Abstracts of the 3rd International DCC Conference

2023-02-28 to 2023-03-02

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01 Digital Calibration Certificate as part of an Ecosystem

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Abstract

Digital calibration certificates are an important part of the calibration ecosystem, providing a way to store and transmit calibration information electronically between organizations.

In this presentation, we will explore the role of digital calibration certificates in the broader context of the calibration ecosystem, including the various stakeholders, systems, and processes involved. We will discuss the benefits of using digital calibration certificates, such as improved efficiency and accuracy, and we will examine the standards and guidelines that may be relevant to their use. We will also look at some of the challenges and considerations involved in implementing digital calibration certificates, including challenges related to security, interoperability, and regulatory compliance. We will highlight the complex IT situation in the pharmaceutical industry, which can benefit from an ecosystem approach due to regulations that place a very high priority on data integrity. Finally, we will also highlight economic factors that may be of great interest to industrial companies striving for operational excellence and improvement of calibration processes.

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02 Calibration, Certification, Testing – Is Compatible Cigitalisation Possible?

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Abstract

There have been impressive digitalisation advances at an international level relating to the calibration and conformity assessment of instruments and equipment. While not as globally coherent, there has been effort directed towards digital assurance over traded goods. There are fundamental differences in the handling of such conformity data, compared with equipment assurance data, yet there are potential payoffs if a degree of harmonisation could be achieved given that the national accreditation bodies (ABs) and, in some cases the conformity assessment bodies (CABs), are the same. The digitalisation of accreditation data elements will be considered in terms of reconciling elements which are tightly defined, such as the Digital SI system, with more loosely structured data elements applicable to testing and certification. The challenge of validating accreditation status of CAB certificates will also be considered, with the premise that individual ABs have responsibility for deciding how an accreditation 'match' is determined. In principle, whenever data sets are agreed, it should be possible to bring these into a broader framework without compromising established data validation systems. Some insights will be reported from an Australian collaboration exploring these matters. The work will be placed within the context of a Draft White Paper from the United Nations Trade Facilitation and E-business group, dealing with digital exchange of conformity certificates and which builds on the emerging practice of barcoded URLs in certificates for authentication. It is hoped that drawing attention to these developments may facilitate discussion regarding engagement on digitalisation matters between the scientific and trade measurement community and the wider conformity community.

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03 Towards Digital SI Traceability Statements in Calibration Certificates Issued by NMIs and DIs

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Abstract

In line with Resolution 2 of the 27th CGPM [1], we propose a simple first step on the route towards digital SI traceability. We demonstrate how a calibration certificate covered by the CIPM Mutual Recognition Arrangement (CIPM MRA) can be directly linked to the issuing laboratory's internationally agreed and published calibration and measurement capability (CMC).

The concept of metrological traceability is the backbone of modern international acceptance and reliability of measurement data. The CIPM MRA provides the fundamental framework for international recognition of the national measurement standards of participating NMIs and DIs and the certificates they issue [2]. One of the outcomes of the CIPM MRA are the peer-reviewed CMCs published in the BIPM key comparison database (KCDB) [3], which are generally underpinned by the results of international comparisons [4]. When calibration certificates are issued to customers by NMIs/DIs, the CIPM MRA logo and a statement referring to CMCs published in the KCDB can be used. The use of the sentence and the logo is copyright-protected and granted by the BIPM as laid down in the policy document CIPM MRA-P 11 [5].

A recent survey on digital transformations carried out amongst members of the CIPM's Consultative Committees (CCs) [6] showed that there is significant interest in the development of digital calibration certificates (DCCs), but currently little awareness as to how metrological traceability to the SI might be digitally addressed. In this presentation, we propose and discuss the concept of including of an explicit link to the underpinning CMC; this can be introduced into calibration certificates with immediate effect, and easily translated into DCCs. The concept is effectively a digital extension of the use of the CIPM MRA logo and corresponding statement and is compatible with the digital requirements and FAIR principles of DCCs.

[1] CGPM, On the global digital transformation and the International System of Units, 27th CGPM Resolution 2, 2022, URL: https://www.bipm.org/web/guest/committees/cg/cgpm/27-2022/resolution-2

[2] CIPM, Mutual recognition of national measurement standards and of calibration and measurement certificates issued by national metrology institutes, CIPM MRA, 1999, URL: www.bipm.org/documents/20126/43742162/CIPM-MRA-2003.pdf

[3] BIPM key comparison database (KCDB), www.bipm.org/kcdb

[4] CIPM, CMCs in the context of the CIPM MRA: Guidelines for their review, acceptance and maintenance, CIPM MRA-G 13, 2022, URL: www.bipm.org/documents/20126/43742162/CIPM-MRA-G-13.pdf

[5] CIPM, Overview and implementation of the CIPM MRA, CIPM MRA-P 11, 2021, URL: www.bipm.org/documents/20126/43742162/CIPM-MRA-P-11.pdf

[6] BIPM, Evaluation Report of the survey on digital transformations, 2022, URL: www.bipm.org/documents/20126/77500070/Evaluation-Report-CC-Survey.pdf

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04 Recent Advances in Digital Representation of Measurement Data by the D-SI Metadata Model

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Abstract

Establishing machine-useable and machine-interoperable measurement data based on the International System of Units (SI) is a fundamental perquisite to foster an integration of digital metrological data into highly automated processes. Today, the international Digital Calibration Certificate (DCC) format is implementing this requirement by using the D-SI metadata model for the representation of values of all physical quantities. The steadily growing maturity of the DCC format, the increasing expertise from DCC users, and developments towards a digital provision of the SI by the International Committee for Weights and Measures (CIPM) and its bureau in Paris (BIPM) has raised promising ideas for further advancements of the D-SI. An update of the metadata model to adopt to these ideas is currently being discussed and will be presented. One highlight is the outline of approaches for future interoperation with the new BIPM Unique SI Reference Point which will be providing authoritative definitions of the SI for digital data.

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Session B: DCC and Accreditation

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- 21 DKD's Contribution to DCC Harmonisation and Coordinated Development

05 Bringing the Digital Accreditation Symbol and the Digital Calibration Report (DCC) into Practice

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Abstract

As national accreditation body, DAkkS supports the implementation of the DCC as digital version of a result report in the specific form of a calibration certificate.

In this contribution, DAkkS will present the status quo regarding the implementation of a digital accreditation symbol for accredited bodies. This will be realized within a project which will also include the launch of DCCs in accredited calibration laboratories. This digital accreditation symbol enhances the opportunity of fully machine readable test or calibration reports but also further kinds of attestations. This allows the integration of digital test reports in fully automated processes.

This contribution will further address the necessary requirements for CABs regarding accreditation procedures as well as the necessity of general guidelines from experts regarding the correct implementation of normative requirements for a certain measurand in the DCC XML scheme.

The project is integrated within a broader initiative of the central players in German quality infrastructure (QI) - DIN, DKE, DAkkS, PTB, and BAM. The joint initiative "QI-Digital" develops digital and interlinked processes and solutions for a modern quality infrastructure that serves the analogue as well as the digital product world.

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06 The General DCC Rulebook and the Rules under the Aspects of Accreditation

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Abstract

Machines are still far from being intelligent. In the digital transformation towards Industry 4.0, this must also be considered. The Good Practice (GP) approach to DCCs reflects this. GP developments have shown that a general set of rules for the creation of DCCs can be derived from them. In the first part of the presentation, the resulting draft of a set of rules will be presented.

DCCs prepared by an accredited calibration laboratory have to comply with ISO/ICE 17025 in its current version. In addition to the fulfilment of a DCC schema-compliant XML data set, further criteria must be met for this. Some of these criteria can be checked by means of the Schematron test. For example, it can be checked whether the environmental conditions have been included in the measurements.

In the second part of the presentation, the author shows a draft of a rulebook, which consequences result from the requirements of section 7.8 of ISO/ICE 17025 for the creation of a DCC. A procedure is shown how these points can be fulfilled. The aim is to create an internationally agreed and accepted set of rules in cooperation with the accreditation bodies.

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07 Qualified Electronic Seals - The Peace of Westphalia in the Laboratory Sector

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Abstract

We all recognize seals from history lessons. Princes, kings and bishops used coloured wax, heated it and stamped their coat of arms into it. This was used to confirm the authenticity of a document. A contract, a passport or an escort bill with a seal was considered genuine, and breaking a seal was punishable by severe penalties.

In legal transactions, the seal has been out of fashion for a very long time, but the last traces of it can still be found on the registered letters of the German postal service or the rubber stamps of the tax office on the annual income tax assessment notice.

The EU's eIDas regulation is now bringing the government and corporate seal increasingly into the focus of public institutions and companies.

It makes sense to look for application scenarios for seals, because signatures usually cost more time and money, while seals are suitable for mass use.

In the future, incoming mail from a health insurance company, for example, will probably only be processed with a qualified electronic seal. Paper and fax documents can be destroyed and a legally valid digital workflow can be established. With several million incoming documents every day, this is a step that is hard to avoid.

We all know there are mass transactions in the laboratory sector, such as the sampling of water on the basis of the Drinking Water Ordinance, or of soil samples by farmers on the basis of the Fertilizer Ordinance.

Our presentation will use practical examples to illustrate the benefits of a qualified electronic seals: saving paper and an increased operational efficiency through digitalisation. The technical solutions for such scenarios are ready. A TÜV-approved eIDAS qualified electronic seal from the Bundesdruckerei | D-Trust is easy to integrate into existing laboratory software architectures and can therefore be quickly and successfully implemented.

Customers and recipient institutions of laboratory reports can check them digitally for authenticity and forward them to other recipients if necessary. In a time when time and trust are high commodities, digitization is a must.

