

Capstone Project

Building a System for Collecting and Processing
Electrical Energy Data at Level of a City and
Internal of Buildings

Supervisor:
Co-Supervisors :

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Class : **15PFIEV2**

Plan



I. Introduction

1. Context of project
2. Project's objectives

II. Analysing System and Building Hardware

1. Linky smart meter and LinkyTIC
2. GeeLink

III. From LoRa to Application Server

1. InfoTIC and TTN
2. Application server

IV. Review and Prospects

Introduction



Smart city

Energy distribution :

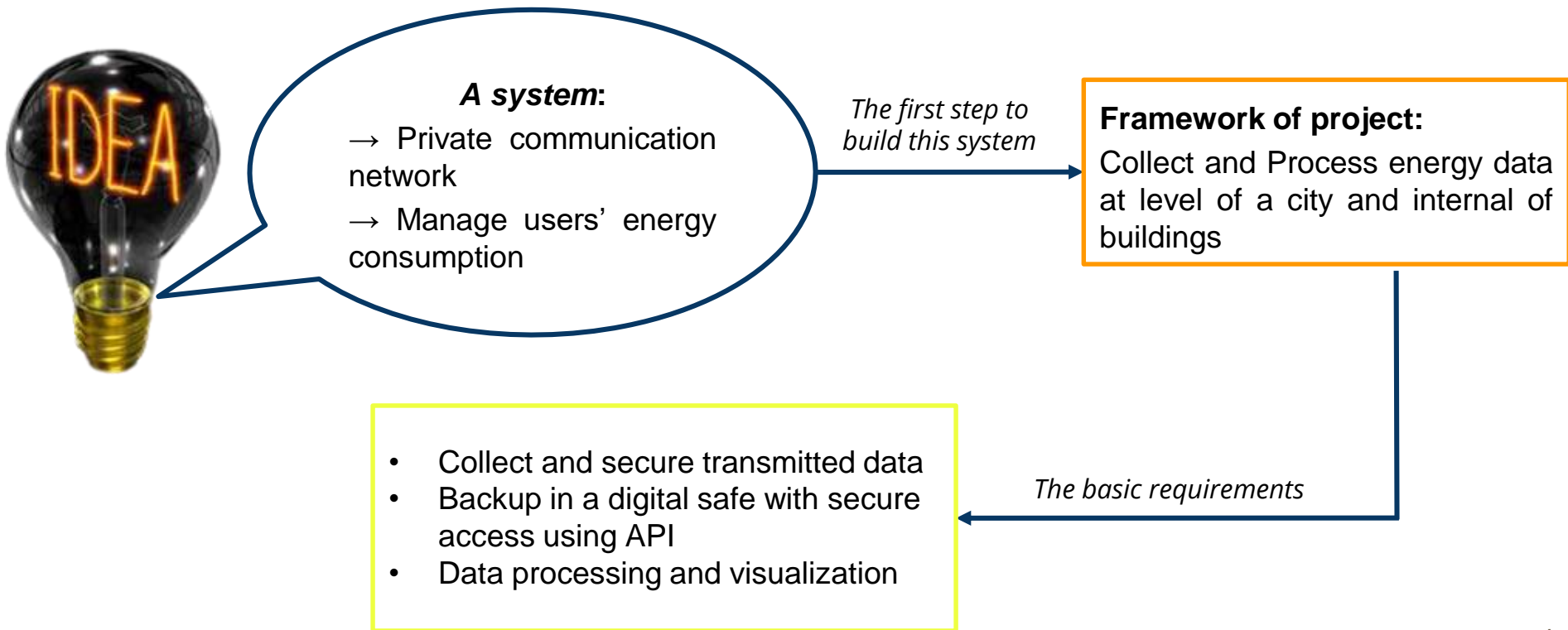
Decentralization!!!

- Complex set of producers and consumers
- Difficult to manage

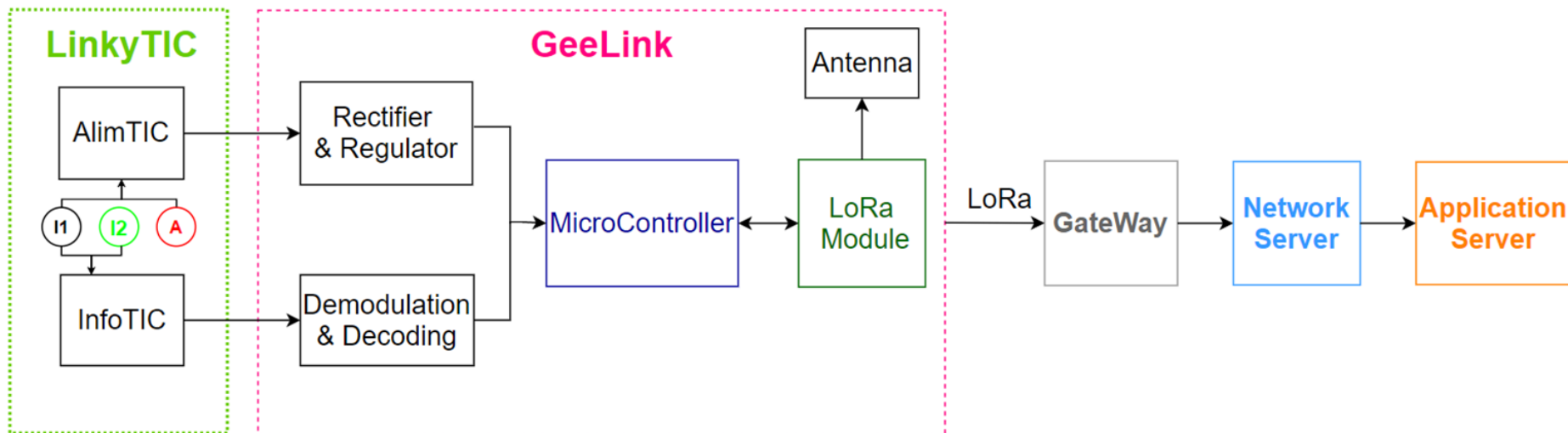


Solution?

