A Research on Edge Computing and Blockchain-based IoT for Disaster Recovery and Prevention

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***Abstract*—The world population is increasing since people have been immigrating to urban city. Consequently, it causes hardness to manage facilities if disasters occur. This research focuses on a technology which is blockchain-based IoT to prevent and reduce the effect of disasters. Besides, we also involve edge computing research in this study, which aims to recover communication facilities after the occurrence of the disasters. The study shows that by using blockchain, which is the currently emerging technology, can help identify and ensure collected data trustable. Furthermore, edge computing with WAN optimization can assist data reduction across WAN for disaster recovery.**

Keywords—IoT; Disaster; Blockchain; Edge Computing; Recovery and Prevention

I. Introduction

Urban space is getting more density along years. It does not only provide many facilities for people who are living in but also improve their convenience life. The government spends much money to protect those facilities since disaster happens unexpectedly. In the IoT based research [1], the authors presented up-to-date urban crowd mobility prediction and resilient disaster information gathering mechanism. They stated that with the rapid progress of the Internet, smartphones, and IoT devices, the methods for disaster information gathering/distribution are drastically changing. Besides, million ordered smartphones and sensors become powerful means. Recently, a blockchain has emerged to transact data among peers which is unanimous. It is originally blockchain is a continuously growing list of records, called blocks, which are linked and secured using cryptography. Each block typically contains a hash pointer as a link to a previous block, a timestamp and transaction data. Regarding blockchain research, the authors [2] reported that with low levels of intrinsic involvement among employees, a lack of task visibility from upper management and limited social interaction among group members, many organizations struggle to combat the issue of social loafing in cross-functional working groups.

WAN (Wide area network) optimization encompasses traffic shaping, in which traffic is prioritized, and bandwidth is allotted accordingly. It also does data deduplication, which reduces the data that must be sent across a WAN for remote backups, replication, and disaster recovery. Mobile Edge Computing (MEC) [3] is a network architecture concept that enables cloud computing capabilities and an IT service environment at the edge of the cellular network. Combining MEC and WAN, each region occurs disaster must have a backup neighbor at other MECs. We use WAN optimization to replicate data.

The rest of paper is organized as follows. In section 2, we present related works which interest in WAN optimization and blockchain. In Section 3, we introduce the IoT-based blockchain and MEC system. In section 4, we describe our experiment and discuss the results achieved. Section 5 presents our findings with future research directions.

II. Related Works

In today's IT environments, network managers are facing and coping up with a vast number of challenges for the commercial WAN. Increasing data volumes, data replication at offsite, and the higher than ever use of content-rich and Big Data, applications are mandating IT organizations to optimize their network resources. Trends such as Virtualization and Cloud computing further emphasize this requirement of this current era of big data. The authors [4] covered the introduction to WAN optimization, extended WAN optimization techniques, WAN optimization products used for big data analytics and finally future trends and research Issues of WAN optimization in the ensuing era of big data.

Regarding IoT research, the authors [5] stated that a smart city uses information technology to integrate and manage physical, social, and business infrastructures to provide better services to its dwellers while ensuring efficient and optimal utilization of available resources.

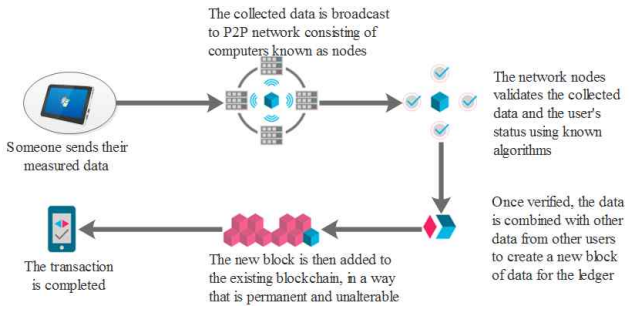

Fig.1. IoT blockchain technology to validate gotten data from users

III. System Overview

In the system, we use block-chain technology to verify reported data from users because we collect information from users openly and the information is anonymous which might

is not reliable. Blockchain technology, widely acknowledged as enabling openness, can facilitate the development of an immutable, transparent, secure and verifiable application for capturing individual's intellectual property as they work. As shown in Fig. 1, the collected data is verified through several steps in the P2P network. Once the collected data is verified, it will be added to the existing chain of data which was collected from other users.

Fig.2. WAN optimization between data center and MEC

We deliver the recorded content by employing two methods as shown in Fig. 2 First, using many data servers containing multi-part of content, each part is sent to a user via multi-path. Secondly, a multimedia server can dispatch content in multi-path. These methods should ensure that more important data units must have a high priority to be sent in the high-quality path. By doing so, we can guarantee the streaming service is always available with the best quality.

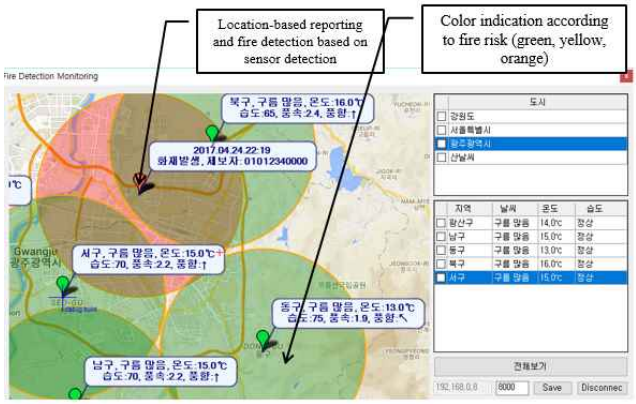

Fig.3. Real-time monitoring and forecasting server.

IV. Experiment and Discussion

We implemented the system including client and server. The client runs on Android smartphone to collect data such as weather, temperature, from registered users and anonymous users. The server is Node.js-based [6] program and Docker [7], which virtualizes cloud environment. We do not only collect data from users but also use weather, geological data which are provided by Korean government official website (Korea Meteorological Administration) because they cannot obtain data widely and in detail.

As shown in Fig. 3, red circle describes the location where a user reports that fire is occurred by using a smartphone. Then, this information is broadcasted to other users via implemented Android application or message. By the received data, the user can know which route or place will be safe for them if they have some affairs which need go through the disaster area.

Regarding edge computing, we simulated WAN optimization instead of testing on a real system, we cooperated our research with the TOFFEE project (Available at: *http://the-toffee-project.org/index.php*). We experimented that a server is down for a certain amount of time due to the occurrence of disasters. Consequently, other edge computing server will establish a tunnel to serve users who are in the disaster area.

V. Conclusion

In this research, we presented a study on blockchain-based IoT to prevent or reduce the effect of the disaster. Besides, we involved in edge computing research to recover communication facilities after the occurrence of the disaster. As a result, the study showed that using blockchain which is the currently emerging technology can help identify and make collected data trustable. Furthermore, edge computing with WAN optimization could assist data reduction across WAN for disaster recovery.

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