To: Correlator Group

From: R. C. Walker

Subject: Fractional Bit Shift etc. and Short Baselines.

A primary goal of the VLBA is to be able to make very high dynamic range maps of compact sources. To meet this goal, it important to keep all systematic, non-closing errors to a minimum. I am not sure what the exact spec should be but it probably will be well under 1 percent in amplitude and 1 degree in phase.

I am concerned that some false assumptions about the nature of the VLBA data are being made that may introduce such systematic, non-closing errors. In typical, current VLBI experiments the natural fringe rates and bit update rates are high. The high natural fringe rate effectively separates the effects of DC offsets in the clippers from the data and insures that the three level fringe rotator is going fast enough that its digital nature does not introduce offsets. The high bit update rate insures that the same fractional bit shift correction applies to all baselines. The VLBA will be used with antennas of the VLA to obtain a wide range of spacings. Therefore baselines as short as 10 km must be treated properly. Such short baselines will have such small fringe rates and bit update rates that methods different from those now in use must be used to ensure the quality of the data.

The effects of the low fringe rates could be dealt with by offsetting the lo's on any antennas involved in short baselines or by using a phase switching scheme like that used on the VLA in conjunction with software fringe rotation for short baselines. The effects of the variable bit update rate must be corrected in the amplitude and the phase and as a function of frequency in a manner that works for all baselines between 10 and 8000 km and for the full range of sample rates of the VLBA. See VLBA Memo 270 and the Correlator System chapter of Vol 3. for discussion of some possibilities. Unfortunately, both proposed systems either have problems or are incomplete as proposed. The software correction of Memo 270 does not address the amplitude correction although I'm sure the method could be extended to do so. The frequent transform and correction proposed in the Correlator System Chapter is somehow more pleasing except that it may introduce offsets (systematic, not-closing) in the amplitudes of up to 5 percent in the longest baseline, widest band observations. Such errors will be statistically simple and could be corrected in software but must not be forgotten.