An OCPP interoperable services system based on a SmartM3 core

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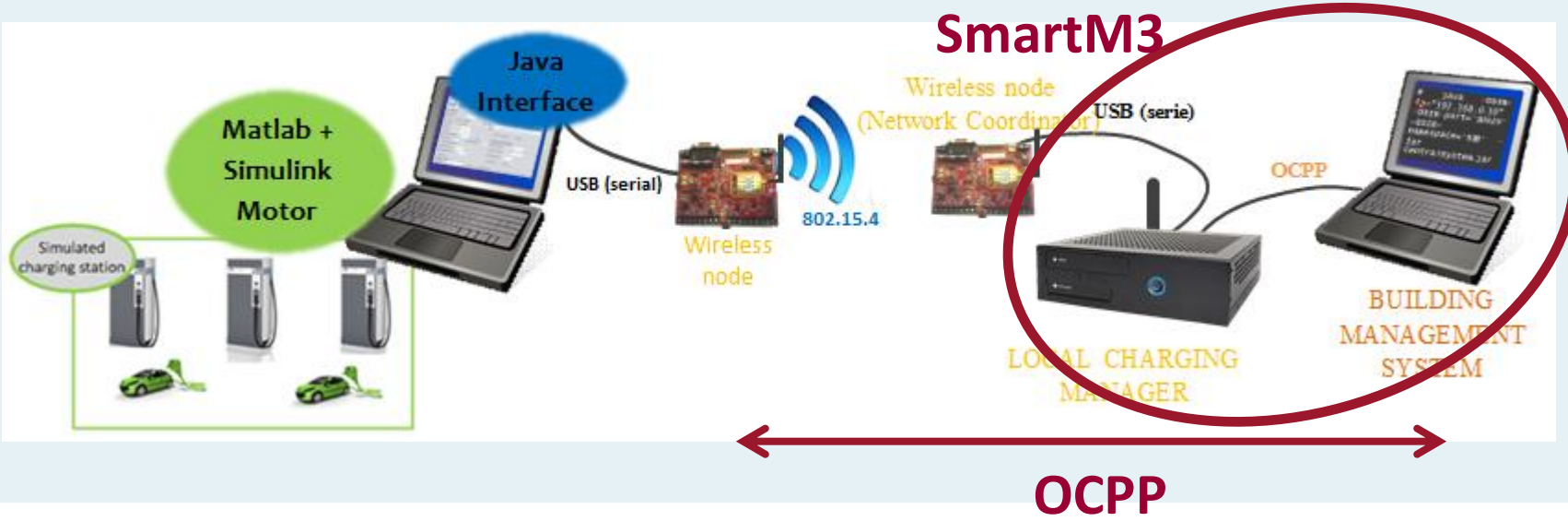
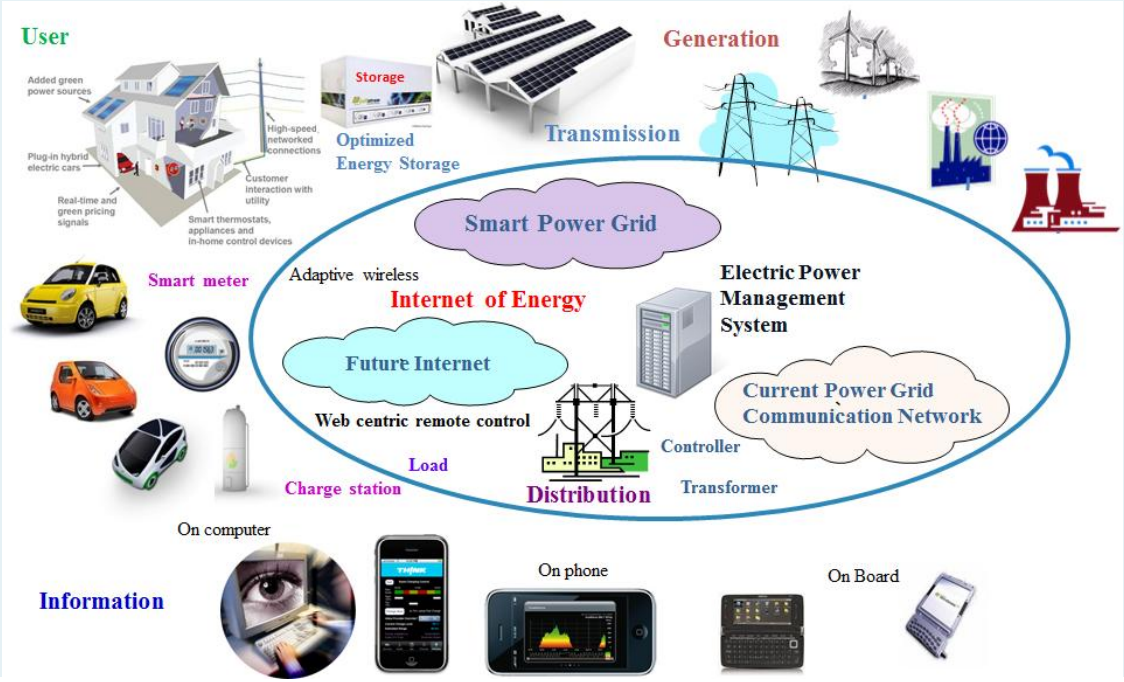
Introduction

