The Development of 4G LTE Cloud Server and Solar Cell Panel based Environmental Radiation Monitoring Systems

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1. Introduction

Currently, the Korea Atomic Energy Research Institute (KAERI) is operating a high-pressure ion chamber radiation monitoring (RS-Detection, GE) for monitoring environmental radiation around HANARO research reactor facilities as shown in Fig. 1. However, the difficulties in the immediate disclosure of radiation measurement information, loss of power, and communication failures can make it difficult to maintain continuity of data measurement. Especially when using physical servers, it is difficult to respond to immediate increases and changes in measurements in the event of a radiation accident, and field control in environmental exploration is difficult. Accordingly, our team developed an integrated system for environmental radiation using cloud servers, LTE networks, and solar panels.

Fig. 1. Environmental Radiation Monitor deployed on site

2. Methods and Results

2.1 Cloud Server

The Environmental Radiation Monitoring Server is currently in progress with a physical server configured inside the KAERI office building. Although staff managers in charge of running physical servers can carry out management quickly, it is difficult to control them in the field or radiation accident due to policies such as cyber security. Accordingly, we tried to solve the problem using a government-certified cloud server. Cloud servers are used by KT G-cloud servers and many government agencies are currently managing them. The main advantage of a cloud server is that in the event of a radiation accident, or when equipment management is required at the site, repairs due to malfunction, etc., can be immediately carried out and verified through on-site control. In the event of a radiation emergency accident, it is also possible to operate the equipment and verifying the data in the control room outside the EPZ. The cloud server consists of a management server and a database server, which includes a daemon program for sending and receiving data, enabling fast-cycle data to and from each other via TCP/IP communication. In addition, web page-based operation methods allow managers to easily check data and to know equipment abnormalities in the field. The web page is consists of tabs ERM status, ERM management, log check, and DB queries. Each tab consists of web pages for managing equipment, etc.

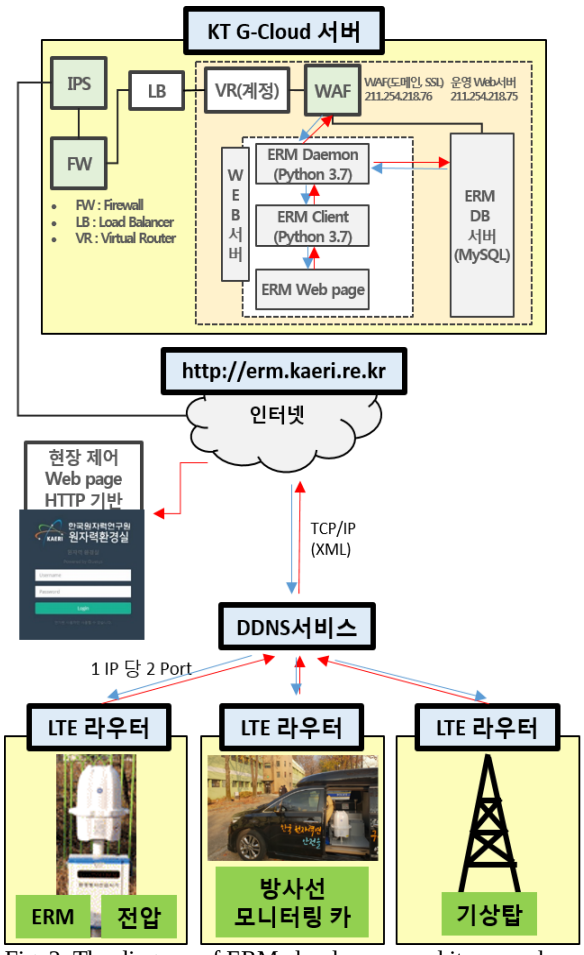

Fig. 2. The diagram of ERM cloud server and its procedures.

2.2 4G LTE Communication

The use of TCP/IP connections to HPIC equipment as above requires a communication method that enables rapid data and events to be sent quickly. Currently, 2G and 3G method are mainly used for data communication method that is mostly used and many organizations are establishing telecommunication connection using 4G LTE and LoRa connection method. Among the existing connected communication methods, our team applied 4G LTE communication method. In the current applicable communication method, LTE method was judged to be universal and the method of using the network could be efficiently carried out as domestic telecommunication businesses established networks in various regions. Then, we applied KT LTE routers to each ERM equipment and also applied power supply verification using Arduino. Therefore, one HPIC radiation detector, an Arduino, and an LTE router were installed in each environmental monitoring post so that each information could be sent and received organically.

2.3 Solar Cell based Power Supply

The previously mentioned Arduino equipment in LTE communication is used to check whether it provides permanent power or solar power. For current use of GE's RS-Detection equipment, measurements can be made for up to 50 hours using a built-in Lithium ion battery. However, additional backup power is required to send and receive data collected at the site. The current uninterruptible power supply system (UPS) is an equipment that can be used in emergencies in case of loss of permanent power by changing DC to AC voltage (220V) using battery pack of batteries. However, the UPS system is inefficient because it changes the stored DC voltage to AC voltage, which can cause significant differences in additional operating time depending on the period of use, such as the aging of each equipment, and the amount of battery pack. Therefore, environmental radiation monitoring systems that operate continuously for a long period after installation of equipment should operate as efficiently as possible to maintain continuous monitoring. Solar panels can generate emergency power from DC voltage in an emergency, enabling efficient communication connections, although they vary depending on the amount of sunlight. Currently, testing was carried out using solar panels and additional battery storage packs, and since DC voltage is directly connected to HPICs and communication routers using a customized board, the integrity of the equipment operating without permanent power was identified and it shows in Fig.3. It is also possible to manufacture an Arduino logic to distinguish between the voltage coming from the permanent power and the solar power, and thus configure the function to transmit the loss of power alarm in case of loss of the permanent power supply.

Fig. 3. Solar Panel based Radiation Monitoring System

3. Conclusions

To ensure efficient operation of the environmental radiation monitoring system, we developed a system using secondary solar panel based power, 4g LTE communication, and cloud servers and our team currently testing the entire system. Building a modified environmental radiation management system considering a number of complex factors, such as radiation accident and radiation prevention, has several advantages, including securing the convenience of equipment management and rapid data processing and disclosure. The research team will also conduct an integrated environmental radiation system with map-based radiation mapping system using spatial gamma dose rate data and meteorological data. Based on this study, the benefits of continuous surveillance data generation and rapid disclosure of information to the public could result in public acceptance and reliability.

Acknowledgements

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