**3.1.1 Bandwidth/Data Rate**

Bandwidth and data rate are often used to measure the amount of data being transferred (bit rate) in a given time unit, usually seconds. Bandwidth means the Hertz spectrum range that a system can use for digital communication. The data rate depends on the Internet connection's bandwidth. If the bandwidth is high, if adequate digital communication technologies are used, the bit rate tends to be high. In LoRaWAN, a trade-off between the range of communication and the duration of the message selects the data rate. Virtual ducts (channels) are created with varied data rates and without interference as a result of spread spectrum technologies.

**3.1.2 Battery Life**

None of the incumbent technology can meet the technical and practical challenges facing energy storage in IoT for electronics. For cost, availability and convenience reasons, most things are powered by non-rechargeable batteries. Nevertheless, the need for replacement, limited energy resources, and ecological implications will become a serious problem when powering billions of IoT devices that use non-rechargeable batteries as primary energy storage. The LoRaWAN server controls the RF output (Radio Frequency) and output rate by means of an adaptive scheme for each end device to maximize the life of the device batteries.

**3.1.3 Range**

New technologies aim to provide people / things away from the big metropolis with information access to the Internet. In order to cover longer distances, the radio power should be increased, resulting in increased battery consumption. Thus, following a green energy approach, new protocols aim to achieve greater distances with lower energy consumption. These ideals are being disputed commercially by LoRaWAN and other protocols. This protocol currently obtains approximately 2-5 km of urban perimeter coverage and approximately 45 km in rural areas.

**3.1.4 Latency**

Currently, social media like applications demand strict requirements on latency. In order to build the architecture of the fifth generation (5G), one must reconsider how to use limited resources to serve various types of traffic flows in different environments. There is a trade-off between downlink latency communication versus battery life, which can be solved in a LoRaWAN device through QoS classes.

**3.1.5 Throughput**

LoRa provides a greater throughput than ALOHA-based technologies, with low MAC (Medium Access Control) complexity, but LoRa is a limited long-range communication for different environments, i.e. 2-5 km urban and 45 km rural, with data rates ranging from 290 bps to 50 kbps.