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# A High Performance Blockchain Platform for Intelligent Devices

Shitang Yu, Kun Lv, Zhou Shao, Yingcheng Guo, Jun Zou, Bo Zhang

***Abstract*—In the area of IoT (Internet of Things), more and more intelligent devices are being connected to the Internet. These intelligent devices have been producing a huge amout of useful data over time, however there is still a lack of a platform which can efficiently transfer and utilize the value of the massive IoT data. Blockchain is able to transfer value with a relative low cost, which makes it possible for the data from smart devices to create economic value. This work of this paper is to design a high performance blockchain platform, using technologies such as distributed network architecture, intelligent devices node mapping, as well as PBFT-DPOC consensus algorithm to realize the decentralized autonomy of intelligent devices.**

***Index terms*—Blockchain, Intelligent Device Nodes Mapping, PBFT-DPOC**

## I. Introduction

People are benefiting more and more from technological advancement, and enjoying more convenient and efficient services provided by intelligent devices, such as traffic lights, automatic vending machines, etc. In the past, people did not realize or could not capture the plentiful valuable data generated while using these devices. However, with the increase of awareness promoted by the big data boom, it has been a universal consensus that data is the most valueable asset of a business. With sound protection of data privacy, people are trying to make better use of the data created by intelligent devices. However, at present, there is no comprehensive platform that can make the intelligent devices easy to access and continuously exchange data value at low cost. The blockchain technology has the characteristics of high security, decentralization, and tamper-proof, which enables all participants to realize value interconnection and transmission at a very low cost.This paper explores the possibility of building a high performance blockchain platform for intelligent devices to shift from traditional services providers to data value providers and consumers, so that it can create more value.

## II. Related Work

In order to build an efficient blockchain network for intelligent devices, this paper makes a in-depth study on characteristics and mechanism of blockchain technology and intelligent devices network.

### A. Blockchain

Blockchain technology is a new technology that integrates decentralization, distributed computation, asymmetric encryption, timestamp, consensus algorithm[1]. It provides a distributed ledger that simplifies account reconciliation process through encryption techniques and distributed message transmission protocol, and maintains a large amount of data through decentralization. It is able to boost data processing efficiency, and provides data sharing function while still ensuring data security. Therefore, comparing to traditional technologies, blockchain technology is equipped with the strengths of sustainability, compatibility, data sharing, and interconnectivity.

### B. Internet of Intelligent Device

At present, most intelligent devices are connected to the central server of their corresponding carriers through network optical fiber, to increase the maintenance efficiency[2]. At the same time, there are very few intelligent devices to further utilize users' data. The advancement of online payment technology enables the intelligent devices to obtain information of actual users. Through further analysis and use of data, it can realize functions such as distributing the rights and interests of users' consumption data by intelligent devices and pushing targeted advertisements, and realize higher value of data.

## III. Proposed Solution

In order to ensure the security and stability of the system, the inherent characteristics of intelligent devices, such as functional specificity and minimum system configuration, are fully considered in the design of the system. In the process of joining the blockchain network, intelligent devices do not actually carry out "mining" or similar resource-consuming proof of work, so as to ensure the stable operation.

### A. Network Architecture

This system mainly adopts a three-layer architecture, including the intelligent device layer, blockchain layer and DAPP layer, in which the intelligent devices and blockchain nodes are connected by the mechanism of node-to-node mapping, as shown in the Fig. 1 below. Distributed architecture is adopted among blockchain nodes to realize the sharing and maintenance of accounts through consensus algorithm. DAPP layer mainly provides data service interface for data consumers. DAPP developers can develop personalized DAPP applications according to users' actual needs. The open blockchain system adopts the mode of issuing token for incentivizing users and distributing equity, so as to encourage all participants to actively participate in system maintenance and ensure its stable operation.

### B. Intelligent Device Nodes Mapping

Due to the limited hardware resource of intelligent devices, the utilization of the intelligent device for resource-consumptive "mining" operation may cause device downtime or other problems. Therefore, this paper proposes a node-to-node mapping mechanism. In this mechanism, each intelligent device can be mapped to a node in the blockchain network through the identity registration protocol, and then participate in the verification and maintenance of the entire intelligent device blockchain. This

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Shitang Yu (ystang@grgbanking.com), Kun Lv (lkun10@grgbanking.com), Yingcheng Guo, Jun Zou(zjun23@grgbanking.com), Bo Zhang(zbo20@grgbanking.com) are with Department of Research and Development, GRG Banking Blockchain, Guang Zhou, China
Zhou Shao is with China Computer Federation, Technical Committee of Blockchain

