TIME ACTIVITIES AT THE BIPM

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Abstract

Almost 70 laboratories participate at present to the calculation of TAI and UTC at the BIPM. Their contributions involve about 350 atomic clocks linked by various techniques.

Significant progress has been made in time transfer for clock comparison at the BIPM in 2008, either in the routine calculation of Circular T or in studies tending to enhance the quality of the reference time scales.

Most time links (70%) are computed from multi-channel GPS receivers, either single-frequency or dual-frequency; 15% of the links from TWSTFT observations in Europe, North America, and the Asia-Pacific region.

The section treats, in total, TW observations from 20 laboratories, half of them not still included in the routine calculation, but under study aiming at their inclusion. Studies on the use of TW for supporting GPS equipment calibration were undertaken and used for a particular link. Following the recommendation of the Consultative Committee for Time and Frequency (CCTF) in 2006, a pilot experiment whose aim is to regularly compute some TAI links with the Precise Point Positioning (PPP) technique was proposed to time laboratories. More than 20 laboratories participate in this experiment, whose results are regularly published on the ftp server of the BIPM.

GPS equipment calibration continued during the last year, reports have been published, and a Web page has been created to favor the dissemination among laboratories of results of calibrations, and organization of future campaigns.

Studies to analyze the influence of some types of atomic standards on TAI have started with the aim of investigating a new possible procedure for the frequency prediction of the hydrogen maser.

INTRODUCTION

[1]

PRESENT PERFORMANCE OF TAI

- **relative frequency stability:**
  0.4×10^{-15} @ 20 – 40 days
- **relative frequency accuracy : ~2×10^{-15}**

About 70 time laboratories contribute with

- **~350 atomic clocks**
- **12 primary frequency standards (9 cesium fountains)**
- **2 independent time transfer techniques: TWSTFT, GPS (GPS P3, GPS MC, GPS SC)**

BIPM FTP SERVER

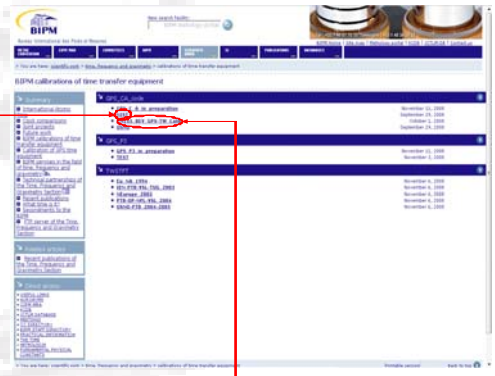
The following data are available:

- **Input data (clocks, time links, primary frequency standards)**
- **Publications (including Circular T)**
- **Time link comparison**

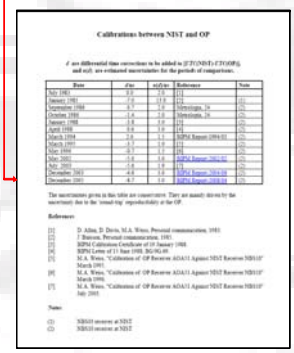
GPS equipment calibration – Web page

The calibration of GPS equipment with a travelling reference receiver continued during the last year. As usual reports have been published, and a web page has been created to provide a wider dissemination of the calibration results.

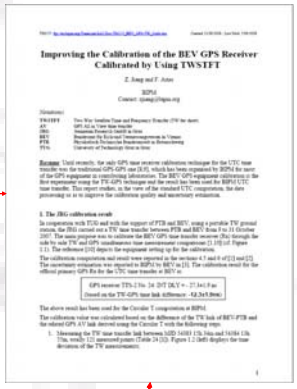
http://www.bipm.org/jsp/en/TimeCalibrations.jsp



Example: NIST

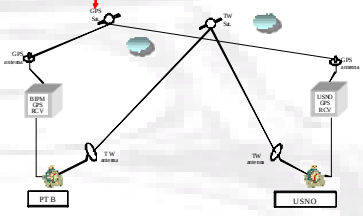


BEV GPS-TW Calibration with TW travelling station



Transferring TWSTFT calibration to GPS

Set up of the GPS receiver calibration using two remote ground clocks that are linked by the calibrated UTC TWSTFT time link between PTB and USNO; the BIPM calibrated GPS receiver at PTB and the USNO GPS receiver to be calibrated.

