LBA CORRELATOR MEMORANDUM NO. VC 017

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To: VLBA Correlator Group Date: 9 Feb 1984

From: Martin S. Ewing

Subject: Minutes of Corr. Group Mtg 8 Feb. 1984

Attending:

-Pasadena: Rayhrer, Vavrus, Rogstad, Seling, Brock, Ewing
-OVRO: Pearson
-Ottawa: Fort
-CV: Hvatum, D'Addario, Walker, Romney, Benson, Escoffier
-GB: LaCasse

We reviewed the progress (!) made at the Charlottesville meetings last week.

1. The Maximum sampling rate is 16 Ms/s for the VLBA. Higher rates can not be justified.

2. Interface to playback systems- The new arrangement is that Haystack will supply a playback system incorporating all deskewing and delay functions. Output will be synchronous, transparent data streams, up to 16 channels.

Some of the details of how the correlator tells the playback system to sync up were discussed, but in the absence of Haystack people this seemed premature.

The kinds of data validity information we need were discussed at some length. Do we need a validity flag for each channel tagging each bit? This is the extreme proposal. Ewing notes that this would double the number of wires and connections for no clear gains compared, say, to one flag bit for 16 data bits. This latter validity stream could be multiplexed onto a single wire per station.

Another philosophy is expressed by Rayhrer's proposal: use a good error detection and correction scheme. This could reduce the practical error rate so much that a "software" flag to the control computer would suffice to tell if data is OK. Overhead is about 13% for a system that would compensate for a completely

dead tape track -- about the same overhead that Mark III requires for much less effective protection.

What if there is no "wideband" validity link for normal operation? How would you handle the non-transparent Mk III inputs, for example? (The blanking might be calculated at the correlator.) How would you handle pulsar blanking? (Rayhrer observes that a single pulsar timing generator for the whole correlator could be fed to an external blanking level for all baselines.)

3. Can we remove the lobe rotator (LR) function from the correlator? There are many issues relating to the LR. If placed before recording, at the antennas, data cannot be reprocessed for other phase centers. On the other hand, we must be able to handle multiple simultaneous phase centers (up to 29 Hz of fringe rate apart). If we can do this with fast correlator dumps, there is no loss in using a pre-recording LR. (See accompanying correlator memo for more detail.)

4. What about SSB digital lobe rotation? This is D'Addario's suggestion -- to use a digital all-pass filter (Hilbert transform) to make a LR that will cancel noise from the undesired sideband (negative fringe rates). While there is general agreement that the technique works in principle, it is unclear whether a simple FIR design will give adequate performance. We are unlikely to enlarge the correlator multipliers to handle more that 2 bits; thus there will be some SNR loss. The filter's amplitude response will be imperfect and will not yield perfect sideband suppression. Furthermore, it appears that we will need one LR per 64 correlator lags, so an LR has to cost much less than 64 VLSI accumulators.

We need to understand the digital SSB approach better, and D'Addario offered to help. Infinite Impulse Response (IIR) filters might be a better choice. Your chairman's preliminary conclusion is that if we are serious about novel techniques, we should look very seriously at having the LR at the antenna.

(Note that LR at the antenna does funny things to the phase calibration signal! The phase cal. detector will have to track a moving tone with full VLBI phase accuracy. This is an argument for placing the cal. detectors at the antennas, where all the information would be conveniently available.)

5. Playback interface, again. D'Addario and Ewing agreed that there is little point in the old "subchannel" concept now that 32 and 64 Mb/s channels are thrown out. We therefore delete this term from further discussions. How should we treat 2-bit samples? Ewing suggests that, for purposes of the playback - correlator interface, we consider all channels to be 2 bits wide, with one bit ignored for 2-level processing. Thus each channel runs at 16 megasamples/second, which sometimes is 32 megabits /second. Whether the 2 bits are multiplexed on a single wire is left for later discussion.