Letter of the chairman of the Committee on GPS and GLONASS Time Transfer Standards

Professor Sigfrido Leschiutta,
President, Consultative Committee for Time and Frequency
Professor Paul Paquet,
Chair, Working Group on TAI
Dr. Elisa Felicitas Arias,
Head, Time Section, BIPM
Dr. W. Lewandowski,
Time Section, BIPM

Dear Colleagues,

I am writing to you as the chair of the Committee on GPS and Glonass Time Transfer Standards. As I am sure you know, last May the US Department of Defense turned off Selective Availability (SA) on the GPS satellites. (While SA was on, the clock on each satellite was dithered so as to decrease the usefulness of the signal for real-time applications. This dither did not affect common-view observations, since this method cancels the fluctuations in the satellite clock to a very considerable degree.)

As a result of the decision to switch off SA, civilian (non-authorized) users who simply use the signals as they are received from the satellite in a one-way mode can achieve a precision that was previously only attainable with common-view methods. Although it is impossible to provide any guarantees about the future, the combination of the changing political climate in the US and the presence on the horizon of the Galileo satellite system makes it quite unlikely that SA will ever be used again on the GPS constellation.

A second important consideration is that essentially all National Metrology Institutes and timing centers currently measure the difference between their realization of UTC and GPS system time. As a minimum, the laboratories follow the tracking schedules published by the BIPM in making these measurements. The track schedules typically list 48 (or more) 13-minute tracks per day for each region, which means that every laboratory is observing the GPS constellation throughout the day with an average duty cycle of about 50%. This practice is certain to continue for the foreseeable future, because these data form the basis for international time and frequency coordination by the BIPM, including the computation of ALGOS and TAI and the computation of the values of UTC(lab) - UTC published in Circular T.

In addition to providing the data to the BIPM, many of the laboratories routinely publish their GPS data on web pages and ftp sites, and have been doing so for some time. Because of this near-universal practice, GPS system time is directly traceable to the time scale of essentially every timing laboratory. Furthermore, the measurements that support this traceability have been in place for several years and so are well understood by all of the participants and by the general user community.

The combination of the real-time, nearly continuous observations of GPS system time by all National Metrology Laboratories and the significant improvement in the precision available from using the GPS signals in a one-way mode that resulted from the removal of SA, suggests that the GPS constellation could serve as an extremely effective distribution mechanism for the real-time realization of UTC of EVERY National Metrology Institute. In fact, for almost every National Metrology Institute (including NIST), using GPS to distribute UTC(lab) in this way would provide

better access to the UTC of the laboratory than any other method that is currently available to the general user.

It is a bit difficult to know exactly how well this method would work. Some of the advocates for using GPS system time claim that the system can deliver time with a precision of several nanoseconds. I think this is probably somewhat optimistic, but the important point is that even if its advocates are a bit too enthusiastic, there is no other generally available distribution system that can come close to this level of performance. This is not to say that no other system could ever match this capability, and my argument would obviously be just as valid for any comparable system. For example, while the current implementation of the Glonass system has a number of technical problems, it is very likely that the proposed Galileo system could be just as good as GPS is now. Timing systems based on geo-synchronous satellites could also be useful in this way.

In order to make this idea generally useful, I propose that the BIPM publish the measured values of UTC(lab) - GPS time using a uniform format that is yet to be chosen. A special web site for these data might be a good way to do this. These data are already acquired by the laboratories and forwarded to the BIPM, so that the incremental effort in publishing these tables may not be too great. Ideally, some semi-automated method could be developed to transfer the data automatically. Participation in this procedure would be voluntary, but every lab that submitted its data would immediately provide the users of its realization of UTC with an access to its scale that would be difficult or impossible to realize any other way at the present time. The advantages of this improved access both to the laboratories and to the timing community in general seem to me to far outweigh the effort that is required to realize it.

The idea of using GPS system time to distribute UTC(lab) does not depend on how GPS system time is defined or computed, and we need not concern ourselves with the internal operations of the GPS monitor and tracking sites. Likewise, while the data that we publish might be considered useful by the GPS operators in helping them to evaluate the performance of the algorithm that defines GPS system time, I am not suggesting any arrangement or agreement, formal or informal, between the timing laboratories and the GPS system operators.

While I think NIST would benefit from this arrangement and I will argue strongly for its participation, NIST has not yet taken an official position on this question. I am writing this as the Chair of the CGGTTS and not as a representative of NIST. I am writing at this time so that we can discuss this question informally before the meeting of the CCTF and its associated working groups next June. Depending on the outcome of these discussions, it might be appropriate to prepare a more formal proposal for the consideration of the timing community next June.

With best regards for the new year,

Judah Levine
Time and Frequency Division
NIST Boulder
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