

Consultative Committee for Time and Frequency

Eighteenth Session

(Sèvres, 4 and 5 June 2009)**Progress Report
from the
CCTF Working Group on the MRA
(WGMRA)**

F.Cordara, chairman

1.0 Introduction

The Working Group on the MRA, established by the 14th CCTF in 1999, was decided to be renewed during the 17th CCTF (September 2006). The final report on its activities, presented by the chairman G. de Jong, registered the finalization of the work done in collaboration with the BIPM to establish the CCTF KC for Time (CCTF-K2001.UTC) and suggested further actions to be taken, including changes in the Terms of Reference of the WG to take into account the JCRB recommendation to every CC to form a working group on CMCs, with the objectives reported in the document JCRB-11/6(2) namely: *“to coordinate the review of existing CMCs in the context of new results of key and supplementary comparisons”*.

During the 2006 CCTF meeting it was also proposed and accepted to start to work in collaboration with BIPM on a new KC for frequency called CCTF-K002.FREQ. The chairman and some WG members resigned after that meeting and, meanwhile a new chairman was nominated by the CCTF President at the beginning of 2007, the nomination of the RMOs representatives has been a longer process.

1.1 Terms of Reference

The original (2001) terms of reference of this WG were not formally changed at the last CCTF meeting even if the additional tasks proposed by G. de Jong (see page 28 of the BIPM Report of the 17th Meeting of the CCTF) were found being already performed in practice by the WG. A revised list of ToR integrated by the 2006 suggestions and the JCRB ToR could be the following one:

- Authorization on a provisional basis for any action needed between meetings of the CCTF as indicated by the MRA, in consultation with the CCTF President;
- Perform coordination activities related to MRA between RMOs;
- Act as point of contact for BIPM and JCRB on MRA matters;
- Report of its actions to the next CCTF meeting, the CCTF revising the decisions as required;
- Identify areas where additional key comparisons and supplementary comparisons are needed and develop the necessary guidelines and procedures;
- Provide guidance on the range of CMCs supported by particular key and supplementary comparison;
- Establish and maintain a list of service categories, and where necessary rules for the preparation of CMC entries;
- Agree on detailed technical review criteria;
- Coordinate the review of existing CMCs in the context of new results of key and supplementary comparisons.

1.2 Action List

The list of actions after the previous CCTF meeting in September 2006 was:

- Nomination of the RMOs members of the WG;
- Proposal of the CIPM CCTF KC for Frequency in collaboration with BIPM.

2.0 Activities Performed

2.1 WGMRA Membership and Meetings

In the period February 2007 to June 2009 the WG membership as indicated by the RMOs was as follows:

- APMP: Dr H.S. Lee (KRISS, Korea), since 2009 Dr. M.Hosokawa (NICT, Japan)
- EURAMET: Dr. G. Dudle (METAS, Switzerland), since 2008 Mr. P. Whibberley (NPL, UK);
- SIM: Dr. M. Lopez (CENAM, Mexico);
- AFRIMETS (ex SADC MET): Dr. Chris Mathee (NMISA, South Africa);
- COOMET: no representative
- Secretary: Dr. F. Arias
- Chairman: Mr. F. Cordara (INRIM, Italy).

Some informal meeting of the WG chairman with the BIPM and with some RMOs representatives occurred between March 2007 and February 2009 to prepare a work program and the first formal meeting of the WGMRA took place in Besancon (France) on April 23, 2009. The relevant outcome of this meeting was the agreement on the study performed by G. Panfilo and F. Arias of the Time, Frequency and Gravimetry Section of BIPM, that will be presented at the 18th CCTF meeting.

2.2 Collaboration with BIPM

As a follow up to what agreed at the 17th CCTF, on 2007 March 19 the KC for Time identification in the Key Comparisons Data Base (KCDB) was changed into CCTF-K001.UTC. At present (May 2009), there are 68 participant laboratories in this KC and the degrees of equivalence D_k [UTC – UTC(k)] are computed for 50 laboratories as of March 29, 2009.

33 NMIs have Calibration Measurement Capabilities (CMCs) for the Time and Frequency service categories approved and published in the KCDB.

The WGMRA chairman answered in April 2007 and again in January 2009 to a questionnaire received by the JCRB Secretary about the maintenance activities on the CMCs performed in the Time and Frequency field. More details can be found at point 4.0 and in Annex 1.

