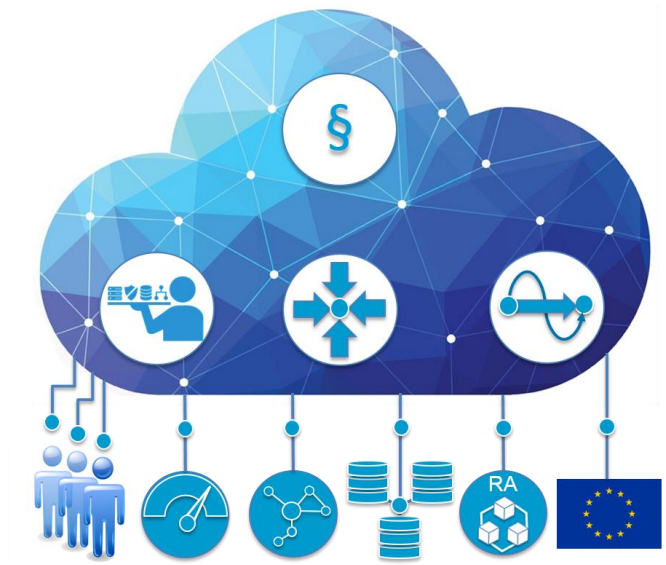
Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin
Nationales Metrologieinstitut

Metrology Cloud



WP3: Technology-driven metrological support services

D. Peters

Outline:

- General Objectives
- Partners
- Time Line
- Tasks:
  - 3.1: Supporting Repair and subsequent Verification
  - 3.2: Supporting Software Maintenance / Smart Contracts
  - 3.3: Digital Verification Marking
- Summary

General Objectives

- Transform established procedures in Legal Metrology into the digital domain
- Broader surveillance of meters
- Better planning of the processes and services
- Less down time of the instrument for the user
- Beneficial for market surveillance and verification, notified bodies, manufacturers, and users
- Future maintenance of software in measuring instruments

To develop new technology-driven metrological services: Technological net-based services may include: remote verification and diagnostics, condition monitoring, (predictive) maintenance and verification with the help of the digital representation, i.e. e-market surveillance and e-compliance according to [COM2014/25].

WP3: Partners

Industry:

Itrón, GILBARCO VEEDER-ROOT, Espera, sartorius, BIZERBA

NMIs:

PTB Messen ▪ Forschen ▪ Wissen, NPL National Physical Laboratory, CEM Centro Español de Metrología, LNE Laboratoire National d'Essais, CMI Czech Metrology Institute

Verification Authorithies:

Science:

Technische Universität Berlin, SECT Security in Telecommunications

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Supported by: European Cooperation in Legal Metrology WELMEC

Work Packages: Responsibility

WP1: Trustworthy Metrological Core Platform (Nordholz / Neumann)

- Task 1.1: Single Point of Contact (Digital Representation) (Dohlus, Yurchenko, Nischwitz, n.n.)
- Task 1.2: Join Infrastructures and Databases (Dohlus, Yurchenko, Neumann, n.n.)
- Task 1.3: Metrological Administration, Trust and Security (Wetzlich, Nischwitz, Neumann, n.n.)

WP2: Reference Architecture (Oppermann)

- Task 2.1: Reference Architectures for IoT Devices (Peters, Nordholz)
- Task 2.2: Reference Architectures for distributed Instruments (Oppermann, Nordholz)

WP3: Technology based Metrological Support Services (Peters)

- Task 3.1: Supporting Repair and subsequent Verification (Peters, Nordholz, Neumann)
- Task 3.2: Supporting Software Maintenance / Smart Contracts (Peters, Dohlus, Nordholz)
- Task 3.3: Digital Verification Marking (Dohlus, Nischwitz, Neumann, n.n.) / Digital Calibration Certificate?

