ElCaCon - Electric Car Station Controller

Degree programme: BSc in Electrical Engineering and Information Technology | Specialisation: Embedded Systems
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Industrial partner: Source Engineers GmbH, CH- Bern; BE Netz AG, CH- Luzern

Climate change is the defining challenge of the 21st century. Electric cars play a crucial role in reducing greenhouse gas emissions so that humanity can achieve carbon neutrality. In addition to more marketable electric cars, appropriate infrastructure is needed to meet growing demand. To this end, the ElCaCon project sets out to create a device which allows for the remote monitoring and power source control of electric car charging stations.

State of the problem

The purpose of the ElCaCon project is to allow Source Engineers GmbH to monitor and control the electric car charging stations of industry partner BE Netz AG. Monitoring includes data collection, analysis, and visualization for record keeping, among other purposes. Control refers to the ability to send and receive commands, with the ultimate goal of choosing the optimal power source (renewable or nonrenewable) at any given time. The ElCaCon controller device was built with maximum flexibility in mind. In the future, similar control and monitoring mechanisms could be implemented for other targeted systems such as heat pumps or solar panels.

Implementation

To support the required extendibility, the controller has been developed on a Revolution Pi (similar to a Raspberry Pi) using a Linux/Raspian operating system. A microservice architecture was developed that runs on the Linux/Raspian operating system and communicates via Google's gRPC framework. Additional services with specialized tasks can be added to the microservice architecture as needed. These specialized services can, for example, communicate with targeted systems such as the charging stations, heat pumps, or solar panels. In particular, the service that communicates with the charging stations uses the OCPP 1.5 protocol to poll data and send commands. Data polled by this communication service is sent through the microservice architecture to the Azure cloud using the MQTT protocol, where the data is analyzed and visualized. The Azure cloud can also send commands to the controller to change settings, install updates, and control targeted systems. Connecting the controller to the cloud opens up the possibility to scale the project to a virtually unlimited amount of controllers which can be managed in multiple locations and for variable use cases.

Results and outlook

This thesis project was able to yield a controller that can monitor the charging stations in the cloud and distribute commands received from the cloud to the relevant services. Additionally, the controller can update its operating system as well as software when prompted by the cloud. Moving forward, an updated OCPP protocol (1.6 for example) is vital to effectively control the charging stations and optimize power sourcing. With the working microservice architecture and the connection to the cloud, the controller is now well-prepared to support a wide variety of targeted systems and sensors. With this new tool, Source Engineers GmbH is able to quickly expand its repertoire of supported systems.

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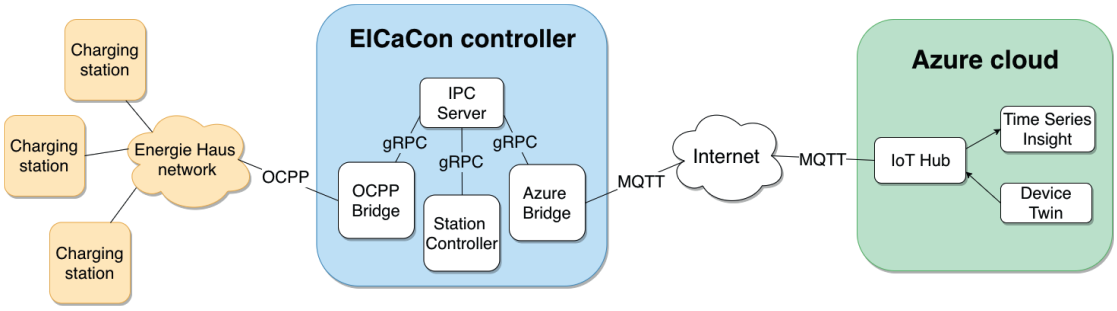

System overview