

A COMPARISON OF ESTIMATED COSTS FOR THE AT AND THE US VLB ARRAY1. INTRODUCTION

Both the AT and the US VLB Array are presently under review for funding at levels of approximately \$25M and \$50M respectively. The estimated construction and operating expenditures are compared in this note with a view to highlighting any potential deficiencies or imbalances in the AT budget.

The US VLB Array is conceived as a 10-element array of 25m antennas at locations as diverse as Hawaii, Alaska and the east coast of the USA. The wavelength range of the antennas will extend to at least 7mm and include all the commonly used radio astronomy band allocations between 7mm and 90cm. Phase coherence over the VLBA will be ensured by the use of independent hydrogen maser oscillators at each site. Operation of the array will be controlled from the Array Operating Centre located most likely in the vicinity of the VLA. The IF signals will be recorded on high density digital recordings and shipped to the Operations Centre for later correlation and analysis. The tape processor will be based on high speed recirculating correlators, and will allow up to 14 tapes to be simultaneously correlated with full polarization capability and up to 32 continuum delays. In line mode up to 512 frequency channels per baseline can be used with 10 antennas. Post processing and image formation systems will be very similar to those of the VLA.

Estimated costs are compared for investment (capital and manpower) in Section 2 and operation in Section 3. Some conclusions are drawn in Section 4. The AT costs come from ASTDOC61.

2. CAPITAL AND MANPOWER COSTS DURING CONSTRUCTION

2.1 Capital (\$K)

Item	AT	VLBA
<u>Array elements</u>		
Antennas (including site works, rail)	10360 (a)	19720
Control	200	550
Feeds	160	970
Frontends	1200 (5 frequencies)	3200 (10 frequencies)
I.F.	2370 (b)	1390
L.O.	(c)	2280
Other equipment	-	1110 (d)
<u>Central Laboratory</u>		
Correlators/control computer	360 (e)	1930 (e)
Data processing computer	950	2650
Central LO/Test facility	220	200
Buildings	1200	1650
Spares	-	1565
Tapes	-	450
<u>Management, documentation</u>	240	500 (f)
TOTAL	17260	38165

2.2 Manpower (\$K)

Item	AT	VLBA
<u>Array elements</u>		
Antennas/site, rail	560	1340
Antenna control	705	180
Feeds	510	370
Frontends	2145	1510
Cables, radio links	280	-
I.F.	150	330
L.O.	(c)	250
<u>Central Laboratory</u>		
Correlators, control computer	1350	904
Data processing	1180	380
Central LO/Test facility	255	-
<u>Management, documentation</u>	1930	1500 (f)
TOTAL	9065	6764

2.3 Summary of construction costs

	AT	VLBA
Construction	17260	38165
Manpower	9065 (g)	6764
Contingency	2270 (a)	6000
GRAND TOTAL	28595	50929

Notes:

- (a) the AT antenna costs tabulated above do not include contingency funds. These are included in the overall contingency costs at 10%.
- (b) the IF costs for the AT are primarily those of the radio link between Parkes, Siding Spring and Culgoora as estimated by AWA but downsized to remove space diversity. The present estimate is \$600K higher than given in ASTDOC61.
- (c) no allowance has been made in the estimates for an L0 link between Parkes, Siding Spring and Culgoora.
- (d) "other equipment" at each antenna includes test equipment, water vapour radiometers, Rubidium oscillators and timing receivers.
- (e) the VLBA processor includes \$340K for an online computer, \$604K for tape playback equipment and \$730K for the correlator and support hardware for 46080 correlators (45 baselines, 512 complex points per baseline). The AT correlator cost estimate is based on 48 baselines and 128 complex points per baseline.
- (f) the project management estimate for the VLBA has been split (arbitrarily by me) into \$500K for "construction" and \$1500K for "manpower".
- (g) manpower costs attributable to the AT project are \$6030K, the remainder will be covered by the Division of Radiophysics (ASTDOC61). The total costs attributable to the AT project are therefore \$25560K.

3. OPERATING COSTS (\$K)

	<u>AT</u>	<u>VLBA</u>
Staff remuneration	2920 (80 people)	2100 (80 people)
Tape shipping	-	200
Travel	-	180
Communications for control of remote telescope	not estimated	190
Utilities)		400
Maintenance)	750	580
Development)		500
TOTAL	<u>3670</u>	<u>4150</u>

4. CONCLUSIONS

- (1) the ratio of the total construction cost estimates of the AT & the VLBA is approximately the same (within 10%) as the ratio of the number of new antennas in each project.
- (2) the proportion of construction manpower to investment is far higher for the AT (32%) than for the VLBA (13%). This reflects a tradeoff of manpower for investment in the areas of feeds, frontends and correlators/online computing. These tradeoffs should be examined critically in the detailed planning of the AT.
- (3) offline software costs may be too high for the AT in view of the software that already exists at other synthesis telescopes which could be taken over and adapted for the AT. The costs for this item for the VLBA are based on the assumption that only 10 man-years are required to upgrade existing software.
- (4) consideration will have to be given to allocating funds for
 - (a) spare parts during the construction phase of the AT,
 - (b) the hardware required for an L0 link between Parkes, Siding Spring and Culgoora,

- (c) the operating costs of the radio links.
- (5) in view of the publicity given the VLBI aspects of the AT, it is perhaps surprising that no funds have been specifically allocated for VLBI equipment.

CORRECTION TO ATDOC106:

"A comparison of estimated costs for the AT and the US VLB Array"

page 4, point (e) should read:

The VLBA processor includes \$340K for an online computer, \$604K for tape playback equipment and \$730K for the correlator and support hardware for 11648 multipliers operating at 50 MHz (91 baselines, 2 bands, 32 lags, sine and cosine, recirculation). The AT correlator cost estimate is based on 48 baselines and 128 complex points per baseline (12288 multipliers operating at 50 MHz, no recirculation).