WP4: Data based Metrological Support Services (Esche)

- Task 4.1: Closing the Risk Assessment Loop (Esche, Grasso-Toro)
- Task 4.2: EU ring comparison

WP5: Coordination (Thiel)

WP6: Impact (All)

Rough Time Line

Mai 2018 — 36 Monate

WP1: Trustworthy Metrological Core Platform (Nordholz / Neumann)

- Task 1.1: Single Point of Contact (Digitale Repräsentation)
- Task 1.2: Join Infrastructures and Databases
- Task 1.3: Metrological Administration, Trust and Security

Integration of metrological Services

WP2: Reference Architecture (Oppermann)

- Task 2.1: Reference Architectures for IoT Devices — Prototyps / Connection to Platform
- Task 2.2: Reference Architectures for distributed Instruments — Prototyps / Connection to Platform

WP3: Technology based Metrological Support Services (Peters)

- Task 3.1: Supporting Repair and subsequent Verification (Peters, Nordholz) — Integration in Platform
- Task 3.2: Supporting Software Maintenance / Smart Contracts — Integration
- Task 3.3: Digital Verification Marking — Integration

WP4: Data based Metrological Support Services (Esche)

- Task 4.1: EU ring comparison — EU Harmonisation
- Task 4.2: Closing the Risk Assessment Loop — Implementation

Time Line

June 2018 — 36 Months

- WP1: Trustworthy Metrological Core Platform
- WP2: Reference Architecture
- WP3: Technology based Metrological Support Services
- WP4: Data based Metrological Support Services
- WP5: Coordination
- WP6: Impact

Convergence

- Platform/QI Demonstrator
- Integration of:

