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Research on Sharding Model for Enabling Cross Heterogeneous Blockchain Transactions

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이기종 블록체인간 거래를 위한 샤딩모델 연구

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Abstract While blockchain platforms for various purposes have been developed and the blockchain ecosystem is being developed, interoperability problems are emerging in which each blockchain is isolated and operated. In this study, we introduce interchain and sidechain technologies, which are blockchain that connect blockchain, and explain examples of using heterogeneous blockchain transactions and functions by applying them. In addition, blockchain, artificial intelligence, and IoT technologies, which are drawing attention in the fourth industrial revolution, are going through a process of converging and developing beyond their own development. In this regard, we present processes for combining artificial intelligence or IoT in blockchain, and propose a model that can operate without intervention by applying the combination of blockchain and artificial intelligence IoT to processes for trading and exchange between heterogeneous blockchain.

Key Words : Blockchain, Artificial Intelligence, IoT, Interchain, Sidechain, Blockchain Interoperability

요 약 다양한 목적의 블록체인 플랫폼이 개발되어 블록체인 생태계가 발전되는 와중에 각 블록체인들이 고립돼서 운용되는 상호운용성 문제가 나타나고 있다. 이에 본 연구에서 블록체인들을 연결해주는 블록체인인 인터체인과 사이드체인 기술을 소개하고 이를 적용함으로써 이기종 블록체인간 거래와 기능을 사용하는 예를 설명하였다. 또한, 4차 산업혁명에서 주목받는 기술인 블록체인, 인공지능, IoT 각각의 기술들이 독자적인 발전과정을 넘어서서 서로 융합하여 발전하는 과정을 거치고 있다. 이에 대해서 블록체인에 인공지능을 또는 IoT가 결합하는 과정들을 제시하고 더불어 블록체인과 인공지능 IoT의 결합을 이기종 블록체인간의 거래와 교류를 위한 과정에 적용해서 개입 없이 작동할 수 있는 모델을 제안하였다.

주제어 : 블록체인, 인공지능, IoT, 인터체인, 사이드체인, 블록체인 상호운용성

1. Introduction

After Bitcoin, dozens of blockchain platforms such as Ethereum, Eos, and Polkadot have been developed and marketed, and the blockchain ecosystem is rapidly evolving [1]. The development of blockchain platforms with various purposes has resulted in a large number of platform-specific coins and tokens. However, most of these developed blockchains and digital

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assets are independent and isolated, and only used within the corresponding blockchain platform developed. Typical examples include the inability of the Ethereum platform's main functions, Smart Contract and Dapp, to be used in Bitcoin.

These problems, namely interoperability between blockchains, can be advanced in a variety of ways, such as interchain projects that play a role in connecting each blockchain platform or sidechain projects that can add functionality by connecting different subchains to the blockchain. Blockchain that solves interoperability problems can get out of isolation and gain various benefits through exchanges with other blockchains. Examples include movement of digital assets between different chains, the ability to call contracts on chains without smart contracts, entrust security, and address scalability issues [2]. For example, Rootstock is a sidechain project that connects its own chain to Bitcoin, allowing Bitcoin to call Ethereum's smart contract. It is also a platform that enables asset movement between each other, addresses Bitcoin's problems with slow transaction throughput and low general purpose with Rootstock, and compensates for a certain amount of sidechain coins when Merge-mining and miners merge mining to achieve Bitcoin's strengths, security and stability [3-4]. Like the Internet, where computers around the world are connected and networks are formed, solving these blockchain interoperability problems can develop into the establishment of a perfect blockchain ecosystem by forming a network that connects each blockchain project.

2. Related Works

2.1 Combination of Artificial Intelligence and Blockchain

Currently, the most notable technologies in the fourth industrial revolution will be AI(Artificial Intelligence) and Blockchain. AI and blockchain technologies continue to innovate in many areas, including services, technology, manufacturing and finance. For example, McKinsey's 2020 global AI survey found that 48% of companies are operating AI in one or more functional organizations, and the 2020 Asia-Pacific Economic Cooperation (APEC) AI report suggested that AI will become more important in the future. In addition, Gartner, an IT research institution, selected blockchain in 2020 following 2019 as a technology that will peak in the next five years, showing wider use cases and influence than before, moving away from the initial state of technology in "10 Strategic Technology Trends 2020" [5-6].

Although each technology is worth a lot as a technology leading the fourth industrial revolution, innovations are taking place to find and combine blockchain and artificial intelligence technologies. This is because we expect synergies to occur that complement the limitations existing in the two technologies through combination and maximize their advantages. In the case of machine learning-based artificial intelligence, decisions are made based on countless information and many variables, and if unverified information exists in the information, artificial intelligence may make wrong decisions. In this case, blockchain will be introduced to artificial intelligence to record the decision-making process of artificial intelligence in part using blockchain timestamps, etc. to help humans understand and track artificial intelligence decisions, which will solve the black box problem of Deep Learning. In addition, the process of sharing and verifying fragmented information among participants using decentralized blockchain will provide reliability and integrity to the information learned by artificial intelligence [7-9].

