FUNDAMENTALS

Average reading time: 9 minutes.

LoRa technology and LoraWan protocol

Introduction to LoRa protocol

The technological progress in communications, in general, caused many technologies to emerge, especially in mobile communications, the devices are getting increasingly intelligent and robust, the applications and artificial intelligence allowed a leap into the future and this leap has reached the communication between devices or electronic objects, which means that inside your home your electronic devices can communicate with each other, fantastic isn’t it? IoT devices are already a reality and we will check one of the protocols and devices of this universe!

Image 01: LoRa Technology. Source: *Shutterstock*.

Definition

LoRa (Long Range) is a low-power wide area network (LPWAN) technology. It is based on spread spectrum modulation techniques based on chirp spread spectrum (CSS) technology. It was developed by Cycleo of Grenoble, France and acquired by Semtech, the founding member of the LoRa Alliance.

What are End Node Devices

The “End Nodes”, or “End Devices”, represent the remote LoRaWAN devices, as an example we have the LoRaWAN Bee. These devices send and receive information from the “Gateways”, or “Concentrators” as they are also known, which basically represent the connecting antennas, such as those of the ATC (American Tower Corporation), for example.
From the connection antenna, the information exchanged with the devices is sent over the Internet to the Network Server which is responsible for properly directing the messages from a certain device to its respective end application, or the other way around. Finally, the information reaches the “Application Server”, which represents the platform where the communication information is finally displayed, or from where it originates, as examples: the PROIoT and The Things Network.