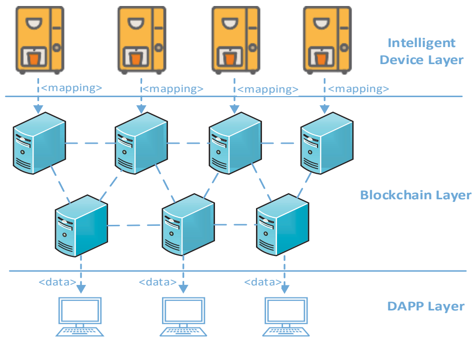


Fig. 1. Network architecture of intelligent device blockchain platform

node can be either a lightweight node or a Block Producer node. Intelligent devices can share users' useage data in the blockchain network through this node, and get rewards after the data is consumed and used by others.

### *C. PBFT-DPOC Consensus Algorithm*

Numerous devices and their limited hardware resources will exert great pressure on the blockchain network if all nodes participate in bookkeeping activities. Therefore, this paper puts forward a new DPOC (Delegated Proof of Contribution) algorithm to enable any node in the network to run for BP (Block Producer). Candidates need to contribute their own hardware infrastructure (including computing power, storage, and bandwidth), and all nodes can take part in voting. The final campaign ranking is determined by votes and miner's weight-sum ranking of seniority. The actual vote is calculated by the following formula:

$$S = \left(\sum_{i=0}^{n} N_i\right) \times k\% + M \times (1 - k)\% \qquad (1)$$

Where $S$ is the number of votes; $N_i$ is the number of votes for node $i$; $k$ is the proportion coefficient of token; $M$ is candidate's seniority. 21 super nodes and several substitute nodes will be generated during the voting process. These super nodes generate blocks through PBFT (Practical Byzantine Fault Tolerance) algorithm and finally reach consensus[3][4]. Every block has the digital signature of the remaining BP nodes, and if a dishonest or inactive node is found during the block verification process, it will be blacklisted and replaced by a substitute node.

### *D. Economic Model*

Intelligent devices need to pay a certain amout of tokens to upload the users's behavioral data, so as to prevent the device from maliciously uploading a large number of invalid data and causing network congestion. At the same time, after a BP node generates a block, it will receive a certain number of tokens as reward, which will encourage more nodes to compete for bookkeepig, and they collectively maintain the consistency of the blockchain ledger. DAPP developers, who develop personalized applications for intelligent devices, need to pay a certain amount of tokens for deploying DAPP to the blockchain, and tokens can be earned from DAPP users as a service charge. In order to obtain the corresponding data resources, the data consumer needs to pay some tokens to the data producer before using the data. Ordinary users of intelligent devices, can obtain certain token rewards after using intelligent devices and use these tokens to exchange goods or services from various device operators.

## IV. RESULTS

This paper tested the transaction throughput and system delay of the intelligent device blockchain, and compared it with the performance of public blockchains such as Bitcoin and Ethereum[5][6].

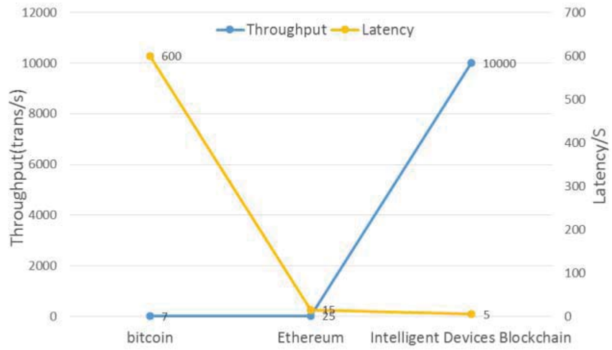


Fig. 2. Throughput and latency results of different blockchains

The result in Fig. 2 shows that the intelligent device blockchain has higher transaction throughput and lower transaction latency than that of Bitcoin and Ethereum.

## V. CONCLUSION

The main contribution of this paper is the design of a high performance blockchain platform for intelligent devices. The platform achieves efficient connection of intelligent devices through the node-to-node mapping mechanism of intelligent devices. At the same time, we design a blockchain consensus algorithm for intelligent devices, which provids higher consensus efficiency while guarantee the decentralization, provide higher efficiency. This system can make all the relevant parties of the intelligent devices obtain higher efficiency and benefits, and achieve a result of multi-win.

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