Development of a wireless telemetering system for urgent seismic observations by using IoT technology

*Naoki Uchida[1], Goshi Sato[2], Satoshi Hirahara[1], Katsuhiro Temma[2], Toshio Kono[1], Tomomi Okada[1]

1. Research Center for Prediction of Earthquakes and Volcanic Eruptions Graduate School of Science, Tohoku University, 2. Resilient ICT Research Center, National Institute of Information and Communications Technology

Earthquake and volcano observations prefer near-source and low human-noise environments to obtain high quality data. However, such environments usually contradict with the conditions for the deployment of digital communication network (e.g., base stations, optical fibers) for commercial use. Therefore such observations are mainly done by offline mode, using expensive and large satellite equipment (VSAT), or only within the service area of mobile communication devises. These limitations prevent a rapid deployment of online seismic stations that are valuable in urgent aftershock observations or other temporal observations of earthquakes and volcanoes. In this study, we develop an inexpensive private communication system that can be deployed easily and operated by renewable energy. We employ NerveNet system that can configure a wireless mesh network automatically and has high reliability. We newly used a portable hardware of NerveNet which is suitable for IoT. It has features of low power consumption and small size and weight. The hardware is composed of a Raspberry Pi (small single-board computer) and module for LoRa (Long Range) wireless communication standard. The LoRa wireless communication standard is one of LPWA (Low Power Wide Area) that can communicate relatively long-range (up to around 10 km) with slow speed (292 bps ~ 37.5 kbps). As a result of multiple experiments in a field of actual seismic observation sites, we found that the connection can be possible between most stations that are separated within ~5 km at Kamaishi area, Iwate. However, the speed is lower than that required for the real-time transmission of seismic waveform data (~9.6 kbps). Therefore, we are now developing a system that can transfer waveform data for selected events (earthquakes). In the system, waveform files in data recorder in WIN format is transferred to the relay station by the NerveNet system and the data is transferred to Tohoku University by a mobile data communication. The field experiments of the mobile wireless telemetering system have important implications not only for the style of future seismic observations but also for developing a prototype of an on-demand field IoT infrastructure that can be activated in a necessary space and time.

