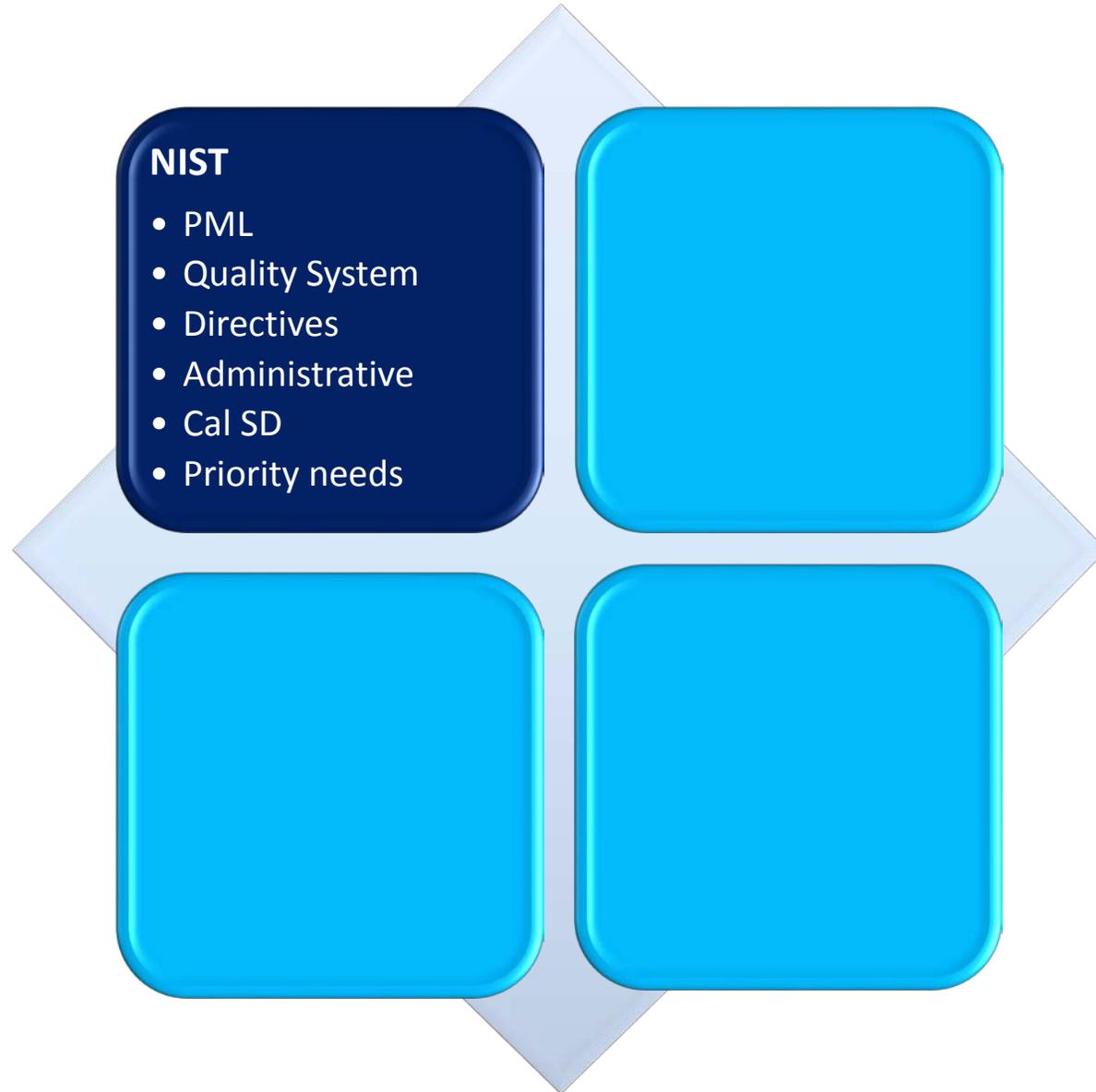


Understanding the Metrology Puzzle

Supporting Measurement Services – Calibrations



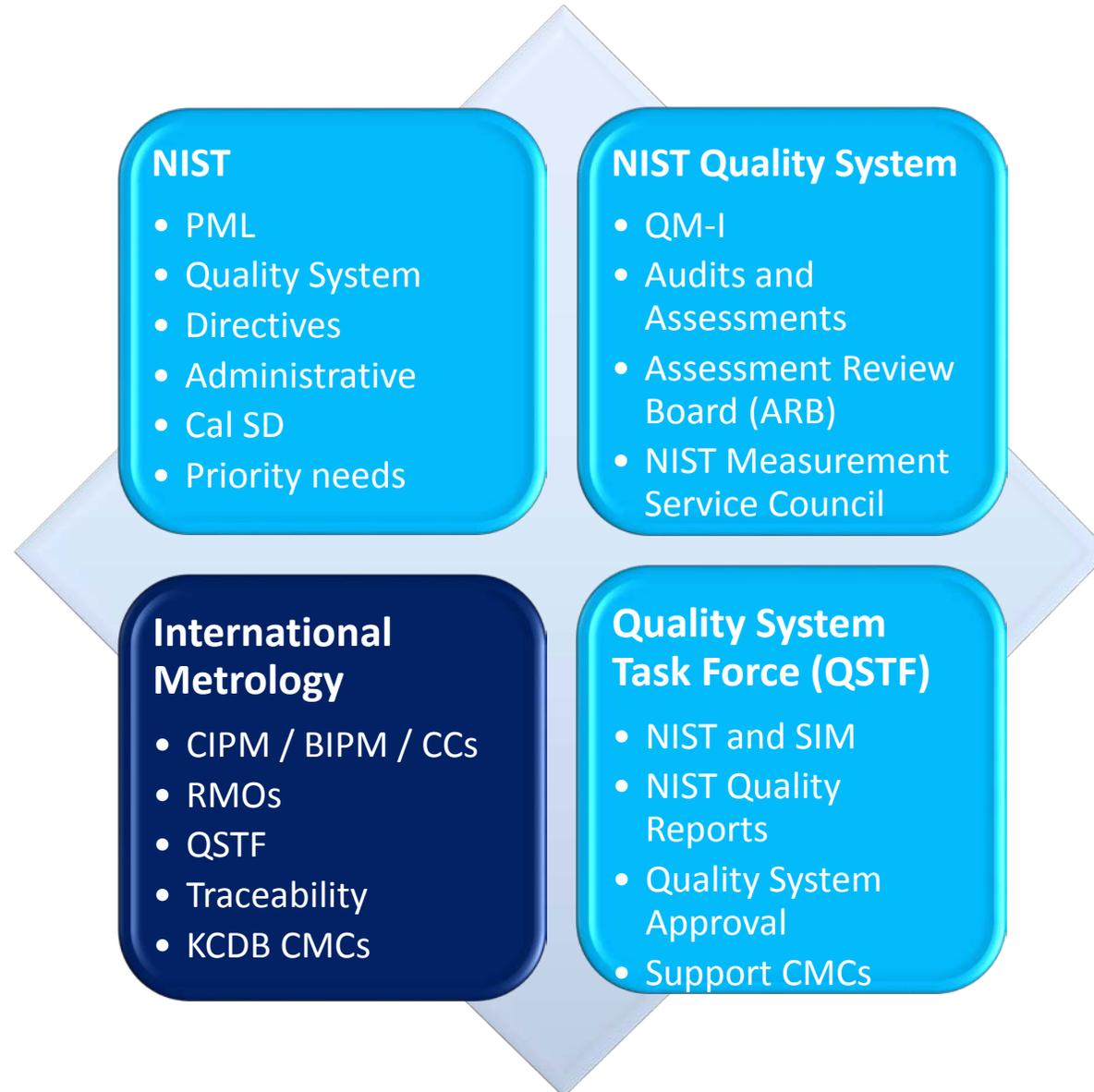
Supporting Measurement Services – Calibrations



