Final Report for Contract NAS5-01073

NVI, Inc.

Support of the Laboratory for Terrestrial Physics for Dynamics of the Solid Earth (DOSE)

February 1, 2001 –July 31, 2001

This final report for contract NAS5-01073 summarizes the accomplishments during the contract period. Under the contract NVI, Inc. provided support to the VLBI group at NASA's Goddard Space Flight Center. The contract covered a period of approximately eight years during which geodetic and astrometric VLBI evolved through several major changes. This report is divided into five sections that correspond to major task areas in the contract: A) Coordination and Scheduling, B) Field System, C) Station Support, D) Analysis and Research and Development, and E) Computer Support.

A. Coordination and Scheduling

Observing Support. Master observing schedules for 24-hr sessions and 1-hr Intensive sessions were created for all observing years since 1979. The databases for the sessions during 1997 through 2000 were reviewed to determine the actual network for each session, then the 1997 through 2000 master schedules were modified to reflect the actual networks. At the end of the contract period coordination activities began for planning the master schedule for calendar year 2002, including messages to the stations, special requests for special information, correlator estimates, and tape usage.

The geodetic schedule files and intensive schedules that were observed during the contract period were created and posted to cddisa for the stations. The 2000 Annual Report for IVS was prepared for the CORE Operations Center, covering the period of March 1999 to December 2000.

Schedules for the NEOS and Intensives were generated under this contract through mid-June, to support USNO while a staff member was on leave. Test schedules for the Intensives were made using a 112 Mb/s fan-out mode, compared to the 56 Mb/s Mark III mode C then in use. The analysis report of the results (see Task 4) convinced USNO to switch to the new recording mode on June 1.

The Station Usage Chart was added to the IVS web site. The chart displays the number of times a station participate during the observing year and number of times a station participates in a particular session during the year.

The available tapes at each station were counted using *track* and the master schedule was utilized to determine how many additional tapes would be needed at each site. The tape shipping plan was updated and distributed twice (March and June) during this contract.

Technical Liason. NVI organized the TOW (Technical Operations Workshop) held at Haystack Observatory in March. A presentation on the resources needed for continued expansion of the CORE program was presented at the workshop.

NVI provided the IVS Coordinating Center Director function. This included activities such as coordinating the 5th IVS Directing Board meeting held at Goddard. NVI/ Raytheon supported editing, publication, and distribution of the 2000 IVS Annual Report during this contract.

Support was provided for the CORE review panel meeting, held in February at GSFC. A web site was created, an e-mail list and archive was set up, and material for the panel was posted. Travel and meeting arrangements were coordinated.

The joint proposal with A. Volvatch (Simeiz) to the Civilian Research and Development Foundation (CRDF) for support of the Simeiz station was completed and submitted. The first draft of the proposal was heavily revised and comments from the co-investigators were also incorporated. The budget form was filled in and the project narrative describing how the proposed funds would be spent was written. Volvatch traveled to Simpheropol to get his institute director=s signature and then to Kiev to submit the proposal hard copy before the submission deadline.

B. Field System

TOW 2001. NVI provided written materials, teaching and discussion section leadership for many sessions at the first IVS Technical Operations Workshop (TOW) Haystack Observatory. Topics covered included: operations, pointing, narrow track calibration, FS future plans, TOW feedback, FS wish lists, Mark IV decoder support and usage, and FS code development.

FS 9.5. NVI distributed alpha and beta test versions of the version and incorporated bug fixes and feedback from users into successive versions. As of the end of the contract feedback was still coming in. The new version includes support for K4 equipment, dual sequential longitudinal recorder use, automated Mark III/IV attenuator adjustment, and many other enhancements and bug fixes.

New Installable Linux Kernel for FS Use. NVI helped coordinate development of the new operational kernel (FS Linux 4), as of the end of the contract collaborative work on finalizing the new kernel continues with personnel from Metäshovi Observatory in Finland.

EVN TOG Meeting and Operations Workshop. NVI represented the VLBI group at the EVN TOG meeting and acted as one of the teachers for the associated EVN Operations Workshop. Topics covered by NVI at the workshop included: future FS plans, two head recorder support, and Mark IV decoder support. A plan was developed at the TOG meeting that may allow Semeiz to get a mark IV formatter by sharing the two spares in Europe, one astronomical and one geodetic, between the two communities. Discussion on this topic will continue.

Mark III/IV Signal Levels NVI collaborated with personnel Haystack Observatory to develop new guidelines for signals levels in Mark III/IV racks. This work corrected a nearly 20 year misunderstanding on how signal levels should be set.

VSI-S. NVI participated in discusses on the formation of the VLBI Standard Interface - Software (VSI-S).

C. Station Support

IVS Network Coordination. NVI supplied the Network Coordinator for International VLBI Service (IVS). The coordinator was responsible form monitoring network station performance and representing the stations to the IVS directing board. The Network Coordinator began a database of correlation clock offsets so that will possible to assess the impact of differences in the way correlators handle clock offsets on the accuracy of VLBI UT1 estimates.

