

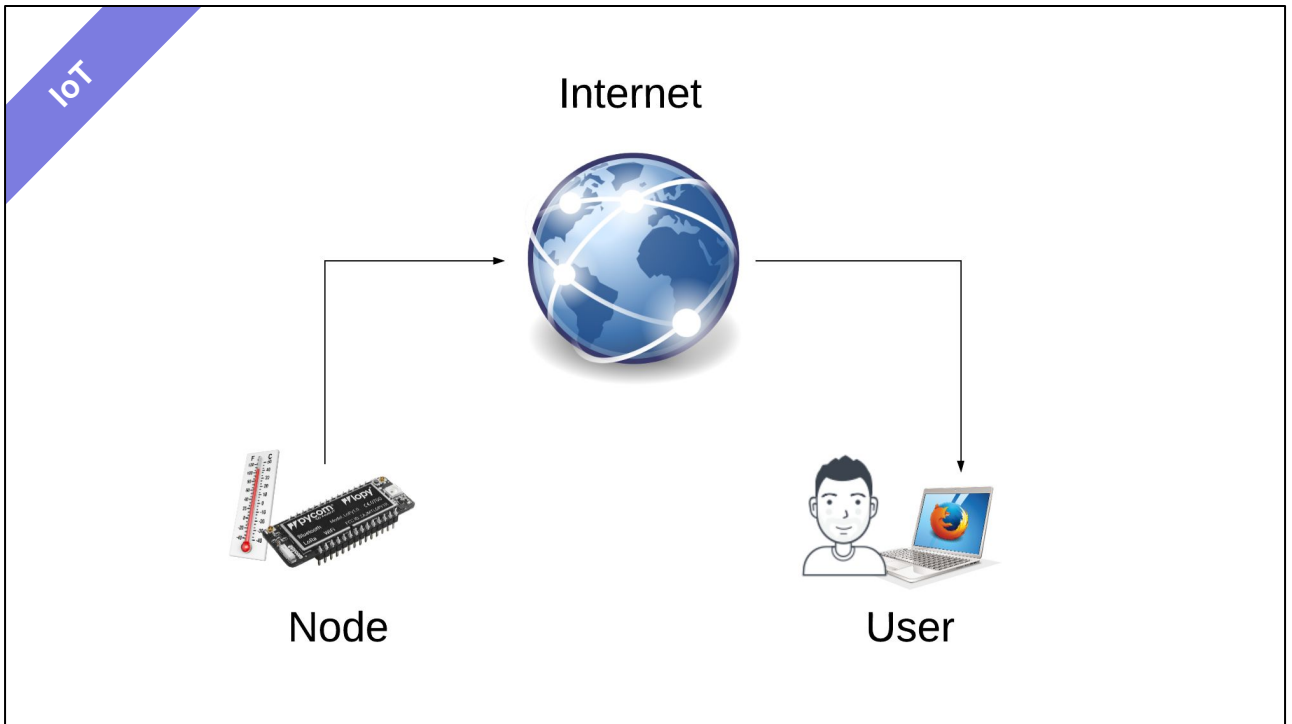


# THE THINGS N E T W O R K

<https://github.com/joarolai/loathack/tree/ttn>

Powered by Wireless Trondheim

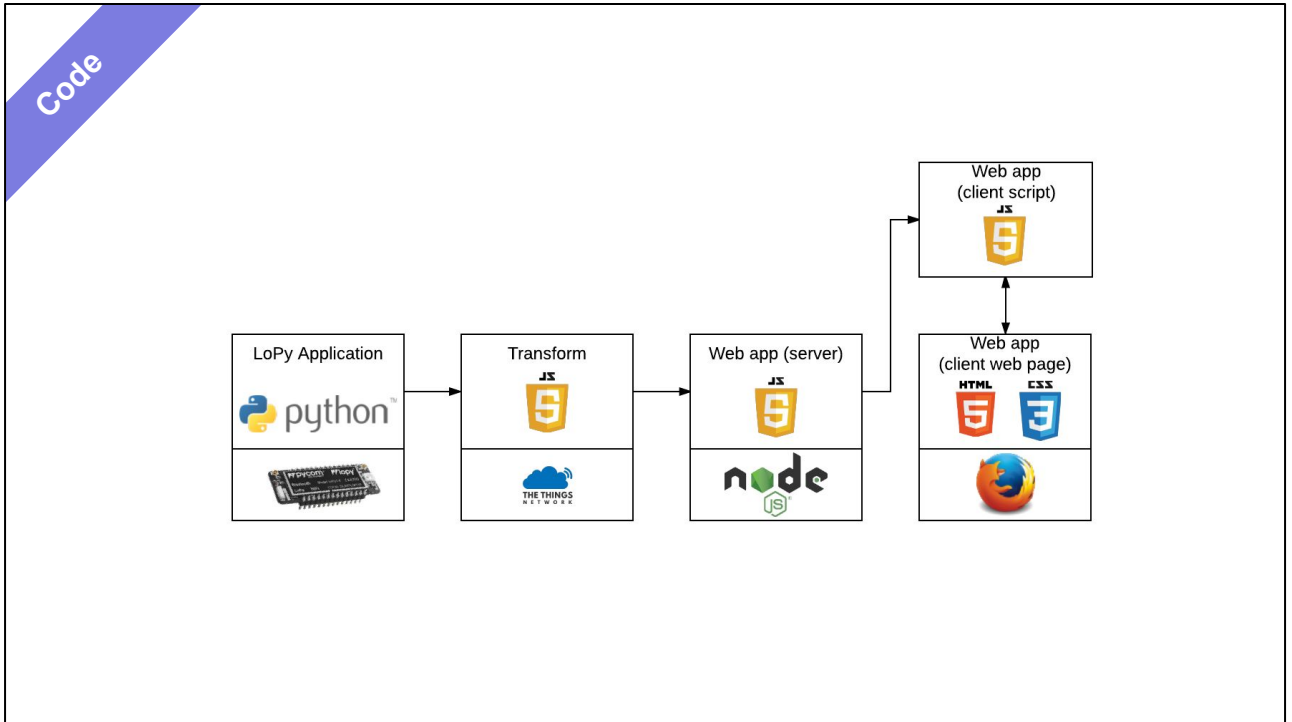
Version 1.1:



In this presentation we are looking at a simple application that is sending sensor data (temperature) via the internet to a web application where the users can observe the temperature change in real time (more or less) via their browsers.

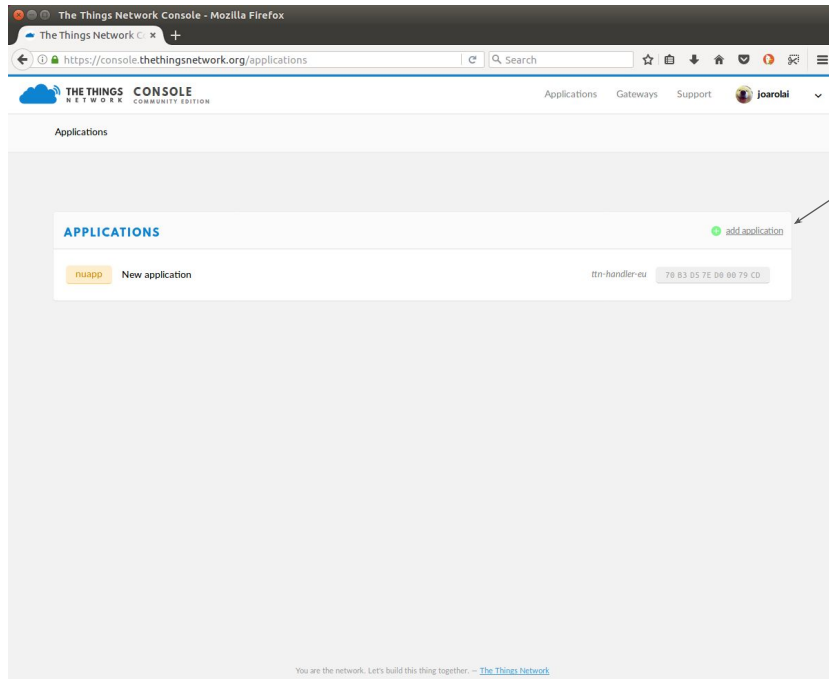
Node = Sensor node operating on a network, also called a mote

TTN = The Things Network



A typical IoT application may include several components that each need custom code developed for it. In our example we have the following:

- Code for the LoPy written in Python
- A transform script written in Javascript that shall run in TTN
- A node.js application written in Javascript that shall run on your web server
- A user interface in the form of a webpage written in HTML, CSS and Javascript



The screenshot shows the 'Applications' page in the The Things Network Console. The browser address bar displays 'https://console.thethingsnetwork.org/applications'. The page header includes the 'THE THINGS NETWORK' logo, 'CONSOLE COMMUNITY EDITION', and navigation links for 'Applications', 'Gateways', and 'Support'. A user profile 'Joarolai' is visible in the top right. The main content area is titled 'APPLICATIONS' and features a green '+ add application' button, which is pointed to by an arrow. Below this, a card for a 'New application' is shown, containing a yellow 'tnsapp' button, the name 'tn-handler-eu', and a MAC address '78 83 05 7E 08 08 79 CD'. At the bottom of the page, a footer message reads: 'You are the network. Let's build this thing together. - The Things Network'.

