The Digital SI meta-data format

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Digital processes in the quality infrastructure: the digital calibration certificate contribution
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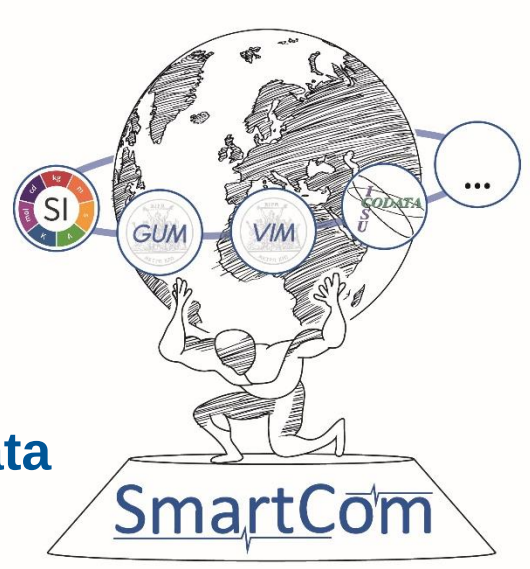
Why is it needed?

- More and more measurement data is being captured, transmitted and processed
  - Data from different sources being combined to inform decision making
- Degree of human interaction with data is decreasing
  - Automation of measurement processes, AI, etc.
- It is imperative that data can be interpreted correctly
  - Interpretation must not rely on assumptions, e.g., of unit of measurement
  - Data must not be ambiguous
- Ensures a consistent approach may be applied to all metrology domains and enhances the reporting of measurement information

What are its key requirements?

- Treat all common types of measurement data
  - Real, complex, univariate, multivariate, etc.
- Ensure that unit of measurement is always provided
- Allow uncertainty information to be provided
  - Expanded uncertainty, coverage interval, covariance matrix, coverage regions
- Alignment with key metrology documents and standards
  - VIM, GUM and its supplements, BIPM SI brochure, etc.
- **Facilitate ease of use and trustworthiness of measurement data**



How can it be implemented?

- Easiest to think about a single real quantity…

- What information must be representable?
  - Quantity value
  - Unit of measurement
  - Uncertainty information
    - Expanded uncertainty
    - Coverage interval
  - Label (optional)
  - Date and time of measurement (optional)

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- What information must be representable?
  - **Quantity value**
  - Unit of measurement
  - Uncertainty information
    - Expanded uncertainty
    - Coverage interval
  - Label (optional)
  - Date and time of measurement (optional)

Decimal point as separator

IEEE 754

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Base units, derived units, non-SI units accepted for use with the SI
Decimal multiples
Powers of units
BIPM SI brochure
LaTeX package siunitx

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Standard uncertainty
Lower limit of interval
Upper limit of interval
Coverage probability
Inherited unit
GUM

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UFT-8 character string

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ISO 8601

How can it be implemented?

- XML used within SmartCom but use of alternative languages such as JSON is equally valid

- Example: Single real quantity with coverage interval

```
<si:real>
  <si:value>838</si:value>
  <si:unit>\nano\metre</si:unit>
  <si:coverageInterval>
    <si:standardUnc>36</si:standardUnc>
    <si:intervalMin>745</si:intervalMin>
    <si:intervalMax>932</si:intervalMax>
    <si:coverageProbability>0.99</si:coverageProbability>
  </si:coverageInterval>
</si:real>
```

How can it be implemented?

- Single complex quantity
  - Real and imaginary parts or magnitude and phase
  - Uncertainty information represented by covariance matrix
  - Coverage region (rectangular, ellipsoidal)

- Multivariate quantities
  - “List” structure
  - Same measurement unit for all quantities?
  - Same uncertainty value for all quantities

- Quantities that use unconventional units
  - “Hybrid structure”
  - Represented using both non-SI and SI units

Looking to the future

- Development of software tools
  - Digital SI representation of measurement data acquired by measuring instruments
  - Processing of measurement data
  - Integration of the Digital SI into commercial software packages?

- The Digital SI is subject to updates
  - New versions of the BIPM SI Brochure
  - Feedback from user communities
  - Dealing with reference materials and procedures
  - Backwards compatibility

- Continued use within higher level data structures, e.g., DCCs

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Thank you for your attention