In the case of blockchain, some privacy coins

such as Monero and Z-Cash have solved the problem of personal information in remittances through information recorded on the blockchain between transactions, but data privacy in the smart contract process is not fully protected. Through artificial intelligence algorithms, this problem can be implemented to prevent the spread of damage, such as preventing hacking attempts by hackers who attack the vulnerability in advance or preventing damage from spreading to other blocks. In the blockchain consensus algorithm mechanism, there are problems such as high energy consumption and monopoly of minority participants in proof of equity. By combining these problems with artificial intelligence, the consensus algorithm mechanism can be improved to increase efficiency. In addition, as the stored information on the chain increases, it will be possible to clean up bloated blocks by applying a distributed algorithm between block nodes using artificial intelligence and implement fast TPS through minimizing transaction verification [9-12].

Cortex (CTXC), a combination of artificial intelligence and blockchain, is the first programming cryptocurrency platform that combines blockchain and artificial intelligence. Cortex implements artificial intelligence models into smart contracts, enabling the use of artificial intelligence inference consensus functions. It is also possible for users to directly implement artificial intelligence Dapp through compatibility of artificial intelligence models on their own. Previously, Ethereum handled smart contracts through a central processing unit, but it was difficult to implement artificial intelligence models with complex code with the computational capabilities of the CPU. Therefore, Cortex allows the implementation of AI models using GPU (graphics processing unit) and FPGA (field programmable gate array) for full nodes. Cortex plans to apply information protection mechanisms using Zero-Knowledge Proof, isomorphic codes, etc. to model data privacy and intellectual property in applications such as machine learning in the future [13].

Minds Lab, a company specializing in artificial intelligence, signed an MOU with Deep Brain Chain, a blockchain AI company, in 2018 with the goal of cooperating in product development and technology development. It is to increase data security and efficiency in the artificial intelligence learning process by decentralizing and personalizing blockchain in Mind Lab, which mainly develops customer support services such as Mind AI and AI Financial Secretary High Banking. As in the above cases, this combination of blockchain and artificial intelligence will provide more advanced services, help new business and technology models emerge, and accelerate innovation.

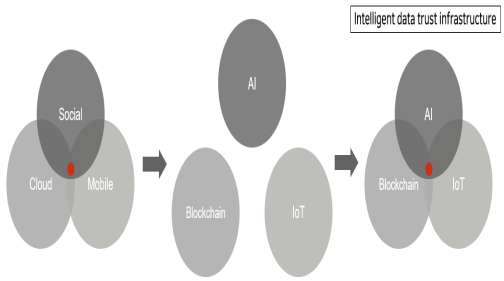

Fig. 1. Technology convergence trends change process

Figure 1 below illustrates the process of changing technology convergence trends, and advances in the new digital era from conventional social, mobile, and cloud convergence will be transformed into convergence of AI, Blockchain and IoT technologies. As each of these three technologies widens the base of their domains, convergence models will continue to emerge such as IoT owning data, Blockchain managing it, and being serviced by AI [14].

3. Proposal Models

3.1 Blockchain and IoT Network Convergence Models

Data trading models in IoT based on blockchain are used to implement various technology models or business models by mitigating the imbalance problem of collection and control over data and maximizing the utilization of IoT technologies. In this process, users will be able to produce and sell data without having to build a separate IoT data infrastructure or to purchase the necessary data appropriately [15].

The existing method of collecting data from IoT was to utilize sensors. However, there is a problem that this method of configuring IoT networks has resource-constrained limitations that users install and operate. Methods for increasing communication coverage in resource-constrained limits can be distinguished by using Multi-Hop communication methods Zigbee or Wi-SUN, the next generation Low-power wireless communication specifications, or using Sigfox or LoRaWAN, a type of low-power wide-area network LPWA. LPWA IoT networks, which are most commonly used as IoT-only network technologies, are commonly used for services that do not worry about data collisions by transmitting small data. LPWA (dsLPWA), which applies technologies such as prioritizing data by differentiating according to the priority of services utilized in areas where concentrated and diverse types of data are mixed on a large scale, is developing.[15-16]. Figure 2 shows data lookup process flowchart.

