EVS27
Barcelona, Spain, November 17-20, 2013

e-DASH' E-Mobility Broker

Maria Martin-de-Vidales-Ramirez Maria, ATOS Madrid, maria.martin-de-vidales-ramirez@atosresearch.eu
Martin Wagner Neumann, ATOS Madrid, martin.2.wagner@atosresearch.eu
Rolando Palma Zelada, ATOS Madrid, rolando.palma@atosresearch.eu

Abstract

The massive implementation of Electric Vehicles in Europe needs support from ICT systems. Technological trends, best practices, standards and regulations have to be taken into account. e-DASH faces the challenge of development ICT tools focused on balancing energy in the grid, which also means making feasible smart charging/discharging processes of EVs. E-DASH is composed by role based intelligent systems, being the e-Mobility Broker the module responsible of the distribution of energy data (needs and availability) in the full defined architecture.

Keywords: Electric Vehicle, Energy Broker, Balancing Area, Fleet Manager, Grid

1 Introduction

The massive implementation of Electric Vehicles in Europe needs support from ICT system; technological trends, best practices, standards and regulations must be taken into account for a sustainable solution.

e-DASH aims at the harmonization of electricity demand in Smart Grids to manage a sustainable integration of electric vehicles. This is addressed by an intelligent charging system supported with near real-time exchange of charge related data between EVs (Electric Vehicles) and the grid.

e-DASH faces the challenge of developing ICT tools focused on balancing energy availability in the grid, which also means the improvement of charging/discharging processes for EV.

This is made through intelligent systems, being the E-Mobility Broker one of the modules in the full required architecture.

This paper describes the concept of the e-Mobility Broker, describing it, functional and technically including the architectural picture of the E-Mobility Broker (EMB) system, providing a common view of functionalities and features related to the EMB service infrastructure:

1. *Management of Balancing Areas*
2. *Management of Load Profiles*
   a. *Global Load Profile*
   b. *Day ahead Load Profile*
   c. *Intraday Load Profile*
   d. *Updated Intraday Load Profile*

A general EMB Architecture defines which components in the overall systems are needed and how these components collaborate.

Finally, the conclusion section analyses the impact this component will have in a European large scale use of EVs, as well as further steps, according to the state of the art and market trends.

2 E-Mobility Broker

In order to provide a definition that should be consistent, coherent and well understood by all parties, it is necessary establish a common definition agreed by all stakeholders to precise what the system is and what the system should do.

The aim of this paper is to describe the E-Mobility Broker (EMB) concepts and to provide an overview of the scenarios, use cases, requirements, initial architecture and elements involved in the EMB system.

2.1 Definition

The E-Mobility Broker (EMB) is the entity and associated system that allows managing the offering energy demand and supply, scheduled energy consumption plan, forecasts of load profile and balancing area maps information. The E-Mobility Broker notifies energy demand to Balancing Responsible Party (BRP) and power supply to the e-DASH OEM Back-End, which represent also the Fleet Manager (FM).

The EMB is also considered a Commercial Virtual Power Plant (CVPP) because its capacity to manage several OEM Back-Ends represented by a set of a FM or CVPP.

The E-Mobility Broker provides information regarding Balancing Area (BA) locations to CVPP (as Fleet Manager) and information about energy demand and supply of the Balancing Areas (BA) locations to the OEM Back-End. EMB also receives charging and discharging capacities data from CVPP per BA.

Consequently, the E-Mobility Broker is not only considered an aggregator for charging and discharging needs for BA, but also a collector of data related to charging and discharging requirements for a set of Balancing Areas. Additionally, the EMB manages the decomposition of BRP schedules for CVPP through a disaggregation process.

In summary:

- E-Mobility Broker manages the relationship between BRP schedules.
- BRP manages and provides a plan of schedules for the forecast of the energy consumption and supply.
- The e-DASH OEM Back-End provides the forecasts of load profiles optimized and applied by the Fleet Manager.

All of these taking into account the corresponding BAs where specific areas could need more or less energy than predicted. Moreover, E-Mobility Broker is responsible for distributing eligible tariff information to relevant actors, based on the information provided by E-Mobility contractors.

Finally, the EMB can be considered to manage services and data in the scope of covering HUB functionalities which allow multiple external entities to communicate (service and data) between all others through a platform which can coordinate, orchestrate, adapt, process, compute, transform, distribute and dispatch the information to each actor or entity allowing and ensuring a high level of interoperability with other services or entities.

2.2 Use cases

Name	Short description
Manage Day ahead forecasts	Manage the next-Day forecasts that the *EMB* receives from e-Dash OEM Backend.
Manage Fleet charging profile	Manage the Global Load Profile and create multiple Fleet charging profiles; for each Fleet manager.
Manage Update fleet charging profile	Manage the intraday Update fleet charging profile; when the BRP detects change in the capacity of supply.
Manage Balancing Area Map	Manage the Balancing Area Map of assets for a BRP.