The approach to be followed to establish a key comparisons for frequency was discussed mostly with dr. F. Arias and G. Panfilo of BIPM during informal meetings in March, May and September 2007 and also in a meeting organized in April 2008 during the EFTF2008 attended also by the EURAMET and SIM representatives.

The starting point was the examination of the spread of CMCs in frequency as reported in the KCDB, discussing how to elaborate the BIPM computed UTC- UTC(k) data to the purpose of establishing a KC for frequency. It was also considered what should be the most suitable representation for CCTF-K.002FREQ allowing a clear interpretation by the customers of the traceability chain established within a country between the NMI and the accredited calibration laboratories, formally consistent with the KCDB rules and the WGMRA Guidelines.

The results of this investigation are reported in the BIPM document “The uncertainty for the KC in frequency CCTF-K002.FREQ”, discussed at the WGMRA meeting of April 23, 2009 and available for this CCTF meeting. To summarize briefly, the solution proposed is based on the computation of the UTC(k) frequency deviations every 5 days from the time deviations already computed by BIPM for CCTF-K001.UTC, evaluating the frequency uncertainty from the type A uncertainties of UTC-UTC(k) values.

At the WGMRA meeting (April 2009) it was also considered to propose at the CCTF another key comparison for frequency regarding Primary frequency standards (PFS), as they are regularly compared through TAI and the results are already published in Section 4 of BIPM *Circular T*. As some laboratories declare CMCs where the frequency reference is that of a PFS, obviously, these CMCs cannot be supported by key comparison CCTF-K002.UTC, but another key comparison could be established by the CCTF for comparing the frequency of PFS with that of TAI/UTC. The comparison already published in *Circular T* seems to be the best suited for becoming a key comparison, and the WG members agreed on presenting to the CCTF a proposal for a new key comparison under the name CCTF-K003.PFS, derived from Section 4 of BIPM *Circular T*. The BIPM agreed in drafting a written proposal for being submitted by the WG on the MRA to the CCTF.

The convenience of running a special campaign of comparison of PFS, with a common interval of measurement, as is the case in most key comparisons, was also stressed, encouraging the laboratories to adopt a kind of “magic period” for having regular measurements and suggesting that this period could end on the 10 of each month, very close to the date of publication of *Circular T*. This question will be brought by F:Arias to the attention of the CCTF WG on PFS together with the request of having a written document with the guidelines for revising the 1st evaluation of a PFS reported to the BIPM, reflecting the guidelines already used inside the WG on PFS. This request is in agreement with par.6 - *The technical protocol for a key comparison of document Guidelines for CIPM Key Comparisons (1999, rev.2003)*.

3.0 MRA tasks for the CCTF meeting

According to the responsibilities assigned to the Consultative Committees for the MRA implementation, as listed in the CIPM Technical Supplement to the arrangement(2003) under par. T8, we can summarize what follows.

- a) identify the key comparisons in the field of Time and Frequency and maintain a current list (Appendix D): the list shall be updated for the CCTF-K002.FREQ and for CCTF-K003.PFS if accepted by the CCTF.
- b) initiate and organize, with the collaboration of BIPM, the execution of key comparisons at intervals to be decided individually for each comparison: this is already realized for Time and should be started for Frequency according to the CCTF decisions.
- c) review the results of CIPM key comparisons and determine the reference values and degrees of equivalence on the basis of the proposals of the appropriate working groups: this activity has been accepted by the WGMRA to be performed by the BIPM Time, Frequency and Gravimetry Section and is regularly performed since 2005. Any proposal for modification can be discussed and decided at this CCTF meeting.
- d) approve the final report of CIPM key comparisons for publication by the BIPM: the WGMRA accepted that this task is realized by the BIPM Time, Frequency and Gravimetry Section with the publication of UTC(k) Time Deviations on the KCDB. Any proposal for modification of this procedure can be discussed and decided at this CCTF meeting.
- e) examine and confirm the results of RMO key and supplementary comparisons and incorporate them in Appendix B and the key comparison database: no results of KC or SC performed by RMOs are known to the WGMRA and no action has been taken.
- f) examine and confirm the results of bilateral key comparisons for entry into Appendix B and the key comparison database: no results of bilateral comparisons are known to the WGMRA.