1. Data bases and Infrastructures
2. Fundamental Services
3. Reference Architectures
4. Prototypes
5. Existing MI

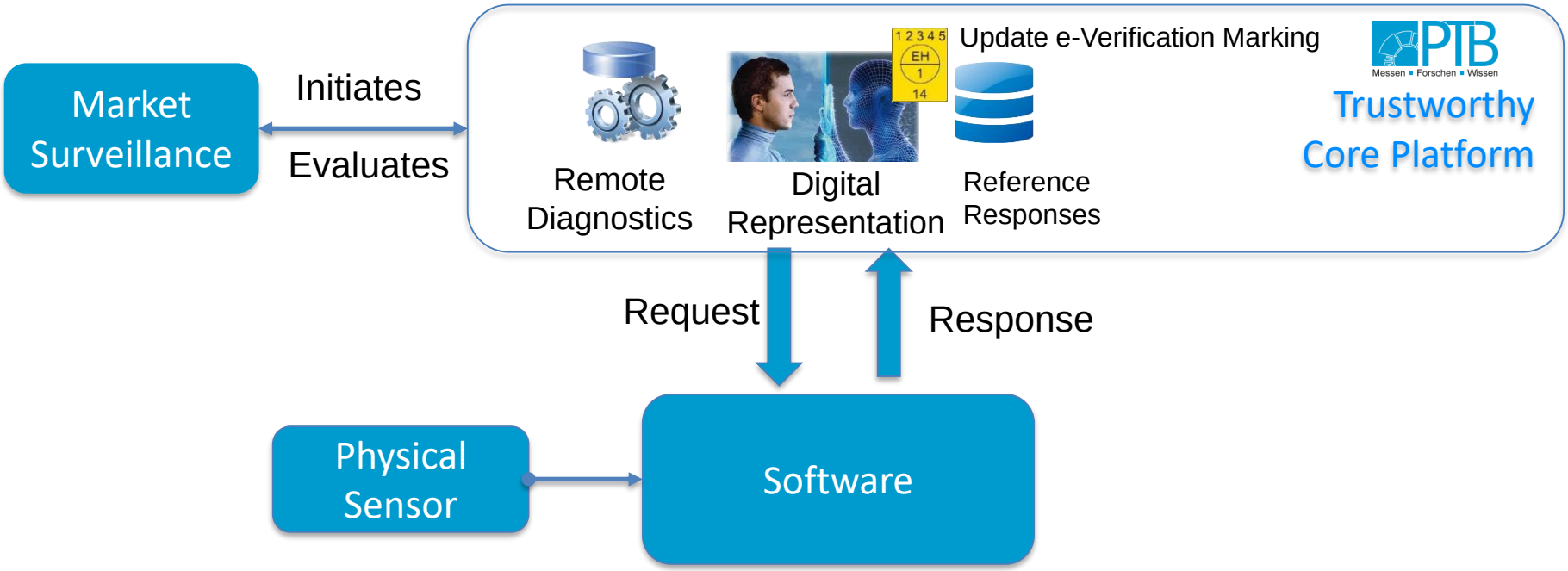
=> Requirements catalogue

Main Impact:

- Metrological Trust Anchor
- Streamline processes
- Repair / Verify a large number of MI remotely
- Reduce down time
- Harmonize processes

Task 3.1: Support of Repair/Verification

- Pretesting § 37(1) MessEV
- Verification of Parts § 39 (3) MessEV

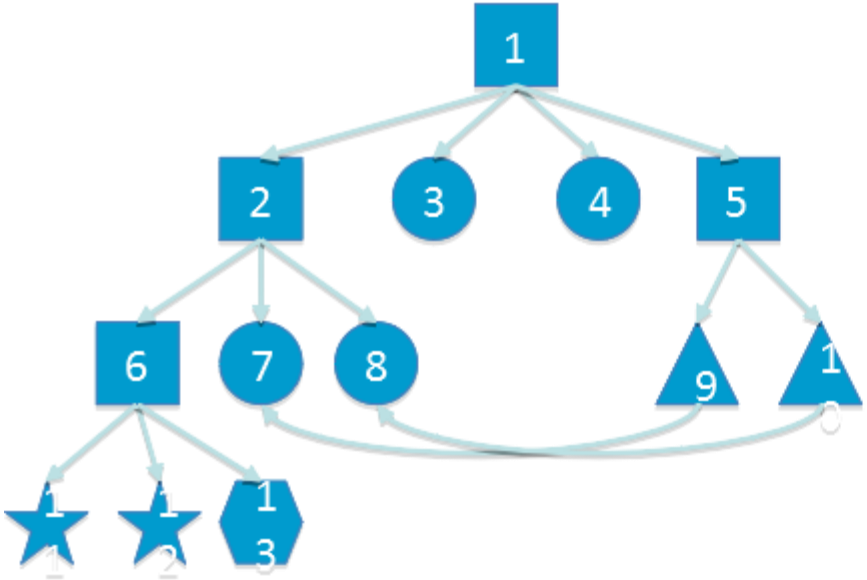


Complexity

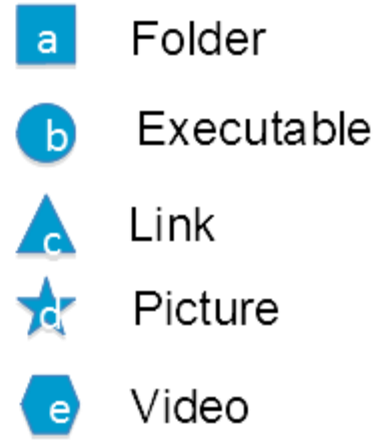
<u>Types of Requests or Tests to Support Verification:</u>

1. Check protocol, or log files
2. Check system/module integrity,
3. Condition Monitoring / Verification of File Systems
4. Apply Test Data / Test Cases

File-system Checking (Remote Maintenance):



