IVS Technology Coordinator Report

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Abstract

The efforts of the Technology Coordinator in 2010 include the following areas: 1) support of work to implement the new VLBI2010 system, 2) e-VLBI development, 3) continuing development of global VLBI standards, and 4) DiFX software correlator for geodetic VLBI. We will briefly describe each of these activities.

1. VLBI2010 Progress

Progress continues towards the goal of a next-generation VLBI2010 system. Much more detailed information about VLBI2010 development is presented elsewhere in this report; here we briefly report some of the highlights:

1.1. Development of the VLBI2010 Broadband System

The VLBI2010 system continues to develop at several locations:

1. Completion and demonstration at Haystack of an RDBE personality for geodetic VLBI observations: The current working version accepts two 512mHz IFs, channelizes each into fifteen adjacent 32mHz-wide channels using polyphase filter band (PFB) technology; the user can choose any 16 of these channels to be sent to a 10GigE data link at an aggregate rate of 2 Gbps, which is then recorded on a Mark 5C data system in Mark 5B+ data format. A version of this RDBE supporting the VDIF output format is currently under development, as well as an RDBE version capable of supporting up to four 512mHz IFs. Support for Tsys calibration is also being added to the RDBE firmware.
2. Mark 5C VLBI data system: Mark 5C is now used routinely at 2 Gbps to a single 8-disk module. Mark 5C has been successfully tested at 4 Gbps to dual 8-disk modules, and operational support software for this mode will be released in early 2011. A new SATA-module PCB backplane is being developed by Conduant that will allow 4 Gbps to be recorded to a single 8-disk module; this module will have a different module connector and will not be compatible with the current Mark 5 systems.
3. Development of firmware for the FILA10G board for the dBBC continues at MPIfR. This board is installed in the dBBC developed by Gino Tuccari to support 10GigE output to Mark 5C or other similar VLBI data recording systems.
4. The new 'Eleven' broadband feed for VLBI2010 developed at Chalmers University in Sweden has been successfully tested between the 18-m antenna at Westford Observatory and the 5-m antenna at NASA/GSFC. Another broadband feed concept, developed at Caltech and called 'QRFH', has recently been tested and is being considered.
5. A new 12-m antenna from Patriot Antenna Systems has been installed at NASA/GSFC in Maryland and will be commissioned in early 2011. Installation of two new 13-m VLBI2010 antennas is underway at Wettzell.

6. A number of VLBI2010 data-taking sessions between Westford and NASA/GSFC were undertaken during 2010. Most were recorded onto four Mark 5B+ units at each station using older DBE1 backend units as data sources, at an aggregate data rate of 8 Gbps/station. Late in 2010, a successful experiment using a prototype RDBE and Mark 5C was conducted. Most data were processed on the Mark IV correlator at Haystack Observatory, though successful correlations have also been performed on the DiFX software correlator at Haystack Observatory.

2. e-VLBI Development

2.1. Continuing Expansion and Development of Routine e-VLBI Data Transfers

MPIfR continues regular e-VLBI transfers of data for which the Bonn correlator is the correlation target. This includes data from Japan, Onsala, Ny-Ålesund, and Wettzell. All data recorded on K5 systems at Tsukuba and Kashima are transferred either to MPIfR or Haystack depending on the target correlator. Syowa K5 data are physically shipped to Japan and electronically transferred to Haystack or MPIfR. UT1 Intensive data from Wettzell, Japan, and Ny-Ålesund are transferred to either MPIfR or the Washington correlator. Welcome news! After a long and tortured process, the Kokee station was finally connected to the world at 100 Mbps. This connection is helping to lower the processing latency for time-critical UT1 data from days to hours. Efforts are underway to significantly increase the data-rate capability to support higher-bandwidth observations and still lower latencies.

2.2. 9th International e-VLBI Workshop Held at Perth, Australia

The 9th International e-VLBI Workshop was held 18-20 October 2010 in Perth, Australia, hosted by the International Centre for Radio Astronomy Research (ICRAR) and Curtin University. The workshop was attended by more than 50 participants from 10 countries.

