

## REPORT OF THE 14th MEETING OF THE CCTF WORKING GROUP ON TWSTFT

held in Paris, France  
on 10-12 September 2006

The 14th meeting of the Consultative Committee for Time and Frequency (CCTF) Working Group (WG) on Two-Way Satellite Time and Frequency Transfer (TWSTFT) was held on 10-12 September 2006 in Paris Observatory. The WG meeting was organized by the LNE-SYRTE and was chaired by Bill Klepczynski of USNO. Other contributions to the meeting, and attendee list, are available on the BIPM open access website:

<http://www.bipm.org/wg/AllowedDocuments.jsp?wg=TWSTFT>

Documents related to the details of financial issues, and attendee list with e-mails, are available for Participating Stations on TWSTFT restricted access of:

<http://www.bipm.org/en/committees/cc/cctf/>

### Agenda

**Sunday 10 Sept. afternoon:** Participating Station Reports

**Monday 11 Sept. morning:** Technical Reports

INTELSAT Status Report, *P. Whitacre, INTELSAT*  
Galileo use of TWSTFT, *A. Bauch, PTB*  
Some Aspects of Measurement Noise in TWSTFT, *D. Piester, PTB*  
BIPM Report, *W. Lewandowski, BIPM*  
TimeTech - Latest Developments, *W. Schaefer, TimeTech*

**Monday 11 Sept. afternoon:** Discussion on Intelsat Cost Sharing in Europe and North America

**Tuesday 12 Sept. morning:** Discussion on Intelsat Cost Sharing (cont.), and Tour of OP

## **Summary of the meeting**

***Reports from Participating Stations*** (see full reports on BIPM TWSTFT web-site).

**VSL.** Equipment: two TWSTFT antennas, Topcon Legacy E GPS CV P3, improved Satellite Simulator. Future work: Galileo measurements, clock ensemble time scale.

**USNO.** Set up of TWSTFT station in Hawaii in 2007. Diurnal effects  $> 1$  ns in TWSTFT data. Stronger involvement in GPS CP.

**TL.** Four Earth stations. TL/VSL TWSTFT link. Future work: TWSTFT links with Hawaii, PTB, OP, INRiM.

**SP.** Calibration campaigns: TWSTFT, GPS C/A and P3. TWSTFT low degree 3.9 deg. to IS707: Problems during heavy rain, might be solved by using larger antenna. GPS CP comparisons with TWSTFT: some systematics on SP/PTB, SP/USNO.

**PTB.** New software for TWSTFT data processing with warnings. PTB/NICT TWSTFT operational but not used for TAI (P3 is used).

**OCA.** Soon reporting UTC(OCA) to BIPM.

**NTSC.** Atlantis, NICT and TimeTech modems. Links with Asia and Europe.

**NPL.** Two TWSTFT stations.

**NMIJ.** Experimentation on TWSTFT CP over short baselines.

**NIST.** Excellent time transfer stability for one day  $< 100$  ps for most links in Europe. A problem with interference coming from other end TWSTFT stations in

Europe, degrading TWSTFT links. NIST is getting money for TWSTFT because of its contribution to GPS CP and vice-versa. Because of expensive TWSTFT operation NIST will be looking closely to TWSTFT performance. This requires an emergency contact to report interference if it appears.

**METAS.** Automated link calculation implemented. As for now UTC(CH) is a paper clock existing once a day at 00:00 UTC. Implement UTC(CH) as physical timescale. Environmental sensors are installed.

**NICT.** Delay measurement system. Time management system for QZSS, with TWSTFT link to USNO through Hawaii, or California.

**OP.** Satellite simulator. Second station linking OP to NTSC, NICT and TL, end of 2006 (?).

**INRiM.** Change of name from IEN to INRiM. From 23 June 2006 UTC(IT) generated by a Datum MHM 2010 Active Hydrogen Maser. Two TWSTFT stations. The old one is now a back-up.

