

**CALIFORNIA INSTITUTE OF TECHNOLOGY**  
VLBA Correlator Memorandum

To: VLBA Correlator Group  
From: Steve Kator, Dave Fort, Martin Ewing      Date: 29 July 1985  
Subject: Subsystem Estimates

This memo provides further descriptions of major portions of the VLBA correlator architecture of Memo VC041 and some more recent design information. These include estimates of chips, materials costs, and power dissipation. NOTE: Estimates do not include design costs or other labor costs.

**STATION ELECTRONICS.** Table I shows the Station Electronics breakdown which is meant to be closely similar to the design presented in VC041. The cost estimates supplied as a deliverable under Phase A1 of the Caltech contract from NRAO are based on this table. The item labelled "Criss-cross crates" did not appear in the Memo; it is a passive subsystem that simply reorganizes input cables, arranged, for example, by DPS number to outputs arranged by channels, etc.

Table II reflects a design approach investigated after VC041 was published. In this system, the large crossbar and criss-cross assemblies are eliminated in favor of carrying delay- and phase-corrected signals for all 24 possible DPS units to the correlator electronics. Interconnections are substantially simplified compared with the Table I design, and costs are somewhat reduced even though more delay and phase boards are required.

Table III is our latest design, reflecting the interconnection scheme of Table II with the addition of a gate array implementation of the delay and phase circuits. System size is reduced from 2 racks to 1, and all major functions are accommodated on one type of board. This design appears to offer considerable system simplification and cost savings compared with the "Table II" or "Table I" designs.

**CORRELATOR ELECTRONICS.** Table IV is our current breakdown of the Correlator Electronics subsystem. It is somewhat more detailed than the description in VC041, but it retains essentially the same design features. A "Data Concentrator" has been added to interface between the DR11-W TOP Input interface and the COP processors in the ECAs. This is a small 68000 system that buffers and switches incoming data. Refer to memo VC051.

**VLBA STATION ELECTRONICS I (Architecture Report Version)****SUBSYSTEM ESTIMATE**

7/29/85

**I/O BOARD**

Number of standard MSI chips:	53
Estimated materials cost:	\$462
Estimated power dissipation:	19. W

**DELAY/PHASE BOARD**

Number of switch VLSI chips:	3
Number of standard MSI chips:	335
Estimated materials cost:	\$1,340
Estimated power dissipation:	68. W

**PHASE CAL BOARD**

Number of switch VLSI chips:	3
Number of standard MSI chips:	215
Estimated materials cost:	\$845
Estimated power dissipation:	44. W

**CONTROLLER BOARD**

Estimated cost:	\$2,000
Estimated power dissipation:	20. W

**DELAY/PHASE CRATE**

Number of I/O boards:	2
Number of Delay/phase boards:	10
Number of Phase Cal boards:	2
Number of Controllers:	1
Estimated materials cost (inc. backplane hdwe.):	\$19,364
Estimated power dissipation:	826. W

**DELAY/PHASE RACK**

Number of Delay/phase crates:	4
Estimated materials cost (inc. rack and pwr. sup.):	\$84,950
Estimated power dissipation:	3,650. W

**CHANNEL CROSSBAR BOARD**

Number of switch VLSI chips:	16
Number of standard MSI chips:	63
Estimated materials cost:	\$804
Estimated power dissipation:	24. W

**CHANNEL CROSSBAR CRATE**

Number of Channel Crossbar boards:	10
Number of Controller boards:	1
Estimated materials cost (inc. backplane hdwe.):	\$11,040
Estimated power dissipation:	260. W

**CRISS-CROSS CRATES (estimated materials costs)**

Criss-cross 1 (24x3x16 pair in, 16x3x24 pair out):	\$696
Criss-cross 2 (16x4x20 pair in, 20x4x16 pair out):	\$928
Criss-cross 3 (40x4x16 pair in, 32x4x20 pair out; 2 crates):	\$1,856
Subtotal estimated materials cost (inc. packaging hdwe.):	\$4,400

**CHANNEL CROSSBAR RACK**

Number of Channel Crossbar crates:	2
Number of Criss-cross crates:	4
Estimated materials cost (inc. rack and pwr. sup.):	\$28,000
Estimated power dissipation:	575. W

**CABLING (estimated materials costs)**

Stations to Criss-cross 1 (24x3x16 pair, 15 m):	\$4,223
Criss-cross 1 to Delay/phase rack (16x3x24 pair, 10 m):	\$2,808
Delay/phase rack to Criss-cross 2 (16x4x20 pair, 10 m):	\$3,744
Criss-cross 2 to Channel Crossbar (20x4x16 pair, 2 m):	\$1,042
Channel Crossbar to Criss-cross 3 (40x4x16 pair, 2 m):	\$2,083
Criss-cross 3 to Correlator Electronics (32x4x20 pair, 10 m):	\$7,488
Subtotal estimated materials cost (inc. connectors):	\$21,400

**COMPLETE SUBSYSTEM**

Number of Delay/phase racks:	2
Number of Channel Crossbar racks:	1
Estimated cost of test bed and prototyping materials:	\$9,500
Total estimated materials cost:	\$228,800
Total estimated power dissipation:	7875. W

**VLBA STATION ELECTRONICS II**  
SUBSYSTEM ESTIMATE

7/29/85

**I/O BOARD**

Number of standard MSI chips:	43
Estimated materials cost:	\$422
Estimated power dissipation:	19. W

**DELAY/PHASE BOARD**

Number of switch VLSI chips:	3
Number of standard MSI chips:	335
Estimated materials cost:	\$1,340
Estimated power dissipation:	68. W

