SECURITY OF INTERNET OF THINGS USING BLOCKCHAIN: AN OVERVIEW

Amandeep Verma*

Keywords: Security; BlockChain; IoT	**Abstract** Now days, Internet of Things (IoT) and Blockchain are new buzzwords across the world. IoT has substantial impact on human life. IoT consists of various heterogeneous devices that are communication over the globe. All IoT applications are producing huge amount of data daily, which raises the concerns about its security. Although there exist centralized access management technologies but there are numerous technical limitations to manage these resources globally. On the other hand, Blockchain, which is based on decentralized and distributed approach, maintains reliable archives of data at different locations with the help of tamper resistant ledger. Blockchain can address the data security concerns in IoT networks. This paper reviews the concepts of IoT, blockchain and advantages of incorporating Blockchain with IoT.

*UIET, Panjab University,Chandigarh, India

1. Introduction

Internet of things (IoT) is considered as the prospect or the next generation of internet. IoT connects daily used objects to the internet with a simple goal to provide the users with a smarter and efficient experience in various fields [1]. Numerous IoT applications include healthcare, smart cities, smart grid, water management, smart waste management etc., In the near future, the IoT devices will become an important part of our daily life [2]. Every IoT application uses as well as produces a large amount of electronic data through various sensors to manage heterogeneous resources. This data can be very critical and sensitive. So, its become very important to collect, transfer and process this data in some secure manner, otherwise, it can lead catastrophic events [3]. As, IoT is maturing very fast and making its presence in almost every field of technology, there would not be a single security solution for all IoT applications. Also, with its rapid evolution, it has made itself more prone to cyber-attacks. Therefore, there is an earnestness to mark IoTmore safe [4].

This paper reviews the concepts of IoT, blockchain and advantages and challenges of integrating Blockchain with IoT. Section 2 and section 3 of the paper give the understanding of blockchain technology along with its pillars. Section 4 describes the benefits of integrating IoT with Blockchain. In last, Section 5 concludes the paper.

2. Blockchain Technology

Blockchain is one of the emerging technologies in the IT industry. The blockchain technology was first came into existance in 2008 by Satoshi Nakamoto for the cryptocurrency called Bitcoin [5]. Blockchain was the building blocks for this peer to peer electronic cash system, which solved many existing problems in the prior versions of such systems.

The blockchain is a linked list of blocks. Each block consists of records. This list keeps on growing by adding a new block at the end of the record. The adjacent blocks of this chain are secured using cryptography hash functions. The blockchain is inherently resistant to modification of the data inside the blocks. After adding data to one block of the blockchain, it is difficult to modify the contents, as alteration in any data will result in the need for alteration of all the data

blocks, which comes after it. Therefore, blockchain is a secured method for storing and transferring the data[6].

Now a day, blockchain technology uses in numerous applications other than Bitcoin. It has the following properties [7]:

a) *Decentralized and Distributed*: Blockchainis based on decentralized and distributed approach in whichno central authority dictates the rules. Each network node retains areplica of the blockchain information.

b) *Data Transparency and Auditability*: The data is transparent and auditable as all the peers of blockchain have the full copy ofevery transaction ever executed in the system. So, every transaction is public to all the members.

c) *Decentralized Consensus*: The transactions over blockchain are validatedby all the nodes of a network instead of by a single entity in centralized approach which leads to decentralized consensus.

d) *Secure*: The blockchain is tamper-proof and cannot be manipulated by malicious actors.

3. Pillars of Blockchain
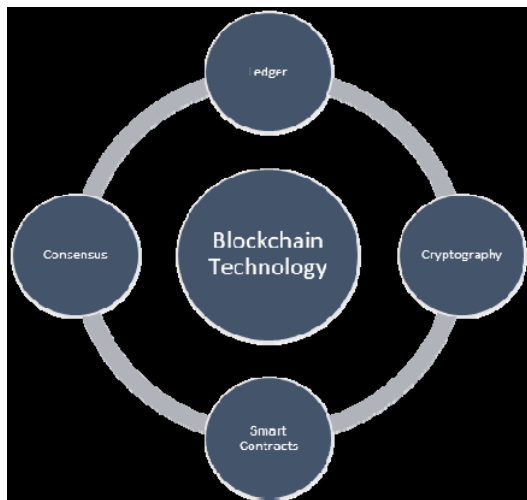
Blockchain technology basically has 4 pillars [8]:

Figure 1. Pillars of Blockchain [8]

a) Consensus, which provides the proof of work (PoW) and verifies the action in the networks

b) Ledger, which provides the complete details of transaction within networks.

c) Cryptography, it makes sure that all data in ledger and networks gets encrypted and only authorized user can decrypt the information.

d) Smart contract, it is used to verify and validate the participants of the network.

4. Integrating IoT with Blockchain

IoT consists of physical things or objects that are connected through a network of sensors, software's and electronics. It is emerged from the advancements in wireless sensor networks, mobile cloud computing and networking devices [9]. With the rapid development of IoT technology, its applications are also increasing day by day. Healthcare services[10], Smart Water Management, Smart cities [11], Smart home[12], Video surveillance[13], *etc*. are the major applications of IoT. These applications require large storage and fast computational resources Over the last few years, cloud computing technologies have contributed to providing the IoT with the necessary functionality to analyze and process information and turn it into real-time actions and knowledge. As IoT devices are generally of limited processing and storage capacities,IoT applications can be offloaded to the cloud. Thus, these applications can get the required resources from the cloud and at the same time, users should pay for these resources.