The Things Network Console - Mozilla Firefox

The Things Network C. \* +

https://console.thethingsnetwork.org/applications/add

THE THINGS NETWORK CONSOLE COMMUNITY EDITION

Applications Gateways Support Joarobi

Applications > Add Application

### ADD APPLICATION

**Application ID**  
The unique identifier of your application on the network

nuapp

**Description**  
A human readable description of your new app

New application

**Application EUI**  
An application EUI will be issued for The Things Network block for convenience, you can add your own in the application settings page.

EUI issued by The Things Network

**Handler registration**  
Select the handler you want to register this application to

ttn-handler-eu

Cancel Add application

You are the network. Let's build this thing together. - The Things Network

Register device

The Things Network Console - Mozilla Firefox

https://console.thethingsnetwork.org/applications/ruapp

THE THINGS NETWORK CONSOLE

Applications Gateways Support Journal

Applications > ruapp

Overview Devices Payload Formats Integrations Data Settings

### APPLICATION OVERVIEW

Application ID: ruapp [documentation](#)

Description: New application

Created: 10 days ago

Handler: ttn-handler-eu (current handler)

### APPLICATION EUIs

[manage euis](#)

EUI: 70 83 05 7E D8 90 79 C0

### DEVICES

[register device](#) [manage devices](#)

2 registered devices

### COLLABORATORS

[manage collaborators](#)

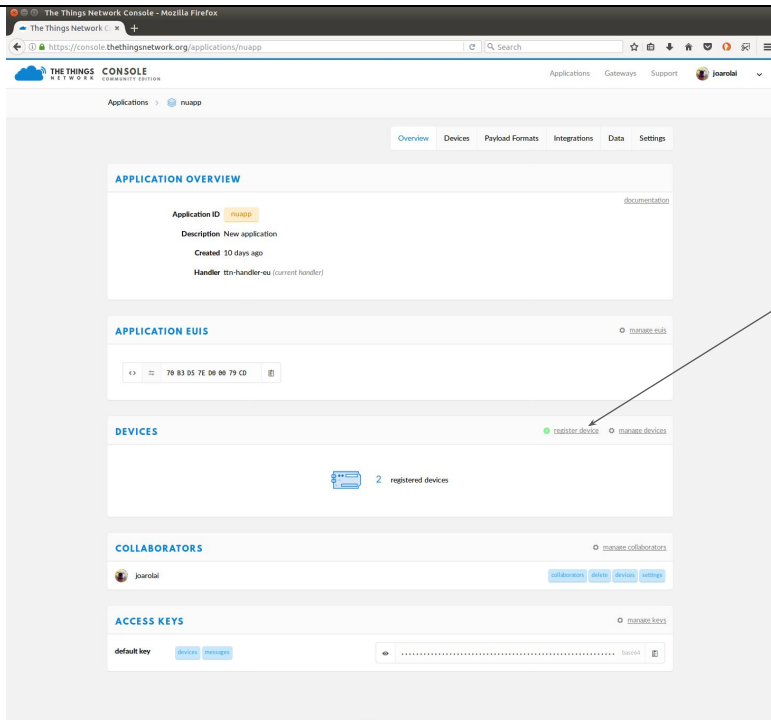
Journal [collaborators](#) [devices](#) [settings](#)

### ACCESS KEYS

[manage keys](#)

default key [devices](#) [messages](#)

..... base64



Device

The Things Network Console - Mozilla Firefox

The Things Network Console

ApplicationsGatewaysSupportJoarolal

Applications > nuapp > Devices

OverviewDevicesPayload FormatsIntegrationsDataSettings

REGISTER DEVICE

[bulk import devices](#)

Device ID

This is the unique identifier for the device in this app. The device ID will be immutable.

another

Device EUI

The device EUI is the unique identifier for this device on the network. You can change the EUI later.

