

News from the BIPM

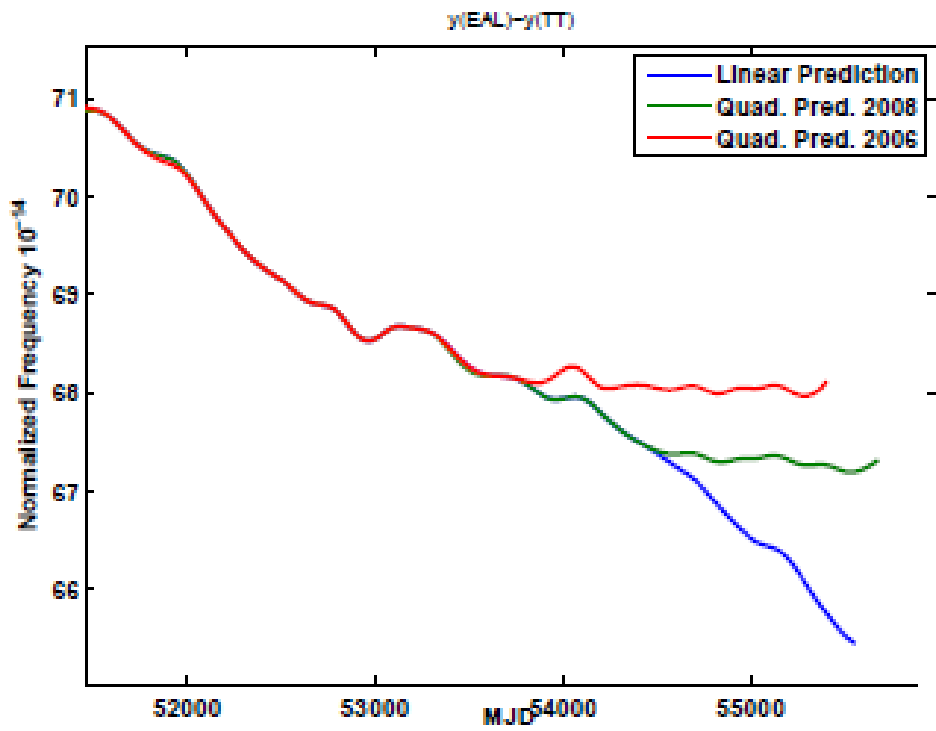
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Time Department



Drift of EAL, improving the long term stability

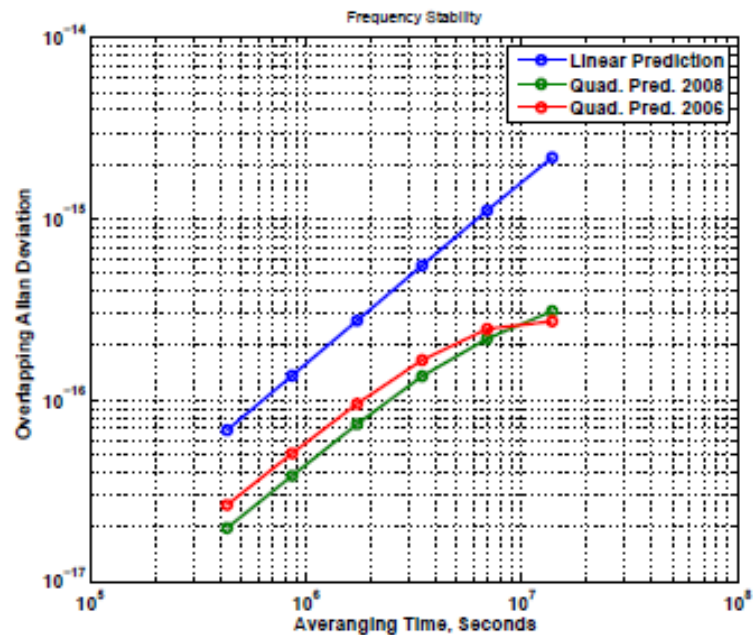
- ✓ EAL presents a drift of about $+4 \times 10^{-16}/\square$ month with respect to TT(BIPM);
- ✓ Strong monthly frequency corrections (see Section 3 *BIPM Circular T*) have shown little of not effect;
- ✓ The algorithm (ALGOS) had a linear model for the clock frequency prediction
 - ✓ Well adapted when it was developed, with “young” Cs clocks, no H-masers, few primary frequency standards
 - ✓ 23% of the clocks in TAI are H-masers
 - ✓ The Cs are aging
 - ✓ About a dozen PFS report measurements, most of them Cs fountains
- ✓ A new model has been implemented and incorporated in ALGOS, with a parabolic model for all clocks.(Panfilo, Harmegnies, Tisserand). *Circular T* of August was calculated with the new model.



