Blockchain Based Model for Cloud Computing Security

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Abstract: Blockchain technology is a data structure used to create a distributed ledger along with report of information holding the entire particulars (like a hash of the previous block, timestamp means when the block was created, block reward, block number etc.) of the dealings accomplished as well as disseminated between the nodes existing in the association. Total dealings accomplished in the arrangement are established by the protocols of consensus which used to keep the blockchain secure like Proof-of-work, proof-of-stake etc., and the records once put in storage cannot be changed. Bitcoin is a most fashionable electronic Cryptocurrency uses Blockchain technology. In the environment of cloud is an on demand availability of computer resources and live out of using a system of faraway servers accommodated on the net to data storage, data control, and processing information, more willingly than a private computer or native server. Authenticity, confidentiality and integrity are the major challenges still having in the cloud environment. In this research work, we have revealed more or less of the important challenges handled through the cloud moreover projected great solutions by assimilating it through technology of Blockchain.

Keywords: Blockchain technology, Cloud computing, Security, Blockchain Cloud, Decentralized.

I. INTRODUCTION

Cloud based computing is a novel model of computing that permits the customer to right to use a huge quantity of applications and facilities from everywhere, irrespective the platform, just having an access device or terminal linked to a platform using Cloud Computing. Cloud based computing is distinct machinery that appeared from comprehensive, remote-access data processing machinery. Cloud assistances to decreases the special consideration liability on consumers [1]. The cloud comprises of a communications infrastructure consisted of software, a set of hardware, telecommunications networks, interfaces, control and storing devices which permit the distribution of computing as a service [2].There are several benefits like decreasing hardware and looking after expenses, accessibility across the sphere, flexibility with a greatly computerized procedure, and easy availability. Numerous leading companies have implemented cloud-like Google, IBM, Microsoft and Amazon. A lot of implementation of applications are models which have turn up for example the Amazon Cloud, App Engine of Google, the Elastic computing stage, Cloud Platform of Google, etc. [3]. It delivers us the capability of paid against the use of strategy plus malleable structural design of IT available over the net from moveable gadgets. Although the cloud computing has several beneficial facilities, the administrations are unhurried in acquiescent this because of their confidentiality worries. Safety apprehensions plus the cloud's computing confronts are major disadvantages of obstructing the environment of cloud [4]. Blockchain machinery is the upcoming of the businesses struggling for safety and confidentiality enhancements. Blockchain with its remote-access data processing, translucent and protected environment has developed as troublesome innovation machinery for the successor invention of various industrialized applications [5]. From a technological point of view, Blockchain is remote-access ledger machinery that was primarily utilized to help as the public electronic ledger of Bitcoin Cryptocurrency [6] for commercial dealings.

Blockchain is based on dispensed ledger that chronicles impenetrable facts in the arrangement of a series unaccompanied by some central power. The members or the gadgets are called nodes in the machinery of Blockchain. It delivers a distributed network wherein altogether the set-up nodes have dynamic contribution to authenticate plus confirm the information. The statistics to stock on the Blockchain will be encoded by using cryptography. All block comprises an encoded hash, hash of the preceding block, and timestamp in the sequence over that the block will link. Hence, the statistics residing in the Blockchain machinery is impenetrable. It delivers the records in the midst of safety, and contributing customers will be certified in the set of connections, reducing the information's confidentiality apprehension [7]. To smooth development of cloud computing, we are able to get the better of the information's confidentiality and safety worries by incorporating through Blockchain machinery. It increases the record safety, accessibility of services, and also cope records of cloud. Within this research work, section II contributes the overview to computing of cloud formations as well as enlightens Blockchain knowledge, its appearances, categories, layers, design, functioning, and other foremost applications. Section III explains the proposed architecture and advantages of incorporating cloud in the company of Blockchain machinery. In section IV we will conclude our research work.

II.   CLOUD COMPUTING & BLOCKCHAIN TECHNOLOGY

A.   Cloud Computing

Cloud computing is a preparation of employing a set-up of distant servers to stock, control and statistics activity from every place over the earth. It is utilized in region of a neighbourhood host computer or a non-public pc. Services of cloud computing like stocking the information and softwares are brought to the company's gadgets thru the net [8]. Cloud offers numerous facilities, and they are categorized into primarily three distribution forms. The foremost facility is Software as a Service (SaaS). The CSP brings the whole applications on a single platform, proposing numerous facilities for customers. Customers have no control above the infrastructure of cloud. SalesForce.com, Amazon web services, Google Mail establishes an important instance of SaaS. The subsequent facility is Platform as a Service (PaaS). The CSP permits us to install our application inside the platform. Windows Azure, Google app engine are the most excellent example for PaaS. The Infrastructure as a Service (IaaS) is third facility. It provides the customer to openly right to use the processing, storage, and additional resources over the net. Virtualization plays key role in IaaS to allocate the substantial assets to fulfil the request of resources from cloud consumers. GoGrid, Amazon EC2, are the best model of IaaS [9].

Mainly four most important cloud deployment forms are: (i) Public cloud - used by dissimilar consumers who want to come to be collected on host computer and these are retained plus controlled by providers. Google App Engine and Microsoft Azure are examples of public cloud [10]. (ii) Private Cloud - This is mainly constructed on the requirement of particular customers, giving possession on records, its protection, and customer devoted. The packages which are retained by using the users are installed in it. In compare to public cloud it is protected and exclusive. Policy on safety and bandwidth limits are supplied in the personal clouds. Eucalyptus System provides the excellent services of a personal cloud. (iii) Hybrid cloud - is combination of deployment models of cloud i.e. two or more models form this model. A nicely built hybrid cloud can offer protection services, but the trouble lies incompetently generating and leading any such result. A well-known instance of a hybrid cloud is Amazon Web Services. (iv) Community cloud – it is specially designed for a particular group of people from dissimilar corporations with collective apprehensions. This sort of cloud is helpful in banking or educations fields. A good instance of a community cloud is Facebook.

