

IVS Technology Coordinator Report

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Abstract

Abstract: The efforts of the Technology Coordinator in 2004 were primarily in the following areas: 1) continued work on IVS Working Group 3 “VLBI2010” study, 2) continued development and deployment of e-VLBI, 3) support of the 3rd annual e-VLBI Workshop held in Japan. We will describe each of these briefly.

1. IVS Working Group 3 - VLBI2010

Work continues towards the conclusion of the IVS Working Group 3 (WG3) “VLBI2010” report. A first draft report completed in the fall of 2004 is undergoing review and revision. VLBI2010 is examining current and future requirements for VLBI geodetic systems, including all components from antennas to analysis, and will produce a report with recommendations for a new generation of systems that meet the following criteria:

- Highest-precision geodetic and astrometric results
- Low cost of construction
- Low cost of operation
- Fast turnaround of final results

Among the issues being explored are:

- Modernization of VLBI data-acquisition systems for higher stability and reliability, wider bandwidth, lower cost
- Small, low-cost, fast-moving antennas
- New observing strategies
- Optimum and practical observing frequencies
- Fully automated observations; remote monitoring
- Transmission of data via high-speed network (e-VLBI)
- Possible correlator upgrades
- Fast turnaround of results by full pipelining of data from antennas to correlator to final analysis

Among the factors encouraging VLBI 2010 initiative:

- Continuing RFI problems at many sites
- DSN moving to X/Ka (32 GHz) band observations.
- Aging antennas
- Technology advances in disks and e-VLBI

- Concerns in the US:
 - Retirement of current practitioners
 - Reduced support for VLBI technology development by sponsoring agencies

We are drawing on the resources of both the astronomy and geodesy VLBI communities in these investigations, as well as other relevant expertise (such as SKA and ATA, for example).

The VLBI2010 Working Group is composed of 16 members drawn broadly from the geodetic VLBI community:

- Brian Corey—antennas, RF/IF systems, calibration
- Hayo Hase—antenna systems
- Ed Himwich—control, data management
- Hans Hinteregger—digital backend systems, correlators
- Tetsuro Kondo—data systems, data transport, real-time
- Yasuhiro Koyama—data systems, data transport
- Chopo Ma—post-correlation analysis; data management
- Zinovy Malkin—post-correlation analysis
- Arthur Niell—atmospheric calibration, analysis
- Bill Petrachenko—antenna arrays, multi-beam VLBI, frequency standards
- Wolfgang Schlüter—antennas, observing strategies, frequency standards
- Harald Schuh—post-correlation analysis, cross-technique use
- Dave Shaffer—observing strategies, systems, analysis
- Gino Tuccari—digital backend systems
- Nancy Vandenberg—scheduling, observing strategies
- Alan Whitney—data systems, data transport, correlators

The Working Group is co-chaired by Alan Whitney and Arthur Niell. A final report is expected to be available in spring 2005.

2. e-VLBI Development

e-VLBI development is continuing on a number of fronts, which we will briefly mention here.

2.1. VSI-E Reference Implementation

A reference implementation of the proposed VSI-E specification has been developed. This implementation is intended to act as a demonstration model for VSI-E and is available to all interested parties. The VSI-E framework provides signaling, control, framing and statistics support and is an extension to the Internet standard RFC3550. It also provides flexibility in that it allows users to choose the transport protocol that most suits their networking environment (e.g. UDP, TCP or other variants). Once the reference implementation is fully checked out, attention can be turned to optimizing the code for high-speed operation.

2.2. Continuing Expansion and Development of e-VLBI Experiments

e-VLBI continues to grow rapidly. Within the last year, e-VLBI transfers for geodetic-VLBI have become routine, particularly between Japan and the U.S. for data recorded at Kashima, and between Japan and Europe for monthly UT1 data recorded at Tsukuba. We expect that daily UT1 Intensives taken at Kokee and Wettzell will soon be transmitted regularly to the USNO correlator. Transfer rates, especially across international networks continue to improve. Japan/U.S. transfer rates as high as ~ 900 Mbps have been observed, with sustained rates as high as ~ 700 Mbps. Work is on-going between U.S. and Europe, and we expect soon to conduct a 512 Mbps real-time experiment between the U.S. and Europe. 512Mbps real-time experiments using the Mark 5A have already been conducted within the U.S.

The biggest impediment to rapid e-VLBI expansion continues to be station connectivity to high-speed networks, but that is improving. Tsukuba, Kashima, Onsala, and Westford are all, in principle, connected at 1 Gbps, though some issues remain in actually using some of the links at full speed. Wettzell and Kokee are connected at somewhat lower speeds. And there are indications that some other stations may soon be connected at good speeds and start to become usable for e-VLBI.

3. Third International e-VLBI Workshop Held at Makuhari, Japan

Approximately 70 attendees representing 13 countries participated in a 2-day workshop hosted by NICT and held in Makuhari, Japan on 6-7 October 2004. The purpose of this workshop was to continue the work of the 2002 and 2003 e-VLBI workshops held at Haystack Observatory and JIVE to explore the current state and future possibilities of high-speed VLBI data transmission. Among the topics discussed were:

- Reports on e-VLBI tests and demonstrations
- Plans for ongoing e-VLBI development
- Status of interaction with network providers and developers
- International networking facilities - now and future
- Standards and protocols for e-VLBI data transfer.
- Hardware and software interfaces to telescope back-ends and correlators

During the workshop, many exciting developments in the field of e-VLBI and high-speed networks were presented. Researchers from high-energy physics and education also participated since there are many common interests. Progress in e-VLBI continues to be rapid, particularly with the rapid spread of global high-speed networks, the adoption of e-VLBI compatible data systems (Mark 5, K5, PC-EVN), and the rapid drop in prices for high-speed network equipment. In addition to e-VLBI data transmission, we heard about the development of new software correlators in Japan, Europe and the U.S., as well as plans for continued e-VLBI development in many countries. An international e-VLBI technical committee was established, led by David Parsley of Haystack Observatory. With the departure of David from Haystack in December 2004, we are looking to re-organize this committee with a new technical leader. The program committee consisted of Yasuhiro Koyama of NICT, Steve Parsley of JIVE, Jon Romney of NRAO

and Alan Whitney of Haystack Observatory. Presentations from the workshop are available online at <http://www2.nict.go.jp/ka/radioastro/evlbi2004/>. We warmly thank MCT and our Japanese colleagues for hosting such a fine meeting, even providing the additional exciting attractions of an earthquake and a typhoon! Tasso Tzioumis of CSIRO proposed that the next e-VLBI workshop be held in Australia in July 2005. The proposal was warmly accepted and is being looked forward to by all.