

# Redefinition of the second: why, how, when?

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Under the supervision of the International Committee for Weights and Measures (CIPM), the Consultative Committee for Time and Frequency (CCTF) is the international body steering activities in Time and Frequency (TF) metrology related to the definition and realization (with primary and secondary standards) of the unit of time of the International System of Units (SI), TF transfer techniques, establishment and diffusion of International Atomic Time (TAI) and Coordinated Universal Time (UTC), Mutual Recognition Agreement (MRA) and metrological traceability. In order to meet the current and future needs in TF metrology, the CCTF is addressing various “hot” topics that are transverse to core CCTF activities and correspond to major challenges for TF community, especially the redefinition of the second.

Since 1967, the definition of the SI second relies on the Caesium atom hyperfine transition frequency. Caesium primary frequency standards are currently realizing this unit with a relative frequency uncertainty at low  $10^{-16}$  level, but in the last two decades they have been surpassed by optical frequency standards (OFS) demonstrating the capability of much lower realization uncertainties, typically 2 orders of magnitude better, after a redefinition.

The CCTF has set up in 2020 a dedicated Task Force to update its roadmap towards the redefinition of the second. This updated roadmap<sup>1</sup> has been approved in 2022 by the General Conference on Weights and Measures (CGPM) that adopted Resolution 5 “On the future redefinition of the second”<sup>2</sup>. The Task Force is continuing its hard work towards a redefinition with an organization in three subgroups devoted 1) to the analysis of the possible options for the redefinition, 2) to the monitoring of criteria to quantify the status of the developments of OFS and frequency transfer techniques and their maturity for a redefinition, 3) to the associated education and communication activities. The global objective is to converge on a new definition that offers a real improvement in the quality of its realization (relative frequency uncertainty) and is acceptable by all National Metrology Institutes and stakeholders.

After a reminder of the current and previous definitions of the second, this presentation will address some Frequently Ask Questions (FAQ<sup>3</sup>) related to various aspects of the future redefinition and concerning the rationale (Why?), the methodology (How?) and the schedule (When?).

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<sup>1</sup> N. Dimarcq et al, *Roadmap towards the redefinition of the second*, Metrologia 61, 012001 (2024). Open access. <https://iopscience.iop.org/article/10.1088/1681-7575/ad17d2>.

<sup>2</sup> Resolution 5 of the 27th CGPM (2022) “On the future redefinition of the second”. <https://www.bipm.org/en/cgpm-2022/resolution-5>.

<sup>3</sup> <https://www.bipm.org/en/faq-redefinition-second>