Interoffice

VLB ARRAY MEMO No. 137

National Radio Astronomy Observatory

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To: VLBA Design Group

From: R. Escoffier

Subject: Preliminary Record/Playback System Interface Specifications

The two attached figures constitute a first attempt at an interface specification for the VLBA record/playback system. This interface specification has been made as simple and as versatile as possible for two reasons: first, so as to not tie the VLBA into a specific recorder yet and second, to make the playback system and the correlator systems as independent of each other as possible. Either a multi-track instrumentation or a multi-VCR record/playback system can be made to meet this specification with a little digital multiplexing-demultiplexing.

Figure 1 shows the record system required at each antenna. The frequency standard signal might be a single signal at, say, 100 MHz (high enough so that any requirement can be counted down to). The time code could be an up to 64-bit transfer that counts from wee-nanoseconds to day of year or a truncated version of this that ticks and gets recorded when some number of less significant bits are all zeros.

The record system gets all other information such as when antennas are slewing, etc. via the controller link to the central antenna computer.

The playback system in Figure 2 will contain sufficient data buffering capacity to remove recorder mechanical variations, recorder-to-recorder playback offsets, and antenna geometric terms and will deliver to the correlator data streams with all antenna signals aligned to a common wave front. One second ticks from the correlator (or from the master oscillator feeding both the playback and correlator systems) will allow the playback system to update antenna dependent delays each second. The correlator must then have a small buffer to provide for the faster delay updates required. Alternately, the time ticks could be at, say, 60 Hz and the playback system could do all delay trimming. If a recirculating correlator is used, however, the recirculator is an ideal buffer in which to do fine delay trimming. So, for now, I prefer to leave the one second ticks as shown.

Barry has suggested that in addition to the playback buffer above, an extra delay range of one earth diameter (42 msec) be provided.

I don't see the need for this much memory (about 60M bits or $5k to $10k), however, since with a speed change of only 1%, a recorder can slew 42 msec in 4.2 seconds which is faster than the antennas can slew. The data valid terms would be summations of all the various things that can cause bits to be invalid, delays being changed, antennas slewing, recorder drop-outs, etc.

A single clock is delivered to the playback system from either the correlator or master oscillator system. I suppose this clock could just as well go from playback system to the correlator.

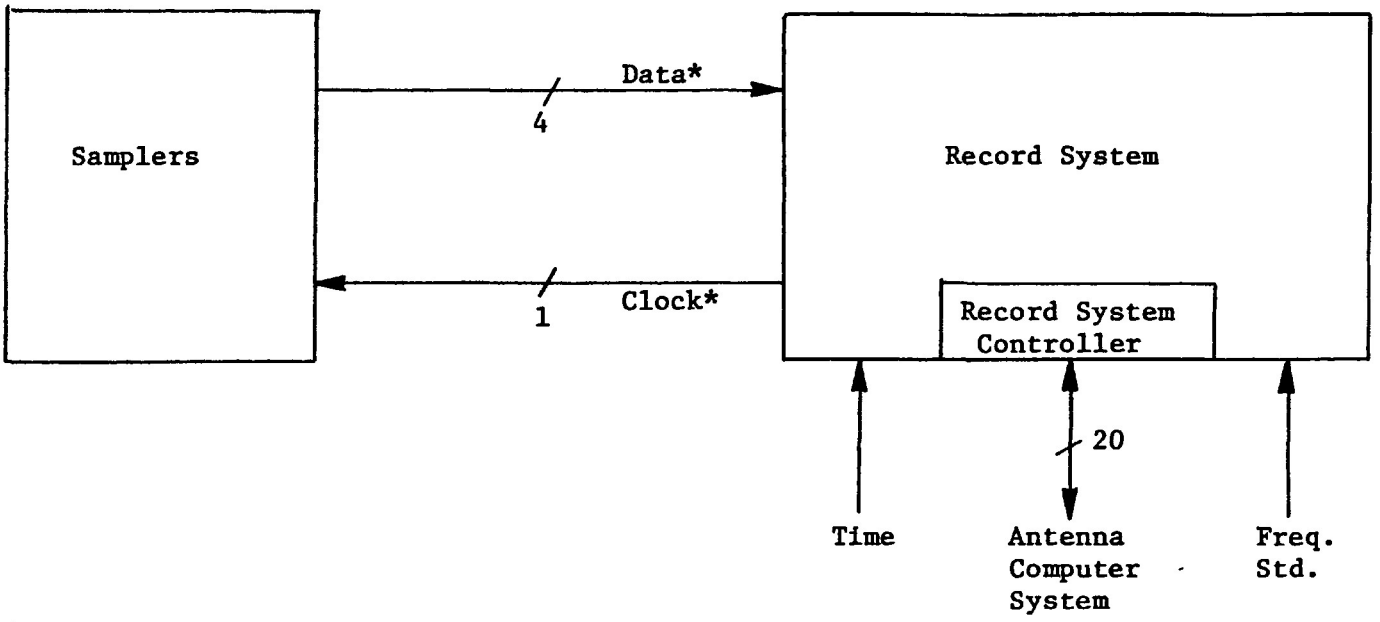
The frequency standard signal will be similar to that used by the record system.

