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AN EMERGING APPROACH OF BLOCK CHAIN TECHNOLOGY, COT AND IOT APPLICATIONS AND CHALLENGES

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Abstract

The block chain technology is taking the world by storm. Block chain with its decentralized, transparent and secure nature has emerged as a disruptive technology for the next gener-ation of numerous industrial applications. One of them is Cloud of Things enabled by the combination of cloud computing and Internet of Things. In this context, block chain provides innovativesolutions to address challenges in Cloud of Things in terms of decentralization, data privacy and network security, whileCloud of Things offer elasticity and scalability functionalities to improve the efficiency of block chain operations. Therefore, a novel paradigm of blockchain and Cloud of Things integration, called BCoT, has been widely regarded as a promising enablerfor a wide range of application scenarios. In this paper, we present a state-of-the-art review on the BCoT integration to provide general readers with an overview of the BCoT in various aspects, including background knowledge, motivation,and integrated architecture. Particularly, we also provide an in- depth survey of BCoT applications in different use-case domains such as smart healthcare, smart city, smart transportation and smart industry. Then, we review the recent BCoT developments with the emerging block chain and cloud platforms, services, and research projects. Finally, some

important research challenges and future directions are highlighted to spur further research in this promising area.

Keywords : Block chain, cloud computing, Internet of Things, Cloud of Things, security and applications

1. Introduction

Current years have eyewitness the explosion of interest in block chain, across a wide span of applications from crypto currencies to industries. The speedy enlargement in the implementation of block chain as a troublemaking technology is paving theway for the next generation of financial and industrial service sectors. Indeed, new research activities on block chain and its applications take position day by day, impacting many aspects of our lives, such as finance energy and government services. From a technical perspective, block chain is a distributed ledger technology that was first used to serve as the public digital ledger of crypto currency Bit coin, Unicoin for economic transactions. The block chain is fundamentally a decentralized and public database. The concept of block chain is based on a peer-to-peer set of connections structural design in which trans- action information is not forbidden by whichever single centralized entity. Connections stored in a chain of blocks are publicly accessible to all block chain network members in a trustworthymanner. Block chain uses consensus mechanisms and cryptography to validate the legitimacy of data transactions, which guarantees resistance of linked blocks against modifications and alterations. In fastidious, the block chain technology also boasts the pleasing characteristics of decentralization, accountability, and security which improve service efficiency and save outfitted costs. Such exceptional properties pro- mote the usage of applications built on block chain in modern years. Thus, it makes now the correct time to pay concentration tothis hot research topic.

2. Why Block chain and Cloud of Thing

Today the revolution in the field of information and communication has created a prosperity of opportunities for highly developed technologies, especially Internet of Things (IoT)and Cloud computing. IoT has reshaped and changed our lives with various new industrial, consumer, and profit-making services and applications. Typically, IoT is a system ofphysical objects that can be supervised, controlled or interactedwith by ever-present electronic devices to allow ubiquitous industrial services, e.g., smart cities, smart industries, etc. Dueto the partial resources of IoT devices, they always hand over IoT application tasks to Cloud computing, which gives birthto the Cloud of Things Cloud of Things paradigm. The Cloud of Things make available a flexible, strong cloud computing environment for processing and managing IoT services, showing great prospective to improve the system performance and efficiency ofservice delivery. However, the conventional Cloud of Things infras- structures tend to be unsuccessful due to the following challenges.First, the predictable Cloud of Things solutions have for the most part relied on centralized communication models, e.g. central cloud, for IoTservice procedures which make it hard to scale when IoT net- works become more widespread. Furthermore, most contemporary Cloud of Things systems permission trusting a third party, e.g. a cloudprovider, for IoT data processing, which elevates data space

to you concerns. Final, the federal network infrastructure results in higher announcement latency and power consumption for IoT devices due to long data transmission, which obstructs the large-scale deployments of Cloud of Things in sensible scenarios.

3. Supportive Benefits of Cloud of Things to Block Chain

3.1 Scalable support System

In large- scale block chain applications, the quantity of transactions in block chain networks can be gigantic. Consequently, itis extremely necessary to provide powerful data handing out services to increase speed transaction execution in orderto enable scalable block chain services. In this situation,the cloud can offer on-demand computing resources for block chain procedures thanks to its softness and scalability competence.

For example, public clouds can offera large-scale network of resources for blockchain service operators in a federated cloud environment.

3.2 Fault Tolerance

Cloud can help duplicate block chain data across a network of computing servers which are interrelated robustly by mutual clouds. Thiswill make light of the single-failure risks due to the distractionof any cloud node and thus ensure uninterrupted services. Further, the inter-cloud ecology can enable the block chain system to function endlessly in the eventof a certain cloud server being under molest.