The focus of the meeting was "e-VLBI and the Path to the Square Kilometre Array." Within this context, e-VLBI has a lot to offer as a pathfinder technology for the proposed SKA telescope, and the presentations from both the e-VLBI and the SKA communities made for a particularly interesting forum. The workshop was three days in duration, with the first two days dedicated to scientific and technical presentations. The third day was a networking forum for representatives of networking organizations and scientists to discuss current and future trends in high-speed data transport and relevance to e-VLBI and the SKA.

Many presentations from the Perth workshop are available on-line at

http://cira.ivec.org/dokuwiki/doku.php/events/evlbi2010/start

The 10th International e-VLBI Workshop will be held in South Africa in Q3 2011.

3. Global VLBI Standards

3.1. VLBI Standards Web site Established

http://www.vlbi.org has been established as a one-stop shop for access to global VLBI standards. These include VEX, VSI-H, VSI-S, VDIF, and standardized VLBI file-naming conventions. As new standards emerge, they will also be included in this Web site.

Figure 1. Attendees at the 9th International e-VLBI Workshop held in Perth, Australia.

3.2. VDIF Data Format

Adoption of the VLBI Data Interchange Format (VDIF), ratified in 2008 at the Madrid e-VLBI workshop, continues to accelerate. The VLBI2010 project has adopted VDIF as the standard data format, and work is proceeding to fully implement it. Several other data systems now in development have also embraced the VDIF format, and VDIF is now moving strongly into the astronomical world as well. Broad adoption of VDIF across various VLBI disciplines will allow for more standardization and inter-operational capabilities that will benefit all of VLBI.

The VDIF specification is available at *http://www.vlbi.org*. A VTP Task Force, led by Chris Phillips of ATNF, has been appointed to lead the development of the second half of this standardization effort, which is now on-going. The members of the VTP Task Force are Richard Hughes-Jones, Mark Kettenis, Chris Phillips (chair), Mamoru Sekido, and Alan Whitney.

3.3. VEX2 Task Force Continues Work

The VEX file format is a standardized method to prescribe a complete description of a VLBI experiment, including setup, scheduling, data-taking and correlation, independent of any particular VLBI data-acquisition system or correlator. VEX has gained broad acceptance and is used to support a large fraction of global VLBI observations, but needs updating as new technologies and equipment become available. The VEX2 Task Force was created in late 2009 to undertake this job. The members of the VEX2 Task Force are Walter Brisken (NRAO, chair), Ed Himwich (NASA/GSFC), Mark Kettenis (JIVE), Cormac Reynolds (Curtin University), and Alan Whitney (MIT Haystack). This group continues working to craft the needed VEX updates and to incorporate them into several VLBI-support software packages.

4. DiFX Software Correlator for Geodetic VLBI

The so-called DiFX software correlator was originally developed at Swinburne University in Australia by Adam Deller, primarily for astronomical VLBI use. The development of an economical and powerful software correlator, a dream less than a decade ago, has been made possible by the relentless march of Moore's Law to provide powerful inexpensive clustered PCs with high-speed data interconnections that can distribute and correlate VLBI data in an efficient manner. Since the original DiFX development several years ago, the use of the DiFX correlator has spread, and a global DiFX user group has been formed to coordinate continued improvements and additions. Several institutions that support geodetic VLBI correlation processing now have DiFX correlators (MPIfR, USNO, Haystack Observatory) and have been working to augment the core DiFX software to meet the needs of geodetic VLBI. This includes the integration of much of the Mark IV correlator software involving data management, output data formats, fringe finding and delay estimates, and editing/quality-assurance software. In addition, a substantial amount of work has been done to integrate accurate multi-tone phase-calibration processing into the DiFX correlator, a task that is often not important for astronomical VLBI. Progress towards developing the necessary additions and improvements to DiFX for geodetic VLBI has been rapid, allowing the DiFX correlator to take over the job of current hardware correlators. MPIfR closed its Mark IV hardware correlator at the end of CY2010. Haystack Observatory is planning to phase out its Mark IV correlator by the end of 2011, with USNO likely to follow soon thereafter.