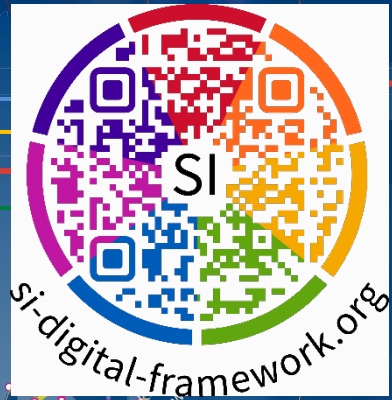
Digitally Transforming the International Quality Infrastructure: Panel Discussion



Dr Anna Cypionka, Director International Liaison and Communication

Bureau International des Poids et Mesures (BIPM)

NCSLI, July 2024

Bureau International des Poids et Mesures

The Metre Convention

Signed **20 May 1875**
by representatives of 17 nations

for the **„Unification and perfection of the metric system“**

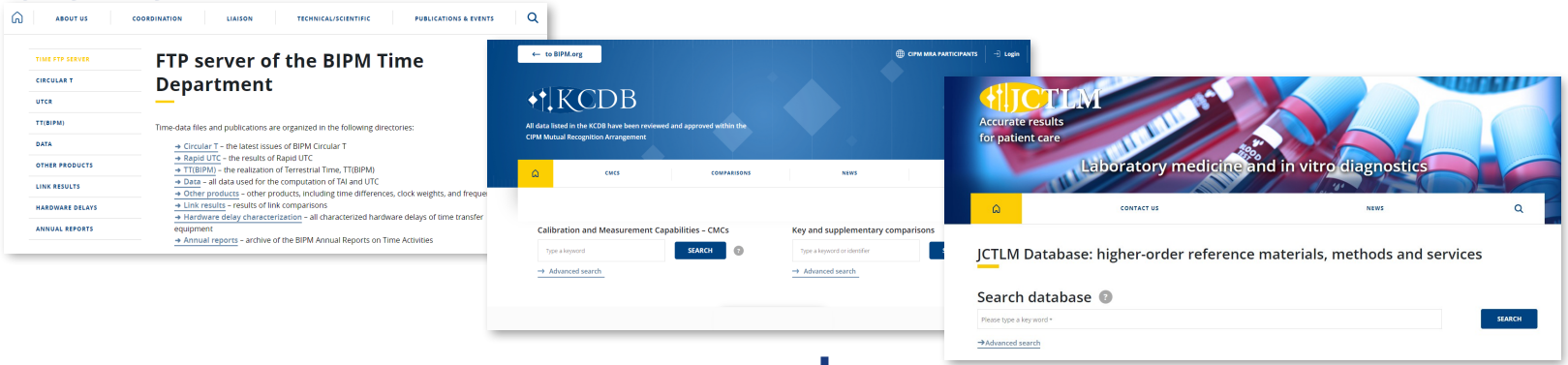
“A fully digital representation of the SI”

- Provide the globally accepted anchor of trust for metrology in the digital era
- Facilitate the use of digital certificates and the adoption of the FAIR principles

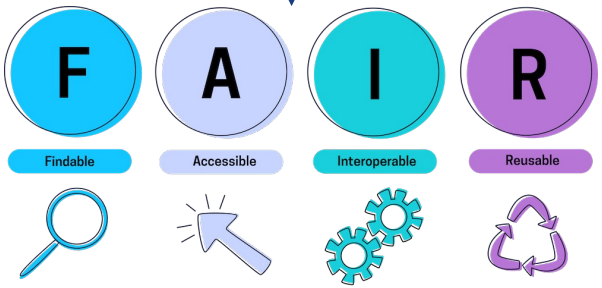
pdf
human readable

FAIR
machine readable

“Adoption of FAIR principles for metrological data”

