

Blockchain for digital transformation of metrology

Kruno Miličević

<https://www.linkedin.com/in/kruno-milicevic-60760521/>

Faculty of Electrical Engineering, Computer Science and IT Osijek, Croatia

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Abstract

The traceability of the measurement result as one of the foundations of trust in the measurement results, and thus metrology in general, is also exposed to the opportunities and challenges of information and communication technology, i.e. digital transformation.

Namely, according to [1], some future trends are already apparent:

- the move to an increasingly paperless world, including reduced use of paper money;
- continued introduction of digitization in all areas;
- redefinition of the SI is likely to lead to increased availability of intrinsic standards;
- the “internet of things” will lead to increased size and complexity in measuring systems, with a proliferation of sensors; and
- artificial intelligence will become an increasingly important feature in the software of measuring instruments.

and is clear that in the future how calibration and verification is performed will have to adapt to meet these developments.

According to [1], the digital transformation of scientific, industrial and legal metrology activities requires a holistic approach that includes all relevant aspects and activities: (re)calibration, (re)testing, (re)certification, (re)verification/inspection, market surveillance, accreditation, standardization.

Thereby, the so-called FAIR+T approach is recommended for the data. It should be: Findable, Accessible, Interoperable, Re-usable, Traceable. Some issues must be resolved technically and the blockchain technology seems to have needed properties, Table I.

Although not requested by digital transformation, there is also an inherent smart contracts mechanism in blockchain from which measurement traceability could profit. Namely, smart contracts are programs stored on a blockchain that run when predetermined conditions are met. They are typically used to automate an agreement's execution so that all participants can be immediately certain of the outcome, without an intermediary's involvement or time loss. They can also automate a workflow, triggering the following action when conditions are met [2]. They could be used for automated decision-making about (un)successful calibration process, and for recording the decision on the blockchain in the form of a digital certificate. To be smart contract enabled, some technical prerequisites are imposed on measuring instruments and systems.

Conclusively, blockchain should ensure traceability of measurement results from the measured quantity and sensors up to the definition of the measurement unit, through all levels of the metrology pyramid, providing insight into the digital calibration documents as vertical links between adjacent pyramid levels. In addition, it is technically feasible to ensure horizontal traceability as well, i.e. provide insight into a chronological succession of reliable measurement results.

Table I. Blockchain as an answer for digital representation in metrology processes

Requirements for digital representation in metrology processes, [3]	Blockchain properties	Recommendations/possible issues
Contain all relevant information for conformity assessment, verification, market surveillance in a machine-readable way	Data comprised in blockchain transactions	The amount of data could be a problem. It is needed to use/store data in databases outside the blockchain.
Contain all relevant information for customers to gain trust and confidence in the products and quality measures		
Know the relevant standards and regulations, and provide machine-readable information about it	Blockchain uses machine-readable information only	It is necessary to make relevant standards and regulations also machine-readable
Provide machine-readable interfaces for users and manufacturers to enable „smart quality assurance“		-
Combine machine-readable documents and certificates, enable automation of digital QI processes		
Are secured and validated to provide access to information only to eligible parties	Blockchain uses asymmetric cryptography to grant access to users.	To limit who can have access, a private blockchain network is recommended.
Not requested, but could be an additional benefit	Smart contracts as programs stored on a blockchain.	Automated decision-making and recording of the decision on the blockchain

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Other references that will be used for lecture (of course, it will be updated according to the final version of the lecture)

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