



## 1. General Aspects

This report summarises the activities of the EURAMET Technical Committee for Time and Frequency (TC-TF) during 2017-2018.

TC-TF at present has contact persons from 29 EURAMET member countries, including a new representative from Denmark.

A core aspect of the work of TC-TF is to contribute to the generation of the international reference time scale, Coordinated Universal Time (UTC), by the BIPM under the single Key Comparison in Time & Frequency. Institutes participating in UTC generation provide both clock data and time transfer data regularly to the BIPM, and TC-TF supports this activity by coordinating the calibration of GPS-based time transfer links. The BIPM Time Department therefore maintains close contacts with the TC, and participates in its annual meetings.

## 2. Projects

There are currently 3 active projects within TC-TF:

**Project 1152:** *GNSS receiver performance monitoring.*

The project started in 2010, and aims to investigate the long-term performance and stability of GNSS timing receivers. The method adopted is to compare data from 2 or more receivers referenced to the same clock, and to investigate the environmental and other causes of changes observed in the differences between the receivers. The long duration of the project is continuing to provide valuable information about the actual behaviour of GNSS receivers that contribute to the generation of UTC.

Coordinating institute: GUM (Poland); 4 participating partners.

**Project 1156:** *GPS link calibrations in support of CCTF-K001.UTC.*

Calibration of the time transfer links between institutes participating in UTC computation is an essential aspect of the Key Comparison. To reduce its workload, the BIPM Time Department now only calibrates directly the GPS timing receivers at a small number of institutes (the G1 laboratories) within each RMO. The G1 laboratories in turn carry out calibrations of the GNSS timing receivers at other institutes within the RMO, and the purpose of this project is to support the organization and coordination of regular calibrations to ensure that all institutes are able to maintain the calibration status of their time transfer equipment. During 2017, the 3 G1 labs within EURAMET all carried out campaigns that supported a total of 9 G2 institutes.

Coordinating institute: ROA (Spain); 15 participating partners.

**Project 1288:** *Time interval comparison Pilot Study.*

The purpose of the project is to develop portable delay standards and measurement protocols for use in time interval measurement intercomparisons, building on the work carried out under EURAMET project 828. New optical fibre-based travelling standards have been prepared by a



Slovenian partner company, InLambda, in collaboration with SIQ (Slovenia), and have been thoroughly characterised at GUM (Poland) during 2017 along with an additional travelling standard developed by GUM. The project will be closed after completion of a final report, but activity will continue with the preparation of a calibration campaign that will be registered as a Supplementary Comparison.

Coordinating institute: MIRS (Slovenia); 8 participating partners; 4 additional partners.

### 3. Comparisons

Within the Time & Frequency field there is one Key Comparison, CCTF-K001.UTC, which is of indefinite duration and covers the computation of UTC by the BIPM. An essential aspect of this work is the regular submission of clock difference and time transfer data to the BIPM by the approximately 70 contributing institutes worldwide. The majority of institutes represented in TC-TF participate in the KC.

There were no active Supplementary Comparisons in Time & Frequency during 2017. However, TC-TF Project 1288 (described above) has been developing the transfer standards and protocols required for a Supplementary Comparison of time interval measurement capabilities. This SC is expected to start during 2018-19.

### 4. CMCs

There has been little change to the EURAMET TF CMCs during the period, with only France submitting a revised set of CMCs for review. A proposed new service for relative delay calibrations of GPS timing receivers raised some concerns during the EURAMET review, and a lively discussion of the issues took place during the TC-TF annual meeting in March 2018. The decision reached was to put forward the revised French CMCs for inter-RMO review, to obtain a broader range of opinions.

During the reporting period, 2 sets of revised TF CMCs from other RMOs were reviewed by TC-TF. One was submitted by APMP (for NIM, China), and the other by SIM (for INACAL, Peru).

### 5. Activities of the Subcommittees

The TC-TF does not have any Sub-committees.