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08 How to Apply Digital Signatures on a Digital Calibration Certificate

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Abstract

Digital calibration certificates (DCCs) should be digitally signed to protect the content against undetected manipulation and to achieve authenticity. Digital signatures can be applied in various ways using different specifications, encodings and file formats. Clearly, this is a nightmare for interoperability when DCCs are created by many organizations around the world.

Therefore, we have analyzed technical and operational requirements for digital signatures applied to the machine readable DCC with the goal to find a flexible signature format that allows broad interoperability for many use cases.

Based on our analysis, we show in our presentation that the enveloped XML Advanced Electronic Signature (XAdES) specification outperforms other methods. Moreover, we demonstrate how this signature format can be used in practice together with a Public Key Infrastructure (PKI) as Trust Framework. A private key associated with a qualified digital certificate can be used to create a qualified signature compliant to the eIDAS Regulation, which yields a digital version of a handwritten signature in the European Union. XAdES is not limited to qualified signatures inside the European Union. The specification allows parallel signatures, and we show how this can be used to apply digital signatures that are compliant to different international regulations.

Our results foster a wide international adaptation of digital signatures for the DCC, since a common signature format is the foundation for all secure applications of the DCC.

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- 51 How does a Machine Distinguish the Different Types of DCCs?

09 The Semantics of Measured Quantities

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Abstract

There are two distinct notions of quantity involved when reporting measurement results: the kind of quantity associated with units of measurement and the quantity intended for measurement---the measurand. While practitioners should precisely specify measurands, kinds of quantity remain general. Digital representations of measurement data should address these different notions of quantity and the relationships between them. We require unique identification of kinds of quantity, as well as a flexible system of classification for measured quantities. The latter should somehow accommodate the variety of information about measurement capabilities currently published in 'calibration and measurement capabilities' and 'scopes of accreditation' and likewise identify measurement results in DCCs. A simple taxonomy of quantities, built up from a general parent class---the kind of quantity, would satisfy the simultaneous demand for a specific and a general classification. More complicated and expressive hierarchical structures for quantities may have uses but will require ontologies.

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10 Persistent Identification of Instruments and the Digital Calibration Certificate

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Abstract

Instruments play an important role in producing research data, but they are mostly only identified with free text in research assets (e.g., dataset metadata or scientific literature). Through the use of persistent identifiers (PIDs), it is now common practice to establish traceable links between research assets. This webinar introduces the work by the RDA PIDINST WG [1] on persistent identification of instruments. Of particular focus are the PIDINST Metadata Schema [2] and the proposed solutions for publishing PIDs for instruments with DataCite and ePIC as established PID providers. Furthermore, we will sketch a proposal for how to interlink the PIDINST Metadata Schema with the Digital Calibration Certificate Schema.

[1] Research Data Alliance Persistent Identification of Instruments Working Group, https://www.rd-alliance.org/groups/persistent-identification-instruments-wg

[2] Krahl, R, Darroch, L, Huber, R, Devaraju, A, Klump, J, Habermann, T, Stocker, M, & RDA PIDINST WG Members. (2022). Metadata Schema for the Persistent Identification of Instruments (1.0). https://doi.org/10.15497/RDA00070

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Session C: Different DCC Approaches

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- 17 The Digital NIST: Pilot Project for the Digital Transformation of NIST's Measurement Services
- 24 Python Tools Examples for the Transition to DCC

11 DCC and Digitisation versus Digitalisation and Digital Transformation

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Abstract

The utility model [1] is a description of the scope to which data formats are suitable for use in the Industry 4.0 or IIoT environment. The levels assigned range from level 0 (paper) to level 5 (machine-controllable content). PDF is seen at level 1 (digital document). XML without an XML schema referenced to it reaches Level 2 (machine-readable document). Since a DCC XML file is a file validated according to the DCC XML schema, the elements and attributes used in the DCC are defined. Therefore, a DCC XML file reaches level 3 (machine-readable with executable content).

Based on this model and the comparison between the previous methods and procedures, it is analysed to what extent the different approaches known to the author meet the requirements of a digital transformation. As a result, the question is discussed to what extent the individual methods differ from each other and to what extent the methods can be merged.

[1] https://www.dke.de/resource/blob/2076816/facc9bde1806e2194a3d26a60c79bf77/idis-whitepaper-1-en---download-data.pdf

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12 Development of PDF based Digital Calibration Certificates at NMIJ, AIST

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Abstract

Digital Transformation in metrology has grown to be a worldwide interest since the publication of the Joint Statement of Intent on the digital transformation in the international scientific and quality infrastructure in March 2022 [1]. During the year 2022, NMIJ, AIST has carefully made interactions with domestic stakeholders upon their demands. Through such communication, we have identified that many of our stakeholders prefer to experience a moderate transition to digitalization.

Having the leading examples such as the PTB's XML approach [2] and the PDF approach proposed by METAS [3] and some further investigations upon the ISO Standards related to PDF, we have selected the PDF approach to implement our first Digital Calibration Certificate (DCC) to be issued under our governing domestic law. The PDF file has an appearance very similar to our existing calibration certificates issued on paper, however, it also includes digital data embedded, such as the metadata of the calibration as well as calibration results in CSV format as a courtesy to our customers [4]. Since November 2022, we have officially initiated our service to issue DCCs for service items that are prepared for issuing DCCs to those customers anticipating them. Among approximately 600 service items that we provide, we have given priority to those service items that contain a large amount of data (eg. calibration certificates in radio frequency) and the number of DCC issued has just exceeded 10. In our presentation, we will explain the domestic background, the considerations we have made until we finally decided to initiate the official service to issue DCCs to our customers along with the technical details of our DCC format utilizing the various features of the PDF.

[1] https://www.bipm.org/en/liaison/digital-transformation
[2] https://dccwiki.ptb.de/en/home
[3] https://www.sciencedirect.com/science/article/pii/S2665917421002452
[4] Presentation at the APMP DXFG webinar, 28 November 2022. https://apmp-dxfg.org/dxfg-eoy-webinar-2022.html

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13 Software for the Creation of Machine-Readable and Human-Friendly Reports

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Abstract

Towards the fourth industrial revolution, the metrology community will be required to report metrological information in digitalized structured forms. Beyond the discussion of which structures will be harmonized in reporting types and formats, it is imperative to start developing software, good practices and examples that help metrologists to report digitally structured information.

Mapping seems to be the most important issue to address when generating digital reports. Hence, this paper refers to mapping as the link from the information source to the final report, providing traceability and provenance when required.

This paper also shows a practical way of approaching mapping for metrologists to engage in the generation of data and metadata models, an XML for a given XSD, as well as to harmonize the generation of digitalized reports by PDF-A.

This paper bases its example in the data structure (XSD) of the DCC XML schema hosted by PTB.

To simplify the approach of generating results as an XML and a PDF-A, this example makes its foundation in simplifying the mapping to scripts written in Python and XSLT. The usage of a subscriber file, a JSON data structure, allows the approach to articulate between the different scripts. The software that manages them is also written in Python.

Finally, the paper takes as a source a spreadsheet, used as a simple data collector. The mapping to other types of sources, such as relational and non-relational databases, can be also addressed. XML generation is handled by generateDS, a python library that generates methods from the XSD to be used in the scripts, as well as for validation and parsing. An XSLT script is the link to transform the XML in the PDF-A.

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14 Machine Readability – Automating the Extraction of Data from DCC's

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Abstract

For DCC's to be practically machine readable where data can be extracted in a consistent automated way, data needs to be stored in an algorithmically consistent form with consistent and harmonized wording.

Starting from the best practice guide for temperature and DCC schema 3.1.2 we have created and implemented algorithms to extract data. In this process it was necessary to make additional assumptions and rules to ensure consistent extraction. We are exploiting how these extra constraints can be communicated through the use of well described ref_type tags in the DCC. The implemented software will be presented along with our conclusion on necessary steps to ensure consistent machine readability. Methods of standardization and communication of sub-sets of rules for machine readable DCCs constrained for specific purposes will be discussed, along with consideration addressed within the TC-IM 1448 WP1 working group on "Harmonising DCC structure for machine readability".

DFM's work is supported by funds from The Danish Agency for Institutions and Educational Grants.

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Session C: DCC-News

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- 06 The General DCC Rulebook and the Rules under the Aspects of Accreditation

15 What's New in the DCC Schema Version 3.2.0?

Presenting author: Benjamin Gloger, Physikalisch-Technische Bundesanstalt (PTB), Germany

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Additional authors: Siegfried Hackel, Gamze Söylev Öktem, Shanna Schönhals, Justin Jagieniak, Lutz Doering, Jan Loewe, Muhammed Ali Demir, Moritz Jordan, Kai Mienert, Christian Keilholz (all PTB)

Abstract

Version 3.2.0 of the XML schema is scheduled for release in February 2023. Backwards compatibility with version 3.0.0 is guaranteed, as these are additions.

Over the last year, a lot of experience has been gained with the DCC. There was feedback from all areas of the calibration pyramid. From the National Metrology Institutes (NMIs), organised in Regional (partly continental wide) Metrology Organisations (RMO) to the accredited laboratories to the industry. The valuable feedback from the participants of the DCC Summer School in June 2022 was also implemented. There was also feedback from the accreditation bodies. The result has been implemented in the new version 3.2.0. A selection of the changes is listed in this presentation and the release protocol is provided.

Links and a list will be added to the summary after the release is published.

