market making associations to extricate enormous expenses for their job as money related go-betweens. Blockchain removes the center man, in a manner of speaking.[2].

It is past the extent of this paper to portray all the various kinds of money related subordinates, however we will clarify at any rate one, Credit Default Swaps (CDSs), for instance. Credit Default Swaps (CDSs) are an ideal fit for the model of blockchain.

In CDSs, a gathering, A, that is presented to a specific credit chance – i.e., that has loaned some cash to another substance and wishes to relieve the hazard that that element would default on its obligation can go into a CDS with an outsider, B, that accepts that the danger of default on this specific obligation is adequate.

For whatever length of time that the borrower basic this agreement continues paying its loan costs normally, A pays regular premiums to B. On the off chance that a credit occasion happens, if the borrower quits paying due premium or goes into chapter 11 for example, B pays the whole assumed worth of the obligation just as the premiums it had been receiving to A.

It is similar to protection on the obligation. This agreement can without much of a stretch be encoded utilizing a programming language and executed on a blockchain so it is automated [5].

**Asset Tracking:** Another conceivable use-case for blockchain is as a benefit following apparatus for finding out evidence of proprietorship or provenance of a specific resource. The nearness of taken products thus called blood precious stones in the worldwide inventory network is an issue that necessities tending to.

It is required to have an arrangement of openly distinguishable, changeless, confirmed records of proprietorship that can be inspected whenever to decide the provenance of a specific thing.

Blockchain gives precisely this arrangement of traits and in this way is an ideal fit for this application [1-4].It would make it simple for everybody to concede to who claims what, and to follow back every one of the exchanges including a specific thing as it changed turns in the worldwide store network.

**Payment System:** It is conceivable to utilize the blockchain to actualize installment frameworks in fiat money. This is a characteristic augmentation of its capacity to oversee installments and exchange in crypto forms of money.

Keep in mind that blockchain offers network verification; this implies the particulars of the agreement is known to everybody and can't be reneged on. In this manner, giving security to counterparties taking part in money related contracts.

It is additionally, in principle at any rate, changeless, hence giving a perpetual and open record of the considerable number of agreements and what occurred in them that can be utilized by administrative associations to comprehend the occasions in the market – to put it plainly, it has straightforwardness inherent [7].

Through computerizing monetary subsidiaries, it is conceivable to improve productivity, increment deceivability of market activity for administrative associations, and decrease exchange costs.

**Crypto Identity:** Similarly as blockchain can be utilized to follow proprietorship and provenance of merchandise, it can likewise be utilized to store the character of individuals [4]. Envision that your international ID is put away on a blockchain and the visas you get and your entrance and takeoff from nations are recorded as blockchain exchanges.

This implies they are changeless, network confirmed and decentralized. By adding keen contracts to the framework it might likewise be conceivable to encode rules for denying section to specific individuals – sanctions against nations of inception, security reasons or some other reason – and have them consequently executed on the blockchain.

The guidelines would be noticeable to all and robotized which would decrease the probability of human mistake going into the procedure [6].

**Distributed File Storage:** Rather than putting every one of your information in one area on the cloud and giving a solitary purpose of disappointment as far as security, protection, and unwavering quality, it is conceivable to have your records put away on a blockchain.

The blockchain can be utilized to arrange a cost for putting away your documents on specific PCs and its replication would give protection from information misfortune. Obviously, the information itself would be scrambled to guarantee security.

## 2.7. Cryptocurrencies in the Financial Markets

We now return to the first application developed on blockchain: Cryptocurrencies. Cryptocurrencies have two important roles in the financial markets, the first is as assets in as off themselves and the second is as a novel method for raising funds for a startup. In this section of the paper, we will discuss both these roles of cryptocurrencies.

- **Cryptocurrencies as an asset class:** There are two ways to obtain cryptocurrencies, you can either mine them as described above, or you can buy them. In this section of the paper we will concentrate on the latter. Buy and selling cryptocurrencies converts them into an asset class that can be invested or speculated in.

At the time of writing this paper, Bitcoin, the cryptocurrency with the highest market capitalization, traded at about $15,000 per coin. To put this into perspective, the price of a Bitcoin seven years ago was a quarter of a cent. No other asset class in the market can beat this yield.

Despite the upward trend in the market, the price of cryptocurrencies is very volatile – mainly due to small market capitalization and limited liquidity. These two factors combine to make any speculative move by investors in the asset able to move the mar- ket significantly. The current price of $18,000 is a drop from almost $20,000 a while ago.

This drop was caused by a series of bad news reports about Bitcoin and cryptocurrencies in general. Some investors claim that the current high valuation of cryptocurrencies is akin to a bubble and that buying into the market at this stage can lead to serious financial loss if the bubble bursts, but this hasn't, so far, had a lasting effect on the price of Bitcoin. So cryptocurrencies as an asset class offers the op- opportunity of significant yield, especially in the current low yield environment of most other assets.

