

**REPORT OF THE 15th MEETING  
OF THE CCTF WORKING GROUP ON TWSTFT**

held in Bern, Switzerland  
on 17-19 September 2007

The 15th 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 17-19 September 2007 in Bern. The WG meeting was organized by the METAS 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**

**17 Sept.** A forum on Asia/Europe TWSTFT link.

**18 -19 Sept.** Participating Station Reports,

and Technical Reports:

Summary of SatSim Efforts, *C. Rieck, SP*

Status of VSL Transportable SatSim, *NMi VSL*

Bandwidth Improvements to TWSTFT, *A. Pawlitzki, TimeTech*

Implementation Practice of Recommendation of ITU Format, *D. Piester, PTB*

Performance evaluation of NICT modem, *NICT*

Comparison of TWSTFT to GPS/AV, *Z. Jiang, W. Lewandowski, BIPM*

Intelsat report about move of satellite, *given by B. Klepczynski, USNO*

**19 Sept.** Tour of METAS

## **Summary of the meeting**

***A forum on Asia/Europe TWSTFT link.*** For these three or four years, PAS-4 link seems to be available. *Let us use the most of this link.* NICT will cover the link fee until March 2009 (Both NICT modems and SATRE modems). From April 2009, NICT hope to share the fee. The paper work should be started by Aug. 2008. Monthly payment is possible. The plan should be decided by the start of the paper work. A longer term plan should be discussed. BIPM will write a letter to Russian and Indian authorities about possible use of their telecommunication satellites.

***Reports from Participating Stations*** (see full reports on BIPM TWSTFT website).

**USNO.** Set up of TWSTFT station in Hawaii still in progress. Diurnal effects > 1 ns in TWSTFT data. It is no easy to model it. They have inconsistency in calibration up to 5 ns. They investigate GPS CP to have them as back-up in case TWSTFT breaks.

**NIST.** They monitor transatlantic link. There is a diurnal seasonal effect of about 1 ns. It is very confusing. A solution would be control electronics. Time transfer stability for one day <100 ps. They monitor power level. UTC Tom Parker retires on 12 October 2007. He will continue as contractor, an asks to keep him on TW mailing list. The main TW contact will be Victor Zhang.

**NICT.** Comparison caesium fountains with PTB last December. Monitor of Earth station delay variation is working well. New TWSTFT using dual PRNs. TW carrier phase frequency transfer with ETS-VIII. Time management system for QZSS, with TWSTFT link to USNO through Hawaii. This link might be ready in about one year.

**TL.** TL/VSL TWSTFT link. TWSTFT links with North America will be operational as soon as Hawaii station is ready. Other planned links are with PTB and Australia.

**NTSC.** Two Earth stations. Links with Asia. Regular link with VSL since May 2007, however a strange 24 h effect of 100 ns. Link with OP under development. Link with PTP expected.

**NMIJ.** 7 Cs (data of 4 sent do BIPM), 4 HM. Two NICT modems and one SATRE modem. JSAT-1B links within Pacific Rim Asia with 1.8 m. 2.4 m antenna for PAS-4. TW calibration with NICT. TW Carrier Phase development.

**OP.** Progress in satellite simulator. Set up of second Earth station for Asia links. One antenna is motorized. Pas-4 is very low. It is easy to point to both, Pas-4 and Intelsat.

**NPL.** Four people in time-scales and time transfer activities. Time scale relocated to new NPL building. TW and GPS in old building. Two independent TWSTFT stations. Plans: restore operation of NPL01, move NPL02 to new building.

**VSL.** TW Equipment: Mitrex, two TWSTFT antennas, improved Simulator Satellite. GPS equipment: Topcon Legacy E GPS CV P3, Septentrio, old 3S. Problems with link to TL. VSL can start links to other Asian links. Future work: change from Mitrex to Satre, clock ensemble time scale.

**SP.** TW SP/PTB link since April 2007. Regular Satellite simulator measurement at odd hours. Problems during heavy rain, might be solved by using larger antenna. Moving to new satellite will help.

**PTB.** PTB01 Satre modem to European and US labs, PTB02 Satre modem X-band link, PTB03 modem NICT link to NICT and KRISS. Developing a watchdog system. Inclusion of the two Galileo Precise Time Facilities into the European TW network. Installation of a simulator from USNO. Calibration of PTB/USNO X-band in March 2007. PTB/NICT TWSTFT is used for TAI.

**OCA.** Two HP5071A. Three GPS receivers. One Earth station, 1.8 m VSAT. monitoring of environmental conditions. On 4 June 2007 negative answer from LNE on UTC(OCA). OCA cooperates with T2L2, which will be launched in June 2008. OCA participates in TW calibration campaigns.

**INRiM.** Nothing has changed in hardware set-up since last year. Temperature dependence studies: diurnal signatures on transatlantic links. There is no clear idea of the causes of these diurnals. Oscillations for transatlantic links is larger than for European links. It seems that OP does not have temperature dependence.

**ROA.** HM drives now TW station. Second station V-SAT for testing. Rain attenuates transmission power. More Tx power. ROA proposes to use a GPS multi-channel to fill gap in TW calibrations.