Names:
1: root
2: usr
3: kernel
.
.
13: circus



N = r o o t u s r k e r n e l … c i r c u s

N_B = 1 0 00 1 00 1 0 00 00 … 100 0 00

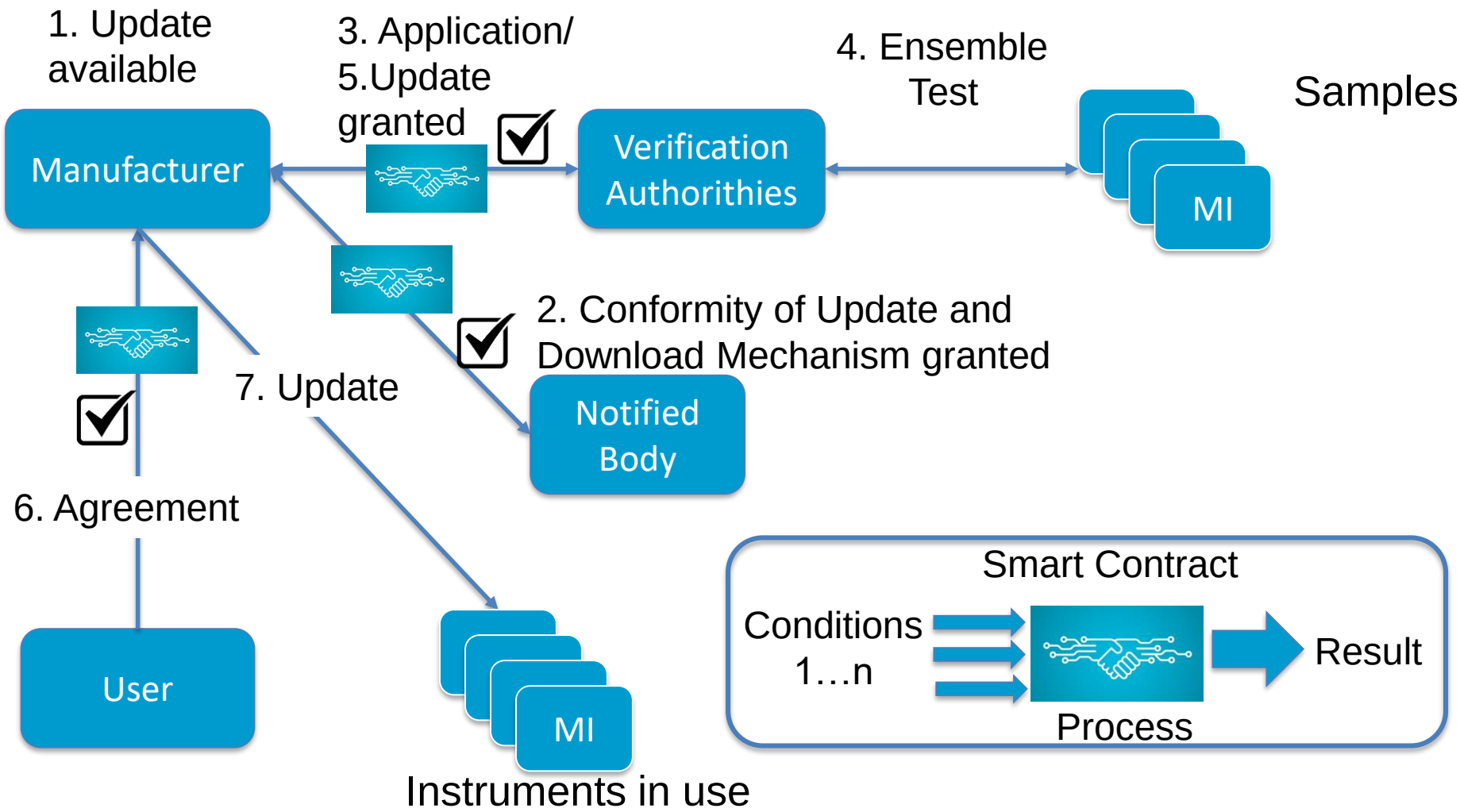
F = a a b b a a b b c c d d e

F_B = 0 1 0 0 0 1 0 0 1 0 1 0 0

L = 7 8

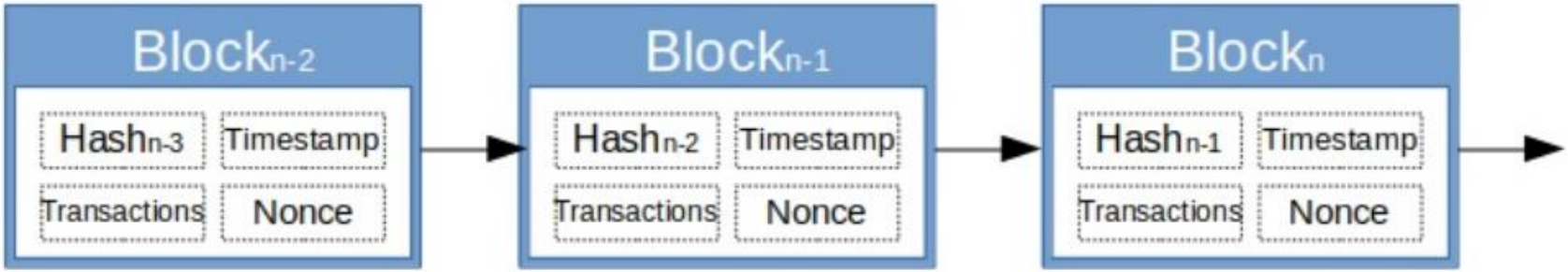
Task 3.2: Supporting Software Maintenance

Standard Procedure § 40 (3) MessEV, (WELMEC Guide 7.2 Extension D)



