

## Development of the new real-time VLBI technique using the Internet Protocol (Part 2)

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Communications Research Laboratory has been developing the multi-channel real-time VLBI system using the Internet Protocol (IP-VLBI). This system has a maximum sampling frequency of 16 MHz per channel, and a system equivalent to the current geodetic VLBI is achieved by use of 16 channels. Real-time data transmission and a coherent sampling up to 8 MHz sampling have been checked by present. Regarding a software correlation processing, we have prospect of real-time processing up to 4 MHz sampling at present. Furthermore, the algorithm is reexamined in order to attain improvement in the speed.

Communications Research Laboratory has been developing a new real-time VLBI system that adopts Internet Protocol (IP) as a real-time data transmission from VLBI site to a correlation-processing center. In a conventional VLBI observation, signals from a radio source received by an antenna is recorded to a magnetic tape. Then the tape is sent to a correlation-processing center, and correlation processing is carried out. In the Key Stone Project (KSP), real-time VLBI system for routine observation use was developed for the first time in the world for monitoring regional crustal deformation around the Tokyo metropolitan area. In this system, the signal from a radio star is converted into the digital signal of 256 Mbps, and they are transmitted to a correlation processing center in real-time through a high-speed (2.4 Gbps) Asynchronous Transfer Mode (ATM) network instead of recording them to a magnetic tape. At the correlation-processing center, a dedicated correlator connected to ATM network performs correlation processing in real-time (this real-time VLBI system is called "ATM-VLBI" or "VLBI over ATM"). Since the cost of a high-speed ATM network use is still expensive and a connection site is also limited, the ATM-VLBI has not yet been well spread. Therefore, development of new real-time VLBI system which aimed at reduction of network cost and expansion of connectivity was started by using IP technology which has already spread widely (this system is called "IP-VLBI" or "VLBI over IP").

Two kinds of systems can be considered as IP-VLBI. One is a system that merely transposes high-speed data stream put on ATM network to IP. The concept of the channel in geodetic VLBI is missed in this system. Since the data are only transmitted at high speed, the system should prepare a dedicated correlator able to process the multi-channel data of geodetic VLBI like ATM-VLBI. Otherwise a reception side needs to decompose the data into each channel data.

Another is a system based on each channel data. In a geodetic VLBI system, the total number of frequency channel is usually 14 or 16 which includes both S (2GHz) and X (8GHz) bands. Each channel data are transmitted independently in this system. This system is called multi-channel IP-VLBI. If the system is established for one channel data, a geodetic VLBI observation is easily realizable by preparing the necessary number of the system. Only the transmission capacity of a network will restrict the total number of channels, and a sampling frequency. This system is thought to be more suitable for a geodetic VLBI. Thus we started the development of this system.

The PCI sampling board that we are developing has capability of sampling signals at a maximum of 16 MHz. We have been evaluating a sampling board from various kinds of aspect, e.g., coherence, real-time transmission, etc. In parallel to these evaluations, we are developing real-time processing software for computing correlation function of two stream data transmitted through the network by using a PC. Real-time data transmission and a coherent sampling up to 8 MHz sampling have been checked and their performance has been confirmed. Regarding a software correlation processing, we have prospect of real-time processing up to 4 MHz sampling at present. Furthermore, the algorithm is reexamined in order to attain improvement in the speed.