Supporting Measurement Services – Calibrations



Supporting Measurement Services – Calibrations

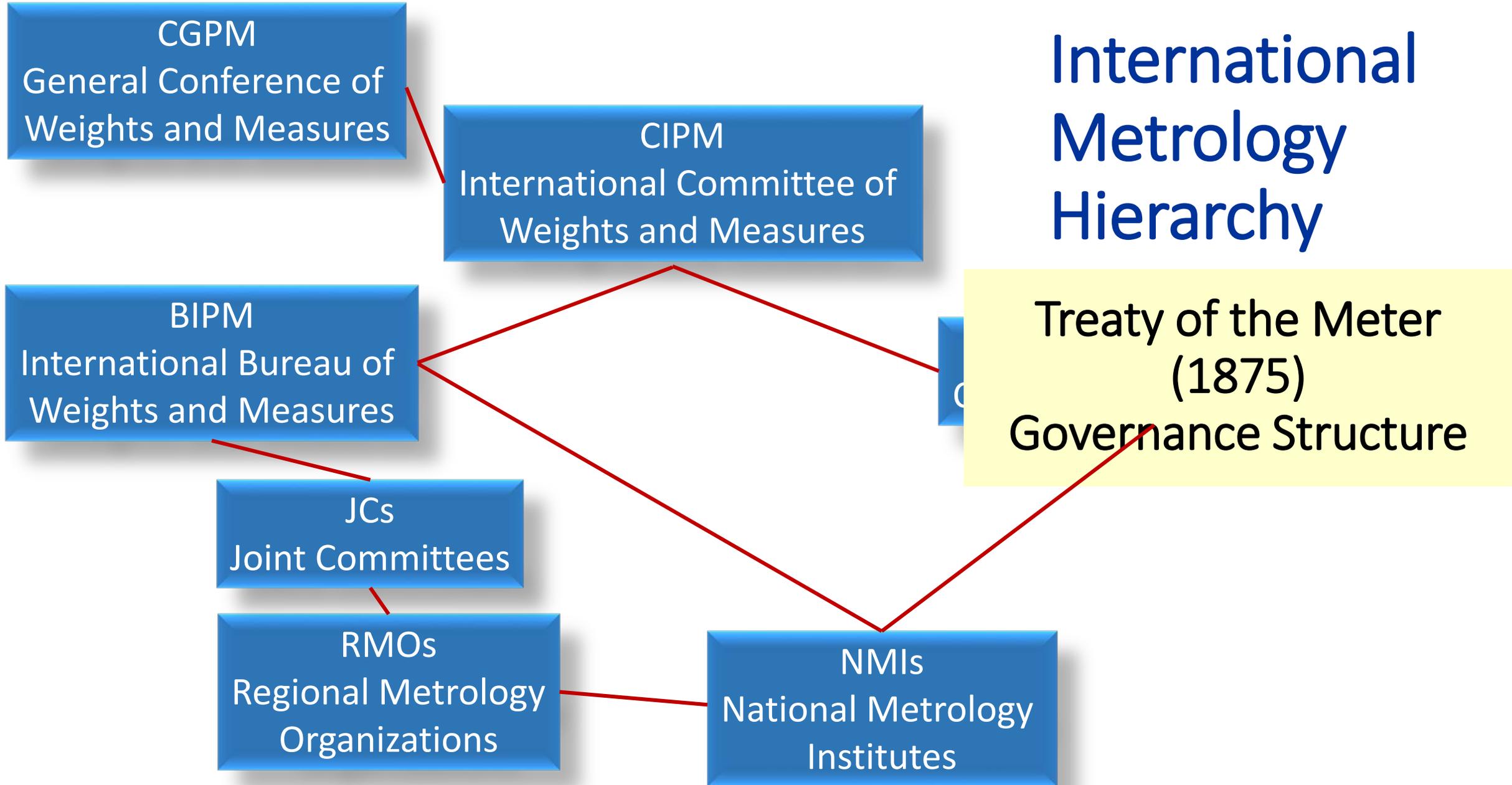


Supporting Measurement Services – Calibrations



Understanding International Metrology

International Metrology Hierarchy





CGPM General Conference of Weights and Measures



Dr. Willie May
Director of NIST
CGPM Delegate

Comprised of 57 delegates of the governments of Member States and 40 observer Associates

Responsibilities

- Examines the arrangements required to ensure the propagation and improvement of the International System of Units (SI)
- Endorses the results of new fundamental metrological determinations and various scientific resolutions of international scope
- Decides all major issues concerning the organization and development of the BIPM and the Governance of the BIPM

CIPM
International Committee of
Weights and Measures



Dr. Willie May
Director of NIST
CIPM VP

Comprised of 18 individuals elected by the CGPM

Responsibilities

- Promote world-wide uniformity in units of measurement
- Mutual Recognition Arrangement
 - Framework for NMIs to establish international equivalence and validate calibration measurement capabilities to promote global trade
- Oversees the 10 Consultative Committees for metrology areas
- Reports to the CGPM

BIPM International Bureau of Weights and Measures



BIPM

Established in 1875
after the signing of the
Treaty of the Meter

- Mission of the BIPM
 - Ensure and promote the global comparability of measurements
 - Maintain the international system of units (SI) to
 - Promote scientific discovery and innovation
 - Promote industrial manufacturing and international trade
 - Sustain the quality of life and the global environment
- Unique roles
 - Coordinate the realization and improvement of the world-wide measurement system (SI) to ensure it delivers accurate and comparable measurement results
 - To promote the importance of metrology to science, industry and society, in particular through collaboration with other intergovernmental organizations and international bodies and in international forums
- Joint Committees of the BIPM created for special metrology tasks



Doug Olson
BIPM JCRB
Executive
Secretary

JCGM: Joint Committee for Guides in Metrology (NIST Staff, $n=2$)

- Guide to the Expression of Uncertainty in Measurement (GUM)
- International Vocabulary of Basic and General Terms in Metrology (VIM)

JCRB: Joint Committee of the Regional Metrology Organizations and the BIPM (NIST staff, $n=1$)

- Coordinates the activities among the RMOs for the mutual recognition of calibration and measurement certificates according to the CIPM MRA

JCTLM: Joint Committee for Traceability in Laboratory Medicine (NIST Staff, $n=2$)

- Establishes lists of available reference materials, measurement procedures and measurement laboratories for laboratory medicine

CCs
Consultative Committees

CC	# NIST Staff	Metrology Area
AUV	1	Acoustics, Ultrasound and Vibration
EM	6	Electricity and Magnetism
L	3	Length
M	11	Mass and Related Quantities
PR	4	Photometry and Radiometry
QM	12	Amount of Substance Metrology in Chemistry and Biology
RI	6	Ionizing Radiation
T	7	Thermometry
TF	3	Time and Frequency
U	5	Units

