VLBA Correlator Memo No. 103

Correlator Software Status, March 1991*

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Abstract

A status report for the real-time software project for the VLBA correlator for the period late-January 1991 to mid-March 1991 is given. During this period the team made further progress in preparation for the impending integration of the software with the operational hardware. Tapes coded in VLBA format are being tested with the parallel-reproduce modules and track-recovery cards. Firmware is now being downloaded and command registers are now being set in the deformatter and FFT modules. The specification and procurement process for the archive has begun. Discussions about the use of barcodes have continued.

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*To be distributed for the Wed13Mar91 correlator teleconference.

1 Tasks

1.1 stnTask

Code has been added to load the variety of "personalities" and control words into the deformatter and track-recovery cards through the HCB [Hardware Control Bus]. Considerable effort has been required to devise this code because of the numerous operating modes which will be supported. New personalities and words are downloaded as observing modes change in observations or crossbar re-assignments occur. Code has been added which downloads and initializes the FFT control cards. Near the end of the period code was being added to download control words and 1 KB of window functions to the 40 FFT cards. We now have four of the production-version HCB Control Cards available; three will be sufficient for the Correlator.

1.2 tapeTask

During this period we received prototype formatter PROMs to support the VLBA tape format. Tests of reading and writing in the VLBA format are underway, using both the mini-decoder and the track-recovery modules. During this period we received the first of the production parallel-reproduce (read) modules for our PBDs, and tested them successfully.

There has been some trouble with loss of vacuum during operations of the PBDs. There is some indication that the problem occurs more often during operation of two drives, suggesting that maybe some sort of interaction is occurring between PBDs. Investigation is continuing.

2 Archive and Distribution

In April 1990 the team decided to defer work on the archive and distribution system until the RT control "axis" could be completed (Memo 98). Now that the first release has occurred, as discussed in the last report of this series (Memo 101), the team has resumed work on these components of the Correlator.

2.1 Archive and Distribution Architecture

Details of the archive architecture are still being worked out. The general strategy is that data will be received from the Filter module by means of a DR-11W DMA controller (yes, this is the ancient DEC protocol). The data

Medium	Dimensions (mm)	Size (MB)	Speed (KB/s)	Access (s)	Price ($)
6250bpi	280 diam	150	600	200	6300
QIC	152 × 100 × 16	150	50:	200:	850
Exabyte	95 × 62.5 × 15	2600	250	300:	2300
DAT	73 × 54 × 10.5	1300	183	45	1300

Table 1: Prices and Properties of Cartridge Devices

will be written to files on a SCSI disk of about 1 GB capacity. Individual files will be 20-30 MB in size, and will be on a per-array basis (multiple jobs, each with one or more arrays, may be correlating simultaneously). FITS header files and auxiliary table files will also be written to the disk. Dæmons will copy the disk files to cartridge tape(s), concatenating the headers, tables and visibility files, and adding error recovery and file label information. At high data rates two or more disk files may be copying to two or more tapes simultaneously in order to double, triple or quadruple the aggregate data rate. Probably we will also be able to support "real-time-filler" operations to some extent, transferring FITS files from the disk to an AIPS task across the network.

The distribution system will be a separate RT computer with multiple tape drives for reading the archive volumes and multiple output devices of various types (probably 4 mm DAT, 8 mm Exabyte, QIC, 9-track 6250 bpi and the Internet). Files associated with a specified project will be copied from the archive volume(s) to the distribution device. The format of visibility data will be 3-D binary tables (see sect. 2.3 below).

