

# Canadian VLBI Technology Development Center

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## Abstract

The Canadian VLBI Technology Development Center has been active in a number of areas during 2002.

The S2 Geodetic VLBI program continues to make significant advances on many fronts, including development of the frequency switched S2 VLBI data acquisition system, enhancement of the S2 correlator capabilities, utilization of a transportable antenna and the expansion of capabilities for scheduling, data processing and analysis. A number of sessions using the S2 system have been conducted using the Algonquin, Yellowknife and the Canadian Transportable VLBI Antenna (CTVA). These sessions have benefited by the expansion of the S2 network to include the Kokee observatory and the Transportable Integrated Geodetic Observatory (TIGO) located in Concepcion Chile. These observations were part of the IVS observing program under the E3 network.

## 1. Introduction

The Canadian VLBI Technology Development Center is a collaborative effort of the Space Geodynamics Laboratory of the Center for Research in Earth and Space Technology, (SGL/CRESTech), 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 geodetic VLBI program continued to evolve in 2002. Building on several years of successful national geodetic observations, S2 systems were deployed to Kokee, USA, and Concepcion, Chile. This year focussed on refinements to the S2 system. The S2-DAS underwent hardware modifications to improve observation quality. Software developments at the correlator added observation analysis tools, streamlined the correlation process and allowed for more statistical analysis of session performance. Release of E3 data to IVS data centers lead to the first IVS analysis of S2 databases.

## 3. S2 VLBI Data Acquisition System (S2-DAS)

The S2 VLBI data acquisition system is being jointly developed by SGL and the GSD. The S2-DAS is designed to accommodate up to four VLBA/MkIV-type single sideband baseband converters (BBCs), each with a local oscillator (LO) independently frequency switchable under computer control. The objective of the development of the S2-DAS is to enable high sensitivity group delay measurements without appealing to a more costly parallel IF/baseband sub-system.

There are currently seven S2 DASs in use. Six are owned by GSD/SGL and the seventh deployed by BKG to TIGO in Chile. GSD/SGL operate a DAS at all three Canadian VLBI sites. In March, Bill Petrachenko and Mario Bérubé went to Kokee to install a fourth S2-DAS. They configured Kokee's PCFS for S2 operations at that time.

All of the DASs during 2002 were updated with hardware modifications and improvements

that have occurred as a result of recent tests. Systems were improved for use in the field and first generation DASs were updated to reduce noise in the IF.

The DAS Operating System (DASOS) has seen extensive development in the past few years. The first official release occurred on August 31, 2001. This release contained all functionality for full use of the DAS features. Further software development continues to improve robustness and efficiency. The first version of the user's manual was released in early 2002.

DAS-PCFS communication has advanced considerably with modifications to the local version of the PCFS at the three Canadian stations. We have been in discussion with the IVS and NASA/GSFC regarding incorporating these software modifications into the official PCFS releases. Enhancements to DAS-PCFS control improved operational reliability with a more automated set up and observation monitoring.

#### **4. S2 VLBI Correlator**

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. Recent activity has focussed on the development of visualization and statistical analysis software to enhance system performance monitoring.

All of the six playback terminals are scheduled for extensive maintenance in early 2003.

#### **5. Canadian Transportable VLBI Antenna (CTVA)**

The CTVA is a 3.6m radio telescope acquired to facilitate densification of the terrestrial reference frame in remote regions. The antenna will be collocated with GPS elements of the Canadian Active Control System (CACs) to provide fiducial station positions. The GSD is responsible for CTVA system development.

In October, 2002 the antenna left Shirley's Bay, Ontario (near Ottawa) on its way to St. John's, Newfoundland. At St John's, the CTVA participated in its first VLBI session in November of 2002. It is likely to remain in its current location for at least one year, and observe on a monthly or more basis. The CTVA participates as a member of the IVS E3 network.

We have obtained a robotic tape changer that interfaces to the S2 recording terminal. The robot was tested at Algonquin during CGLBI sessions this year.

#### **6. S2 Geodetic Experiment Scheduling, Operations and Analysis**

The Canadian Geodetic VLBI program involves all aspects of Geodetic VLBI operations, from experiment design through analysis.

Five developmental experiments (CG044/January through CG049/August) were performed in 2002 using the S2 VLBI system, ALGOPARK, Yellowknife, and the CTVA. The first international geodetic S2 network was launched in 2002, in which monthly IVS-E3 sessions using the Canadian antennas, Kokee and TIGO were conducted. These sessions began in February.

Early analysis on the E3 sessions points to the potential contribution of the new network to TRF and EOP determination. Observations are complicated by the network size (four stations between October–March, five for the rest of the year) and the small size of three of the antennas. Correlator improvements delayed the release of E3 data to the IVS, however three sessions were



Figure 1. CTVA positioned in St. John's, Newfoundland.

made available during 2002. All data observed during 2002 will be released in early 2003.

Scheduling sessions for a sparse network with many small antennas proved to be quite challenging. Optimization for such a network motivated discussion for new tools. Preliminary work on these tools has begun. Additional software to accommodate correlator requests for tape change timing was developed in 2002.

We wish to encourage further usage of the S2 equipment and expansion of the E3 network. To facilitate this, in some cases, we may be able to provide a short term loan of equipment in order to give any interested station an opportunity to join the E3 network on a trial basis.

A talk on the development of multi-beam VLBI (several small antennas co-observing with large ones) was presented by Bill Petrachenko at the IVS general meeting in Tsukuba Japan.

The GSD website ([www.vlbi.ca](http://www.vlbi.ca)) has been taken offline while it is redesigned to reflect the "common look and feel" standards of the Federal Government. It is expected to be put back online in 2003.

## 7. The Space Geodynamics Laboratory

The Canadian VLBI community, with the support of the Canadian Space Agency (CSA), has been a major participant in the Japanese-led VSOP Space VLBI mission. The spacecraft HALCA was launched in February 1997 and funding was provided by the Canadian Space Agency to Canadian VLBI participants for five year mission support. The CSA funding and support for the Space Geodynamics Laboratory (SGL) was extended by the CSA for an additional year to complete a sky survey of 350 quasar sources. This survey is nearing completion and funding support for SGL has been reduced as the mission draws to an end. The engineering staff at SGL are no longer on full salary but are now working on a contract/consulting basis. At SGL we

are presently ramping up an effort with CSA funding to refurbish the S2 playback systems at the six station S2 VLBI correlator at Penticton. This same correlator is used for the processing of the S2 frequency switched geodetic VLBI observations. SGL will continue to operate in this reduced mode for the immediate future pending a reorganization. In the meantime messages sent to "s2support@sgl.crestech.ca" will not be answered as promptly as before.