Five major distinctiveness of cloud computing are [7]:

- On-order facilities
- Wide-ranging network entrée
- Resource sharing
- Considered facilities
- Elastic Scalability

Although the cloud makes available numerous characteristics, there are also a number of drawbacks exist in the cloud. A few of them are [11]:

- Safety of information
- Downtimes
- Limited control
- Network dependency
- No officially permitted accountability for vendors

Following are the research issues in cloud computing environment

- Reliability
- Compliance
- Service level agreement
- Cloud data management
- Data encryption
- Interoperability

B.   Blockchain Technology

A blockchain is an information arrangement used to construct a decentralized ledger. The advent of Bitcoin introduced the Blockchain machinery. Bitcoin is a type of virtual money distributed all the way through an artificial name in 2008

mentioned to as "Satoshi Nakamoto". A white paper he makes public, "Bitcoin: A Peer to Peer Digital currency System," that provides the straight online payment to each other without any third party involvement [12].

This digital money scheme generally conquers the double-spending trouble of the money, mainly the electronic money permit being effortlessly copied and consumed more than once. This issue is resolved by connecting every business deal with one another in an alter-defiant approach. The unrestricted ledger is being utilized to attach dealings in a way of resistance to tampering. In the midst of this ledger, a set-up is able to confirm the operations record plus verify that the money has not previously been spent [13]. Blockchain may be described as translucent remote ledgers of electronically signature dealings which can be assembled into blocks. Every block includes a value of hash created by cryptography that connects one block in the company of another, the transaction data and a timestamp.

Blockchain information will not be altered by means of its design architecture [14]. When we put in force blockchain machinery, government intervention doesn't required, and hundred percent of cheating free just because of consensus confirmation. Without any third-part charges and involvement, immediate transactions can be done. Such characteristics develop financial competence [5]. In spite of various benefits, blockchain has a few drawbacks e.g. very volatile, also probability of growing society offences due to nameless dealings which are undetectable by the individual or node exterior the set-up.

i. Blockchain Functionalities and Characteristics:

- **Federalization** - The blockchain made up of peer-to-peer blocks not including union of any third party. Therefore no dependency required on centralized server by blockchain.
- **Persistence** - each and every dealings are confirms in the blockchain, and truthful miners gather the business deal information. Erasing or roll back the dealings are not easy if the transactions are integrated in the list [15]. Additionally, these blocks cannot be manipulated as authenticated by other miners.
- **Auditability** - Sender digitally signed all the transactions in the blockchain, along with timestamp trouble-free for clients to follow and authenticate the operation.
- **Obscurity** - Asymmetric encryption techniques used to secure data in blockchain. To validate the receiver, all disbursement is signed through electronically. The dispatcher interrelates with the blockchain to maintain an email by self-generated and to keep their individuality as a clandestine produces an exceptional set of addresses [16].
- **Self-governing** - As we know there is no particular individual maintaining the blockchain set-up, we are able to post the signed one nodes and overview them if existing previous nodes admits all them in the decentralized community. The consensus support appeared by accommodating a node by all previous node in the community, certifying that the information transmits will be carried out correctly within the blockchain.
- **Immutability** - The transaction statistics are authenticated earlier than it is established into the Block [17]. The blockchain everlastingly holds the dealings without any tamper. If somebody attempts to adjust the statistics, it might be stuck because statistics inside the blocks is connected via the hash key, and alteration in the statistics would reject the subsequent blocks.
- **Clearness** - In blockchain machinery, the structure records and upholds business statistics facts in unlock distributed ledger [18]. This statistics is unlock and dependable to every node available in the same network to fetch the data.
- **Traceability** - Using hashing algorithms data is encrypted in the blocks of blockchain. Every block holds a hash key and in the network each block holds the hash key of prior blocks' and is connected through them [19]. Therefore, searching the block with using hash key is simple and easier within the blockchain community.

ii. Types of Blockchain

a) **Public Blockchain** - any node in public blockchain can go into the network and be able to connect in the dealing out, stocking, and confirmation of the dealing information by using a method of consensus.

b) **Private Blockchain** - In this type of blockchain no one can rapidly turn out to be a component of the community. It is a kind of federal blockchain handled by a middle power for admission. Private Blockchain is particular to small industries or limited organizations. Different kinds of the private blockchain are - Digital identity, Vote counting, Asset ownership etc.

c) **Consortium Blockchain** - It is a partly decentralized sequence. The pre chosen node can have the power to pick out the category of facility beforehand. Residual nodes may possibly have right to use the blockchain dealings, however no longer inside the consensus technique. Examples of consortium blockchain are Eenterprise software company-R3CEV and Hyper-ledger.

Table 1 shows the relationship among different kinds of blockchain considering following properties.

