



ÅBO AKADEMI UNIVERSITY

SYSTEM ARCHITECTURE OF IOT

Assignment 1



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0.1 Using your own words, how would you define the what is the IoT?

The internet of thing (IoT) is a system where a network is able to transfer data to a physical devices via software, sensors, electronic. This physical device, is usually called a thing and it can be a vehicle, a building, a person.

0.2 Please reproduce and complete on your answer sheet the following (IoT) architecture template with possibly missing components.

0.3 What are the two main families of IoT protocols on the application layer? Explain the main difference(s) between them (feel free to draw figures). For each family provide the name of at least one used protocol and a simple application example for it.

The two main families of IoT protocols on the application layer are:

- Request - response: this can be used in a HTTP + WebSocket (both an API and a Protocol)
- Publish - subscribe: this protocol can be use in a Advanced Message Queueing Protocol (AMQP) - messaging protocol, originating in the world of financial institutions

0.4 What are the main characteristics of Low Power Wide Area Networks (LPWANs)?

The characteristics of a Low Power Wide Area Networks (LPWANs) are:

- Geographical range: Long-range communications up to 10-40 km in rural zones and 1-5 km in urban zones;
- Low power consumption: Thanks to techniques search as sleep mode, the battery life of this devices increased to 4+ years;
- Transmission of data: LPWAN's idea is to regulate the non-constant transport of small amounts of data.

0.5 What are the common sources of energy for energy harvesting system? For each one, list the associated advantages and disadvantages. Which source(s) has/have high power density?

The most common sources of energy for a energy harvesting system are:

- Light energy: From sunlight or artificial light. This source is affordable, easy to get and to use, on the other hand is very low efficient;

- Kinetic energy: From vibration, mechanical stress or strain. An advantage of this source is that it can be used in small spaces, although its expensive;
- Thermal energy: Waste energy from heaters, friction, engines, furnaces, etc. This source can be seen as a really good idea since its made by non-expensive, non-toxic materials, there is no need for fuel, no moving parts, and its natural rechargeable. But this technology can be only used in temperatures above 0° and it has a very low power/energy generation.
- RF energy: From Radio Frequency signals. It's a different way of reusing the radio frequency but it has also a low generation of power/energy.

From this table [1] we can see which source of energy harvesting has the best power density, which is the light:

Energy source	Characteristics	Efficiency	Power density
Light	Outdoor	10–25%	100 mW/cm ²
	Indoor		100 μ W/cm ²
Thermal	Human	0.1%	60 μ W/cm ²
	Industrial	3%	10 mW/cm ²
Vibration	Hz-Human	25–50%	4 μ W/cm ²
	kHz-Machines		800 μ W/cm ²
Radio frequency	GSM 900 MHz	50%	0.1 μ W/cm ²
	WiFi 2.4 GHz		0.001 μ W/cm ²

Figure 1: Power Energy Harvest Density

Bibliography

- [1] Pieter De Mil, Bart Jooris, Lieven Tytgat, Ruben Catteeuw, Ingrid Moerman, Piet Demeester, Ad Kamerman, Design and Implementation of a Generic Energy-Harvesting Framework Applied to the Evaluation of a Large-Scale Electronic Shelf-Labeling Wireless Sensor Network