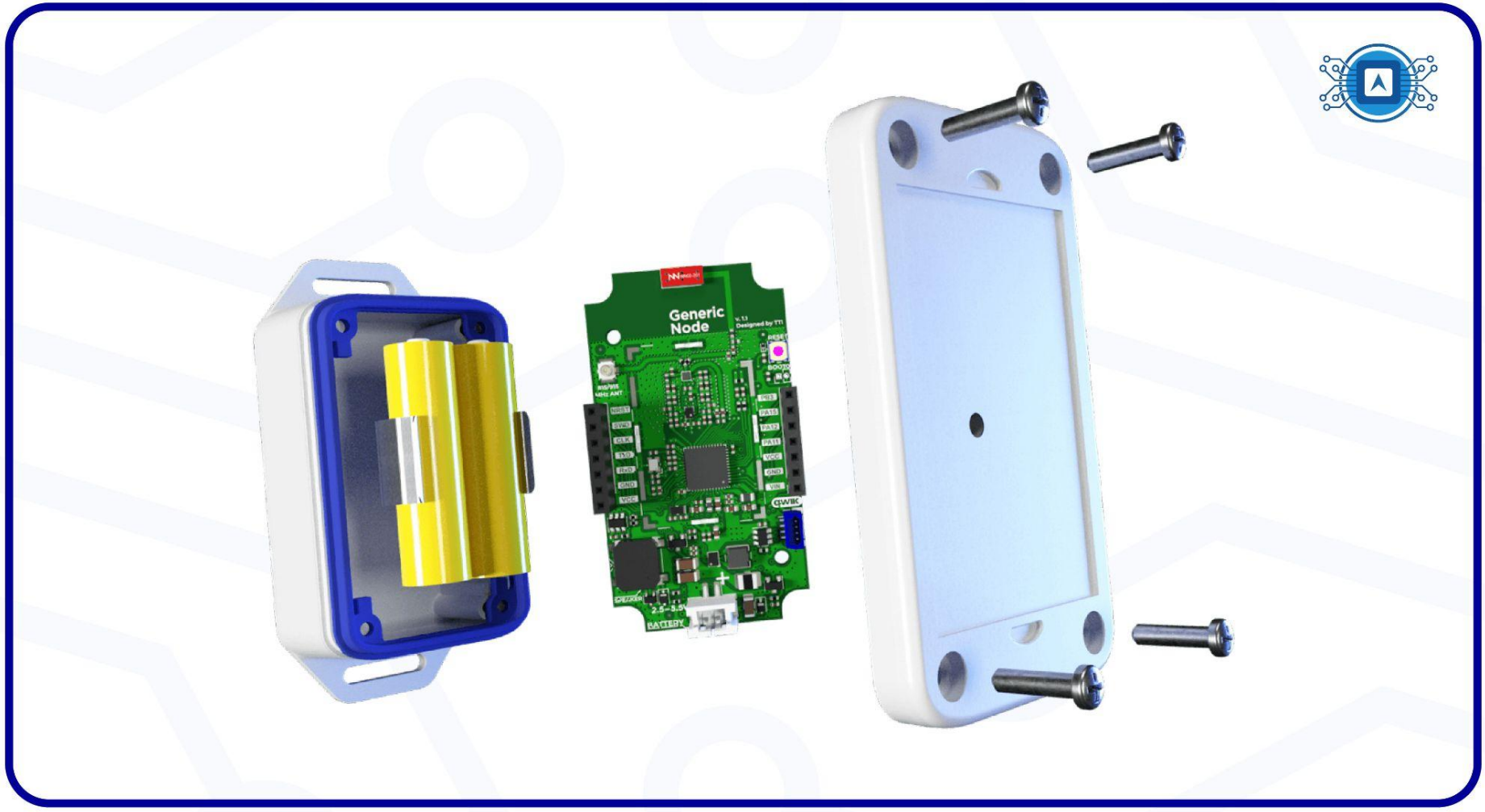

Image 02: “End Nodes” or “End Devices”.
Source: The Things Work <https://www.thethingsnetwork.org/forum/t/generic-node/43013>.

- Lora x LoraWan

LoRa	LoRaWAN
LoRa (Long Range) is a spread spectrum modulation technique based on Chirp Spread Spectrum (CSS) technology. LoRa is a long-range, low-power wireless platform that has become the finest wireless platform for the Internet of Things (IoT).	LoRaWAN is the name given to the protocol that defines the system architecture as well as the communication parameters using LoRa® technology. The LoRaWAN protocol implements the details of operation, security, quality of service, power settings to maximize the battery life of the modules, and the types of applications on both the module and server.

Chirp Networks

A chirp is a signal in which the frequency increases (up-chirp) or decreases (down-chirp) with time. In some sources, the term chirp is used in the same way as a sweep signal. It is commonly used in sonar, radar, and laser, but has other applications, such as in spectral scattering communications.

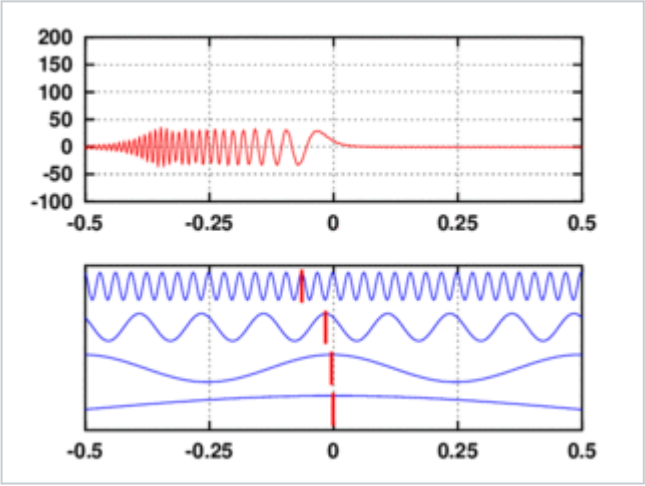

Image 03: Chirp networks and their signal pulses. Source: *Wikipedia <https://en.wikipedia.org/wiki/File:Chirp_animation.gif>.*

Since LoRa defines the lower physical layer, the upper network layers were absent. LoRaWAN is one of several protocols developed to define the upper network layers.

LoRa devices and networks (LoRaWAN), enable smart IoT applications that solve some of the biggest challenges facing our planet: energy management, natural resource reduction, pollution control, infrastructure efficiency, and disaster prevention. LoRa devices have built up several hundred known application cases for smart cities, homes and buildings, communities, metering, supply chain and logistics, agriculture, and more. With hundreds of millions of devices connected to networks in over 100 countries and growing, therefore LoRa technology is creating a smarter planet.

Image 04: LoRaWan Network. Source: *Shutterstock*.

- Introduction to LoRaWAN

It is a Media Access Control (MAC) layer protocol created based on LoRa modulation. It is a software layer that defines how devices use LoRa hardware, for example when they transmit, and the message format.

The LoRaWAN protocol was developed and supported by the LoRa Alliance. The first LoRaWAN specification was released in January 2015.