70 B3 D5 49 92 9A B6 26 8 bytes

App Key

The App Key will be used to secure the communication between you device and the network.

this field will be generated

App EUI

70 B3 D5 7E 00 00 79 CD

CancelRegister

You are the network. Let's build this thing together. - The Things Network

Device EUI

Use REPL for this


```
import network,binascii  
binascii.hexlify(network.LoRa().mac())
```



The Things Network Console - Mozilla Firefox

The Things Network <https://console.thethingsnetwork.org/applications/nuapp/payload-formats>

THE THINGS NETWORK CONSOLE COMMUNITY EDITION

Applications Gateways Support  joarolai

Applications > nuapp > Payload Formats

Overview Devices **Payload Formats** Integrations Data Settings

### PAYLOAD FORMATS

**Payload Format**  
The payload format sent by your devices

Custom

decoder converter validator encoder

[remove decoder](#)

```

1 function Decoder(bytes, port) {
2
3   var payload = String.fromCharCode.apply(String, bytes);
4
5   var variables = payload.toString('ascii').split(',');
6
7   return {
8     | 'temperature' : variables[1]
9   };
10 }

```

decoder has no changes

Transform

```
function Decoder(bytes, port){  
    var payload = String.fromCharCode.apply(String, bytes);  
    var variables = payload.toString('ascii').split(',');  
    return {  
        'temperature' : variables[1]  
    };  
}
```

## Raw data (string)

TEMP,49

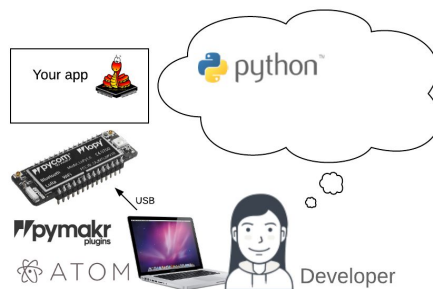
## Uplink data (data structure)

## TTN data structure

```
{
  app_id: 'nuapp',
  dev_id: 'another',
  hardware_serial: '70B3D549929AB626',
  port: 2,
  counter: 5892,
  payload_raw: <Buffer 54 45 4d 50 2c 35 38 39 31>,
  payload_fields: {
    temperature: '49'
  },
  metadata: {
    time: '2017-10-10T11:34:50.160318598Z',
    frequency: 867.9,
    modulation: 'LORA',
    data_rate: 'SF7BW125',
    coding_rate: '4/5',
    gateways: [ [Object] ]
  }
}
```

## TTN gateways

```
[{
  gtw_id: 'trt-samf-loragw01',
  gtw_trusted: true,
  timestamp: 3869682171,
  time: '2017-10-10T11:37:47Z',
  channel: 4,
  rssi: -118,
  snr: -9.25,
  rf_chain: 0,
  latitude: 63.422485,
  longitude: 10.395755,
  altitude: 20
}, {
  gtw_id: 'eui-008000000000bc6c',
  timestamp: 4068030371,
  time: '2017-10-10T11:33:13.36681Z',
  channel: 4,
  rssi: -115,
  snr: -4.2,
  rf_chain: 0,
  latitude: 63.42883,
  longitude: 10.3857,
  altitude: 21
}]
```



A sensor node usually contain:

- A sensor
- A microcontroller with networking capability
- A microcontroller application

For our scenario the LoPy is our microcontroller, and our application is written in a variant of Python called Micropython.

Our application can be created using the Atom editor, and the LoPy can be programmed directly from Atom, via USB, after installing the Pymakr plugin.

<https://atom.io/>  
<https://docs.pycom.io/chapter/gettingstarted/installation/pymakr.html>

You should also consider going through the complete getting started guide from Pycom: <https://docs.pycom.io/chapter/gettingstarted/>

You are not required to install python on your computer since micropython runs inside the LoPy.

App Key

The Things Network Console - Mozilla Firefox

https://console.thethingsnetwork.org/applications/nuapp/devices/another

THE THINGS NETWORK CONSOLE COMMUNITY EDITION

Applications Gateways Support Joarolai

Applications > nuapp > Devices > another

Overview Data Settings

### DEVICE OVERVIEW

Application ID **nuapp**

Device ID another

Activation Method **OTAA**

Device EUI <> 70 B3 05 49 92 9A B6 26

Application EUI <> 70 B3 05 7E 00 00 79 CD

App Key <> .....

Device Address <> 26 01 2D 6A

Network Session Key <> .....

