EEL: OCPP Over Cloud

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Abstract

Our team has worked alongside FLO, a Canadian Electric Vehicle (EV) charging station manufacturer and network operator on this project. Connectivity of charging stations to network operators is a fundamental component to EV charging stations and networks. Some of FLO’s chargers currently utilize a proprietary network protocol to facilitate communication between the charging stations and network operators. The EV charging industry has adopted the Open Charge Point Protocol (OCPP) which defines a standard protocol for communicating between charging stations and network operators.

FLO has adopted the OCPP standard in some of their newer models, but this leaves older models communicating on an older protocol unless retrofitted. Our project develops a cloud-based solution to allow existing hardware to communicate with network operators using the OCPP standard without on-site modifications. OCPP over Cloud provides a solution for existing EV charging network operators to utilize a single backend server and protocol to communicate with FLO charging stations. Additionally, this allows for better compatibility with third-party EV charging stations and software solutions for EV charging networks.

Methods

Introduction

As the adoption of EVs increases and international automotive targets draw closer, the infrastructure required to power EVs will become more important. Increases in the number of EVs on the road will lead to an increase in the number of EV chargers being installed. Early adopters of EV chargers may be utilizing hardware that can only interact with the manufacturer’s own network or require hardware upgrades to communicate with third-party servers. A cloud solution allows for interoperability and will allow for EV charge point operators (CPOs) to move to a new charging infrastructure instead of retrofitting old stations. By utilizing the cloud solution and the OCPP protocol for communication, CPOs can utilize the same charging network software resulting in lower development costs by not updating existing hardware.

Diagrams

Figure 1: High-level diagram illustrating the information flow through the OCPP Over Cloud service. Components developed by EEL are highlighted in orange.

Figure 2: Messages flow from the router to the host pod queues. Messages in the queue until they are held until handled by the EEL host pods.

Figure 3: Chain of subscriptions used for by EEL for tracking message events from the routers.

Glossary

Open Charge Point Protocol (OCPP) – An open standard for communicating between EV chargers and EV charging networks.

Charge Point Operator (CPO) – An entity that is operating a public EV charger.

Host Pod – A container hosted in a Kubernetes cluster that is responsible for handling OCPP WebSocket connections between the service and CPO services.

Router – A container hosted in a Kubernetes cluster that is responsible for receiving and routing messages to host pods.

Monitor – A container hosted in a Kubernetes cluster that is responsible for monitoring resource utilization of host pods and dynamically scaling them up or down based on predefined thresholds.


Service Bus – A message broker that allows different applications to communicate with each other with message queues and publish subscribe topics.

Dynamic Scaling – The system automatically adjusts its resources based on the load on the system.

Topic – A messaging entity that allows for one-to-many messaging, where all subscribers receive the message sent to the topic.

Cloud Deployment – The service is currently deployed on the Azure cloud platform. By using Dapr to wrap platform-dependent services and utilizing Kubernetes our system is cloud agnostic and could be deployed to any of the cloud platforms.

Results

The OCPP over Cloud service developed as part of the project successfully satisfied the specifications outlined in the design phase. The solution can dynamically scale the number of hostpods based on system demand, allowing the service to accommodate up to 40,000 chargers that currently exist within FLO’s network. Utilizing Dapr, our service can subscribe to messages on an Azure service bus, with flexibility to be configured to use comparable applications on other cloud providers, allowing us to swap them out.

Upon receiving the message (FLO proprietary), the router routes the message to the designated hostpod if one is already assigned to that charger; otherwise, it assigns one based on performance metrics. Subsequently, the message is packaged into an OCPP message and dispatched to the CPO network. The system supports the core OCPP 1.6 protocol and can be further expanded to accommodate additional profiles within the 1.6 standard. Most importantly, integration with FLO’s systems allows seamless communication between hardware utilizing proprietary FLO protocols and OCPP compliant CPOs.

Conclusion

This project allowed our team to learn more about the inner workings of EV chargers and the networks that CPOs use to operate them. Hands-on experience with technologies such as Dapr, Kubernetes, Azure, RabbitMQ and Rebus has developed our skills that are sought after in the industry. By leveraging these technologies, our team was able to deploy and manage our cloud-based solution that is scalable for up to 40,000 chargers.

This cloud-based solution signifies a step towards international adoption of EVs. By eliminating the need for retrofitting old stations, our solution allows for both interoperability and reduction of development costs.

References