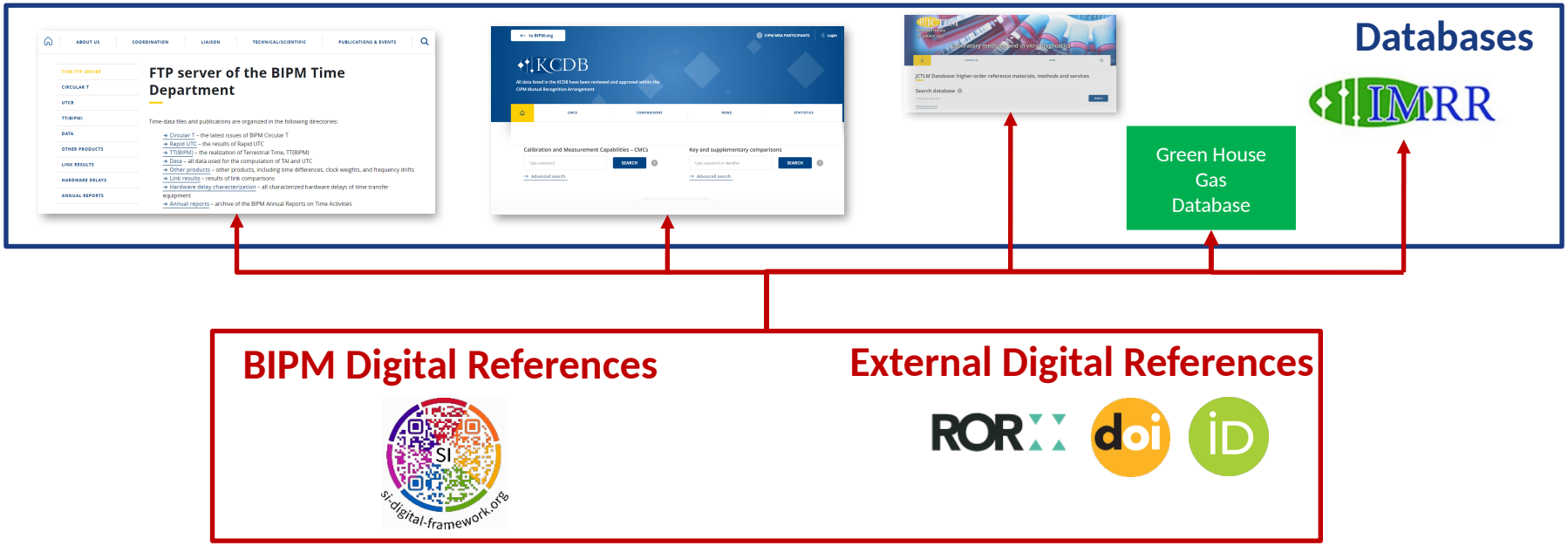


? **Persistent Identifier!**

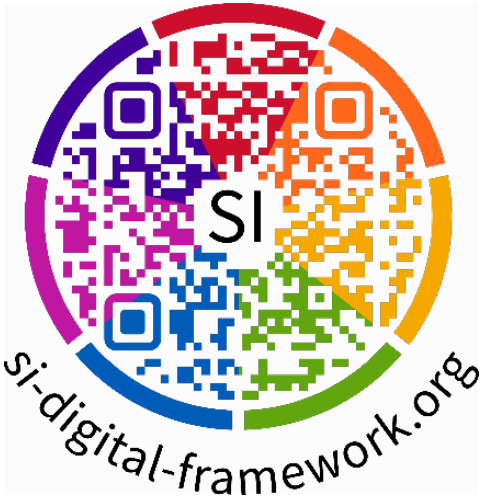


SI Digital Framework

- To provide the globally accepted anchor of trust for metrology in the digital era
- Facilitate the use of digital certificates and the adoption of the FAIR principles



BIPM Digital References



Version 1.0: Beta Testing

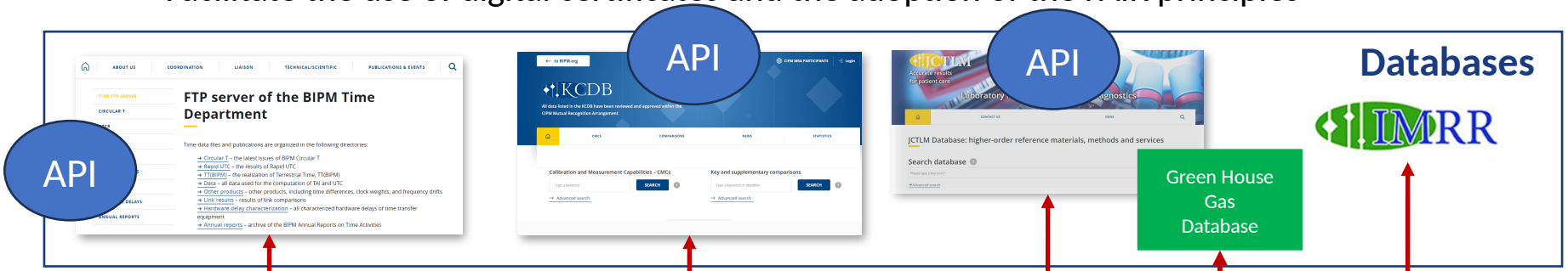
- Units
- Prefixes
- Defining constants
- Quantities - used in the SI Brochure
- Decisions

- CMCs
- Measurement service categories

  for Physics (exc RI)

SI Digital Framework

- To provide the globally accepted anchor of trust for metrology in the digital era
- Facilitate the use of digital certificates and the adoption of the FAIR principles



BIPM Digital References

si-digital-framework.org

External Digital References

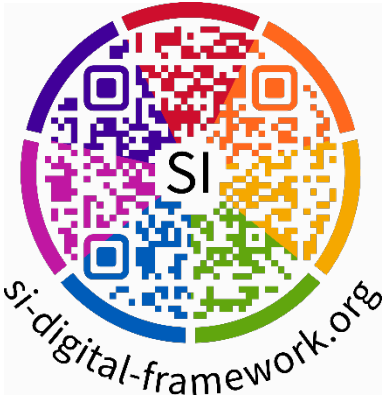
ROR doi iD

NMI services

- Digital Certificate
- Service Catalogue
- Database
- .....

At the BIPM we are -

- supporting open data practices by providing digital reference points and machine-accessible data,
- providing the anchor of trust for metrology data.

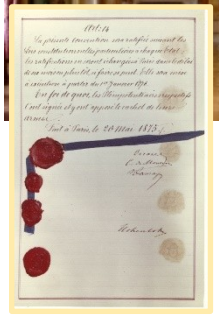


The BIPM


CENTRE for COLLABORATION
ADVOCACY
BIPM
COORDINATION
64 Member States
36 Associates of the CGPM

The BIPM - Bureau international des poids et mesures

The Metre Convention was signed in Paris by 17 nations on **20 May 1875** “to assure the international unification and perfection of the metric system”



CGPM – Conférence générale des poids et mesures

Official representatives of Member States

CIPM – Comité international des poids et mesures

14 then 18 members all from different nationalities and elected by the CGPM.

Headquarters (Scientific and technical secretariat, Sèvres, France)

1875

17 Member States

14 CIPM Members

Director + 2 Assistants

2024

64 Member States

18 CIPM Members

Director + 70 staff

Members and Associates (May 2023)

- 64 Member States* and
- 36 Associates of the CGPM
  (States and Economies)

** The official term is "States Parties to the Metre Convention"; the term "Member States" is its synonym and used for easy reference.*

251 Institutes participating in the CIPM MRA

- 97 National Metrology Institutes + 3 Ministries
  - *64 Member States*
  - *36 Associates*
- 4 International organizations
  (ESA, IAEA, JRC, WMO)

1 825 comparisons
1152 KCs, 673 SCs

25 863 CMCs
Peer-reviewed declarations

Members and Associates *(May 2023)*

Reconnaissance mutuelle
des étalons nationaux de mesure
et des certificats d'étalonnage et de mesurage
émis par les laboratoires nationaux de métrologie
Paris, le 14 octobre 1999
Supplément technique révisé en octobre 2003 (pages 17-20)

Mutual recognition
of national measurement standards
and of calibration and measurement certificates
issued by national metrology institutes
Paris, 14 October 1999
Technical Supplement revised in October 2003 (pages 38-41)

Comité international des poids et mesures

Bureau International des poids et mesures
Organisation Intergouvernementale de la Convention du Mètre

- **64** Member States* and
- **36** Associates of the CGPM
  (States and Economies)

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  (ESA, IAEA, JRC, WMO)

