



CCTF Task Force Roadmap for the redefinition of the second

subgroup A:

Time & Frequency users and the
impact / stimulus of the
redefinition

TF-A Working team

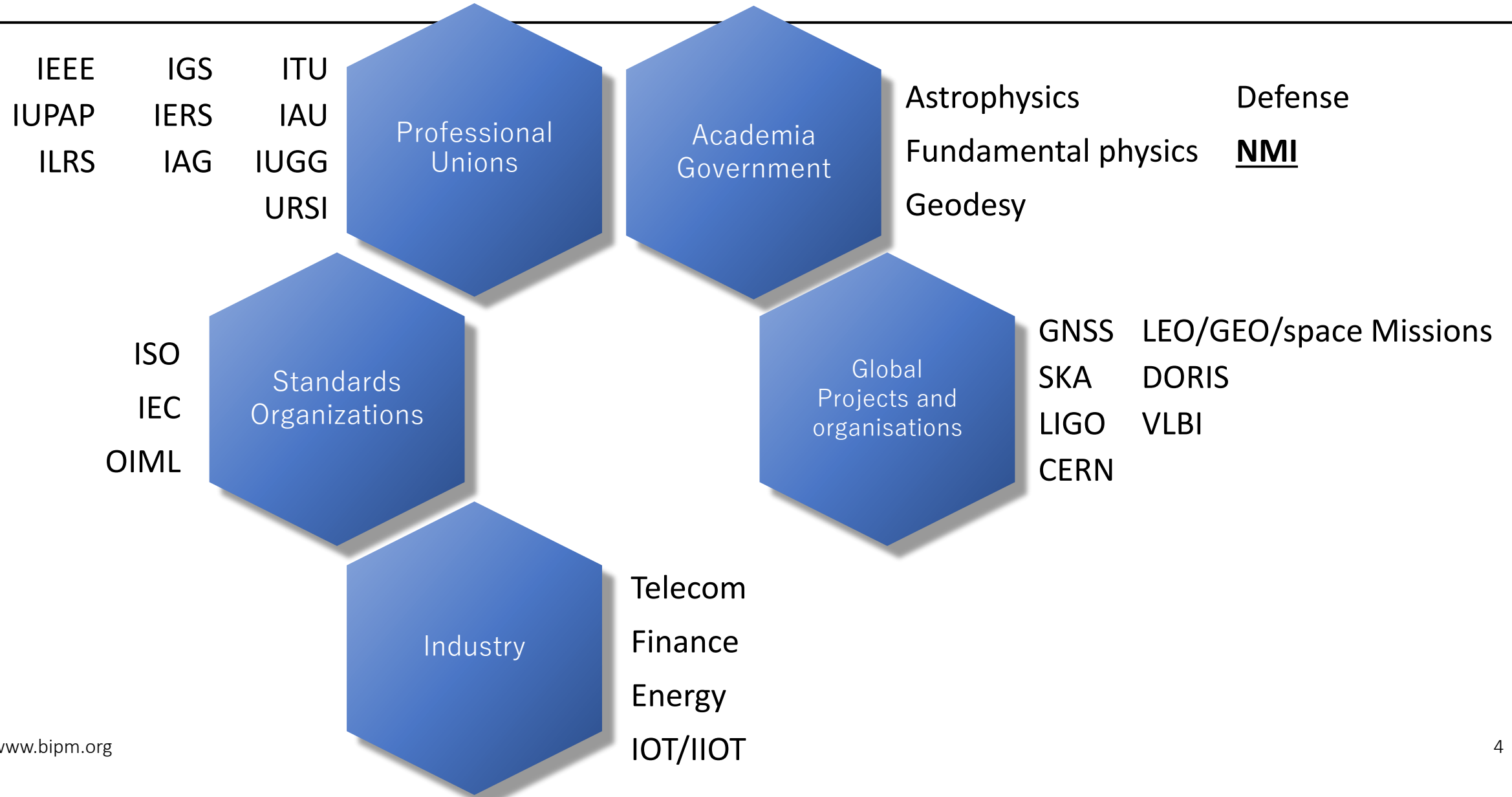
- ✓ Chairs
- ✓ Members
- ✓ Users / Liaisons / Stakeholders (NMI)

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Users / Liaisons / Stakeholders



Main objectives and topics to be addressed

The aim of the taskforce is to prepare a detailed roadmap of redefinition of the second for the CGPM 2022 identifying the intermediate objectives and open issues, based on collection of information and critical assessment.

