When Blockchain-Enabled Internet of Things Meets Cloud Computing

Hui Lei, Futurewei Technologies, Inc.
Chao Qiu, Tianjin University
Haipeng Yao, Beijing University of Posts and Telecommunications
Song Guo, Hong Kong Polytechnic University

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As 5G and wireless sensor networks are deployed, the Internet of Things (IoT) has recently seen a surge. Regarded as a technical and economic trend after the Internet, the IoT calls for deep integration across information sensing, data sharing, and intelligent decision making. The integration of these techniques further enhances the performance of intelligent recognition, positioning, tracking, monitoring, managing, and controlling in the IoT. With the rise of the IoT, Internet-based networks have shifted from the Internet of machines to the Internet of instrumented objects. A number of emerging IoT applications have come into existence. For example, smart houses employ sensors and connect appliances into the IoT to remotely monitor, control, access, and provide services for users. Similar scenarios exist in smart farming, smart factories, and so on. So far, a centralized control architecture is typically deployed to meet the requirements of users. Nevertheless, IoT applications are much more flexible and dynamic than traditional applications, where IoT equipment may be frequently moving and accessible to numerous controllers. Additionally, a massive amount of private data is sensed and exchanged by the IoT, and many security problems threaten current IoT systems. Moreover, IoT devices are substantially resource limited, with regard to CPU, memory, energy, communication bandwidth, and so forth. These issues are hindering the progress and evolution of IoT systems and applications.

In "Cloud Computing Assisted Blockchain-Enabled Internet of Things," Chao Qiu, Haipeng Yao, Chunxiao Jiang, Song Guo, and Fangmin Xu develop a blockchain-enabled IoT system using agent and cloud mining approaches.[1] They deploy a decentralized IoT architecture using blockchain,

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where blockchain acts as an open, cryptographic, and decentralized database to maintain immutable ledgers accessible but tamper-proof for IoT devices. However, traditional blockchain usually relies on powerful computing resources, where participants (miners) solve a hash puzzle and exchange massive amounts of data. Unfortunately, an IoT system is constrained with respect to computation and communication capabilities. Thus, the authors propose agent mining and cloud mining in the blockchain-enabled IoT.

The agent and cloud mining approaches mean that miners work as agents for IoT devices, offload hash puzzles to nearby cloud computing servers, and dynamically consume communication bandwidth. Of course, IoT devices should pay to employ agents, cloud servers, and communication resources. Using agent and cloud mining further enables less powerful IoT devices to join a decentralized, safe, and reliable system.

To enhance the utility of miners and the performance of the IoT system, the authors model the selection of IoT devices, computing resource allocation, and networking resource allocation as a joint optimization problem. The IoT devices willing to pay more are more likely to be served by agents and receive more cloud server cycles and communication bandwidth. Because joint optimization is highly dynamic and dimensional, it is difficult to solve using traditional methods. The work is notable in that it uses a dueling reinforcement learning approach to solve the optimization problem. This way, the initial assignment and subsequent changes in IoT device selection and the allocation of computer and communication devices are trained and obtained by deep backpropagation networks, which significantly improves decision making.

In the future, it will be very valuable to enhance incentive mechanisms and consensus protocols of blockchain in the IoT. Additionally, the learning results in deep reinforcement learning are trained from historical samples, which present robustness challenges that need to be addressed.

REFERENCE

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HUI LEI is the vice president and chief technology officer of cloud and big data at FutureWei Technologies, Inc., and the editor-in-chief of *IEEE Transactions on Cloud Computing*. He is a Fellow of the IEEE. Contact him at dr.huilei@gmail.com.

CHAO QIU is a lecturer with the School of Computer Science, College of Intelligence and Computing, Tianjin University, China. Contact her at zjkchouchao@163.com.

HAIPENG YAO is an associate professor with the School of Information and Communication Engineering at Beijing University of Posts and Telecommunications, China. Contact him at yaohaipeng@bupt.edu.cn.

SONG GUO is a full professor with the Department of Computing at Hong Kong Polytechnic University. Contact him at song.guo@polyu.edu.hk.

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