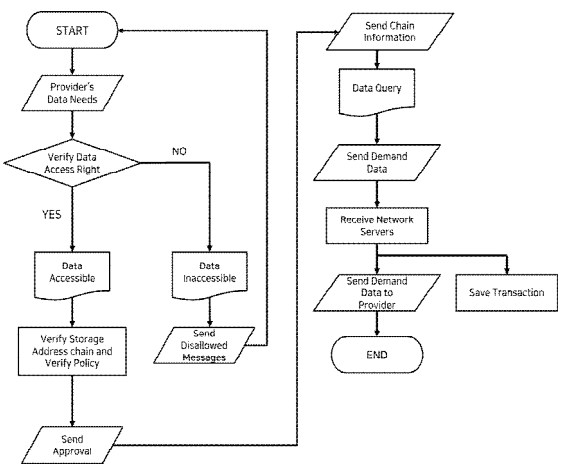

Fig. 2. Data Lookup Process Flowchart

3.2 LPWA model with Blochchain

However, if an open distributed sharing structure blockchain is applied to existing LPWA IoT networks as shown in Figure 3, flexible data sharing is possible on each server. In addition, even if one part fails, distributed sharing of data minimizes fault propagation and allows limited replacement of functions to other servers instead of the failed servers. Moreover autonomous data trading infrastructure can be provided through blockchain smart contracts. However, applying Distributed Ledger Technology to IoT devices for data reliability over blockchain is not realistic considering devices with limited power supply, memory, and computational capabilities, making it appropriate to apply decentralized colon technology, a key technology in blockchain itself [16].

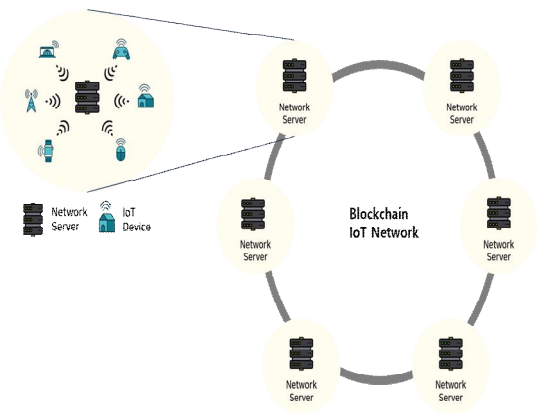

Fig. 3. LPWA IoT Network with Blockchain

Figure 4 shows the process of storing data in a blockchain-applied LPWA IoT network. Figure 3 identifies whether the initial data sends data

from IoT devices to a network server and can be stored in the local blockchain network, the associated storage address, and the policy. If allowed, the network server will store the data it receives in the cloud, send the overlay to the overlay network, send the stored block's number to the network server, and then again, the network server will store the transactions for the history on the local blockchain network.

Figure 4 shows that when a provider request a data lookup, the network server request it to the local blockchain network and checks the local blockchain network for access to that data, storage address and policy of the data. If allowed, the network server sends chain information about the data stored in the cloud. The cloud uses this to transmit the data found to the network server, where the network server stores transactions about the lookup history in a local blockchain network and indicates the sequence of data lookup processes that end with the provider sending the requested data.

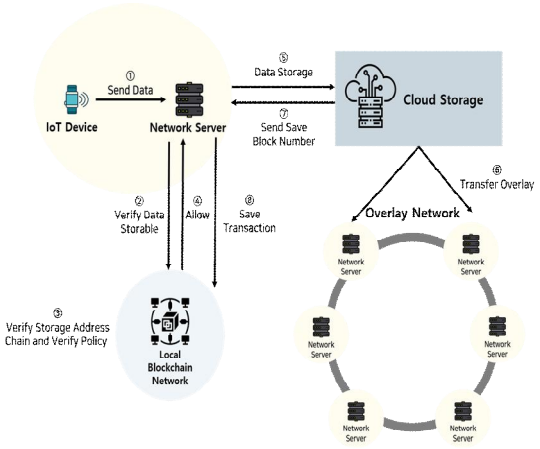

Fig. 4. Blockchain-applied LPWA IoT network.

4. Conclusion

The blockchain ecosystem is rapidly developing due to the application of blockchain technology to various fields such as blockchain platforms, related crypto currencies, and logistics industries that apply blockchain technology. In the blockchain ecosystem, solving the problem of interoperability, which is impossible to trade or share functions between heterogeneous blockchains, and is unable to interact with each other individually, is as important as the development of a new blockchain platform. Like the rapidly developed Internet by forming a network between computers, network formation through inter-blockchain exchanges will enable the formation of a more stable and open blockchain ecosystem. Therefore, the methods and processes of interchain and sidechain technologies, which are technologies for connecting between heterogeneous blockchains, were examined and practical applications were introduced.

Furthermore, through the convergence of these technologies, IoT technologies can establish autonomous and efficient transaction infrastructures between users and blockchains through heterogeneous blockchain connections. The processing of information and transactions occurring using artificial intelligence and processing chain blocks intelligent decision-making process of convergence model's proposal that will also be stored in. Rather than simply applying the technology individually, building a convergence ecosystem through various convergence and connectivity will play a central role in the new forward of blockchain technology.

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