

18. May 2012

1. General Aspects

Currently 27 member states have nominated Contact Persons in the Technical Committee Time and Frequency (TC-TF), 19 of whom participated in the 2012 meeting of the TC. Details are given below.

During the last year European institutes have continued to play a major role in the co-operation with the BIPM Time Department in the realization and distribution of Coordinated Universal Time UTC. Currently 69 institutes from 52 states world-wide collaborate in this field, 30 of which reside in 24 EURAMET member states. They have contributed with data from more than 100 commercial atomic clocks and 10 primary clocks during the last 12 months. Among the latter are the most accurate primary clocks ever built whose uncertainty of realizing the SI second is at a level of 3×10^{-16} . This is a very healthy situation which demonstrates that the European measurement infrastructure in the T+F domain is internationally competitive and recognized and is based on high-quality research. On the other hand, in the TC-TF we have representatives from emerging member states and it is not easy to support them in meeting their respective national requirements in the field, keeping balance with the high level research undertaken in the developed countries. One way of achieving this (hopefully) is the continuation of EURAMET projects in parallel with the more ambitious EMRP projects.

In addition to the collaboration with BIPM several institutes in Europe conduct research projects with APMP, COOMET, and SIM institutes on a bilateral basis.

2. Projects

The latest status of the projects can be seen on the TC-TF web page. Progress reports have been given on the recent annual meeting and are published in the restricted part of the TC-TF web page.

The work for the following projects is ongoing, or has come to a state of maturity:

1117: Survey of European countries' legal time regulations (MIRS/SIQ).

A booklet containing the findings has been published by EURAMET thanks to the financial sponsorship of MIRS/SIQ. Later an inconsistency was noted, that is to say, the distinction between NMIs and DIs had initially been not sufficiently made clear. The online version was rapidly corrected, and the booklet is now distributed with an extra page of clarifications.

1118: Involvement of the TC-TF in EMRP (MIRS/SIQ).
(see later)

1130: GPS disciplined oscillators, NPL (UK)

A draft version of a EURAMET Technical Guide on the use of GPS disciplined oscillators in calibration laboratories (GPSDO), prepared in continuation of previous work of EA, was handed to the delegates in mid April. There is still some debate how one should find the balance between a restrictive interpretation of the standard ISO 17025 which requires a calibration of reference standards used in calibration laboratories and the technical function of a GPSDO which a priori is a "self-calibrating" device. It is hoped that a common view among the delegates contributing to this work can be found soon.

1146: Time transfer using optical fibers (IPE, CZ);

This project was initially launched as a bilateral project. The work done in this Project is one part of the activities continued now in the frame of JRP-s11 NEAT-FT, “Accurate time/frequency comparison and dissemination through optical telecommunication”.

1152: Studies of GPS receiver performance in dependence on environmental parameters (GUM, PL).

The results of this study are very relevant in the context of the cooperation with BIPM on time links calibrations and their uncertainties. Investigation into the performance of several GPS receiver (types and installation in different institutes) showed temporal variations of various kinds and causes, some identified as correlated with human operations, with environmental conditions, but some of apparently spontaneous kind. It is the aim to identify hopefully a majority of causes or, alternatively, to identify the best suited receiver types for the respective measurement task.

1156: GPSCALEU, performing regional campaigns of GPS (in the future GNSS) receiver characterization. This project was started in 2010 in reaction to Recommendation 2 of CCTF 2009. It was deplored that the strategy of undertaking such calibrations and using the results by BIPM has not been sufficiently well harmonized during the last two years.

3. Comparisons

The Consultative Committee on Time and Frequency has during its session in 2009 clearly expressed that in the T+F domain a single key comparison – today with participation from 69 institutes world-wide – is completely sufficient to guarantee the traceability of all participating national institutes to the international standards – the unit of time (and frequency) and to the epoch (time scale UTC). Thus the vast majority of TC-TF delegates is happy with the current situation and does not see a need to organize additional key comparison in the field. The GNSS receiver characterization (project 1156) is supporting the work of BIPM as it supports assignment of uncertainties to the published values on UTC-UTC(k) where UTC(k) is the local realization of UTC in institute “k”, based on firm grounds.

