Performance test of a telemetry system for volcano monitoring using TCP/IP network

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New telemetry system for volcano monitoring is installed around three active volcanoes, Mts. Komagatake, Usu and Tarumae, that are located in southwestern Hokkaido.   The major part of the system consists of a TCP/IP network that connects the satellite stations and Usu Volcano Observatory (UVO), Hokkaido University.   There are two major advantages using the TCP/IP network for data transmission.   First, new monitoring instruments are easily installed at the satellite stations even if the instruments require various data formats, because TCP/IP network can transmit many sorts of data by a single line.   Second, we can send the data obtained at the satellite stations to plural facilities without changing the cable connection if IP addresses and routing tables are well administrated.   It results in not only increments of efficiency of network for data transmission but also reducing the costs for development of new monitoring instruments and for rental of public communication circuits.   The telemetry system has been operated at Mt. Usu since April 2000.   The data from Mts. Komagatake and Tarumae have been stored at UVO from Autumn 2000 and Autumn 2001, respectively.   The data sent from these three volcanoes are the time series data such as seismic wave, tilt, strain, and airwave that are sampled at a rate of 2 – 100Hz, the GPS data sampled at a rate of 1 Hz, and the visible image data sampled at 1-minute interval.   Below is a brief summary of the ways of data transmission and the computer network.

Time series data:

Analog signal from sensors are converted to win format digital data by a data converter such as LT8500, and then the digital data are transmitted to UVO using win protocol (win format UDP packet).

GPS data:

The data about the position of GPS satellites and the phase data sampled at a rate of 1 Hz that are output in LB2 format from Leica SR530 type GPS receiver are packed in win format data, and then they are transmitted to UVO using win protocol same as the time series data.

Visible image data:

Visible image from video camera for volcano monitoring is captured and converted to jpg format file at 1-seconds interval, and then the jpg file transmitted to UVO using FTP protocol at a rate of 1 picture per minute.

Network for data transmission:

The TCP/IP network for data transmission use NTT exclusive lines.   Digital and analog lines are connected to digital and analog routers, respectively.   For the analog lines, there are problems that the rate of data transmission decreases as the length of the line increases, and that the analog router is very sensible to the change of cable condition.   At the stations where the exclusive lines are not available, we install three kinds of radio telemeters according to the setting condition and quantity of data; RT-48 (frequency band: 400MHz, 34 - 56kbps), RM800 (frequency band: 400MHz, 9.6kbps) and RTB2400 (frequency band: 2.4GHz, 2Mbps).   RT-48 is the most stable system and suitable for data transmission from the vicinity of volcanoes where commercial power supply is not available, since it can transmit the data over 10 km and needs the small current (150mA at 12V DC).   RM800 can stably transmit the data when the route is clear and is shorter than 20 km. However, it consumes large electricity (700mA at 12V DC) so that it is difficult to secure the electric power.   RTB2400 is not good for the continuous data transmission for volcano monitoring since it consumes large electricity (1A at 12V DC) and often losses many data packets due to climate change and obstacles.