In this context, the sub-group A focuses on the **end users**.

TF-A tasks

Inform

Educate

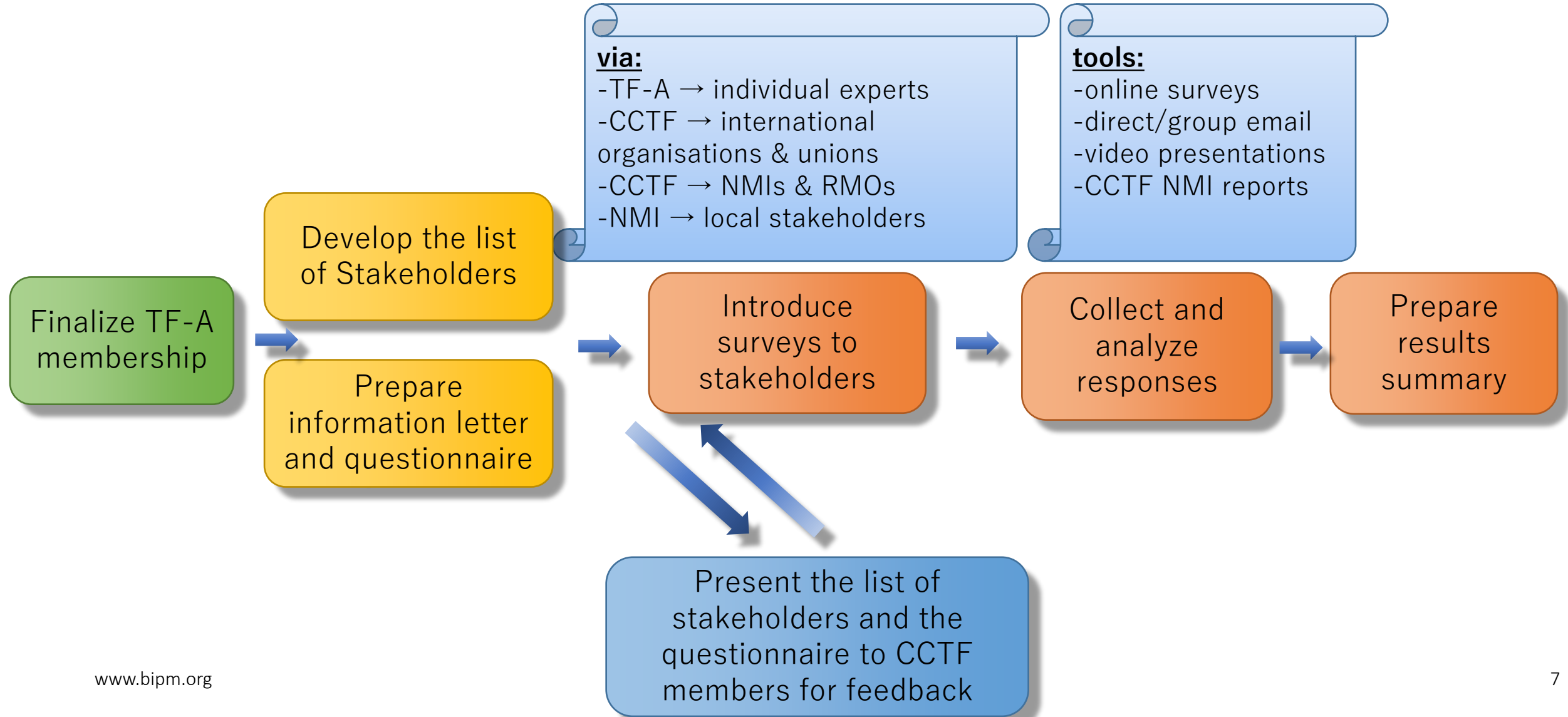
Survey

Identify and understand **technical needs** of the user community

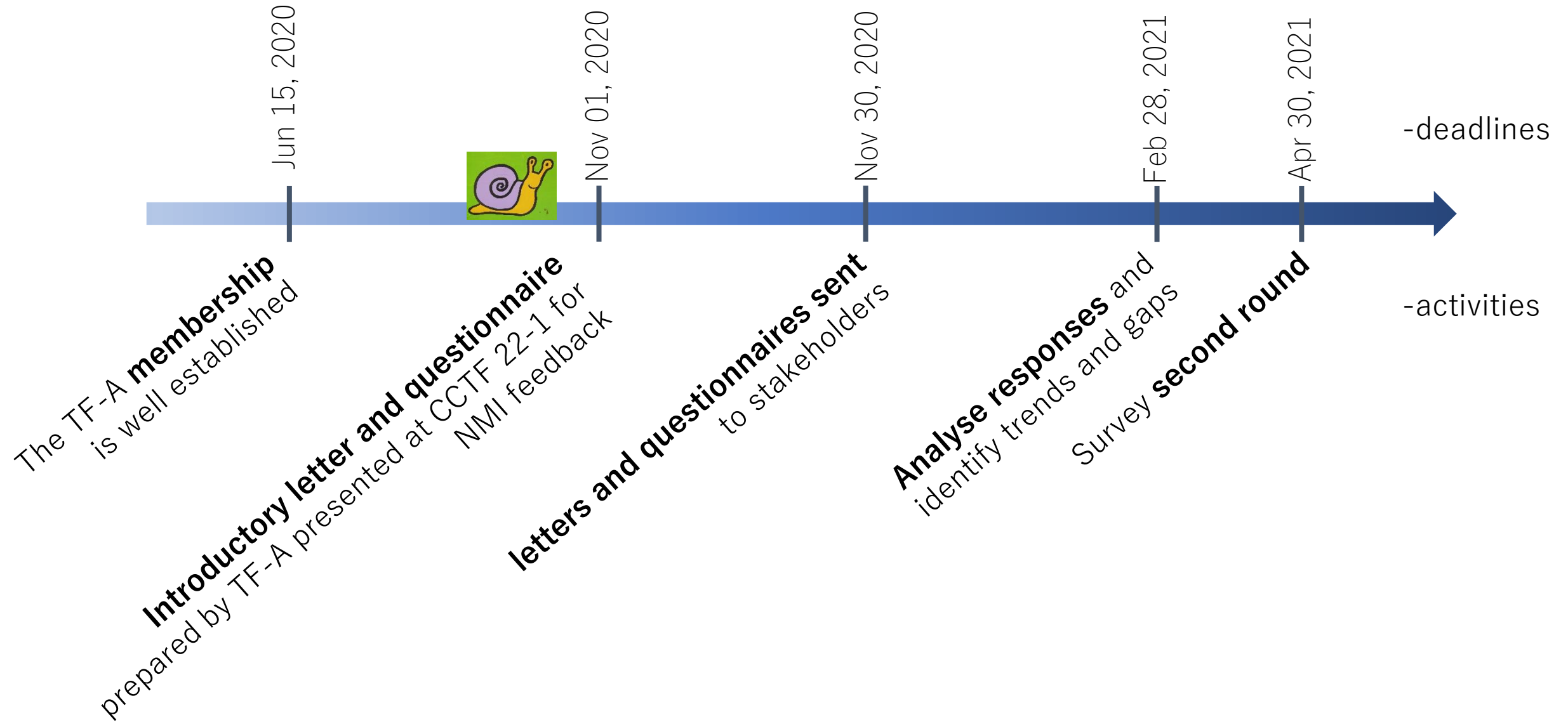
Identify **challenges** in adopting the new definition

Identify **opportunities** the redefinition promises for user applications

Methodology of work



Status of activities, initial results and next steps



Introduction Letter

Dear Colleague,

The last time the definition of the SI second was changed was in **1967** when Caesium atom hyperfine frequency transition was chosen as the reference value.

Since then first the primary thermal beam caesium clocks and then **caesium fountains** have been providing the SI second realization values to steer the International Atomic Timescale. The current fountain uncertainties are at low **1E-16** level.