The integration of promising technologies like IoT and cloud computing has proven to be invaluable. Blockchain can improve the IoT by providing a trusted sharing service, where information is reliable and can be distinguishable [14]. In the cases where the IoT information should be securely shared between many participants, this integration would represent a key revolution. As alteration in any data block in blockchain, will result in the need for alteration of all the data blocks, which comes after it. Hence, a data leak in any part of the chain could lead to fraud. Therefore, a blockchain is a secured method for storing and transferring the IoT data.
The advantages of integrating IoT and Blockchain can be, but not limited to [15]

a. ***Decentralization and scalability***: The shift from a present centralized architecture of IoT to a Peer2Peer distributed architecture of blockchain technology, will overcome the problem of failures and bottlenecks of central points. It will also improve the fault tolerance and system scalability.

b. ***Identity:*** Using a common blockchain system, all the participants are able to identify every single device. Data provided and fed into the system is immutable and uniquely identifies actual data that was provided by a device. Additionally, blockchain can provide trusted distributed authentication and authorization of devices for IoT applications.

c. ***Autonomy***: With blockchain, devices are capable of interacting with each other without the involvement of any servers. This could benefit IoT applications to provide device-agnostic and decoupled-applications.

d. ***Reliability***: Asblockchain is tamper-proof and cannot be manipulated by malicious actors, data from IoT applications can remain immutable, reliable and distributed over time in blockchain. This will also improve sensor data traceability and accountability.

e. ***Security:*** Every data exchange over Blockchainis validated by smart contracts, thus leads to a secure communications between different devices. Current secure standard protocols used in the IoTcan be optimized with the application of blockchain.

5. Conclusion

This paper present an overview of the use of Blockchain to resolve the myriad of data security concerns in IoT. We have reviewed the key points where blockchain technology can help improve IoT applications. Advantages of integrating blockchain nodes on IoT devices have also been discussed. It is expected that blockchain will revolutionize the IoT in the coming years.

References:

[1]   Singh, Dhananjay, Gaurav Tripathi, and Antonio J. Jara. "A survey of Internet-of-Things: Future vision, architecture, challenges and services." IEEE World Forum Internet of Things (WF-IoT), 2014.

[2]   Atzori, and Morabito, "The internet of things: A survey", Computer Networks, 54(15), 2787–2805, 2010.

[3]   Humayed, Abdulmalik, "Cyber-Physical Systems Security—A Survey." arXiv preprint arXiv:1701.04525, 2017.

[4]   M. Díaz, C. Martín, B. Rubio, State-of-the-art, challenges, and open issues in the integration of internet of things and cloud computing, J. Netw. Comput. Appl. 67, 99–117, 2016

[5]   S. Nakamoto, Bitcoin: A peer-to-peer electronic cash system, 2008. Available online: https://bitcoin.org/bitcoin.pdf

[6] C. Li and L.-J. Zhang, "A blockchain based new secure multi-layer network model for Internet of Things," in *Proc. IEEE Int. Congr. InternetThings (ICIOT)*, pp. 33–41, Jun. 2017.

[7]   Xu Wang, Xuan Zha, Wei Ni, Ren Ping Liu, Y. Jay Guo, XinxinNiu, Kangfeng Zheng. "Survey on blockchain for Internet of Things" , Computer Communications, 136, pp; 10-29,2019

[8]   Madhusudan Singh, Abhiraj Singh, Shiho Kim. "Blockchain: A game changer for securing IoT data" , IEEE 4th World Forum on Internet of Things (WF-IoT), pp: 52-55, 2018

[9]   L. Schubert, K. Jeffery, and B. Neidecker-Lutz, "The Future of Cloud Computing. Opportunities for European Cloud Computing Beyond 2010," *Eur. Comm. Cloud Expert Gr.*, p. 66, 2010.

[10]   D. Gachet, M. De Buenaga, F. Aparicio, and V. Padr??n, "Integrating internet of things and cloud computing for health services provisioning: The virtual cloud carer project," in *6th International Conference on Innovative Mobile and Internet Services in Ubiquitous Computing, IMIS 2012*, pp. 918–921, 2012

[11]   R. Petrolo, V. Loscrí, and N. Mitton, "Towards a smart city based on cloud of things," in *ACM international workshop on Wireless and mobile technologies for smart cities - WiMobCity '14*, pp. 61–66 , 2014

[12]   S. Y. Chen, C. F. Lai, Y. M. Huang, and Y. L. Jeng, "Intelligent home-appliance recognition over IoT cloud network," in *9th International Wireless Communications and Mobile Computing Conference, IWMC 2013*, pp. 639–643 , 2013

[13]   R. C. Andrea Prati , Roberto Vezzani, Michele Fornaciari, "Intelligent Video Surveillance as a Service," in *Intelligent Multimedia Surveillance*, A. C. Pradeep K. Atrey, Mohan S. Kankanhalli, Ed. Springer Berlin Heidelberg, pp. 1–16, 2013

[14]   Oscar Novo. "Blockchain Meets IoT: an Architecture for Scalable Access Management in IoT" , IEEE Internet of Things Journal, 5(2), 2018

[15]   Ana Reyna, Cristian Martín, Jaime Chen, Enrique Soler, Manuel Díaz. "On blockchain and its integration with IoT. Challenges and opportunities" , Future Generation Computer Systems, 88, pp: 173-190,2018