4. Emergence of Block chain vs Cloud of Things

Blockchain is mostly known as the technology underlying the virtual crypto currency Bitcoin which was invented in 2008 by a person known as Satoshi Nakamoto.In a nutshell, the block chain is briefly explained as public, expectation and shared ledger based on a peer-to-peer network. This emerging technology has also recently become a hot topicfor researchers and been argued to innovate block chain-based applications beyond Bit coin.

4.1 Network of Block Chain Technology

A blockchain network is construct from some key modules, including data block, distributed ledger, agreement, and smart contracts. To be clear, each block contains a number of transactions and is linked to its right away-previous block from side to sidea hash label. In this way, all blocks in the chain can be traced back to the previous one, and no modification or alternationto block data is possible.

4.2 High Security System

Blockchain can make available high-security properties for its applied scenarios, such as Cloud of Things. The most significant characteristic is delegation which means block chain does not rely on a central point of be in charge of to manage transactions. This outstanding property brings promising benefits, including eliminating single point malfunction risks due to the disruption of innermost authority, saving prepared costs and attractive responsibility.

4.3 Transparency System

An additional imperative feature is transparency which stems from the fact that all information of transactions on block chain is viewable to all network participants. In other words, the same copy of records of block chain spreads across a large network for public verifiability. As a consequence, all block chain users can completely access, authenticate and track operation activities over the network with equivalent exactly.

4.4 Decentralization Technique

The decentralized agreement algorithms in block chains frequently necessitate extensive processing power and high computing energy to mine blocks and preserve the block chain network. This makes block chain infeasible to resource-constrained IoT procedure in Cloud of Things applications. Even though we can carry out energy-intensive block chain mining in a centralized cloud, this would essentially negate the advantages of a dispersed COT.

5. Importance of Cloud of Things

Nowadays, IoT has constituted a fundamental part of the future Internet and drawn increasing attention from academics and industries thanks to its great potentials to deliver exciting services across various applications. IoT faultlessly interconnects varied devices and objects to generate a physical environment where sensing, processing and communication procedure are implemented robotically without human involvement. On the other hand, massive volumes of data generated from a large number of devicesin current IoT systems become a bottleneck in assurancethe desired Quality of Service (QoS) because of constrained power and storage resources of IoT devices. for the time being, cloudcomputing has unlimited resources in terms of storage and computation power, which can provide on-demand, powerful and efficient services for IoT use areas. In general, the CoT platform can offer immediate services to users wherever and anytime thanks to automatic resource pro- vision competence of cloud computing. It facilitates autonomous service delivery without the need for human engagement. With unlimited practical processing capabilities of cloud computing, CoT open up new opportunities to improve IoT computation by enabling data offloading and implement data remotely. This not only improves computation abilities of local devices, but also addresses effectively issues of IoT systems in terms of power-saving and bandwidth preservation.

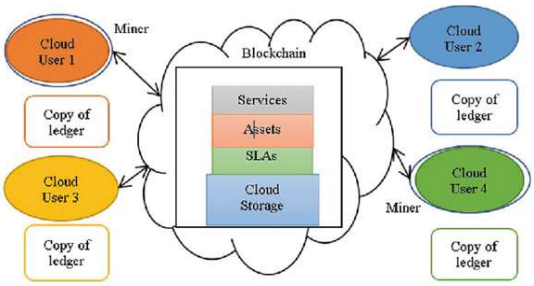

Fig: 1 Block chain vs Cloud of Things

6. Applications of Block Chain Technology

Such as smart healthcare, smart city, smart transportation, and smart industry have an important role.

6.1 Smart Healthcare

Healthcare is an manufacturing sector where associations and medical organizations provide health- care services, medical equipment, and medical assurance to facilitate healthcare delivery to patients. The adoption of BCoT models can present great potentials to resolve critical issues in terms of security and service efficiency, and thus is possible to advance medical services and transform current healthcare system.

6.2 Health data sharing

CoT enable efficient healthcare data sharing environments where EHRs can be processed and stored online on the cloud storage while users can use their mobile devices (e.g., smartphones) to access their medical information for health monitoring. This promises to offer on-demand healthcare ser- vices, save healthcare costs, and improve quality of experience [83]. However, healthcare data sharing based on such dynamic cloud IoT environments is always vulnerable to security and privacy risks due to attack potentials and the lack of trust between healthcare cloud providers, cloud storage, and users

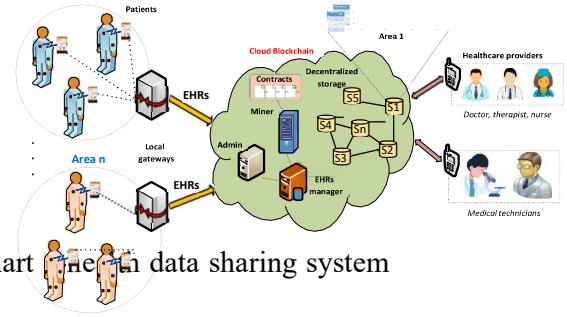

Fig. 2: A smart healthcare data sharing system

6.3 Transfer Contracts and Wills

We are moving away from the days when contracts or wills were made on paper with different middlemen involved. Thanks to Blockchain technology, paper wills, contracts, and inheritances may now be replaced with digital ones. Smart contracts are another name for these. Smart contracts bind all parties to the document legally. This data is kept on the blockchain network and may be retrieved when needed, binding all participants to the terms established in the smart contract.