The computer to playback system controller link will allow the computer to control this system, initiating recorders, controlling band mode, etc. This link will allow the playback system to do tasks normally thought of as the correlator's function, such as setting buffers to remove geometric delays.

I have allowed for possible accelerated data processing by imposing on the correlator a requirement to operate at clock rates between 1 and 1.2 times the sample rate. This requirement is probably not practical for such a large system. However, selecting a specific playback factor (except unity) could restrict the selection of a specific recorder and I don't know exactly what to do at this time. I did not consider a playback factor as high as 2 since such a requirement would double the size of a recirculating correlator (and probably any other optimized correlator).

If two-bit sampling is considered, the number of data lines from the samplers and to the correlator would double.

Figure 1. Record System



*ECL Differential signal.

SIGNAL INTERFACES

DATA: 4 continuous NRZ data streams (synchronous with clock).

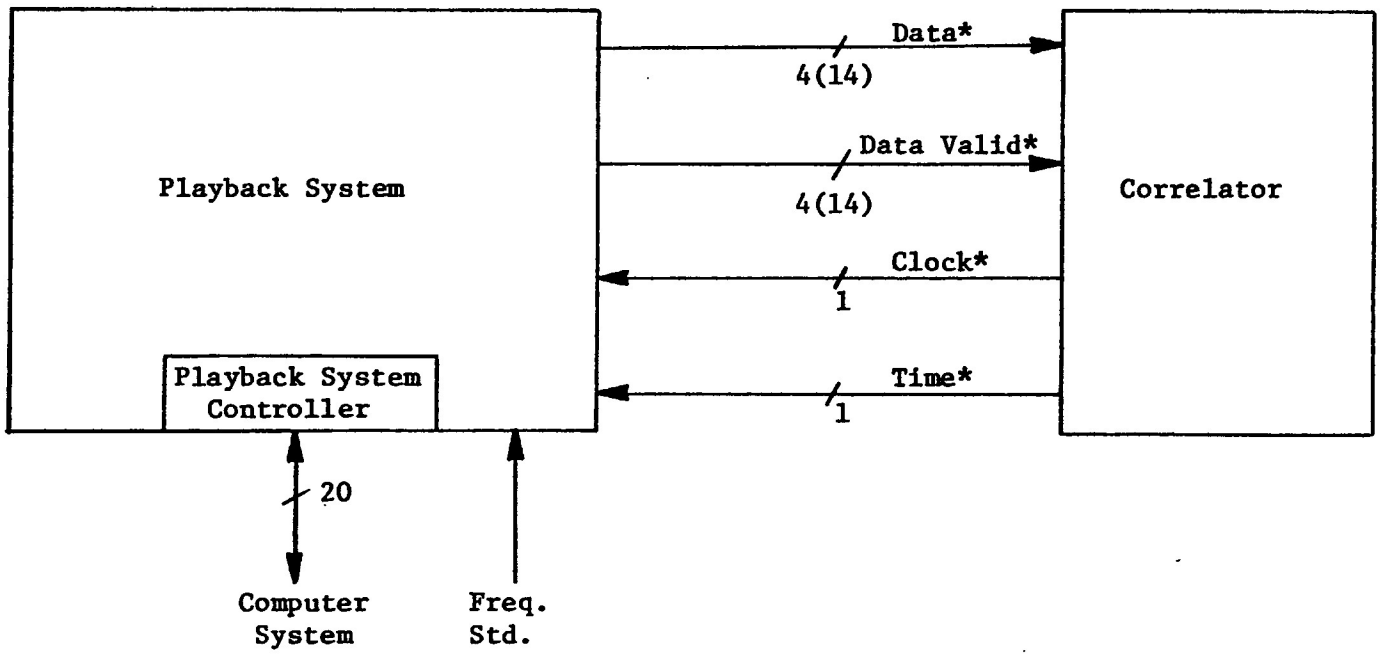
CLOCK: 1 continuous 25 MHz clock.

FREQ. STD.: one or more standard frequencies from antenna L.O. system.

TIME: multi-bit time code reflecting time from nanoseconds to day of year.

CONTROLLER BUS: 16-bit bi-directional computer-microprocessor link with handshaking lines.

Figure 2. Playback System



*ECL differential signal (synchronous with clock).

SIGNAL INTERFACES

DATA: 4 continuous NRZ data streams per antenna synchronized to a common wave front.

DATA VALID: 4 streams per antenna that specify the validity of corresponding data bits.

CLOCK: 1 continuous 25 to 30 MHz clock to allow processing at from 1 to 1.2 times sample rate.

TIME: one second tick identifying one second milestones of a wave front, adjusted to the 1 to 1.2 times playback rate.

FREQ. STD.: one or more standard frequencies from master oscillator system adjusted to the 1 to 1.2 playback rate.

CONTROLLER BUS: 16-bit bi-directional computer-microprocessor link with handshaking lines.