4.0 Open questions for the WGMRA and the CCTF

4.1 Review of CMCs and other JCRB issues

A questionnaire was received from the JCRB Secretary in December 2008 (see Annex 1, 2, 3) regarding the review of CMCs and related matters (DUT uncertainty contribution, lower level services, new CIPM traceability statement, procedures for inter-RMOs reviews of CMCs). According to the JCRB directives, revision of lists of CMC are responsibility of the relevant working groups in consultative committees, and this revision should take place after five years. No revision has been made in this group until now, but considering that the first CMCs declarations in Time and Frequency were published in 2003, that the first key comparison results dates from January 2005 and the KC for Frequency is not yet implemented, this is a task to be fulfilled by this WG in the next term. The recommended periodicity of the review process is 5 years and this WG should discuss and establish appropriate rules for coordinating the inter-regional review of the CMCs. According to document JCRB-11/7(a), It is indeed a task of the RMOs to monitor the impact of key and supplementary comparisons results on CMC claims for its member NMIs.

Concerning the inclusion of the uncertainty of the device under test in the CMCs (see Annex 4) in our metrological field it is not straightforward, since it depends on the field and type of instrument. WGMRA Guideline 2 (Annex 4) states that the “best measurement capability” should refer to a measurement system with an ideal DUT; the certificate of calibration should include in the uncertainty budget the DUT contribution.

The document CIPM2008-46 on traceability makes a statement (see point 1 of Annex 3) concerning the laboratories with primary realisation of a unit of measurement that should be considered by this WG.

4.2 Implementation of CCTF-K002.FREQ

For the practical implementation of the key comparison for Frequency in the KCDB it has been discussed in the WGMRA a different approach from that followed for the KC for Time, that seems more appropriate to the relevant number of deviation values for this quantity, that will be available every 5 days, and that will be presented at this CCTF meeting. It is worth reminding that most CMCs of calibration laboratories accredited within ILAC and the corresponding regional accreditation organisations are related to the Frequency field, therefore the monitoring of the KC results in this field versus the CMCs claimed by the NMIs could be of the highest priority.

4.3 Review of the CMCs for Time Scale Difference quantity

In the framework of the CCTF-K001.UTC the evaluation of the prediction uncertainty of UTC-UTC(k) has been declared by many NMIs. The time interval considered to declare the prediction uncertainty is usually 20 days but the values declared for the prediction uncertainty from the different laboratories at 20 days show a big variation, namely from 20 ns to 200 ns. Considering the differences in the values declared, it will be necessary to start to study the problem, in collaboration with BIPM, both in this working group and in the RMOs Technical Committees.

The solution, to be included in a guideline, should indicate reasonable values for the prediction uncertainty of UTC-UTC(k) depending on the clock used and on the time transfer method implied in the traceability to UTC.

5.0 Possible resolutions to be adopted by the CCTF

The following proposals developed by the WGMRA in collaboration with BIPM could be formally adopted by this CCTF:

- Key Comparison for Frequency CCTF-K002.FREQ,
- Key Comparison for Frequency CCTF-K003:PFS,
- New Terms of Reference for the WG on MRA.

Annex 1

JCRB Questionnaire for CCs and WGs

Dear Colleagues,

During the last few years, a series of resolutions and recommendations were taken by the JCRB and CIPM, related to the operation of the CIPM MRA.

Many of these resolutions were required to be implemented at a Consultative Committee level or at CC Working Group level.

We would appreciate it if you could give the JCRB a brief feedback about the work done in your respective working groups by responding to the questions listed below this message.

If you have any other issues related to the CIPM MRA that you think should be discussed at the JCRB, please include them with your answer, under point 6).

Thank you very much in advance:

Luis Mussio
JCRB Executive Secretary

1) Periodicity of CMC reviews.

The JCRB has recommended that CMCs should be subjected to a re-review every five years.

This recommendation is being implemented differently in different WGs.

Has this been discussed in your WG?

If so, was there any mechanism proposed to perform the re-review?

2) Work and issues related to the DUT (device-under-test)

The inclusion or not of the uncertainty components due to the device under test in the declared CMCs, depends strongly on the area or work and the type of instruments involved.

Has your WG reached any conclusion on whether the DUT components should be included in the CMC's uncertainty? (Including the problem of the "best available instrument", or "best commercially available instrument")

If so, please make a brief description of the conclusions.