Blockchain Technology

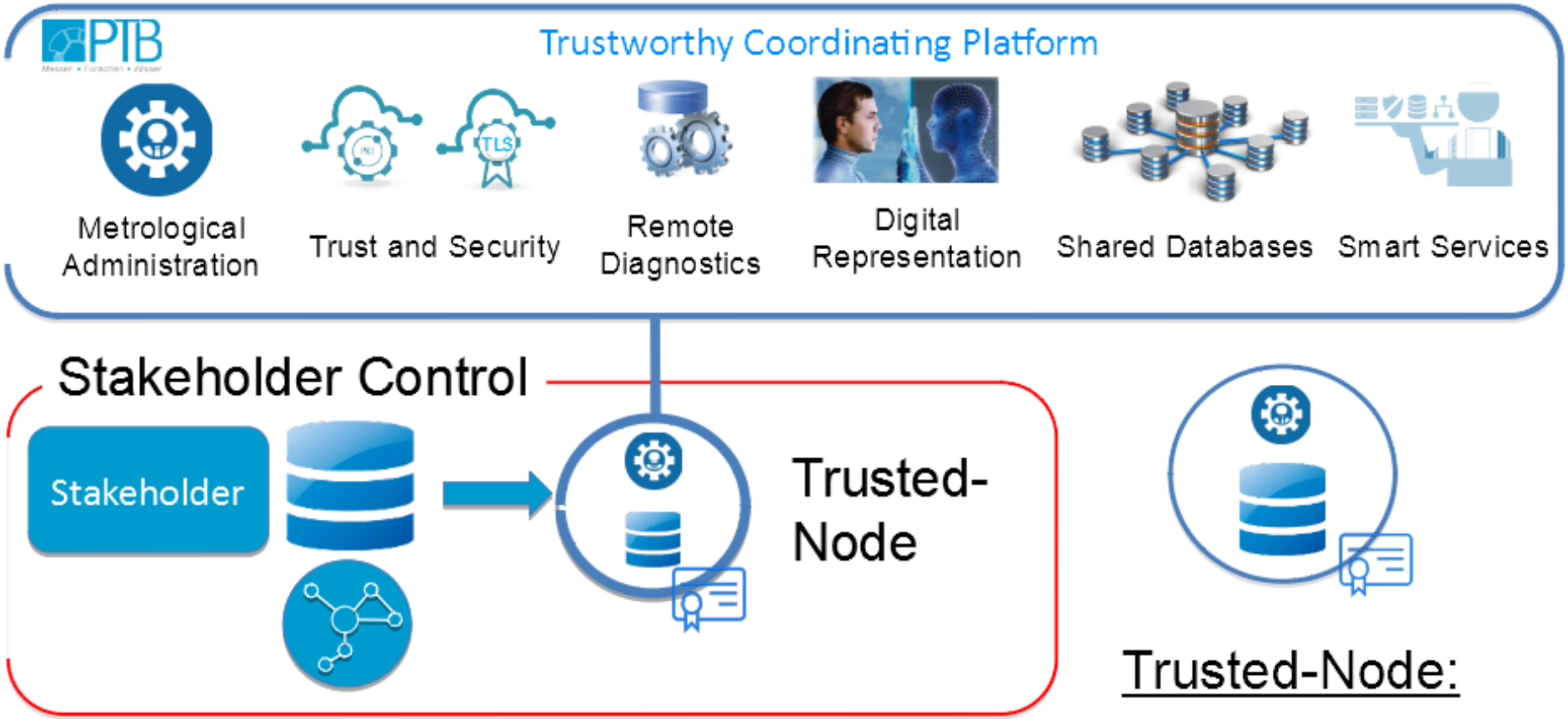
- a **database** in which entries are grouped in blocks
- **blocks** are linked in chronological order
- based on **cryptography** and peer-to-peer (**P2P**)
- distributed **consensus** systems
- the whole data of the blockchain is stored **redundantly** in each node
- Different approaches like **Proof-of-Work** and **Proof-of-Stake**