6.4 Management of the Supply Chain Management

The unchangeable ledger of blockchain makes it ideally suited to activities like real-time tracking of commodities as they travel and change hands across the supply chain. Using a blockchain provides enterprises carrying these items with various possibilities. An entry on a block chain might be used to prioritize supply chain tasks such as allocating freshly delivered commodities among numerous shipping containers. Block chain technology offers a new and dynamic way of organizing and utilizing tracking data.

6.5 Protection of Copyright and royalties

Many copyright and ownership regulations on music, films, blogs, and other internet content are required in today's world. Blockchain technology can make these regulations more secure and easy to apply. It also provides content creators and artists with real-time and genuine royalty distribution statistics. Any type of digital material download might be traced to guarantee that the artist or author gets their fair share.

6.6 Crypto currency

Crypto currency is one of the most prominent block chain applications. Everyone is aware of bitcoin. One of the numerous benefits of adopting block chain for crypto currencies is that it has no territorial boundaries. As a result, crypto currencies may be utilized for global transactions.

The only thing to remember is that exchange rates may fluctuate and that consumers may lose money in the process. This alternative, however, is far superior to localized payment applications, such as Pay tm in India, which are only applicable in a single nation or geographical region and cannot be used to send money to individuals in other countries.

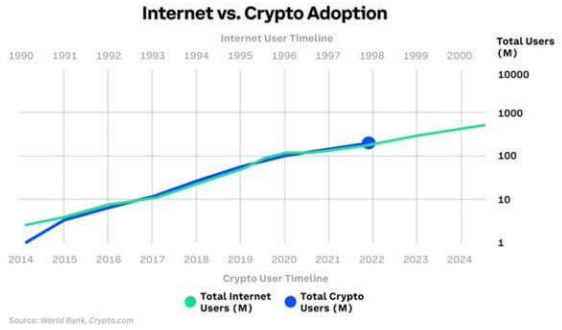

Fig 3.Internet vs Crypto Adoption

6.7. The Internet of Things (IoT)

The Internet of Things (IoT) is a system of networked devices that may exchange data and communicate with one another to provide useful insights. When a system of "things" is linked, it becomes IoT. The most prominent example of IoT is the Smart Home, in which all home equipment such as lighting, thermostats, air conditioners, smoke alarms, and so on may be connected on a single platform. Block chain, on the other hand, is required to provide security for this enormously dispersed system. In IoT, system security is only as good as the least secure device, which is the weak link. In this case, block chain can ensure that the data received by IoT devices are safe and visible only to trustworthy parties.

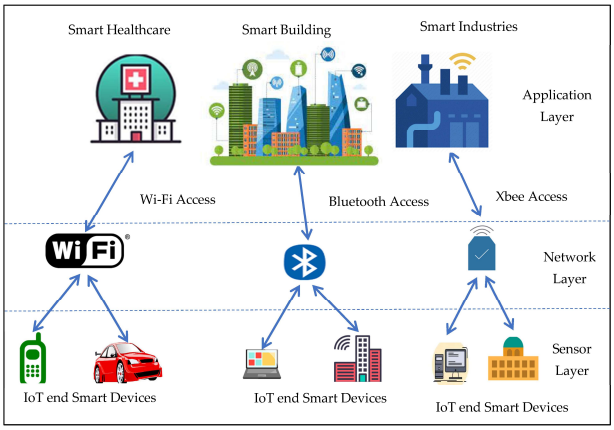

Fig: 4 IOT vs BCOT

7. Research Challenges

We highlight five major challenges in BCoT research, namely standardization, security vulnerability, privacy leakage, intelligence, and resource management.

7.1 Standardization

Since its inception, the blockchain technology has revolutionized industries by offering new net- work models with its decentralized and secure natures. The arrival of this emerging technology is potential to change the current shape of CoT markets and transform industrial network architectures with advanced BCoT paradigms.

7.2 Security Vulnerability

Although block chain can bring security benefits to CoT thanks to its distributed nature immutability, verifiability, and encryption, security issues inBCoT still remain due to the vulnerabilities of both CoT andblockchain systems. In CoT, there has been an increasing demand of outsourcing IoT data to clouds for storage andcomputation services due to the constrained resources of IoTdevices.

