

GPS time and its steering to UTC(USNO)



*International Committee on GNSS
Provider's Forum*

***Saint Petersburg, Russia
12 September 2009***

*Edward Powers
US Naval Observatory*



GPS Timing

■ **UTC Time**

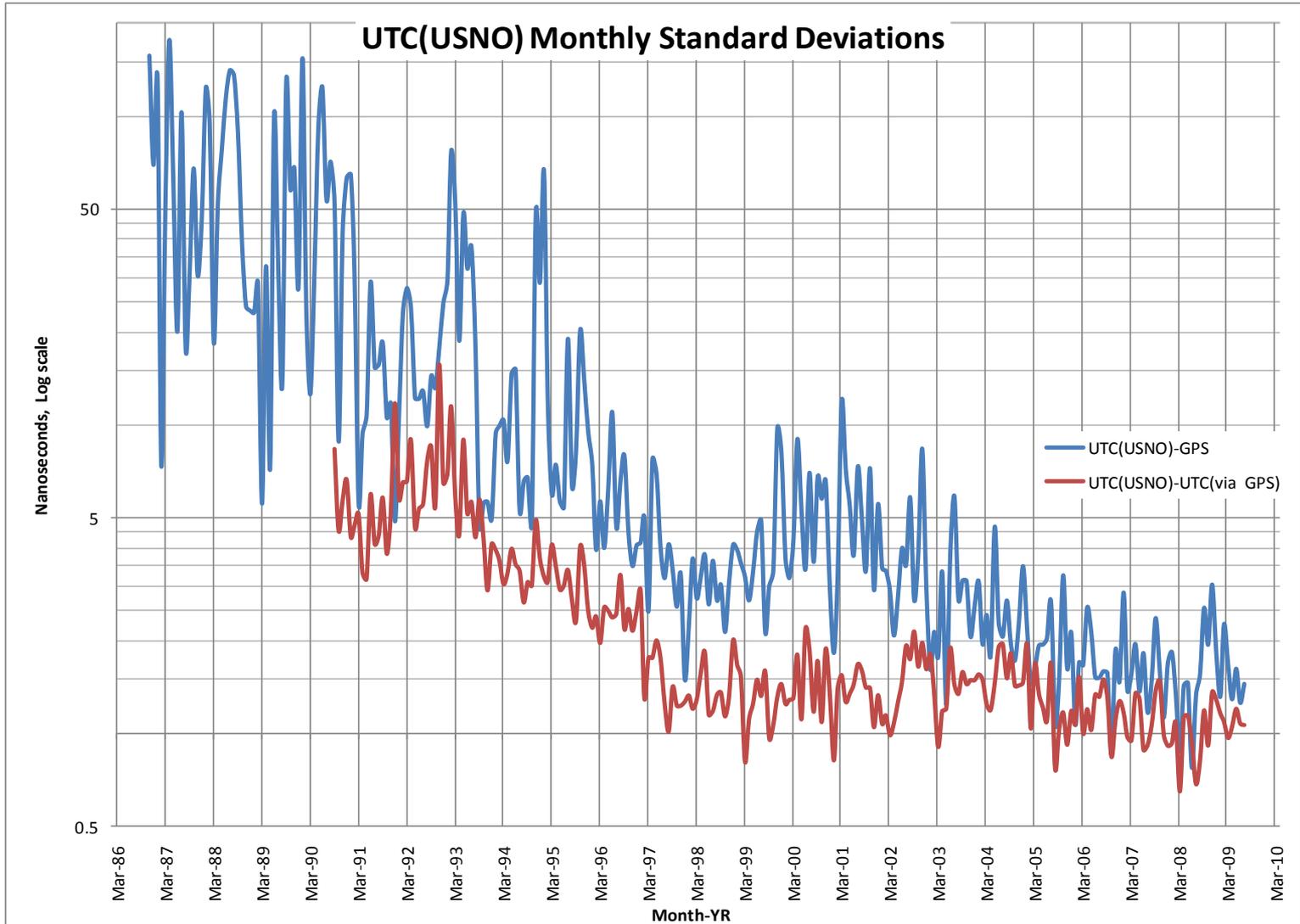
- The UTC broadcast from GPS is referenced to the U. S. Naval Observatory real-time realization of UTC called UTC(USNO) .
- UTC(USNO) is obtained from GPS by subtracting an integral number of seconds (leap seconds) and applying the fine UTC correction information contained in the broadcast navigation data.

■ **Global Positioning System (GPS) System Time**

- Internal navigation time scale computed from the ensemble of clocks that make up the GPS system and is steered closely to UTC(USNO) modulo one second.