Table 1: Relationship among different kinds of Blockchain

Property	Public	Private	Consortium
Consensus strength of mind	All	Limited to one party	Certain nodes
Consensus Process	less consent	Consent	Consent
Centralised	No	Yes	biased
Competence	Less	Elevated	Elevated
Immutability	Not possible	might be alter	might be alter
Examine consent	Public	Not for public	Not for public

Table 2 shows below the comparing different platforms of blockchain

Table 2: Relationship among different kinds of Platforms

Types	Bitcoin	Ethereum	Hyperledger fabric
Idea	Cryptocurrency	Smart contracts	design for industry
Stored data	Cryptocurrency transactions	Cryptocurrency, electronic possessions, smart contracts	Chain code, smart contracts
Scripting language	Script	Serpent, Solidity	Go
Participation	GitHub provides source code	GitHub provides source code	list for individuality to the set-up
Currency	Bitcoin	Ether	N/A
Transparency	Agreed	agreed	unidentified
Release timing of block	10 Minutes	12 seconds	Configure
volume of operations	250 bytes average	No max	Configurable
Mining	Proof of work	Ethash algorithm used by Proof of work	N/A

iii.Blockchain generations

The materialization of blockchain technology is considered keen on three generations. The 1st generation of blockchain is 1.0 as electronic money, 2nd generation of Blockchain is 2.0 is known as the electronic financial system, and Third generation of Blockchain is 3.0 known as an electronic society [19].

a)   1st generation blockchain - This machinery is initially established to the arena throughout the electronic money know as Bitcoin. It is a type of electronic money established through the fake person's name called Satoshi Nakamoto. Its characteristics are additional appropriate for virtual money. Business deal information is accumulated in the blocks, cryptographically encrypted, and those blocks are connected with one and all via complicated cryptographic methods. The statistics is unchangeable, and doesn't permit updating the statistics in the blocks. The existence of an open remote-access ledger allows the virtual currencies to keep away from double-spending within the blockchain. Virtual money assists to decrease the transaction cost greatly.

b)   2nd generation blockchain – This machinery materialization showed that it might be utilized afar easy disbursement, dealings, relocate and comprises stocks, and mortgages that entail depositories. In the 2nd generation smart contracts play a vital role which is broadening the virtual currencies into a virtual economy. Self-executing line of code is a smart contract i.e. a contract in the middle of the purchaser and the supplier and it is triggered with a business deal. Each of them could be having a completely exclusive address. On satisfying the precise code conditions the smart contracts implement by design in every node available in the community. These make faith among two clients who don't recognize one another. The information available inside the smart contract is saved in the block of blockchain machinery that is without altering and without-forging. Smart contracts are implemented to numerous situations i.e. dealing contracts, insurance, mortgages, monetary information recordings, supply chains and so on. Ethereum is the best example of a smart contract.

c)   3rd generation blockchain – Blockchain 3.0 developed various applications without including the financial zone. It provides us well turned-out towns with well turned-out authority, elegant resource consumption by well-groomed people providing us a well turned-out financial system. (IoT) Internet of Things in the company of Blockchain is being built up to put into effect elegant assets dealings and statistics disbursement without any participation of mediator. Such integration moreover set up a marketplace for authority from device to device and holds digital medicinal files data. Blockchain 3.0 is helpful in virtual individuality anywhere, clients those not having bank account may uphold their identities so that banks able to done their official procedures for example KYC as well as fetch bank financial records. As we know this is the period of internet a lot of dealings are done between unidentified persons. Holding records in the block and bringing dealings via blockchain set-up would provide reliable clients [20].

iv. Blockchain nodes

A node in the blockchain is a device and the kind of node is classified on the job made through it into the blockchain network. Such types of nodes are:

- Mining nodes – simply generate blocks plus insert them to the sequence which available above the set-up where full nodes authenticate and include them into the blockchain.
- Full nodes – This node organize manages and transmits the duplicates of blocks to the entire community nodes. During publishing its main work is to authenticate dealings up to the genesis block. Subsequent to justification, the records are transferred to every node in the system to make sure the dependability of the blockchain. If there are additional nodes with an additional decentralized community, it would emerge as difficult to steal or hack it. Super Node is a node that dependent on the number of swap over dealings created as of a full node. Constantly dynamic Super Nodes attach the left over full nodes and put together them to materialize everywhere in the community.
- Light nodes – It show comparable actions as full nodes, but only a part of the whole block they hold. Light nodes are not influential it only linked to the Full node. They assist build the community more decentralized because it don't take much room for data, and comparing to full node light nodes move long distance at low price.

v. Blockchain Layers
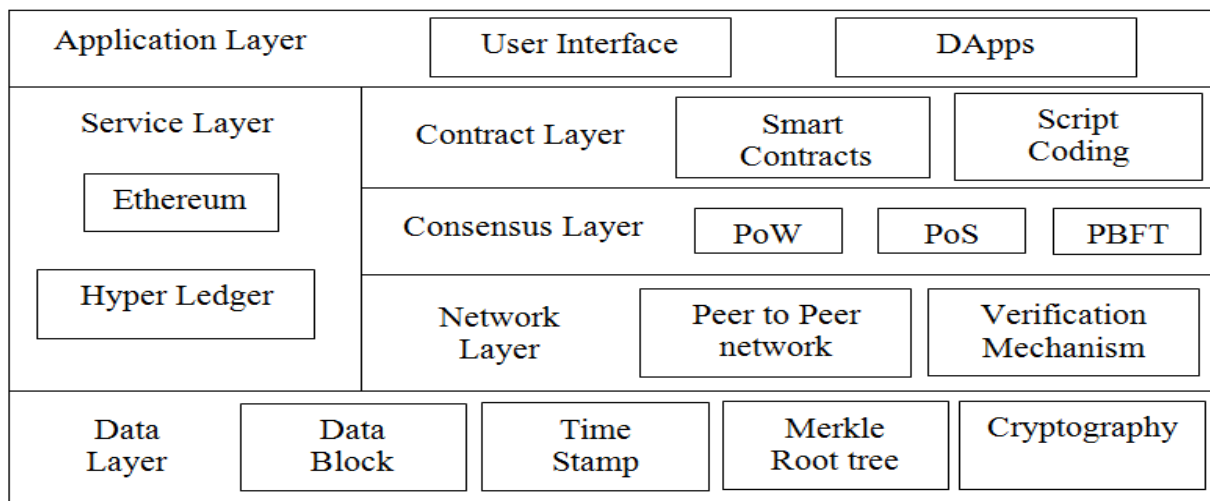
Figure1. Blockchain layers

As shown in figure 1. Blockchain does not enclose any tree arrangement. We can explain it with six layers: Top two layers, Data and Network layers assemble records and authenticate it.

