Development of Metropolitan Seismic Observation network (MeSO-net) system

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Metropolitan Seismic Observation network (MeSO-net) is different from conventional seismic networks in the following points: the network is managed under a 5 years project, and the number of planned stations is 400. The network is managed by a university, in which the number of supporting staff is severely limited. Network size is not so large (50km diameter), but almost stations are deployed at the dense populated region where it is not so easy to find the place for sites. To deploy the seismic network quickly and to maintain it efficiently, we develop the seismic observation system for quick installation and easy maintenance. In this presentation, we focus on the hardware of the system control for easy maintenance. There are two newly developed points. One is the field bus that connects the sensor unit and telemeter unit. Another is a robust protocol to send the data using the Internet.

- Field-Bus system

Three component seismic sensor and AD converter unit is packed inside of waterproof metallic case (underground unit) and installed in borehole whose depth is 20-30 m below the ground surface. Seismic sensor is a force balance type accelerometer and its dynamic range is more than 120dB. The telemeter unit is set on the ground surface close to the borehole. The telemeter unit is composed of a power supply with battery, Internet router, a barometer, a thermometer, a GPS receiver and a control unit. The seismic data are sent to the control unit from the underground unit through a serial bus line, which is ISO11898 standard (CAN-BUS). The timing signal is also sent through the bus line using IEEE1588 technology, and timing in the underground unit is synchronized with clock based on the GPS receiver within 50 micro-seconds. The underground unit and the telemeter unit are separately installed and connected through the standardized serial bus. It is one of the outstanding points in this system. The sensor unit can not be replaced easily because of the cost of installation, but the control unit may be done as developing of computer technology. If a new technology for data transmission will appeared in future, we can easily upgrade the control unit. Moreover, if we will need to add the other kind of sensors at the site, we only arrange the sensor that is suitable for CAN-BUS standard. Actually, a thermometer and a barometer are connected to the control unit using CAN-BUS. The system developed here is well-standardized and object-oriented system.

- Newly developed data transmission protocol

Data transmission using the Internet is a normal technology at present, and it is commonly used in conventional telemeter systems for seismic observation. However, in these systems, catastrophic loss of data sometimes occurs in the case of excess load or temporally faults of data line or the server system. And concentration of the data traffic is one of causes of damage of data management center (server). Therefore, we need the system to realize that all stations are harmonized to keep data transmission in good condition without any control from the server. To materialize the above system, we developed new protocol based on UDP/IP called ACT (Autonomous Cooperative data Transfer) protocol. In this protocol, the client system (telemeter system at station) sends 8-16 packets of data to the server and checks ACK (acknowledge) signal from the server. The ACK signal contains the information of the data packets that are sent correctly. If the rate of correctly sending packets decreases in time, the client system recognizes that the traffic is crowded or the server is busy, then the client system reduces the rate of data transmission. On the other hand, if it increases, the client system recovers the transmission rate. It is the effective to prevent traffic jam in the network and the overload of the server. In addition, the client system resent the missed data packet automatically. It leads easy management of data archive in the server system.