Recommendation CCTF #? (2015): On the design of GNSS receivers

The Consultative Committee for Time and Frequency

considering that

- The use of a combination of code and carrier phase GNSS measurements enables time and frequency transfer with sub-nanosecond precision,
- This technique is routinely used for UTC generation,
- GNSS measurements are expected to be used by a greater number of applications that require greater precision, such as the comparison of optical frequency standards and atomic fountains,
- The precision of the GNSS time and frequency transfer solution relies on the accurate knowledge of the lathing time (effective reception times) of each measurement;

noting that

- while considered as synchronous, the latching times of phase and code data can be systematically offset by several microseconds,
- some receiver produce code measurements corrected for a constant bias to account for internal hardware delays, inducing an apparent latching time offset between the code and carrier phase measurements,
- the difference between the latching times of code and phase induces a Doppler increment in the carrier phase measurements relative to the codes, causing a frequency bias in the phase data and hence in the clock solution obtained from GNSS analysis,
- this frequency bias results in a laboratory clock's frequency appearing to be biased by 30 ps/day for every microsecond of latching offset;

recommends that

- Manufacturers design future receivers and firmware upgrades so that the absolute value of the latching time offset between code and carrier phase measurements provided in the observation files is less than 100 ns, taking into account all relevant receiver internal delays, and include this information in the receiver specifications.