

LoRa / 2 / CSS

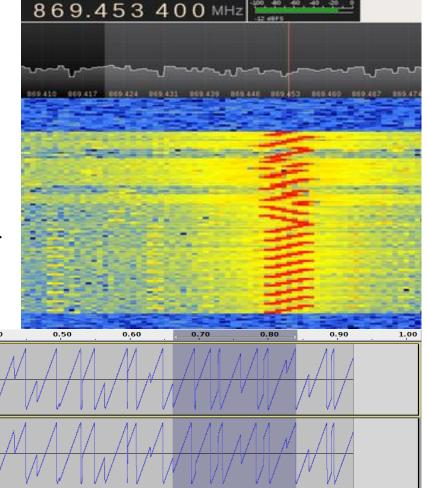
Chirp Spread Spectrum

What is a chirp?

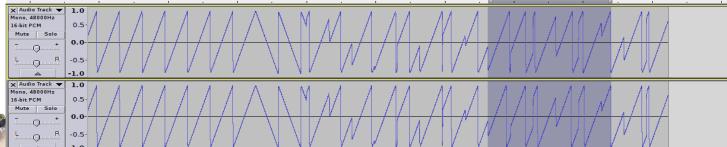
Source: https://revspace.nl/DecodingLora

Preamble (of variable length), here:

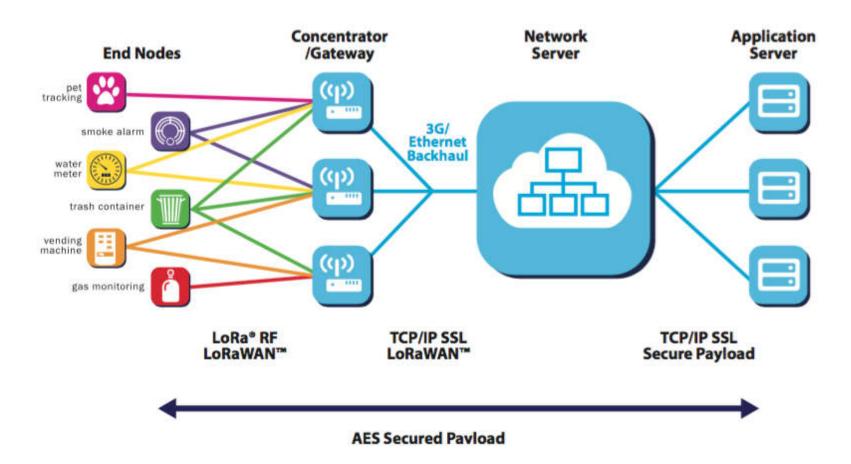
10 up, 2 down ->



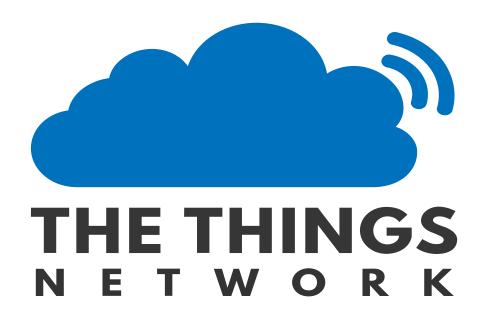




LoRaWan / 5 / architecture



The Things Network / 1



The Things Network / 2 / Manifesto

Everything that carries power will be connected to Internet eventually.

Controlling the network that makes this possible means controlling the world. We believe that this power should not be restricted to a few people, companies or nations. Instead this should be distributed over as many people as possible without the possibility to be taken away by anyone. We therefore founded "The Things Network".

The Things Network is an open source, free initiative with the following properties:

It connects sensors and actuators, called "Things", with transceivers called "Things Gateways" to servers called "Things Access".

The first connection is "Over The Air", the second is "Over The Net". The distributed implementation of these concepts is called "The Things Network".

