Canadian VLBI Technology Development Center

Bill Petrachenko, Mario Bérubé, Anthony Searle

Abstract

The Canadian Technology Development Center has developed an "end-to-end" geodetic VLBI system built on S2 equipment. The development of this system has led to an operational IVS network. Development work continues to streamline operations and improve S2 instrumentation. The Technology Development Center is actively preparing to engage in the development of the VLBI2010 systems.

1. Introduction

The Canadian VLBI Technology Development Center is a collaborative effort of the National partners interested in the advancement of VLBI technology, namely the Geodetic Survey Division of Natural Resources Canada (GSD/NRCan) and the Dominion Radio Astrophysical Observatory (DRAO) of the Herzberg Institute for Astrophysics of the National Research Council of Canada, (DRAO/HIA/NRC).

2. S2 VLBI Geodesy

The S2 VLBI observation program continued in 2006 as the operational "E3" IVS observing network. The "E3" Network consists of Algonquin, Yellowknife, the Canadian Transportable VLBI Antenna (CTVA), Kokee Observatory, Svetloe Observatory, and the Transportable Integrated Geodetic Observatory (TIGO) located in Concepcion, Chile.

3. S2 VLBI System

The S2-DAS is designed to accommodate up to four VLBA/Mark IV type single sideband baseband converters (BBCs), each with a local oscillator (LO) independently frequency switchable under computer control. The recording system uses 8 modified super–VHS recorders.

The Canadian Correlator is a six station correlator (expandable to ten stations) using S2 playback terminals and is designed to handle S2 frequency–switched bandwidth synthesis data.

4. Canadian Transportable VLBI Antenna (CTVA)

The CTVA is a 3.6m radio telescope acquired to facilitate densification of the VLBI measurements of the Canadian Spatial Reference System (CSRS). The antenna will be co-located with GPS elements of the Canadian Active Control System (CACS), part of the CSRS, to provide fiducial station positions. The Canadian Technology Development Center is responsible for CTVA system development.

At the end of 2005 the CTVA in Saint John's was disabled by a nearby satellite radio ground transmitter. In 2006, the CTVA system was packaged into a standard shipping container and returned to Ottawa.

On September 25, the Canadian government announced the cessation of Very Long Base Interferometry activities in Canada. Operations of the S2 correlator, CTVA, and the E3 network

program were stopped.

Figure 1. CTVA being prepared to be packaged in shipping container

5. S2 Geodetic Experiment Scheduling, Operations and Analysis

The "E3" network continued to contribute to the IVS observing program with several EOP sessions using 6 stations. Several sessions were rescheduled this year to maximise the observations at Yellowknife. The loss of the Gilmore Creek antenna to the network impacted the decision.

Several of the sessions conducted outside of the IVS using the S2 and the Canadian stations were added to the IVS master schedule and the data added to the IVS collections. Though these sessions are only 2 and 3 stations, they should provide an improved VLBI position for the PENTICTN site.

6. VLBI2010

Active contributions in a number of areas continued toward VLBI2010.

Simulations were performed to demonstrate that the broadband delay concept could be used successfully to produce high precision delay measurements even at comparatively low SNR. Together with Arthur Niell, a study was undertaken to investigate the corrupting effect of source structure on the broadband delay process. A further study, including Patrick Charlot, has been proposed to investigate the effectiveness of using source structure corrections to mitigate degradation in cases where source structure is known to be a problem.

A study was undertaken into alternate scheduling algorithms to increase the number of observation per day and to improve uv coverage for the purpose of using the geodetic/astrometric data

directly to produce source structure corrections.

A study was undertaken into the pros and cons of having multiple antennas at a site.

7. Dominion Radio Astrophysical Observatory (DRAO)

There are currently two projects under way at DRAO with potential relevance to VLBI2010.

A 32-station correlator is being developed for the eVLA project. The correlator, which handles up to 64 Gbps per station (assuming standard 2-bit VLBI sampling), can efficiently be scaled back to handle lower bit rates, e.g. the 8 Gbps anticipated for VLBI2010. VSI interfaces have been incorporated into the design, and the correlator is fully VLBI capable. The design phase of the project is now complete and prototypes of all major components have been produced. Prototype testing is well under way.

A capability is being developed to produce low-cost light-weight composite radio antennas for astronomy and geodesy. If properly designed, composites have very low coefficient of thermal expansion and are typically characterized by a high degree of stiffness per unit weight. These properties translate into structures that experience both low thermal and gravitational deformation. In addition, the light weight of the reflector ($\sim$15% of a metal antenna) greatly eases the design and cost of a high slew rate drive system, an important requirement of the VLBI2010 antenna spec. To date, materials and processes have been studied in depth. It is expected that a proof-of-concept 10 m dish will be fabricated before the end of 2007.