Smart Contracts an DAOs

- Smart contracts are **computer programs** that can make decisions when certain conditions are met
- Concept was introduced by Szabo in 1996
- Blockchain offers a suitable medium for implementation
- **Scripts** with the contract details are **stored in a specific address** of the blockchain
- If the specified external **event occurs**, a **transaction** is **sent to the address** whereupon the terms of the contract are executed accordingly
- A Decentralized Autonomous Organization (**DAO**) can be defined as a decentralized network of autonomous subjects where both humans and devices can cooperate with each other
- DAO actions are based on rules and processes dictated by smart contracts, as well as ownership relationships that are registered in a blockchain

Smart Contracts running on Trusted Nodes



Trusted-Node:

Trusted Metrological Architecture,
e.g. provided by PTB,
supervised by MA

Blockchain Technology

- Blockchain technology is **disruptive** and in its beta stage
- Very **promising**, because **legal metrology** directives and guides formulate many requirements, e.g., parameter integrity for the measuring instrument, durability of measurement result, and possibilities to identify transactions, which can all be fulfilled by a blockchain.
- Examples are an update process, a decentralized audit trail and a PKI system.

Challenges:

- Embedded devices should handle the huge amount of data
- Many approaches like **Proof-of-Work** and **Proof-of-Stake** algorithms, or even other technologies, e.g. **DAG-systems, Hashgraphs**

Task 3.3: Digital Verification Marking

- Compile the requirements for the support of software maintenance in measuring instruments, combining remove, repair and verification concepts
- Evaluate different concepts for supporting software maintenance with respect to the benefits in Legal Metrology, considering the results of Task 3.1 and Task 3.2.
- Develop a prototype of the most beneficial concept for software maintenance in Legal Metrology
- Integrate the concept into the TMC-platform and study its feasibility, industry partners provide technological support

Summary

Development of a digital representation of the measuring instrument should:

- Contain administrative data, a log file and system model of the instrument
- Collect, evaluate and disseminate data
- Collect and share information of the type of instrument
- Initiates actions if certain conditions are fulfilled

Challenges:

- Digital “support of repair” and “support of verification”
- Exploring the “streamlining of software maintenance” for all stakeholders’ benefit
- Focusing on remote testing module of the logical part
- Initiation of runtime integrity tests
- Test during runtime, like file system test or permanent condition monitoring of the instrument

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