Consensus algorithms are concerned in the consensus layer, for authentication [20]. To implement trust in the contract layer smart contracts are used. Through Services and Application layers Blockchain activities are implemented. In table 3, we revealed the workings available in every level of blockchain.

Table 3: Blockchain components of each layer

Components	Layer
Data Blocks, Chain structure, Cryptography, Timestamp, Merkle tree.	Data layer
P2P network, a broadcast protocol, Verification mechanism	Network layer
PBFT, PoW, PoS	Consensus layer
Script coding, Smart contract	Contract layer
Ethereum, IBM, Azure Hyperledger	Service layer
Cloud service, Health-care, Cryptocurrency	Application layer

vi. Hashing

It may be defined in easy languages as figuring out an exact thing from a set of same things. A huge quantity of records is changed into a hash key with the help of functions of hash. Hash table is a data structure used to store the value acquired by using a hash function. The function of hash uses hash table to obtained hash code or hash value [21].

vi.Smart Contracts

Nick Szabo in 1994 activated smart contracts within the shape of automatic business deal modus operandi. The idea of smart contracts added in advance than blockchain which can be described in digital shape as a sequence of commitments [17]. In a blockchain, Smart Contracts are program that run in a container. The information is alter-resistant and against-forged, as the information of smart contracts is available in the blockchain. The smart contract permits own-implementation at what time an exact situation is satisfied on all the nodes exist in the set-up [22]. A few researches give the solutions that smart contracts may have the capacity to assess efficiency, scalability and, availability. Smart contracts' accuracy evaluated by TDD and BDD. Ethereum is the good instance that creates smart contracts [23].

vii.Digital Signatures

A digital signature is described as electronically signed statistics dispatched from one-to-many or one-to-one, making sure no information thrashing. Each customer may have a public key and private key. If a customer wishes to transmit some information, he has to produce the hash value from the transaction records after that utilize their confidential secret key to encrypt the hash value. This method is referred to as electronically signing, and the phase is referred to as signing digitally. The transactions digitally signed are circulated all through to nodes exists in network. The payment data acquired can be decrypted with the assist of the unrestricted key of the beneficiary [24].

(ECDSA) Elliptic Curve Digital Signature Algorithm is utilized for authentication in the blockchain [25]. In verification phase the hash value is decrypted and confirmed by judging it by means of the value of hash achieved from the dispatcher's information.

viii.Blockchain Applications

Numerous blockchain based software are rising in our everyday life. The packages encompass Asset control, coverage claims, voting, smart appliances, smart car, food supply chain, smart phone, cyber security, e-passport, fitness concern management, and individual fitness file-keeping, marriage and death certificates, motor vehicle cyber physical scheme in the IoT, IoBT, Blockchain music, Identity management, academic records, Blockchain in 5G network, Blockchain in aviation sector, In smart homes, etc.
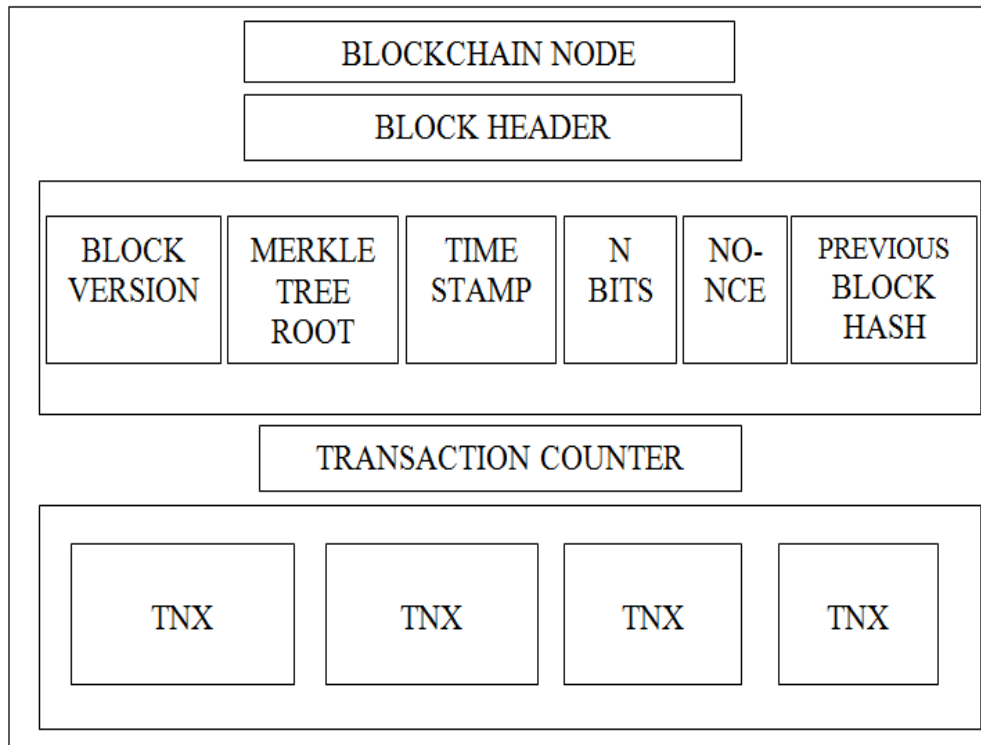
ix.Blockchain Architecture