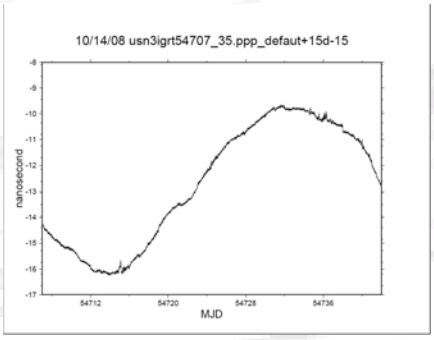


The Precise Point Positioning (PPP)

BIPM **TAIPPP** results on **ftp://tai.bipm.org/TimeLink/TAIPPP**

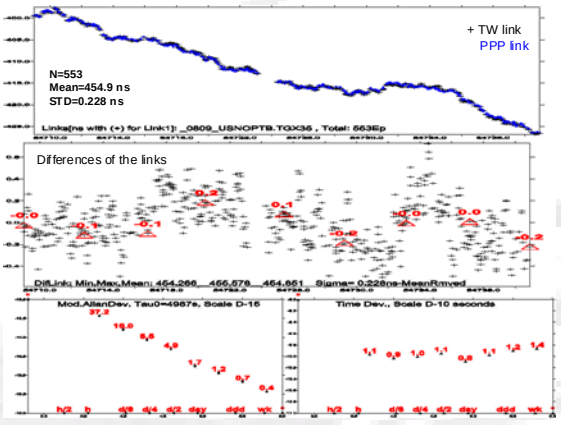
Status of October 2008
21 Laboratories participating to PPP experiment

Example: PPP solution IGRT-UTC(USNO)



Link comparisons results on **ftp://tai.bipm.org/TimeLink/LkC**

Example: link comparison USNO-PTB

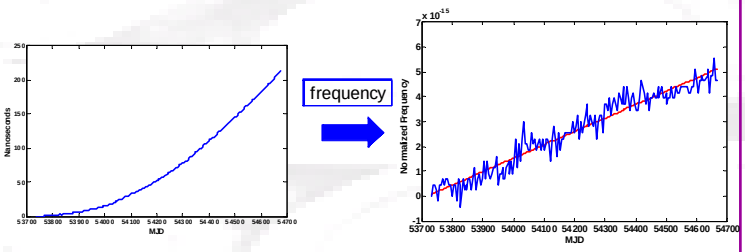


The time scale Algorithm

A study to understand the frequency drift shown by the Echelle Atomique Libre (EAL) with respect to primary frequency standards has been started. As H-Masers has a frequency drift a test version of EAL has been calculated removing the H-Masers from the clock ensemble.

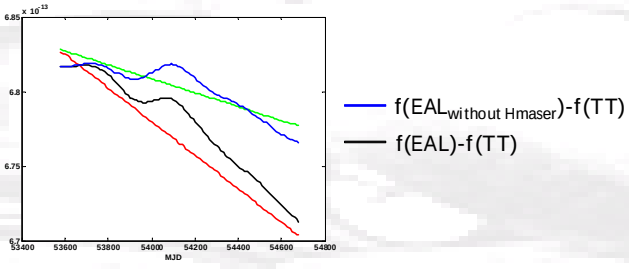
Test period: January 2006 - July 2008

$EAL_{without\ Hmaser}$-EAL



Frequency drift: 1.6×10^{-16}/ month

To show the influence of H-Masers on EAL drift we consider TT as independent reference:



REFERENCE

[1] A. Niessner, W. Mache, B. Blanzano, O. Koudelka, J. Becker, D. Piester, Z. Jiang, and F. Arias, 2009, *"Calibration of the BEV GPS Receiver by Using TWSTFT,"* in Proceedings of the 40th Annual Precise Time and Time Interval (PTTI) Systems and Applications Meeting, 1-4 December 2008, Reston, Virginia, USA (U.S. Naval Observatory, Washington, D.C.), pp. 543-548.