### 6. Participation in EMRP/ EMPIR

There are currently 3 active EMPIR projects closely related to Time & Frequency, all from the 2015 calls:

<b>15SIB03</b>	OC18	<i>Optical clocks with 1E-18 uncertainty</i> Coordinator: Rachel Godun (NPL)
<b>15SIB05</b>	OFTEN	<i>Optical frequency transfer – a European network</i> Coordinator: Harald Schnatz (PTB)

**15SIP04**      TIMEFUNC      *Time synchronisation impact enabling future network communication*  
Coordinator: Erik Dierikx (VSL)

A further 3 JRPs were approved as a result of the 2017 calls:

**17IND14**      WRITE      *White Rabbit industrial timing enhancement*  
Coordinator: Davide Calonico (INRIM)

**17FUN03**      USOQS      *Ultra-stable optical oscillators from quantum coherent and entangled systems*  
Coordinator: Filippo Levi (INRIM)

**17FUN07**      CC4C      *Coulomb crystals for clocks*  
Coordinator: Ekkehard Peik (PTB)

## 7. Capacity Building: Activities of the last year and future needs

Within the EMPIR OC18 project, RMGs are proving to be a very effective mechanism for transferring expertise in optical clock construction and operation to another institute. The project is supporting 2 visiting researchers funded by RMGs, both from ROA (Real Instituto y Observatorio de la Armada, Spain). One has now returned to ROA to start up its optical clock programme after working for a year at INRIM (Italy), while the other has extended his visit to OBSPARIS (France) by a further year.

The TC-TF has not run any training activities during the last year, but 3 of the TC-TF contact persons provided tuition in a 2-day course on “Effective participation in Coordinated Universal Time (UTC)” that the BIPM delivered under its Capacity Building and Knowledge Transfer (CBKT) programme. There were 51 applications for the 24 available places on the course, indicating a need for more training events in the Time & Frequency field.

## 8. Meetings

The TC-TF meets annually, usually in March. The 2018 meeting was held at IPQ, Lisbon, Portugal over 7-8 March, with plenary sessions during the first day and morning of the second day, followed by a tour of the host institute.

In addition to the TC-TF contact persons, the 29 attendees included 2 GULFMET observers from SASO (Saudi Arabia), the new Director of the BIPM Time Department and one of her colleagues, and 2 other invited representatives who gave presentations on specific projects.

The main topics covered during the meeting were:

- a) News from EURAMET, including EMN proposals;
- b) Reports from the BIPM Time Department on recent activities;
- c) Status of European finance sector regulation and supporting time services;
- d) Updates on EMPIR, Horizon 2020 and other projects;
- e) CMC changes and reviews;

- f) Activities under the TC-TF projects;
- g) Presentations on other subjects of interest to the TC.

The 2019 TC-TF meeting is likely to be held at NPL, again in early March.

## 9. Issues

The new European regulations (known as MiFID II) requiring traceable timestamping of financial transactions came into effect on 3 January 2018. Within MiFID II, Regulatory Technical Standard (RTS) 25 specifies that automated timestamps must be correct to within 100  $\mu$ s of UTC. A number of the NMIs within EURAMET are offering or developing time services to meet the MiFID requirements, but there continues to be a lack of understanding of the concepts of time metrology among financial institutions and regulators. The question of whether GPS satellite signals can provide a valid and traceable UTC reference remains a source of disagreement.

Two EMNs with a significant Time & Frequency component have been submitted to EURAMET for approval: EMN-Q on Quantum Technologies, and EMN-SEG on Smart Electricity Grids. Suitable mechanisms need to be established to allow effective participation within the larger EMNs by representatives from all of the fields that they bring together.

## 10. Strategic Planning

Despite efforts to set up discussions of ideas for PRTs in advance of the 2018 calls, it proved to be a considerable challenge to exchange and coordinate proposals within Time & Frequency. As in previous years, the submitted PRTs were generated by a small number of NMIs and only circulated more widely within a few days of the submission deadline.

The road maps for TF were produced in 2012, and need to be revised and updated. The most effective approach is under consideration, and may result in a Strategy Working Group being formed within TC-TF during 2018.

## 11. Outlook for 2018/2019

A proposed Supplemental Comparison on time interval measurement capability is expected to start during the period.

The proposed EMN on optical fibre time and frequency dissemination will be reconsidered later in the year, and a decision made on whether to submit it to the expected call in early 2019.

The next annual meeting of the TC-TF is likely to be held at NPL in March 2019.

Peter Whibberley  
EURAMET TC-TF Chair