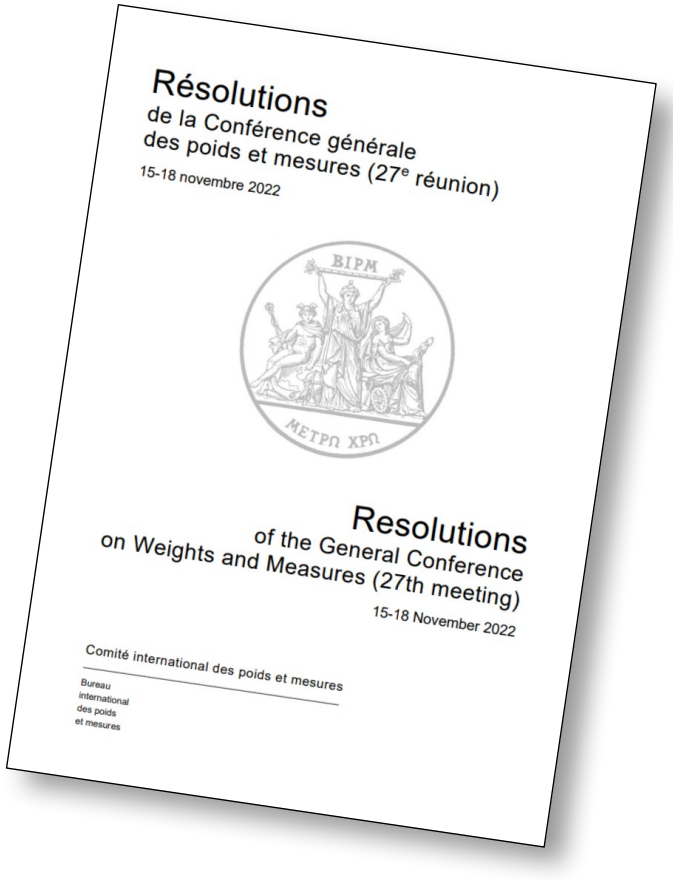
1 825 comparisons
1152 KCs, 673 SCs

25 863 CMCs
Peer-reviewed declarations

KCDB

Mandate from the 27th CGPM

Resolution 2
On the global digital transformation
and the International System of Units



See: https://www.bipm.org/en/cgpm-2022/resolution-2

Mandate from the 27th CGPM

encourages

- the CIPM to continue its outreach and engagement initiatives to ensure that the Metre Convention naturally extends its role as the globally accepted anchor of trust for metrology into the digital era,
- the CIPM to undertake the development and promotion of an SI Digital Framework, that will include the following features:
  - a globally accepted digital representation of the SI, compatible with, and useable within, digital data exchange standards and protocols, whilst maintaining compatibility with existing non-digital solutions,
  - facilitating use of digital certificates in the existing robust infrastructure for the world-wide recognition and acceptance of calibration and measurement capabilities,
  - the adoption of the FAIR principles (Findable, Accessible, Interoperable, and Reusable) for digital metrological data and metadata, ensuring that other communities recognize the critical importance of metrological traceability for measurement data, the latter being an established requisite for building trust,

Digital Transformation

One of many definitions:

Digital transformation is the **process** that an organization applies to integrate digital technology in all areas of a business, fundamentally changing how it delivers value to customers.

Digital Services in metrology:

- Facilitate measurement processes and the communication of results
- Save time and resources
- Improve quality of data due to automatic handling
- Address customers' needs
- Increase the "FAIRness" of data

Digital References

What are **digital references**?

- A persistent identifier (PI or PID) is a long-lasting reference to a document, file, web page, or other object.
- ….. you can type it into a web browser and be taken to the identified source.

Barcodes

eg DOIs

Citation S M Judge *et al* 2023 *Metrologia* **60** 012001

DOI 10.1088/1681-7575/aca67a

10.1088/1681-7575/aca67a

QR codes

eg ORCID iDs

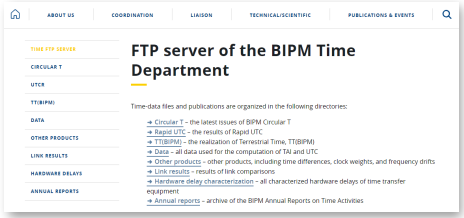
Olav Werhahn https://orcid.org/0000-0002-2317-3436

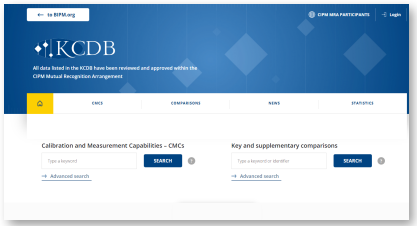
Chingis Kuanbayev https://orcid.org/0009-0004-0902-417X

0009-0004-0902-417X

SI Digital Framework

- To provide the globally accepted anchor of trust for metrology in the digital era
- Facilitate the use of digital certificates and the adoption of the FAIR principles



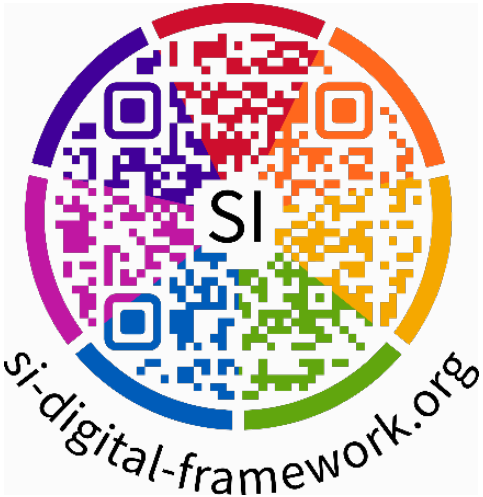


Green House Gas Data Base

Databases

IMRR

BIPM Digital References



Version 1.0: Beta Testing

- Units
- Prefixes
- Defining constants
- Quantities - used in the SI Brochure
- Decisions

The SI Reference Point

https://si-digital-framework.org/ : the root URI and web endpoint

https://github.com/TheBIPM/SI_Digital_Framework : public github repository where files and documentation are available, and issues can be raised.

