VLB ARRAY MEMO No. 510

VLBA STATION TIMEKEEPING - AN ALTERNATIVE (851120)

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Larry D'Addario has described a system of station timekeeping in VLBA Memo 504. Although I am in concurrence with his design considerations, he has described a system which permits the computer system to set and reset timekeeping at a level below one second, a feature I regard as undesirable to the point of unacceptability. I therefore describe here a system which does not permit the computer to meddle with the fundamental long term tick, which is taken here to be one second, rather than ten seconds.

Using one second results in a vastly simpler system, both conceptually and in the amount of hardware required, which I regard as highly desireable in such a critical component. I do not believe there is any problem with transmitting an unambiguous one second resolution time from the central computer to any station on a direct modem connection - I would have reservations about anything much shorter, but crude estimates of maximum transmission delays plus software delays look like no more than 150 ms, so that a 1 sec resolution should be quite easy. Even a statistical multiplexor should have a total turnaround substancially less than a second. The only worry would be using a commercial packet switching network for communication. However, I doubt if this service is ever appropriate for the VLBA. It is never the cheapest way to move bits. It is true that if a station is only operating a small fraction of the time a leased line is uneconomic, but packet switching nets do not seem to compete with dial-up lines in our application. They are effective for the mode of operation in which a modest sized packet is sent at short enough intervals that the effort of dialing the phone and establishing the connection is substantial. I believe that the VLBA will tend to the mode in which the line is used very hard for a few hours a day, with longish intervals when the line can be hung up to save money, resulting in a lower charge than the network cost for the number of bits we would like to move. With the anticipated data rates, within the continental US the dial-up lines are cheaper even if never hung up while the station is on the air, and are about the same to Hawaii and St. Croix.

A block diagram of the system suggested is given in the attached figure. This device would be packaged with its own power supplies to run from the 110 VAC UPS. It is settable from short external seconds pulses, either positive or negative going, and provides the 80 Hz and 1 Hz ticks used to synchronize the various other devices about the station.

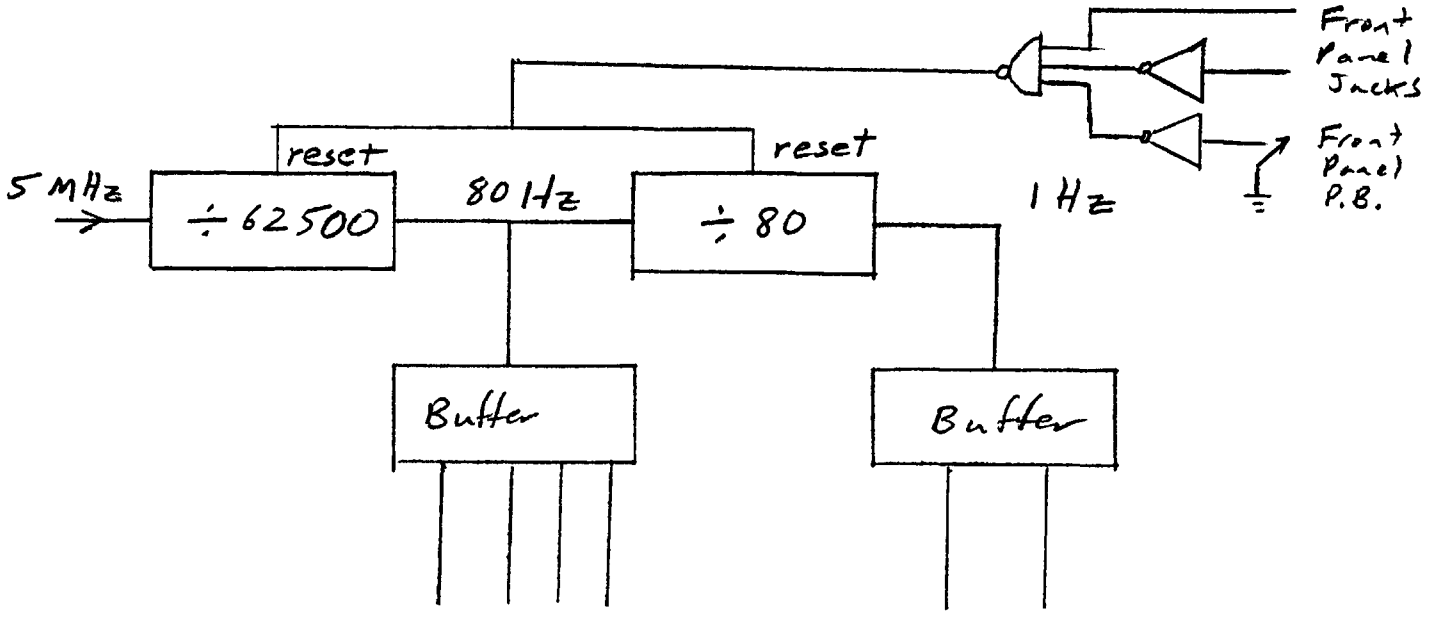
The station computer would rely on a hardware clock located in the formatter. Use of this design imposes two requirements upon this clock. 1). The clock must have a bit which changes on the edges on the station timing signal. That is, if the station timing signal is 80 Hz, the clock must count eightieths of a second. 2). The clock countdown must have a bit that changes on the second, and this bit and all bits to the left must be setable from the computer.

The other function discussed in Memo 504 for this device was the generation of a 1 MHz signal to be multiplied up to generate the 32 MHz sample clock. I feel it is more appropriate to generate this signal

from 5 MHz in immediate proximity to the samplers, to avoid the problems and complexities of transmitting yet another "fundamental" timing signal.

I have accepted here the 80 Hz station timing signal suggested in Memo 504, but the design would be affected in only simple, obvious ways if another frequency were chosen. This and related topics have been discussed in various places, but it seems to me that the discussions have not really converged, and that a more general concensus is needed. The topic is unfortunately somewhat intertwined with the issue of phase rotation at the stations.

This design, like that of Memo 504, is inappropriate for the case of phase rotation at the stations. In that case, the station timing signal and the seconds pulse should correspond to the time at which the wavefront arrives at earth center, and an obviously much more complex device is needed to generate these delayed waveforms.



Square wave, 50% duty cycle two TTL level, two RS 485 drivers

Negative going pulse 250 ns duration, TTL levels. Transitions as near as possible to zero crossing of 5 MHz input sine wave.