Lightweight Blockchain of Things (BCoT) Architecture for Enhanced Security: A systematic literature review

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*Abstract*—As the concepts of blockchain and the Internet of Things are more and more popular in the field of civil and military, many researchers are working on intelligent selection of blockchain based adaptive IoT application for enhanced security. The research to date has tended to focus on solutions rather than comparison between different solutions. After research 65 papers spanning over 20 years, we are trying to give a literature review of research on lightweight blockchain of things architecture for enhanced security. In particular, we first introduce integration of internet with blockchain technology and we will further talk about its challenges individually.

Keywords—Collaborative security, Lightweight blockchain of things, Blockchain security, IoT security, Traceability System

# Introduction

As technology have changed the way that we live, a multitude of devices connected in the network are providing us ways to communicate between machine and people in our data-drive society [1]. However, the pervasiveness of internet of things device undoubtfully gives the privacy and security some vulnerabilities. Weaknesses on the internet of things such as poor privacy and security vulnerabilities are getting more concerned [2].

Meanwhile, blockchain technology which offers the method to address the challenge of IoT technology has consequently formed the lightweight blockchain of things [3]. There are many researchers working on this new technology.

This technology is essentially a distributed database technology, which does not rely on a central or third-party organization to ensure the authenticity of the data. The objects stored in the database can not only be "value" such as Bitcoin, but can also store other things that need to be registered. It can be applicable to the area of Certification, traceability, transaction or sharing. More specifically, important industries such as ownership, production process, control signals, copyright and even health records are urgently need this technology [4].

In addition, once the conditions for the realization of the smart contract are reached, the blockchain system will automatically execute the contract and complete the benefit distributions [5], which is a very important feature.

But most studies in the field of lightweight blockchain of things for enhanced security have only focused on IoT security solutions but few of them are concerning about the common and difference among different solutions [6]. These studies would be more useful if they give a comparison between different methods.

Here we are trying to give a brief comparison between different blockchain technology with internet of things architecture. By implementing a series of observations, we are . But this is not the end, we still need to conduct further study to ascertain the effectiveness of lightweight blockchain of things. In this article, Our survey is focusing on blockchain security techniques that are designed for IoT.

# Methodology

## Methodology

In this paper, we used Barbara Kitchenham's Systematic Literature Review research method [7] to conduct extensive literature research and classify these literatures. Then, we carried out a secondary study to integrate research related to the topic and organized it in a mixed mode.

## Search Process

We are trying to cover a wide range of articles by searching keywords in the following databases: ACM Digital Library, IEEE Xplore, Springer, Wiley, Web of  
Knowledge. Related keywords are permuted and combined to find the related articles and weights are compared to sort these articles. We carefully selected 65 authoritative papers in the last 20 years and reproduced based on systematic literature review and secondary study [7]. It is possible to include the same article in multiple different databases. After sorting, we also screened out duplicate articles.

## Study inclusion and exclusion criteria

The research is based on multiple databases. We mainly focus on those journal articles with high index weight and journal with high authority. Conference proceedings and presentation abstracts are not taken into account. Initially, our scope had 65 papers. We closely followed the method proposed by Chris Hart [8] and gradually reduce the scope of papers to 30 high-quality papers.

# Research status

Blockchain is an open and transparent database. All data is shared by all nodes and is supervised by all users. Based on the characteristics of this technology centralization, the application scenarios of blockchain should also be further expanded and can be applied on the Internet of Things [9]. This innovative technology takes trust as its core and promotes the maintenance of security and privacy.

Since the concept of lightweight blockchain of things was put forward, academia has carried out many researches on it [10], which also provides a theoretical basis for the wide application of blockchain technology. Including but not limited to energy, medical, finance and other disciplines [11].

In recent years, the importance of blockchain technology has gradually increased. Generally speaking, people still lack effective corresponding technical solutions and management plans. We need to continue to accumulate experience to break this technical barrier [12].

Mandrita Banerjee proposed a blockchain future for internet of things and suggested several methods that are designed application of IoT [1] which can help to ensure the security and privacy of data. Ruinian Li’s research are mainly focus on blockchain and edge computing solutions applicable for large-scale of devices. In the approach of Qun Song [13], a supply-chain system framework is proposed which follow the architecture proposed by Vitalik Buterin [9] who divide the blockchain technology into three, namely public, private and consortium blockchain. The existing body of research of Abderahman Rejeb [14] suggests that leveraging internet of things and blockchain technology has great application prospects in supply chain.

