Monitorización (y control) de una carga mediante el uso de Arduino

Conceptos preliminares sobre el funcionamiento de una API y el protocolo HTTP-REST

Sesión 3: Consultar y obtener información de una API

Introduction

In this second session related to IoTs concepts, we will work with computer engineering concepts. Here, we will learn what the paradigm client-server means. We will work with APIs to get information from a website, in this case, Red Eléctrica de España (REE) website.

In order to develop this session, there are different concepts that you have to prepare before our laboratory session.

First, you will find the theoretical concepts that you have to read and watch before the laboratory session. At the end of the document, you will see the requirements in terms of software and others that are needed to develop the laboratory session.

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Which is the problem we want to solve?

In this session we want to get data from the Red Eléctrica de España (REE) website, to include them in our Energy Efficiency Project. From this website, we will obtain the hourly energy prices once the day-ahead market has closed, and the scheduled energy production at each hour.

To do this, we need to use a programming language different from the one we use with Arduino. The main objective is that, during the session you run a Python script to request the information from the Day-Ahead Spanish market.

Spanish electricity Market: OMIE and REE

Since we want to collect data from the Spanish Electricity Market, we need to know few concepts from it.

In Europe, Electricity prices are daily based in timeslots of one hour, and they are set for the following day. This is called the Day-Ahead Market. Here, electricity is traded one day before the delivery.

At the end of the Day-ahead market, the market must be in balance, according to Eq.1. The scheduled generation within the market zone i has to be equal to the forecasted demand in the market zone i plus the net export from i to other market zones j.

$$ScheduledGenerationii = F\,orecastedDemandii + NetExportij \quad \text{(Eq.1)}$$

In this market, the price is determined by the balance between supply and demand, based in a double auction mechanism. In Figure 1, the demand and supply curves for an specific hour in the day-ahead market (DAM) can be observed. The marginal price is obtained by the inter-section between the supply and demand curves. Hence, the energy production is determined. Then, taking into account technical restrictions, interconnections and complex offers, some generators can be replaced by other ones, resulting in a different final price, which is usually higher. As a result of the Day-Ahead market, the Final Viable Daily Schedule (PDVD) is obtained.

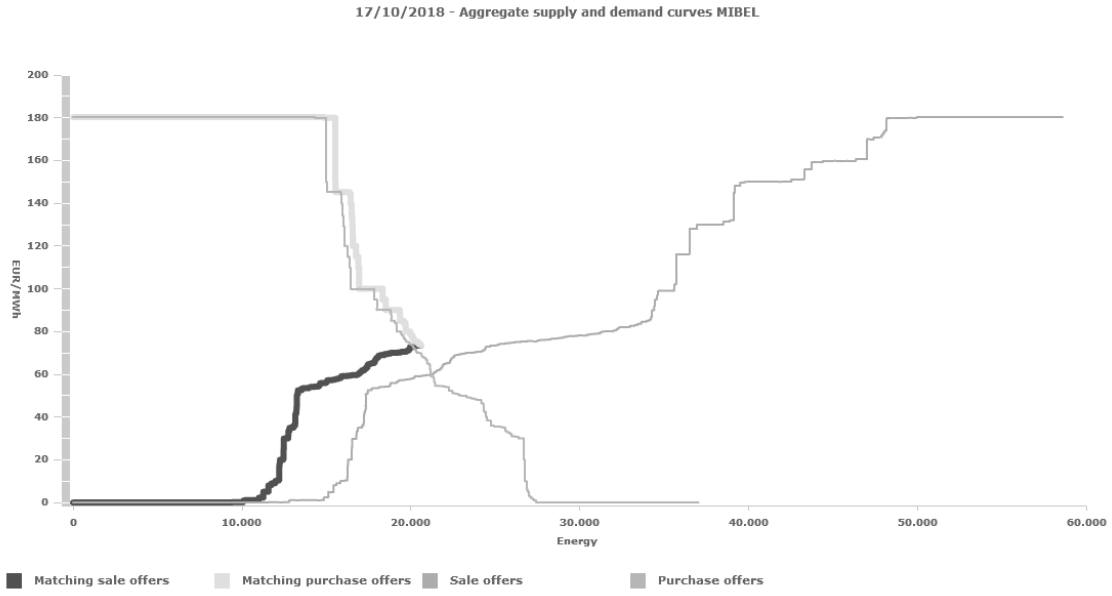

Figure 1: Aggregated supply and demand curves.

The Spanish Electricity Market is based in four different but complementary markets: Future or Derivative market, Day-ahead market (DAM), Intra-day market and Ancillary services market (Mercado de Servicio de Ajustes). We will work with the DAM, which is the one that deals with more than the 90% of the total energy transactions.