7.3 Privacy Leakage System

The privacy of IoT data in BCoTcan be compromised accidentally and hence the disclosure of data is respectively beneficial for the attacker and harmful to the users. In current BCoT systems, data can be stored off- chain in cloud storage to reduce the burden on blockchain.

7.4 Intelligence System

Currently, BCoT systems are mainly used for data storage, data sharing and security services. However, there has been a lack of research attention in integrating intelligent services in BCoT applications. In fact, modern industries have increasing demands in intelligent services suchas smart data analytics, smart decision making systems or automatic management tools to facilitate user service delivery.For example, a smart clinical support system based on cloud computing in healthcare can make diagnosis and treatment much easier.

7.5 Resource Management

In BCoT applications, to achieve sustainable profit advantage, cost reduction, and flex- ibility in cloud service provision, the resource management in cloud blockchain is vitally important and needs more research efforts. In fact, resource management in cloud blockchain networks requires adaptive and robust designs to solve series of technical problems, from resource allocation, bandwidth reservation to task allocation and workload allocation.
Results

8. Emerging Approach of Block Chain

Proof of Work (POW): POW is the mining technique used in Bitcoin and is currently used
by many other blockchain technologies. In this technique, mining nodes need to solve the hard-

mathematical puzzle. Once the nodes validate the transaction and solves the puzzle, the block is added to the blockchain network. Other mining nodes validate the block to make sure the submit-ted block is not false. Once all the miners agree that the block is legit, that block will be added to the blockchain and submitter mining node is rewarded. The agreement here is based on a majority consensus. Thus, it is difficult to fake unless the attackers compromise more than 50 percent of mining nodes

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8.2 Proof of Stake (POS): dissimilar POW, in POS mining nodes are not required to solve a computational mathematical puzzle. In this miner or next block creator is chosen in a random way. Here if the nodes wealth or stake is high that node has the chance being chosen to create the new block. In other words, more money a node has, higher its chance to mine the block. POS does not reward the miner in native version, but extended versions of POS awards and punish the miners based on their performance. In this method selection is totally based on richest account, this may result that a single account is handling all the creations.

8.3 Proof of Space: Proof of space is similar to proof of work except that the puzzle requires a lot of space. In this technique, the mining needs need to have a high luggage compartment capability instead of having a high computational capability. Several theoretical and practical implementations of POSPACE have been released however the challenge is high requirement of memory space.

8.4 Proof of Importance: This mining technique determine the significance of an individual node based on the transaction amount and the balance of that node. It assigns a priority with a hash calculation to more significant nodes. Then the node with the highest priority is chosen for the next block creation.

8.5 Measure of Trust: This is another way to perform mining. It uses the dynamic trust measure-ments and selects the node with the highest trust level as the block initiator. The trust worthiness is based on the node's behaviors; therefore, good behaving nodes that follow the protocols are rewarded. The trustworthiness is approximated by the history of good and bad actions that the node has taken so far. If specific node plans to increase its trustworthiness for several interactions in order to attack the network later. The MoT approach could be subject to malicious attacks

8.6 Minimum Block Hash: In this approach, a miner is chosen randomly and not based on its re-sources. The system selects the miners based on a generated minimum has value across the entire network. The next miner thus is selected randomly and the probability of selecting

the same miner is low. This approach was implemented on a modified Bitcoin network and it was shown to offer energy saving for mining.

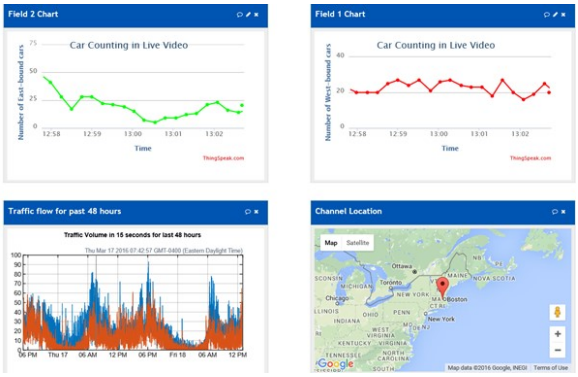

Fig: 5. Accelerate the development o Block Chain analytics

9. Conclusion and Future Scope

To realize the full potential of blockchain in future BCoT applications, improving blockchain efficiency is highly important. Due to the security features of blockchain, each blockchain node is often required to verify transactions and authenticate user messages, which may require large com-puting and storage resources. Blockchain also requires net- work bandwidth and energy resources from cloud services to implement the mining process. Moreover, current blockchain designs still remain scalability issues from the perspectives of throughput, storage and networking. For example, many current block chain platforms suffer from a long queueing time for transaction processing due to the block size restriction, which results in high block generation latency. In addition to that, each block chain node often has to store a copy of complete transaction data which poses a storage burden on the block chain system.

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