Anyone shall be free to set up "Things" and connect to "Things Gateways" that may or may not be their own.

Anyone shall be free to set up "Things Gateways" and connect to "Things Access" that may or may not be their own. Their "Things Gateways" will give access to all "Things" in a net neutral manner, limited by the maximum available capacity alone.

Anyone shall be free to set up "Things Access" and allow anonymous connections from the Internet. Their "Things Access" will give access to all "Things Gateways" in a net neutral manner, limited by the maximum available capacity alone. Furthermore their "Things Access" will allow connection of other "Things Access" servers for the distribution of data.

The "Over The Air" and "Over The Net" networks shall be protocol agnostic, as long as these protocols are not proprietary, open source and free of rights.

Anyone who perpetrates a "Things Access" or a "Things Gateway" will do so free of charge for all connecting devices and servers.

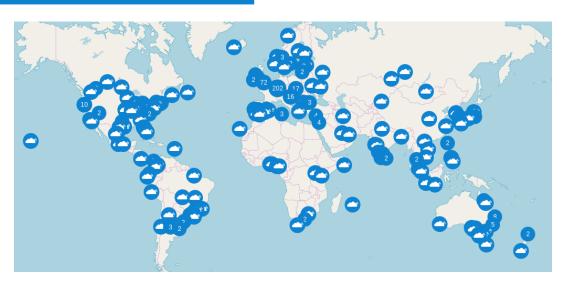
Anyone making use of the network is allowed to do so for any reason or cause, possibly limited by local law, fully at own risk and realizing that services are provided "as is" and may be terminated for any reason at any moment. The use may be open for anybody, limited to customers, commercial, not-for-profit, or in any other fashion. "The Things Network" providers will not pose restrictions upon its users.

We invite you to sign this Manifesto, and uphold its principles to the best of your abilities.

Source, Details:

The Things Network





Anyone shall be free to set up "Things" and connect to "Things Gateways" that may or may not be their own.

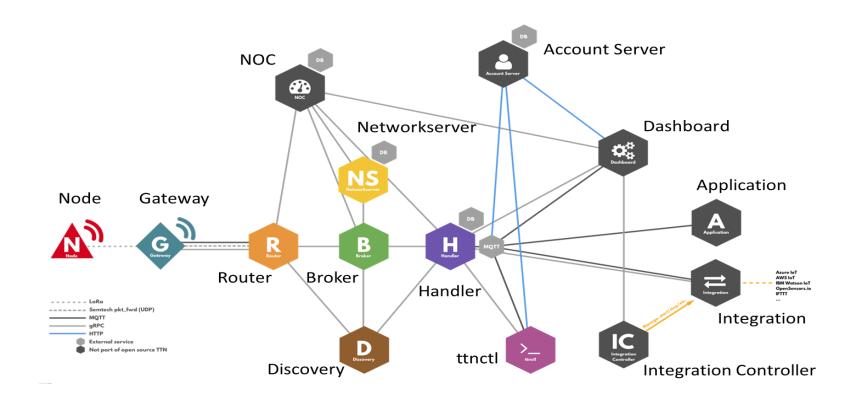
Anyone shall be free to set up "Things Gateways" and connect to "Things Access" that may or may not be their own. Their "Things Gateways" will give [free] access to all "Things" in a net neutral manner, limited by the maximum available capacity alone.