- **Electric Mobility** is becoming a reality.
  - New **ICT services** and tools are needed.
  - **Standarization** effort is crucial.
- **Semantic interoperability** and **Smart Environments** are pillars for the growing Semantic Web and IoT.



Introduction

- **ARTEMIS IoE project:** **Integration and interfacing** between the power network represented by the **grid** and the data network represented by the **Internet** and focusing on transmission, substation and distribution control, metering, substation monitoring and diagnostics and location information systems into **seamless and coherent Internet of Energy**.



AICIA-GIE in IoE project

Our tasks

- Developing a **standard communication network** applied to **electric vehicle system** → **OCPP**
- Working towards an **open source platform** able to integrate different communication technologies based on **IP** → **SmartM3**
- Focused on **wireless radio technologies** for smart metering and for the integration of sensors and actuators → **IEEE 802.15.4**
- Contributing to the **user interface** through a smartphone, an application for remote monitoring of charging in progress → **Android app**

Communication technologies

Communications technologies:

- WSNs: **IEEE 802.15.4** for Charging Stations (EVSE – Local Charging Manager).
- **SSAP/IP** (OCPP ontology based, SmartM3) between Charging Stations and Central System.
- **SOAP/IP** (pure OCPP) between Charging Stations and Central System for third parties.

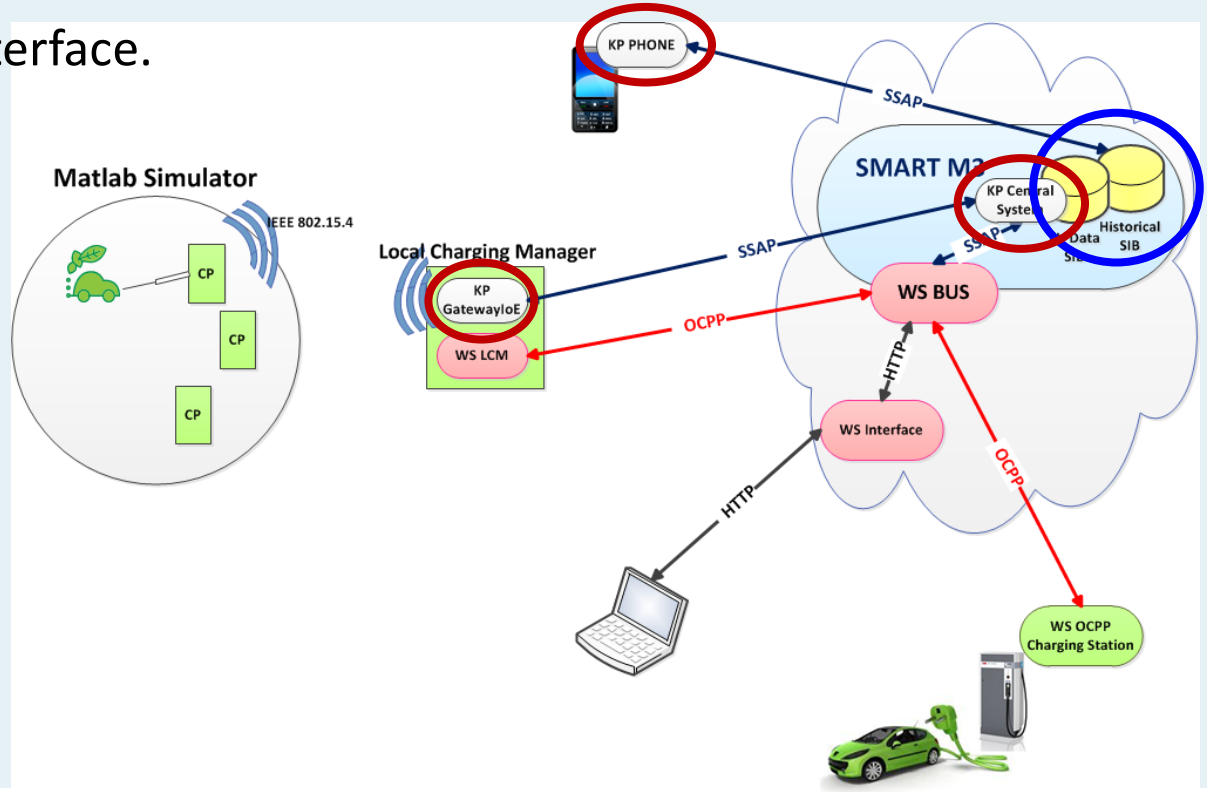
Semantic Web

- **SmartM3** is a Semantic Web open-source SW project → Smart Environments (born in ARTEMIS SOFIA project)
  - Components: **Ontology** (data structure), **SIB** (data store) and **KP** (applications).

- System Smart-M3 based:
  - Ontology models EV infrastructure entities. We share ontology with UNIBO.
  - **Two SIBs**: EV data SIB & Charging Historical data SIB.
  - **Three KPs**: GatewayIoE, CentralSystem and Phone.

Smart-M3 entities

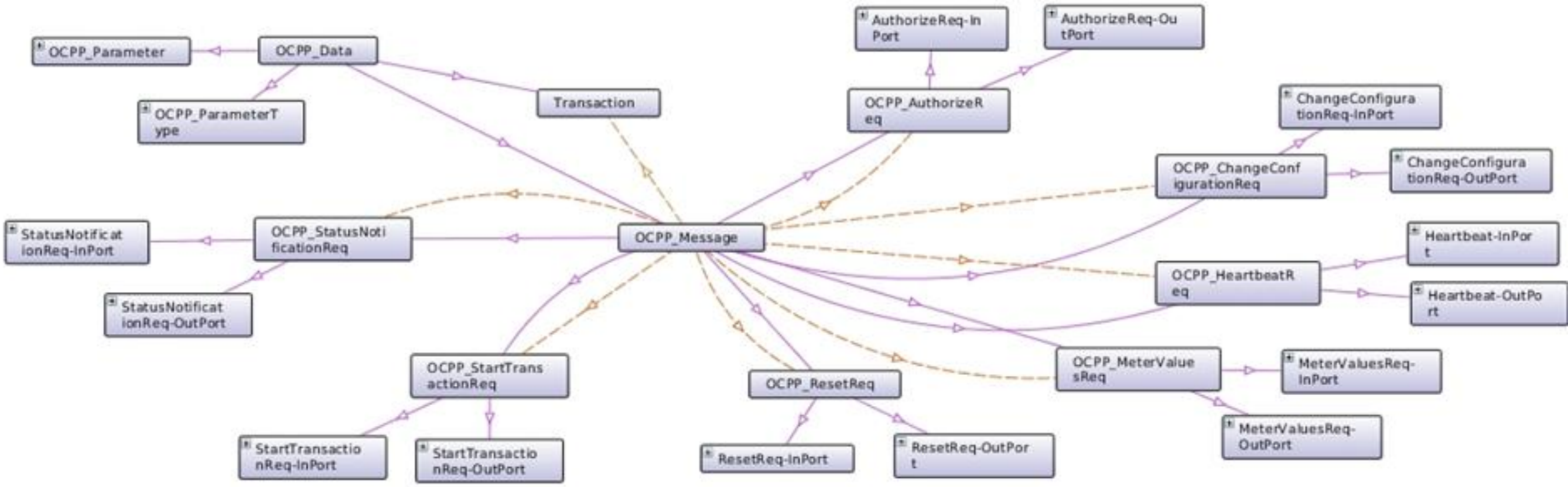
- **Two SIBs**: EV data SIB & Charging Historical data SIB.
- **Three KPs**: GatewayIoE, CentralSystem and Phone.
  - **Gateway IoE:** receives the data from the CP, processes and sends to the Central System.
  - **CentralSystem**: manages the interaction with the SIBs.
  - **Phone**: user interface.