Introduction

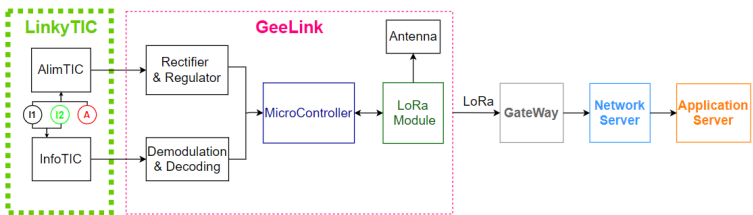


Architecture of the system



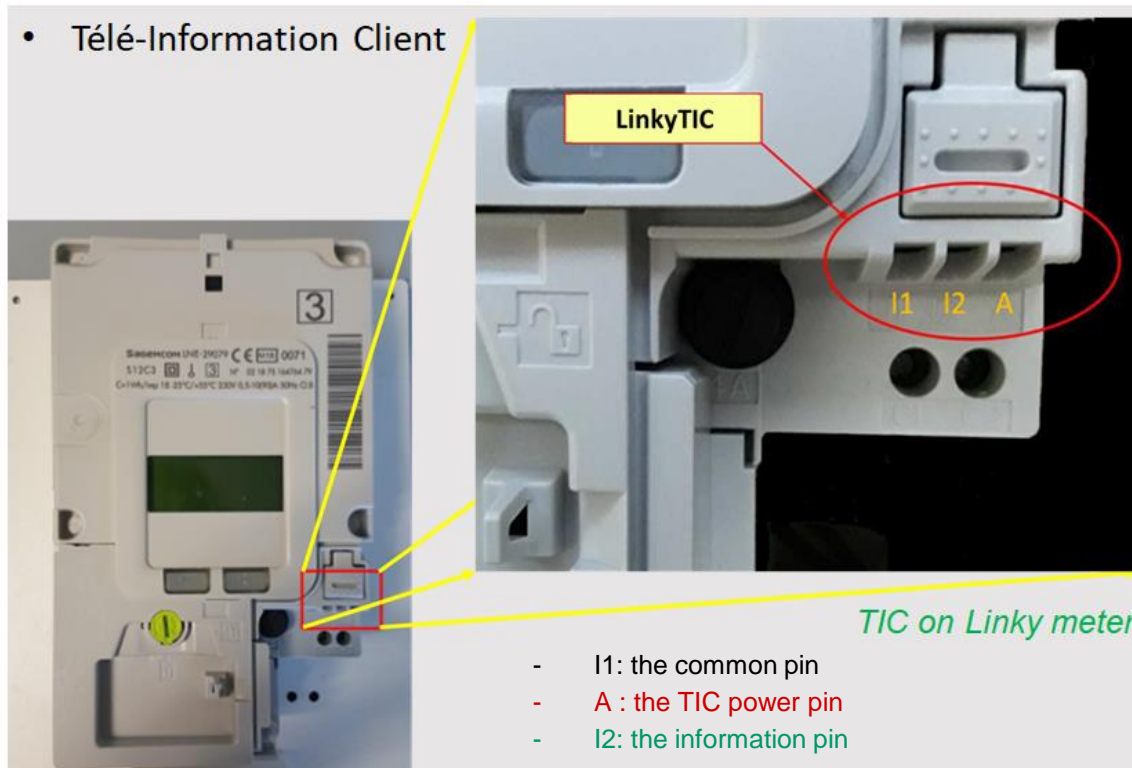
Linky smart meter

- Retrieve historical power consumption data
- Control electrical appliances in customers' homes
- Measure both of the electrical production and consumption
- Receive bills based on the actual consumption

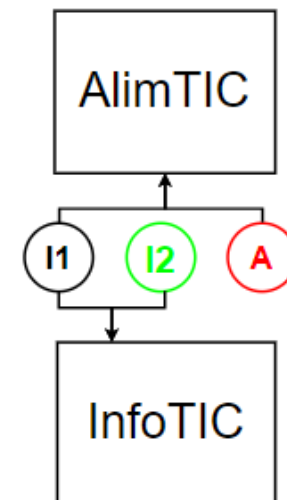


TIC

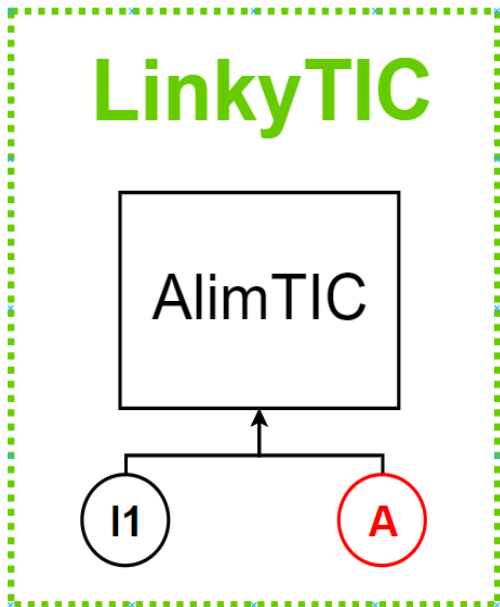
• Télé-Information Client



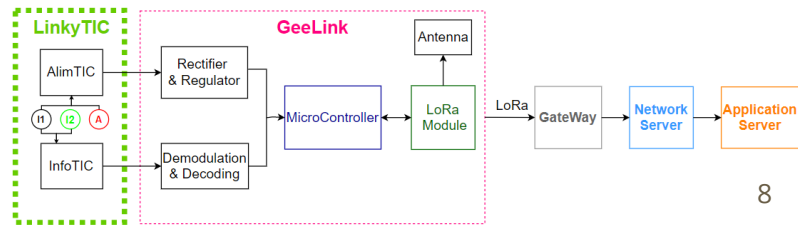
LinkyTIC



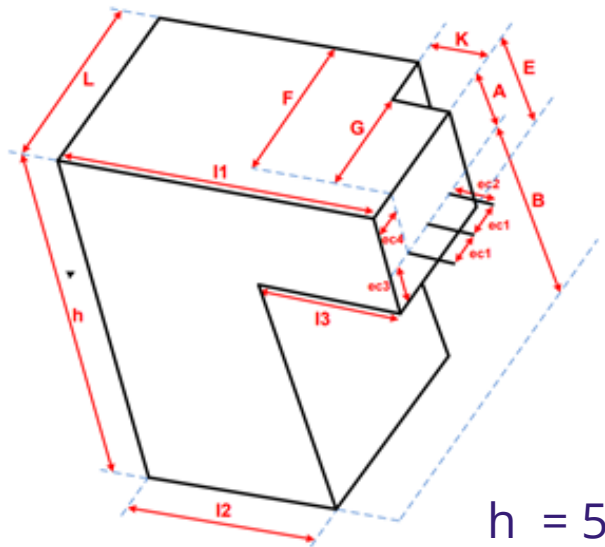
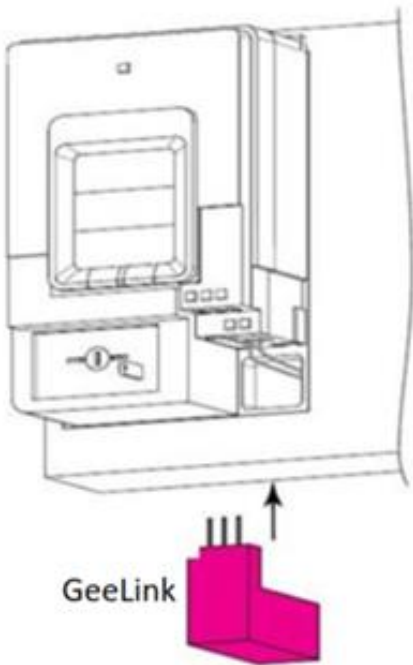
AlimTIC



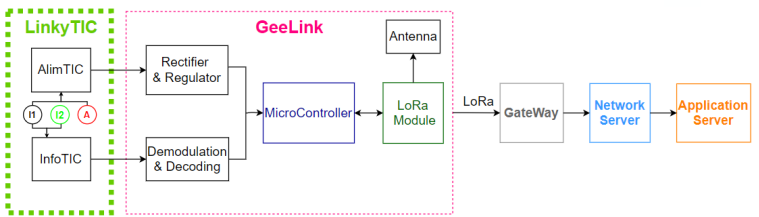
Specification	Value
Power source	Minimum 130 mW
Voltage	6 Vrms +/- 10% (max 12V peak)
Frequency	50 kHz



