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A Cloud Native Architecture for automated Metrological Services

Manuel Meiborg, Alexander Oppermann, Samuel Eickelberg, Anke Keidel, Catharina Kulka-Peschke
Physikalisch-Technische Bundesanstalt (PTB), Abbestr. 2-12, 10587 Berlin, DE

Corresponding Author's e-mail address: alexander.oppermann@ptb.de

Summary:

The Operation-Layer is an applied architectural concept to interconnect and digitally transform PTB's internal processes. It consists of of three main pillars to modernize PTB's digital infrastructure: a modern self contained container environment; a state-of-the-art identity access management solution; harmonized software development guidelines to ensure streamlined, secure and pointedly special tailored applications in a cloud native environment. Breaking up data silos, streamlining process flows and simplifying IT management while centralizing administrative IT environments will have a tremendous positive effect on the every-day-workflow for any employee at PTB.

Keywords: *Digital Transformation, Universal Service Hub, Metrological Processes, Digital Calibration Certificate, Robotic Process Automation*

Introduction

In contrast to other public bodies, the Physikalisch-Technische Bundesanstalt (PTB) consists of very specialized and independent departments, working groups as well as laboratories. Each group has unique technical requirements due to their specific metrological task. The working groups have little to no overlap in their daily work. Furthermore, these groups often represent the national or international standard of calibration or the current state of research. Depending on the grade of digitalization and exisiting programming skills, some of these groups write and operate very advanced software systems. Despite of the high complexity and maintenance effort, these information systems, are usually maintained by very few non IT experts. These special tailored systems often compromise security, reusability, generic coding patterns and coding quality due to limited time, knowledge and interest. In defiance of the introduced security issues, this operating principle does not advertise innovative solutions and prevents other parts of the organization to participate and to profit from the invested time and effort for automatizing work flows. Best case scenario is unnecessary repetition. However, most working groups lack the required IT-skill and therefore are stuck with their labor-intensive manual work flow.

Cloud Native Architecture

This problem area will be addressed by the Operation Layer (OP-Layer) introducing a harmonized, centralized and containerized software development platform for special tailored applications (see Fig. 1). By offering a secure framework with harmonized interfaces and identity access management, the research groups can focus on their actual problem solving method and outsource the maintenance as well as security to the centralized IT department.

The OP-Layer offers an internal service hub to host special tailored application ideally with a generic entitlement to serve several working groups. By reducing the administrative

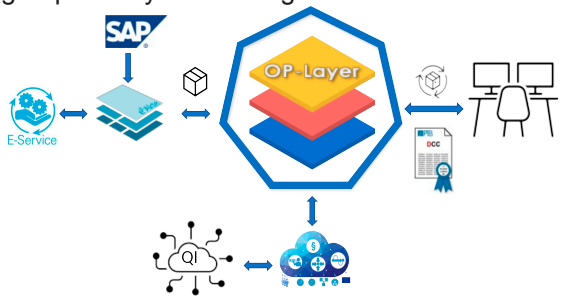

Fig. 1. Workflow overview with a scalable cloud native infrastructure at heart. The OP-Layer harmonizes interfaces, exchange formats and processes throughout the organization.

overhead for the research staff more time can be claimed for original research and in addition increasing security and quality for special tailored applications. The OP-Layer development is defined by three main pillars:

1. **Container Environment**: A self hosted sophisticated container environment with prepared CI/CD pipelines, secured networking and resource-management – Kubernetes is the current state-of-the-art solution.

2. **Identity and Access Management**: A central solution for handling authentication (with organization-wide PTB-ID) and access control for services in the OP-Layer – the de-facto-standard solution Keycloak is employed.

3. **Service Guidelines**: Providing and enforcing principles of modern software design for distributed services. Furthermore, it is encouraged to publish the code as Open Source. A service should be as lightweight as possible, provide REST-interfaces and come with some basic documentation.

Digital Calibration Certificate Process

Facilitating the adoption of the OP-Layer within PTB, reference implementations are provided of commonly used services with high impact factors. Thus, the Digital Calibration Certificate (DCC [3]) process has been entirely digitally transformed and implemented [4] within the OP-Layer.

The digital calibration process starts with the E-Service Portal. A customer portal, which offers a calibration certificate application. After applying for a calibration certificate for a measuring instrument, the process continues with a automatically created file in the E-File System. All data is automatically transferred and archived in a file. The responsible department checks the validity of the application. At this point in the process, the OP-Layer offers a convenient way to automatically transfer all necessary data to the calibration laboratory via unified REST interfaces. Moreover, a DCC service is built that automatically imports administrative data from the E-File System, in order to create a proper DCC. The resulting DCC can be automatically uploaded via the OP-Layer into an existing file within the E-File System. From there, the file handler submits the DCC to the E-Service Portal.

The OP-Layer offers also a modularized web application frontend (Fig. 2) to demonstrate the abilities of the OP-Layer.

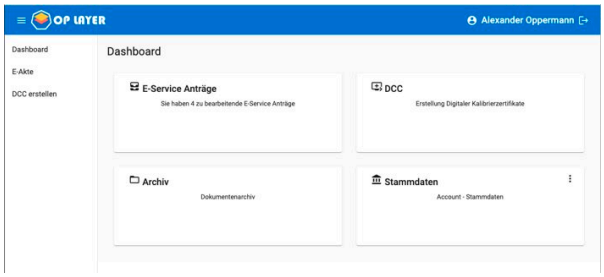

Fig. 2. Dashboard of the OP-Layer with special tailored applications such as DCC Service, E-File Service, Archive and Core Data Service. The tiles can display dynamic data from each advertised service.

Conclusions and Future Work

The first implemented Digital Calibration Certificate Process has shown a huge potential for automation and optimization. Especially for future use cases it has proven the efficiency gains and the simplicity of a digital transformed process. However, transforming the process also highlighted the challenges in defining mandatory standards and minimal shared requirements within a federal organized body such as PTB.

The next phase is to onboard working groups to the OP-Layer service infrastructure. These early adopters will have enough IT skills to export their special tailored application to the OP-Layer. This will enhance the service guidelines and is a great opportunity to connect the development community within PTB. Moreover, harmonizing development and deployment procedures increases tremendously IT security of the whole organization.

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