Ali Dorri and others discussed the privacy and security in IoT devices due to their heterogeneity between such a large scale and talk about some solutions proposed by the previous researchers [15]. And finally suggest a smart home lightweight blockchain of things architecture consisting of smart home, the overlay, and the cloud storage.

Lijun Wei attempts to solve the problems using a trust management system in service-oriented IoT which will evaluate the trust worthiness of devices based on their identities [16]. This trust management system can prevent Self-promoting attacks (SPA), Bad-mouthing attacks (BMA) and so on.

Papers from Meiyu Lin [17] introduces a blockchain based IoT card system whose core function is real-name registration security management consisting of blockchain network infrastructure and point of scale terminal.

The study of Liangqin Gong set out to investigate the usefulness of BCoT sentry, a system which try to enhance the security by analyzing the traffic flow pattern in the peer to peer connection network [18].

[19] tries to establish a healthcare system with enhanced security in paper “ Blockchain and Its Role in the Internet of Things” which talks about the identification of healthcare field as a subsector of lightweight blockchain of things.

From the above research, we know that the lightweight blockchain is currently being used more and more widely. More scholars are trying to make breakthroughs in related fields, especially in security.

But at the same time, we must also realize that blockchain-related technologies are not omnipotent [20]. Multiple units can be combined into a huge whole to tamper with the data on the entire network. Once the computing power exceeds 51%, it will become An absolute majority is likely to be monopolized by huge interest groups [21]. What we want to achieve is advanced security rather than monopoly. Therefore, we must pay special attention to this.

In the paper of Steve Hickle [22], the application scenarios of various lightweight blockchain of things are depicted in the future, but they are limited by the possible problems of civilian IoT devices, such as poor performance to deploy a block network or insufficient device functions. If we try to solve these problems by improving the performance of the equipment, it will not be widely used because of the high cost.

At present, the requirements for IoT devices based on blockchain technology are higher. However, IoT devices have low power consumption and poor performance [23]. Nodes participating in the network are limited by resources, such as micro-sensors, it is difficult to store and keep accounts, and they cannot undertake consensus tasks [24]. In addition, the consensus node will have a relatively large impact on the performance of the blockchain network. If there are too many nodes. Consensus dissemination will take a lot of time, and in a large amount of data scenario, it is often not able to meet our needs [25].

# Application status

Blockchain, the core of lightweight blockchain of things, was first used as a means of monetary payment that tried to break away from the national credit system, but its application scenarios have gradually increased over time. Now this decentralization technology which an prevent single point of failure problem[26]. Moreover, its user anonymity is quite suitable for IoT device. This transparent in computing but non-transparent in identification technology can be further extends to the Internet of Things, medicine, and economic fields [27]. Its potential application scenarios even extend to election voting, notarization, recognition of academic qualifications, network security and so on.

There have been some commercial applications of lightweight blockchain in the world [27]. For example, the energy company LO3 Energy cooperated with Bitcoin company Consensus Systems to establish an interactive grid platform TransActive Grid based on the blockchain system and the Internet of Things technology.

At the same time, the ecology of the lightweight blockchain of things for enhanced security is becoming more complete. For example, a light code environment has emerged [28]. For example, a company called Blockchain of Things, Inc, is providing the draggable editor which can create bitcoin blockchain apps builder. We have face in the face that the prospects of blockchain is becoming more accessible with the improvement of related industries.

At present, commercialization is not completely perfect. In commercial applications, the lightweight blockchain of things still has a series of shortcomings [23]. The most important and most important issue is the lack of subjects. Because of the anonymity of subjects, we cannot find specific responsible persons and cannot carry out subsequent accountability.

In addition, blockchain technology has only been around for 9 years and is still in its infancy[29]. We can't even determine what potential problems exist in commercial applications of this technology.

# Conclusion

The core function of lightweight blockchain of things is to break trust barriers. This mechanism can achieve trust and self-organization, and promote the efficient development of business [30] . At the same time, we mainly conduct legality verification based on digital signatures to protect data security.

However, this technology also has certain shortcomings. Blockchain data needs to be synchronized to all nodes on the computing network, which limits the peak value of data processing, and also puts forward higher requirements on database capacity and bandwidth [31]. We need to update Blockchain technology system with shorter intervals. In addition, the fault tolerance challenge of the asynchronous consensus network of the blockchain also needs to pay great attention to [18]. Blockchain technology itself is an asynchronous consensus network. In theory, there is almost no algorithm to ensure that the system can guarantee absolute consensus.

In the end, the combination of blockchain and IoT technology simplifies the handover procedure and greatly increases the reliability of the data on the chain on this platform.

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