**VNIIFTRI.** Will be buying TWSTFT.

**AOS.** Installation in October 2006. Intelsat visible at 3.6 deg, this is why Andrew 2.4 m antenna was ordered.

**TUG.** Co-located TWSTFT stations TUG01, TUG02&TUG03.

**Galileo use of TWSTFT.** Galileo will use TWSTFT at PTF1 and PTF2. Practical coordination of operations is PTB task under the Fidelity contract building the GTSP.

**TWSTFT noise.** Various aspects of increased chip rate, more or less stations on air. According to Intelsat representatives they could provide onboard data for some periods for experimentation.

**BIPM Report.** Comments on UTC(k) uncertainties and on BIPM TWSTFT webpage.

**Summary of a TWSTFT calibration Campaign 2006.** Involved TUG, PTB and METAS.

**TimeTech Report.** ESAs Deep Space Network wants to contribute to TAI with 9 masers by 2008 (approx.)

**Emergency contacts.** Tom Parker also underlined the need for emergency contacts, phone numbers and e-mail address for all stations. INTELSAT and laboratories must be able to contact anybody at any time, even during vacation times.

**Report by INTELSAT representative.** Two representatives of Intelsat have attended the 11 September morning session. Phil Whitacre reported on the privatisation of Intelsat in 2001 and present status. Now Intelsat owns 50 satellites and has \$2B annual revenue. In addition to Intelsat IS-707 used for Europe and North America TWSTFT links, links in Asia are using PAS-4, 72E and PAS-7 now owned by INTELSAT. At this time there are not plans to turn everything to digital multiplexing onboard satellite. That would jeopardize TWSTFT operations.

Next he explained the reasons why Intelsat management has decided to charge for satellite IS-707 used by TWSTFT community. Intelsat charges TWSTFT community less than other users. Financial details are provided on BIPM TWSTFT restricted access webpage. Now we have a temporary contract for 1-30 September 2006. Contract is negotiated for 24 hours use of transponders, which will allow continuation of current 12 sessions per day.

***Intelsat Cost Sharing.*** Andreas Bauch resumed this year history of European discussion on Intelsat payment. Two proposals were presented (details are provided on BIPM TWSTFT restricted access website):

1. Applying United Nations coefficient to each participating European TWSTFT laboratory (plus equal charges for CH, INRiM, OP, PTB, NPL for their special use of transatlantic links). Such approach is practised by a number of international activities and organisations, in particular by EUROMET, and also BIPM. Its advantage is taking into account economic situation of each country, so the laboratory. Important differences in financial possibilities of participating stations were reflected in a BIPM last summer survey, requested by WG, on satellite payment. Contribution by ESA is subject of a separate agreement. The disadvantage of this proposal is its complexity, especially in case of more than one participating laboratory in a country.

2. Based on equal payment for 12 European laboratories plus ESA (Galileo PTF1 and PTF2), with additional equal charges for CH, INRiM, OP, PTB, NPL for their special use of transatlantic links. Additional charge for ESA is subject of a separate agreement. Advantage of this proposal is a bigger simplicity and equality of contributions.

After a detailed discussion, advantages of second proposal prevailed, which was reflected by a vote.

Following this, European Participating Stations have agreed that the PTB should be cosigner with NIST of the contract with INTELSAT. The PTB will distribute a draft agreement between PTB and other 11 European laboratories, which will be paying their contributions to PTB. Contract signed by laboratories will not be signed by ESA. A separate agreement will be concluded between PTB and ESA.

***Coordination of the satellite simulator (SATSIM).*** It was suggested that Kenneth Jaldehag of SP will be coordinator of the SATSIM simulator measurements performed at several stations.

### **Forthcoming meetings**

Next meetings of Participating Stations will be held in December 2006 during the PTTI, and in May 2007 during the EFTF-IEEE/FCS. The next 15th meeting of the Working Group will be held on 17-19 September 2007, at the METAS, Bern-Wabern, Switzerland.

W. Lewandowski  
Secretary of the CCTF WG on TWSTF