**METAS.** Station failure on 21 January 2007. Station in operation again since 23 April 2007. A calibration of PTB/CH link in June 2006. Since July 2007 sine June 2007. Automatic Alarm System implemented. In future hardware improvement. Expecting a new TW calibration. Environmental sensors are installed. UTC(CH) is still a paper clock existing once a day at 00:00 UTC. Implementation of UTC(CH) as physical timescale not before the end of this year. Required software is still under development.

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

**Summary of Satsim by SP.** Now is relative monitoring device. Labs equipped: VSL, OP, SP, USNO, TL. NICT is working on a satellite simulator. According to TimeTech an absolute calibration is possible but the amount of work is huge. However, OP wants to do it. May be some first results from OP next year. Using Satsim on regular basis to monitor stations is an urgent challenge for TW community. Next report during EFTF'2008.

***Bandwidth Improvements to TWSTFT.*** New method exist. Results promising, but still experimental. TW Carrier phase needs rigourous data analysis and data need to be improved. Modulated tone needs experiments via satellite (ESA shows great interest) Set-ups and stations to take advantage of new methods.

***Implementation practice of recommendation of ITU format.*** There are some problems with this format. There are inconsistencies. Tolerance must be applied to deal with. At present, the practice of data recording does not follow the standard ITU-R IF.1153-2. The ITU-R IF.1153-2 itself is not fully consistent. An increasing network requires more disciplined work. If the CCTF WG on TWSTFT agrees, I would like to collect comments and suggestions for a draft revision of the ITU-R IF.1153-2, for an input document for the next ITU WP7A meeting which is scheduled for 1 – 3 April 2008. We will provide a Word Document of the REC to interested parties who commit to submit their proposed changes by end of November 2007. Please, give me your comments and suggestions, now, later, or during the next weeks. Comments and suggestions should be send to D. Piester. He will then elaborate a format update which might next year submitted to ITU. It was suggested to put agreed updated format on BIPM restricted website and start to use it immediately, not waiting for ITU. Drafting group Dirk Piester, Juan Palacio, Zhiheng Jiang, Victor Zhang, Joseph Achkar, Daniele Rovera, Luca Lorini, Peter Whibberly. At PTTI group will organize a working meeting.

***Intelsat telephone call.*** Satellite will be moved definitively within two months in November 2007. There will be polarization change uplink and downlink vertical and horizontal for Europe and not for US. Another option, polarization change for Europe and US. This change requires hardware change and new calibration. This is a dramatic change, which never happened before. The cost by laboratory would be about 30000 USD (new sophisticated antenna and its set-up). In any case there will be frequency change. Change of frequency requires new calibrations. They ask to describe what change will cause recalibration. Description consequences of will be sent to Intelsat within two weeks.

They send late a proposal. It is available in a document on BIPM web restricted area. Option two seems that will require less hardware change.

***NICT modem.*** Performances of NICT and SATRE modems were evaluated in comparison to DMTD at zero baseline. In long baseline, measurement results by NICT and SATRE modems were compared. These results proved that their performances were equivalent and there was no clear difference for mid-term (several days). Regarding long-term performance of NICT modem, consistency with GPS AV seems to be enough. Long-term comparison of NICT and SATRE modems is planed in long baseline.

***BIPM comparison of TWSTFT to GPS/AV.*** TW links within Europe are showing higher noise than transatlantic and Asian. ROA suggests to make an experimentation of single links to PTB (now redundancy), to cut down the noise

(action ?). NICT/KRIS and NICT/TL are showing outstanding performance: sigma respectively 0.08 ns and 0.14 ns.

### **Actions:**

**1) *Update of ITU format:*** . Drafting group Dirk Piester, Juan Palacio, Zhiheng Jiang, Victor Zhang, Joseph Achkar, Daniele Rovera, Luca Lorini, Peter Whibberly. Comments and suggestions should be send to D. Piester. He will then elaborate a format update which might next year submitted to ITU. It was suggested to put agreed updated format on BIPM restricted website and start to use it immediately, not waiting for ITU. During PTTI'2007 group will meet at PS working meeting.

**2) *Intelsat satellite change:*** Description of hardware consequences due to satellite and polarization change will be sent to Intelsat within two weeks.

**3) *Hardware equipment on BIPM website:*** BIPM should provide on its website an up to date table with hardware equipment of laboratories. BIPM will send to the laboratories this table for update.

**4) *A satellite for Asia-Europe link.*** BIPM will write a letter to Russian and Indian authorities about possible use of their telecommunication satellites.

**5) *Noisy TW European links:*** TW links within Europe are showing higher noise than transatlantic and Asian. ROA suggests to make an experimentation of single links to PTB (now redundancy), to see if the noise is cut down (action ?)

### **Forthcoming meetings**

Next meetings of Participating Stations will be held in November 2007 during the PTTI, and in April 2008 during the EFTF. The next full meeting of the Working Group will be held during autumn 2008 at SP or USNO around PTTI'2008.

W. Lewandowski  
Secretary of the CCTF WG on TWSTF