

ACT (Autonomous Cooperative data Transfer) Protocol, a new technology of seismic observation developed for and applied to MeSO-net

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MeSO-net is dense seismic observation network, newly established under special project for Earthquake Disaster Mitigation in Tokyo Metropolitan Area. To realize dense seismic network, a data acquisition system is one of the key technologies. We need to receive data stably from hundreds of stations without failures, and we need the system to be maintained with ease by limited members. In the field of seismic observation, the WIN protocol has been widely utilized and it occupied one of the standard of telemeter system in Japan. However, the WIN protocol is probably weak in case of the overload of data center and/or concentration of data traffics, because the WIN system does not have any function to control the data traffic from observation stations. Moreover, the WIN protocol does not have any function for reacting temporal line disconnections.

We developed a new data transfer protocol named ACT (Autonomous Cooperative data Transfer) Protocol, which buffers data packets, resends lost packets, and controls sending rate autonomously on the station side. This protocol is tolerant to occasional lowering of traffic rates, and even to line disconnection for several days or more, so long as the average traffic rate of line is higher than the minimum requirement of generated data in observation.

In each station (ACT client), data acquired by seismometer are formatted as WIN packet, and stored in the buffer memory with a given priority (e.g. data acquisition time or the component of data). Then the most prior data are sent to the data center first. Those data are sent at a controlled sending rate, that is determined by the system at station in changes of traffic condition. The handshake between a station and the data center is realized by ACK (acknowledgement) messages from the data center. If the system at station fail to receive ACK message within a given duration time (typically several seconds), the data are brought back into the buffer, and will be resent soon after. If the data transmission fails for long time and the buffer memory is fully occupied, the data in the buffer are moved to the external storage (SD card), and are read back to be sent after the traffic is recovered.

At the data center (ACT server), received data are stored on its storage devices, and ACK message is sent to each station. One ACK packet contains the information for 8-32 data packets to reduce the traffic from the data center to stations. Using the above system, observed data are stably and safely transmitted, even under UDP/IP that does not guarantee robustness of data transmission.

As concerns the sending rate control, the system at each station calculates its ACK rate (ratio of number of successfully acknowledged data packets / number of sent data packets). If the ACK rate decreases substantially, the system suppresses the sending rate. And if the ACK rate recovers, the sending rate is put back. Using such a simple control, the network is expected to act as an autonomous cooperative system that realize the stable seismic network with low cost for maintaining the system.

MeSO-net has adopted TS13850 as an ACT client in each station, which is durable for line disconnection for ca. 2 weeks, and TS13880 as an ACT server in the data center. The present system stably receives the data from about 50 stations.

We will show examples of data reception via ACT protocol from some MeSO-net stations with some difficulties in communications.