The Things Network / 3 / Essentials

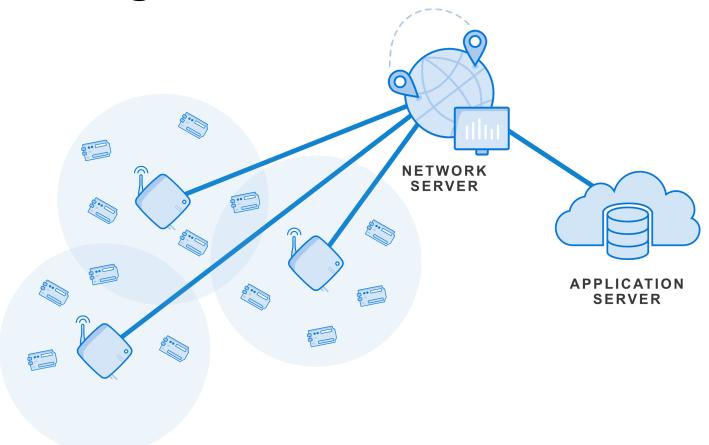
- Open source (except for web GUI)
- Free ... to set up and run their own, in particular:
 Anyone who perpetrates a "Things Access" or a "Things
 Gateway" will do so free of charge for all connecting
 devices and servers and without traffic prioritization
 other than governed by capacity
 (-> network neutrality)

This to some degree explains our current interest in TTN, in an educational context.

The Things Network / 5 / Architecture



The Things Network / 4 / Architecture



The Things Network / 6 / Security

Defined by LoRaWan

NwkSKey, AppSKey and AppKey

Activation: OTAA Over the Air Activation

ABP Activation by Personalization

Challenge of key provision

The Things Network / 7 / Security, cntd

Dynamically activated devices (**OTAA**) use the application key (AppKey) to derive the two session keys during the activation procedure. In The Things Network you can have a default AppKey which will be used to activate all devices, or customize the AppKey per device.

What you will use, in your code:

DevEUI, AppEUI, AppKey

Keys will be generated on TTN server, on registration (but can be changed manually)

Source, Details:



The Things Network / 7 / Security, cntd

ABP:

What you will use, in your code:

NwkSKey, AppSKey, DevAddr

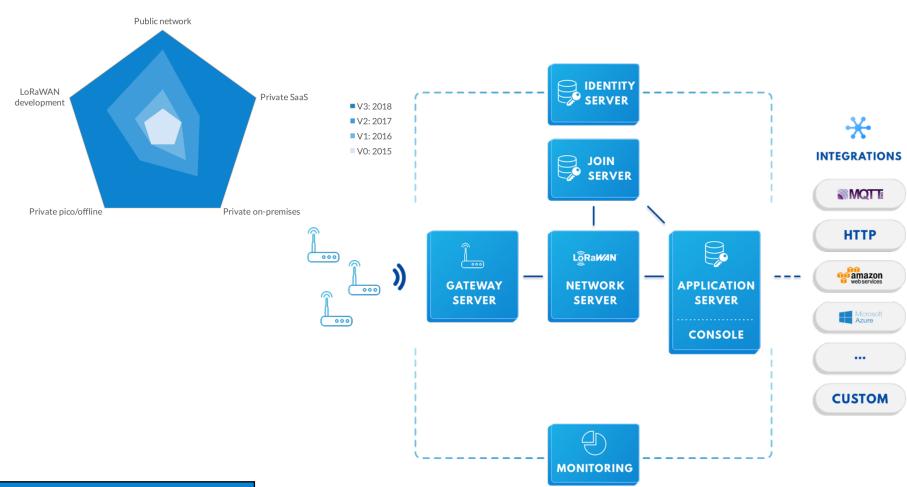
Source, Details:

https://www.thethingsnetwork.org/wiki/LoRaWAN/Security

Conference highlights 2019

End-to-end Security Hardware without the hardware **New Gateways** Peering **V3 Open Source Network Server** LoRaWAN from space The Things Network China and...

V3 stack



IT UNIVERSITY OF COPENHAGEN

V3 stack

DEPLOYMENT SCENARIOS

Public networks

Public community network and operated public networks



Private networks

Software-as-a-service, on-premises, pico and offline networks



LoRaWAN development

For device makers, application developers and prototype development





Take-Aways, Networking 2

- Be able to name protocols and standards on

PHY, MAC and higher layers -Know which protocol belongs where

- Be able to describe and place

LoRa LoRaWan The Things Network

- Be able to explain security measures for these