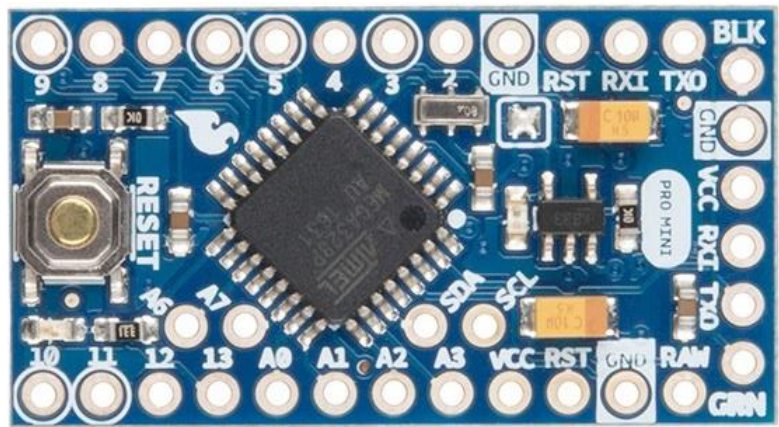
TIC



h = 58 mm
 L = 30 mm
 I2 = 27 mm
 I1 = 50 mm



μController & LoRa module

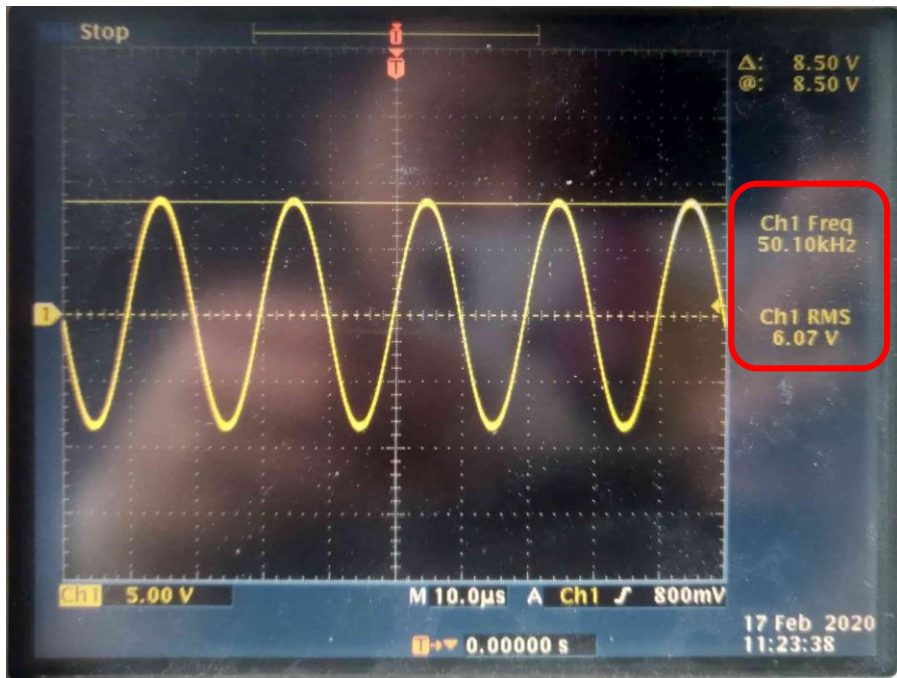


Arduino Pro Mini 3.3V 8MHz
(18x33mm)

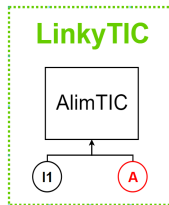


RFM95W LoRa 868MHz
(16x16mm)

AlimTIC Emulation

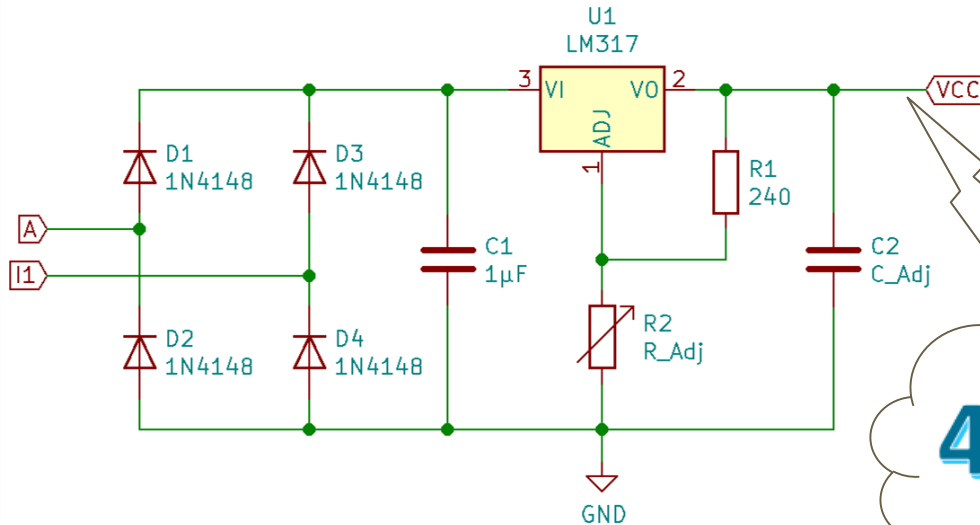


- $V_{rms} = 6 \text{ Volts}$
- $\text{Freq.} = 50 \text{ kHz}$



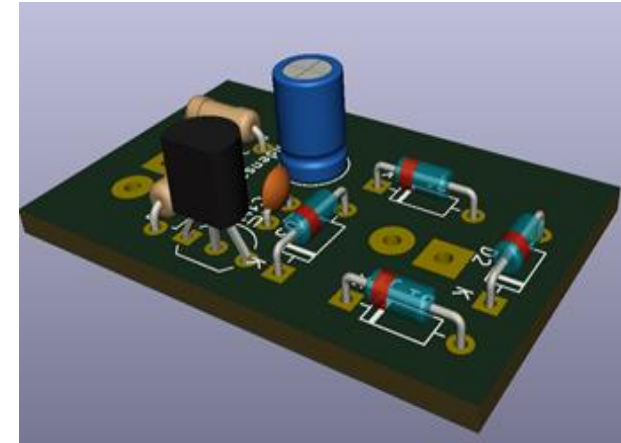
Rectifier and Regulator

$$V_O = 1.25 \times \left(1 + \frac{R_2}{R_1}\right) + I_{Adj} \times R_2 = 3V3$$



Output
Current

40 mA

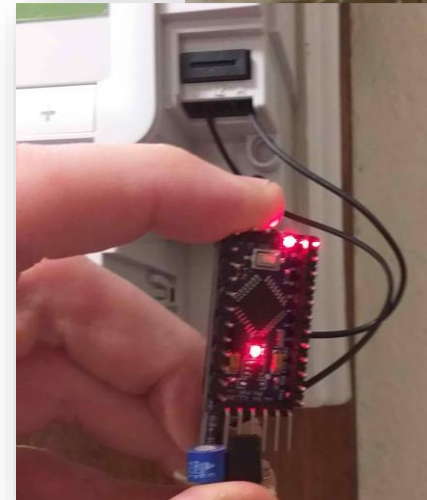


3D Model

Result



No-load Output Voltage



Power consumption of RFM95W

At 3V3



consumes 1,6 mA.

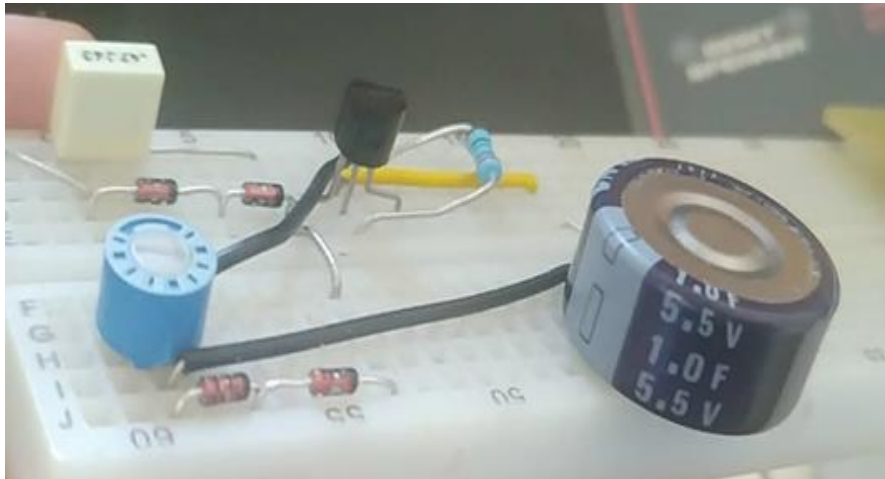
However, for the *joining request*, it takes...