CCs Consultative Committees

Establish Working Groups and Task Groups to

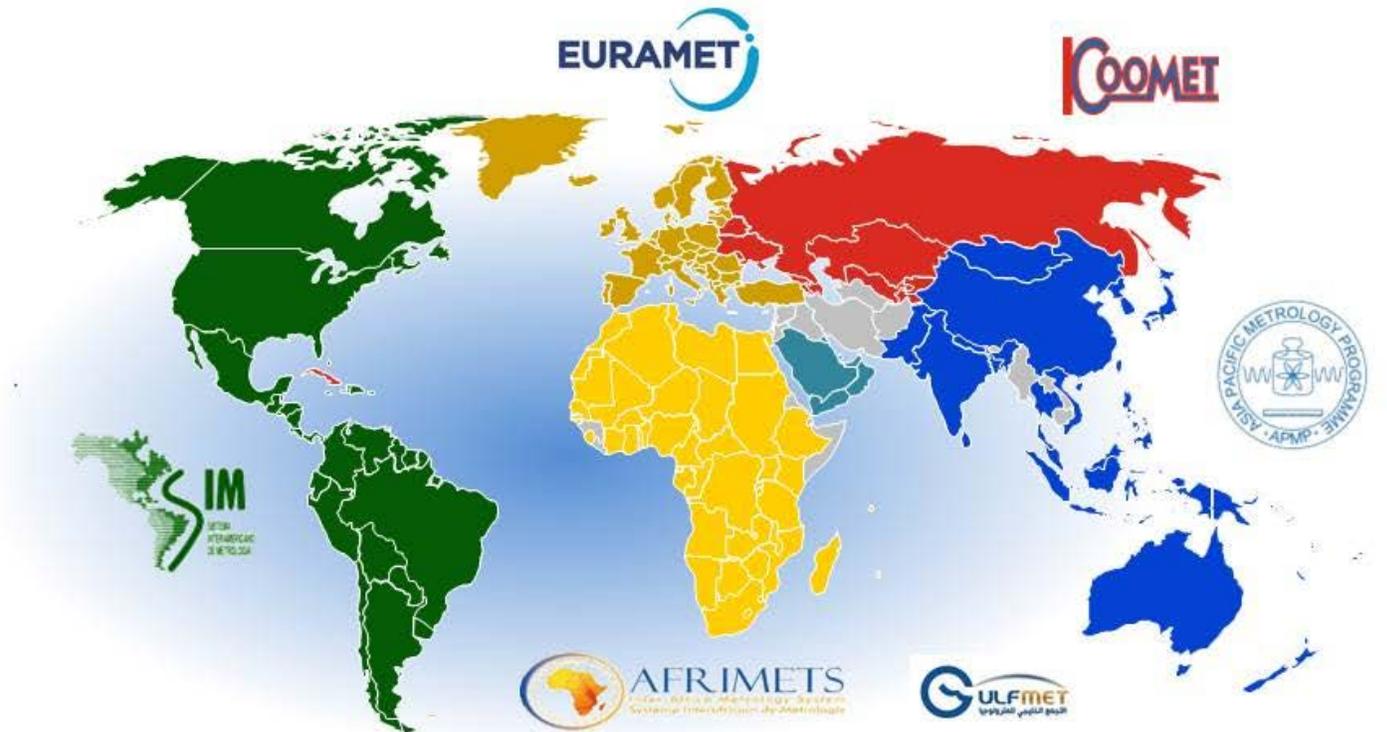
- Advise the CIPM on all scientific matters that influence metrology
- Establish global compatibility of measurements through promoting traceability to the SI or other internationally agreed references
- Contribute to the establishment of a globally recognized system of national measurement standards, methods and facilities
- Contribute to the implementation and maintenance of the CIPM MRA
 - Run BIPM Key Comparisons
 - Approve NMI Calibration and Measurement Capability Statements (CMCs)
- Act as a forum for technical exchange of information amongst NMIs
- Create opportunities for collaboration amongst NMIs

