IVS Technology Coordinator Report

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Abstract

The efforts of the Technology Coordinator in 2003 were primarily in the following areas: 1) creation of IVS Working Group 3 for VLBI2010, 2) continued development of the VSI-E specification for e-VLBI, 3) support of the 2nd annual e-VLBI Workshop held at JIVE. We will describe each of these briefly.

1. IVS Working Group 3 - VLBI2010

At the September 2003 IVS Directing Board meeting, the IVS Working Group 3 was formally created. The VLBI2010 Working Group will examine current and future requirements for VLBI geodetic systems, including all components from antennas to analysis, and 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 to be 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 the VLBI2010 initiative:

- Continuing RFI problems at many sites
- DSN moving to X/Ka (32 GHz) band observations. Advantage: eliminates S-band RFI
- 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

Goals of VLBI2010:

- Unattended observing
- Global coverage
- Electronic data transfer, near real-time correlation.
- Smaller antennas? (~12m for expected to be available for ~$150k)
- Spanned bandwidth 4 GHz

We will draw 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 Schlueter - 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 draft report is expected to be available in spring 2004, with a final report approximately 3 months later.

2. VLBI Standard Interface - e-VLBI (VSI-E)

Work continues on the development of the VSI-E specification for a standardized data format for e-VLBI interchange. At the 2003 e-VLBI Workshop in JIVE, many of the members of the VSI-E committee met to discuss the choice of an underlying protocol for VSI-E. There was general consensus that the well-known and well-developed Internet Real-Time Protocol (RTP) would best serve as a base for the development of VSI-E. RTP has the following advantages:

- Developed for real-time transmission of digitally-sampled analog data
- Well developed, supported, and widely used
- Built-in monitoring and network and end-system performance
- Adaption to varying network capability and performance
- Built-in multi-cast and multi-streaming support

On the other hand, RTP, as currently defined, is not entirely suitable for the wide range of e-VLBI operational conditions, ranging from disk-buffered at both station and correlator to full real-time operation. Much effort has been expended to extend the current RTP protocol to handle the full range of operational space that e-VLBI demands. Furthermore, these extensions are being developed as generally as possible so that the extended RTP standard that encompasses e-VLBI will have a good chance of being accepted as an Internet standard protocol by the Internet Engineering Task Force. Acceptance by the IETF would lend worldwide credibility to the extended RTP standard and help encourage its use and support. To this end, the draft VSI-E standard is being subjected to minute scrutiny by non-VLBI network experts as well as VLBI network experts. We expect a final draft for ratification to be ready in early/mid 2004.

The members of the VSI-E committee are:

- Wayne Cannon; York University, Canada
- Brent Carlson; DRAO, Canada
- Dick Ferris; ATNF, Australia
- Dave Graham; MPI, Germany
- Ed Himwich; NASA/GSFC, U.S.
- Richard Hughes-Jones; Manchester Univ, England
- Nori Kawaguchi; NAO, Japan
- Tetsuro Kondo; CRL, Japan
- David Lapsley; Haystack, U.S.
- Sergey Likhachev; ASC, Russia
- Ari Mujunen; Metsahovi, Finland
- Sergei Pogrebenko; JIVE, Netherlands
- Jon Romney; NRAO, U.S.
- Ralph Spencer; Jodrell, England
- Harro Verhouter; JIVE, Netherlands
- Alan Whitney; Haystack, U.S.

3. Second International e-VLBI Workshop Held at JIVE

Approximately 80 attendees representing 15 institutions worldwide participated in a 2-day workshop held at JIVE on 15-16 May 2003. The purpose of this workshop was to continue the work of the 2002 e-VLBI workshop at Haystack Observatory to explor the current state 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

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. Over the last year, international e-VLBI demonstrations have reached as much as 700 Mbps (Japan to U.S.). In addition to e-VLBI data transmission, we heard about the development of new software correlators in Japan and Europe, as well as plans for continued e-VLBI development in several countries. The program committee consisted of Yasuhiro Koyama of CRL, Steve Parsley of JIVE, Jon Romney of NRAO and Alan Whitney of Haystack Observatory. Presentations from the workshop are available on-line at *http://www.jive.nl/evlbi_ws/meeting*.