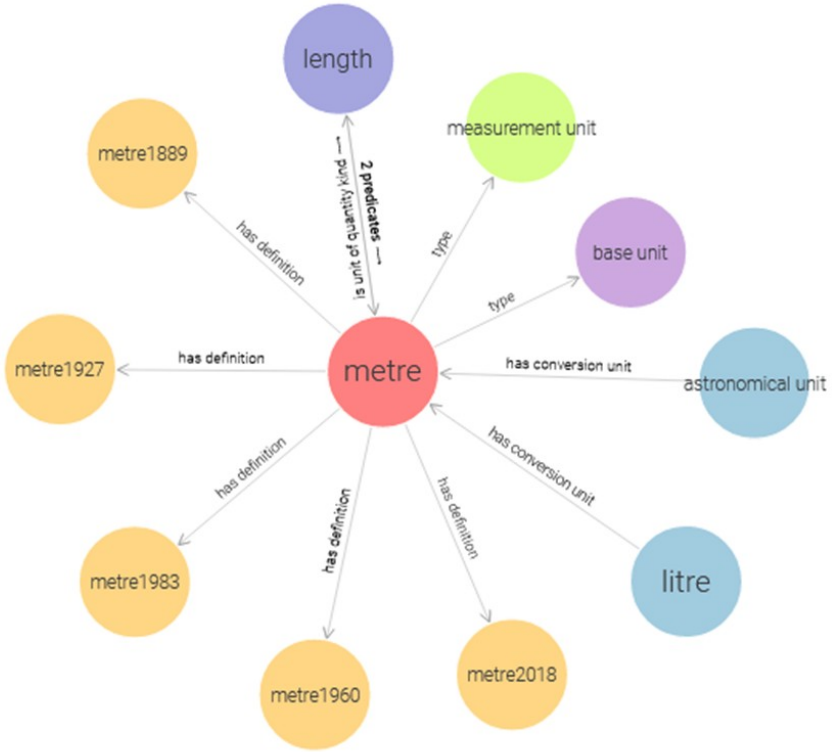
Current version : 1.0beta, **comments and feedback welcome**.

Thanks to

Janet Miles (BIPM), A. Ben Abdallah (web dev), S. Chalk (UNF), G. Dudle (METAS, now OST), M. Gruber (PTB), J.-L. Hippolyte (NPL), F. Meynadier (BIPM)

BIPM

SI Reference Point



Knowledge Graph:
Makes the information for a machine visible for a human

Bureau International des Poids et Mesures

SI DIGITAL FRAMEWORK

Digital references for FAIR measurement data

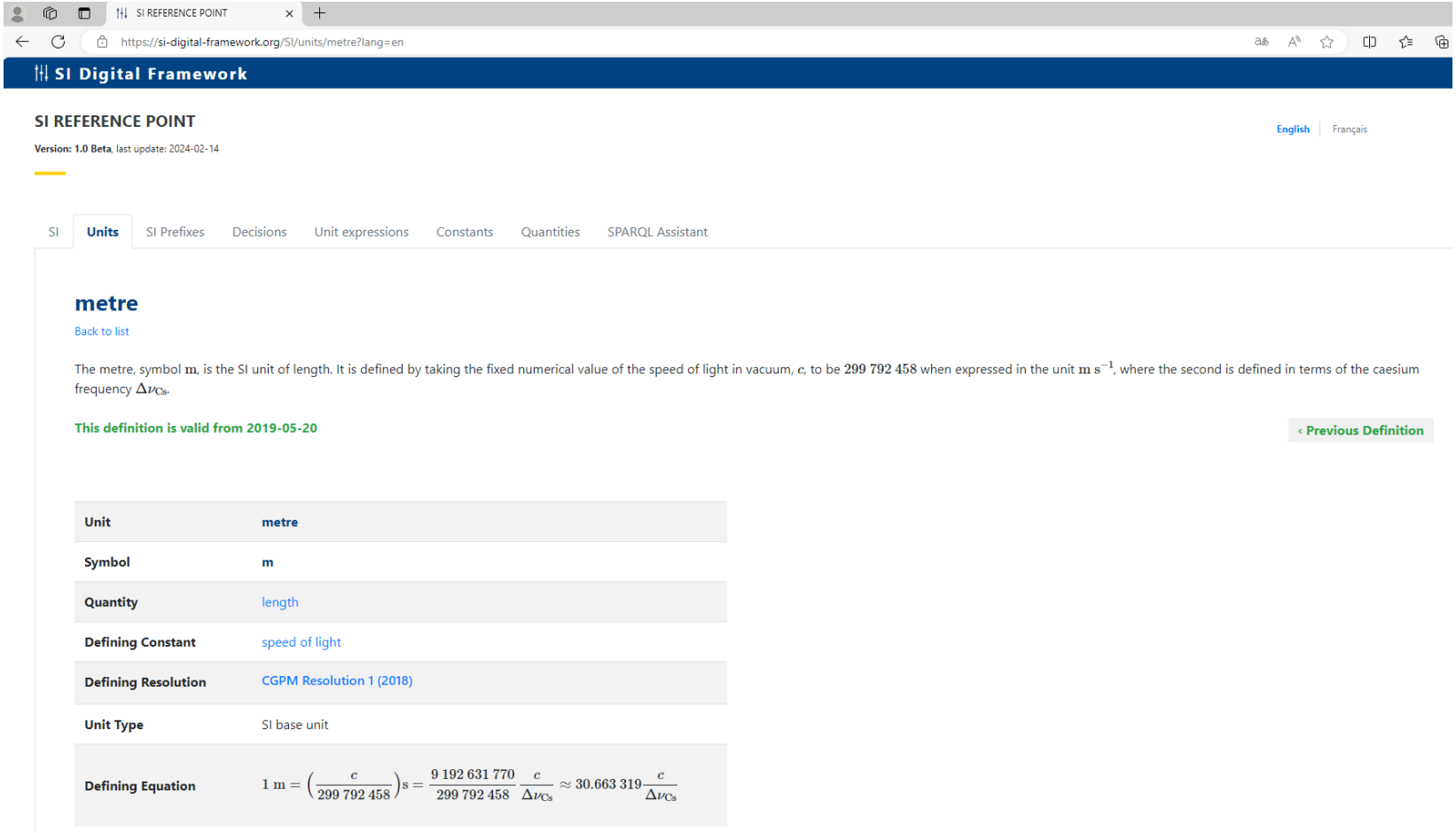
SI Reference Point

English | Français

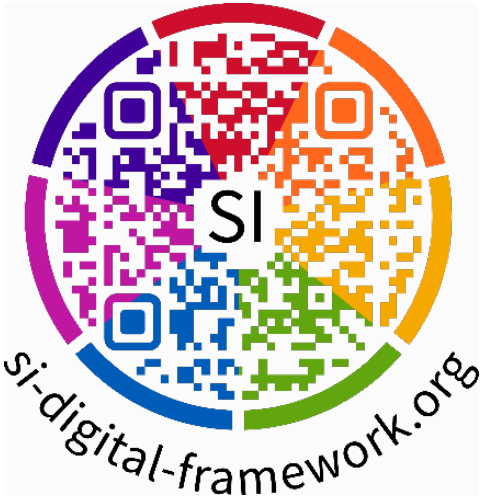
This service constitutes the authoritative digital reference for the International System of Units (SI). It provides Permanent Digital Identifiers (PIDs) for the named SI units, SI prefixes, and defining constants, and a parsing tool to provide the PID and semantic model for compound units.