3) Reactions and actions on "lower level" service categories

During the meetings with ILAC and the Regional Cooperation of Accreditation Bodies (RCABs), the need has been discussed to have a common list of Service Categories that could be used by NMIs that have been accredited for secondary methods and services. The present lists used for the CIPM MRA are actually used by many accreditation bodies, but this list does not cover the lower accuracy methods often used by NMIs when providing a commercial service. Therefore it was recommended to the WGs on CMCs, to study the possibility of extending these lists. (See also document "On the new definition of CMC")

What action, if any, has your WG taken any action on this issue?

4) Reactions to the CIPM traceability statement

During the 97th CIPM meeting, a new statement to establish a clear policy on traceability was approved (see document “Traceability of CMCs in the KCDB”)

Although it has been a short time since this policy was approved, have you detected any problems related to the application of this policy?

What problems do you foresee in the future?

5) Different procedures for inter-RMO reviews of CMCs (if at all)

Does your Working Group have plans to use a different method to review CMCs than the use of the BIPM website? (For example, the CMC WG of the CCQM, use a different method consisting of meeting once a year to review substantial numbers of CMCs).

If so, please make a brief description of the planned procedure.

6) Additional issues or questions related to the CIPM MRA for discussion at the next JCRB meeting.

Annex 2

On the new definition of CMC – complement to questionnaire

On the new definition of CMC

Since the CIPM MRA was established, there have been many discussions about the meaning of the terms CMC and BMC.

Eight years after the CIPM was first signed, the Metrology and Accreditation communities reached an agreement on equivalence of the terms CMC and BMC and have also developed a common definition. This agreement was accepted by the ILAC General Assembly meeting in October 2008 and by the International Committee for weights and Measures, also at its October 2008 meeting.

This definition is now in use and describes the information existing in the KCDB as well as the information provided by Accreditation Bodies on the scope of accreditation for calibration and testing laboratories.

However, the definition itself does not cover all the aspects related to CMC and that makes it necessary to develop further concepts and criteria that should be publicly available to both communities.

As a result of discussions, notably those between the Regional Metrology Organizations (RMOs) and the Regional Cooperation on Accreditation Bodies (RCABs), complementary points are now under discussion in different committees and meetings.

These are:

- common criteria on the influence of the device under test on the uncertainty declared in a CMC and;

- a common list of services categories that can be used either to declare CMCs in the CIPM MRA as well as to declare CMCs in a scope of accreditation.

At present, the list of services categories used in the CIPM MRA context, was designed to apply to those services, usually those at a high metrological level, provided by NMIs To extend the use of these services lists to the accreditation community, as well as to the growing number of NMI

signatories to the CIPM MRA which offer services with larger uncertainties or in other categories, it is necessary to complement them with other level services (high uncertainty, on site calibration services, etc).

It is important to continue a harmonized work that will lead to a common list used by both communities. However, all communities recognise that the high level of metrology knowledge and expertise is located in the Consultative Committees (CCs) and CC Working Groups (CCWGs). This makes the CCs and CCWGs the natural place to do this work.

Annex 3

CIPM2008-46

Traceability of CMCs in the KCDB

The CIPM noted that the JCRB recommended that there should be a CIPM statement of policy on traceability of CMCs in the KCDB. The CIPM further noted that during its 21st meeting, the JCRB asked the BIPM to consider amendments to the statement made during its 20th meeting. After discussion, the CIPM therefore recommends:

For the purpose of publishing CMCs in the KCDB the following rules on traceability must be followed.

1. A laboratory with a primary realization of the unit of measurement concerned, or applying primary “higher-order” methods, must declare traceability to its own demonstrable realization of the SI.
2. A laboratory taking traceability from another laboratory must choose from either the BIPM or another laboratory having CMCs published in the KCDB with the appropriate level of uncertainty in the relevant area. In this case, the laboratory must still make a full assessment of the uncertainties involved in its measurement activity and must openly declare its chosen traceability route when submitting its CMCs for intra- and inter-regional reviews.
3. A laboratory is free to use measurement services provided by laboratories accredited by a signatory to the ILAC Arrangement, for calibration of instrumentation, reference standards or other components as parts of its measurement systems, provided that it can be shown that these components have only a minor influence on the total combined uncertainty of its CMCs.

Note: Paragraph 1 includes the case of laboratories using CRMs or high purity primary chemical references obtained from sources that are not recognized under the CIPM MRA only when the NMI has the recognized capability to analyze the composition by itself.

Annex 4

CCTF

WGMRA Guideline n.2

The estimation of uncertainties for T&F CMC entries