SOFTWARE REQUIRMENTS FOR THE GREEN BANK OVLBI EARTH STATION

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General Requirements

A set of programs running in a dedicated control computer at the earth station is required to perform the following main functions.

1. Automatically control and monitor all equipment at the station. It must do this by reading one or more *control files* and writing one or more *log files* while communicating with the station hardware in real time. One of the control files will be the *schedule file*, which will contain the starting and stopping times of each assigned tracking pass and the equipment setup parameters to be used (e.g., recording mode). Another file will contain time-specific geometric data, such as the predicted orbit of the satellite. Monitoring data will be collected from the hardware on a predetermined schedule and analyzed to detect any equipment faults; selected data will be written to a log file. Equipment control includes commanding the antenna motion to track the satellite, with all necessary geometrical calculations.

2. Provide automatic protection for the antenna and other major hardware. This involves stowing the antenna in the event of very strong winds, and shutting down some electronics in the event of high temperatures or other severe faults.

NOTE: Once the appropriate programs are started, operation should continue without human intervention until the end of the schedule file, unless a severe fault or disturbance is detected.

3. Provide displays for a human operator and allow manual control. The operator interface must be runnable either locally, at the station computer's console, or remotely via local- or wide-area networks. The operator should be able to examine current monitor data, review the log files, override the automatic functions, select which control files to use, and transfer files to and from remote computers. Operator monitoring and file transfers must not interfere with the automatic operation of the station, which proceeds simultaneously.

4. Analyze some of the monitor data to determine certain scientifically important parameters, and put these in a form (TBD) needed by other elements of the mission. This includes interpreting the round-trip timing measurements for both orbit determination and correlator timing. It also includes extracting spacecraft receiver data from the wideband data stream and re-formatting it as required. Programs for these functions may run off-line, not in real time.

5. Provide programs for converting files received from other elements of the mission into earth station control files, if necessary. This includes schedule information and predicted orbit data. Such programs may be run off-line.

NOTE: Tasks 4 and 5 involve defining interfaces to other organizations both inside and outside the NRAO. These include the VLBA project, NASA/JPL, and each of the foreign space agencies.

Constraints

1. The interfaces should have the "look and feel" of a VLBA station as much as possible. This includes the operator displays and commands; in particular, devices that have nearly identical counterparts at VLBA stations (e.g., recorders) should be seen through identical operator interfaces. In addition, the schedule and log files should follow VLBA formats whenever possible.

2. All real-time communication with the station hardware will be via the VLBA monitor and control bus (MCB), which is described in NRAO Specification A55001D001.

3. Communication with locations outside the station will be via the Green Bank ethernet LAN. Gateways to wide-area networks are available.

4. Software will be written in the C language whenever possible, since this language has become a de facto NRAO standard.

Options

1. The VLBA stations have a control computer that uses Motorola processors (680x0) in a VME bus architecture, running under the VxWorks operating system. This same hardware and operating system might be adopted for the earth station.

2. A hardware platform based on Intel 80x86-series processors in an IBM PC architecture might be adopted. An appropriate operating system that provides good support for real-time operations and networking would need to be selected. Use of MS-DOS does not appear to be feasible.

3. The VLBA control software has been written as numerous C modules, and includes considerable code for controlling and monitoring VLBA station hardware over the MCB, for providing operator displays, and for following a schedule file. Regardless of the platform and operating system adopted for the earth station, much of this code can be adopted.

4. Interferometrics, Inc., is a commercial producer of VLBA recording equipment and is engaged in other businesses involving VLBI. They have announced a project to produce a system of VLBI station control software within the PC architecture that will support both Mark III and VLBA recording equipment. By virtue of a license agreement, NRAO will have the right to use this code. Especially if option 2 above is adopted, we should collaborate with Interferometrics in choosing a platform and operating system, and we should consider using as much of their code as possible.