- **SI Reference Point**

- Units Lists the named SI units
- Prefixes Lists the SI prefixes
- Defining Constants Returns the defining constants of the SI
- Decisions Returns the decisions of the CGPM and the CIPM bearing directly upon definitions of the units of the SI, prefixes defined for use as part of the SI, and conventions for the writing of unit symbols and numbers.


SI REFERENCE POINT
https://si-digital-framework.org/SI/units/metre?lang=en
SI Digital Framework
SI REFERENCE POINT
Version: 1.0 Beta, last update: 2024-02-14
English | Français
SI
Units
SI Prefixes
Decisions
Unit expressions
Constants
Quantities
SPARQL Assistant
metre
Back to list
The metre, symbol m, is the SI unit of length. It is defined by taking the fixed numerical value of the speed of light in vacuum, c, to be 299 792 458 when expressed in the unit m s−1, where the second is defined in terms of the caesium frequency ΔνCs.
This definition is valid from 2019-05-20
‹ Previous Definition
Unit
metre
Symbol
m
Quantity
length
Defining Constant
speed of light
Defining Resolution
CGPM Resolution 1 (2018)
Unit Type
SI base unit
Defining Equation
1 m = (c / 299 792 458) s = (9 192 631 770 / 299 792 458) c / ΔνCs ≈ 30.663 319 c / ΔνCs

BIPM Digital References

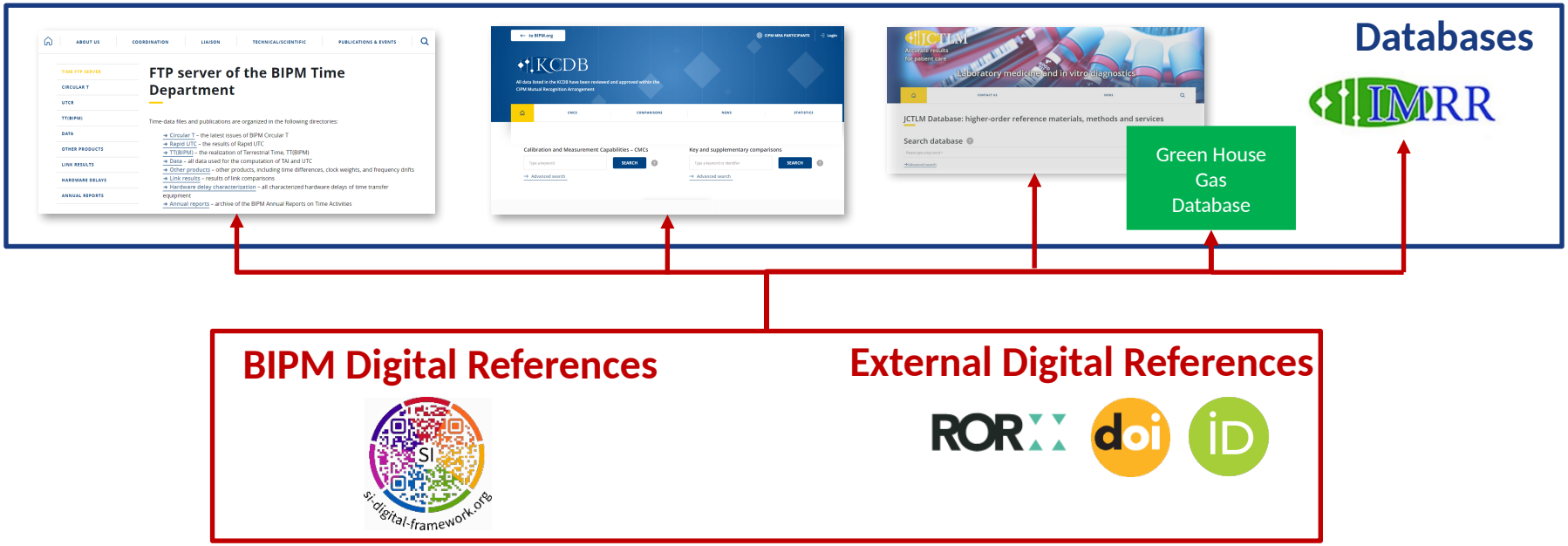


Under Development

- Measurement service categories for RI and Chemistry
- NMIs/DIs
- Quantities – used in the KCDB
- Fundamental constants…

SI Digital Framework

- To provide the globally accepted anchor of trust for metrology in the digital era
- Facilitate the use of digital certificates and the adoption of the FAIR principles