~80 mA

Series of 5 capacitors 4700 μ F vs Supercapacitor




Series of **5 capacitors 4700 μ F**
 Time to fully charge from 0V to 3,3V is
15 seconds



Supercapacitor **1 Farad**
 Time to fully charge from 0V to 3,3V is
14 minutes

❖ Output current from TIC: **~40mA**

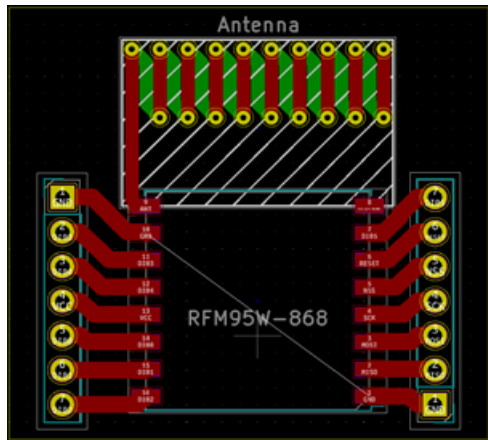
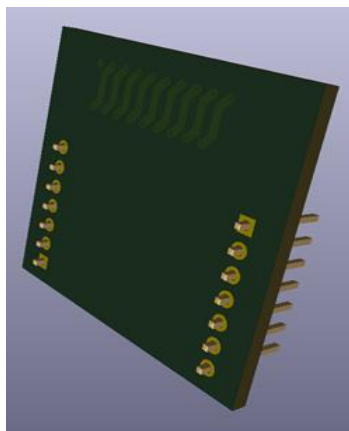
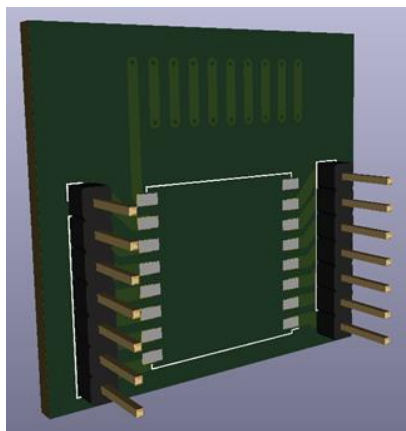
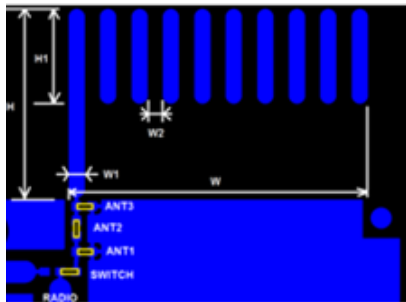
Consumption of Low-Power mode on Pro Mini

Only Arduino Pro Mini @3.3V (8Mhz)	Keep power LED		Removed power LED	
	"Active" mode	Low-Power mode	"Active" mode	Low-Power mode
	6,34 mA	1,86 mA	4,18 mA	83,4 μ A
	5,48 mA	1,45 mA	3,96 mA	81,6 μ A



❖ Output current from TIC: ~40mA

PCB Antenna 868MHz

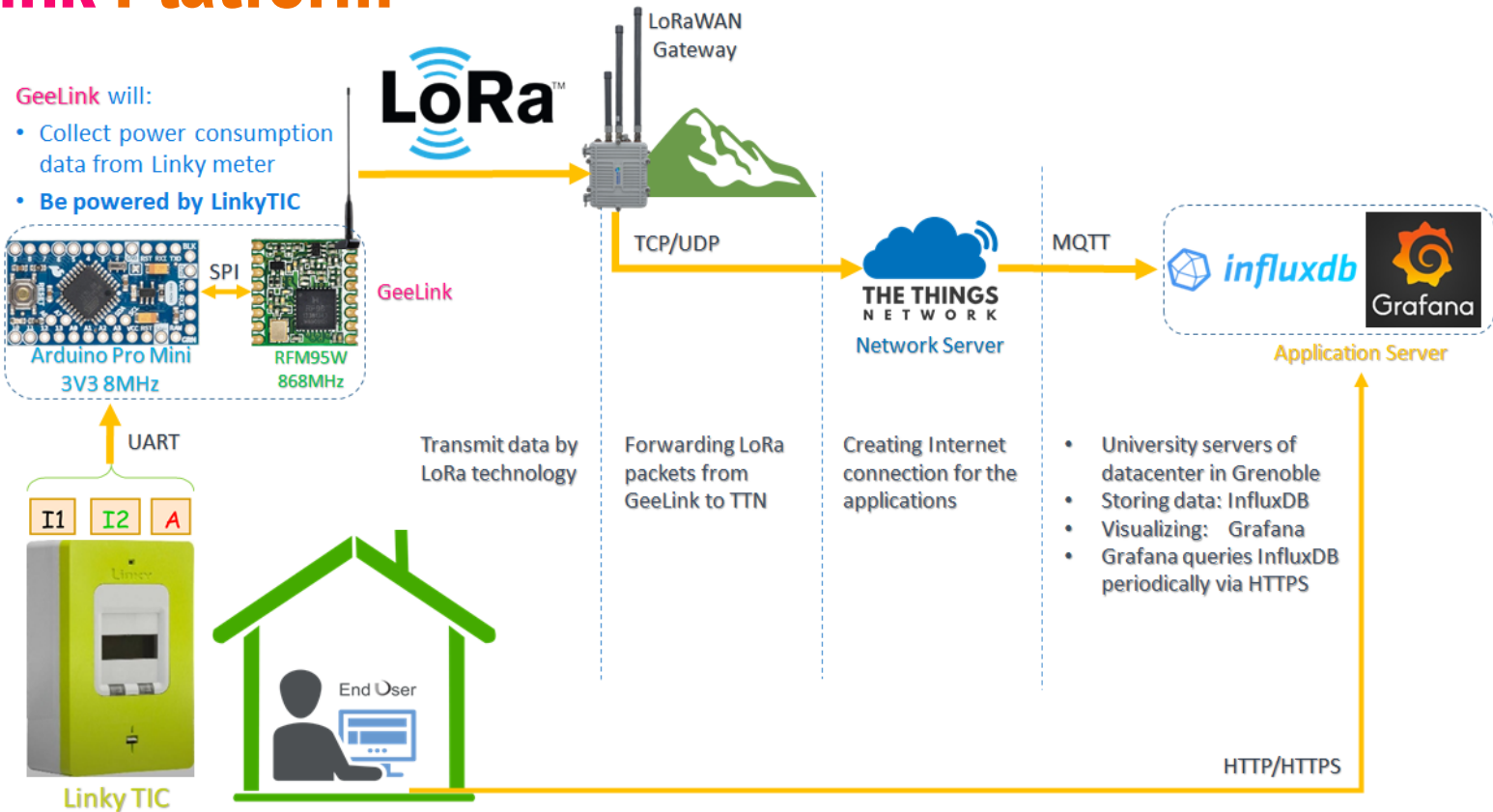


RFM95W footprint +
PCB Antenna 868MHz

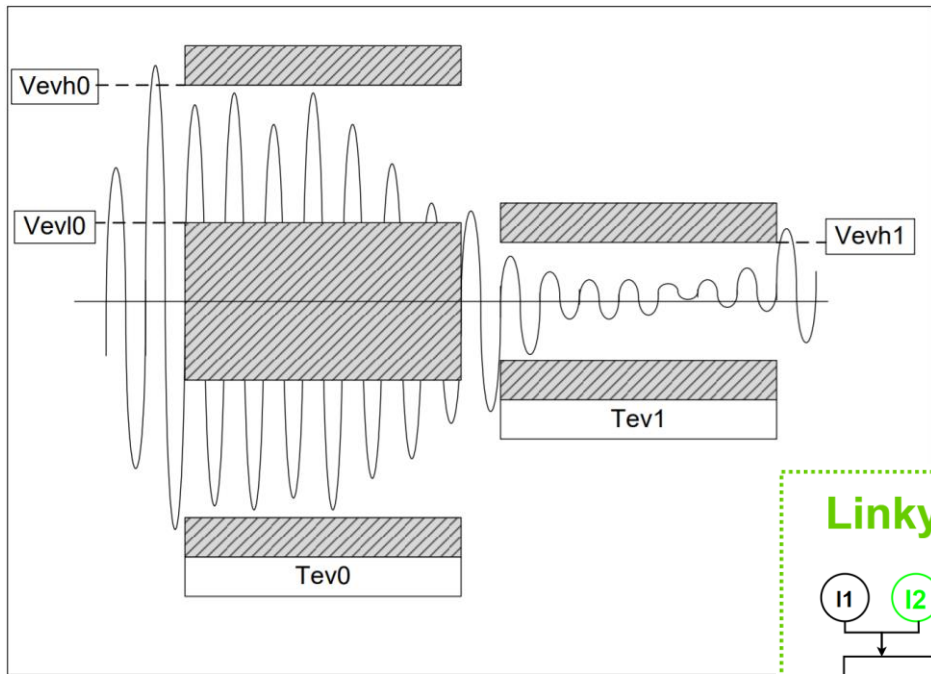
GeeLink Platform

GeeLink will:

- Collect power consumption data from Linky meter
- Be powered by LinkyTIC



InfoTIC



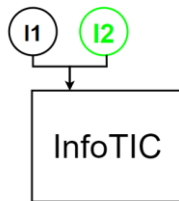
ASK Modulation.