Release log: https://gitlab.com/ptb/dcc/xsd-dcc/-/releases

Direct link: https://www.ptb.de/dcc/dcc.xsd

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16 Validation Methods in the Preparation of DCCs: The Schematron Validation Tool

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Additional authors: Siegfried Hackel, Benjamin Gloger, Shanna Schönhals, Justin Jagieniak, Lutz Doering, Jan Loewe, Muhammed Ali Demir, Moritz Jordan (all PTB)

Abstract

In this lecture, we will show which types of errors can be found automatically during the creation process of a Digital Calibration Certificate (DCC). First of all, schema validation will be used. This includes unfilled mandatory elements or incorrectly arranged XML elements. This form of validation of the structure of the XML file against an XML schema is offered by almost every advanced editor. Still, there is also the possibility of validation with Schematron. Schematron is a schema language which is used to write logical rules for XML files. Therefore, with Schematron, an XML file like the DCC can be checked for logical errors. For this, individual rules are created which can either throw a hint, a warning, or an error. In DCC development, Schematron is used, among other things, for the implementation of the rulebook. This is a very elegant way to check the XML. Every DCC creator is free to write additional Schematron rules for his own use case and to check his XML with them. For a better presentation, a Schematron validation tool has been created by the DCC team by using open-source tools. The aim of this presentation is to show which errors can be found through schema validation and which errors can be found through Schematron validation.

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Session D: Community-Feedback for Further Developments of the DCC

Presentations that would also fit into this session:

- Parallel Session 6: Community-Feedback for Further Developments of the DCC
- 06 The General DCC Rulebook and the Rules under the Aspects of Accreditation
- 09 The Semantics of Measured Quantities
- 11 DCC and Digitisation versus Digitalisation and Digital Transformation
- 31 DCCs for Non-Automatic Weighing Instruments (NAWIs) – Current Status of a Respective Working Group Elaborating “Good Practice” Conventions
- 39 Two Implementations of Digital Calibration Certificates in Industrial and Metrological Services
- 48 Mapping of Processes and Risks in the Digital Transformation in Metrology of Ionizing Radiation - A Case Study in X-Ray Air Kerma Calibration
- 51 How does a Machine Distinguish the Different Types of DCCs?

17 The Digital NIST: Pilot Project for the Digital Transformation of NIST's Measurement Services

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Abstract

At the beginning of 2022, NIST embarked on a pilot project to produce a few examples digital calibration reports and certificates of analysis for the purpose of assessing the scope and challenges of digital transformation in these measurement services.

The aims for the NIST pilot project are

1) to generate a digital calibration report (DCR) from calibration data, customer metadata, and other data and metadata as needed;

2) to generate a digital reference material certificate (DCRM) from certification data, descriptive information about the material, and other data and metadata as needed;

3) to generate a human readable report from both DCR and DCRM;

4) and to hold a workshop to gather stakeholder feedback.

At the completion of the pilot project, it was determined that the PTB supported digital calibration certificate (DCC) schema is an excellent start towards creating DCR; however, it will need to be customized to address NIST specific needs. In contrast, DCRM will require a new schema, which NIST has begun to develop.

Through the stakeholder workshop, we confirmed a high level of interest in the community for fully digital delivery of calibration reports and reference material certificates.

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18 On the Construction and the Dissemination of Digital Metrology Datasets for Research and Development Purposes

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Abstract

While the metrology field is progressively transforming digitally, new forms, procedures, techniques, artifacts and tools are continuously emerging. The Digital Calibration Certificate (DCC), the Digital Test Certificates (DTC), the Digital Certificates for Reference Materials (DRM), and the D-SI are few examples of the most prominent formats in “digital” metrology. Plenty of systems and applications are expected to be built upon these important artifacts that, from one hand, will replace existing traditional counterparts and on the other hand will open the door widely for novel applications. Fortunately, there is a considerable effort on the design of such artifacts with a plethora of ideas. However, unfortunately they most likely remain conceptual and prototypical, yet untested. Therefore, they are faraway from being mature for production and operational deployments in real environments. One reason of this problem could be the lack of sufficient datasets of these new metrology forms and formats.

To foster the advancement of Met4DT, we discuss in this presentation several issues related to the creation and the dissemination of DCC datasets that can be used in researching and developing new metrology systems and applications. Then, we propose a new framework that enables and encourages creating, comparing and sharing such datasets. First, we explain the need and the benefits to have such a repository of DCC Datasets. Accordingly, we identify what we need exactly and how that can be achieved. Moreover, we discuss the main components that are necessary for the implementation of the suggested framework.

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19 Analyzing the Conformance of DCC Prototype Architecture to Calibration Laboratory Expectations Report

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Additional authors: Narin Chantawong, Jariya Buajarern, and Sunantiya Parana

Abstract

This work aims to survey a calibration laboratory opinion in Thailand about changing the calibration format to digital. We hold two meetings in the dimension field and the electrical field to present a DCC prototype. For the DCC prototype, we digitalize the data in the Certificate of Calibration, which was previously issued by Microsoft Excel. We explore the utilization of an Extensible Markup Language (XML) map which adapts from the DCC guideline to automatically generate the DCC from XLSX files. Thus, the XML file is then displayed on a web browser for human readability. The questionnaire has 9 questions and we found some participant has a problem using the certificate in paper form and almost all of the participants agree to change the certificate format to the DCC. The participants also agree with the DCC can rise their service capability. In addition, they have a suggestion about adding calibration due date and decision rule. The second survey is divided into two parts which are compared between the type of organization and between job positions. From the survey, most participants agree with changing the calibration format to digital. However, they still have concerns. Their apprehension depends on the type of organization and job position. For the type of organization, the private sector has biggest concerned about changing organizational culture but the government sector has most concerned about the staff's lack of the new knowledge to support the DCC system. For the job position, the laboratory head and staff are concerned about the operation process while the department head focuses on budget and costs.

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20 A Proof of Concept for a Digital Calibration Environment for Digital Multimeters

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Additional authors: D. Coppa and A. Toran

Abstract

This abstract presents a proof of concept for a digital calibration environment for digital multimeters (DMM). The calibration of DMM is a critical process that ensures the accuracy and reliability of measurements taken with this instrument, which is broadly used in industry. The approach proposed in this work utilizes digital structured information, like DCCs, and relational databases to manage the calibration process, improving its efficiency and effectiveness.

The DMM calibration laboratory of the Instituto Nacional de Tecnología Industrial has developed the software for data acquisition of calibration measurements. Then, the measured data is analyzed using a spreadsheet to calculate errors, tolerances, and uncertainties. From these results, the calibration report is generated with a word template. This process is adapted for each multimeter model, which includes particular spreadsheets and templates.

This work aims to create a unified environment for data acquisition, processing, and report generation for the calibration of digital multimeters. The environment utilizes digital metrology data from digital calibration certificates, a middleware, and a database system. The final output is a digital calibration certificate in XML and PDF format for the calibrated DMM.

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21 DKD's Contribution to DCC Harmonisation and Coordinated Development

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Abstract

The development of the DCC schema has reached a maturity stage which brings its practical implementation in operative environment in a reaching distance. However, to ensure a harmonised use and development of interoperable processes and structures, the development of good practice examples by the individual technical communities is considered to be the most effective way.

In Germany, the German Calibration Service (Deutscher Kalibrierdienst DKD) offers an ideal environment to facilitate the technical discussion at the national level and to agree on the required conventions, as it represents more than 400 accredited laboratories and companies from the various metrology disciplines. The DKD is also open for accredited calibration laboratories outside of Germany. It is organised in 13 technical committees (TCs) that are responsible for specific technical subjects. In 2022, subgroups have been established in many of the TCs that discuss the implementation of the DCC. They are actively supported by the PTB. Additionally, a cross-sectoral committee has been established to discussed general and overarching topics. Another essential task of the DKD working groups is to document their work in DKD expert reports which serve as guidelines and have the character of pre-normative documents. This talk will give an insight of this work and associated workflows.

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22 GEMIMEG-II – Status and Progress Report

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Abstract

The GEMIMEG-II project is a German lighthouse project to path a way for digitalization in metrology. The acronym reflects the project aspiration by combining GEMIni for the digital twin of the MEtrology equipment for Global application. The central element of this digitalization initiative is the digital calibration certificate (DCC) and its fully automated application in modern industrial IT and IOT infrastructures. The user story is a calibration together with the related DCC that is created (automatically) in the calibration process and then transferred safely and without human intervention to the customer of the calibration. At the customer site, the DCC is read, processed, and interpreted automatically by machines in truly digital workflows in typical Industry 4.0 scenarios. The information extracted from the DCC will be used to update the plant management system (ERP) and all calibration related information in production.

This talk presents an overview of the recent project status of GEMIMEG-II in its final phase. It shares some insights on the concept developed and solutions implemented so far. 5 RealBeds will be setup in the project to showcase and prove the applicability of the GEMIMEG concept in the fields of the i) Digital Competence Centre for Wind power (d-CCW) at PTB (Germany), ii) fab of the future, iii) process- and pharma industry and iv) mobility for autonomous driving and v) a legal simulation.

The GEMIMEG-II project is funded by the German ministry for economic affairs and climate action based on a decision by the German Bundestag under grant number 01 MT20001A.

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Parallel Session 1: DCC-Tools

Presentations that would also fit into this session:

- Parallel Session 4: DCC Tools
- 07 Qualified Electronic Seals - The Peace of Westphalia in the Laboratory Sector
- 19 Analyzing the Conformance of DCC Prototype Architecture to Calibration Laboratory Expectations Report
- 43 Using a Spreadsheet to generate XML Based on XSD Schema
- 44 XML Tree Editor
- 53 DCC Middleware – Obstacles and Approaches
- 56 DCC via iPhone (or iPad)

23 The GEMIMEG Tool – A Software for Creating Digital Calibration Certificates (DCCs)

Presenting author: Moritz Jordan, PTB, Germany

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Additional authors: Muhammed-Ali Demir, Jan Loewe, Justin Jagieniak (all PTB)

Abstract

The GEMIMEG-Tool in its current state is a web application that offers a user-friendly way to create and edit DCCs without the need of XML skills. A rich graphical user interface guides the user through the process of filling in administrative and calibration data. The user can choose between multiple different Good-Practice examples as a template, create a new DCC from scratch, or edit any existing DCC that follows the Good-Practice guidelines.

