Data Transmission over High Speed Network in the IVS VLBI Observing Sessions

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Since October 2003, there have been four IVS VLBI observing sessions using the 34-m antenna station at Kashima. In these sessions, observed data were recorded by the K5 VLBI system and the recorded data were transferred to Haystack Observatory over the high speed shared network for correlation processing instead of shipping the recorded media as in the conventional procedure. This is a series of attempts to utilize e-VLBI in the regular international VLBI sessions. Details of the procedure and the initial results will be presented.

At Kashima Space Research Center of NICT (National Institute of Information and Communications Technology, formally Communications Research Laboratory until March 2004), developments of the K5 VLBI system have been continuing based on conventional PC systems to realize e-VLBI observations and data processing over the high speed Internet. By using the prototype models of the K5 system, various geodetic VLBI experiments have been performed and the results were evaluated to investigate the performance and the function of the K5 system. In the two domestic geodetic VLBI experiments, the results from the K5 system were compared with the results from the K4 VLBI system and it was confirmed that the K5 system is performing as expected. Since October 2003, all IVS (International VLBI Service for Geodesy and Astrometry) sessions in which Kashima 34-m station participated were recorded by the VLBA recorder as well as by the K5 system in parallel, and the K5 data files have been transferred to Haystack Observatory after converting the format of K5 data files to the Mark-5 data format in the first three sessions. In the fourth session, the K5 data files were transferred to Haystack Observatory and the file format conversions were preformed at the Haystack Observatory. The data were then recorded to Mark-5 disk units for correlation processing and the recorded Mark-5 disk units were transported to Washington Correlator and Bonn Correlator. The data were processed by using Mark-4 correlators. The results of initial analysis suggested that there was no obvious problem and the procedure seems to be working successfully. These procedures will become first and important steps towards the routine e-VLBI operations in the IVS sessions in the future.

K5 VLBI system is currently under development to realize real-time VLBI observation and correlation using commonly used shared network. The system is also capable to record sampled digital data in the internal hard disks for near real-time VLBI processing. These capabilities allow to transfer observed data in real-time if the connecting network is fast enough, or in near real-time if data buffering is required. The K5 observation system is consisted with four FreeBSD PC systems each with a newly developed data sampling board called IP-VLBI board. The system is capable of sampling 16 base-band signals at various sampling speeds and quantization bits up to 16 Msps (samples-per-second) and 8 bits-per-sample, respectively. The sampled data can be transferred to the network by using TCP/IP or can be recorded to internal hard disks as ordinary data files. The current prototype unit has achieved data recording at the data rate of 128 Mbps. It is expected that the maximum speed will be increased along with the technical innovation of the PC industry because the K5 architecture is adopting standard PC peripheral devices. The K5 correlation system is also under development using FreeBSD PC systems. The correlation system is a software correlator which receives data from observation systems over the network and then performs cross correlation processing. Since easily re-writable software programs and general PC systems are used, the processing capacity and the function of the correlator can be easily expanded and upgraded.