Considerations on GNSS Timescale Offsets

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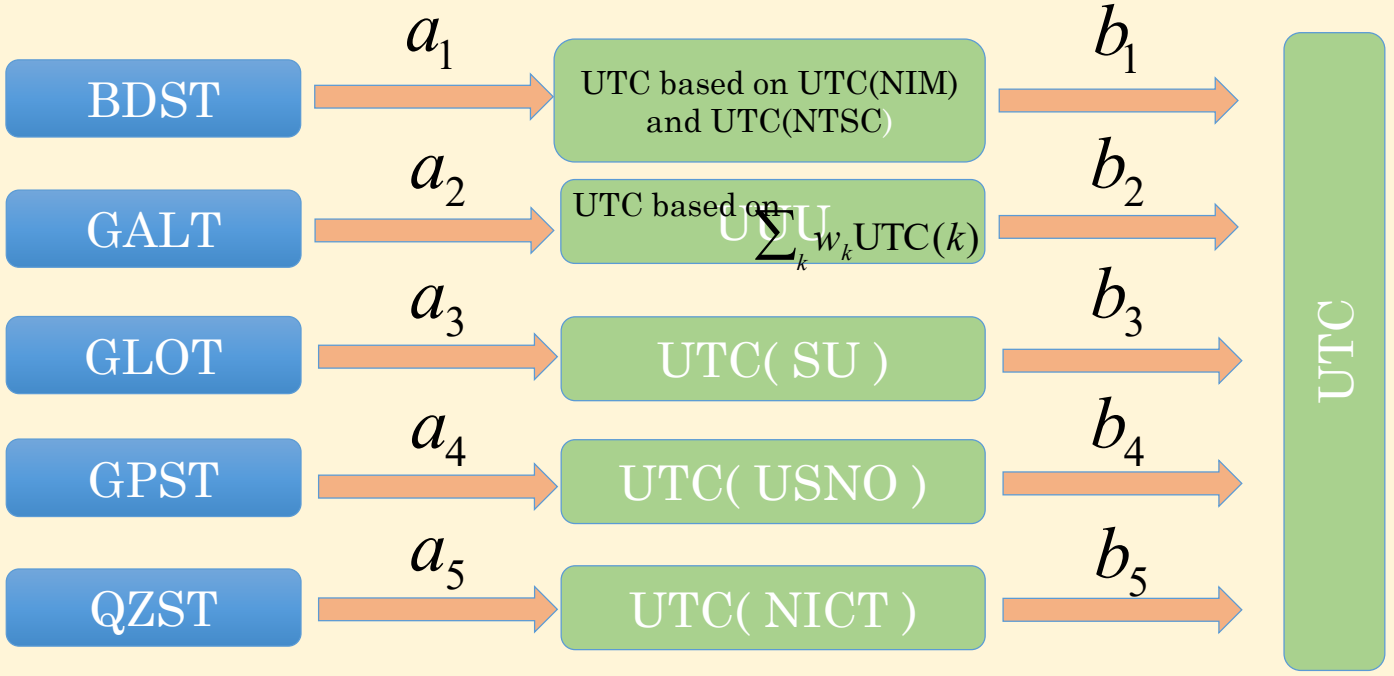
Overview

- Recommendation has been formed among several members of the IGS's Clock Products Group and BIPM.
- Main argument is that UTC should be utilized as the common time reference between GNSS as it is the international reference timescale standard.
- Present operation and architecture of GNSS systems should be sufficient to support this approach.
- Statements are supported by the BIPM Time Department.
- Discussion will continue within the IGS (and also the working group) which consists of members from several different organizations.

Current Timescales

- Many reference times are now in existence:
  - TAI UTC UT1 GPST GALT BDST GLOT IGRT IGST …
- For timing product users, there are two “times” that are important:
  - The reference time for a particular datum; and,
  - The time of epoch at which the datum occurred.
- The ambiguity of these two points grows when more timescales are critical components of systems that disseminate timing products.

Timescale Steering Architecture



Stability and accuracy of UTC(k) vs. the UTC timescale will help each system time drive toward the international reference time standard.

a_i are differences between GNSS(k)T and UTC(k). These are estimated by the system and broadcast.

b_i are differences between UTC(k) and UTC and are published latent to real time– when CircularT is published.