A human-readable HTML as well as an XML preview of the DCC complement the feature set. Furthermore, the software automatically validates any DCC with the schema version 3 or later and updates the used schema to the latest version.

In this presentation, we give an overview of the most recent developments in the GEMIMEG-Tool:

- Improved interface for adding multiple languages to the DCC
- Optional HTML Human Readable attachment in document element
- Integrated references to DCC Wiki
- Viewer for files that are attached to the DCC
- Update on release of standalone desktop version

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24 Python Tools Examples for the Transition to DCC

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Abstract

Digital Calibration Certificates (DCC) offer well known advantages over the traditional paper or pdf based ones and impact only the final phase of the calibration process. Nevertheless during the transition period to DCC, both certificate models could coexist and some efforts should be made in order to keep consistency of data and ease integration of the DCC software with the existing software setups of the laboratory.

This work describes a modular software divided into three steps for the certification phase of the calibration process. Every step is further divided into specialized submodules. The interchange of data is performed using a human readable textual format. The first step collects the calibration data. Data series from old certificates can be imported automatically or manually input by means of separated specialized submodules. New incoming calibration data can also be read in this step by means of another dedicated submodule. The second step processes the data e.g. adding mandatory fields required by DCC standard which were not present in the historical data. The third step generates the certificate in DCC and legacy formats. Keeping the steps separated and splitting the tasks into submodules eases debugging, developing efficiency and data consistency verification. Another advantage of software modularization is the possibility to centralize steps 2 and 3 into a dedicated server, yet allowing the laboratories to send their calibration data to the server by means of a specialized submodule of step 1. This reduces the distribution of unnecessary submodules to each laboratory and eases the overall software maintenance and version tracking.

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25 Generation of Digital Calibration Certificates for Temperature Sensor Calibrations using Python and Excel

Presenting author: Ian Smith, National Physical Laboratory, UK

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Abstract

At the second International DCC (Digital Calibration Certificate) Conference in 2022, I presented initial thoughts from the UK's National Physical Laboratory (NPL) on the use of the Python programming language to generate DCCs using information stored in Microsoft Excel workbooks [1]. A significant proportion of calibration services at NPL involves the capture of measurement data using Excel and it seemed reasonable to consider how DCC generation might be integrated into those services. Python is widely used nowadays and there are numerous packages available to implement different tasks, hence the decision to employ it.

While the primary focus of the 2022 presentation was the concept of developing an "Excel to DCC" pathway, this presentation describes initial efforts in the implementation of such a pathway. NPL and the National Composites Centre (NCC) [2] have conducted a case study involving the calibration of temperature sensors. NPL considered the storage of administrative data and measurement results in Excel workbooks, and subsequently developed Python software to extract that information and generate (and validate) DCCs. A small number of DCCs has been generated and provided to NCC, allowing them to gain experience of working with DCCs, better understand how their internal infrastructure and processes may need to be updated to work with DCCs, and provide feedback as a user of DCCs. A summary of the case study will be written and made openly available.

The presentation will centre on the aspects of information storage and DCC generation. Points discussed in the 2022 presentation will be revisited to review if the initial implementation of the "Excel to DCC" pathway has altered thoughts presented a year ago.

References

[1] Proceedings of 2nd International DCC Conference, pages 138–147, https://oar.ptb.de/resources/show/10.7795/820.20220411

[2] National Composites Centre, https://www.nccuk.com/

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26 Dynamic Web Tool for Generating DCC

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Abstract

CENAM currently generates the calibration certificates electronically (PDF format) for which it has an internally developed web system in which, through an identifier of the service performed, data that is already in a database is retrieved, most of these data can be defined as administrative data (customers, dates, calibration location, etc.); the results are uploaded in a pdf file; at the end the system combines the result file with the one generated with the administrative data to obtain the electronic certificate.

Now with the digital certificate, CENAM has the vision of also generating a web system, based on the current one, where administrative data can be obtained in the same way; for the results it is going to have two options, one is going to be through capturing the results individually, the second one is upload xml files (with the format of the digital certificate schema) generated by other tools developed inside the laboratories or by excel files currently used by metrologists to analyze their results. If an xml file is uploaded, the system would combine it with the one generated with the administrative data; otherwise, the system would generate the digital certificate in its entirety.

Anticipating that the schema may have changes over time, the system will be dynamic and configurable with respect to the schema, that is, it will generate the fields according to the schema provided; and it will be configurable for non-mandatory elements and that for reasons of processes within the institute may not be necessary, they are not going to be showed.

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27 The Use of (Anonymised) Timestamps in the DCC

Presenting author: Gamze Söylev-Öktem & PTB & Germany

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Additional authors: Siegfried Hackel, Benjamin Gloger, Shanna Schönhals, Justin Jagieniak, Lutz Doering, Jan Loewe, Muhammed Ali Demir, Moritz Jordan (all PTB)

Abstract

For measurements and analyses, it can be important to record the point in time when the data is collected. For example, the sequence of data recording or the sequence of data analysis can be documented. The accuracy of the recording of the time can be handled in very different ways. This flexibility is made possible by the format used by the DCC.

However, in some situations it might be preferrable to not use exact time of recorded data. This might be due to various reasons, such as labour law or issues with the protection of personal data. The sequence of the recording of e.g., data collection, in other words which data is recorded first, second, and so on, could still be important and could be possible in this way without additional effort.

In this presentation, we show one solution to this issue, namely using anonymised time stamps. The anonymised time stamps allow a conclusion to be drawn about the sequence without giving rise to the problems of time recording. The DCC team has developed a demonstration tool for anonymised timestamps. In the presentation, an example is used to present this tool and explain how it works.

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Parallel Session 2: DCC and Machines

Presentations that would also fit into this session:

- Session C: DCC and Machines
- 01 Digital Calibration Certificate as part of an Ecosystem
- 06 The General DCC Rulebook and the Rules under the Aspects of Accreditation
- 10 Persistent Identification of Instruments and the Digital Calibration Certificate
- 11 DCC and Digitisation versus Digitalisation and Digital Transformation
- 14 Machine Readability – Automating the Extraction of Data from DCC's
- 22 GEMIMEG-II – Status and Progress Report
- 38 The Quality of Sensing, of Data or of Information
- 51 How does a Machine Distinguish the Different Types of DCCs?

28 Pilot Comparison Project in Terms of Air Kerma in Radiation Protection between Digital Twin Laboratories

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Abstract

Proficiency Testing (PT) activities, especially in ionizing radiation, are an essential tool for continuously monitoring the performance of laboratories in their processes and maintaining the reliability of participants and other interested parties. However, PT events bring operational challenges, mainly logistics. Even big international programs have some years-long PT events. Technologies from the fourth industrial revolution and metrology 4.0 can be used to mitigate these difficulties. The objective is to develop a technical framework for comparisons in terms of air kerma between digital twin laboratories, using physical measurements taken in the physical laboratory (kerma_P and spec_P) and virtual measurements from the digital twin (kerma_V and spec_V) simulated in Monte Carlo. The idea is to dispense with equipment logistics so that the provider laboratory (lab_prov) only delivers a virtual transfer chamber to the participating laboratory (lab_part). Such measures are used to calculate the normalized error (En) of each PT event from lab_prov and lab_part's digital calibration certificates (DCC) issued. The characterization of virtual laboratories, simulated in EGSnrc, has brought promising results such as average energy differences of 1.4% between raw experimental and simulated spectra of N-60 radiation quality (ISO 4037). When the spectra are corrected, the differences become non-significant. Some challenges in measurements of kerma_V in ionization chambers, in the same scenario, are not converging to kerma_P yet. Data generated from physical calibrations and quality control tests performed periodically in laboratories are used to predict trends and infer the status of the physical system promoting corrections and improvements in the digital and physical systems.

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29 Data Analysis and Business Intelligence - Digital Metrology

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Abstract

The aim of this work is to identify the impact of business intelligence on strategic performance in the measurement and calibration sectors. Our focus will be on digital transformation for the use of reference materials for calibration of measuring equipment. This needs the development of algorithms and models for data analysis and extraction of "information" for a number of objectives. An example for the application of our proposal can be the calibration of a gas monitor using a certified reference material through the following steps:

1. Obtaining data related to the one-point calibration using a reference gas (R).
2. Processing and checking the obtained data.
3. Making three measurements of the sample (S) and calculating the average.
4. Building, developing, and applying the algorithms and models necessary for calculating the concentration and uncertainty of the unknown sample (S).
5. Presenting the final results to the decision makers, in an automated way by machine learning and artificial intelligence.

The main tasks required to achieve the proposed work are: 1) predating data from previous measurements regarding the number of injections, calibration points of the GC-TCD measuring machine. 2) testing the data for outliers. 3) calculation of the concentration and uncertainty. 4) Testing the relationship between the reference values and measured concentration of the sample (S). 5) checking the quality of the algorithms to ensure quality of the obtained results.

