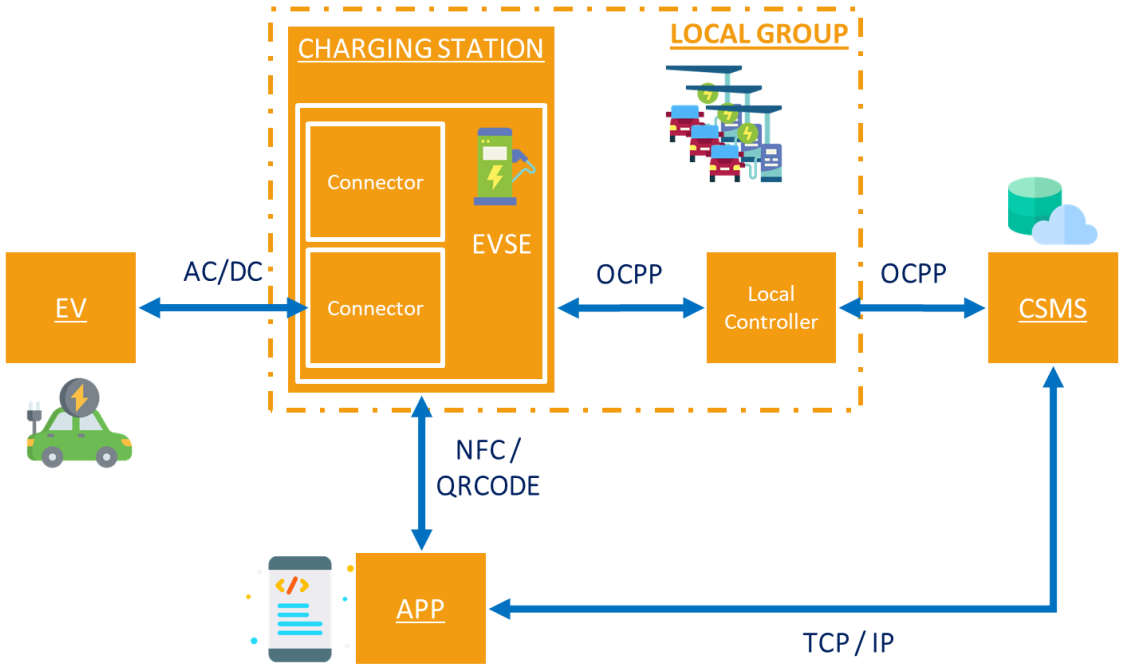
CINI Smart Cities University Challenge 2023

Smart Charging Station Managemet System

The project consists in the development of a smart system for managing and monitoring Charging Stations (CS) for Electric Vehicles (EV).

The reference architecture is the following one:



Components of the system

- A Charging Station (CS) provides one or more Electric Vehicle Supply Equipments (EVSE)
- An EVSE is equipped with one or more connectors of different types, only one connector can be used at time
- Types of connectors include their name (e.g. Type 1, Type 2), the type of current (AC/DC) and the maximum recharge power in kW
- A Charging Station Management System (CSMS) authorizes an EV Driver to start or stop charging, operates CSs and monitors the status of the connected EVs and of CSs
- Optionally, a Local Controller (LC) can be employed to facilitate some operations on a local group of CSs, for instance to get aggregated data or manage CSs in case of communication problems with the CSMS
- Communication between the CS, the LC and the CSMS is based on the OCPP protocol

  Remark: to simplify the implementation, a more general protocol can be adopted instead of OCPP for the communication between the CS, LC, and CSMS.

Scenarios description

The EV Driver uses an APP to be authenticated and to be authorized to start or stop charging. The APP comunicates with the CSMS via the HTTP protocol.

The EVSE used for charging the EV is identified through Near-field communication (NFC) or QR code or a code inserted by the EV Driver in the APP.

If authorized, the CSMS sends to the CS a request to start or stop charging.

When charging starts the CS notifies to the CSMS the new status “occupied” of the EVSE, when charging stops the CS notifies to the CSMS the new status “available” of the EVSE. If for any circumstance an EVSE becomes unavailable or faulted, then the CS notifies to the CSMS the new status “inoperative” of the EVSE.

When an EVSE in “occupied” the CS sends to the CSMS periodic meter values including the energy imported from the grid supply (in kWh) and the state in percentage of charge of charging EV.

Functionalities

Besides the basic functionalities described in the scenarios above, the following additional ones should be provided:

- A dashboard for monitoring all the available CSs
- Persistency of the time series acquired from the meter values of CSs for analytics purposes
- Notification to the EV Drivers sent when the percentage of charge has reached a certain threshold

Submission

The project submission consists of

- slides presenting the proposed architecture (see (*))
- prototype source code on Github (see (**))

Please include link to slides in the Github documentation.

(*) Proposal of the architecture of the IoT system with a particular attention on the following points:

- communication infrastructure and middleware
- software components for data acquisition, storage and processing, dashboard and visualisation and main functionalities of the different components
- interaction schemes (UML-like, state machine etc) that describe the main protocols needed in the system

(**) Implement a prototype of of the system using some of the programming frameworks or platforms discussed in the course (e.g. Arduino, RPi4, Tinkercad, Wokwi, Node.js, Node-red, ThingWorx, Ubidtots, etc) possibly combined with other technologies and platforms.
Devices can be simulated with Tinkercad/Wokwi, or with scripts.