

THE CCDS WORKING GROUPS

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Abstract

The Comité Consultatif pour la Définition de la Seconde (CCDS) deals with the definition and realization of the second, and the establishment and diffusion of the International Atomic Time (TAI) and the Coordinated Universal Time (UTC). As other consultative committees, it has created a number of Working Groups in order to advise on specified problems. At present, there exists three CCDS Working Groups:

- *the CCDS Working Group on TAI, which includes a Sub-Group on GPS and GLONASS Time Transfer Standards,*
- *the CCDS Working Group on Two-Way Satellite Time Transfer, and*
- *the CCDS Working Group on Application of General Relativity to Metrology.*

This paper gives reports of the work done within these groups, together with their future actions.

CCDS: COMITE CONSULTATIF POUR LA DEFINITION DE LA SECONDE
Consultative Committee for the Definition of the Second

President: Prof J. Kovalevsky

Membership: Institutions or laboratories

+

Invited guests (experts invited for one particular session of the CCDS)

+

Prof B. Guinot, member by appointment

+

The Director of the BIPM and the Physicists of the BIPM Time Section

RECOMMENDATIONS → CIPM → CGPM

REPORT for each session

Last session (13th): 12-13 March 1996 (≈ 3 years)

CCDS WORKING GROUPS

Working Group on TAI

Chairman: Dr P. Pâquet, ORB

Rapporteur of the last session: Dr G. Petit, BIPM

Sub-Group on GPS and GLONASS Time Transfer Standards (CGGTTS)

Chairman: Dr D.W. Allan, Allan's TIME

Secretary: Dr C. Thomas, BIPM

Working Group on Two-Way Satellite Time Transfer

Chairman: Dr W.J. Klepczynski, ISI

Secretary: Dr W. Lewandowski, BIPM

Working Group on Application of General Relativity to Metrology

Chairman: Prof B. Guinot

Secretary: Dr C. Thomas, BIPM

Working Group on the Expression of Uncertainties in Primary Frequency Standards

Chairman: Dr R. Douglas, NRC

Working Group on TAI

Charter

1. To examine the remarks and requirements expressed by the users of the service of TAI
2. To prepare directives for the improvement of the service of TAI to be submitted for approval by the CCDS and then by the CIPM

Membership

Representatives of the four unions IAU, IUGG, URSI and ITU, and of the CIPM

The Director of the BIPM, the person in charge of TAI at the BIPM

Meetings of representatives of the timing laboratories before CCDS meetings

Actions

Last meeting: black-body radiation shift

Change of the upper limit of weight in TAI computation

TAI updates every 5 days

Publication of $[UTC - UTC(k)]$ within ± 1 ns

Requirement for data before the 5th of the month

Future

Watch upon TAI

Sub-Group on GPS and GLONASS Time Transfer Standards

Charter

Standardization of commercial GPS and GLONASS receiver software and hardware
→ improvement of the accuracy of GPS and GLONASS time transfer

Membership

Experts of time laboratories + representatives of receiver manufacturers
(formal meetings + open forums)

Actions

Standardization of one-channel one-frequency C/A GPS time receiver software:
TECHNICAL DIRECTIVES
Adaptation to GLONASS time receiver software

Future

Standardization of GPS and GLONASS time receiver hardware:
sensitivity to outside temperature
Problems of calibration
Multichannel GPS and GLONASS receivers: CCDS formal request

Working Group on Two-Way Satellite Time Transfer

Charter

CCDS 11th meeting (1989): BIPM *ad-hoc* Working Group

Its task is to define conditions of the operational system:

- * satellites and frequency bands,
- * specifications of the earth stations,
- * station calibration,
- * measuring procedures and schedules,
- * data processing.

CCDS 12th meeting (1993): CCDS Working Group with the task of:

- * assisting the establishment of regular two-way experiments and their evaluation,
- * preparing a standard format for data exchange.