Smart-M3 & OCPP

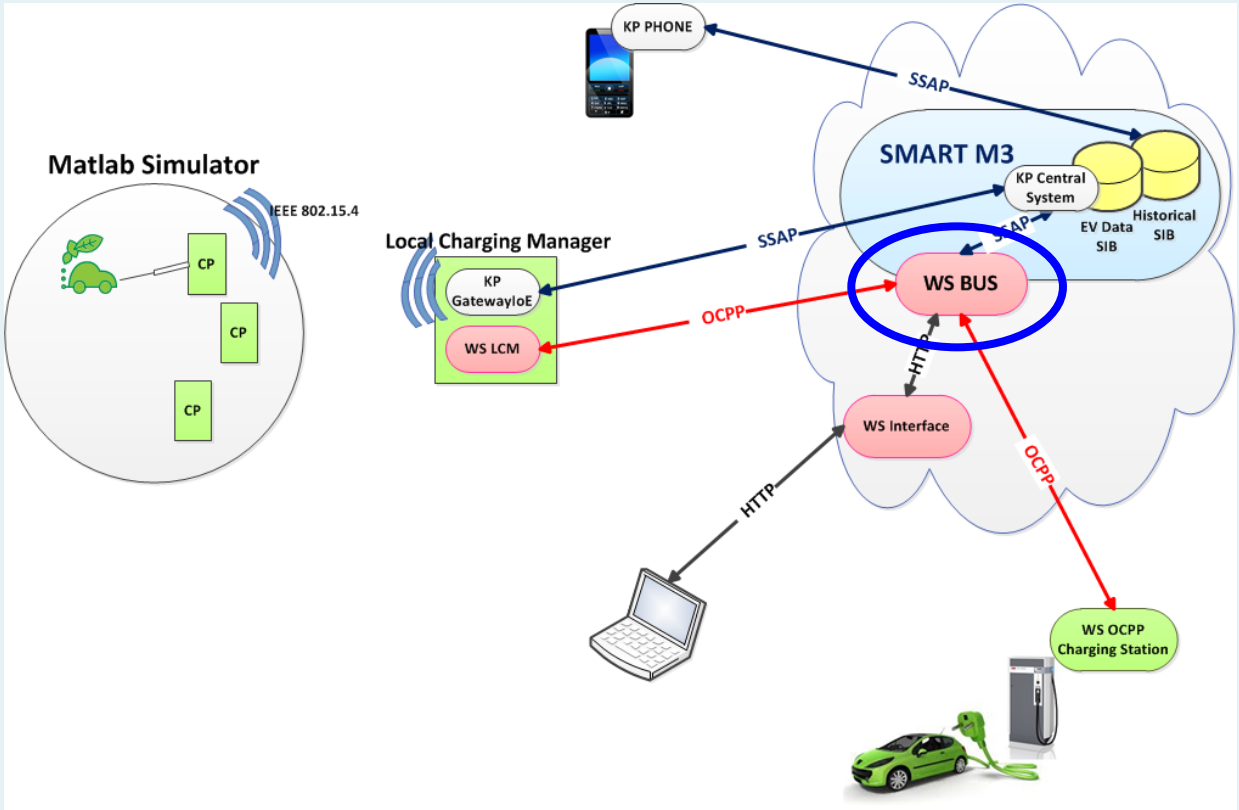
OCPP interoperable:

- Applying OCPP model data to the specification of the ontology.
- Developing an interface to enable other “pure” OCPP systems to use the SmartM3 technology in an interoperable and transparent way.



