European Partnership on Metrology
Call 2025 – Health, Integrated European Metrology, Regulation and Research Potential

Selected Research Topic number: **SRT-r03**
Version: 1.0

Title: Advanced digital infrastructure for harmonised temperature metrology

Abstract

The calibration of temperature sensors through the automation of data collection, storage and processing is of great interest to the thermometry community, health sector and industry as it will shorten calibration times and reduce errors. The increasing importance of seamless communication with temperature sensors, the automation of temperature measurement and calibration processes, and the validation of digital procedures is anticipated to become an essential part of the metrological process in the future. Consequently, there is a pressing need for emerging NMIs / DIs, with limited resources, to extend and cultivate their digital thermometry competencies and to improve their capabilities which will enable them to exchange knowledge and experience and to create a common compatible infrastructure, fostering smart specialisation. Therefore, proposals addressing this topic should focus on the implementation of a common compatible digital infrastructure for temperature measurement and dissemination by employing open-source solutions.

Keywords

Calibration, digitalisation, harmonisation, machine-interpretable, immutability, digital identities, automation

Background to the Metrological Challenges

The use of modern techniques like artificial intelligence, digital twins and digital calibration certificates requires new approaches, complex algorithms and models to be added to temperature measurement processes. Therefore, the digitalisation of the thermometry services provided by the metrology community needs to be fostered. The larger NMIs / DIs have successfully embraced the digital transformation of temperature measurement and dissemination. However, their smaller counterparts have encountered challenges in independently navigating this shift. The emerging NMIs / DIs generally do not have separate departments dealing with digital transformation and almost all have a need for the automation of temperature measurements and digitalisation of the entire temperature measurement process.

In addition, many calibration laboratories have identified the need to move away from proprietary software packages whose licensing is paid on an annual basis, and to base their future work on the automation and digitalisation of temperature measurements on open-source solutions. Thus, the need arises to switch to open-source solutions, which are familiar to many in the metrology community. This transition should primarily enable the availability of software solutions for smaller and emerging institutes as well as facilitating cooperation between institutes. These efforts can be decisively supported by harmonised and machine-interpretable data exchange formats. The development of a standardised framework for temperature measurement and dissemination will need to align with the unique processes of each NMI's / DI's calibration procedures. Prior to any automation, a digital workflow must be meticulously designed, adhering to the findability, accessibility, interoperability and reusability (FAIR) principles. This approach will not only ensure accuracy by reducing systemic errors, but it will also facilitate the data sharing.

A mechanism needs to be put in place across Europe to facilitate the validation and exchange of developed temperature measurement software between the different metrology institutes. The aim is to prevent duplication of effort and to facilitate use of validated software, as well as to enhance collaboration and the transparency and reliability of measurements through intercomparisons between NMIs / DIs.

EURAMET MSU,
Email: part.msu@euramet.org
Metpart.eu

European Partnership Co-funded by the European Union
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Special care should be taken on the security and authentication of data by ensuring data immutability and self-sovereign identities and giving users full control over their digital identities, in line with eIDAS regulations (electronic identification, authentication, and trust services), promoting trust, interoperability, and secure cross-border digital interactions. These efforts should be accompanied with additional machine-interpretable exchange documents which will include machine-interpretable information such as interpolation equations or uncertainty calculations.

Objectives

Proposers should address the objectives stated below, which are based on the PRT submissions. Proposers may identify amendments to the objectives or choose to address a subset of them in order to maximise the overall impact, or address budgetary or scientific / technical constraints, but the reasons for this should be clearly stated in the protocol.

The proposal shall focus on the development of metrology capability in the digitalisation of temperature measurement and dissemination.