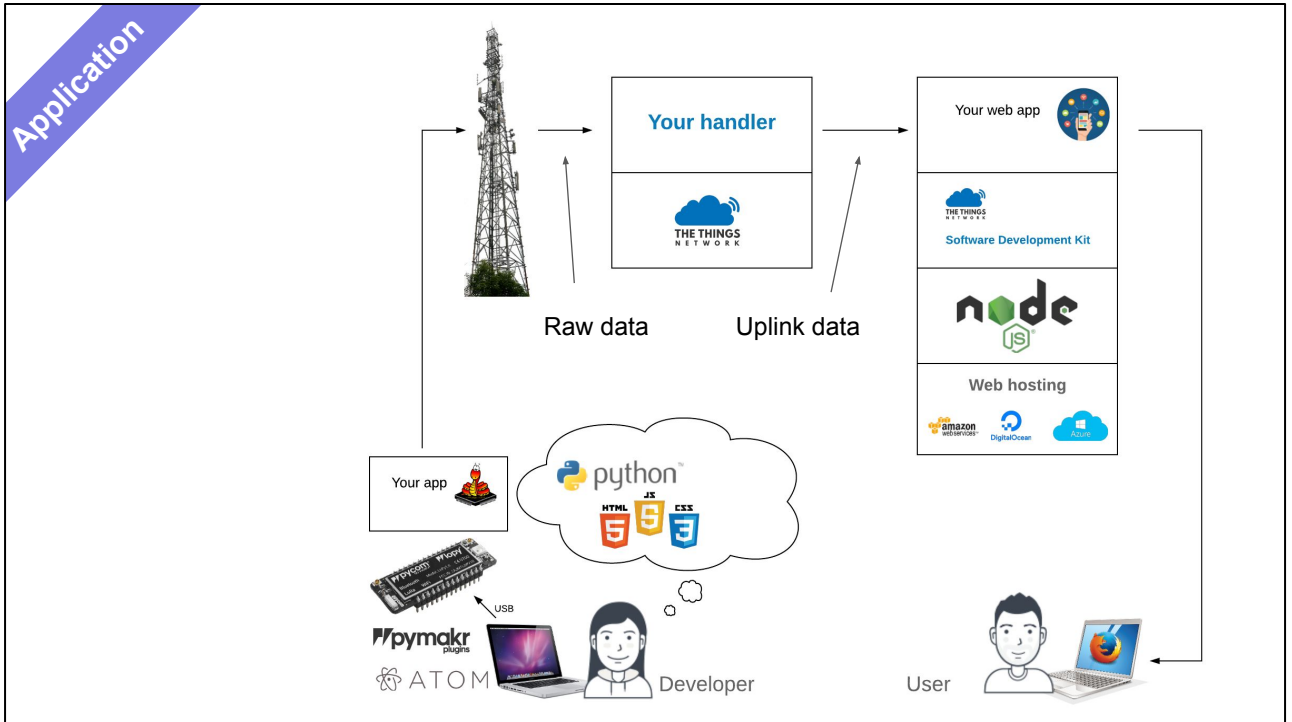
App Session Key <> .....

Status ● 6 seconds ago

Frames up 20 [reset frame counters](#)

Frames down 0

lopy/main.py



When you have been able to send data to TTN from your LoPy, the next step is to present the data in a web application that your users can access.

The code shown in the next slide, and the transform shown in the slide after that is needed to get the application in the tutorial to work.

If you are hosting the node.js server on your own computer then you do not need to change anything in the **index.html** file

If you want to install the node.js server on a hosting service like Digital Ocean, you must change line 34 in **index.html** to match the IP/domain of your server instead of **localhost**

Access key

The Things Network Console - Mozilla Firefox

https://console.thethingsnetwork.org/applications/nuapp

THE THINGS NETWORK

CONSOLE

community edition

Applications Gateways Support joaroli

Applications > nuapp

Overview Devices Payload Formats Integrations Data Settings

APPLICATION OVERVIEW

documentation

Application ID nuapp

Description Now application

Created 10 days ago

Handler ttn-handler-eu (current handler)

APPLICATION EUIs

manage euis

70 83 05 7E 00 80 79 00

DEVICES

register device manage devices

2 registered devices

COLLABORATORS

manage collaborators

joaroli

collaborators devices devices settings

ACCESS KEYS

manage keys

default key devices messages

base64

webapp/index.js

Security

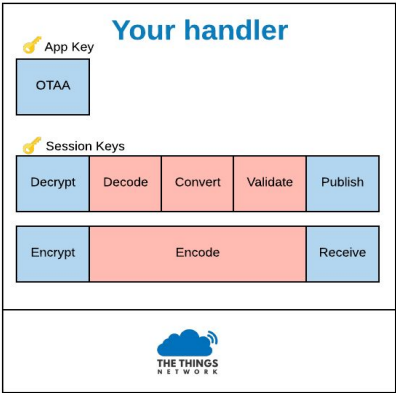


"TEMP,49"

Join

Send data

Receive data



MQTT: Uplink data structure

Uplink

Downlink