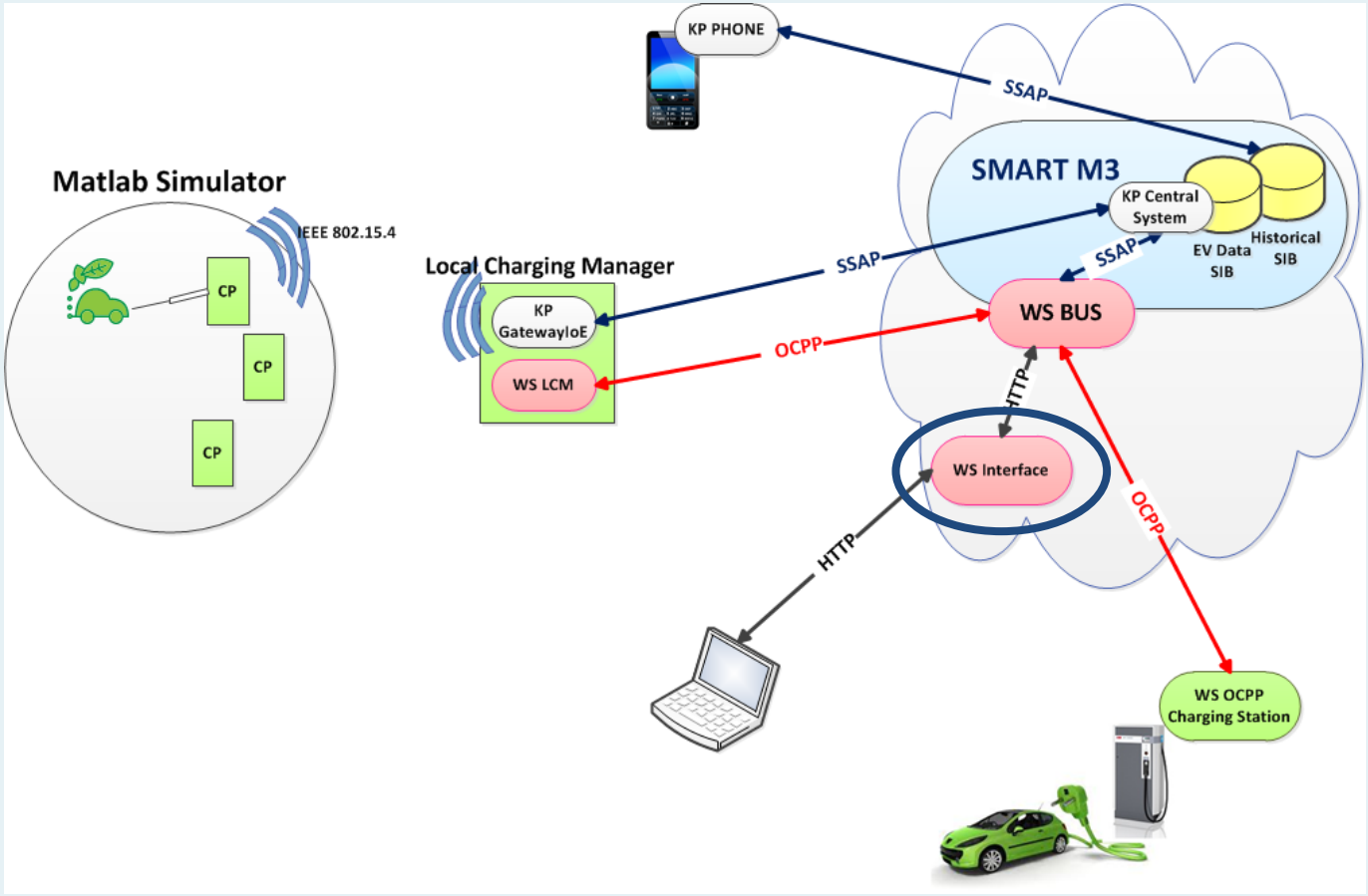
Smart-M3 & OCPP

- OCPP interoperability using Web Services:
  - WS Interface: Implements a web-based interface.
  - WS LCM: OCPP at local level.
  - WS BUS: **Gateway OCPP/SmartM3 core.**



