

**REPORT OF THE 11th MEETING OF THE CCTF WORKING GROUP  
ON TWO-WAY SATELLITE TIME AND FREQUENCY TRANSFER**

held in Teddington, UK,  
on 9 and 10 October 2003

The 11th 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 9 and 10 October 2003 in Teddington, UK. The WG meeting was organized by the National Physical Laboratory (NPL) and was chaired by Bill Klepczynski of US State Department. The list of participants is given in the Appendix to this report. John Lavery of the NPL welcomed participants. Other contributions to the meeting are available on the BIPM web site

[http://www.bipm.org/en/committees/cc/cctf/working\\_groups.html](http://www.bipm.org/en/committees/cc/cctf/working_groups.html)

and NPL web site

<http://www.npl.co.uk/time/>

**Agenda of the meeting**

- 1) Opening remarks (John Lavery – NPL)
- 2) Status of Intelsat agreement
- 3) New observing schedule (G. deJong – VSL)
- 4) Coordination of Tx and Rx Codes (G. deJong – VSL)
- 5) Results of recent TUG calibration trip between IEN & PTB (L. Lorini and D. Piester)
- 6) Preparation of transportable earth station for calibration among Pacific Rim region
- 7) VSL – Taiwan Links
- 8) Two-way link between Pacific Rim region and US and Europe
- 9) Pacific Rim status (CRL)
- 10) GPS Calibration trips (W. Lewandowski – BIPM)
- 11) BIPM TWSTFT Reports (W. Lewandowski – BIPM)
- 12) Standards for outputting data from two-way modems (T. Parker – NIST)
- 13) Station Delay Monitoring using 2.5 and 20 Mchips (TimeTech)
- 14) Participating Station Reports (VSL, PTB, IEN, NPL, ROA, OCA, CRL, NTSC, TL, SP, METAS)

## Summary of the meeting

**Status of INTELSAT agreement.** The time metrology community continue to have free time from INTELSAT, and with new satellite there is more service. B. Klepczynski is in charge of the relations with INTELSAT management.

**New observing schedule.** TWSTFT observations switched from three sessions a week to five sessions a week. Now that we have learned that we can observe 24h a day on new satellite (three channels: EU–EU, EU–NA, NA – NA), new opportunities are open. Sessions every day at 00h00 UTC can be considered. Next, one may move to sessions every 4h. Ultimate goal are sessions every 1h. This is already the case for the NIST/USNO link, in the frame of a interagency GPS project.

On the other hand, with new station arriving, as SP and METAS, we are running out codes for Mitrex modems. However, Satre modems allow 32 codes.

**Coordination of Tx and Rx Codes.** The BIPM should have a role in assigning codes.

**TWSTFT calibration trips.** Detailed results of recent TUG calibration trip between IEN and PTB were presented. For the next calibration trips TUG is going to use a new air-transportable TWSTFT station. All European stations expressed a strong interest in upcoming new TWSTFT calibration trips in 2004. A next calibration trip could be organised already in April 2004 involving a couple of stations.

The USNO will continue its calibration of USNO/PTB X-band link. Next calibration exercise is scheduled for the beginning of 2004. A NIST/USNO TWSTFT calibration is scheduled for November 2004. Repeated calibrations of this link are consistent below 1 ns.

**VSL – Taiwan Links.** A TWSTFT link was established between VSL and TL using PAS-4 satellite at 72° east. Elevation angles are 28.74° at the TL and 4.90° at the VSL. The differences between TWSTFT and GPS CV for VSL/TL have a rms of 3 ns.

**Two-way link between the Pacific Rim region and US and Europe.** M. Imae reported on some experimentation between the CRL and Vadenbourg station on the US West Coast. The TWSTFT link between Vadenbourg and the USNO via a US domestic satellite is completing this exercise.

A TWSTFT link between the CRL and the PTB might be possible in 2004 with CRL modem at the PTB.

**Preparation of transportable earth station for calibration in the Pacific Rim region.** The CRL is preparing a series of TWSTFT calibration trips in the Pacific Rim. The station is air-transportable, and will be ready for mid-March 2004. For the first trip, one person will travel with the station. For future trips, the station will be shipped without staff.

***Pacific Rim status.*** The CRL has installed TWSTFT equipment at the KRISS.

***BIPM reports.*** The BIPM will continue its contribution to temporary calibration of TWSTFT links by GPS portable equipment. The *BIPM TWSTFT Reports* will soon change format and will become *BIPM Time Links Reports*, including other available time transfer techniques.

***Sagnac effect.*** Because of the change of satellite, Sagnac effect must be recomputed especially for the transatlantic links (CALR is affected). Application of changes should be coordinated by the BIPM.

***Standards for outputting data from two-way modems.*** There is a 0.5 s shift between different modems. It might introduce a significant error, which is not obvious, at least 24h continuous observations are performed. According to TimeTech, Satre modem data are corrected for this effect. Because this problem can concern other modems, T. Parker will write for the next meeting a draft recommendation for an update of ITU data format.

***Station Delay Monitoring using 2.5 and 20 Mchips.*** W. Schaefer briefed the WG on delay monitoring using high chip rate (20 Mchips). Results are substantially better, for short and long terms, than with 2.5 Mchips. Some unexplained instabilities are observed for 2.5 Mchips. He strongly recommended high chip rate for experimental Cs fountain comparisons between OP and PTB. This should be done in cooperation with Intelsat for providing this facility which is not yet available.

***Reports from Participating Stations.*** In Europe, the SP is now fully equipped by TimeTech with TWSTFT. The METAS is investigating its contribution to TWSTFT project. The OP is ready to receive portable TWSTFT station during first months of 2004. The OCA will be equipped with the Satre modem in 2004, and would like to take part in BIPM GPS calibrations. The TUG time laboratory will resume regular work during spring 2004. The VSL modifies antenna polarisation rotation (between Intelsat and Panamsat), develops software for use of the Satre modem instead of the Mitrex, changes schedule for seven sessions a week. The IEN, NPL and PTB are participating in the Galileo bed test. In the frame of this cooperation, a TWSTFT calibration between the IEN and PTB was undertaken. TL is equipped with three Satre modems, two Mitrex modems, and one CRL modem.

### **Forthcoming meetings**

It was agreed that the next meeting of participating stations would be held during the PTTI conference at the beginning of December 2003, and in April 2004 during the EFTF. The next full meeting of the Working Group will be held at the CRL, Tokyo, Japan, during fall 2004.

## APPENDIX

### List of participants

J. Achkar, BNM-SYRTE  
F.E. Arias, BIPM  
Th. Bartholomew, Northrop Grumman TASC  
F. Baumont, OCA  
F. Cordara, IEN  
J.A. Davis, NPL  
R. Hlavac, NPL  
Li Huanxin, NTSC  
M. Imae, CRL  
K. Jaldehag, SP  
G. de Jong, NMi VSL  
W.J. Klepczynski, US State Department/Office of Space & Advanced Technology  
W. Lewandowski, BIPM  
C. S. Liao, TL  
S.Y. Lin, TL  
L. Lorini, IEN  
J. McA Steele, NPL  
D. Matsakis, USNO  
T. Parker, NIST  
A. Pawlitzky, TimeTech GmbH  
D. Piester, PTB  
C. Rieck, SP  
W. Schaefer, TimeTech GmbH  
Ch. Schlunegger, METAS  
P. Stacey, NPL  
T. Suzuyama, CRL  
M. Tran, USNO  
W.H. Tseng, TL

*Excused:*

J. Palacio, ROA