4. CMCs

Preceding the 2011 annual TC-TF meeting, a survey among the members had been conducted regarding

- CMCs published?
- CMC entries needing update?
- Number of services offered?
- Number of services actually requested by external customers?

Five institutes have no CMC tables published, and there was no change noted during the last year. They are encouraged to work on this, and support by other TC-TF members has been offered. Seven institutes noted the need to update their CMC entries, and three sets of CMC were submitted during the last year. When discussing the status of the TF CMCs recently, TC-TF member institutes were encouraged to consider submitting revised CMC tables if necessary. The CMC Analysis Working Group is comprised of Anton Niessner (BEV, AU), Kenneth Jaldehag (SP, SE), Peter Whibberley (NPL, UK) and Andreas Bauch (PTB, DE). In contrary to what has been reported as experience in other TCs, the process of the inter-RMO review of CMCs was noticed to happen during an acceptable time. The support of Omer Altan of BIPM is greatly appreciated.

During the report period, the Group has been involved in the analysis of 4 CMC tables from other RMOs. The AWG members do not see a need for substantial changes of the practice of CMC review. The proposed fixing of more strict deadlines is in principle welcome. The preparation of the CMC table of NIS (Egypt) had suffered substantial delay because of controversial statements in the initial CMC table and unclear responses from the other RMOs on what their objections are. But the matter could be closed in early 2012.

5. Activities of the Sub-Committees

TC-TF has no sub-committees.

6. Participation in iMERA-Plus and EMRP

TF has not been specifically involved in the 2011 Environment call. Preceding the Call “SI-Broader Scope” a preparatory meeting was organized by Harald Schnatz of PTB, whereas another PRT was drafted using electronic communication only. Both PRTs were approved for funding and are currently awaiting kick-off:

- JRP-10 “High-accuracy optical clocks with trapped ions” coordinated by E. Peik, PTB
Partners: CMI (CZ), MIKES (FI), NPL
- JRP-11 “Accurate time/frequency comparison and dissemination through optical telecommunication networks”, coordinated by H. Schnatz, PTB
Partners: BEV, CESNET, INRIM, MIKES, NPL, ObsParis, SP, UFE, VSL.

In response to the 2012 Calls the following PRTS were submitted in the T+F field:

Industry:

“Compact and high-performing microwave clocks for industrial and technological applications”, submitted by INRIM (Salvatore Micalizio), IT, 4 co-authoring NMIs: LNE-SYRTE, MIKES, MIRS, ROA, 2 co-authoring institutes: FEMTO-ST, LTE-UNINE, 3 co-authoring European industries: GMV, SELEX GALILEO, SPECTRATIME.

Open Excellence:

“Quantum engineered states for optical clocks and atomic sensors”, submitted by LNE-SYRTE, F, 2 co-authoring NMIs, NPL and PTB.

“Time and Frequency Metrology in Curved Space-Time (MiCST)”, submitted by PTB, 2 co-authoring NMIs, LNE-SYRTE and NPL.

SI Broader Scope:

“International Time Scales with Atomic Clocks”, submitted by NPL, UK, co-authored by 3 NMIs: INRIM, LNE-SYRTE and PTB.

7. Meetings

The 2012 TC-TF annual plenary meeting took place in Gothenburg, Sweden, on 23 April 2012. It was organized by SP and took place on the Monday before the European Frequency and Time Forum, held at Chalmers University of Gothenburg. This was done to reduce travel cost and motivate delegates to participate in this leading European conference in our field. Several delegates were presenters or co-authored presentations given during the conference. Delegates had the opportunity to visit SP on Friday, after the EFTF conference. The 2013 meeting will be

again held as a separate event in March. ROA (Spain) invited the TC-TF to have the meeting in San Fernando. A final decision has not been made, but up to now no other volunteer identified himself.