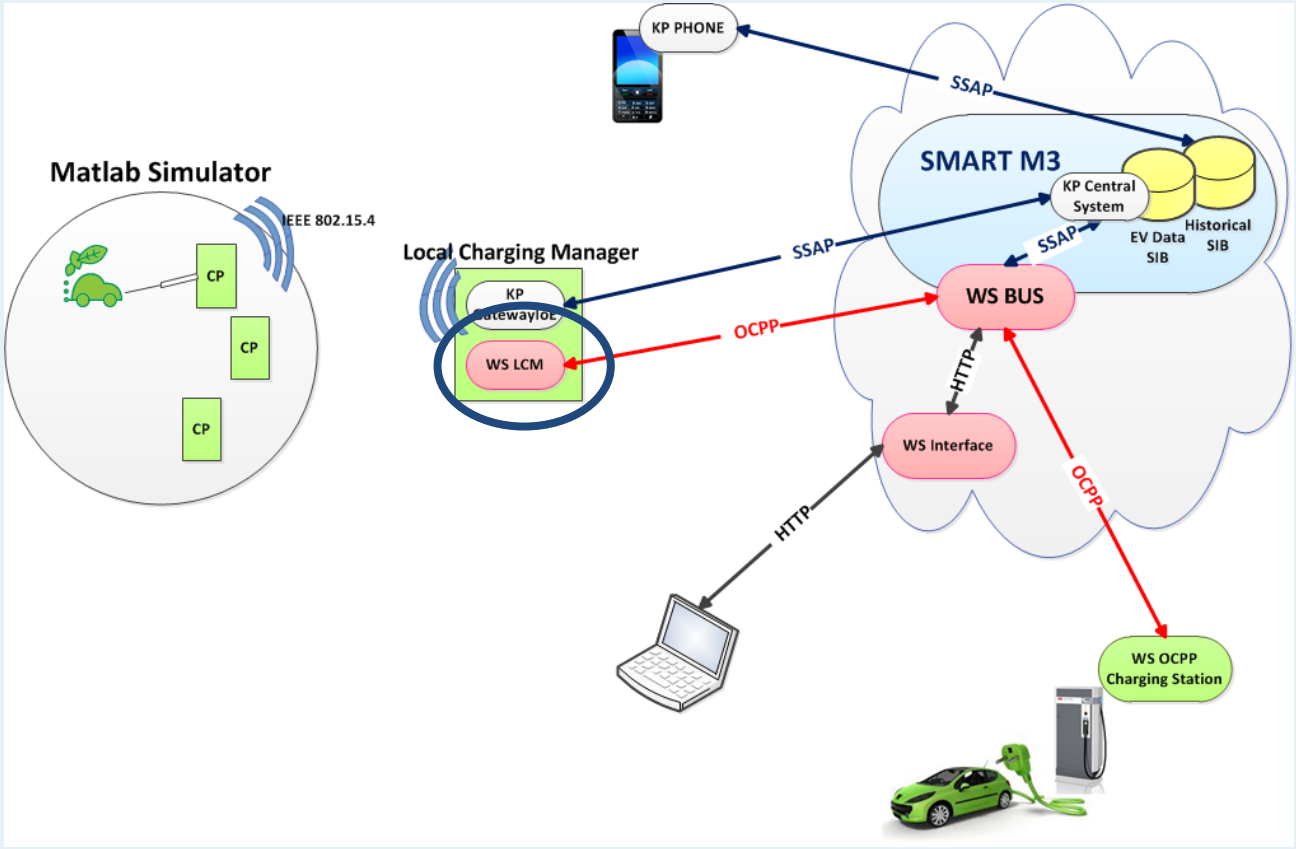
Web Services functionality

- **WS Interface**: Implements a web-based interface. Based on OCPP and xml, display the information received from the SIB in a Web-based interface.