- LoraWan Network Architecture

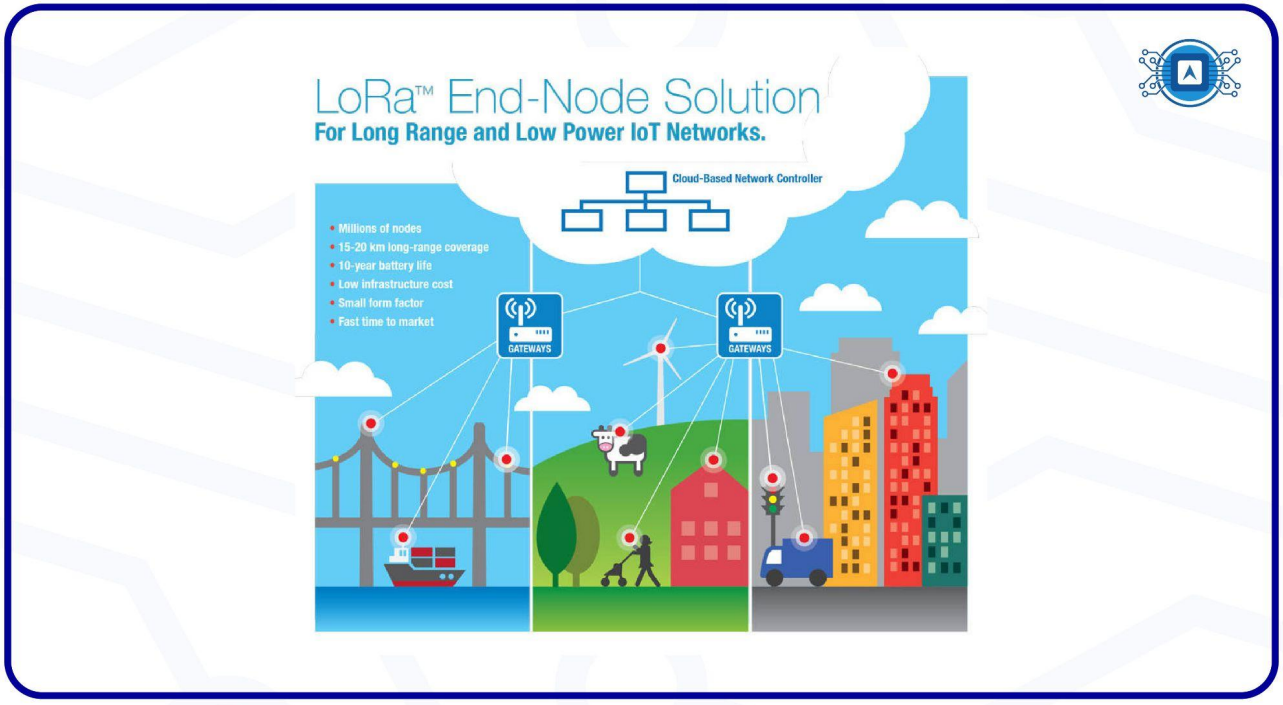

Image 05: LoraWan Architecture. Source: *Solid State Supplies <https://www.sssltd.com/microchip-lora-technology/>*.

1. Modules (end-points or end-devices)

These are the basic elements of the network, such as:

- temperature sensors, motion sensors, on-off sensors, …
- Readers of energy consumption, water, gas, …

2. Gateways

They are the connecting elements between the modules and the network servers.

A single gateway can receive data from thousands of devices and forward it to the network server, depending on the site topology conditions, a single gateway can cover a radius of 2Km to 15 Km.

3. Network Servers

The network servers are responsible for managing the information sent by the gateways.

4. Application Servers

Application servers are specific programs that receive the packets from the network servers and according to the information received, perform one or more specific actions.

LoRa Cloud Services

Semtech's LoRa Cloud services provide easy-to-use information that solution providers can use to add value faster with less development overhead. The service enables developers to quickly create IoT solutions that utilize multi-modal location capabilities (including Wi-Fi, GNSS, and geolocation via LoRaWAN) without taking on the development complexity involved in creating a solution from scratch. LoRa Cloud services are designed from the ground up to support flexibility in deployment options, cost-effectiveness and ease of use.

- Device Classes and Data Security

To meet the most diverse needs in the LaRaWAN™ protocol, three classes of devices (modules) have been defined:

- **➔ Class A - Sensors**
  - ◆ Two-way communication, reception after transmission (The modules can only receive data in predetermined time windows and immediately after performing a transmission)
- **➔ Class B - Actuators**
  - ◆ Two-way communication, with scheduled reception windows
- **➔ Class C - Bidirectional, receiving data with hardly any delay**
  - ◆ In this class the module is always able to receive data from the gateway

Important: All modules must work in class A.

Some LoRaWAN Use Cases

Here are some excellent LoRaWAN use cases provided by Semtech, to give you some tips on how LoRaWAN can be applied:

1. Vaccine cold chain monitoring

LoRaWAN sensors are used to ensure that vaccines are kept at proper temperatures during transportation.