Carrier Frequency: **50kHz**

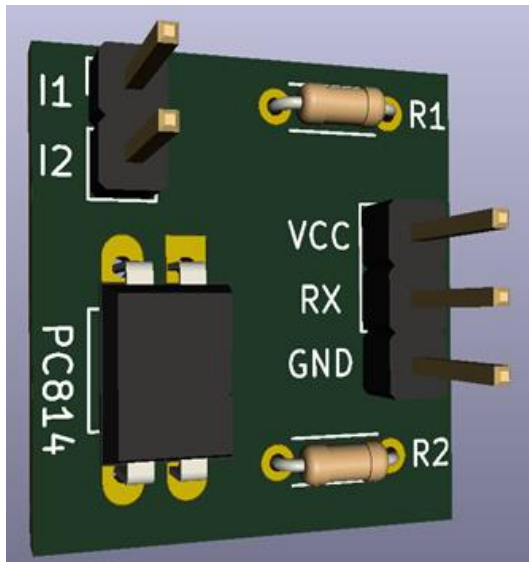
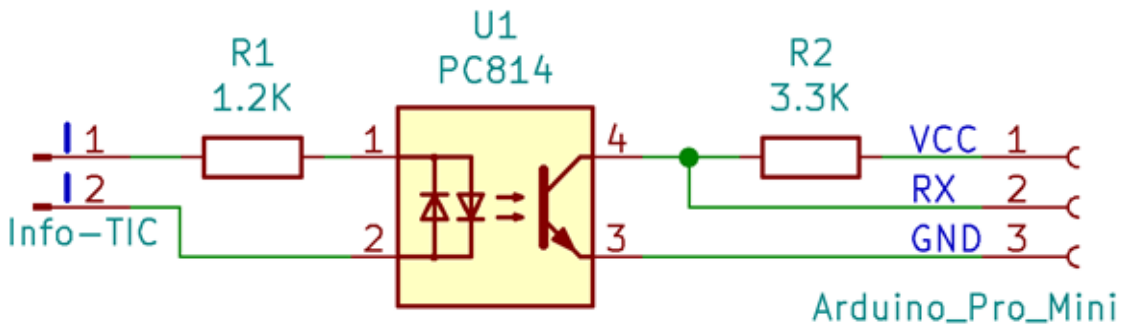
Physical Specification:

- Vevh0 = 25 Volts
- Vevl0 = 0.8 Volts
- Vevh1 = 0.4 Volts
- Tev0 = Tev1 = 50 μ s

LinkyTIC

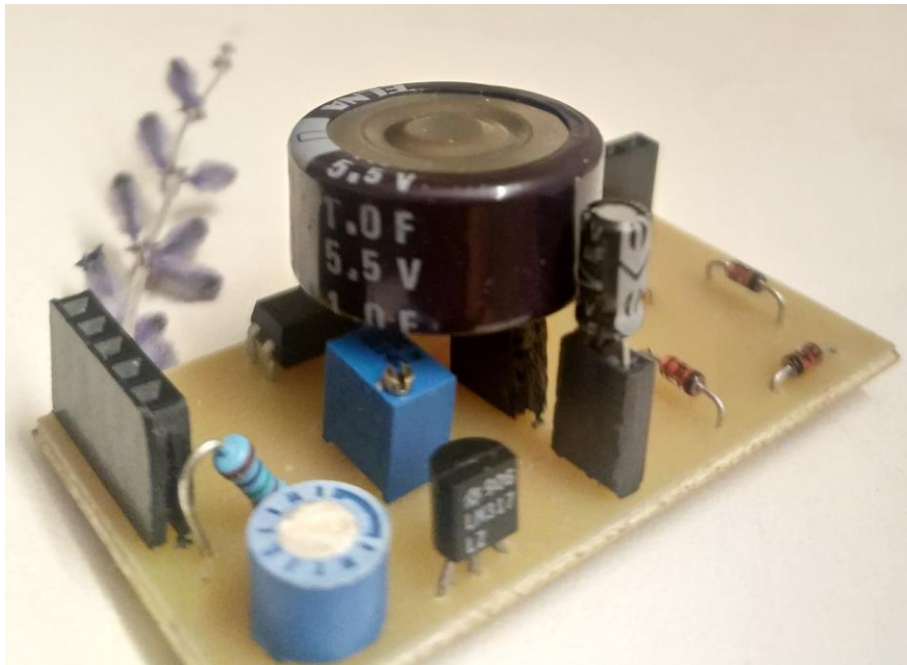
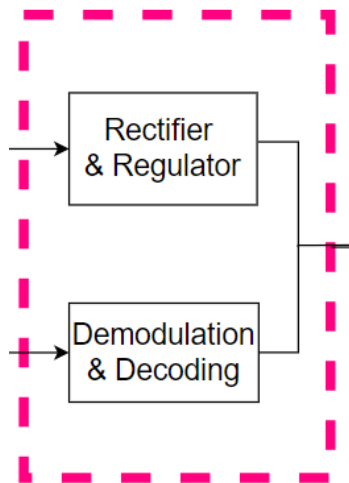


Demodulation & Decoding



Combination

Combination of



InfoTIC mode Historic

❖ *Example of a frame from LinkyTIC in Historic mode :*

- **IINST** : instantaneous current in A,
- **PAPP** : apparent power in VA,
- **HCHC** : Off-peak hours index in Wh,
- **HCHP** : Full hours index in Wh,

Group of Data:

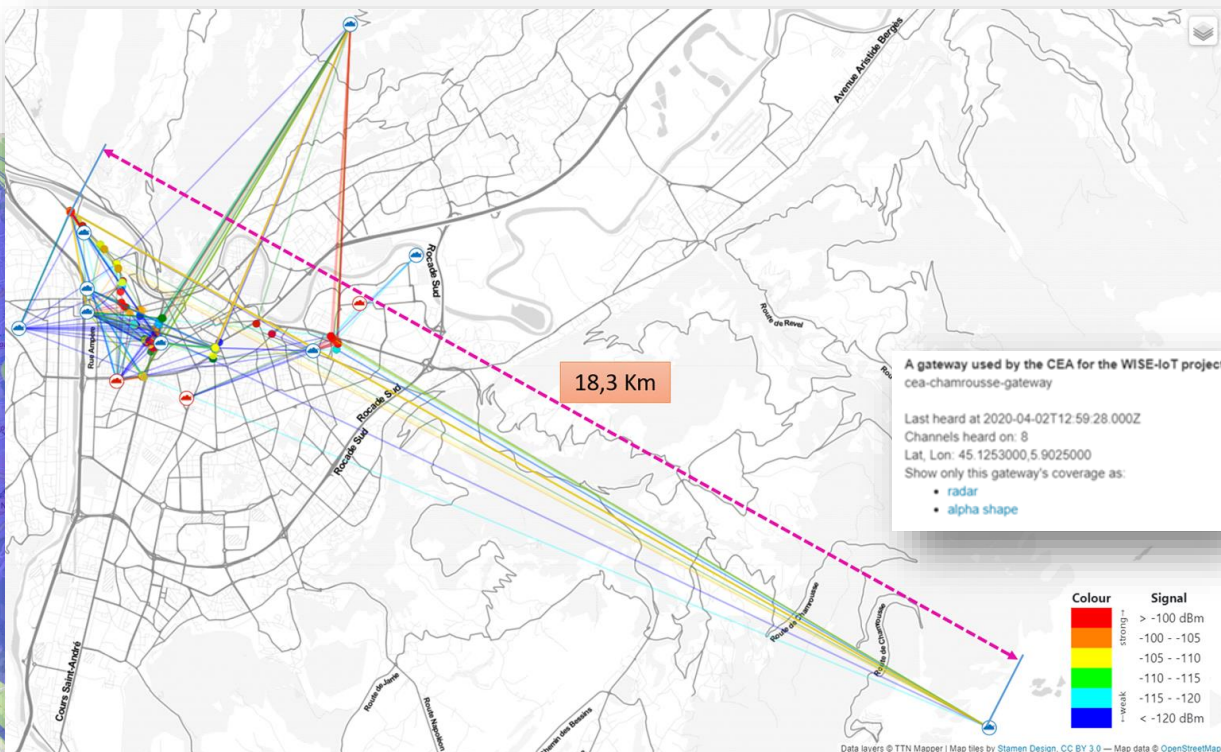
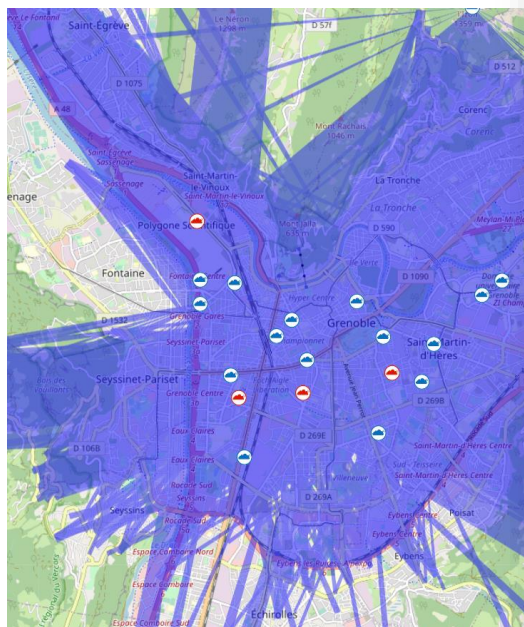
LF(0x0A)	Label	SP(0x20)	DATA	SP(0x20)	Checksum	CR(0x0D)
	HCHP		000927475		5	

STX


```
ADCO 061864103475 D
OPTARIF HC.. <
ISOUSC 30 9
HCHC 003640462
HCHP 000927475 5
PTEC HP..
IINST 002 Y
IMAX 090 H
PAPP 00390 -
HHPHC A ,
MOTDETAT 000000 B
```

ETX

TTN Mapper & LoRaWAN gateway coverage



The Things Network server

Applications >  geelink

Overview

Devices

Payload Formats

Integrations

Data

Settings

APPLICATION OVERVIEW

[documentation](#)

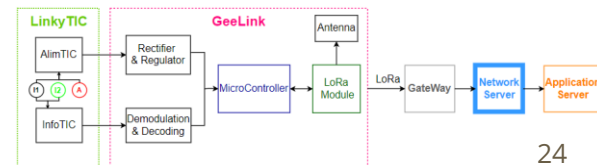
Application ID geelink

Description GeeLink - G2Elab - 2020

Created last month

Handler ttn-handler-eu (*current handler*)

OPEN, *free-to-use* community network server.



Payload decoder on TTN

Payload Format

The payload format sent by your devices

Custom

decoder

converter

validator

encoder

[remove decoder](#)

```
1 function GeelinkDecode(bytes) {  
2  
3   var data_types = {  
4     0 : {'size': 2, 'index': 'VccTIC (in V)', 'divisor': 100},  
5     1 : {'size': 2, 'index': 'IINST (in A)', 'divisor': 1},  
6     2 : {'size': 3, 'index': 'PAPP (in VA)', 'divisor': 1},  
7     3 : {'size': 5, 'index': 'HCHC (in KWh)', 'divisor': 1000},  
8     4 : {'size': 5, 'index': 'HCHP (in KWh)', 'divisor': 1000},  
9     5 : {'size': 5, 'index': 'BASE (in KWh)', 'divisor': 1000},  
10    6 : {'size': 2, 'index': 'PTEC', 'divisor': 1},  
11  };  
12  
13  function arrayToDecimal(stream, divisor) {
```

decoder has no changes

Payload decoder on TTN

Payload

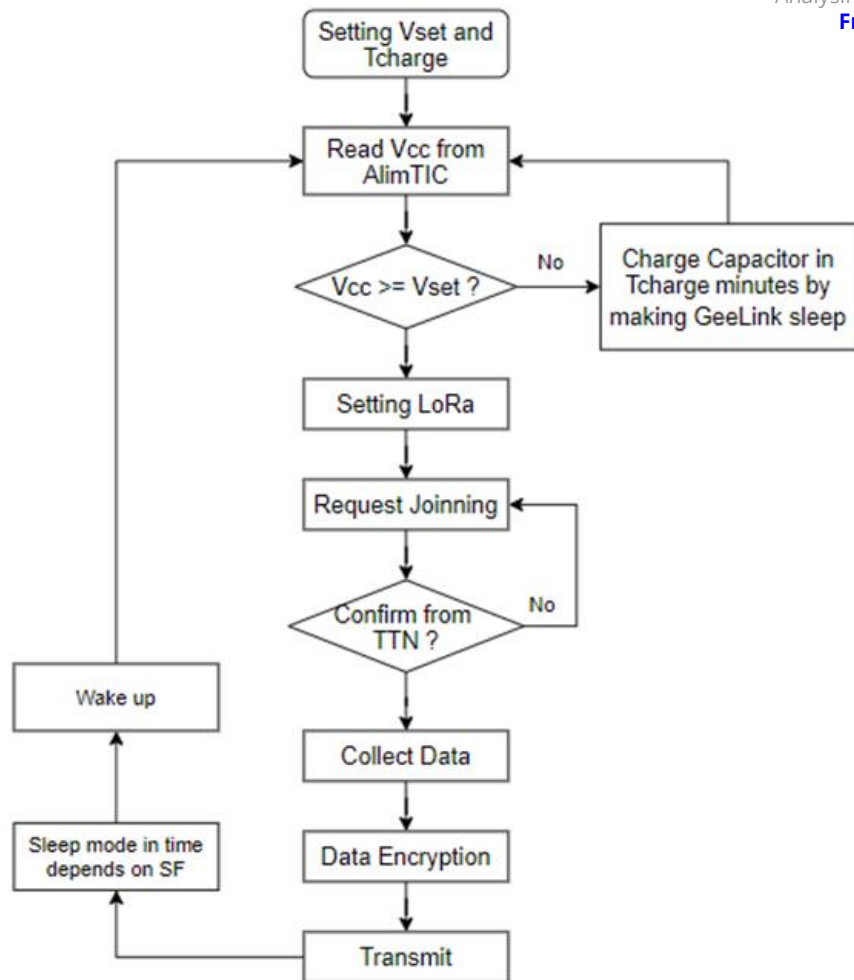
00 01 80 01 00 2D 02 00 27 8D 03 00 00 41 34 30 04 00 00 56 5A 97 05 00 00 97 8E C7 06 00 00