RMOs

Regional Metrology Organizations

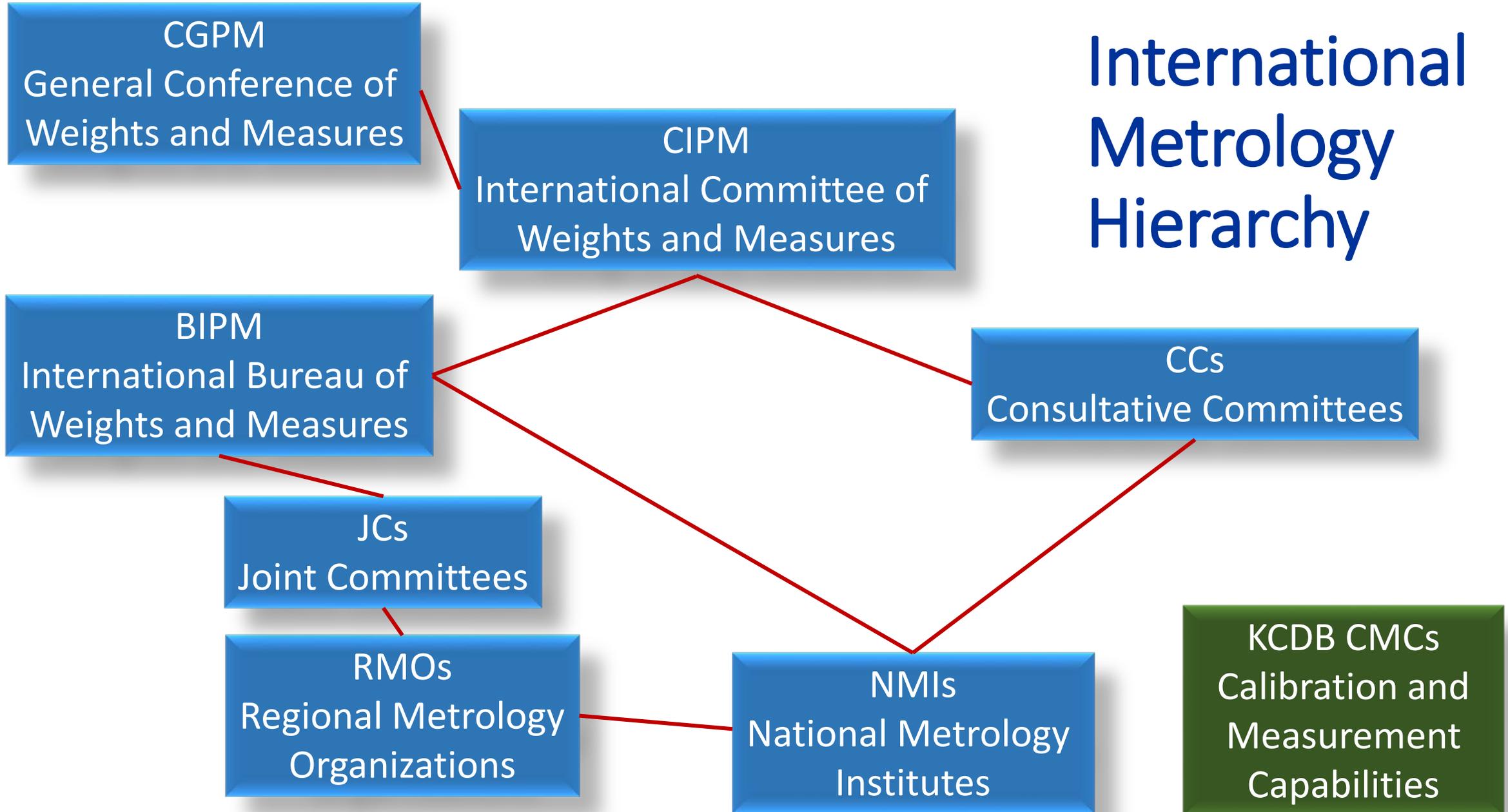
6 regional associations of national metrology institutes

- Run RMO key comparisons and supplementary comparisons to support the CIPM MRA
- Participate in the JCRB
- Validate NMI Quality Systems
- Review NMI Calibration and Measurement Capability Statements (CMCs)



Each RMO has Metrology Working Groups that mirror the CIPM Consultative Committees

