

# Redefinition of the SI Second: Impact on Users and Stimulus for the Redefinition

Subgroup A of the CCTF Task Force "Roadmap to the redefinition of the second"

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**Summary—** We present the current status of our work within the CCTF Task Force for the redefinition of the second.

**Keywords—** CCTF, second

## I. INTRODUCTION

The Consultative Committee on Time and Frequency (CCTF) has been focusing its activities on preparing for the redefinition of the SI second. CCTF has formed a Task Force to develop a roadmap for the redefinition of the SI second to be presented at the meeting of the General Conference on Weights and Measures (CGPM) in November 2022.

Within the framework of the CCTF Task Force, our Subgroup A has been tasked to reach out and engage with the wider time and frequency community. In particular, our goal is to assess the impact of the upcoming redefinition, gather feedback from users that may provide additional incentive for this redefinition, and more generally, to spread the word about the ongoing redefinition effort. We also want to ensure everyone has the opportunity to voice concerns and to make suggestions that can improve the process and ensure the most efficient and valuable outcome.

## II. METHODS/RESULTS

Our subgroup group is chaired by members of the Task Force and composed of academic and technical experts with various scientific backgrounds. It was formed by inviting representatives from all Regional Metrology Organizations to participate. The subgroup members created an extensive list of

contacts for experts from different academic communities (astrophysics, fundamental physics, geodesy), users in industry (hardware manufacturers, telecom, finance, energy, etc.), and other organizations. One of the most challenging aspects has been to establish and maintain the involvement of all “stakeholders,” including communities who depend (sometimes strongly) on time and/or frequency references, but for which time and frequency is not a core activity. Many stakeholders have different visions and interests, and we have made a persistent effort to include the interests of all parties.

A major milestone in the past year has been the conduct of a detailed survey under the auspices of the CCTF. Of the 79 questions in this survey, 24 pertained to Subgroup A, with some directed specifically at NMIs and others at the wider stakeholder community.

One group of questions was around the role that the current definition of the second plays in national laws and regulations and also in industry standards and guidelines. We wanted to gauge how much effort might be needed to update these.

Another set of more technical questions focused on time standards: what were the applications for highly accurate time signals; what were the current and future uncertainty requirements; what is the reference timescale in use how is traceability achieved; and what improvements and new applications might better clocks enable. These questions were then repeated for frequency standards, recognizing also that these have a very different user group to time standards. In both cases our goal was twofold – to evaluate the accuracy needs as

well as to understand the level of expertise and metrological literacy to plan for possible activities on education.

In all, more than 200 responses were received, prompting a large analysis effort. The analysis was supplemented by other relevant studies, particularly when the number of responses to a question was insufficient to form a representative view. For example, there was only one respondent who identified themselves as being in the financial sector.

There was a high level of awareness of the proposed redefinition. Of the 88 responses that were received from NMIs that did not participate in UTC (6) and stakeholders (82), 76 indicated awareness.

In regard to the effect of a redefinition of laws, regulations and guidelines, 62 of 141 responses said that some work would be necessary to update these. Although some respondents said that they thought this would be relatively simple, it is not possible from the responses to say how long it might generally take.

One question of interest was how many NMIs and stakeholders would replace their current cesium microwave frequency standards with an optical standard. Of the 96 responses, about one quarter indicated that they would, with a further quarter saying that they would if “the price was right”.

The responses to the technical questions on time and frequency standards were more or less aligned with our expectations. There was clear demand in some sectors for the very highest levels of performance enabled by optical frequency standards and an optically defined second.

### III. DISCUSSION/INTERPRETATION

We began the survey with what we believed was a reasonably comprehensive view of the stakeholders in the time and frequency, their applications and their requirements. The responses to the survey supported most of our initial assumptions, but also allowed us to clarify the meaning and the consequence of the ongoing effort for the community and learn of advantages and challenges of the future redefinition to a broad group of stakeholders.

Some key actions have begun to emerge as needs for the short or mid-term future:

- Particular attention should be paid to any legal adjustments that may be needed in several cases, which requires planning.
- Outreach should continue to enhance our understanding of the requirements of stakeholders, including for future applications of a redefinition of the second.
- More widely, broad, public communication should be maintained so that we don't overlook any corner case or application.

An important output of our work this year will be our contribution to a “White Paper” that is currently being prepared in collaboration between all three subgroups of the CCTF Task Force. This document will give more details and context to what has only been sketched here.

### IV. CONCLUSIONS

The work of preparing for the redefinition of the second is only beginning. So far, our investigations suggest that there is no major obstacle on the road to redefinition from the end-users' point of view. We will continue to support the process, notably in preparation for the CGPM meeting in November 2022.