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Parallel Session 2: Good Practice (GP)

Presentations that would also fit into this session:

- 06 The General DCC Rulebook and the Rules under the Aspects of Accreditation
- 10 Persistent Identification of Instruments and the Digital Calibration Certificate
- 17 The Digital NIST: Pilot Project for the Digital Transformation of NIST's Measurement Services
- 21 DKD's Contribution to DCC Harmonisation and Coordinated Development
- 22 GEMIMEG-II – Status and Progress Report
- 45 Digital Transformation of NMI: Practical Experience on DCC and Beyond @ NIS-Egypt
- 51 How does a Machine Distinguish the Different Types of DCCs?
- 54 Digital Calibration Certificate with MetricodeHUB, a Real Implementation Case

30 Calibration 4.0: A DCC Implementation in Electrical Metrology for the Calibration of Digital Multimeters

Presenting author: J. C. Suarez Baron, INTI, Argentina

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Additional authors: R.J. Iuzzolino and A. Tonina (both INTI)

Abstract

This work presents a case of study of a DCC applied to the calibration of digital multimeters at INTI. Such calibration requires over 50 points of measurement including DC, AC voltage and current and resistance. The calibration process is automated, and its results are stored in a spreadsheet file format. This file acts as input to a tool that generates an XML metadata-based file and finally a human readable certificate. In this way possible errors and workloads are reduced.

The DCC automation process will be presented to the calibration of a 6 ½ digit multimeter on the quantities described above, where its different functions and ranges with the corresponding uncertainties are finally reported.

This work applies solutions based on DCC and digital SI based on the structure scheme proposed by PTB. It also includes a validation scheme for data quality and trustworthiness.

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31 DCCs for Non-Automatic Weighing Instruments (NAWIs) – Current Status of a Respective Working Group Elaborating “Good Practice” Conventions

Presenting author: Dr. Julian Haller, Sartorius Lab Instruments GmbH & Co. KG, Germany

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Abstract

The advantages of the digital calibration certificate (DCC) for the management of test equipment and further processing of calibration data are obvious. The XML scheme developed by the PTB for the DCC is designed to be very flexible so that it can be applied to all possible measuring devices with their peculiarities. However, due to the great flexibility of the DCC schema, there are different possible ways of implementation in accordance with the XML schema for almost every aspect. This entails the risk that the implementations of different laboratories are not compatible with each other and that users have to adapt their input software to the implementation of the respective laboratory. Such lack of compatibility may jeopardize user acceptance and ultimately the success of the entire DCC implementation.

Therefore, it is inevitable that "good practice" agreements should be made for general aspects as well as for instrument-specific aspects.

For the calibration of non-automatic weighing instruments (NAWIs), a working group has been established within the Technical Committee "Mass and Weighing Instruments" of the DKD (German Association of Accredited Calibration Laboratories) to define and formulate the corresponding "good practice" agreements. The group consists of experts from PTB, EURAMET and renowned manufacturers and calibration laboratories for NAWIs.

The purpose of this presentation is to present the current status of the working group's progress in defining "good practice" agreements for NAWIs and provide an overview of the expected timetable.

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32 Digital Calibration Certificates for Weights and Mass Standards: Rules and Applications

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Additional authors: Martin Häfner, Häfner Gewichte GmbH, Germany; Julian Haller, Sartorius Lab instruments GmbH & Co. KG, Germany; Christian Müller-Schöll, Mettler-Toledo GmbH, Switzerland

Abstract

In 2021, the DKD technical committee “Mass and Weighing Instruments” formed an expert group to discuss the use of the digital calibration certificate schema for the calibration of weights. The results of the extensive discussions were published in an expert report “Instructions on how to use the DCC schema to create a digital calibration certificate for weights” in 2022. The expert group refocused afterwards on applying the instructions on the calibration certificates of mass standards as well as on more detailed discussions about conventions and good practices.

The first part of the presentation will give an overview of the work within the DKD technical committee on weights. This includes mass specific topics such as the reporting of the actual results in a machine-readable and -identifiable way for both conventional weight and mass and describing the calibration item for weight sets and mass standards. Furthermore, more general topics as for example reporting of different locations, the indication of compliance with CMCs or the use of the refType-attribute have been discussed and a summary of the results will be given.

In the second part of the presentation, an example of a practical application of a DCC for weights will be shown. The example shows how a DCC for a weight set, as a future industry standard, can be imported into a balance calibration software. In this process, detailed information on weights, such as conventional mass, measurement uncertainty, maximum permissible error, marking, density, etc., is digitally processed. Until now, this information has been imported via proprietary formats or had to be entered manually by hand, resulting in significant time effort and the risk of transmission errors.

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33 DCC Good Practice Examples for Air Humidity and Air Pressure – Current Status of Respective Working Groups

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Additional authors: Regina Deschermeier, Carolyn Eckerleben, Mattias Brennecke (all PTB)

Abstract

Together with temperature, air humidity and air pressure are among the ambient influence conditions that are required for virtually any measurement and thus within any digital calibration certificate. Therefore, good practice examples for these measurands and associated measuring equipment are urgently required. Whereas temperature good practice examples have been developed and published in early 2022 in a common effort with the PTB-internal calibration lab, the other two measurand followed later in the year.

In this talk, selected structures of the good practice examples for humidity and air pressure will be presented and discussed. These are especially suited to represent how similarities but also differences between the measurands contribute to the implementation of harmonised structures within DCCs. Also, an insight on the current status of the coordination discussions within the respective working groups of the German Calibration Service (Deutscher Kalibrierdienst, DKD) will be given.

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Parallel Session 3: In Development

Presentations that would also fit into this session:

- 01 Digital Calibration Certificate as part of an Ecosystem
- 06 The General DCC Rulebook and the Rules under the Aspects of Accreditation
- 10 Persistent Identification of Instruments and the Digital Calibration Certificate
- 17 The Digital NIST: Pilot Project for the Digital Transformation of NIST's Measurement Services
- 25 Generation of Digital Calibration Certificates for Temperature Sensor Calibrations using Python and Excel
- 26 Dynamic Web Tool for Generating DCC
- 28 Pilot Comparison Project in Terms of Air Kerma in Radiation Protection between Digital Twin Laboratories
- 31 DCCs for Non-Automatic Weighing Instruments (NAWIs) – Current Status of a Respective Working Group Elaborating "Good Practice" Conventions
- 38 The Quality of Sensing, of Data or of Information
- 39 Two Implementations of Digital Calibration Certificates in Industrial and Metrological Services
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- 53 DCC Middleware – Obstacles and Approaches
- 56 DCC via iPhone (or iPad)

34 The DCC in its Role as Networked Data Source

Presenting author: Benjamin Gloger, Physikalisch-Technische Bundesanstalt (PTB), Germany

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Additional authors: Gamze Söylev Öktem, Siegfried Hackel, Moritz Jordan, Justin Jagieniak (all PTB)

Abstract

The Digital Calibration Certificate (DCC) is not simply a translation of an analogue calibration certificate into a digital format. The digital calibration certificate contains much more information than can be found anywhere in the analogue calibration certificate. This additional information is available in the DCC and is even machine-readable and machine interpretable.

The links and the subsequent self-description of a SemantikWeb show here the advantages of using DCCs. In this talk, the reliability and verifiability of DCCs will be discussed with the possibilities of the flexibility of Industrie 4.0 machines. The attribute "refType" in the DCC will be used for this purpose.

The goal is that the DCC can be audited by humans. The following sentence summarises this. "For a human with an appropriate metrological background (e. g. an auditor or a trained employee of the calibration laboratory or its customers), a DCC without refTypes must be fully comprehensible in terms of content."

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35 The Digital SchemaX (DX)

Presenting author: Justin Jagieniak, Physikalisch-Technische Bundesanstalt, Germany

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Additional authors: Benjamin Gloger, Gamze Söylev-Öktem, Jan Loewe, Moritz Jordan, Muhammed-Ali Demir, Siegfried Hackel, Shanna Schönhals (all PTB)

Abstract

DX is the short form for Digital SchemaX. The Digital SchemaX is a modularisation of the Digital Calibration Certificate (DCC) schema and will be used for the future development for of the DCC schema in the version 4.0.0 and up. Furthermore, the DX can be used as an inheritance for other kinds of certificates related to the DCC, because the DX does not contain any XML-like Tree Structure and contains the typically types of a DCC schema instead. This structure makes the DX useful for other certificates. The intention behind the DX is to create a base for certificates in metrology. For example, for the Digital Calibration Request (DCR), the Digital Calibration Answer (DCA), the Digital Certificate for Reference Materials (D-CRM) and the Digital Certificate of Conformity Metrology (D-CoCM). The presentation gives you an overview of news in this development.

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Parallel Session 3: DCC and Industry

Presentations that would also fit into this session:

- 01 Digital Calibration Certificate as part of an Ecosystem
- 05 Bringing the Digital Accreditation Symbol and the Digital Calibration Report (DCC) into Practice
- 09 The Semantics of Measured Quantities
- 11 DCC and Digitisation versus Digitalisation and Digital Transformation
- 21 DKD's Contribution to DCC Harmonisation and Coordinated Development
- 22 GEMIMEG-II – Status and Progress Report
- 31 DCCs for Non-Automatic Weighing Instruments (NAWIs) – Current Status of a Respective Working Group Elaborating "Good Practice" Conventions
- 32 Digital Calibration Certificates for Weights and Mass Standards: Rules and Applications

36 Pharmaceutical Test Case of a DCR- and DCC Implementation in an Accredited Calibration Laboratory

Presenting author: Jakob Fester, Danish Technological Institute, Denmark

E-mail address: jafe@teknologisk.dk

Additional authors: Jonas Emil Vind

Abstract

The practical implementation of digital calibration certificates (DCC) and -requests (DCR) meet a range of requirements and regulations and must link solutions to existing data- and quality infrastructure (QI). These aspects of DCC and DCR can represent serious bottlenecks in the efforts towards implemented solutions before the administrative benefits of the paper less- and machine assisted calibration process can be achieved. In this study, we present a test case together with a major Danish pharmaceutical company where the whole chain from DCR to DCC is demonstrated and evaluated based on a thermometer calibration performed at the designated temperature laboratory (DI) at the Danish Technological Institute (DTI). The DCC and DCR formats are constructed starting from the current good practice examples and online material already published by PTB, and the templates are reviewed with a focus on suggestions for future improvements, as evaluated from both views of the customer and calibration laboratory, respectively. The DCR and DCC versions in the study are XML-based, machine read and automatically exported by internal software. We describe the transfer of data to- and from the internal QI system at DTI and designed an integrated solution where the customer can create and send the DCR through a browser. The primary focus is to provide feedback to the current DCR- and DCC templates and inspire further practical implementations by potential users in industry.

