Nov 30, 1983

To: Hein Hvatum

From: Craig Walker

Subject: Comments on current draft of Vol III

   The comments below are based on the draft of Vol. III of the VLBA report as it stood on about Nov 22, 1983. Considering that the report should be released soon, I have not suggested style or wording changes. Most of my comments relate to inconsistencies that I have noticed or to areas where there may be problems with the current design. The comments on the design should be treated as points to address in the future rather than as suggestions for changes in the text. I have not made comments that duplicate comments by Kellermann in VLBA CC Memo 12 or that have been addressed in design changes that have been made since the document was written and that I have heard about.

General Points:

   We need to design the interface to the VLA for the 'outrigger' antennas. I fear that we may need separate VLA and VLBA IF's on the microwave link if we are not careful. For example, the VLA compatible VLBA sample rates are 24 and 48 Ms/s, one bit only. The VLA, as I understand it, is 25 and 50 Ms/s, two bit, three level. Small differences like that can cause real headaches later. Perhaps someone should write a rough memo on how the 'outrigger' antenna will be interfaced to the VLA so that we don't make obvious mistakes.

   There are major discrepancies between the operations chapter and both other sections of the report and Vol I. I agree with Ken's suggestion that the description of the intended operating style be retained but that the numbers be removed and distributed in a VLBA Memo.

Chapter II. Sites:

   I agree with Ken - let's try to get something other than a 'box' for the AOC. This will depend on the architect.

Chapter III. Antennas:

   The 5 degree elevation limit is still there. Shapiro seems much happier with 2 to 3 degrees. I understand there are physical problems getting below 5 degrees with the VLA style backup structure. However I also understand the problem is not as great with the advanced design. Shouldn't we write the antenna specifications so that 5 degrees is required but also so that it will go lower if that does not present a major problem. I'm afraid that, if we keep

specifying 5 degrees, we will get that even with a structure that could have easily accommodated a lower limit.

How does humidity affect pointing? A 0-50 percent range may cause problems in Puerto Rico all the time and at some of the other stations during the summer. Is this important?

The allowed peak deviation specs differ in C-1 (1.4mm) and D-1 (1.5mm).

Where is the subreflector? It is not discussed anywhere in Volume III! I hope it hasn't fallen out of the summary budget which I do not have.

Chapter IV. Electronics:

I'm worried that we should not count completely on the HEMTs for the high frequencies. They sound promising but as long as the masers have a clear Tsys advantage, we should also be investigating ways to improve the reliability of masers and their associated cryogenics.

Some mention might be made in Vol III of the current plans for a special, fixed frequency synthesizer to support a third IF frequency for geodesy observations.

Chapter V. Data Aquisition:

I found most of Chapter V difficult to read and understand. It is as if someone very close to the project wrote it not thinking about what would and would not be obvious to an outsider. The section on the Formatter was especially difficult.

The VCR costs are dominated by the changer which hasn't yet been designed. When are we going to design it and get realistic cost estimates?

Cost estimates still seem liberal for the Mk III system and conservative for the cassette system.

The operating costs of the two systems have clearly been fudged to come out the same. I thought we had indicated previously that this style of estimate was unacceptable and that realistic, best guess estimates should be made.

Section II on the Mk III Description and Status should be removed and made into a VLBA Memo. It is much too detailed for Volume III.

One problem with the current Mk III system is that the delay calibration system imposes 5 MHz steps between 4 MHz observing bands

limiting the ability to use minimum total bandwidth when wide fields of view are desired or when receivers are narrow band. The latter should not be a problem with the wide VLBA receivers and the available wide band modes may reduce the importance of the former, but isn't having the delay cal system based on different frequency increments than the bandwidths inviting trouble?

Table B1 discusses 3 level sampling, other areas of the report use 4 level. The correlator chapter mentions both. I believe we have settled on 2 and 4 level sampling - let's make it consistent. Also the availability of 2 bit sampling at 24 Ms/s is not consistent between the Aquisition and Correlator chapters.

Should we consider using the VLA's stable of sample rates instead of the Mk III's for greater compatibility when the instruments are used together? If so, one or two bands compatible with Mk III would be needed much as the VLA bands at 24 and 48 Ms/s are provided in the current system.

Fig B8 shows an alarm that is only an audible warning. I hope it is understood that the stations will not be manned most of the time and that the computer (and via the computer, the central operator) need to know about all problems.

The SNR formula does not include the fractional bit shift losses.

Chapter VI. Monitor and Control:

The common control language might just be the facilities provided by a modern, friendly operating system such as VMS or UNIX. I believe that most of the desired tools, such as procedures (command files in VMS), are available and the interface to the computer would be especially easy. I am very wary of any programming project that attempts to do anything resembling writing an operating system (this is where almost all of my quibbles with AIPS lie).

Local analysis of some monitor data might be valuable for real time feedback loops (eg in pointing) and for switching to backups when problems occur during communication outtages (I am thinking specifically about switching to the backup recording system, for example.).

Table 1 shows 64 words/sec of total power information and yet a note later says that the sum total of all monitor points is 11.6 words per second. Something needs to be changed.

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Chapter VII. Correlator:

I think there is ~~too much talk of the 32x16 Mbit~~ rates. The 16
and higher rates are driven ~~by the desire~~ for a small number of wide
bands to simplify calibration. The 32 channels was driven by geodesy
(14 anyway – 32 sounds like it is driven by Mk III) but those
channels were all narrow band. There is a desire for a 200+ Mbit
rate for special experiments but nothing higher has ever been
specified. It seems to me that the C2S correlator, in conjunction
with 16 independent IF converters, does all that we ever wanted
(including the desired number of spectral channels) and there is no
need to talk about the C2F version (except to add confusion).

Can one quadrant really handle 45 baselines at 512 Mbit/sec?

I'm not convinced that the equivalent lag-dump rate product will
be smaller for the VLBA than for the Block II. We will know our
a-priori's better but we may also be dealing with large sources.

We should go over the method to be used to handle the **fractional
bit shift correction carefully.** Any of the proposed methods should
work if done properly but we need to be careful (We are currently
attempting to install a correction for NRAO correlator data).

Chapter VIII. Data Processing:

To reconstruct the 'observables' (eg raw amplitude, delay and
phase at the time of wavefront arrival at one of the stations) it
will be necessary to either save all the details of the model and
calibration or, perhaps better, save accumulated delay, phase,
amplitude and time offsets (probably station A delay to center Earth)
applied to the data. The delay and time offset can probably be
stored for each correlation function/spectrum. The phase and
amplitude corrections are liable to be frequency dependent and will
need to be saved for each data point. All of this data should be
kept on the basic archive tapes. To reduce data set bulk for most
observations, it can be stripped off upon entering the mapping
routines. It still will be valuable to store the model parameters in
the history records as a record of what model has been used.

Chapter IX. Operations:

The daily shipments to and from the telescopes will be about 25
lbs, not 50.

I am worried by the fact that the manpower specified is so much
higher than that in Vol. I. I'm not sure where the problems are and
won't go into detail here. A few quick notes and questions:

1.) It looks like we will have more programmers for maintenance than for developement.. Why?

2.) What level of maintenance and repair can be expected from the people at the sites and was this considered in specifying the other needs?

3.) There are too many recorder engineers and too few recorder technicians.

4.) A more serious attempt to reach the 4.75M$ budget is needed!