International Metrology Hierarchy



Calibration and Measurement Capabilities - CMCs

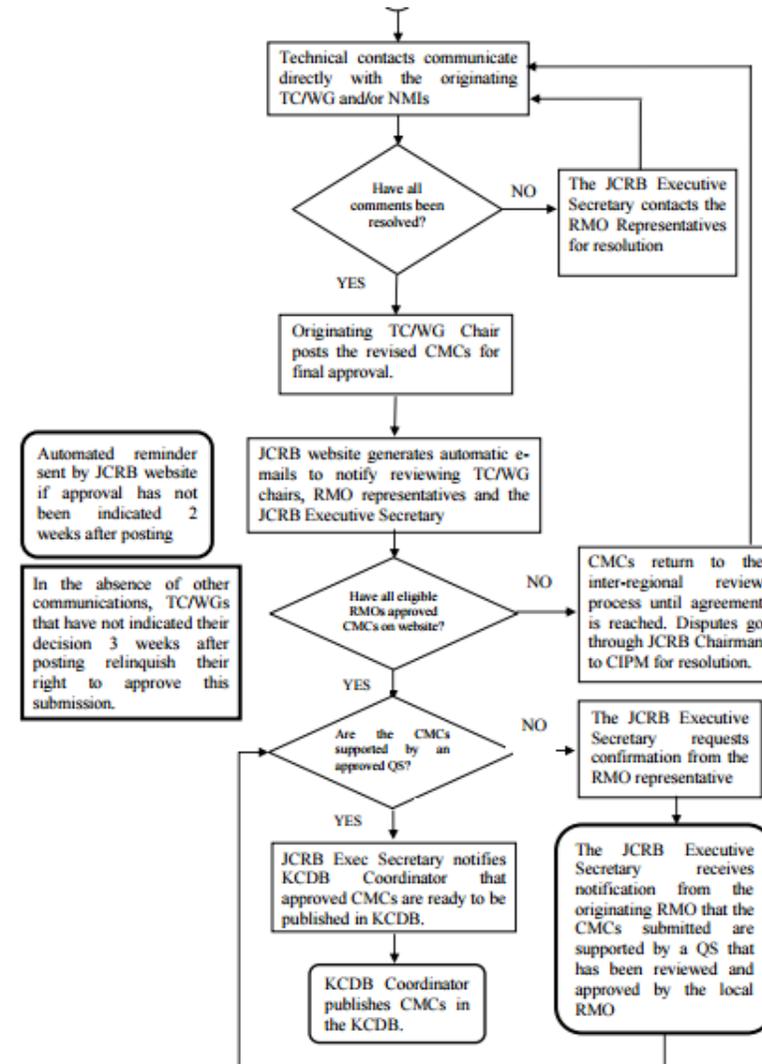
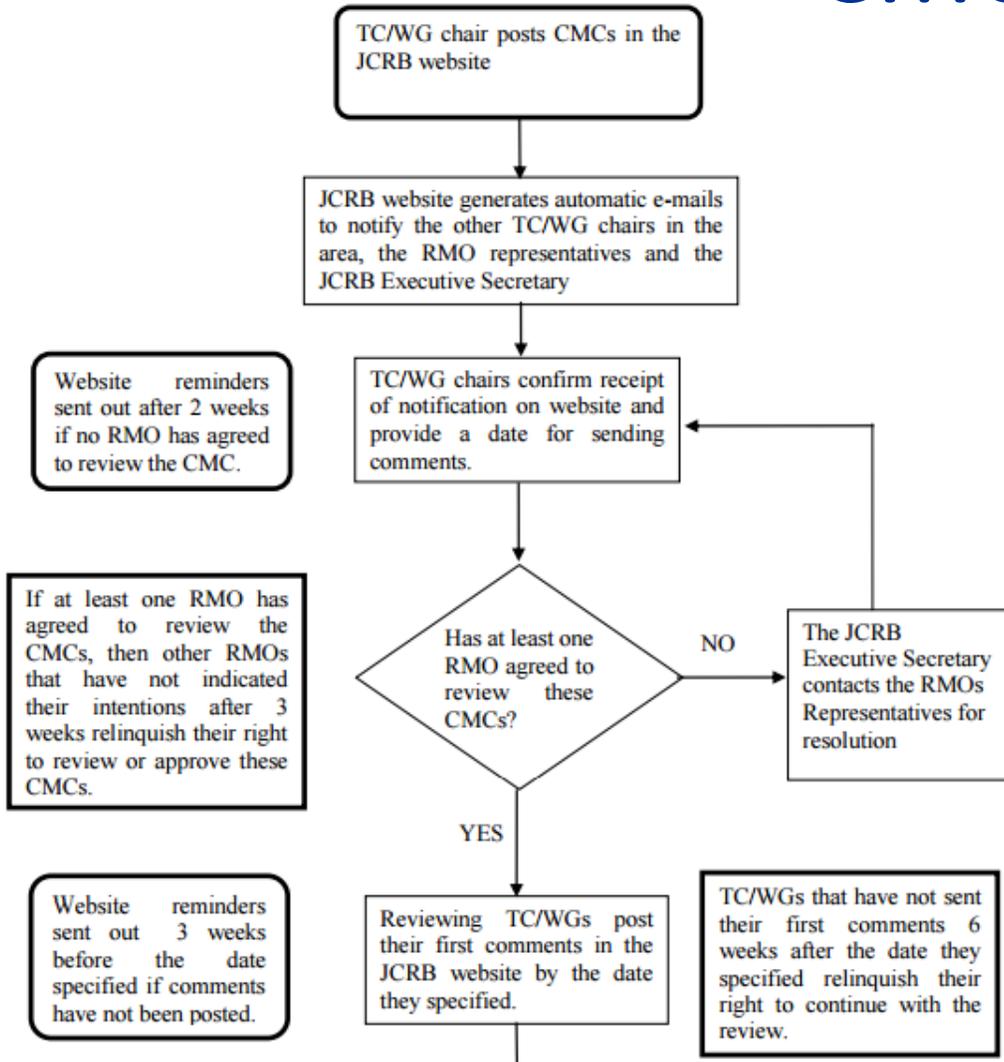
- KCDB Appendix C CMC is a calibration and measurement capability available to customers under normal conditions
 - Calibration Service
 - Measurement Range
 - Uncertainties
- Key elements leading to approval an NMI's CMCs
 - Successful participation in comparisons (e.g., BIPM Key or RMO Key)
 - Implementation and approved quality system (e.g., QSTF)
 - RMO, CC, and JCRB review and approval of claimed CMCs