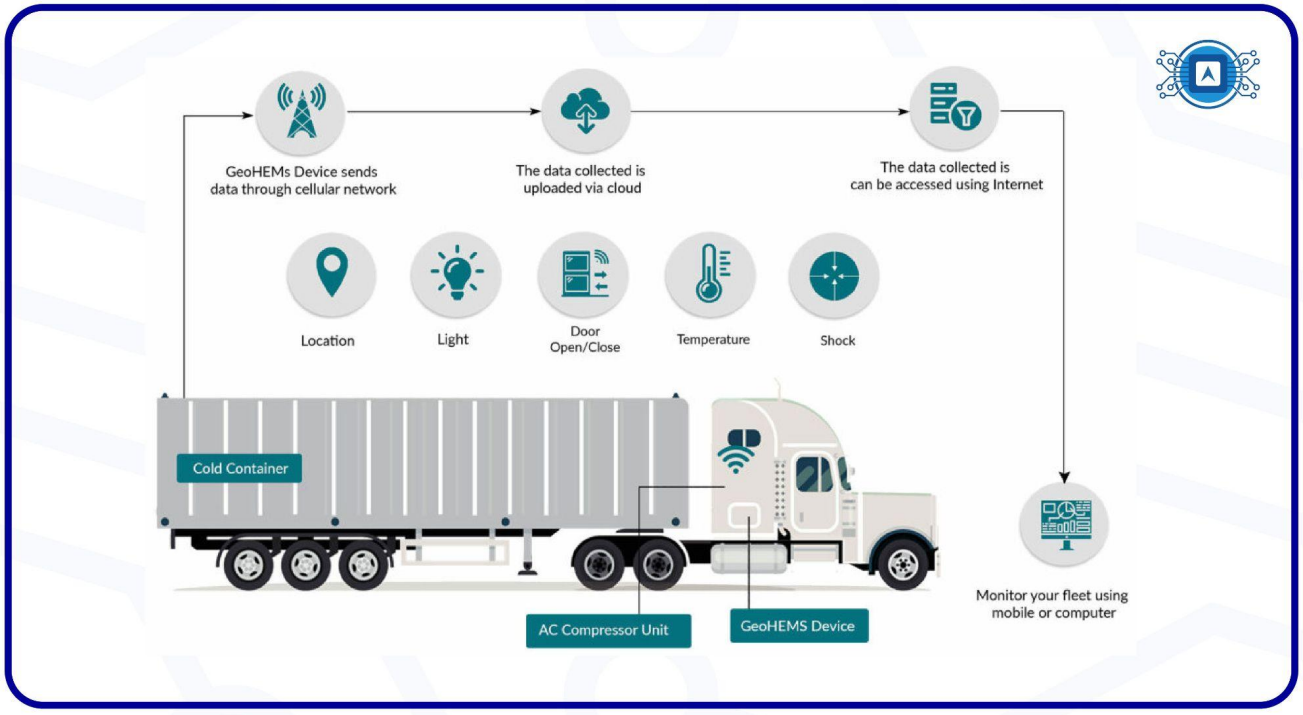

Image 06 - Vaccine cold chain monitoring. Source: *Trackster <https://www.trackster.in/cold-chain-monitoring.html>.*

2. Animal Preservation

Tracking sensors manage endangered animal species, (Ex: Black Rhinoceros).

Image 07: Animal Preservation Project . Source: *Globe News Wire*
<https://ml.globenewswire.com/Resource/Download/eeab487e-eb46-489d-9446-33fc43719c77>

3. Smart Farms

Real-time insights into crop soil moisture and optimized irrigation scheduling reduce water use by up to 30 percent.

Image 08: Smart Farm Project. Source: *Shutterstock*.

References

[1] WHAT are LoRa® and LoRaWAN®? Available at: https://lora-developers.semtech.com/documentation/tech-papers-and-guides/lora-and-lorawan/ . Accessed on: June 20, 2022

[2] MICROCHIP: LoRa Technology. In: Solid State Supplies Ltd. [S. l.], 14 ago. 2020. Available at: https://www.sssltd.com/microchip-lora-technology/ . Accessed on: June 20, 2022

[3] WHAT are LoRa and LoRaWAN?. In: The Things Network. [S. l.], 2022. Available at: https://www.thethingsnetwork.org/docs/lorawan/what-is-lorawan/ . Accessed on: 15 ago. 2022.

[4] WHAT Is LoRa?. In: Semtech Corporation. [S. l.], 2022. Available at: https://www.semtech.com/lora/what-is-lora. Accessed on: June 20, 2022

Additional Readings

Priot

It is an IoT solution provider that aims to capture, manage and transform data into information. In 2019, ProIoT became the first company to sell LoRaWAN connections, fully online, in a simple, secure and fast way. In January 2020, it reached the mark of 150,000 enabled devices and it doesn’t stop there, the company grows constantly and increasingly offers services that simplify the task of connecting objects through the internet.

The Things Network

A global collaborative Internet of Things ecosystem that creates networks, devices, and solutions using LoRaWAN.