Visited Stations to help improve performance: Fairbanks, Kokee Park, and Onsala.. NVI visited the listed sites to review operations, provide additional training, and upgrade and fine tune software. The visit to Kokee Park included install a more up to date kernel (FS Linux 3) than they had been using and installing the beta version of 9.5 so that they could support two tape drives. The trip to Onsala was partly motivated by that station=s poor recent performance.

General Support. NVI answer requests for support from stations regarding software and operations.

D. Analysis

VLBA Calibrator Survey Catalog. NVI/Raytheon developed a VLBA calibrator survey catalog based on 10 VLBA calibrator survey experiments. The survey experiments were processed through AIPS, databases were created, and the sessions were analyzed individually to fix problems like unreliable detections. Analysis was performed to determine the best type of SOLVE VLBI solution to use to determine the survey catalog positions. NVI/Raytheon scientists were coauthors of a paper entitled "Very Long Baseline Array Calibrator Survey" presented at the American Astronomical Society meeting in San Diego.

CORE Panel Meeting. NVI/Raytheon prepared a presentation on VLBI performance for the CORE panel meeting. The presentation discussed EOP precision from the best VLBI experiments, precision of subdaily EOP measurements, comparisons of EOP from simultaneous VLBI experiments, and unmodeled sources of error.

IVS Analysis Workshop. NVI/Raytheon made five presentations at the IVS Analysis Workshop held at Goddard: 1) Current problems in VLBI data analysis and possible improvements, 2) On modeling ocean loading in VLBI, 3) EOP modeling: current status and new approaches, 4) GSFC Analysis Center Report and 5) Report on AIPS processing of VLBA correlator output.

Calc/Solve Improvements. NVI/Raytheon upgraded Calc/solve so that it would run under the HP-UX 11.00 operating system. Solutions can now be run faster by a factor of 3-4.

NVI/Raytheon upgraded dbedit to use a new LCODE, the number of samples used per sideband per change per observation provided by the latest version of Fourfit to refine the compution of ionospheric frequencies in SOLVE and remove group delay noise.

NVI/Raytheon developed many new calc/solve utilities and enhanced various programs used in analysis of solve results.

Investigation of Better Ocean Loading Models. NVI/Raytheon investigated the influence of ocean loading on VLBI results. Two approaches were followed: loading amplitudes were estimated from the VLBI data and different tidal models were compared. The comparison of different models showed that VLBI cannot discriminate in general between models, although a model may be better for certain sites. A presentation, "Determination of Ocean Loading Deformations Using VLBI" was made at the 2001 EGS meeting.

Investigation of Hydrologic Loading Effect. NVI/Raytheon investigated the effect of hydrologic loading in VLBI analysis. A loading series was applied in VLBI analysis. It was found that the precision of baseline length measurements was improved by the expected amount on average. A presentation entitled, "Hydrologic loading in VLBI measured site displacements" was made at the 2001 EGS meeting.

Altimeter Radiometer Land Contamination. NVI/Raytheon generated a Topex microwave radiometer radiance database for all the geodetic calibration sites. The variation of radiances along the track were examined to determine how closely it follows the variation of a model that assumes that the ocean/land radiance difference is a constant. This is the simplest model that can be used to derive a correction for land contamination.

E. Computer Support

Systems Administration. Computer hardware support was provided by Raytheon during the contract period. The following VLBI computer were supported: leo, virgo, lupus, gemini, ivscc, lyra, bootes, dorado, aleph, aquila. For Code 926, support was provided to geodesy, bowie, santafe, nereid, ishtar.

An archive of all web pages was made, in accordance with a NARA directive. The outgoing Clinton administration requested that a snapshot of all web pages up until January 20th be made. So far no request has been made for this archive, but indication was made that there would be. Web pages on gemini, lupus, ivscc, and bowie were included.

Support for e-mail was done by installed and set up procmail (spam) filtering on virgo. A new new IVS data center mirroring schedule was proposed and implemented.

Hardware problems with cddisa entailed reconfiguration of NFS mounts on vlbi side. Some large filesystems previously hosted on cddisa were moved to local disks on bowie in order to free space on cddisa. All NFS mounts were re-directed accordingly. The changes were transparent to users. A total of approximately 35GB were moved and also checkpointed with an archive.

Critical patches were installed on various machines, mainly pertaining to security fixes for various critical conditions, some involving buffer overflows of various system components.

Software Support. Software support activities included: making backups and configuring parameters of backups for a reliable and robust system; updating or installing software as necessary such as Perl, plotting packages, compilers for Fortran and C, PGPLOT, Pine, HOPS, IDL, and utilities. Secure shell was installed on all machines as a security requirement.

The script that filters mail for VLBI sessions was made more efficient and functional with better error checking and multiple session addressing possible. The script that updates session web pages was modified to add more features and checking.

•