Blockchain might be approximating a series of blocks which maintain the whole statistics integration to a set-up in an open community ledger. There are a block header and a block frame in each block. As shown in figure 2, in the block header there are six primary components exist [26]. They are:

- Block version: allow to follow the validation rule.
- Timestamp: generate timestamp with seconds for every block.
- Nonce: four byte field begins at zero and increase by every hash calculation.
- Target: entry of a suitable hash block.

- Previous block hash: the parent block pointed by256 hash value.
- Merkle tree root hash: when a transaction occurs, data is an encrypted using hashing algorithm and send to each node. In the block of each node thousands of records found therefore blockchain uses Merkle tree function to produce a Merkle tree root and final hash value.

Figure2. The blockchain architecture

x. Working of blockchain

Blockchain machinery shows constructing blocks holding records and is connected to the sequence of chain. Blocks are connected collectively throughout every block holding the prior block description [27]. If a few facts are altered in the preceding block, will change the value of hash key, and as a result in the Blockchain disparity of the hash key will occur. It stopped the altering of information. At what time a customer needs to transmit some business deal information to others, will be denoted as a block. Miners of the node require approving the business deal. When the block is produced the miners obtain the power to endorse a block by solving problems. After authentication block is included to blockchain that complete the business deal. The subsequent stage is to choose which customer generated the following block. The group of authenticated blocks is united into a sequence that creates a blockchain set-up [17].

Xi. Consensus Algorithm

The block requests to be confirmed as a valid one by every node exist in the network before adding into the blockchain. The consensus protocol is what decides how much money a node receives. Depending on the consensus protocol, only definite types of nodes receive currency. Consensus algorithms maintain the nodes concerned in the blockchain community to arrive at a business deal order conclusion and sift unacceptable transactions. Many transactions are challenging with each other to get published to achieve the compensation of the transaction. Consensus algorithms came into existence to solve the decision dilemma. To achieve a consensus for the miners is also complicated due to, lacking a middle power, the blockchain set-up is remote-access based on distributed set-up [17]. Similarity among dissimilar consensus set of rules illustrated in table 4. Kinds of consensus set of rules utilized in Blockchains are:

- Proof-of-work
- Proof-of-stake
- Practical Byzantine Fault Tolerance (PBFT)
- Delegated Proof of stake
- Ripple
- Tendermint

Table4. Comparison of different consensus algorithms

possessions	PoW	PoS	PBFT	DPoS	Ripple	Tendermint
Node individuality control	unlock	unlock	consent	unlock	Unlock	consent
power save	Not	unfair	Yes	Partial	Yes	Yes
Accepted Power of opponent	<25% Computing authority	<51% chance	<33.3% unusable replicas	<51% valuators	<20% defective nodes	<33.3% byzantine voting authority
Example	Bitcoin	Peer coin	Hyper ledger fabric	Bitshares	Ripple	Tendermint

Xiii. Blockchain Challenges

Blockchain is capable rising machinery however it handles a few conflicts that occasionally bound the practice of blockchain [24].

A few major confrontations are:

- Portability
- Governance
- Regulations and law
- Privacy leakage
- Storage
- Data management
- Consensus processes

III.   INCORPORATION OF CLOUD AND BLOCKCHAIN

A.   Blockchain assist for Cloud Computing

Cloud computing with Blockchain incorporation takes us into the next generation of data safety and service user-friendliness. Blockchain conquers the majority of the research problems of the cloud with its features.

- Data integrity - All of us know the facts are decrypted earlier than saving it over the cloud that raises the issues on truthfulness of facts. Within the blockchain community, using cryptographic algorithms all of the block statistics is converted into a hash code moreover it produces a value i.e. hash key for every block. Suppose blockchain is utilized to protect job setting up in the cloud. To make sure correctness and everlasting records truthfulness, to manage structure that gathers facts from the job setting up generates hash code and stored it in the blockchain system right away. The ability of Blockchain is block detection consensus technique due to which block data integrity is maintained.

- Service contracts - These contracts inside the cloud are beneficial to the resource contributor or client with no identical fairness. To resolve this problem, we can employ smart contracts of blockchain. A smart contract facilitates in blockchain to construct faith among the customers who do not recognize one another.

- Interoperability - Within public clouds, inner conversation is not approved, due to which many businesses move away from usage of the cloud. After cloud incorporated with blockchain, believing the dissimilar clouds as nodes. Inter-node conversation is feasible within the set-up of blockchain. Every node available in the identical network shares the facts amongst themselves in order that each node holds a duplicate of transactions hence clearness into the arrangement of set-up. They inform each subsequent operation into the ledger that made known to every different node. Herein manner, agencies be able to include several of networks and might keep the ease of access to the facts that gives faithfulness into the network.

