

REPORT OF THE 10th MEETING OF THE CCTF WORKING GROUP ON TWO-WAY SATELLITE TIME AND FREQUENCY TRANSFER

held at the PTB Braunschweig, Germany,
on 7-9 October 2002

The 10th 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 8 and 9 October 2002 at the Physikalisch-Technische Bundesanstalt (PTB), Braunschweig, Germany. An additional session of the Participating Stations (PS) was held on 7 October devoted to a Tutorial on the SATRE Modem of TimeTech. The WG meeting was organized by the PTB and was chaired by Dr W.J. Klepczynski of ISI, Inc. The list of participants is given in the Appendix to this report. Other contributions to the meeting are available on the http://www.bipm.org/en/committees/cc/cctf/working_groups.html

Tutorial on the SATRE Modem, 7 October 2002

The PS Meeting devoted to a Tutorial on the SATRE Modem was held on 7 October 2002. It was given by Wolfgang Schaefer and Alexander Pawlitzki of TimeTech and was followed by an open discussion on operations.

Topics for the Tutorial included:

- 1) Time-stamping by the SATRE Modem
- 2) Compatibility mode with MITREX method and external TIC measurements
- 3) SATRE to SATRE mode
- 4) Raw data output formats
- 5) Automatic operation using the scheduler feature
- 6) Operation of Satellite Simulator
- 7) Built in TIC to measure external 1 PPS
- 8) Fully automatic operation with BIPM compatible output formats
- 9) Station configurations

CCTF WG on TWSTFT, 8-9 October 2002

Agenda:

- 1) Review of Agenda
- 2) Report from BIPM
- 3) Reports from Regional Representatives [North America (USNO), Europe (VSL), Asia-Pacific (CRL)]
- 4) Reports from Participating Stations
- 5) Calibration Efforts
 - a) Absolute Calibration System
 - b) Relative Calibration Station (USNO)
- 6) TWSTFT Uncertainty Paper (B. Klepczynski)
- 7) Five day per week operations [INTELSAT]
- 8) Coordination of observing sessions
- 9) Tour of PTB

Summary of the meeting

The meeting was devoted to an overview of current TWSTFT operations, studies of uncertainties of TWSTFT links, the possible extension of TWSTFT observations to five days per week, calibrations of TWSTFT stations, and expansion of TWSTFT links to the Pacific Rim region including links with Europe and North America. Electronic versions of some reports/presentations are available at the BIPM website (see above).

Report from BIPM. Report was dedicated to the BIPM comparison of TWSTFT and GPS CV, and to evaluation of the uncertainties of TAI time links. The use of uncertainties of type A and B was stressed. Recent calibrations of some TWSTFT links should give type B uncertainties for these links of 1 ns or less, however, repeated TWSTFT calibrations would help a better assessment.

Reports from Regional Representatives. M. Imae of CRL has reported that data for TAI from the CRL modem might be available at the end of 2002. The CRL modem is fully automated and can be controlled from a remote master station.

In the Pacific Rim, two satellites are used: JSAT-1B at 150° E (CRL, NTSC, TL, NMIJ, SG (project), KRISS (project)), and PAS-8 at 166° E (CRL, NML, USNO-California (project)). Sessions seven times a week will soon be performed.

Reports from Participating Stations. The participating stations presented reports on their work. The VSL is improving delay measurements, and plans to write software (visual Basic) for the Satre modem to replace Mitrex. It is also conducting a line-up test on Panamsat PAS-4 at 72° E (at VSL elevation ~ 5°) for connection with TL or others laboratories in the Pacific Rim. Change of polarisation of its antenna is not automated. At the OCA, various pieces of time transfer equipment (TWSTFT and GPS) are now well checked and operational. Joseph Achkar of BNM-SYRTE briefed WG on the status of TWSTFT status in his laboratory. He

joined BNM-SYRTE in June 2001. Previously he had worked ten years for another BNM laboratory. BNM-SYRTE is a new name for an old LPTF; SYRTE stands for *Systèmes de Références Temps Espace*. He also explained that the department of OP, DANOF, became SYRTE, and LPTF+LHA became BNM-SYRTE.

Calibration Efforts. Two different approaches for TWSTFT calibration were discussed. One was an idea to buy TWSTFT community portable TWSTFT equipment. The other was to buy a service from TimeTech, or from the Technical University of Graz (TUG). The TUG has an excellent expertise in TWSTFT calibrations. It organised the first TWSTFT differential calibration using its portable station between TUG, PTB and DTAG.

The USNO has a portable X-band station. Recently, it was used for the calibrations of USNO/PTB and USNO/NPL. There are plans of other repeated calibrations trips.

The WG has expressed its concern that almost all TWSTFT links are calibrated only approximately by GPS CV with uncertainty limited to several nanoseconds. It recognised the urgency for TWSTFT differential calibration trips. Efforts to calibrate absolutely TWSTFT equipment should be conducted simultaneously. The VSL improves its satellite simulator (SATSIM) and investigates production of its improved version.

The BIPM confirmed that waiting for TWSTFT calibrations, it would continue to calibrate TWSTFT links by GPS CV.

Study of expression of uncertainty of TWSTFT links. A need for a reference publication on this subject was underlined by B. Klepczynski.

Five day per week operations [INTELSAT]. The increase of the observations to five days per week has been postponed until the problems of the payments of Intelsat for years 2001 and 2002 have been solved.

Peter Hetzel

The WG expressed its gratitude to Dr Peter Hetzel who retires from the PTB in October 2002. Peter was one of the leading European experts in time metrology, and contributed a lot to the development of TWSTFT technology at the PTB and in Europe. Participants to this meeting wrote their personal messages of thanks and sympathy in a book offered to Peter.

Forthcoming meetings

It was agreed that the next meeting of participating stations would be held during the PTTI conference at the end of November 2002. The next full meeting of the Working Group will be held at the NPL, Teddington, UK, in October 2003.

APPENDIX

List of participants

J. Achkar, BNM-SYRTE
F. Baumont, OCA
A. Bauch, PTB
B. Becker, PTB
F. Cordara, IEN
J.A. Davis, NPL
G. de Jong, NMi VSL
P. Hetzel, PTB
R. Hlavac, NPL
M. Imae, CRL
D. Kirchner, TUG
W.J. Klepczynski, ISI, Inc.
N. Kurihara, CRL
S. Y. Lin, TL
L. Lorini, IEN
W. Lewandowski, BIPM
D. Matsakis, USNO
J. Palacio, ROA
T. Parker, NIST
A. Pawlitzky, TimeTech
B. D. Piester, PTB
Th. Polewka, PTB
E. Powers, USNO
W. Schaefer, TimeTech
T. Suzuyama, CRL