1. Problem

Sensor data is key for optimizing energy usage in energy communities. Unfortunately, the use of different communication technologies led to a diverse landscape of incompatible devices. Problems in this context are:
- Incompatible protocols
- Complicated integration processes
- Disclosed traffic
- Varying security mechanisms
- Different encodings

The question is, what is a suitable way to facilitate interoperability and integration problems with minimal disruptive measures. This intention was achieved by constructing a service-oriented Web of Things architecture. The process followed the design science research process by Peffers et al. and started with the identification of nine key aspects that are visualized in the following figure:

3. Architecture Design

The architectural approach handled the key aspects by outsourcing concerns to five separate services:
- The Directory Service maintains and provides device descriptions for device and service orchestration.
- The Runtime Service dynamically instantiates gateway scripts to transform traffic and translate data.
- The Network Service provides a common (virtualized) network for devices and services.
- The Security Service manages device and service access and authorization.
- The Discovery Service identifies devices via diverse adoption and scanning methods.

4. Solution

A corresponding service architecture can now solve interoperability. For example, the Directory Service can be deployed in a building to maintain a list of local devices. Similarly, the Security Service can be deployed in the cloud for central authorization management. An exemplified deployment could look like this:

5. Service Interaction

Interaction of the services with corresponding users and devices was specified using sequence diagrams. The following diagram shows an exemplified instantiation procedure of a gateway that translates protocol messages:

2. Research

The question is, what is a suitable way to facilitate interoperability and integration problems with minimal disruptive measures. This intention was achieved by constructing a service-oriented Web of Things architecture. The process followed the design science research process by Peffers et al. and started with the identification of nine key aspects that are visualized in the following figure:

6. Implementation & Results

A simulation tested the architecture's feasibility by utilizing the Web of Things standard, HTTP, and JWT. Interoperability was tested by adopting a compatible electric vehicle charging station and a legacy inverter. The solution was evaluated by verifying the predefined architectural properties confidentiality and access control, interoperability, usability, and extensibility. As a result, the experiment showed that a service-oriented and Web of Things-based solution is suitable to facilitate interoperability and integration problems in energy communities.