8. Issues

The CCTF Working Group on Coordination of the Development of Advanced Time and Frequency Transfer Techniques (WGATFT) organized a workshop at BIPM in late June 2011 with the intention to get a concise view of potential improvement on “traditional” time transfer methods and on new methods which are under development in response to the need of comparing optical frequency standards. TC-TF delegates participated in the workshop as presenters and as observers. For many years the TC-TF has had projects aimed at improving the quality of time and frequency transfer. Two current projects dealing with GNSS-based time transfer (see above) are well suited to support those needs. In view of constraints on budget and human resources in many institutes represented at TC-TF, projects of this kind are more relevant for many members than dealing with very ambitious and costly projects. Only a few TC-TF members are reportedly involved in the currently most elaborate time transfer projects, Time Transfer through Laser Link (T2L2, operational today, CNES, Obs. Cote d’Azur, LNE SYRTE) and the ACES Microwave link (to be flown on the ISS in 2015) so that these issues are essentially out of scope of the TC-TF.

The BIPM has started to publish a weekly solution of time scale and clock comparisons from a reduced number of institutes that are ready to provide their clock and time transfer data daily in an automated way. The “product” delivered is dubbed UTCr which is provided as UTCr-UTC(k) for each day of the past week each Wednesday afternoon on the BIPM ftp server. Even if UTCr is currently designated as “not a prediction of UTC”, it can very effectively be used to support the generation of a time scale UTC(k) with very good performance based on just a single 5071 commercial caesium clock. If smaller institutes take this chance, this will simplify their work and help to improve the synchronization of all international time scales to the ± 20 ns level.

9. Strategic Planning

This heading is well suited to present the TC-TF activities regarding the development of new roadmaps in our field. Based on the information and guidelines provided during the 2012 meeting of the TC Chairpersons, the existing TF roadmaps from 2006 were updated with contributions gathered by correspondence and the current version presented and discussed at the recent TC-TF meeting.

A coordinator was nominated for the final updating and editing of each roadmap,
Ground Clocks – Joseph Achkar (F);
Space Applications– Laurent-Guy Bernier (CH);
Time and Frequency Transfer – Andreas Bauch (DE).

The latest version of the roadmaps will be shown and discussed during the General Assembly.

TC-TF wishes to strengthen the “capacity building” aspect in the future EMPIR, but does not see a possibility to reflect this in the roadmaps, which are considered as scientific-technical planning aids for the Programme authors. In short, the following triggers have been identified in relation to the pillars of the envisaged EMPIR:

Great Challenges:

Atomic Frequency Standards (AFS) and Time and Frequency Transfer (TFT) both play an instrumental role in applications like network synchronization and monitoring (e. g. the smart grid) and in environmental monitoring from ground and from space. Research and development involves European industry and many university institutes, maybe more than the NMIs directly.

Innovation:

It is foreseen that a strong need for advanced AFS preferentially from European production will exist in view of continuously operating and upgrading the European satellite navigation system Galileo and the augmentation system EGNOS. Earth exploration and location based services have aside of their scientific involvement (climate monitoring, geodesy) also found commercial interest, and this trend is going to continue.

Basic Science:

Time is one of the basic physical dimensions and also the physical quantity that can be measured to the highest precision. It is therefore not surprising that clocks and frequency standards have played an important role in quantitative tests of the fundamental principles of physics. The development of quantum mechanics relied largely on the success of the theory in explaining subtle features of atomic spectra, and the relevant experimental data are mainly the result of frequency (or wavelength) measurements. Other fields of science that require continuous improvement in AFS and TFT are geodesy, radio-astronomy, space exploration, gravity wave detection.

10. Outlook 2012-2013

The following specific objectives are firmly scheduled for the coming year:

- Felicitas Arias, Director of the BIPM Time Department, clarified that the BIPM is grateful for the work done by EURAMET in response to the CCTF 2009 decision, and expresses regret that the promised guide for conducting or reporting calibrations has not been provided more timely. It should be available within a few weeks, that is mid 2012. It is therefore proposed to delay further calibration activities until this guide has been published, read and understood. But continuing practical work in response to Recommendation 2 of CCTF 2009 in the frame of project 1156 is on the agenda, institutes involved are ROA, SIQ, MIKES, and VSL.
- Developing guidelines for conducting GNSS receiver characterization together with experts from BIPM and other RMOs,
- Closing the work on project 1130 and publishing a Technical Guide.

Andreas Bauch, PTB
Chairman TC -TF 2012-05-18