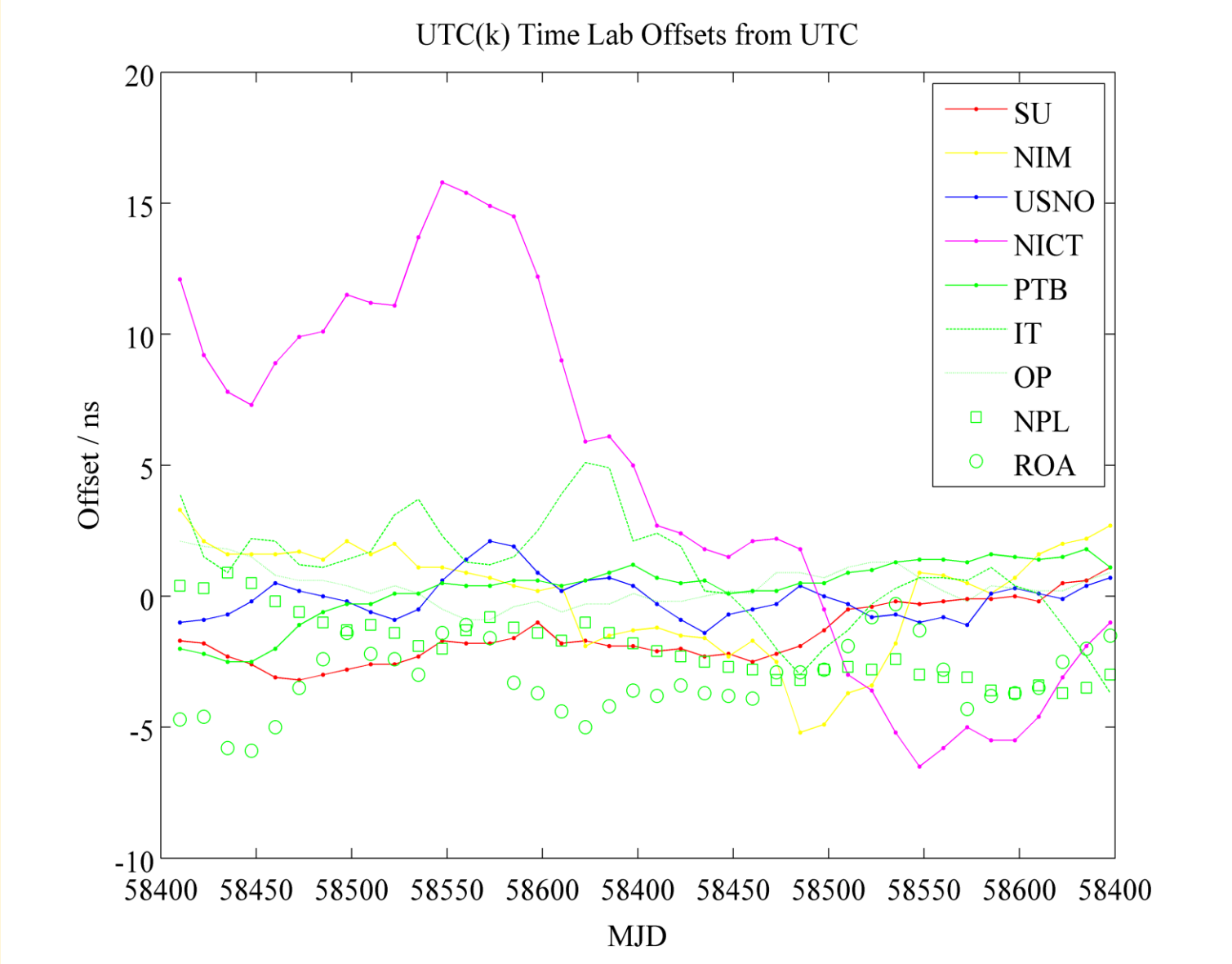
Systems broadcast their best predictions of UTC(k) and thus unknown offsets between any pair of system(s) is of order $\max|b_i|$. Calibration and prediction errors also affect a_i.

Offset of UTC(*k*) laboratories over the past 250 days as published by the BIPM's CircularT.

Graph presents UTC(*k*) that are the steering targets for various GNSS system times:

GPS	USNO
QZSS	NICT
GAL	PTB,IT,OP,NPL,ROA
GLO	SU
BDS	NIM

Spread of these UTC(*k*) reference times falls largely within the range of [-5,+5] ns.



Summary of recommends:

- GNSS providers not consider addition of another system time-scale as a means of promoting interoperability between systems;
- GNSS providers continue to generate the most stable possible internal system reference time and maintain a minimal time offset with respect to UTC (through one or more UTC(k) reference centers);
- GNSS providers continue to transmit the most accurate possible prediction of the time offset of the GNSS internal system time versus UTC or UTC(k);
- UTC(k) timing centers serving as reference stations (in any capacity) for a GNSS or RNSS make efforts to realize UTC(k) with the most stable and minimal possible offset from UTC as published by the BIPM's Circular T.