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37 Development of a Universal Measurement Model Framework

Presenting author: Michael Brown, Fluke Corporation, United States

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Abstract

Calibration processes and software have largely been developed with a direct measurement comparison method at the forefront. While adequate for many routine calibration processes, this approach becomes insufficient for more complex calibrations and often leads to the creation of special processes, tests, or workarounds which are neither ideal nor sustainable over the long term. In some cases, these inadequacies initiate the development of a completely new and separate calibration processes and software designed to specifically address a single calibration discipline or measurement problem. Here we discuss a complete and universal measurement model framework capable of accommodating routine and complex calibration scenarios alike and allows the use of the various comparison types including direct, indirect, ratio, differential, transfer, and substitution measurement techniques. Additionally, the framework generates a comprehensive set of records to include, all original observations, calculations, corrections, conversions, environmental factors, and measurement results, allowing for step-by-step auditing of every measurement performed. When used in conjunction with the Digital Calibration Certificate or DCC, we enable the ability for measurement processes to be exchanged in their entirety in a manner which can facilitate full and complete interoperability.

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38 The Quality of Sensing, of Data or of Information

Presenting author: Dr. Thomas Engel, Siemens AG, Germany

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Abstract

In a digital world, data scientists have to rely on the data they get from the various sources. For the metrology domain it is important to not only have the measured value plus its tolerances and unit but also to have some additional information about the conditions where the measurement was performed. The approach of QoX, where X is an abbreviation for Sensing (S), Data(D) and Information (I), is intended to convey supplementary information about the measurement conditions or environment parallel to the data. It is intended as an open but concise concept to report, transport, and propagate QoX in parallel to the measured data, when they are processed in order to provide respective QoX indicators also for the result. The QoX do reflect the domain where they are generated. This is of great value for data scientist to understand where a specific QoX was generated in the process to trace back easily the origin of the data used.

This talk will introduce to the concept of QoX and present some related methods how to determine QoX values. Furthermore, early concept ideas how to propagate QoX of input values into meaningful QoX related to the output of respective operations or evaluations on the input values will be shared.

This work to optimize the quality of data is part the GEMIMEG-II project which is funded by the German ministry for economic affairs and climate action based on a decision by the German Bundestag under grant number 01 MT20001A.

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39 Two Implementations of Digital Calibration Certificates in Industrial and Metrological Services

Presenting author: Marcos E. Bierzychudek, INTI, Argentina

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Additional authors: D. Coppa, A. Toran, L. Di Lillo, C. Muzzio, L. Gurevich, N. Dini, F. Wainstein, F. Serrano, R. Benevenia, A. Zapata, D. Calero Costa, J. C. Suarez Barón and L. Álvarez.

Abstract

This work presents the implementation of the DCC in two traceability chains from the national standards maintained at INTI (Instituto Nacional de Tecnología Industrial) up to the services of the company HITEC. INTI can provide a DCC to the company's standards. Then, HITEC can perform a metrology service using that DCC and writing a new DCC for the customer.

The first traceability chain is applied in electrical metrology for the calibration of multifunction calibrators. These standards are broadly used in the industry because they are required to realize the performance verification of hand multimeters and other instruments. The calibration procedure includes the measurements of more than 100 points. Thus, the DCC can help to improve the usability and control of all this data. In addition, the DCC eliminates the errors and the workload associated with the human-readable calibration certificate.

The second traceability chain starts with the vibration standard at INTI, and finished with the vibration sensors of the Terative system developed by HITEC. This system analyses the sensor data utilizing an IA algorithm for predictive maintenance of rotating machines. The first step is the calibration of an accelerometer by INTI, which is used to calibrate a shaker at HITEC. Then, the sensors are calibrated and finally, the data generated for these sensors can be corrected before the data processing. This case of use allows embedding the DCC in machine learning software, taking full advantage of new trends.

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Parallel Session 4: Human Readable DCC

Presentations that would also fit into this session:

- 01 Digital Calibration Certificate as part of an Ecosystem
- 12 Development of PDF based Digital Calibration Certificates at NMIJ, AIST
- 53 DCC Middleware – Obstacles and Approaches
- 56 DCC via iPhone (or iPad)

40 Human Readable Digital Calibration Certificate for Piston-Operated Volumetric Apparatus

Presenting author: G.D.Thilini Asoka Pathiragoda, Industrial Technology Institute, Sri Lanka

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Additional authors:

Abstract

The high demand for calibration of piston operated volumetric apparatus fulfilled through digitalization from customer request to issuing calibration certificate. Internationally competitive calibration services provided to local and foreign customers along with digital calibration certificate. This electronic human-readable version reduce handling, storage, retrieval time and more efficient than the analog version in hardcopy. Report preparation and reviewing time has reduced significantly. Each Single page auto generated volumetric apparatus calibration certificate contain delivered volume with uncertainty. Calibration measurement capability(CMC) 0.3µl for micropipette of 20µl. Customer shall extend or reduce recalibration interval over time with trend analysis, statistical process or other methods analyzing the previous data using E_n ratio. Similarly to ensure validity of results and quality assurance; the degree of equivalence evaluated by E_n number statistical formula for measurement results management.

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41 Generating DCC and Human-Friendly Readable Using Auto-Generated XML Schema

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Additional authors: Narin Chantawong and Jariya Buajarern

Abstract

This work aims to transform a calibration certificate into a Digital Calibration Certificate (DCC) for preparing a machine-readable process. The way to create the DCC, we add the process which transfers data into an XML file. However, laboratory staff uses Microsoft Excel to compute measurement results and issue certificates. And then print the certificate in a PDF file to give to the customer. Therefore, the process to produce the DCC is using Microsoft Excel and add-in an XML map function for converting it into an XML file. The XML map guidelines from the DCC good practice on GEMIMEG-II. Our XML map design is less complicated because of the limitation of Microsoft Excel. In this work, we use the certificate of a standard capacitor as an example of the transition process. There are accredited by the Thai Industrial Standards Institute (TISI). The transition process result, our XML map can be imported into Microsoft Excel and elements from the XML source pane can be dropped into data and can be exported to the XML file. This XML file is the DCC which can be uploaded to a cloud network or used in machine-readable form. We program an XSL file to generate a web browser and link data from the XML file to preview the DCC on the web browser for human-readable purposes.

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42 A Human Readable Form for the DCC

Presenting author: Muhammed-Ali Demir, Physikalisch Technische Bundesanstalt, Germany

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Additional authors: Jan Loewe, Moritz Jordan, Justin Jagieniak, Siegfried Hackel, Shanna Schönhals

Abstract

The common interpretation of the Digital Calibration Certificate (DCC) is to electronically store and transmit authenticated, encrypted and signed calibration results + enabling uniform interpretation. The DCC must be machine readable, interpretable and at the end must enable the automation of the processing of (digital) calibration certificates.

Regardless, a human readable version of the DCC is required since the DCC is optimized for machines. In the presentation, it will be shown, how a HTML5 and PDF human readable format can be generated from the DCC XML with the GEMIMEG tool of the PTB. The GEMIMEG tool uses XSLT to generate the Human Readable form of the DCC. The presentation ends with an outlook on a possible road map.

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Parallel Session 4: DCC Tools

Presentations that would also fit into this session:

- Parallel Session 1: DCC-Tools
- 07 Qualified Electronic Seals - The Peace of Westphalia in the Laboratory Sector
- 19 Analyzing the Conformance of DCC Prototype Architecture to Calibration Laboratory Expectations Report
- 23 The GEMIMEG Tool – A Software for Creating Digital Calibration Certificates (DCCs)
- 24 Python Tools Examples for the Transition to DCC
- 25 Generation of Digital Calibration Certificates for Temperature Sensor Calibrations using Python and Excel
- 26 Dynamic Web Tool for Generating DCC
- 27 The Use of (Anonymised) Timestamps in the DCC
- 53 DCC Middleware – Obstacles and Approaches
- 56 DCC via iPhone (or iPad)

43 Using a Spreadsheet to generate XML Based on XSD Schema

Presenting author: José Armando Lopez-Celis, CENAM, México

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Additional authors: Carlos Galvan-Hernández, Itzel Dominguez-Mendoza, Aldo Adrián Garcia-Gonzalez, , Hugo Gasca-Aragón, Oscar Ramos-Monzalvo

Abstract

The generation of calibration certificates at the National Metrology Center (CENAM) is based on spreadsheets (MS-Excel). Metrologists analyze the measurements and generate the report of the measurement results directly or using a word processor (MS-Word).

In order to avoid modifying the data analysis process for the time being and to favor natural change, it was decided to find a way to export the results directly from the work environment to the XML file. Given the variety of services, the work of programming the individual generation of the XML can become a very large task, therefore a way to export the measurement results directly from MS-Excel tables is presented.

At the moment we are not considering how the raw data of the measurements are obtained and we will concentrate on the digitalization of the calibration results to be able to integrate them in the creation of the DCC, this is a task that requires a lot of work thinking that the great majority of the laboratories of the National Metrology Center make use of spreadsheets to process the information of the measurements and from there to obtain the reports that will be used to create the calibration certificates in PDF format.