The specific objectives are

1. To identify all relevant standards, practices, resources and developments related to the digitalisation of temperature measurement and dissemination. This should include the digital SI, which is under development by the BIPM, information on European Digital Calibration Certificates (DCC), and digitalisation of *mise-en-pratiques* and vocabularies or ontologies on temperature measurement and dissemination.
2. To employ data-exchange formats together with application programming interfaces in order to enable direct interpretation by machines and automatic execution of more complex actions and decision processes (like measurement uncertainty assessment, function interpolation, etc.). The resulting software libraries (data conversion, interfaces for various calibration devices, etc.) should be developed and shared.
3. To develop the workflow specification notation, frameworks, programming designs and data formats needed for automated digital workflows (starting with temperature measurements and ending with a DCC) for temperature measurement and dissemination at the participating institutes, leveraging the resources identified in Objective 1. This should include the creation of a harmonised software infrastructure and sharing scheme, which should foster smart specialisation and ensure compatibility. The workflow outputs should be validated and tested within the consortium.
4. To develop a solution in order to ensure data immutability and self-sovereign identities through a decentralised architecture, eliminating single points of failure and giving users full control over their digital identities, in line with eIDAS regulations, promoting trust, interoperability, and secure cross-border digital interactions.
5. To facilitate the take up and long-term operation of the capabilities, technology and measurement infrastructure for temperature measurements developed in the project, by the measurement supply chain (NMIs/DIs, calibration and testing laboratories), and end users (e.g. industry, instrument manufacturers, regulators). The approach should be discussed within the consortium and with other EURAMET NMIs/DIs, e.g. via EURAMET TC-IM and EMNs, to ensure that a coordinated and optimised approach to the development of traceability in this field is developed for Europe as a whole.

Joint Research Proposals submitted against this SRT should identify

- the particular metrology needs of stakeholders in the region,
- the research capabilities that should be developed (as clear technical objectives),
- the area for which the capabilities will be built (Green Deal, Digital Transformation, Health, Integrated European Metrology, Industry, Normative or Fundamental Metrology) and in which future main call the developed research capabilities are planned to be employed,
- the impact the developed research capabilities will have on the industrial competitiveness and societal needs of the region,
- how the research capability will be sustained and further developed after the project ends.

Where relevant, proposals are encouraged to build on, or seek collaboration with, existing projects and develop synergies with other relevant European, national or regional initiatives and funding programmes. In particular, links are encouraged with (i) the projects funded under earlier relevant topics of the Horizon Europe programme; or (ii) other relevant European Partnerships.

Proposers should establish the current state of the art and explain how their proposed research goes beyond this.

The development of the research potential should be to a level that would enable participation in other TPs.

Proposers should note that the programme funds the activity of researchers to develop the capability, not the required infrastructure and capital equipment, which must be provided from other sources.

EURAMET expects the average EU Contribution for the selected JRPs in this TP to be 0.7 M€ and has defined an upper limit of 0.9 M€ for this proposal.

EURAMET also expects the EU Contribution to the external funded beneficiaries to not exceed 20 % of the total EU Contribution across all selected projects in this TP.

Any industrial beneficiaries that will receive significant benefit from the results of the proposed project are expected to be beneficiaries without receiving funding or associated partners.

Potential Impact

Proposals must demonstrate adequate and appropriate participation/links to the 'end user' community, describing how the project partners will engage with relevant communities during the project to facilitate knowledge transfer and accelerate the uptake of project outputs. Evidence of support from the "end user" community (e.g. letters of support) is also encouraged.

You should detail how your proposal's results are going to:

- Address the SRT objectives and deliver solutions to the documented needs,
- Provide a lasting improvement in the European metrological capability and infrastructure beyond the lifetime of the project,
- Facilitate improved industrial capability or improved quality of life for European citizens in terms of personal health, protection of the environment and the climate, or energy security,
- Transfer knowledge to the calibration laboratories and the metrology community.

You should detail other impacts of your proposed JRP as specified in the document "Guide 4: Writing Joint Research Projects (JRPs)"

You should also detail how your approach to realising the objectives will further the aim of the Metrology Partnership to develop a coherent approach at the European level in the field of metrology and include the best available contributions from across the metrology community. Specifically, the opportunities for:

- improvement of the efficiency of use of available resources to better meet metrological needs and to assure the traceability of national standards
- the metrology capacity of EURAMET Member States whose metrology programmes are at an early stage of development to be increased
- organisations other than NMIs and DIs to be involved in the work.

Timescale

The project should be of up to 3 years duration.