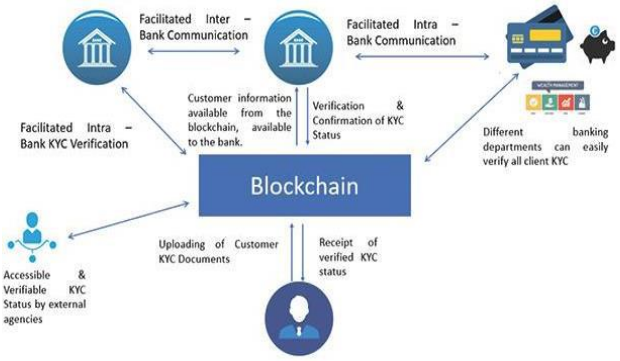

Facilitated Inter – Bank Communication
Facilitated Intra – Bank Communication
Facilitated Intra – Bank KYC Verification
Customer information available from the blockchain, available to the bank.
Verification & Confirmation of KYC Status
Different banking departments can easily verify all client KYC
Blockchain
Accessible & Verifiable KYC Status by external agencies
Uploading of Customer KYC Documents
Receipt of verified KYC status

Figure.8: Banking Operations

However, an investor getting into the market should consider the bubble like valuation of most cryptocurrencies and exercise due diligence when deciding whether or not to get into the market for the first time [8].

- **Cryptocurrencies as a fund raising mechanism:** A new innovation in the financial markets is the Initial Coin Offering or ICOs are an alternative to the traditional Initial Public Offering (IPO) in which firms issue equity in their company for the first time to raise operational funds. However, unlike IPOs, ICOs do not give investors equity in a firm – at least in most cases. A ICO occurs when a new enterprise creates a new cryptocurrency (token) and then sells this token to the general public in exchange for other more established cryptocurrencies, like Bitcoin or Ether, or for fiat money. The company can then either sell the acquired bit- coin or Ether for fiat money to finance its operations or it can use the cryptocurrencies to finance its operations directly, or spend the fiat money it received in return for its tokens for the same [7].

The issued tokens, which investors get, can then be use to buy services within the ecosystem of the newly created company – for example, buying apps on an app store or buying powerups in a crypto game. Tokens that grant investors a stake in the profit earned by the new firm are considered a security, and are thus regulated by relevant authorities as such.

Tokens that do not, receive much less regulatory over- sight. This new trend has applied a little break to the burgeoning ICO market, but it is also a sign that the market is maturing and becoming more stable [7].

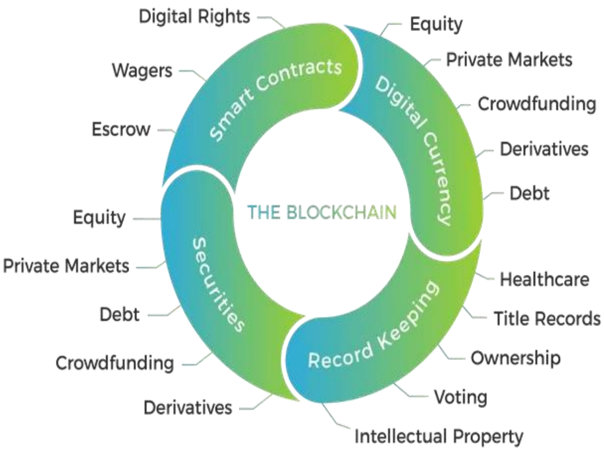


Figure. 9: Block chain Applications in different areas

## 3. Conclusion

The aim intension of this survey and collective work is to provide an overview of blockchain can possibly be a game-changing innovation that will influence ventures as various as fund and distributed computing. By offering a network checked, changeless, conveyed record of exchanges it permits plenty of utilization cases that would profit society and the economy.

Cryptocurrencies, one of the utilization instances of blockchain, offer the chance of making cash that isn't constrained by a unified specialist and that is restricted in sum, therefore, diminishing cash supply inflationary weight that happens when national banks print more cash to support monetary development – as the quantitative facilitating started during the 2008-2009 budgetary emergency represents.

In nations torn by fleeing expansion and strife, crypto currencies offer a place of refuge and store of significant worth that can be utilized to fence against these dangers. Budgetary advancements like ICOs likewise offer the possibility to additional charge the economy by offering more affordable strategies for fund-raising to subsidize new organizations.

Blockchain can likewise be utilized to store evidence of possession, character, and records. The majority of this in a dispersed, non-brought together condition. Likewise, the presentation of a Turing Complete Virtual Machine on some blockchain enable them to actualize keen gets, an advancement that has extensive ramifications for money related markets and business association.

To put it plainly, blockchain, similar to AI, huge information, and the Internet of things, is an outlook changing innovation that will effectively affect how we lead our lives in the coming years. This paper offered a short outline of the field and its applications, we urge the perusers to dig further into the specialized writing encompassing this point as we trust it is a hot research area.

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