Exporting the calibration results to an XML digital exchange format and structuring them in the DCC schema becomes a job that must be carried out individually for each of the different services due to the nature of each one of them. For this purpose, the CDD development team at CENAM makes use of the import of subschemas derived from the main CDD schema. These subschemas contain the necessary elements that each service requires and are aligned to the rules established by the DCC structure.

In this way, the direct export of calibration results to XML can be achieved avoiding the coding of specific routines to generate XML files. It is possible to generalize in most cases the necessary elements for each of the services with similar subschemas, simply by linking the elements of the subschema with the cells in the spreadsheet containing the results to be exported. This reduces the work to generating subschemas for the service variants.

Finally, it remains to link the measurement XML with the XML containing the administrative and comments sections, which in CENAM are generated from a centralized system from the service management databases, thus obtaining the complete DCC.

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44 XML Tree Editor

Presenting author: Justin Jagieniak, Physikalisch-Technische Bundesanstalt (PTB), Germany

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Additional authors: Benjamin Gloger, Shanna Schönhals, Siegfried Hackel (all PTB)

Abstract

The XML Tree Editor is a Qt development written in Python. The aim of the development is to get a better overview of an XML file and to edit it. Similar to the well-known XML Notepad by Microsoft it can be used to load an XML file into a tree view. But the XML tree editor has some differences. One big difference is that the XML tree editor load the scheme out of the XML file (via web or via local file) and use it to construct a skeleton in the program memory. This skeleton can be used to validate the data and to create new nodes inside the tree view. There is no option to create a node with a name by oneself. Instead, you have to use the names suggested by the xml scheme. This prevents errors by the user and is all-designed to be user friendly. The XML Tree Editor aims to be used not for the digital calibration certificate only. It can be also used for other certificates e.g., the Digital Calibration Request (DCR), the Digital Calibration Answer (DCA). The presentation shows the program functions in an early stage of development and gives an overview about planed rollouts in the future.

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Parallel Session 5: Adoption of DCC at NMI's

Presentations that would also fit into this session:

- 12 Development of PDF based Digital Calibration Certificates at NMIJ, AIST
- 17 The Digital NIST: Pilot Project for the Digital Transformation of NIST's Measurement Services
- 20 A Proof of Concept for a Digital Calibration Environment for Digital Multimeters
- 25 Generation of Digital Calibration Certificates for Temperature Sensor Calibrations using Python and Excel
- 30 Calibration 4.0: A DCC Implementation in Electrical Metrology for the Calibration of Digital Multimeters
- 36 Pharmaceutical Test Case of a DCR- and DCC Implementation in an Accredited Calibration Laboratory

45 Digital Transformation of NMI: Practical Experience on DCC and Beyond @ NIS-Egypt

Presenting author: Ahmed H. Ali & National Institute for Standards & Egypt

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Additional authors: Reham Abdellatif abouhogail, Mohammed Gadelrab, Mohammed Elsheikh

Abstract

Generally, sharing experience and information is a good practice in the human communities. Its importance increases in emerging scientific or technical fields as it helps people to learn from each other and apply new technologies faster without repeatedly committing same mistakes. The digital transformation in metrology is an ideal example of this practice where experts share generously their experience with fellows. In this presentation, we present our practical experience regarding the digital transformation (DX) and the digital calibration certificate (DCC) at the National Institute of Standards (the NMI of Egypt). We describe how we approached the problem from the early beginning with a clear vision. Not only we describe how we developed a comprehensive plan to make the transition from traditional systems to become fully digitalized. We also explain how we reached this plan through a comprehensive analysis of the status quo of our institute. Besides the IT infrastructure necessary for the digital transformation and the DCC, our plan also covered the metrology-related processes and the metrology artifacts.

Unlike other presentations, ours may explain some overlooked or uncovered issues that might never be confronted by NMIs in more advanced countries. Therefore, we believe that presenting NIS experience could be beneficial for many NMIs that have similar situations or environment such as ours (i.e., with respect to DX/DCC readiness, available facilities, skills/personnel and budget).

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46 The Strategy and Roadmap for DCC Implementation in Russia

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Additional authors: Alexander Kuzin, VNIIMS, Russia

Abstract

One of the main components of the digital transformation in metrology is the widespread transition to machine-readable documents. The calibration certificate is the main document confirming the traceability and measurement accuracy. We have carefully studied the developments of our colleagues within DCC, SmartCom D-SI, GEMIMEG-II, etc. projects and developed a strategy for the implementation of DCC technology in Russia. We have named this strategy IDEAL Strategy, where IDEAL is an abbreviation for International compatibility, Dual suitability, Easy use, Absolute reliability, Legal compliance.

Implementation of the strategy implies development of user application for DCC generation in the form of XML document, as well as for XML conversion back to human-readable format accepted in the local metrology practice. In the future this solution is supposed to be gradually implemented in our NMI (VNIIMS) calibration laboratories, then to be promoted in external metrology institutes and laboratories, as well as in industry.

As of today, we have developed the technical requirements for the user application and started its development. This work is carried out in close coordination with calibration laboratories, the metrology expert community, and information technology specialists.

The main points of our DCC implementation strategy and main milestones of implementation roadmap will be brought to your attention.

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47 Equipment Management and Tracking System - Cloud Service for Calibration Certificate Management

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Additional authors: Narin Chantawong, Jariya Buajarern, and Praiya Thongluang

Abstract

The NIMT has created an Equipment Management and Tracking System (EMTs) that will provide customers with an open service. The EMTs is created following the ISO17025 standard, the general requirements for the competence of testing and calibration laboratories. The EMTs is a platform to approach the problem of storing calibration certificates. The main purpose of EMTs is to store calibration certificates of various equipment in electronic form and manage data storing calibration results for customers. The benefits of this system are easy-to-find documents, privacy, and security of data. The EMTs planning is divided into two phases. The first phase will be used in the NIMT to test the system and receive inner feedback to improve the system. Then it will be launched for third parties and review the comment to improve the system again before the official launch.

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48 Mapping of Processes and Risks in the Digital Transformation in Metrology of Ionizing Radiation - A Case Study in X-Ray Air Kerma Calibration

Presenting author: Igor Fernando Modesto Garcia, Labprosaud/IFBA, Brazil

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Additional authors: Eric Matos Macedo, Marcus Vinicius Teixeira Navarro, José Guilherme Pereira Peixoto

Abstract

To solve the metrological challenges of an increasingly digitized world, countries are developing applications, infrastructure for DCC and researching the comparability of real and virtual measurements. Objective: to map the processes and risks related to the digital transformation of kerma calibration in air in X-rays. For quantification of risks related to the process, the FMEA was used, which is a method widely used in the aviation and automotive industry due to its reliability. The results presented showed and compared the mappings of processes and risks related to contemporary calibration and the 4.0 model projection for x-ray air kerma magnitude. In the contemporary calibration process 18 risks were found. The main identified risk was the error in the analysis and use of the calibration certificate by the user which uses the CC. The main vectors were complexity and number of magnitudes related to the area of ionizing radiation; lack of user metrological training; lack of metrological management of equipment by the user; manual certificate analysis process associated with the complexity in presenting the results of calibration certificates by laboratories and cultural factors (perception of the meaning of the word “calibration” as “adjustment. This result is important because, of all the risks listed in this process, this is the one that presents the greatest harm to metrological reliability. In the case of 4.0 calibration that uses the DCC as premise, the risk of error in the analysis and use of the certificate was significantly lower because the structure of DCC mitigates the main factors related to the CC. The main level of risk in the case of 4.0 is associated with the sensor/actuator chosen, with the reliability and integrity of the communication network.

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49 Processes and Conventions for the DCC – Results of PTB's 100-Day Programmes in 2022

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Abstract

During the past year 2022, significant advancement towards an operational use of digital calibration certificates has been made. PTB has conducted all together three 100-day programmes, focusing on selected aspects of DCC development and roll-out. Whereas the first programme has been carried out as an internal project, with the major goal to advance the development of the GEMIMEG tool, the consecutive two 100-day programmes involved external partners from other NMIs, calibration service providers, and industry.

General aspects such as accreditation and signing of digital certificates were addressed, but also the development of good practice examples for weighing applications were in the focus of these projects. Moreover, a communication workflow for conventions and harmonisation with the core development team has been established to support the current work of technical committees developing good practice example DCCs within various areas of metrology. Selected results of the 100-day-programmes will be presented in this talk, with an emphasis on processes and conventions for the DCC.

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Parallel Session 5: RMO Activities around DCC

Presentations that would also fit into this session:

- 17 The Digital NIST: Pilot Project for the Digital Transformation of NIST's Measurement Services

50 DCC2GO - Supporting the Implementation of Digital Calibration Certificates in the European Metrology Community

Presenting author: Anke Keidel, Physikalisch-Technische Bundesanstalt, Germany

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Additional authors: David Balslev-Harder (DFM), Peter Friis Østergaard (DTI), Lauri Lillepea (Metrosert), Alen Bosnjakovic (IMBiH), Anu Kärkkäinen (VTT), Daniel Hutzschenreuter (PTB), Clifford Brown (PTB)

Abstract

The Project "DCC2GO" is a "Small Collaborative Project" (SCP) funded by EURAMET. The overall strategic aim of this instrument for capacity building by EURAMET is to fund support activities targeted at emerging EURAMET NMIs/DIs. The project "DCC2GO" supports the implementation of DCCs within the European metrology community, through the coordinated production and sharing of training material. The 2 main outputs from this project will be (1) a DCC training compendium, and (2) a DCC starter kit.

