```
VVV         VVV       LLL                   BBBBBBBBBBBB             AAAAAAAAA
VVV         VVV       LLL                   BBBBBBBBBBBB             AAAAAAAAA
VVV         VVV       LLL                   BBBBBBBBBBBB             AAAAAAAAA
VVV         VVV       LLL                   BBB          BBB      AAA         AAA
VVV         VVV       LLL                   BBB          BBB      AAA         AAA
VVV         VVV       LLL                   BBB          BBB      AAA         AAA
VVV         VVV       LLL                   BBB          BBB      AAA         AAA
VVV         VVV       LLL                   BBB          BBB      AAA         AAA
VVV         VVV       LLL                   BBB          BBB      AAA         AAA
VVV         VVV       LLL                   BBBBBBBBBBBB          AAA         AAA
VVV         VVV       LLL                   BBBBBBBBBBBB          AAA         AAA
VVV         VVV       LLL                   BBBBBBBBBBBB          AAA         AAA
VVV         VVV       LLL                   BBB          BBB      AAAAAAAAAAAAAAA
VVV         VVV       LLL                   BBB          BBB      AAAAAAAAAAAAAAA
VVV         VVV       LLL                   BBB          BBB      AAAAAAAAAAAAAAA
   VVV   VVV          LLL                   BBB          BBB      AAA         AAA
   VVV   VVV          LLL                   BBB          BBB      AAA         AAA
   VVV   VVV          LLL                   BBB          BBB      AAA         AAA
      VVV             LLLLLLLLLLLLLLL       BBBBBBBBBBBB          AAA         AAA
      VVV             LLLLLLLLLLLLLLL       BBBBBBBBBBBB          AAA         AAA
      VVV             LLLLLLLLLLLLLLL       BBBBBBBBBBBB          AAA         AAA


MMM         MMM       EEEEEEEEEEEEEEE       MMM         MMM
MMM         MMM       EEEEEEEEEEEEEEE       MMM         MMM
MMM         MMM       EEEEEEEEEEEEEEE       MMM         MMM
MMMMMM   MMMMMM       EEE                   MMMMMM   MMMMMM
MMMMMM   MMMMMM       EEE                   MMMMMM   MMMMMM
MMMMMM   MMMMMM       EEE                   MMMMMM   MMMMMM
MMM   MMM   MMM       EEE                   MMM   MMM   MMM
MMM   MMM   MMM       EEE                   MMM   MMM   MMM
MMM   MMM   MMM       EEE                   MMM   MMM   MMM
MMM         MMM       EEEEEEEEEEEE          MMM         MMM
MMM         MMM       EEEEEEEEEEEE          MMM         MMM
MMM         MMM       EEEEEEEEEEEE          MMM         MMM
MMM         MMM       EEE                   MMM         MMM
MMM         MMM       EEE                   MMM         MMM
MMM         MMM       EEE                   MMM         MMM
MMM         MMM       EEE                   MMM         MMM
MMM         MMM       EEE                   MMM         MMM
MMM         MMM       EEE                   MMM         MMM
MMM         MMM       EEEEEEEEEEEEEEE       MMM         MMM
MMM         MMM       EEEEEEEEEEEEEEE       MMM         MMM
MMM         MMM       EEEEEEEEEEEEEEE       MMM         MMM
```

```
*START* User CLARK [13,30] Job VLBA Seq. 8148 Date 04-Dec-81 10:06:33 Monitor TOPS10 7.01 VLA:4.6 *START*
File: DSKC:VLBA.MEM<055>[13,30] Created: 04-Dec-81 10:03:53 Printed: 04-Dec-81 10:06:39
QUEUE Switches: /FILE:ASCII /COPIES:1 /SPACING:1 /LIMIT:55 /FORMS:NORMAL
```

VLB ARRAY MEMO No. 42

VLBA correlator--What could the VLA correlator do for us?

B. G. Clark December 4, 1981

The VLA correlator has 11232 real multipliers running at 100 MBit rates. These are combined in various fashions to yield a wide variety of real cross correlation functions or of complex channels. Let us consider what a similar number of real multipliers could accomplish for the VLBA correlator, with a different, more suitable, set of possible interconnections.

For the purpose of this memo, the specifications for the VLBA playback equipment will be:

- There are four bit streams per station.
- Each bit stream as it comes from the recorder has a bit rate of 25MBits.
- Each bit stream is equipped with its own recirculator, so that it is converted to a 100MBit stream played back 2**n times, where n>1.
- There are 14 stations in the playback equipment, although most of the time it will run with the 10 station dedicated array.

A fourteen station array has 91 baselines, 128 real correlators per baseline gives a total of 11548 real correlators, virtually identical to the VLA correlator.

For continuum use, we are always processing four 25 MBit streams, and we might as well consider only the case in which these represent two orthogonal polarizations in each of two bands. A reasonable way to organize things for this case is to divide the correlator into halves, each half processing one of the two bands. This gives us 64 real correlators or 32 complex correlators each. One, not unreasonable, way of organizing things is to run with 32 lag channels and to use the four recirculations to calculate the four polarization cross products. 32 lag channels at 40ns per channel gives a total lag range of plus or minus 0.64 microsecond. The lag range necessary to maintain a 1" radius field of view is plus or minus 0.20 microseconds for earth based instruments. This requires the array clocks to be a priori known to an accuracy of 0.44 microseconds. For a dedicated array doing frequent real-time fringe checks, this seems entirely reasonable.

Line use is much more complicated. There are a large number of possible modes and bandwidths. I first list the modes of interest and then tabulate the number of channels and sprectral resolution each mode yields for each possible total bandwidth.

A) Two bands, two IFs per band, full polarization processing.
B) One band, full polarization processing (two bit streams are idle).
C) Four bands, no polarization processing
D) Two bands, no polarization processing (two bit streams are idle).
E) One band (three bit streams are idle).

Sample Rate MHz	Band-width each band	A numb	A res kHz	B numb	B res kHz	C numb	C res kHz	D numb	D res kHz	E numb	E res kHz
25	12.5	16	780.	32	390.	32	390.	64	195.	128	96.
12.5	6.25	32	195.	64	96.	64	96.	128	48.	256	24.
6.25	3.12	64	48.	128	24.	128	24.	256	12.	512	6.
3.12	1.56	128	12.	256	6.	256	6.	512	3.	1024	1.5
1.56	0.78	256	3.	512	1.5	512	1.5	1024	0.75	2048	0.39
0.78	0.39	512	0.75	1024	0.39	1024	0.39	2048	0.19	4096	0.10
0.39	0.19	1024	0.19	2048	0.10	2048	0.10	4096	0.05	8192	0.02
0.19	0.10	2048	0.05	4096	0.02	4096	0.02	8192	0.01	16384	6Hz

Obviously, the narrower bandwidths provide more data than can ever be processed.

It is also possible that double the number of channels in the table aboved could be provided for 10 stations. This would require an input multiplexor on the front of each multiplier, and would be rather fussy about cable lengths, etc, but is probably still doable without a great increase in cost.

This correlator would be more expensive than the VLA correlator for a number of reasons. For instance, it is probably necessary to provide a fringe rotator per baseline. This device is cheap enough, merely an adder and a gate, but it probably implies an additional counter (essentially an additional correlator channel) to keep track of the attempted correlations.

On the other hand, it is not clear to me that maintaining the three-level capability is worth-while. Clearly, all continuum observing should be done with two-level sampling, as this gives a maximum return in signal-to-noise ratio per recorded bit. Only for line data, and in the case where you are only interested in a narrow line, or if you have excess record capability (Cases B,D, and E) is the three-level scheme of interest.