

Considerations for establishing a timing laboratory

1. Need for environmental control
 - a. Timing system sensitivity to temperature 5 ps/C, quite variable
 - b. Isolation amplifier sensitivity to temperature 1-5 ps/C, quite variable
 - c. 5 MHz to 1 pps dividers, sensitivity to temperature 1-5 ps/C
 - d. Phase stepper sensitivity to temperature 2-8 ps/C
 - e. Compare to resolution of timing system
 - Dual-mixer system: time: 0.1 - 1ps, Adev: 5e-13, Avg time: 1 s
 - f. Compare to stability of phase stepper
 - 1000 s avg time: Allan deviation: 2e-16, tdev < 1 ps
 - g. Frequency sensitivity of masers
 - Admittance to temperature 0.5 - 1e-14/C
 - Admittance to magnetic field 1-3e-14/gauss
 - Admittance to atmospheric pressure 1-3e-15/kPa
 - h. Compare to stability of masers

Avg Time	Allan Deviation
10 000 s	3e-15
1 day	2e-15
10 days	0.5-1e-15
2. Calibration of GNSS time transfer system
 - a. Specification for long term stability of hardware, should be \leq few ns/year
 - b. Multipath sensitivity and mitigation
 - Magnitude of the effect can be 5-10 ns
 - Mitigation with choke rings, narrow correlators, ...
 - c. Temperature stability 0,05 – 1 ns/C
 - d. Sensitivity to input power and signal strength
3. Method of calibration of GNSS system
 - a. Short-baseline common-view using common-clock and standard receiver
 - Limitations due to multipath and position errors
 - b. Zero-baseline common-view using common antenna and common clock
 - Limitations due to impedance mis-matches and reflections in antenna cable