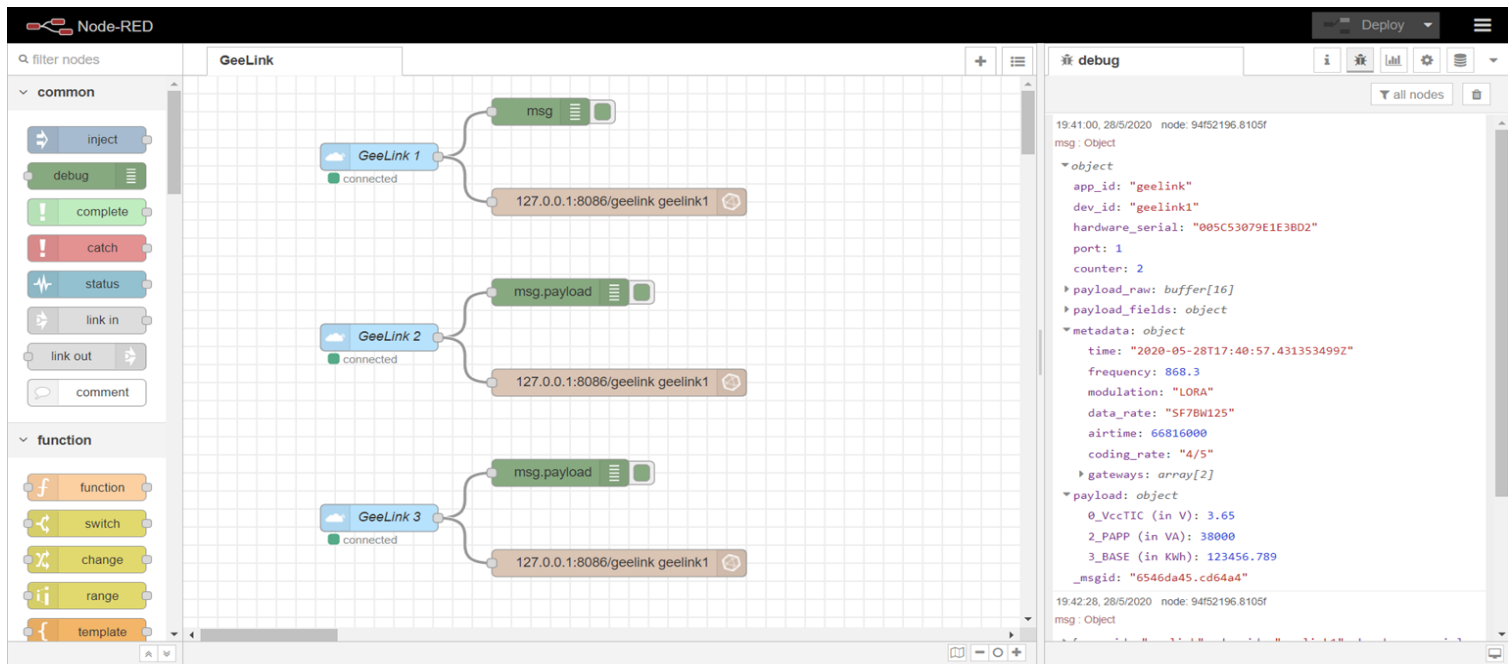
```
{  
  "BASE (in KWh)": 9932.487,  
  "HCHC (in KWh)": 4273.2,  
  "HCHP (in KWh)": 5659.287,  
  "IINST (in A)": 45,  
  "PAPP (in VA)": 10125,  
  "PTEC": 0,  
  "VccTIC (in V)": 3.84  
}
```

System Flowchart

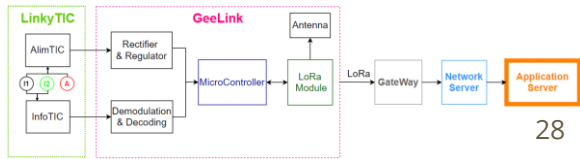
from LinkyTIC to TTN



Node-RED on Application server



The screenshot shows the Node-RED web interface. On the left, there are two panels: 'common' and 'function'. The 'common' panel includes nodes like inject, debug, complete, catch, status, link in, link out, and comment. The 'function' panel includes nodes like function, switch, change, range, and template. The main workspace contains three parallel flows, each starting with a 'GeeLink' node (labeled 'GeeLink 1', 'GeeLink 2', and 'GeeLink 3') which is marked as 'connected'. Each flow then branches into a 'msg' node and a '127.0.0.1:8086/geelink geelink1' node. The right-hand 'debug' console shows the output of the first flow, displaying a JSON object with fields: app_id, dev_id, hardware_serial, port, counter, payload_raw, payload_fields, metadata (time, frequency, modulation, data_rate, airtime, coding_rate, gateways), and payload (0_VccTIC, 2_PAPP, 3_BASE, _msgid).



InfluxDB & Grafana

127.0.0.1:8086/geelink geelink1

⚙️ Properties

Server

127.0.0.1:8086/geelink

Measurement

geelink1



Data Sources / GeeLink

Type: InfluxDB

⚙️ Settings

Name

GeeLink

Default

☒

HTTP

URL

http://222.255.135.132:8086

Access

Server (Default)