SI Digital Framework

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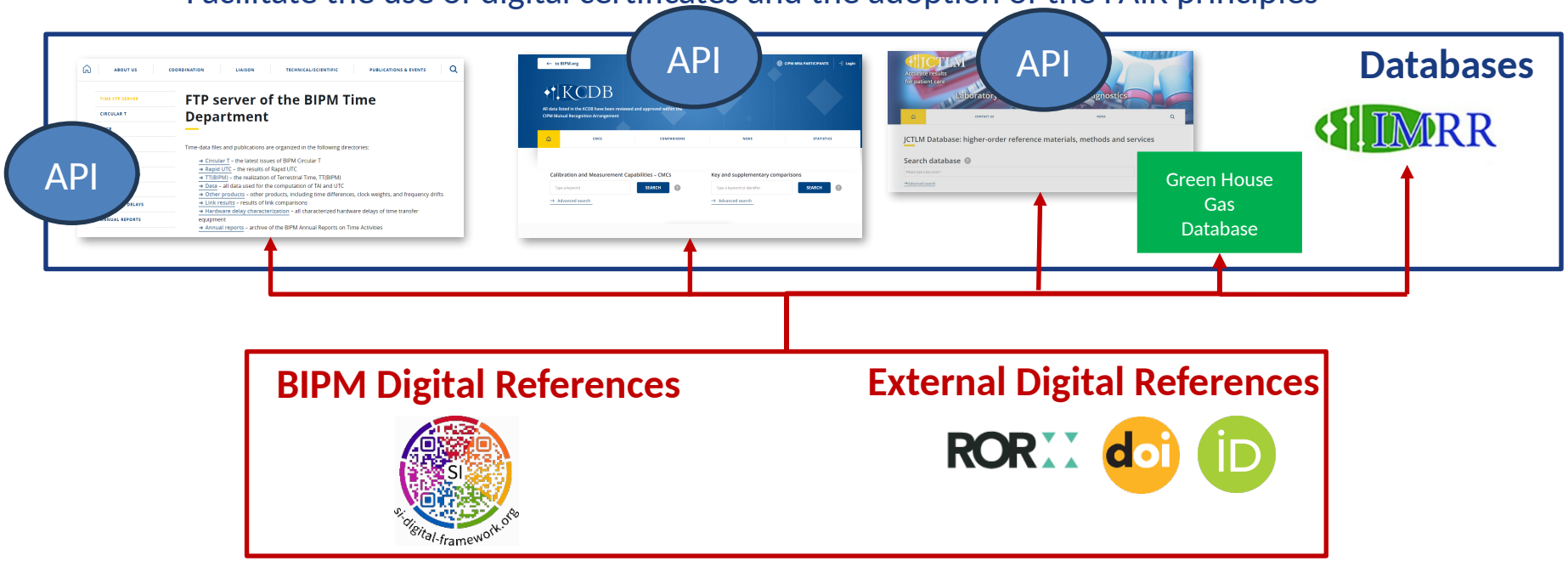


API Application Programming Interface: access for software developer

In practice: What to do first?

Start introducing Digital Identifiers whenever they're available!

Examples of Digital Identifiers:

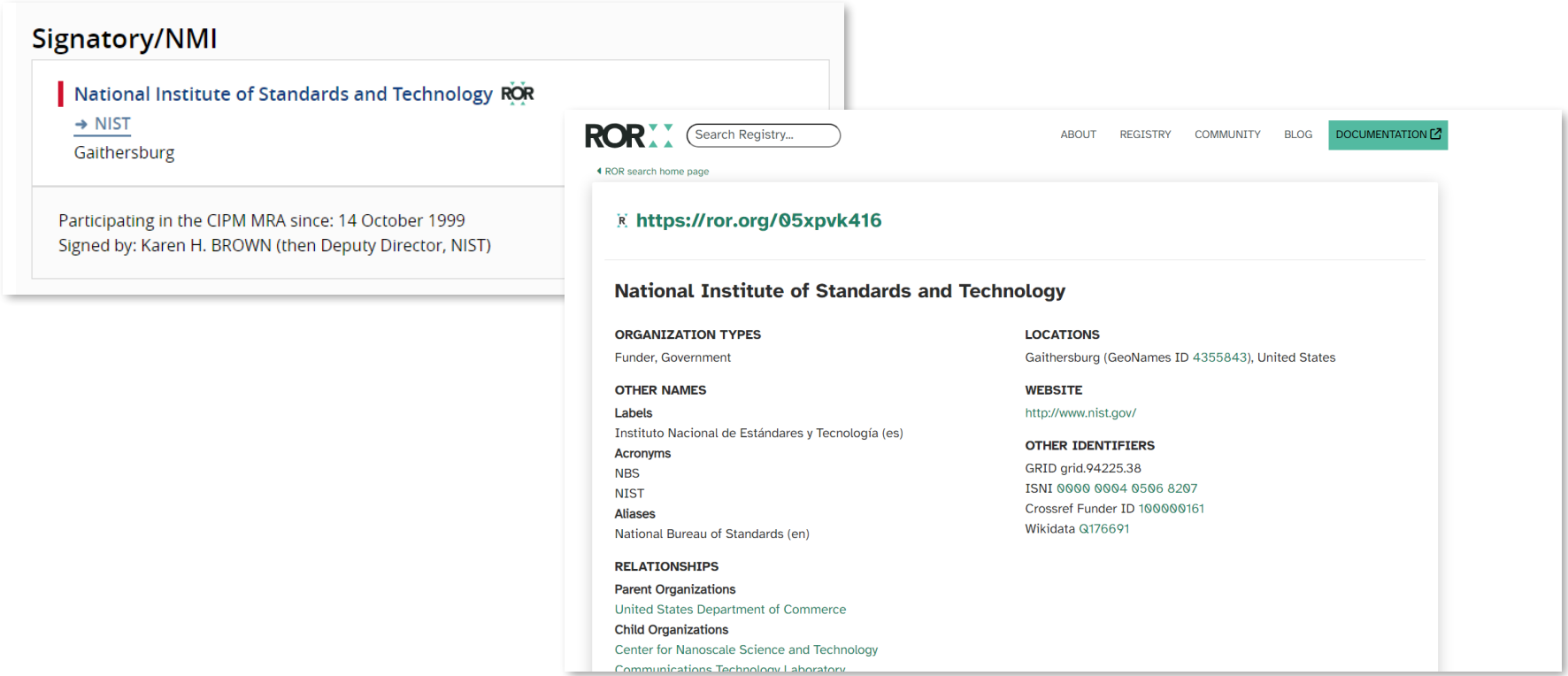
Three Digital IDs you can introduce today (whether or not you have a digital programme in place):

1. For your institute (see the BIPM website!)
2. For your institute's service categories
3. For your CMCs

What are the advantages?

- Improve the FAIRness of your output
- Identify your institute/services in a machine-friendly way: certificates, data, publications
- Be ready for the machine-readable version of the KCDB