Membership

Experts of time laboratories + representatives of modem manufacturers
Annual formal meetings + meetings of station operators

Actions

Field-trial experiment in 1994-95 with 6 stations in Europe & 2 in USA
Demonstration of the permanent operation of a network of stations
Development of a standard data format
Potential for high accurate frequency and time transfer

Future

Re-start of operational links
Improvement of earth station operation
Newly developed modems
Problems of calibration
Two-way frequency transfer between primary frequency standards

Working Group on Application of General Relativity to Metrology

Charter

1. Preparation of a report on the interpretation and use of SI units in the framework of the Theory of General Relativity
2. Studies on the consequences of the increasing accuracy of the realizations of the SI units

Membership

Experts in General Relativity+ members of timing laboratories

Actions

Publication of a *Metrologia* International Report on point 1
'Application of General Relativity to Metrology'
by B. Guinot, March 1997

Future

Point 2

CONFERENCE AND WORKING GROUP UPDATES: THE EUROPEAN FREQUENCY AND TIME FORUM

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Abstract

The European Frequency and Time Forum (EFTF) is an international conference and exhibition, providing information on recent advances and trends of scientific research and industrial developments in the fields of Frequency and Time. EFTF was inaugurated in 1987, by the action of French and Swiss researchers, as a meeting and discussion point for the European PTTI community, but the Forum soon attracted participants from all over the world. The average number of participants is between 250 and 300, with researchers coming from 20-25 countries: The number of papers (invited, presented, posters) rounds to 100-130. The wide spectrum of contributions compels the use of two sessions in parallel; the duration is of three days, usually in March. The venue is alternatively in France (Besançon) and Switzerland (Neuchâtel), but in recent years some events were held alternately in other European countries.

1 INTRODUCTION

EFTF Forum started ten years ago by the initiative of French and Swiss researchers, active in the Frequency and Time field, in two nearby regions of the two countries. Indeed, going back in time to the past centuries, clockmaking activities were widespread in a French region, west of Jura mountains, the Franche-Comptée, and in a Swiss region, around Neuchâtel, in the east side of the same chain. Among the promoters were Prof. R. Besson, the designer of the BVA crystal resonator, and Dr. P. Kartaschoff, of the Swiss PTT administration, and designer, in the early sixties, of the largest cesium tube frequency standard ever made, with an interaction length of over 4 m.

In the next section some details are given about the organization and the venues. News concerning the number of participants, the distribution of papers, and the running of the sessions will be covered in the third section, while in the last an attempt is made to find out the guidelines of development in PTTI matters that can be obtained merely by inspection of the papers submitted in the past ten years at the European Forum on Frequency and Time.

2 THE FORUM

The Forum is organized by an Executive Committee, formed by well known French and Swiss experts in the field: A. Audoin, R. Besson, M. Ecabert, J.J. Gagnepain, P. Kartashoff, and B. Schlueter.

The Executive Committee is assisted by an international Scientific Committee, formed by a large number of experts coming from all over the world. The Scientific Committee meets twice per year, during the Forum and in the fall of the year in order select the papers and to appoint some invited speakers. Papers are solicited by a standard call for papers, sent usually in May.

Each venue of the Forum is supported, from a financial point of view, from local and scientific organizations of the guest country.

The venue were held in the towns listed in Table I.

Table I - EFTF Venues

1st	1987	Besançon	France
2nd	1988	Neuchâtel	Switzerland
3rd	1989	Besançon	France
4th	1990	Neuchâtel	Switzerland
5th	1991	Besançon	France
6th	1992	Noordwijk	The Netherlands-ESA
7th	1993	Neuchâtel	Switzerland
8th	1994	Weihenstephan	Germany
9th	1995	Besançon	France
10th	1996	Brighton	UK
11th	1997	Neuchâtel	Switzerland

3 CONTRIBUTIONS PRESENTED AT THE FORUM

On the average at the annual venue are presented about from 80 to 100 papers, with a maximum observed in 1993 of 121; in that year the attendees were 334, coming from 24 countries. An average of 250-300 people attended the meetings in the last few years.