**PHASE CAL BOARD**

Number of switch VLSI chips:	3
Number of standard MSI chips:	175
Estimated materials cost:	\$765
Estimated power dissipation:	36. W

**CONTROLLER BOARD**

Estimated cost: \$2,000  
 Estimated power dissipation: 20. W

**DELAY/PHASE CRATE**

Number of I/O boards: 3  
 Number of Delay/phase boards: 12  
 Number of Phase Cal boards: 3  
 Number of Controllers: 1  
 Estimated materials cost (inc. backplane hdwe.): \$23,000  
 Estimated power dissipation: 989. W

**DELAY/PHASE RACK**

Number of Delay/phase crates: 4  
 Estimated materials cost (inc. rack and pwr. sup.): \$100,750  
 Estimated power dissipation: 4,350. W

**CABLING (estimated materials costs)**

Stations to Delay/phase rack (24x3x16 pair, 15 m): \$4,200  
 Delay/phase rack to Corr. Elec. (24x16x8 pair, 10 m): 7,500  
 Subtotal estimated materials cost (inc. connectors): \$11,700

**COMPLETE SUBSYSTEM**

Number of Delay/phase racks: 2  
 Estimated cost of test bed and prototyping materials: \$8,800  
 Total estimated materials cost: \$222,000  
 Total estimated power dissipation: 8,700. W

**VLBA STATION ELECTRONICS III (Correlator Memo VC049 Version)****SUBSYSTEM ESTIMATE**

7/29/85

**DELAY/PHASE/PCAL BOARD**

Number of switch VLSI chips: 11  
 (Production cost per switch VLSI chip: \$12.)  
 Number of delay/phase/pcal VLSI chips: 8  
 (Production cost per delay/phase/pcal VLSI chip: \$35.)  
 Number of standard LSI chips: 80  
 Number of standard MSI chips: 37  
 Estimated materials cost: \$1,215  
 Estimated power dissipation: 32. W

**CONTROLLER BOARD**

Estimated cost: \$2,000  
 Estimated power dissipation: 20. W

**DELAY/PHASE/PCAL CRATE**

Number of Delay/phase/pcal boards:	16
Number of Controllers:	1
Estimated materials cost (inc. backplane hdwe.):	\$22,400
Estimated power dissipation:	532. W

**DELAY/PHASE/PCAL RACK**

Number of Delay/phase/pcal crates:	3
Estimated materials cost (inc. rack and pwr. sup.):	\$70,400
Estimated power dissipation:	1,750. W

**CABLING (estimated materials costs)**

Stations to Delay/phase/pcal rack (24x2x24 pair, 15 m):	\$4,100
Delay/phase/pcal rack to Corr. Elec. (16x6x32 pair, 10 m):	6,100
Subtotal estimated materials cost (inc. connectors):	\$10,200

**COMPLETE SUBSYSTEM**

Number of Delay/phase/pcal racks:	1
Estimated cost of test bed and prototyping materials:	\$6,400
Total estimated materials cost:	\$87,000
Total estimated power dissipation:	1,750. W

**VLBA CORRELATOR ELECTRONICS****SUBSYSTEM ESTIMATE**

7/17/85

**INPUT BOARD**

Number of standard MSI chips:	62
Estimated materials cost:	\$475
Estimated power dissipation:	10. W

**CORRELATOR BOARD**

Number of correlator VLSI chips:	32
(Production cost per correlator VLSI chip:	\$70.)
Number of switch VLSI chips:	8
(Production cost per switch VLSI chip:	\$12.)
Number of standard LSI chips:	4
Number of standard MSI chips:	37
Estimated materials cost:	\$3,166
Estimated power dissipation:	25. W

**DSP BOARD**

Number of standard LSI chips:	38
Number of standard MSI chips:	48
Estimated materials cost:	\$807
Estimated power dissipation:	25. W

**COP BOARD**

Estimated cost:	\$2,000
Estimated power dissipation:	15. W

**PARALLEL OUTPUT BOARD**

Estimated cost:	\$1,500
Estimated power dissipation:	10. W

**ELEMENTARY CORRELATOR ARRAY CRATE**

Number of Input boards:	1
Number of Correlator boards:	13
Number of DSP boards:	4
Number of COP boards:	1
Number of Parallel Output boards:	1
Estimated materials cost (inc. backplane hdwe.):	\$50,300
Estimated power dissipation:	460. W

**C.E. QUADRANT RACK**

Number of Elementary Correlator Array crates:	4
Estimated materials cost (inc. rack & power sup.):	\$207,500
Estimated power dissipation:	2,000. W

**PARALLEL INPUT BOARD**

Estimated cost:	\$1,000
Estimated power dissipation:	10. W

**DATA CONCENTRATOR CONTROLLER BOARD**

Estimated cost:	\$2,000
Estimated power dissipation:	15. W

**DR11-W INTERFACE BOARD**

Estimated cost:	\$1,500
Estimated power dissipation:	18. W

**DATA CONCENTRATOR CRATE AND RACK**

Number of Parallel Input Boards:	16
Number of Data Concentrator Controller Boards:	1
Number of DR11-W Boards:	1
Estimated cost (w/backplanes, cables, p.s. & 0.25 rack):	\$23,200.
Estimated power dissipation:	200. W

**COMPLETE SUBSYSTEM**

Number of C.E. Quadrant racks:	4
Number of Data Concentrator racks per quadrant*:	1/4
Estimated cost of test bed and prototype mat'ls:	\$18,000
Total estimated materials cost:	\$871,200
Total estimated power dissipation:	8,200. W

\* There is just one Data Concentrator for the entire correlator.