Digital Identifiers for your Institute

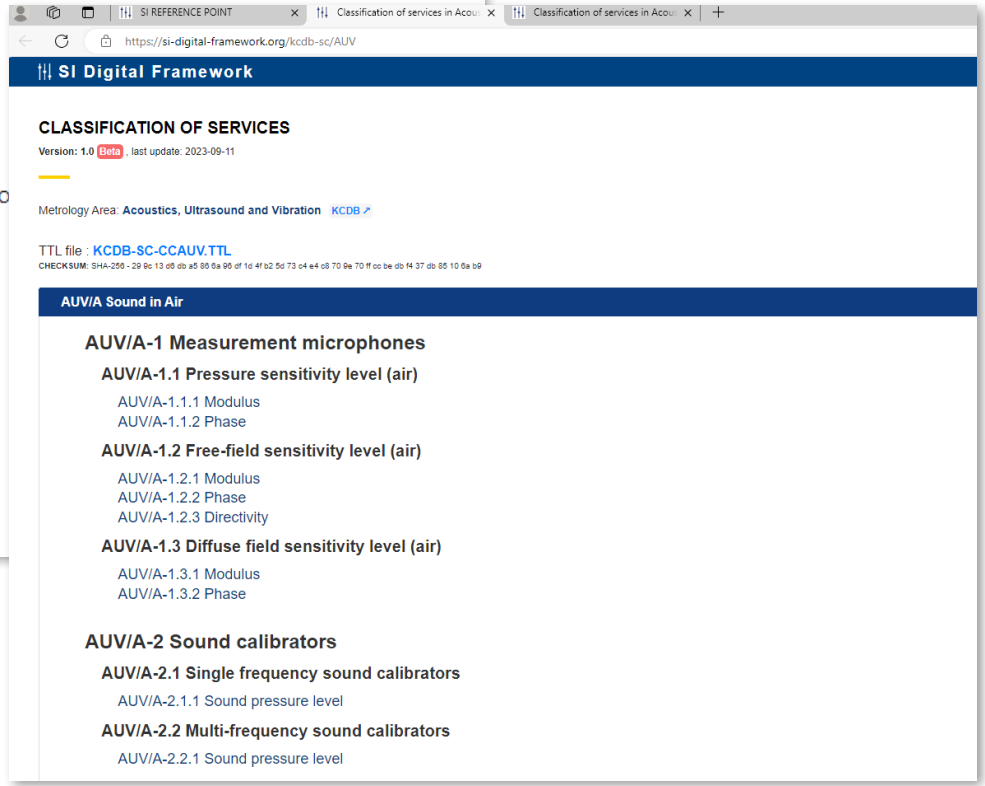


Digital Identifiers for your Service Categories

KCDB Service Categories

This service provides information about CMC service catego

- **AUV** Acoustics, Ultrasound and Vibration
- **EM** Electricity and Magnetism
- **L** Length
- **M** Mass and Related Quantities
- **PR** Photometry and Radiometry
- **T** Thermometry
- **TF** Time and Frequency



New digital reference available for all CMCs

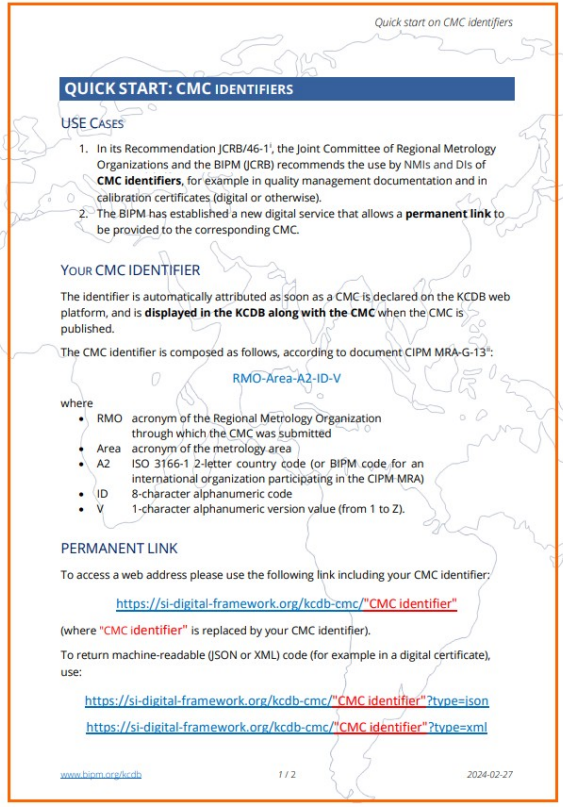
Recommendation JCRB/46-1 (2023) *Noting the availability in the KCDB of a unique and persistent identifier for each CMC (and each version of a CMC), the JCRB recommends the use of these CMC identifiers by the participating NMIs/DIs (for example in their quality documentation) and asks the BIPM Headquarters to make available appropriate training material to encourage this.*

It is thus possible for users to incorporate these unique identifiers when required, for example in quality documentation or calibration certificates to establish a machine-readable link to the KCDB.

A **Quick Start Document** on using Unique CMC Identifiers is available on the KCDB help page.

The BIPM is developing an Application Programming Interface to facilitate the retrieval of CMC records for a specific identifier. This new service will be made available in the near future.

Quick Start: CMC Identifiers



Quick start on CMC identifiers

QUICK START: CMC IDENTIFIERS

USE CASES

1. In its Recommendation JCRB/46-1[1], the Joint Committee of Regional Metrology Organizations and the BIPM (JCRB) recommends the use by NMIs and DIs of **CMC identifiers**, for example in quality management documentation and in calibration certificates (digital or otherwise).
2. The BIPM has established a new digital service that allows a **permanent link** to be provided to the corresponding CMC.

YOUR CMC IDENTIFIER

The identifier is automatically attributed as soon as a CMC is declared on the KCDB web platform, and is **displayed in the KCDB along with the CMC** when the CMC is published.

The CMC identifier is composed as follows, according to document CIPM MRA-G-13[2]:

RMO-Area-A2-ID-V

where

- RMO acronym of the Regional Metrology Organization through which the CMC was submitted
- Area acronym of the metrology area
- A2 ISO 3166-1 2-letter country code (or BIPM code for an international organization participating in the CIPM MRA)
- ID 8-character alphanumeric code
- V 1-character alphanumeric version value (from 1 to Z).