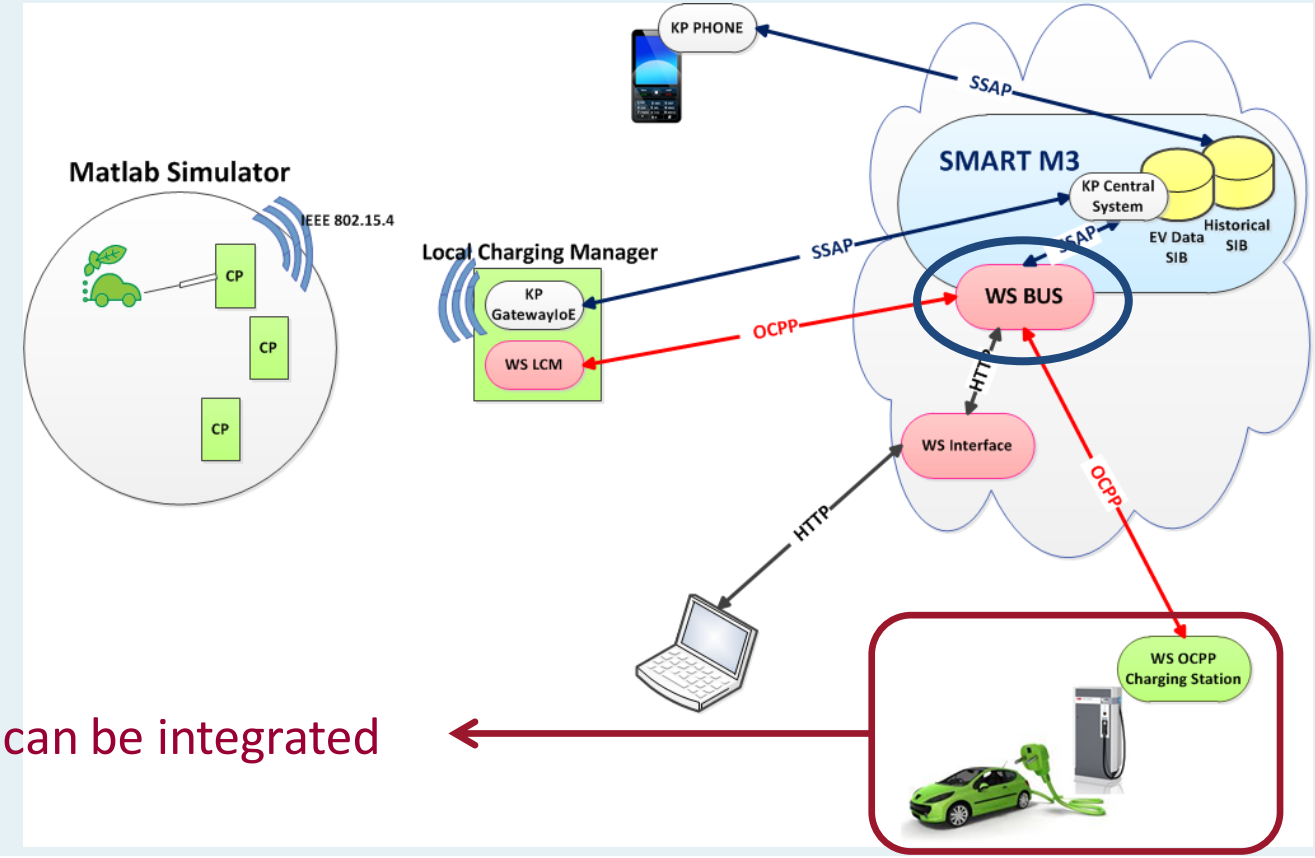
Web Services functionality

- **WS LCM:** It allows the interaction with the SIB using OCPP. It receives the queries from the WS BUS and responds with the corresponding results when the SIB has performed the required operation.



Web Services functionality

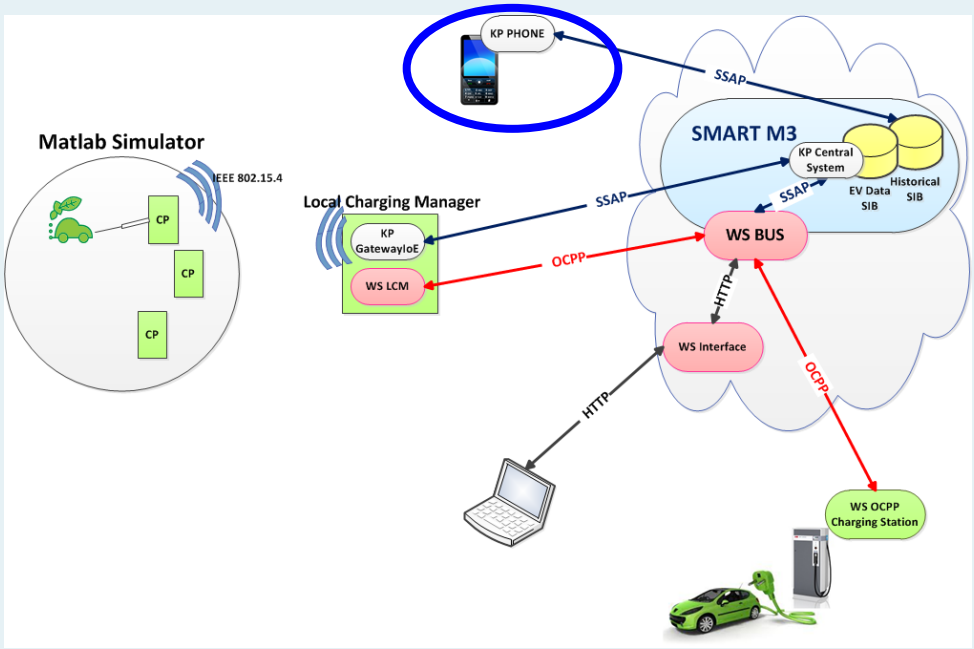
- **WS Bus**: Core for OCPP interoperability, acting as a "virtual" gateway to the Smart-M3 Central System. Common entry point for third systems, receiving the queries coming from external web services.



