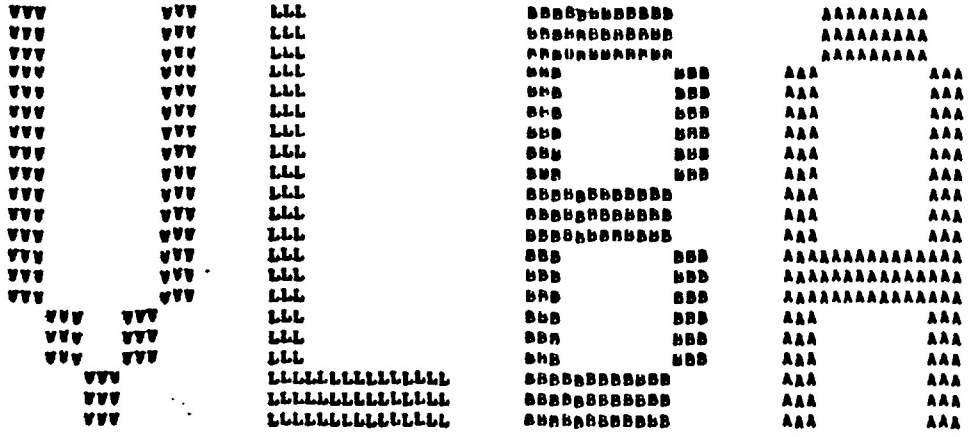
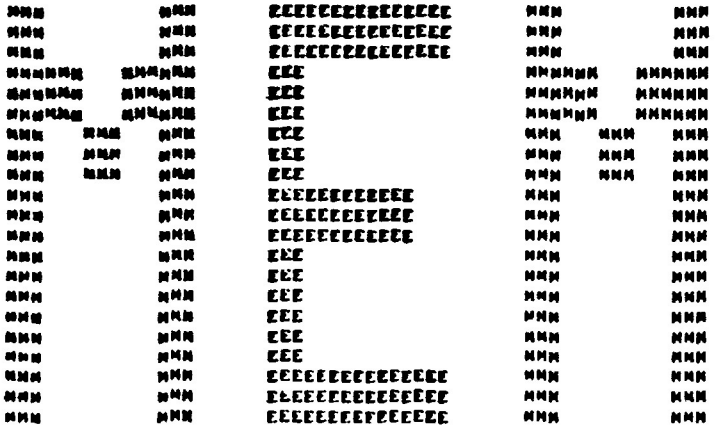
VLB ARRAY MEMO No. 39





•START• User CLARK [13,38] Job VLBA seq. 1858 Date 11-NOV-81 10:56:34 Monitor TOPS10 7.01 VLA:4.6 •START•
File: DSKC:VLBA.MEM<055>[13,38] Created: 11-NOV-81 10:42:06 Printed: 11-NOV-81 10:56:57
QUEUE Switches: /FILE:ASCII /COPIES:6 /SPACING:1 /LIMIT:352 /FORMS:NORMAL

Remarks on the VLBA report--B. Clark--November 10, 1981

Section 3B. Configuration.

The section is, in my opinion, about right in content, but could be improved in form. The primary burden of the section should be to justify ten antennas, and to justify the inclusion of Alaska, the most expensive site. The first of these is most easily defended on the basis of the 200km minimun spacing (itself determined by matching up to MTRLI spacings), and the 8000km/B argument made in table III-1. The latter is not addressed, and probably should be. Can this be done adequately with a foreshortening argument, or to we need to go to the less perspicuous agrument about bow-tie shaped sidelobes?

In the main portion of the section, I would prefer a more narrative style, with fewer numbered paragraphs.

The last two columns of table III-1 should be dropped (their point can be made much more clearly in narrative), and I personally would prefer to see the number of phase closures, rather than their percentage. Amplitude closures are not enough different to justify inclusion.

Figures III-2 and III-3 do not state the limiting elevations.

Figures III-6 occupy far too much space for the point they are trying to make--they should be replaced by a paragraph of narrative.

Remarks on the VLBA report--B. Clark--November 10, 1981

Section 3F. Local Oscillators.

I agree that for cost purposes, the hydrogen maser must be the oscillator of choice. However, I think the remarks on the satelite link could be softened a bit. It should be remarked that the limiting factor is the ionospheric dispersion between uplink and downlink frequencies, which probably excludes the standard 6GHz/4GHz uplink/downlink tranceivers. The use of a 12GHz/14Ghz system (proposed on the ESA L-sat, among others) would probably make the LO link sufficiently more stable than the radiosource radiation itself that it would be useable. The sentence "the cost and maintenance of the necessary ground stations is not negligible," is rather fatuous--compared to hydrogen masers it is.

So far as I know, the paragraph on the SCCO is about right, but anything more OVRO can tell us about it should be included.