- The DCC training compendium will include the current state-of-the-art of DCC development and usage. It will cover a range of information from the basic properties and advantages of DCCs for NMIs, DIs and stakeholders, to full technical specifications for metrology practitioners and technical support (e.g., IT information), to overview documents for senior management and other stakeholder organisations in the metrology community e.g., CIPM, International Organisation of Legal Metrology (OIML) etc. The DCC training compendium will also categorise DCCs currently in use or in development in terms of different types of functionalities, application areas, as well as their benefits and requirements. This should then enable providers and users of calibrations to decide which types of DCCs are the most feasible and appropriate for specific use-cases.
- The DCC starter kit will contain step-by-step guidance for the creation, practical implementation and secure delivery of temperature and pressure DCCs, The guidance will provide knowledge and experience on (i) IT tools for the creation and usage of DCCs, (ii) how cryptographic tools, in particular digital signatures can be securely used with DCCs to protect and validate content and (iii) will consider the large number of issued calibration certificate types and their wide range of applications.

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Parallel Session 6: Community-Feedback for Further Developments of the DCC

Presentations that would also fit into this session:

- **Session D: Community-Feedback for Further Developments of the DCC**
- 06 The General DCC Rulebook and the Rules under the Aspects of Accreditation
- 09 The Semantics of Measured Quantities
- 11 DCC and Digitisation versus Digitalisation and Digital Transformation
- 17 The Digital NIST: Pilot Project for the Digital Transformation of NIST's Measurement Services
- 18 On the Construction and the Dissemination of Digital Metrology Datasets for Research and Development Purposes
- 19 Analyzing the Conformance of DCC Prototype Architecture to Calibration Laboratory Expectations Report
- 20 A Proof of Concept for a Digital Calibration Environment for Digital Multimeters
- 21 DKD's Contribution to DCC Harmonisation and Coordinated Development
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- 31 DCCs for Non-Automatic Weighing Instruments (NAWIs) – Current Status of a Respective Working Group Elaborating "Good Practice" Conventions
- 39 Two Implementations of Digital Calibration Certificates in Industrial and Metrological Services
- 48 Mapping of Processes and Risks in the Digital Transformation in Metrology of Ionizing Radiation - A Case Study in X-Ray Air Kerma Calibration

51 How does a Machine Distinguish the Different Types of DCCs?

Presenting author: Siegfried Hackel, Physikalisch-Technische Bundesanstalt (PTB), Germany

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Additional authors: Muhammed Ali Demir, Lutz Doering, Benjamin Gloger, Justin Jagieniak, Moritz Jordan, Christian Keilholz, Jan Loewe, Kai Mienert, Shanna Schönhals, Gamze Söylev Öktem (in alphabetical order, all PTB)

Abstract

The community has raised the question of how different types of calibration can be addressed in the DCC in such a way that a machine "understands" what kind of calibration is involved in the DCC at issue. This question is made more difficult by the fact that it cannot be derived from the calibration item alone. An obvious example of the calibration job is a digital multimeter (amps, volts, DC, AC, ...). But also, a mass piece cannot only be calibrated with regard to its weight. Often other properties of the mass piece are calibrated, such as density.

The solution to this problem is complex, as it concerns at least two different areas:

A unique storage location in the DCC:

It is intended to use an element in analogy to the element dcc:equipmentClass, as it is already used for the elements dcc:items, dcc:item, dcc:measuringequipments and dcc:measuringequipment. The name for the element is still open.

A directory of calibration types:

We are looking for a directory of calibration types that allows a clear assignment to the DCC. So far, directories of this kind are only rudimentary, see e.g. [1]. The necessity of setting up and operating such a directory service is explained and the community is asked to help.

[1] https://www.ptb.de/cms/en/metrological-services/calibration-and-measurement-capabilities-of-ptb.html

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Parallel Session 6: Traceability

Presentations that would also fit into this session:

- 01 Digital Calibration Certificate as part of an Ecosystem
- 05 Bringing the Digital Accreditation Symbol and the Digital Calibration Report (DCC) into Practice
- 10 Persistent Identification of Instruments and the Digital Calibration Certificate
- 51 How does a Machine Distinguish the Different Types of DCCs?

52 Traceability

Presenting author: Abdullah Al Mamun, Bangladesh Standards and Testing Institution (BSTI), Bangladesh

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Abstract

Traceability comprises of two words i. e. trace and ability. Trace means to find someone or something and ability means to a skill, capability, or talent to do something.

International System of Units (SI). The implementation of Metrology is divided into three basic overlapping activities;

- The definition of units of measurement;
- The realization of these units of measurement in practice;
- Traceability—linking measurements made in practice to the reference standards.

In measurement science, the term “Traceability” means Comparability. Its indicate the ability to compare the results of measurements between different laboratories by the use of a common reference.

According to the Vocabulary in Metrology (VIM) definition ‘Traceability’s a property of a measurement result whereby the result can be related to a reference through a documented unbroken chain of calibrations, each contributing to the measurement uncertainty.

Traceability refers to the procedures and records that are used and maintained to demonstrate that calibrations made by a local calibration laboratory accurately represent the quantities of interest.

To support the claim of traceability, the calibration laboratory must have documented measurement procedures and provide a description of the chain of comparisons to a particular stated reference.

Traceability of a measurement result aim that to a certified value of a common international or national reference standard or the definition of an SI unit; to the measurement results measured with nationally or internationally recognized reference methods.

Each country should have its own national metrology laboratory, which should provide guidance and services to other laboratories in compliance with ISO 17025:2015 requirements. It should maintain national standards and under the prescribed conditions. Such standards should be traceable to international standardization bodies.

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Parallel Session 6: Commercial Approaches to DCC

Presentations that would also fit into this session:

- 01 Digital Calibration Certificate as part of an Ecosystem

53 DCC Middleware – Obstacles and Approaches

Presenting author: Hans Koch, da+d, Germany

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Abstract

When calibration laboratories want to generate DCCs, or, when their customers want to extract information from the DCC, the desirable overall aim should be user friendliness. The handling of the data transfer from and to the respective IT infrastructures should be quick, simple, self-explaining and largely automatic. “Middleware” is the software which supports this data mapping. However, since the individual data management and data formats of the IT of the calibration laboratories and of their customers dispose of a very broad diversity, the middleware must be “personalised”. Often a 1 to 1 mapping is not sufficient, and the data need to be reformatted or modified during transfer to and from the DCC elements.
This presentation will discuss several common cases of such mapping obstacles and describes some practical middleware approaches.

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54 Digital Calibration Certificate with MetricodeHUB, a Real Implementation Case

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Additional authors: Paolo Bonacini, Metricode s.r.l., Italy – Paolo Solinas, A.B.C. Bilance s.r.l., Italy

Abstract

"Metricode HUB" is a "cloud based" platform designed to manage, centralize, integrate and automate the processes and the information generated by a "calibration laboratory".

The “Metricode HUB” software is developed by Metricode; regarding the implementation of the DCC in the platform, the activity is carried out in partnership with:

- PTB (Physikalisch Technische Bundesanstalt Institute) – GERMANY
- INRIM (Istituto Nazionale di Ricerca Metrologica) – ITALY
- A.B.C. Bilance s. r. l. (accredited calibration laboratory LAT 291) – ITALY

The software currently is focused on the management of the "mass calibration" process; specifically "Metricode HUB" will be able to read (and import) a DCC from third parties, and to generate a DCC relating to the calibration operations performed, following the scheme set by the PTB.

The planned validation of the DCC implementation project includes the following steps:

1) Preliminary verification of the DCC scheme, elaborated using the Metricode HUB SW by the PTB.
2) Validation of the software "Metricode HUB" by INRIM and ABC Bilance.
3) Calibration of a reference standard mass and elaboration of a DCC by INRIM, using
4) the "Metricode HUB" SW.
5) Automatic import of the DCC released by INRIM into the "Metricode HUB" SW by ABC Bilance.
6) Calibration of a working standard mass (using the reference standard mass referred to in point 1) and elaboration of a DCC by ABC Bilance, using the “Metricode HUB” SW.

DCCs will be a key part of a fully digitized calibration service delivery process.

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55 Automatic Generation of Digital Calibration Certificates with AnyDCC

Presenting author: Maik Stotz

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Abstract

AnyDCC is software for automatically creating digital calibration certificates.

AnyDCC can be used to create a mapping between the computer system in the laboratory and the structure of the DCC.

Once such a mapping has been created, digital calibration certificates can then be created quickly and in large numbers. All information on the calibrations carried out flows from the laboratory's IT system into the AnyDCC template and is converted there into the XML structure of the digital calibration certificate.

Fluke's MET/CAL software will be used as the it system in the lecture. The MET/CAL software has the great advantage that all data for a performed calibration is stored in a central database. In the lecture, a mapping is set up for this MET/CAL database and digital calibration certificates for PT 100 sensors and handheld multimeters are then automatically created.

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56 DCC via iPhone (or iPad)

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Additional authors:

Abstract

A DCC is platform independent. Thus, it is ideally suited for distributed, multi-platform usage. This is particularly advantageous for mobile operations, e. g. out-door calibrations at the customer site or remote certificate authorization by the responsible person.
In this presentation a step-by-step DCC-generation during a sample workflow will be demonstrated, involving a PC and an iPhone at different stages. The workflow spans over several stations involving different users: creating a new case in the administration, entering item specific components by the specialist, entering measurement results by the technician, and finally authorization by the laboratory head out of office. The used middleware requires as few entries as possible by utilising data base entries. It performs the respected measurement uncertainty calculations and provides as output the DCC, a conventional Calibration Certificate as pdf-file and a printable uncertainty budget.
Finally, the extraction of data from the DCC by the customer with an iPhone will be presented as well.

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