Establishing Traceability – CIPM MRA D-04

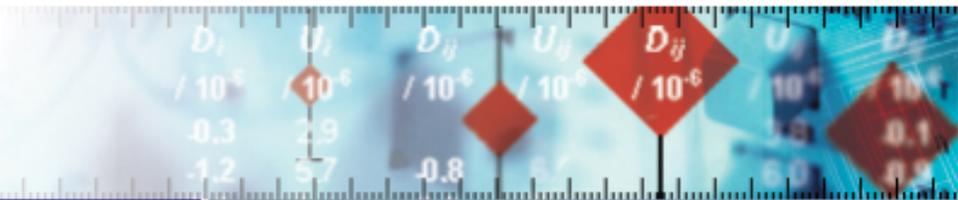
- NMI CMC traceability may be established via one of two routes
 - Primary realization or representation of the SI unit concerned, in which case traceability must be declared to its own demonstrable realization of the SI
 - Calibration provide by another NMI or DI having relevant CMCs or through calibration and measurement services offered by the BIPM

CIPM MRA-D-04 CMC Approval Process



KCDB CMCs

Bureau
International des
Poids et
Mesures



Home Key and supplementary comparisons Calibration and Measurement Capabilities - CMCs

Home > CMCs Search > **T search form**

CMCs - Search form



- ↳ Physics
 - [Acoustics, Ultrasound, Vibration](#)
 - [Electricity and Magnetism](#)
 - [Length](#)
 - [Mass and related quantities](#)
 - [Photometry and Radiometry](#)
 - [Ionizing Radiation](#)
 - **[Thermometry](#)**
 - [Time and Frequency](#)

- ↳ Chemistry
 - [Chemistry](#)

- ↳ Related links
 - [KCDB Statistics](#)
 - [KCDB FAQs](#)
 - [KCDB Reports](#)

Calibration and Measurement Capabilities Thermometry

→ [Instructions](#) → [List of services](#) 

↳ Direct access to full lists of CMCs by country as .PDF files

Country → Display .PDF file 

↳ Search the database

Branch	<input type="text" value="All"/>
Service	<input type="text" value="All"/>
Sub-service	<input type="text" value="All"/>

→ [Reset all](#) → [Search](#)

Consultative Committee Working Group - CMCs

- 2002 –JCRB created a Terms of Reference to allow Consultative Committees to create a Working Group to:
 - Establish and maintain CMC Service Category Lists
 - Coordinate and conduct the CMC review process
 - Identify future need for Key and Supplemental Comparisons
 - CC WG comprised of RMO Working Group (WG-T)
 - Each RMO representative plus a Chair

CCT CMC Submission Review Approval

NMI
CMC Submission

RMO MWG
Review and Submission

RMO QSTF
Quality System Approval

Consultative Committee
Review

JCRB Fast Track
Review and Approval

KCDB Appendix C

Streamlining the Process

Origin of CCT WG8 (WG-CMC)

- First RMO meeting occurred at the 7th Temperature Symposium in 2002
 - Attempt to understand the different ways RMOs were reviewing each other Calibration and Measurement Capability (CMC) submissions
 - Philosophical differences in implementing the MRA and JCRB directives created
 - unforeseen problems in getting Thermometry RMOs to accept each other's CMCs
 - non-harmonized service categories caused confusion of what CMCs could be submitted

CCT WG CMC Terms of Reference

Follows the spirit of the JCRB Terms of Reference

- Establish and maintain service categories
- Agree on detailed technical review criteria
- Coordinate / conduct reviews of RMO submitted CMCs for Appendix C
- Provide guidance on the range of CMCs supported by key comparisons
- Examine the sufficiency of existing comparisons for supporting CMCs and recommend new comparisons
- Coordinate the review of existing CMCs based on new results of comparisons

CMC Service Categories – Temperature and Humidity

- Service Category List divided into 3 main parts
 - Temperature
 - Humidity
 - Thermophysical Quantities
- Using the Service Category List
 - NMI
 - Identify which service category to apply to each submitted CMC
 - RMO WG
 - Identify which review protocol is needed to review their NMI's submitted CMCs
 - CCT WG
 - Identify which review protocols are needed
 - Identify Key and Supplemental Comparison needs
 - JCRB / BIPM
 - Classify accepted CMCs for entry into Appendix C of the BIPM KCDB

CCT WG CMC Review Protocols

- Harmonized CMC submission, review and acceptance process
- Designed to be scientifically based
 - Remove political discussions
- Uniformly applied across the RMOs
- Publicly available
- Key Elements
 - Agreed cutoff criterion based on literature uncertainty values
 - Specific list of evidence items required for acceptance
 - How a comparison is used to review a CMC
 - Level of scrutiny increases as uncertainty values decrease
 - NMI submitting a CMC must be an MRA signatory and their Quality System accepted by their RMO
 - NMI participation in Key and Supplemental Comparisons