The frequency metrology research in recent years has surpassed the microwave clocks, and **optical frequency standards** based on trapped ions and atoms now provide frequency measurements with evaluated uncertainties at the level **1E-18**.

The **frequency comparisons** have also been **advancing** both through improved techniques in Global Navigation Satellite Systems signal analysis and the Two Way satellite Time and Frequency transfer as well as with fibre based frequency links and portable optical clocks.

Frequency combs used to compare frequencies between clock lasers of different optical clocks and also between optical frequencies and microwave ^{133}Cs frequency of 9.192631770 GHz are now routine laboratory equipment and are commercially **readily available**.

These factors now provide **a solid foundation** to prepare **for the redefinition of SI second based on the optical frequency standard**. The exact approach is currently under discussion and it may be selecting one atomic candidate or building an ensemble. The specific requirements and the conditions for the redefinition to take place are also being finalized.

The CCTF has started preliminary work on this subject, to investigate possible scenarios and their possible impact. It is within this framework that **we contact** you, as a member of **stakeholders community**, in order to make sure **your needs** and wishes **are integrated** into the general debate that will take place and may, eventually, lead **to the redefinition of the second**.

With the **new definition**, the frequency measurement accuracy will surpass that of Caesium-based timescale by at least one order of magnitude and will provide an **adequate tool for** current and **future research** into fundamental physics as well as **technology** exploitation.

The **redefinition is not expected to affect** any of the existing **commercial frequency standard** uncertainties such as those of caesium beam clocks or hydrogen masers, because their uncertainties are generally orders of magnitude higher than the expected accuracy of the new definition. The effect on the caesium fountains will also be minimal. The **computation and dissemination of UTC will not change**, but UTC will become more stable and accurate based on the improved optical realizations of the SI second.

We would like to ask **your expert opinion** on whether the redefinition may have any **impact** be it negative or positive **on your field** of study and operation. The **issues** we would like you **to consider** are not just **scientific** and **technological**, but also **regulatory** and **legislative**. Your answers will be carefully examined and taken into account by CCTF in their analysis of Time and Frequency metrology current and future needs and SI second and UTC evolution.

Please find the questionnaire attached to this letter and it is also available online at <https://BIPM.ORG/...>

Questionnaire

The **aim** of the letter/questionnaire:

- to **inform** that CCTF is evaluating hot topics
 - could be accompanied by a video explaining what is under evaluation, and assuring the users on what will NOT change
- to **explore** how the user communities are **impacted** by these hot topics
 - clear, simple, small number of core questions, with successive increasing details and optional additional questions
- to **recognise** the (current/future) user needs in CCTF evaluation

- Do you use **high accuracy Time signals**?
 - How do you use time in your systems?
 - What are your current uncertainty requirements?
 - What is the reference timescale that you use (UTC, TAI, GPS/GLONASS/Galileo/BeiDou Time, etc.)?
 - How do you achieve traceability to accurate time (NTP, PTP, WR, GNSS, TWTFT, etc.)?
 - What is the uncertainty level of the time signal reference that you get?
 - Does your current reference signal accuracy satisfy your current and future needs?
 - What level of time uncertainty and at what averaging times would you like to get access to now and in the future?
 - What achievements would more accurate time signals enable in your field?
- Do you use **high accuracy Frequency references**?
 - How do you use frequency in your systems?
 - What are your current uncertainty requirements?
 - How do you access accurate frequency (calibrated clocks (Rb, Cs, H), GNSS, TWTFT, fibre links)?
 - What is the uncertainty level of the frequency reference that you get?
 - Does the accuracy of your current frequency reference satisfy your current and future needs?
 - What level of frequency uncertainty and at what averaging times would you like to access in the future?
 - What achievements could more accurate frequency references enable in your field?
- If you operate **Cs commercial frequency standards**, will you consider replacing them if the second is redefined? Why and if yes, with what?
- Is the definition of the second via ^{133}Cs documented in any of your **laws, regulations or guidance** documents?
 - What efforts would be required to change the wording to allow for the new definition?

Questions for CCTF members

- ❑ Please provide **feedback** (comments/questions) on the proposed letter and questionnaire
- ❑ Please **identify stakeholders and liaisons** in your country and provide their contact details to be approached with this survey

Thank you

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