The section on phase calibration should be based much more heavily on self-calibration. These techniques work and are dramatically successful. Instead, the section starts off with a bunch of remarks directed to astrometry (surely a rather small, though not neglibible, part of the work to be expected from the array) and water vapor measurements (a technique which, unlike self-cal, has never been made to work, despite multiple attempts). The first half-dozen paragraphs of the section should be moved to the end and prefaced by the remark that some small percentage of the work of the array requires the extension of phase calibration over a larger portion of the sky, and that if so, you have to worry about water vapor, ionosphere, polar motion, earth tides nutation, time and other such annoying concepts.

Remarks on the VLBA report--B. Clark--November 10, 1981

Section 3G. The record system.

(uncalled for remarks)

It is far from clear to me what is meant when it is stated that MkIII will be adopted for costing purposes. What is MkIII anyway? Is it a transport or transport type? Is it a multitrack philosophy (ie feeding each track from an independent sampler)? Is it a system (including a computer with defined duties)? It apparently isn't a head stack--basing the array on the current MkIII headstack is clearly madness. I am also not very happy with the sampler/track philosophy. The only justification is if the system is rather unreliable--it causes the minimum disruption to drop bad tracks. Spreading the bits from a single, broadband sampler (actually you probably want to use up to four) among several tracks is a rather trivial technical problem, and the resulting simplicity in the IF processing gear seems to me to be well worth having. It must seem strange to outsiders that we do a fourier transform to go from frequency to delay (for this is essentially what the "fringe fitter" is) and from delay to frequency (for spectral processing) in the same machine.

Remarks on the VLBA report--B. Clark--November 10, 1981

Section 4A. The playback processor.

The point raised in section 1 is an extremely interesting one, and should be dealt with somewhere, probably in a section on operations. It is certainly the case that with current systems, and probably for the VLBA, the system is limited by the capabilities of the playback processor. In fact, the observing system must be operated at significantly less than its full capability, in order to avoid swamping the playback system. This may include ploys like the one proposed here, of running the system at half bandwidth most of the time, or one which I personally find more attractive, of simply turning off the array thirty or forty percent of the time. This, if well planned, should result in a substancial saving in operating cost. The only alternative to something like this is to go ahead and cost in two processors. This might let the system run at full capability most of the time.

In section two, since the ECL and TTL technology correlators are quite competitive in cost, the requirements should be stated in terms of both lags (appropriate to the TTL) and in multiplications per second (appropriate to ECL). For instance the continuum requirements would be met by

45 (baselines) * 112 (MBits per polarization) * 4 (correlator polarizations) * 128 (20ns lags)

This could be provided by 23040 complex correlators, about the same number as required by the TTL device (but permitting a much simpler fringe search algorithm).

The spectral line case (16 MBits of water with 512 spectral channels) gives

45 (baselines) * 16 (MBits) * 1024 (complex lags)

which could be provided by only 5770 correlators, if the data is played back as slowly as real time. In fact, the ECL philosophy leads directly to the fascinating table below, rather than to table IV-1.

Playback speed with 23040 complex correlators (112MBit)

Bandwidth	512chan	1024chan	2048chan
112MHz	1	.5	.25
56MHz	2	1	.5
28MHz	4	2	1
etc....			

The table assumes that the record time tape can be run more slowly than the playback.

Finally, I state here what I have stated elsewhere, that I am unconvinced of the utility of regarding the recorder output as a 28*8MBit two dimensional bit array rather than as a 1*224MBit stream. It seems to offer two advantages: 1) The system degrades gracefully if a track breaks, and 2) 4 MHz samplers are easier to design than 100 MHz samplers. Against these must be balanced the cost and complexity of 28Ø IF processors (there are only 108 at the VLA, and only 56 of them are currently in use). Also charged against the philosophy is the price of the FFT fringe fitting, which becomes a relatively trivial operation in lag space.

Remarks on the VLBA report--B. Clark--November 10, 1981

Section 4B. Postprocessing.

I think the estimates in this section are about right. In my first reading of it, though, I thought the estimate that line mapping and cleaning were 256 times continuum also included the self-cal, and I was quite upset until I went back and picked the sentence apart word by word.

The estimates do not provide for any of the multiple reprocessing which has been so hard for us here at the VLA. On the other, the VLBA will awaken to an environment which includes a lot of distributed processing power evolved for VLA requirements. I think it would not be inappropriate to keep the on site computer systems relatively modest as the draft calls for, and merely note that the VLBA will call for more intensive use, and some expansion, of the VLA postprocessing network.

My current inclination would be to think in terms of a VAX sized system for preprocessing, and something rather larger for everything else. However, I suppose that the disclaimer included is sufficient.

Somebody must think about how much disk we are going to need. This will probably cost as much as the CPUs, so it shouldn't be glossed over.