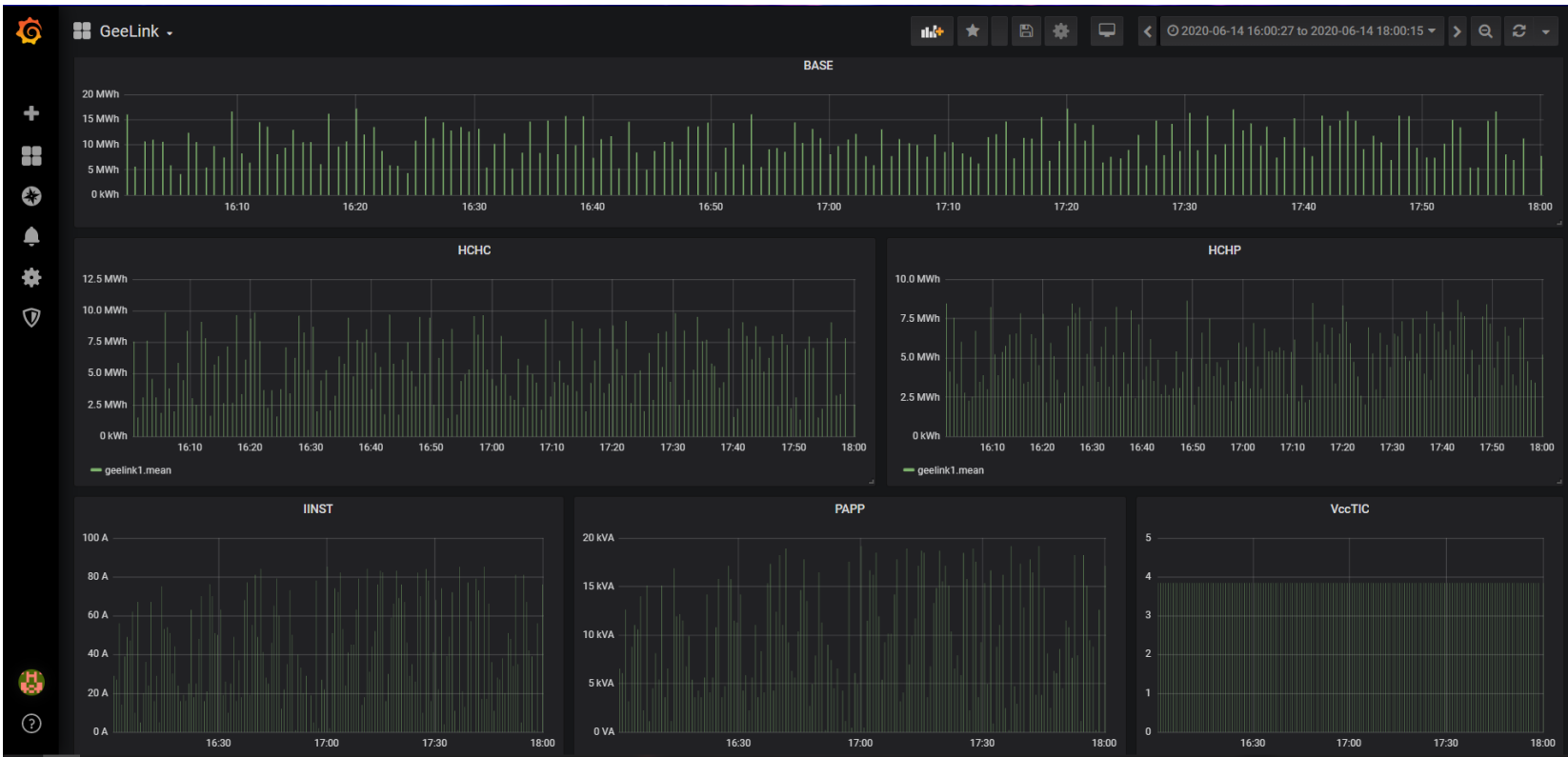
Help ▶

Whitelisted Cookies

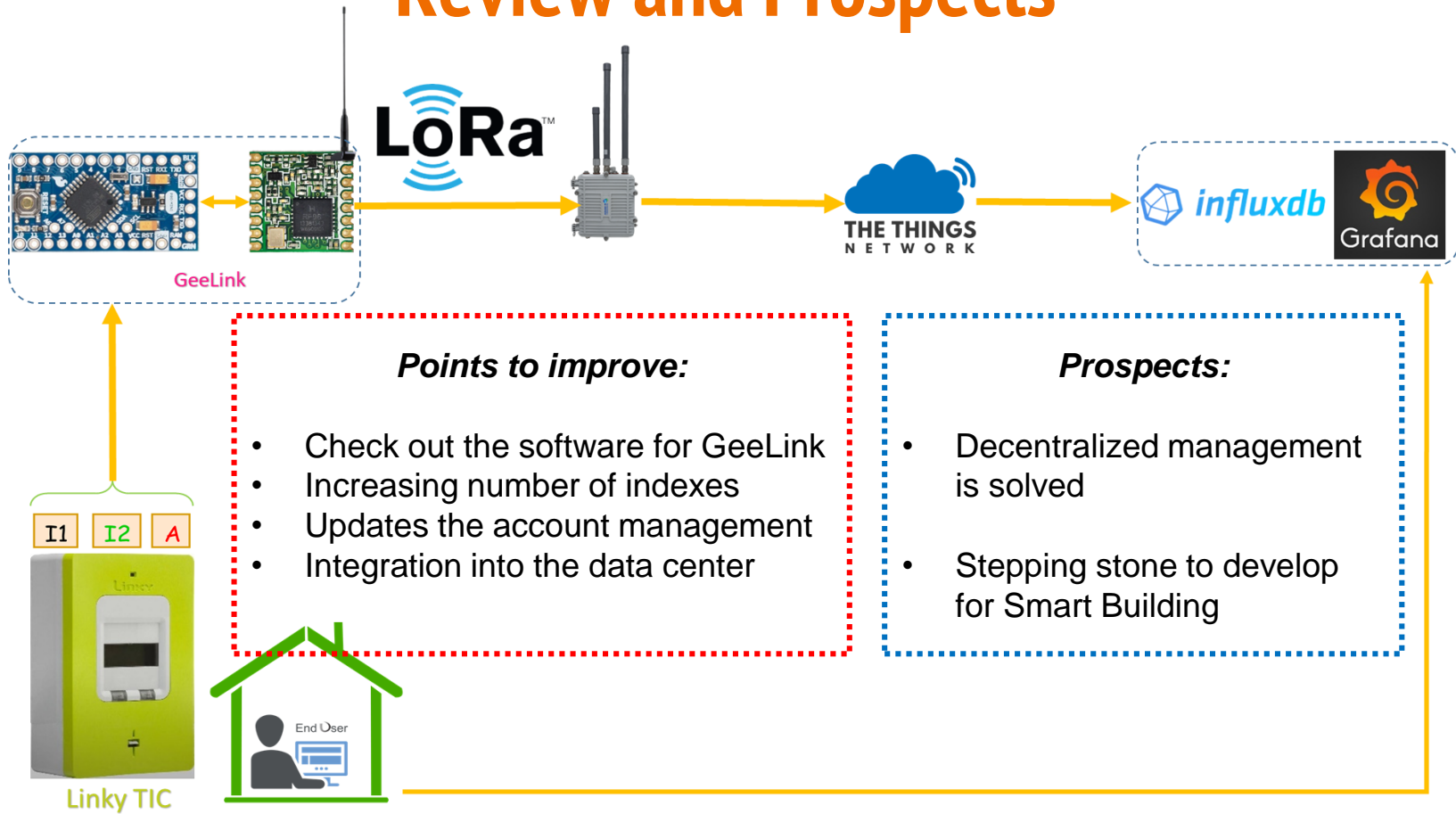
Add Name

29

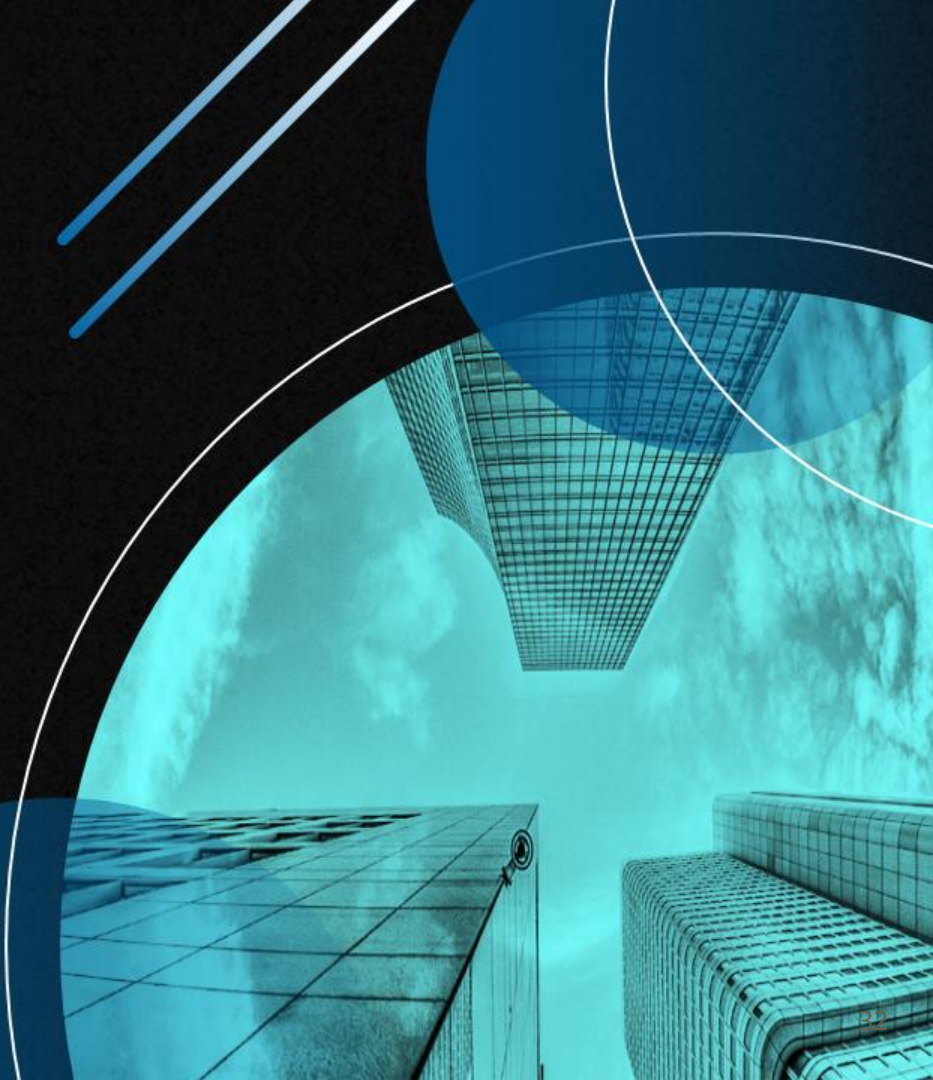
InfluxDB & Grafana



Review and Prospects



Thank You!



GeeLink v1.0