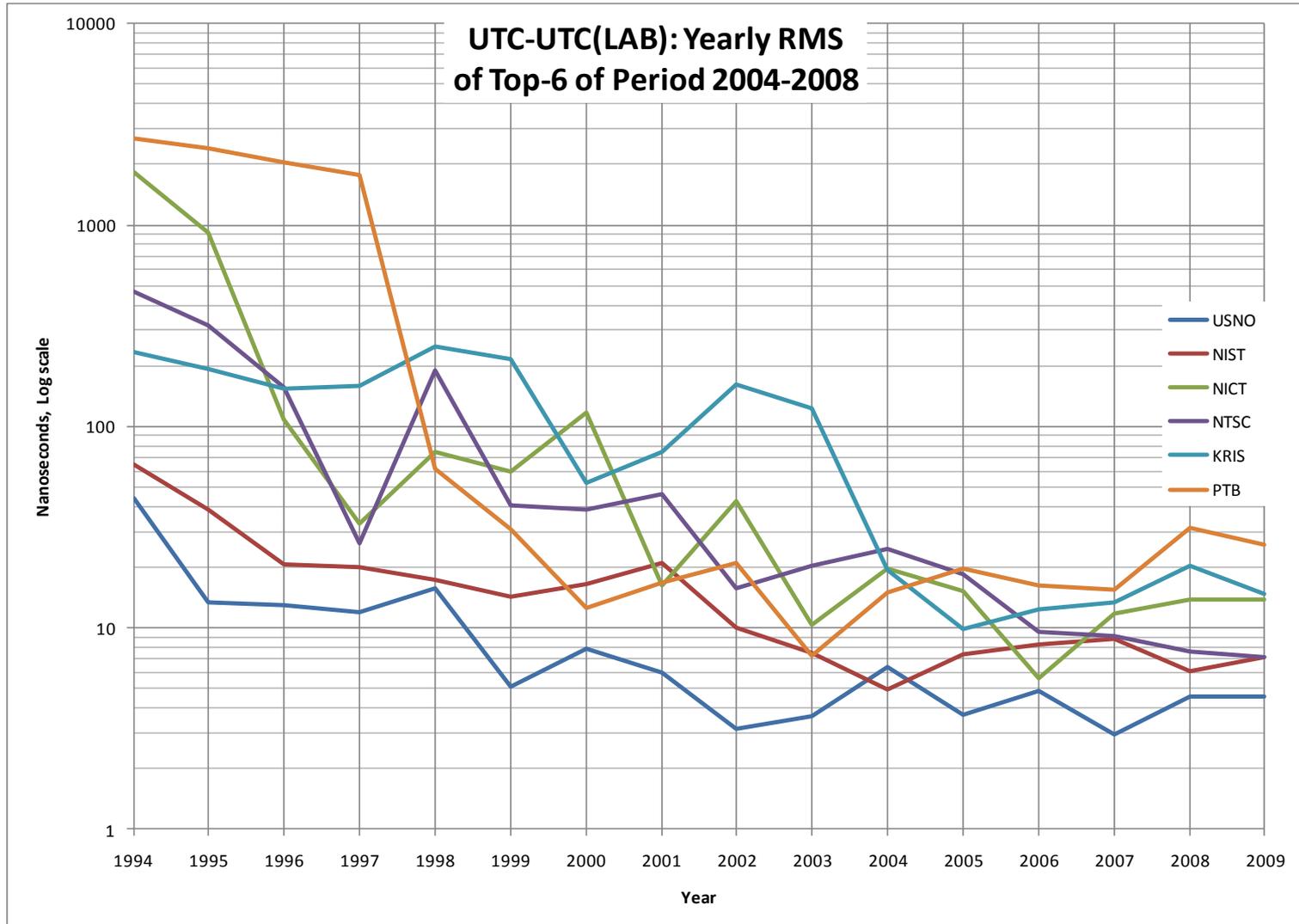


GPS and USNO Timing





USNO and other timing labs over the past 15 years





GNSS Timing Interoperability

- Presently GPS, GLONASS and Galileo align their internal time scale to local representations of UTC (modulo one second) typically much better than one microsecond, and often better than 50 nanoseconds.
- As part of bilateral technical discussion providers GPS, GLONASS and Galileo have reached agreement to broadcasting the timing offsets between navigation systems internal time scales.
- GLONASS has included a GLONASS to GPS time offset correction message for several years as part of newer GLONASS satellites. Galileo is broadcasting a test Galileo to GPS time offset message as part of the Galileo test bed. GPS has included a GNSS to GPS time offset correction as part of the modernized GPS signals.

Interoperability is enhanced through alignment to UTC modulo one second



RNSS and SBAS Timing

- The United States GPS and Japan QZSS have agreed to work together on UTC coordination and will soon establish a timing link between USNO and NICT using two-way satellite time transfer via an intermediate station located in Hawaii.
- The United States Wide Area Augmentation System (WAAS) closely aligns the WAAS Navigation Time Scale to GPS Time (which is closely aligned to UTC modulo one second).
- Many other RNSS and SBAS align the navigation time scales to either GPS Time or a local representation of UTC.

Interoperability is enhanced through alignment to UTC modulo one second



Summary

- Recommend that all GNSS and RNSS/Augmentation systems maintain internal navigation time scales in alignment to UTC (modulo one second)
- Recommend that all GNSS, RNSS and SBAS systems internal time scales be kept to within an agreed upon tolerance with respect to UTC (modulo-one second).
- Recommend that WG-D2 establish recommendations on coordination of GNSS navigation time scales