Third parties can be integrated

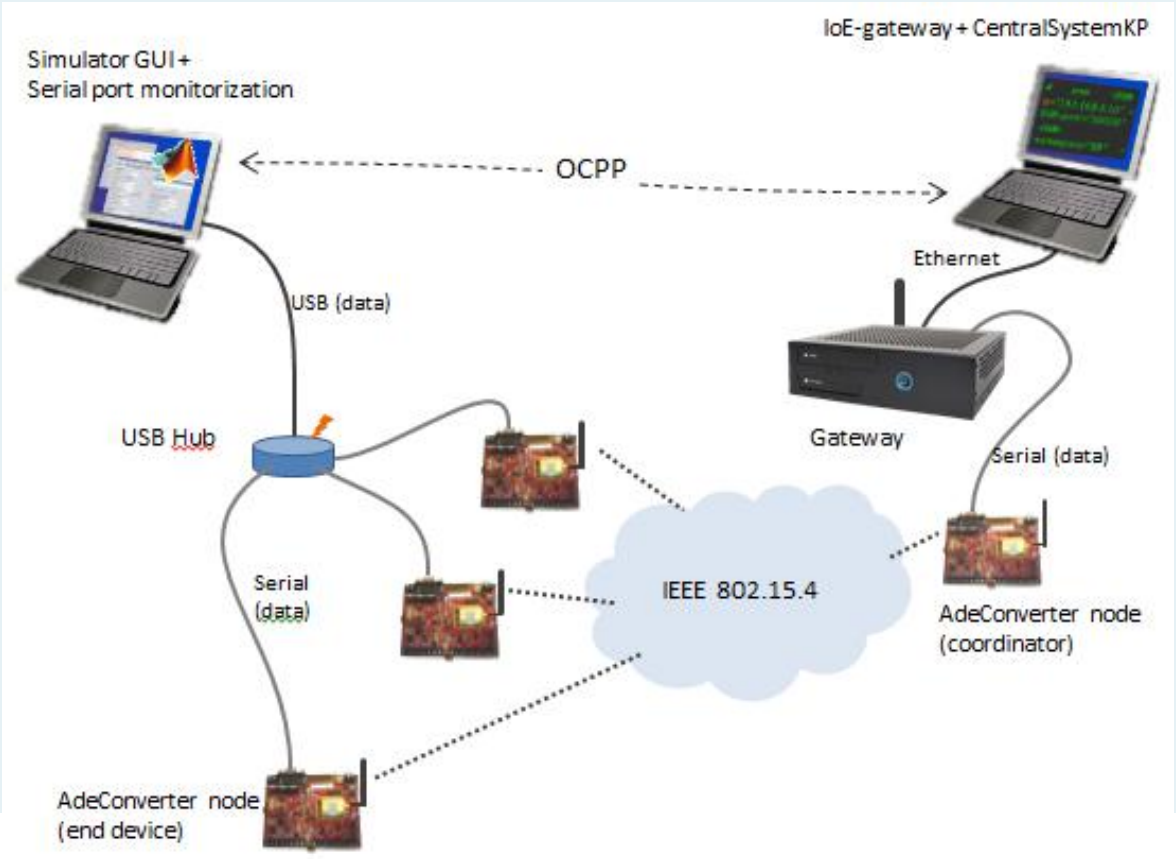
Mobile Application

- A mobile application for Android® systems has been implemented to **monitor the EV charging process in the real time and to implement reservation service**, using subscriptions to the SIB. This application provides information about the user account, associated vehicles, previous recharges, etc.



Validation & Results

- Tests:
  - Component tests → Functionality by unit.
  - System tests → Integration and interoperability.
  - Stress Tests → WLAN robustness.



Conclusions

- WSNs provide wireless communication to EV Charging Stations (incoming wireless charging).
- Semantic web – SmartM3 provides:
  - Interoperability with other services (Ontology specification).
  - Scalable solution.
  - Low-layers platform independence.
- OCPP provides:
  - Interoperable and standard EV communication system.
  - Independence among EVSE suppliers and Service Provider.
- Complete system, from user to Service Provider.
- Open source system that works.

THANK YOU
FOR YOUR ATTENTION

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