Linear prediction (blue)
 Quadratic, data since 2006 (red)
 Quadratic, data since 2008 (green)

EAL – TT(BIPM)

Report to CCTF
 Submitted to *Metrologia*



Time transfer

- ✓ GPS/GLONASS/TW data daily reported – Only laboratories with non-adapted GPS receivers still send weekly files;
- ✓ All laboratories post data in specific ftp directories;
- ✓ Combined GPS/GLONASS and TWPPP links are routinely used in the calculation of UTC;
- ✓ New calibration system for GPS links, allowing maintenance of TW calibration;

Rapid UTC project

- Providing time laboratories and other users more frequent access to UTC, under the form of a rapid product;
- At present UTC is calculated with one-month data batches, and available monthly in *BIPM Circular T* under the form of $[UTC-UTC(k)]$ at five-day intervals;
- *Circular T* also publishes daily differences of $[UTC-GPS\ Time]$; $[UTC-GLONASS\ Time]$ and $[UTC-UTC(USNO)_{GPS}]$; $[UTC-UTC(SU)_{GLONASS}]$.

Rapid UTC project(2)

- [$UTC - UTC(k)$] are available with a latency of about ten days after the last day of data; also [$UTC-GNSS Times$] values.
- Extrapolation of values over 10 to 35 days based on prediction models is necessary to many applications.
- UTC, as published today, is not adapted for real and quasi-real time applications.

Impact of a rapid UTC

- **On UTC contributing laboratories:**
 - More frequent assessing of the UTC(K) steering, and consequently better stability and accuracy of [UTC(k)];
 - Traceability to UTC will be enhanced.
- **On users of UTC(K):**
 - Access to a better “local” reference, and indirectly, better traceability to the UTC “global” reference;
- **On GNSS:**
 - Better synchronization of GNSS times to UTC, through improved UTC(k) and UTC(k) predictions, case of UTC(USNO), UTC(SU), UTC(k) used in the generation of GST and of IRNSS Time, UTC(NTSC).

Characteristics of UTCr (under development)

- Based on daily data reported (daily) by contributing laboratories;
- Automatically generated weekly solution over four weeks of data (sliding solution);
- Weekly access to daily values of $[UTC-UTC(k)]$ and $[UTC-GPS\ Time]$; $[UTC-GLONASS\ Time]$; $[UTC-UTC(USNO)_{GPS}]$; $[UTC-UTC(SU)_{GLONASS}]$ and differences to other GNSS times and broadcast UTC(k) in the future;
- Stability of UTCr comparable to UTC since:
 - ✓ Interval of calculation will cover one month approx.;
 - ✓ Participating laboratories (expected) will represent 50% of the clocks in UTC and 70% of the total clock weight in UTC
- Accuracy improved by steering on TT(BIPM) (predicted)

Characteristics of UTCr

- UTC contributing laboratories will be invited to participate on a voluntary basis to a pilot experiment the BIPM plans to start in the first third of 2012, with the target of producing a report for the CCTF by September 2012;
- Final decision on the routine production of UTCr will be taken on the last third of 2012;
- UTC as calculated and published today will not be affected, however, it will benefit from UTCr
 - Shorter latency of publication (anticipated data checkings and pre-processing)
 - Better quality of data from contributing laboratories (expected)

Meetings (past and future)

- ✓ Workshop « Development of advanced time and frequency transfer techniques » (CCTF WG), BIPM, June 2011
 - ✓ About 50 participants from most laboratories
 - ✓ Optical fibre is very promising
 - ✓ Excellent results (Poland – AOS. GUM, Germany – PTB,)
 - ✓ Projects proposed (France - LNE-SYRTE, Italy – INRIM UK – NPL)
 - ✓ VLBI possible, need to develop
 - ✓ TW phase

- ✓ **International Committee on GNSS (ICG),
5-9 September 2011, Tokyo**
 - ✓ GPS, GLONASS, Galileo, BeiDou, IRNSS, QZSS

- ✓ **ITU-R Working Party 7A, 26-30 September 2011, Geneva**
 - ✓ ITU questionnaire on UTC

Meetings (past and future)

- ✓ Royal Society Discussion « UTC for the 21st century », 3-4 November 2011
 - ✓ 12 invited lecturers, about 40 invited participants
 - ✓ time metrologists, astronomers, national administrations, ITU, IAU, BIPM, GPS, GLONASS, Galileo, BeiDou, IRNSS, QZSS

- ✓ PTTI 2011 and EFTF 2012
 - ✓ CCTF WG meetings

- ✓ 19th meeting of the CCTF
10 – 14 September 2012
 - ✓ CCL/CCTF Frequency Standards Working Group
 - ✓ TAI WG Meeting of Contributing Laboratories
 - ✓ Other WGs to be defined

Publications

- ✓ *BIPM Annual Report on Time Activities for 2010*
 - ✓ Electronic version, user friendly
http://www.bipm.org/en/scientific/tai/time_ar2010.html

- ✓ Special Issue of *Metrologia* (48, Vol 4, 2011)
« Modern applications of timescales »
 - ✓ Guest editors: Arias, Lewandowski
 - ✓ On-line mid-July 2011
 - ✓ Some papers downloaded 250 times (1 month)
500 times (1 month prolongation of free on-line access)