2.3 Requirements and specifications

2.3.1 Day ahead forecast

EMB performs the services to manage reception, validation and classification of the Day ahead forecast received from the OEM Backend. The information is classified, stored and, finally aggregated in a suitable forecast that is send to the BRP. Balancing areas, OEM Backend and time are required for the aggregation process.

2.3.2 Global Load Profile

EMB is responsible for manage reception, validation and classification of the Global Load Profile (GLP) send by a BPR. Once executed the algorithms to disaggregate the GLP and prepare the Day ahead Load Profile (DaLP) by Balancing Area, OEM Backend and charging period time; the results are stored and send each calculated DaLP to the respective OEM Backend.

2.3.3 Intraday flexible demand

The EMB performs services to manage the reception and validations of requests for current energy demand send by BRP and store them. Once disaggregated, next steps are sending the request to the respective OEM Backend, receive response from the OEM Backend and, once aggregated, send it back to the BRP.

2.3.4 Updated intraday load profile

The EMB also is responsible for managing the negotiation process between the BRP requester and the target e-Dash OEM Backend.

The process starts with the reception of a Proposal for Update send by the BRP. Once stored, the EMB executes the algorithms and disaggregation required and sends an Updated intraday load profile to the target OEM Backend.

Once accepted by the EOM Backend, the EMB sends the negotiation results to the BRP and finishes the process.

2.3.5 Balancing Areas

To ensure a coherent use of balancing areas, EMB is also responsible for managing Balancing Areas Map. This information is received from each BRP. Once aggregated the Bas they are stored internally. This aggregation is a continuous process for each Balancing Area.

Finally the EMB manages the request of information about Balancing Area Map received from the OEM Backend.

3 Architecture Overview

The E-Mobility Broker architecture enables the data exchange between other e-DASH modules; it manages the reception, sending and request of data coming from the BRP to send to the e-Dash OEM Backend and vice-versa.

The E-Mobility Broker components provide intelligence (algorithms) to processes the information like aggregation, disaggregation, negotiation and massive storage.

3.1 System environment / infrastructure

The general architectural design defines elements that provide network services dedicated to providing functionality to applications or services located on client and server side and that allow interactivity between the applications and services in the client systems and network systems.

This architecture involves different elements and actors interacting with each other. Figure 1 depicts the context related to the system environment and infrastructure and the elements that compose it.

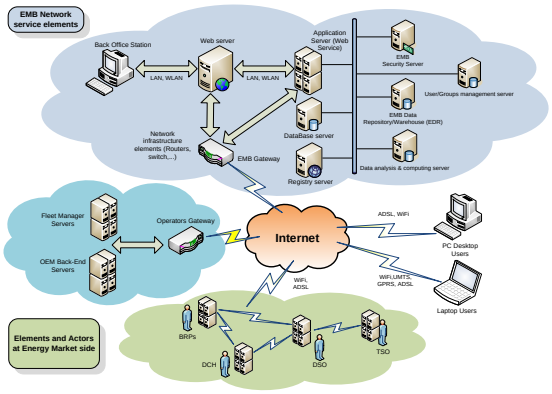

Figure 1: e-DASH General Architecture

3.2 E-Mobility Broker system Context

The E-Mobility Broker mode operation is linked with the BRP and the e-Dash OEM Backend; the real time functions the E-Mobility Broker must exchange messages with these components.

Figure 2 depicts the real context E-Mobility Broker.

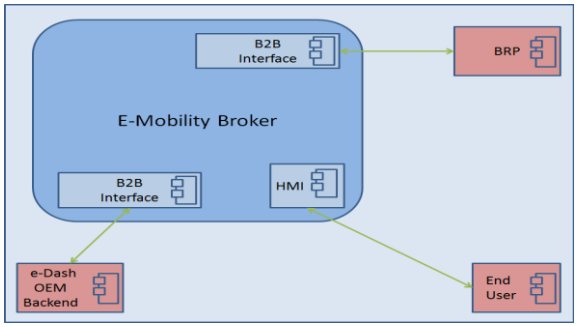

Figure 2: EMB System Context diagram

The BRP and e-Dash OEM Backend access the EMB services using B2B interfaces. The End User that appears in this diagram represents an operator that has access to administrative console of E-Mobility Broker.

3.3 Main E-Mobility Broker subsystems

The E-Mobility Broker functionality is classified in four subsystems; each of the subsystems carries out a set of tasks to achieve the E-Mobility Broker operation. Figure 3 describes the E-Mobility Broker subsystems.

