Technische Universität Braunschweig

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Integration of a Platform for Energy Storage Experiments into a Generic Testbed Framework

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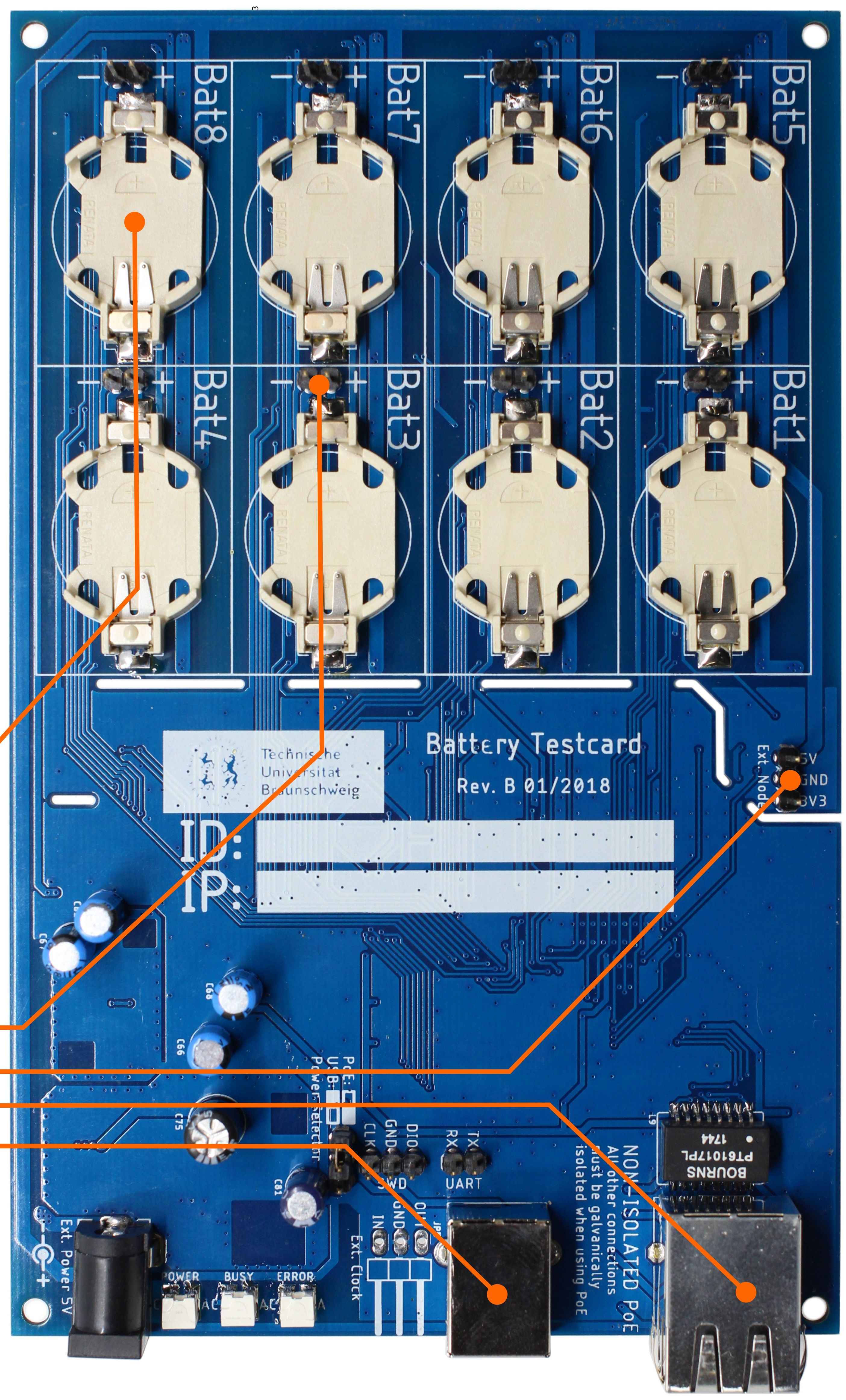
Motivation

Lifetime is one of the most important challenges when deploying wireless networks. **Maximizing lifetime** is the superior goal. For network planning, dimensioning energy sources can be costly and hard, as modeling the behavior is not easy. Finally, the real-time energy status (state of charge) is another important metric when optimizing routing protocols and scheduling algorithms.
However, models are often simple such as a ledger, where drawing current substracts charge and the device fails when the charge reaches zero. Modeling batteries is more complex as they are defined chemical processes and are influcened by many aspects. The shape of the load (discharge pattern) has a huge impact on the lifetime. Additionally, temperature affects the performance, i.e. cold batteries are less efficient. Therefore it is ambitious to make precise statements about the current state of charge.



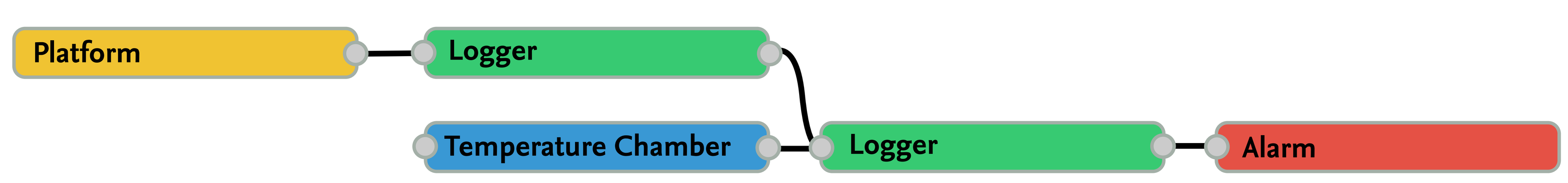
Platform

Our Platform for energy storage experiments allows to study different effects of influcenes on batteries and other energy storage devices. It is designed to support long-term, temperature independent experiments. Its hardware was designed to support measurement eight channels at once. The platform provides several relevant functions, some of which are:

- Battery holder for CR2032 coin cell
- Pin Header for external storage devices
- Connector for external node
- PoE capability and control directly via Ethernet
- USB connector to directly attach to a computer
- Scripting capability

Testbed Framework

Our experiences show a gap between modeled behavior in simulations and real world deployments. Investigating the observed effects is therefore necessary to make networks more reliable and robust. Testbeds fulfill this task, but often lack flexibility as they are designed for specific purposes. Additionally, setting up testbeds is time consuming.
Our testbed framework is based on python modules which can be individually loaded and combined, which reduces setup time dramatically. Communication is based on MQTT which ensures reliability and scalability. Data generated is modeled as a flow towards the database. This allows the user to configure the testbed fast and intuitively.



Circles indicate inputs/outputs and lines the data flow. Connecting an output to an input will automatically create a configuration message subscribing to the specific MQTT topic. Data can be combined by connecting loggers. In this use case, we combine temperature data with the batteries' voltages.

Use Case: Automated Testing

The integration of the platform into our framework allows large-scale, automated testing on energy storage systems. For CR2032 cells we can run months or even years of experiments in parallel. To simulate energy harvesting, we support both charge and discharge. Low frequency readings of voltage and current keep the amount of data low, while high frequency traces allow to analyse data for fine-tuned models.