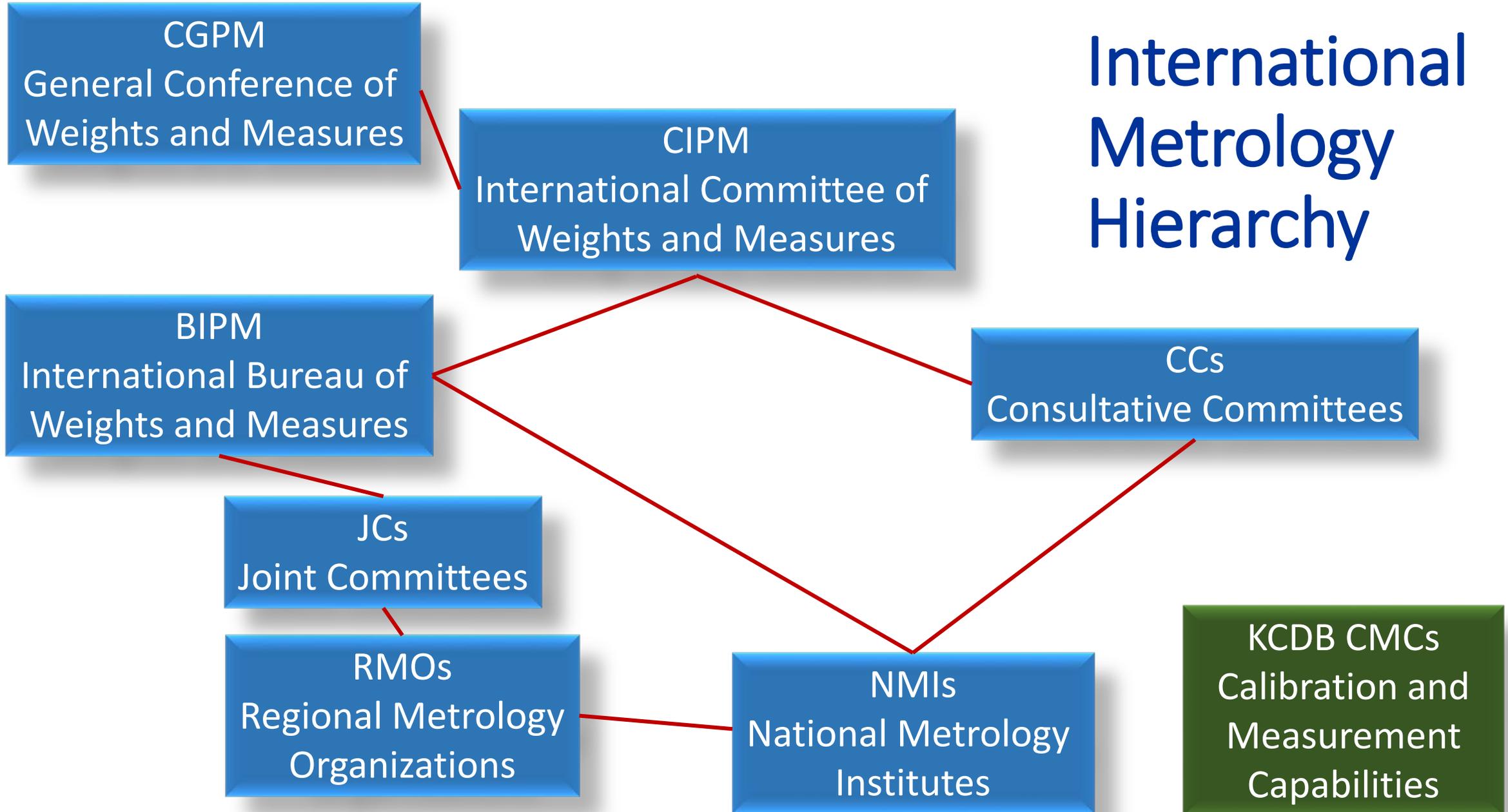
CCT WG CMC Review Protocols

Temperature scales and the kelvin	Future redefinition of the SI	Guides to Thermometry	CIPM MRA – CMCs and KCs
Meeting reports	Strategy document	Member bibliographies	CCT

Guidance documents:

-  Classification of services in T 
-  CMC Review Protocol: TPW
-  CMC Review Protocol: Radiation Thermometry
-  CMC Review Protocol: ITS-90 SPRT Subrange
-  CMC Review Protocol: Calibration of fixed point cells (excluding the TPW) and calibration of SPRTs at fixed points
-  CMC Review Protocol: Calibration of industrial thermometers
-  CMC Review Protocol: Humidity
-  CMC Review protocol: Calibration of high-temperature fixed points
-  CMC Review Protocol: Humidity generators
-  CMC Review Protocol: Relative humidity
-  Registration and progress report form for KCs and SCs
-  Publication of a Final Report in *Metrologia's Technical Supplement*
(please save to your computer and complete locally)

International Metrology Hierarchy





NIST Assessment Review Board (ARB)

- Reviews assessment and audit outcomes
 - Harmonization
 - Ensure non-conformities are adequately resolved
 - Arbitration – resolves disputes
- QM-I
 - Interpretation
 - Review
 - Corrective changes
- QSTF
 - ARB approval of Division Quality System required prior to QSTF meeting
 - Dry runs for NIST Quality Manager