- Data management of Cloud - The record saved within the cloud is in a much amorphous way. The record saved within the blockchain is a completely prearranged way. The hash key produced for every block is used to trace data. Every block holds the hash key of preceding block, and it's key to maintain road of the set-up. The facts in the block are authenticated and fetched by the nodes exist in the network. Cloud sustains flexibility and might deal with the variations in computing burdens at what time necessary. The use of a dispersed ledger, it will be without any problem managed by controlling a huge variety of dealings that reason a diversity of smart contracts, make sure facility service eminence. Blockchain in addition guarantee the client's secrecy, and the customer's data may be securely eliminated from the structure to put off other third party get entry to the customer's records. The combination of the cloud and blockchain will even make certain that numerous industries have confidence, and it will be an on-order facility.

B.   Blockchain Cloud Survey

Based on Blockchains' maintaining cloud computing, Blockchain offers many necessary advantages to cloud computing like information transparency, permission, and additionally offer price-effectual results. A number of the major advantages which, Blockchain is offering cloud facilities are showed in Figure 3. As everyone knows that blockchain may be installed in private, public, and community types and offer remote-access i.e. decentralization. Based on different security requirements, we have done a comparable study on the services made available by blockchain and cloud. One of the important gaps in services of cloud is records protection. By way of this study, we may possibly wind up that the records in the cloud will be more protected by implementing the Blockchain platform. In table 5, we make available based on different protection needs relative study of Blockchain and Cloud.

Various Blockchain-Cloud packages may be useful in our everyday actions, making our records more protected and safe. Different businesses can employ the offerings of Blockchain-Cloud. This combination able to make available us with additional saving space agility, and on the like occasion, it holds the authenticated records. Permission to the set of connections will be supervised, and also it will amplify the set-up flexibility. In figure 4, we offered a thoughts diagram with dissimilar forms of Cloud Blockchain packages.
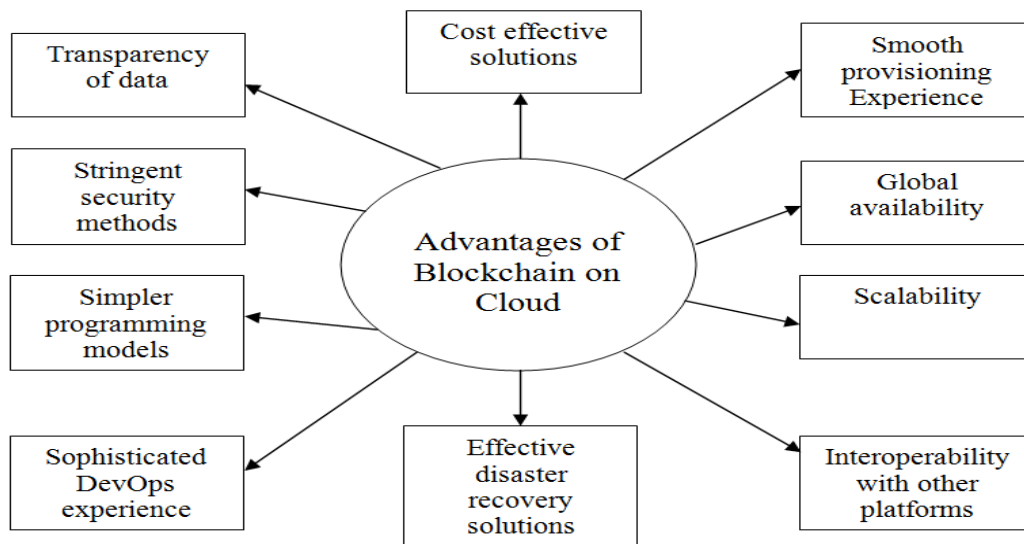
Figure3. Blockchain providing benefits to cloud

Within figure 5, we showed the stream of blockchain through cloud statistics as follows. We can include blockchain services to develop cloud records protection. The information that desires to be saved in the blockchain is separated into tiny portions and after that with hashing set of rules encrypted the divided facts. It is confirmed and authenticated by a consensus mechanism prior to adding the data into the chain. On the basis of the necessity, the contributor can employ a public blockchain or private blockchain.

Table5. Blockchain and cloud-based comparison study

Requirement	Cloud Public	Cloud Private	Cloud Community	Blockchain Public	Blockchain Private	Blockchain Community	Cloud Centralized	Blockchain Decentralized
Data Integrity	fewer apt	Neutral	fewer apt	extra apt	fewer apt	Neutral	fewer apt	extra apt
Trust	fewer apt	Neutral	fewer apt	extra apt	fewer apt	Neutral	fewer apt	extra apt
Non-repudiation	fewer apt	Neutral	fewer apt	extra apt	fewer apt	Neutral	fewer apt	extra apt