OMIE is the market operator for Portugal and Spain. It manages the daily and intraday market for the Iberian Peninsula. OMIP is the market operator for the Futures or Derivative market for Spain and Portugal. Both markets are considered economic.

The System Operator, Red Eléctrica de España (REE), is the one responsible for managing the Ancillary Services market. It is considered a technical market and it can be considered a balancing market for ancillary services.

In addition, REE is the entity responsible to ensure the stability of the grid. Hence, it is responsible for activating the primary, secondary and tertiary reserves to guarantee the frequency and voltage grid stability. For this reason, REE is the entity that collects all the results from the electricity markets and considers technical restrictions to set up the final price and the final energy plan for the next day.

Client-Server architecture

First of all, we need to know that, in communications, an architecture is needed, because we are connecting different devices by means of a network to share information. We need to know some definitions, that are available in the video 1 in Unit 4:

- Network: is a group of devices connected through some medium to share information.
- Medium: is the channel or mode used to send and receive information
- Sender: The device that is passing a message to one or more receivers.
- Receiver: the device that is taking the message.
- Protocol: Set of rules that defines the structure of a message.
- Topology: arrangement of the elements (links, nodes, etc.) of a communication network. It can be used to define or describe the arrangement of various types of networks. E.g: ring, mesh, star, line, etc.

There are different types of computer architectures. For example, peer-to-peer architecture (P2P architecture) is a commonly used computed networking architecture. In this case, each computer has the same capabilities and responsibilities. We are not going to work with this architecture type.

We have to understand that, in this case, we will work under a client-server architecture. It is a computing model in which the server hosts, delivers and manages most of the resources and services to be consumed by the client. This type of architecture has one or more client computers connected to a central server over a network or internet connection. This system shares computing resource. You can see how a Client-Server architecture looks like in Figure 2. In Figure 3, you can see the differences between the Client-Server architecture and the P2P architecture.

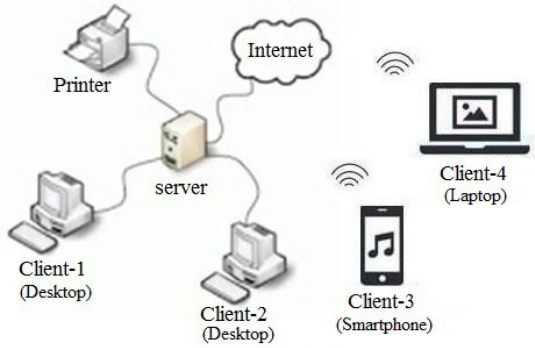

Figure 2: Client Server Architecture.

Source: http://www.rfwireless-world.com/Terminology/Client-Server-Architecture.html

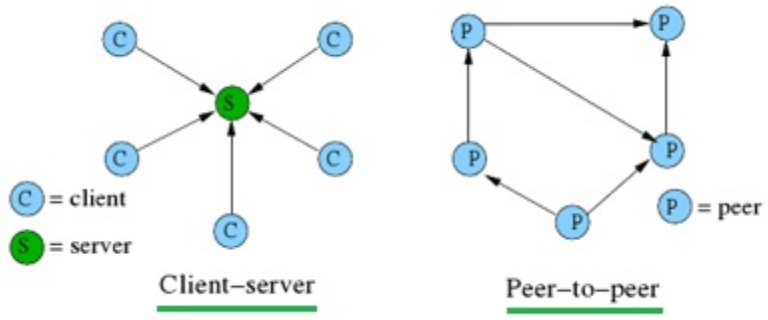

Figure 3: Differences between Client-Server and P2P Architectures

What is an API?

An API (Application Programming Interface) is a set of functions and procedures that allow the creation of applications which access the features of data of an operating system, application or other service. Remember that an API is neither a mobile app nor a web service.

Here you can watch a short video explaining what an API is, in a plain way: https://www.youtube.com/watch?v=s7wmiS2mSXY [1]

REST and HTTP Protocol

REST stands for REpresentational State Transfer, and it is architecture style for designing networking applications. It is based on a client-server protocol, as we have seen before. It is the most used in terms of internet.

We will work with REST-API. In the following video you can learn what is a REST-API and how it works: https://www.youtube.com/watch?v=7YcW25PHnAA [2]

Here we have seen which kind of information we can get from an API in google, google maps, and Instagram. We will get the information from the REE website. From there, we can obtain the day-ahead market prices, the total demand for that day, the generation mix for a specific day and hour, and others.

RESTful uses HTTP protocol to prepare the request the client wants to ask to the server to get a response. On the video [3] you will understand how REST looks like. What Is A RESTful API? Explanation of REST & HTTP https://www.youtube.com/watch?v=Q-BpqyOT3a8 [3]