Usually the invited papers are 5 to 8, the oral presentations around 70, and the posters about 30-40, as can be deduced from Table II.

Table II - Papers Presented to EFTF

	atomic	resonators	posters	total
1987	22	40	-	66
1988	42	32	-	74
1989	29	38	-	67
1990	46	31	32	77
1991	27	27	16	64
1992	39	24	25	88
1993	37	39	45	121
1994	33	25	33	91
1995	33	21	47	103
1996	27	42	38	107

Table II commands some remarks. Under the heading *atomic* are considered papers dealing with atomic frequency standards, metrological matters, time scale formation, synchronization, and dissemination or space uses requiring the utmost accuracy.

Under the heading *resonators* are considered also the materials, measurement techniques on quartz, new materials for oscillators, sensors, and SAW devices. The posters are roughly divided in equal parts between the two headings with the same rule for the oral presentations; over the period 1987-1996, 333 papers can be classified as *atomic* and 339 as *resonators*.

It is worth to note that in Europe, and mostly in France, there is active a strong community of researchers working on piezoelectric materials and devices.

The strong diversification of the interest of the attendees between the two aforesaid "headings" and their parity in number compels the adoption of parallel sessions for a large part of the Meeting.

4 TRENDS OF THE PTTI RESEARCH

The study of some 900 papers over a span of 10 years offers the unique possibility to delineate some trends in the PTTI research. This study is presented in another paper at this PTTI Meeting^[1], but nevertheless some features can be pointed out considering the papers presented at the Forum. A couple of disclaimers are in order: since the field of interest of the authors concentrated under the heading *atomic*, no attempt will be made to trace trends in the *resonators* area, which anyway seems stable. The second is based on the careful control by part of the Scientific Committee of the quality and balance of the program offered; the trends are indeed originated by the "offer" of the papers, but these trends are possibly filtered in order to give a balanced view with a good appeal for the audience.

Confirmed is the traditional interest in the European labs on cesium devices; on the average 10 papers per year are dealing with this kind of standard, in its three approaches: the classic one with magnetic state selection (on the average 6 papers/year), with optical selection (from 1990), and with the cooled fountain (more recently). The first paper on the latter very interesting approach was presented by Clairon et al., in 1991.^[2] As regards the other standard frequency sources, hydrogen masers are under study; meanwhile the rubidium-cell peak of interest was in the first nineties, and it is now declining, but optically pumped Rb masers were proposed, mainly by China. The interest in lasers, as frequency and length standard seems to increase in

the very last years. Regarding comparison methods, Omega, VLF, and Loran-C disappeared after 1990 and the interest on GPS was particularly strong in 1990-1993; the system being now a well known standard, only special applications are reported. The two-way method, after an upsurge in 1990, now is extensively studied, with 20 some papers in 5 years. Considering other topics belonging to precise Time and Frequency activities, three are worth mentioning:

- studies on time scale formation and algorithms, with 5-6 contributions per year since 1991,
- research on frequency synthesis and on the electronic circuits (multipliers, distribution amplifiers, dividers, etc.) to be designed if we really are interested to the path leading to a stability of 10^{-18} ,
- applications requiring utmost accuracies,
- digital telecommunication as time and frequency dissemination systems,
- clock noise modelization/statistics, and
- traceability issues.

5 FUTURE EFTF VENUES

In 1995 an agreement was reached for joint meetings between EFTF and the IEEE International Frequency Control Symposium (FCS). The first of these joint meetings is planned for April 1999, in Besançon, France; the second will take place in 2003 somewhere on or near the East Coast of the United States. The intention of the EFTF and the IEEE/FCS is that these two venues be a test of the concept of joint conferences.

Torino, November 1996

6 REFERENCES

- [1] F. Cordara, A. De Marchi, M. Serafino, and S. Leschiutta 1997, these Proceedings.
- [2] A. Clairon, *et al.* 1991, "A laser cooled cesium atomic fountain: towards a high performance clock," Proceedings of the 5th European Frequency and Time Forum (EFTF), March 1991, Besançon, France, pp. 228-236.