| Privacy	fewer apt	Neutral	fewer apt	extra apt	fewer apt	Neutral	fewer apt	extra apt
Utilization	extra apt	N/A	Neutral	extra apt	fewer apt	Neutral	extra apt	fewer apt
Immutability	fewer apt	Neutral	fewer apt	extra apt	fewer apt	Neutral	fewer apt	extra apt
Scalability	extra apt	N/A	Neutral	extra apt	fewer apt	Neutral	extra apt	extra apt
Privacy	fewer apt	Neutral	fewer apt	extra apt	fewer apt	Neutral	fewer apt	extra apt
Flexibility	extra apt	fewer apt	Neutral	Less Likely	extra apt	Neutral	extra apt	fewer apt
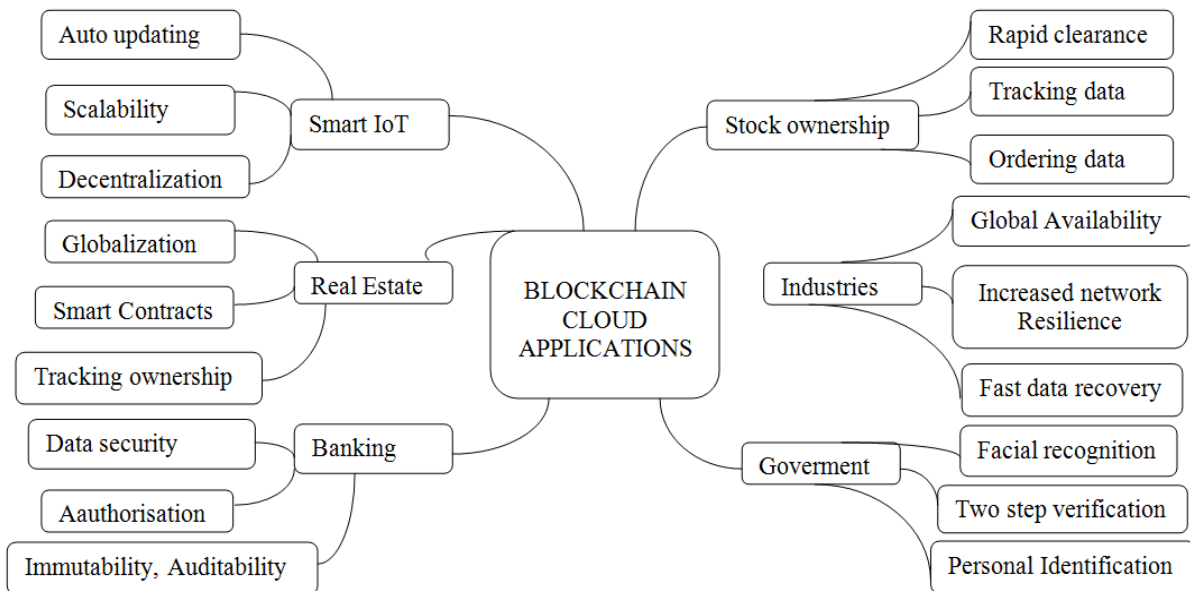
Figure4. Blockchain cloud applications types

C.   Architecture of Integrated Model

Within figure 6, revealed the structure of the combination of cloud computing in the company of blockchain machinery. By the support of the application layer the customer relates with the server. At what time a customer desires a business deal by the application layer, and then particulars of dealing are saved by generating a block for every operation.

To include the generated block into the blockchain community, the blockchain community's facts could be confirmed through validating nodes of blockchain community. The confirmation could be carried out over the basis of consensus. Just once the block is taken into consideration valid, all different community nodes might be linked to the network and transmitted records.
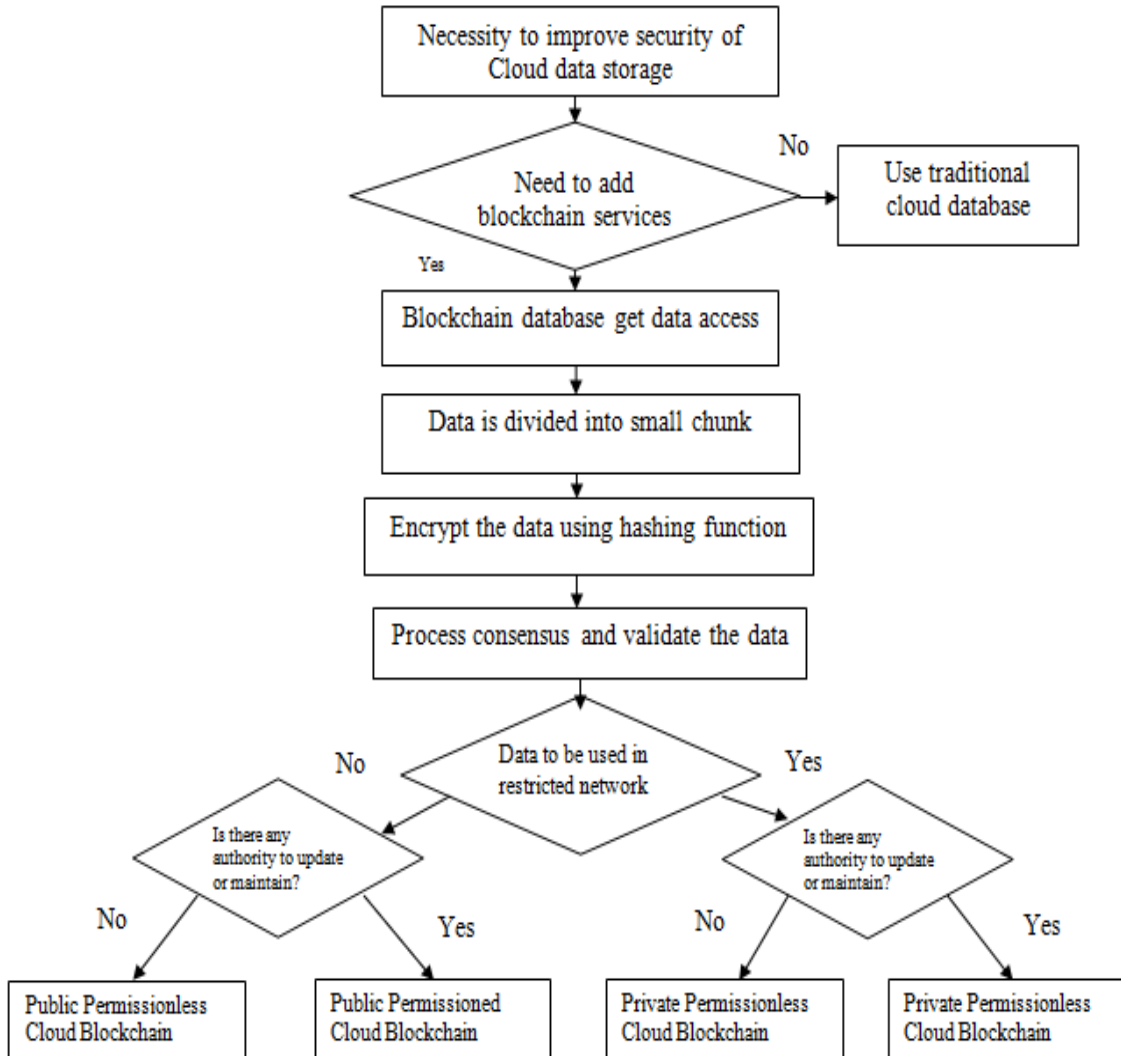
Figure5. Process of Blockchain with cloud data

