Calibration Notes

II - Delays and Phases that need to be calibrated

mjk, 24 April 1986

This is the first pass at a comprehensive list of the delays and phases that will need to be known in order to have the AT operate correctly. This list is offered at this stage with the explicit request for additions/corrections/deletions.

Attached is a companion list of Control points that utilize this information.

1. Transmission time from the central site to the antenna.

ANT_transmission

All the time-triggered events at the antenna (the noise tube, the 180 degree modulators, the synchronizing pulse) will need to know this in order to advance their time specification. (That is, if they are expected to trigger at time T, they will ask for (T - ANT_transmission). [The apparently simpler solution of offsetting the clock has been rejected].

ANT_transmission is rounded to the nearest μsecond as far as the clock is concerned.

2. Fine delay error at the sampler.

IF_sampler delay

The sampler will emit a synchronizing pulse some fixed (so it is believed) delay after receiving the "GO" command corresponding to the start of an integration interval.

This offset needs to be constant, to within one sample interval, from one integration interval to the next.

We need to know, then, the number of samples that separate the requested UT and the synchronizing pulse.

3. Transmission time from the antenna to the delay lines.

IF_transmission delay

This is needed at the FIFO (delay line) in order to locate the "tap" on the delay line from which data should issue. (cf AT/25.1.1/025, fig.4, LO appendix). It is associated with the problem of correlating samples from the same wavefront.

4. RF delay at the antenna

RF_delay

Probably antenna/Feed/Polarizer specific. Probably very similar from one antenna to the next, so will remain largely unknown until the LBA comes along.

NOTE: the polarizer delay may be a different function of frequency in each polarization. (ie. there may be some unpleasant dispersive effects to be catered for).

5. IF delay.

IF_delay

Receiver/IF chain specific.

Control points which need the phase/delay information

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A. Fringe rotators.

1. Phase difference between the site master Frequency source and the antenna frequency source. This is generated by the LO group's line monitoring machinery, assuming that they adopt this route.

2. $(\Delta\phi/2)$, where $\Delta\phi$ is the phase difference between the X and Y IFs, as revealed by the "switched analogue correlators".

3. Geometric (fringe tracking)

4. assorted phase offsets. (antenna and IF specific).

B. Sampler

1. Geometric (fringe tracking)

2. Fine delay (clock, RF, IF, rounded to the nearest μsec)

C. Correlator/delay lines

1. Geometric (fringe tracking)

2. Bulk delays (Clock, RF, IF)

D. Modulators (noise tube and phase shifters).

1. Clock error (transmission time from site to antenna)

2. Geometric delay - we need to "de-delay" the switching

waveform so that the square waves from all antennas are wavefront synchronous; that is, in phase AFTER the delay lines. If T is the UT of the start of the integration interval, τ the delay calculated by EPHEMERIS, and ANT_transmission the signal transmission time, then the event trigger will be asked to start at

$$t = T - (ANT\_transmission - \tau)$$

E. Demodulators, Gain monitors

1. At the antenna the same signal will drive the noise tube and the PSD, so there should be no synchronizing problem.

2. At the central site the waveforms are all in phase.

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