PERMANENT LINK

To access a web address please use the following link including your CMC identifier:

https://si-digital-framework.org/kcdb-cmc/"CMC identifier"

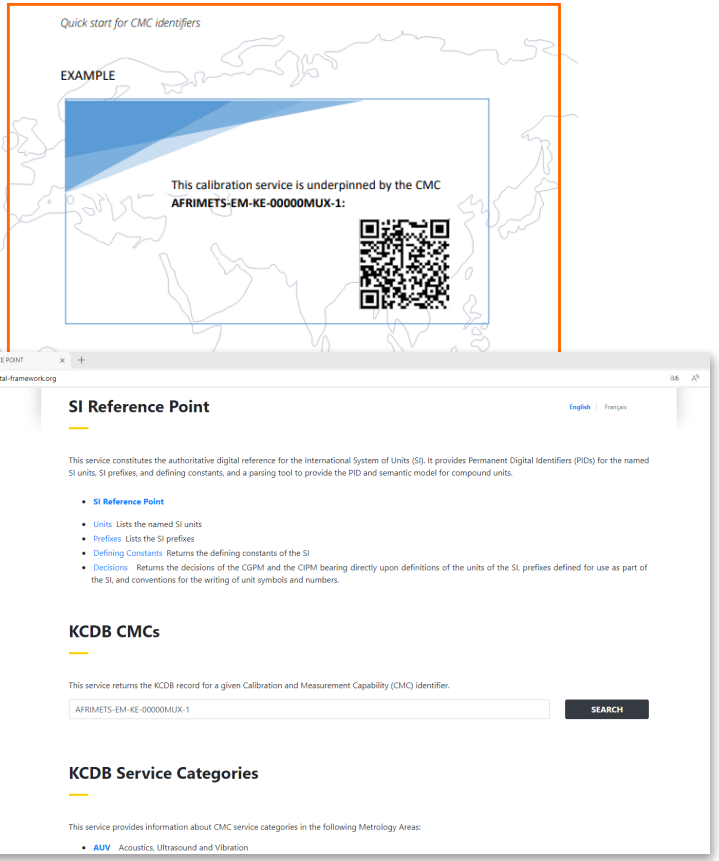
(where "CMC identifier" is replaced by your CMC identifier).

To return machine-readable (JSON or XML) code (for example in a digital certificate), use:

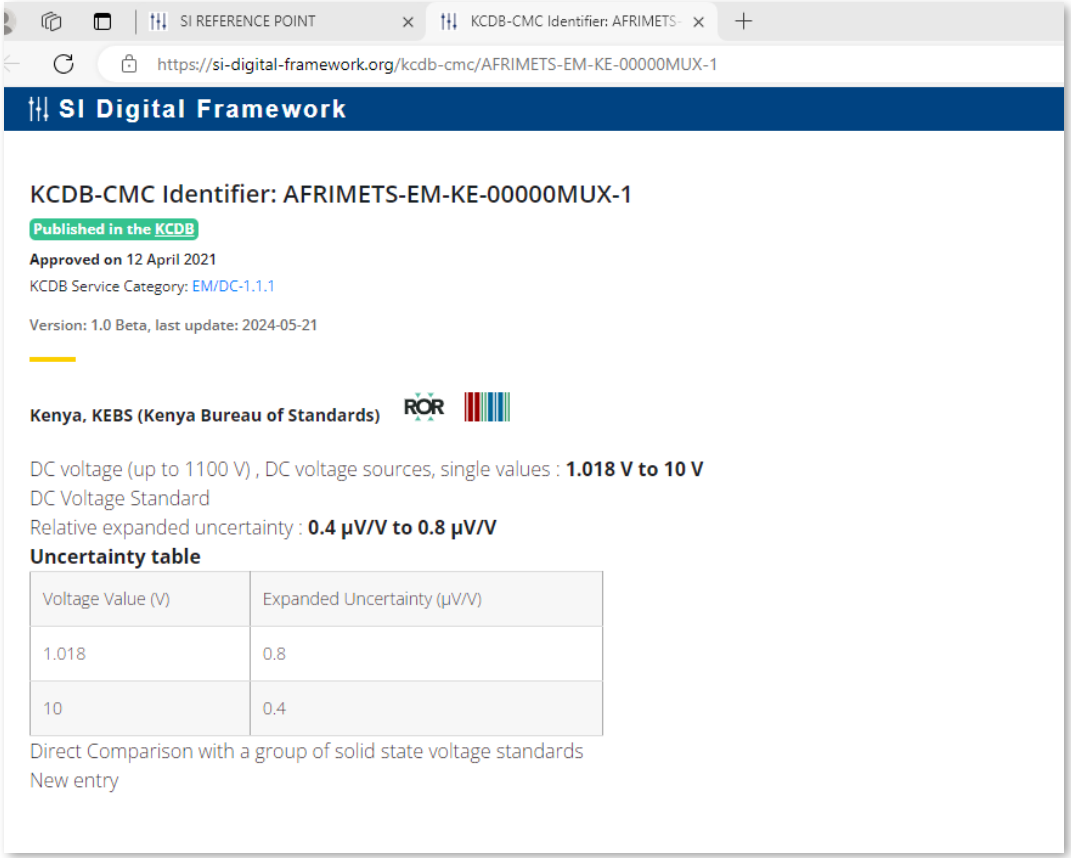
https://si-digital-framework.org/kcdb-cmc/"CMC identifier"?type=json

https://si-digital-framework.org/kcdb-cmc/"CMC identifier"?type=xml

www.bipm.org/kcdb 1 / 2 2024-02-27



CMC Identifiers



Forum on Metrology and Digitalization

First Meeting: 7/8 March 2024, at the BIPM, Sèvres/ France

Chair: Prof. C. Denz (PTB)

Vice-chairs: Ms G. Macdonald (NRC) and Dr H. Laiz (INTI)

Executive Secretary: Dr G. Panfilo (BIPM)

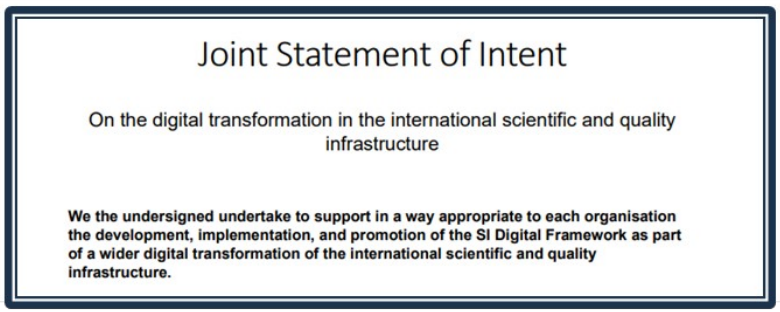
***6 Ad Hoc* Task Groups**

3 Working Groups

The Joint Statement of Intent

Digital Transformation

Joint Statement of Intent *On the digital transformation in the international scientific and quality infrastructure*



OIML · cie International Commission on Illumination · CODATA Committee on Data International Science Council · NCSL International Serving the World of Measurement · BIPM · IEC International Electrotechnical Commission · International Science Council · ilac · IMEKO · ISO

Workshop on FAIR Data and meeting: 5/6 March 2024