The entire blockchain records are saved in blockchain safety cloud storage space. The combination of Blockchain and the cloud endow with records security, transparency and also get better services.
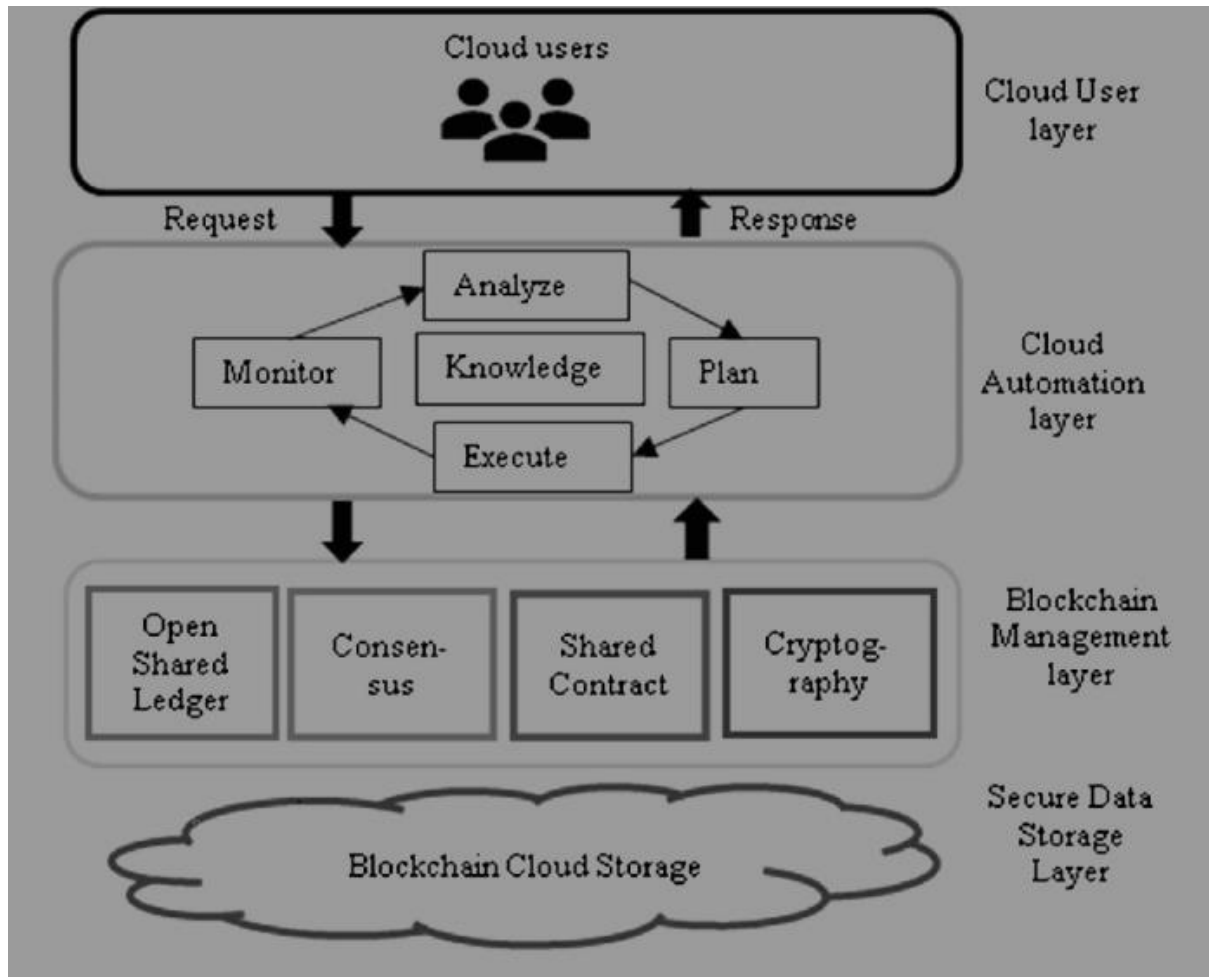
Figure6. Structure of Cloud integrated with Blockchain

CONCLUSION

Cloud computing is a distinguished technology existed for decades. However human beings are nonetheless struggling to conquer some demanding situations of cloud computing like records protection, interoperability, data control, etc. Blockchain is promising technology eminent for its protection and accuracy which can be building the world flips to its region. By combining cloud computing with blockchain, there can be lots of blessings within safety, faith, dependability, records supervision, utilizable, and plenty of other blessings. Within this research work, we in brief established blockchain technology, cloud computing. We mentioned the advantages of combining the scalable cloud environment with a blockchain network to improve confidence, server facility, records protection, and customer records management.

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