National Radio Astronomy Observatory

Charlottesville, Virginia

To: VLB Array Meeting - Computer Subgroup

From: R. C. Walker, B. Burns

VLB ARRAY MEMO No. 19

Subject: Computer Needs

There will be an informal discussion of the VLB Array computer needs after dinner on Monday, September 15. The time and location will be determined earlier on Monday. The discussion should be limited to 10 or 15 people actively involved in VLBI hardware and software development.

The attached documents summarize our current ideas on the magnitude of the post-processing computer needs and present a possible plan for the computer hardware for the array.

Distribution:

J. Ball
T. Clark
M. Ewing
B. Leslie
T. Pearson
M. Reid
A. Rugers
N. Vandenberg
A. Whitney
J. Benson
W. Cotton
K. Kellerman

RCW/nw

VLBI ARRAY COMPUTER NOTES

The computer effort is divided into four areas:

1) Antenna and recorder control
2) Correlator control
3) Post-processing
4) Array control

In specifying and pricing hardware we have used DEC equipment. DEC is useful for beachmarking because they carry a line of equipment from LSIs up thru VAX and because many people understand the various DEC components. If we were building the array today, DEC, ModComp and HP all would be very strong contenders. Other manufacturers equipment would be considered also.

1) Antenna and Recorder Control

Plan A - use three LSI 11/23s (128K byte memory each), one for antenna control and communications, one for the tape recorder control and one for the complete on-line back-up. This latter system may be switched in place of either of the other two.

Cost is $27K each plus some interface and communications equipment. Total cost per antenna ≈ 3 x 27 + 19 ≈ $100K.

Plan B - use single PDP 11/44 (256K byte memory) to control the telescope and recorder. Remote diagnostics via telephone are available on this machine. On-site spares at each antenna are included in price. There is no redundant system in this case. Cost is $73K plus interface and communications equipment. Total cost per antenna ≈ $100K.

For computer/telescope interface we plan to use either CAMAC or a similar serial system. An NRAO designed system like that used at the VLA is also a possibility. This will reduce the number of wires required between the computer and various parts of the antenna and electronics system. It should also make computer switching easier for the case where a redundant computer is used. Cost for the CAMAC crate controller is included in the interface equipment priced above.

It is felt a stripped down antenna/recorder system should be located in the central array control center for ongoing development and for simulation to give telescope support personnel technical support. If plan A is used this might amount to an additional LSI 11/23. If plan B is used, this support might instead come from the hardware used for either array control or post-processing.

In any case, no funds are specifically budgeted. If an additional LSI 11/23 is required there are sufficient funds in the antenna/recorder budget.

Estimated software effort = 5 man years.

2) Correlator Control

It is not clear exactly what is required here since the correlator is not yet designed. Ken has guessed $150K for control computer which is included in correlator budget. There are also trade-offs, for example: whether an external array processor or a homemade device is used.

The software estimate is 10 man years.

3) Post-Processing

Post processing estimates are in units of VAXs (each VAX assumed having an array processor). This is a strange unit but is useful because people have a feel for it. Obvious gains in technology will be made in this area over the next few years; larger VAXs, good alternatives, CPUs with built-in array processors, optical disks, etc. It is felt however, that the trend toward more sophisticated processing techniques will balance the gains in hardware technology. In capacity, we feel about 3 1/2 times the above VAX capacity is required (see attached summary of current VLB post-processing program run times and extrapolation to the needs of the array). The estimated hardware cost for a possible setup with the required capacity is as follows.

2 systems:

VAX with 2 meg memory (basic package including disk and tape drive)	$210K
Array processor (64K bytes)	90K
Printer	10K
Terminals	10K
2nd tape drive (high density)	35K
Extra disks (3 spindles)	60K
Misc.	20K
	$435K

1 system:

Include above	$435K
Additional 2 meg memory	33K
Video disk	40K

Optical disk	40K
Grey scale display	50K
	$598K

Add 10% for price changes effective in late 1980 ($147K). Prices should reflect Jan. '81 pricing. Total = $1600K.

Manpower estimates for the post-processing is estimated at 5 man years. This is low but it is felt much software originally developed for VLA processing can be used.

4) Array Control

The array control computer communicates with each telescope. If separate telescope and recorder control computers are used (2 LSI 11/23s) the communication is with the telescope control. If a single PDP 11/44 is used for both telescope and recorder control, it also handles the communications. For the array control computer we envisage a PDP 11/44 with 512K byte memory. No redundant system is used but this machine supports remote diagnostics and the price of spare parts is included. The system resembles pretty much a standard control system and is priced at $150K. 5 man years software effort is estimated.

Summary

Total computer budget (not including correlator control computer):

Antenna hardware	$1.0 m
Post-processing hardware	1.6 m
Array control hardware	.15m
Software (25 man years/overhead)	.8 m
Total	$3.55m