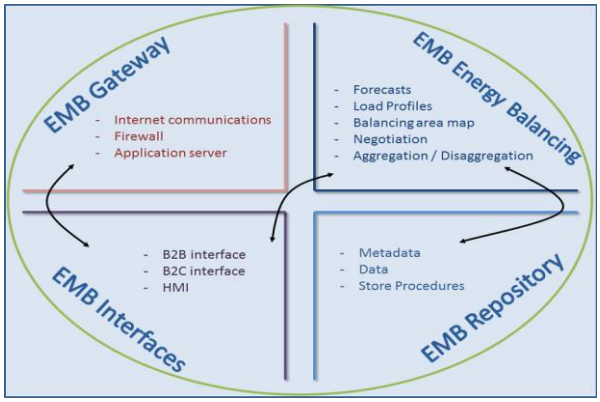

Figure 3: EMB System Context diagram

3.4 Layered architecture

The EMB architecture is separated into three layers; this separation permits achieve the development of specialized applications.

The layers in the E-Mobility Broker architecture collaborate closely to achieve the aim

functionality; the layers are: Core layer, Service layer and Application layer.

Figure 4 depicts the layered architecture of the E-Mobility Broker.

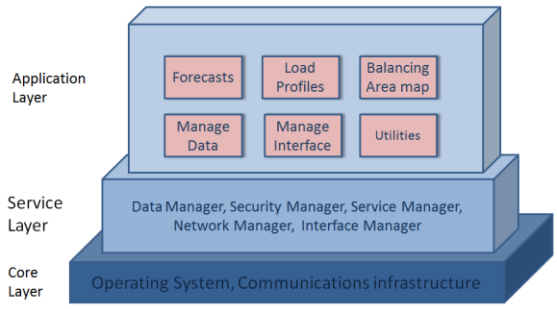

Figure 4: EMB layered architecture

4 Conclusions

The EVs panorama in Europe defines new needs and challenges which can be supported by ICT. Coordination is needed between different actors and a realistic view should be maintained. In fact, the EVs drivers face the need and request availability of energy for their EVs, the grid should be always responding to citizens needs and, therefore, management is needed to assure and control this.

Decision making plays a vital role, for which information would be needed, by different actors implied. Agreements, communication and coordination are needed as well.

The e-DASH EMB faces these challenges in a novel and innovative way, for which, at the moment of submitting this paper, no other approach or solution is functioning. This opens the doors to possible EVs infrastructures implementation and smooth operating, supporting EU objectives for large scale adoption of EVs.

The E-Mobility Broker is a module defined and developed to manage demand and supply energy for EVs, including scheduled energy consumption plan, forecasts of load profile and balancing area maps information.

It also represents a solution for the management to balancing the distribution network by starting from one most relevant singularity that will impact the network: the Electric Vehicle.

Finally, the EMB is also a Commercial Virtual Power Plant (CVPP) because its capacity to manage energy requirements from several players in the distribution arena including DSOs and EV Fleet managers.

Authors

María Martín de Vidales holds a Physics degree from the Complutense University of Madrid and studied as well ICT in the Politecnic University of Madrid. She has experience in basic research with CSIC-UCM-RENFE and the Technical University of Vienna. She has more than 10 years' experience in commercial projects for different sectors, including energy and utilities. She played different roles in large scale projects for companies such as ENDESA, GENERAL ELECTRIC, or GAS NATURAL. Since 2009, she works at Atos Research & Innovation.

Martin Wagner holds two Engineering degrees, one in Mechanical Engineering from the Simón Bolivar University and the other one in System Engendering from the Universidad Nacional Abierta, both in Venezuela. He is currently an IT & BI Senior Consultant at Atos Research & Innovation (I+D arm of Atos Spain) and was working as Project Manager on energy related projects like OpenNode (www.opennode.eu), FINSENY (http://www.fi-ppp-finseny.eu) and, currently, e-Dash (http://edash.eu/).He´s 35 years of experience working with Business Processes, Data Management and Best Practices defined by ITIL and COBIT for organizations in Spain, Portugal, USA and Latin-American. He worked with customers from market segments like banks, insurance, telecommunication, industry and public administrations.

Rolando Palma holds Engineering degree, in System Information from the Mariano Galvez University in Guatemala. He is currently a Senior Organic Analyst at ATOS Research & Innovation (I+D arm of Atos Spain). He´s 20 years of experience working with Development Software activities, Education activities, Coordination activities; and last 4 years on energy related research projects like OpenNode (www.opennode.eu), FINSENY (http://www.fi-ppp-finseny.eu), SCOVIS (http://www.scovis.eu/) and e-Dash (http://edash.eu/). He worked with customers to develop technical solutions for market segments like Finance (banks, insurance) and universities.