Internet of Things: Protocols and System Software

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Doble Grado en Ingeniería Informática y Matemáticas
Universidad de Granada

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Índice general

1. Introduction

In the current technological world, there are three different main trends:

1. Computing: computers are getting smaller, cheaper and more powerful.
2. Sensing: there is a huge variety of sensors that can be used to measure different physical properties. They are also getting smaller and cheaper.
3. Transmission: two factors are being taken into account:
   - There are more and more wirelesscommunication technologies, with different characteristics. This leads to omnipresent connectivity.
   - Energy consumption is a key factor in the design of these technologies, as many IoT devices are battery-powered. This is leading to the development of low-power communication protocols and energy-efficient hardware.

In this context, the Internet of Things (IoT) is emerging as a paradigm where everyday objects become smart and connected to the internet.

Definición 1.1 (IoT Thing)**.** An IoT thing is a physical object that is augmented with embedded electronics, making it therefore "smart".

1.1. Digital Twin

The Digital Twin is a global representation of the world, where every physical object has a digital counterpart. This means that every physical object is represented in the digital world, and every change in the physical world is reflected in the digital world and vice versa. This is a very ambitious vision, and it is still far from being achieved. However, it is a useful concept to understand the potential of IoT and the challenges that it poses. Its three main features are:

- Live: the digital twin is continuously updated with data from the physical world.
- Predictive: the digital twin can be used to predict the behavior of the physical world using simulations and machine learning techniques.
- Interactive: depending on the predictions made by the digital twin, it can change and therefore make changes in the physical world.

In this situation, the world would become observable and programmable in real time, which would have a huge impact on many different fields, such as healthcare, transportation, manufacturing, etc. However, there are still many challenges that need to be overcome to achieve this vision.

1.2. IoT Views

There are two different views on IoT:

- IoT as a network of connected *things*, aka *M2M (Machine to Machine)*.

  It is quite a low-level technical view, where the focus is on the devices and the communication between them. Internet is just seen as a communication medium, and the main goal is to connect as many things as possible.

  It is the view that is usually taken by engineers and computer scientists.

- IoT as a network of connected *data*, aka *Big Data*.

  It is a more high-level view, where there are still things but the focus is on the data that is generated by these things and how it can be used to create value. Internet is seen as a platform for data collection and analysis, and the main goal is to extract insights from the data.

  It is the view that is usually taken by business people and data scientists.

2. Question Sheets

2.1. Introduction

The recorded lecture is provided here.

Ejercicio 2.1.1. What are the two views on IoT discussed in the lecture? How do they differ?

The two views on IoT are:

- IoT as a network of connected *things*, aka *M2M (Machine to Machine)*.
- IoT as a network of connected *data*, aka *Big Data*.

They differ in plenty of different aspects:

- While the first one focuses on the devices and the communication between them, the second one focuses on the data that is generated by these things and how it can be used to create value.
- While the first one sees Internet as just a communication medium, the second one sees Internet as a platform for data collection and analysis.
- While the main goal of the first one is to connect as many things as possible, the main goal of the second one is to extract insights from the data.
- While the first one is usually taken by engineers and computer scientists, the second one is usually taken by business people and data scientists.

Ejercicio 2.1.2. Are IoT gateways always necessary? What are they used for?

IoT gateways are used to connect IoT things to the internet. IoT things are usually resource-constrained devices that cannot connect directly to the internet, so they need a gateway to act as a bridge between them and the internet. However, IoT gateways are not always necessary, as some IoT things can connect directly to the internet using low-power communication technologies such as Wi-Fi or cellular. In this case, the IoT thing itself can act as a gateway, and there is no need for an additional device.

2.2. IoT Systems

The recorded lecture is provided here.

Ejercicio 2.2.1. What is the difference between an IoT system and an IoT platform? Use the WWW to find another IoT platform that is not mentioned in the lecture.

Ejercicio 2.2.2. Is the Microsoft Azure IoT Suite a horizontal or a vertical IoT platform? Why?

Ejercicio 2.2.3. Provide an example (i.e., search on the Internet or come up with your own idea) for a scenario in which you would use predictive data processing but not prescriptive data processing. What is the main legal difference between these?

Ejercicio 2.2.4. What are the differences between mesh-based and edge-based IoT systems? Which one is currently supported by platform providers?