2.2 Archive Media Choice

For three years the Correlator team has watched the cartridge tape market. Throughout this period we have believed that the archive should use either 4 mm (DAT) or 8 mm (Exabyte) cartridges, and our preferred choice has wavered back and forth between the two. Each medium has advantages and disadvantages. For three years, prices on both devices declined steadily, and therefore we deferred the procurement. During the second half of 1990 the decision appears to have been made for us: the price of 8 mm devices has bottomed, while the price of 4 mm devices has continued to go down; there

Medium	Manufacturer	Distributor	Price
DAT 120	Maxell	Inmac	$27.95
DAT 120	Sony	Inmac	29.95
DAT 120	BASF	Tape World	8.99
DAT 120	Denon	Tape World	9.79
DAT 120	Fuji	Tape World	9.49
DAT 120	Sony	Tape World	10.99
8mm 120	Maxell	Inmac	25.95
8mm 120	Sony	Inmac	23.95
8mm 120	Sony	Tape World	5.69

Table 2: Recent Pricing of 4mm and 8mm Media

is now a substantial price gap between the two technologies (see Table 1). DEC recently standardized on DAT. Convex recently offered DAT support, citing better MTBF as justification. We are recommending that 4 mm DAT drives be used for the VLBA Correlator archive system.

There are about five different DAT factories. Some DAT drives now support long tapes which have 2 GB capacity. Some drives include compression chips, useful for disk backup but probably not useful for visibility data. Several "stacker" DAT drives are available, and we would like to choose one of these if we can get appropriate properties at a favorable price. Our market research continues.

The cost of the media will be a factor in the cost of operating the VLBA. Some recent small-quantity pricing is shown in Table 2. We see that data-grade media (from Inmac) differ in price by a factor of only about 1.2 ($25 for 8 mm versus $29 for 4 mm), but that the price ratio for consumer-grade media is larger, about 1.7 ($5.7 versus $9.7). The price ratio between data-grade and consumer-grade media is enormous (roughly 3.5). Probably these ratios mainly reflect economies of scale: the consumer distributor is now in a high-volume mode, especially for 8 mm video tape, whereas the computer distributor has only recently started to even offer DAT cartridges. It is unclear whether the data-grade media have any important advantages over the consumer-grade; both the 4 mm and the 8 mm technologies utilize very strong error detection and correction techniques. Probably we can assume that we will be able to get either 4 mm or 8 mm cartridges for less than $10.

If we typically produce 4 GB/day (a rough estimate suggested in one prior study), we can expect to spend $20-30/day ($7-11K/year) on the archive media.

2.3 3-D Binary Tables Distribution Format

During this period the Correlator software team has had a number of discussions with Phil Diamond regarding the proposed distribution format for the Correlator, for which Phil will code support into AIPS.[1] Phil has prepared a memo to document the proposed format, which is intended to be more general than the VLBA requirements; indeed, it is intended that the new format will be able to replace the traditional random-group (*uv*-FITS) format for all interferometry applications. The visibility data will be carried in tabular form, using Bill Cotton's "3-D Binary Table" format. The actual binary structure of visibility data in table form will generally be *identical* to the traditional random group structure. The improvements are in the header description of the data and in increased flexibility in the structuring of the data and in the combinations allowed.

3 Visit of Haystack Team (Barcodes)

On 28 February and 1 March four members of the Haystack VLBI group visited the Correlator group to discuss both hardware and software issues relevant to their plans for the "Mark IV" project. We discussed PBD details with Roger Cappallo, and we discussed barcode procedures with Alan Whitney. In particular, it will be important to consider compatibility with the conventions used in the Mark III system for VSNs, tape labels, handling and DBMS procedures. We also discussed the notion of building barcode scanners into our PBDs. This discussion is continuing.

4 NSE

We decided to upgrade to the next release of NSE code in order to obtain various bug fixes and improvements. Unfortunately, while we did obtain the advantages which we anticipated, we also uncovered new bugs in the new

[1] Phil will add this VLBA support code to what is now called "AIPS1", the old AIPS. An effort is underway to design a successor to AIPS, which is being called "AIPS2"; eventually the VLBI support code will be ported to AIPS2.

release, and we discovered changes which conflicted with our Makefile conventions. It took some time, and consultation with Sun personnel, to devise work-arounds for the bugs, and a significant re-structuring of our Makefiles was needed to restore proper functioning of our software environment.