@johanstokking @thethingsntwrk
Up to 10,000 devices per gateway
Low power and small messages

so devices can run on solar panels or months to years on batteries
Unlicensed spectrum
US 915, EU 433/868, CN 470/779, AU 925
LoRa

Spread-spectrum; robust to interference, multipath and fading
LoRa
Long range, low bandwidth

Bandwidth

Range

LoRa
802.11ac
WiFi
802.11g
Bluetooth/BLE
RFID/NFC
5G
4G
3G
2G
ZigBee
Our **mission** is to build a **decentralized**, **open** and **crowd sourced** IoT data network

Owned and operated by its users
Our mission is to build a decentralized, open, and crowd sourced IoT data network. Owned and operated by its users.
Croft is ALIVE
TTN
Uw boot staat onder water!

schuif om te antwoorden
Application
Architecture
Connecting Applications

1. Get data directly from MQTT broker
2. Process data in Node RED
3. Collect data in a database
4. Integrate IoT cloud platform
<table>
<thead>
<tr>
<th>Topic</th>
<th>Category</th>
<th>Users</th>
<th>Replies</th>
<th>Views</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Node based on Raspberry?</td>
<td>Nodes</td>
<td>S G</td>
<td>24</td>
<td>2.7k</td>
<td>10m</td>
</tr>
<tr>
<td>Adafruit LoRa Feather -&gt; Gateway</td>
<td>Nodes</td>
<td>D E</td>
<td>32</td>
<td>2.0k</td>
<td>17m</td>
</tr>
<tr>
<td>Where in LMIC is the “fCnt” parameter stored?</td>
<td></td>
<td>Y J O</td>
<td>2</td>
<td>43</td>
<td>1h</td>
</tr>
<tr>
<td>IP server for Europe</td>
<td></td>
<td>A J</td>
<td>2</td>
<td>72</td>
<td>1h</td>
</tr>
<tr>
<td>The LIBRARY basement</td>
<td>News</td>
<td>P</td>
<td>44</td>
<td>2.8k</td>
<td>2h</td>
</tr>
<tr>
<td>Lost with LORAWAN</td>
<td></td>
<td>J M</td>
<td>2</td>
<td>59</td>
<td>2h</td>
</tr>
<tr>
<td>Which backend component sends an ACK (acknowledgment) response to a node for a confirmed message?</td>
<td>Network and Routing</td>
<td></td>
<td>11</td>
<td>234</td>
<td>2h</td>
</tr>
</tbody>
</table>
Leveraging The Things Network to create true value.
This story consists of 4 steps:

1. Link The Things Uno with Ultrasonic Sensor
2. Pass data on to AWS-IOT
3. Pick up the data in an Arrow app
4. Build the Titanium app

The available sensor that made most sense to use was the Ultrasonic Sensor HC-SR04. By following this Random Nerd Tutorial and The Things Uno Workshop I got it to send the distance in cm to TTN.

Here's the full script:

```c
#include "TheThingsUno.h"

// Set your app Credentials
const byte appEui[8] = {0}; // SET
const byte appKey[16] = {0}; // SET
```
We are on a mission to build a global open...
ABOUT THIS COMMUNITY

50 Gateways  
40 Contributors  
09/15 Founded

OUR GATEWAYS

Add a gateway
<table>
<thead>
<tr>
<th>payload</th>
<th>time</th>
<th>frame</th>
<th>RSSI</th>
<th>frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>lux 103</td>
<td>18:47:10</td>
<td>16472</td>
<td>-106</td>
<td>868.10000</td>
</tr>
<tr>
<td>temperature</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lux 106</td>
<td>18:46:48</td>
<td>16471</td>
<td>-105</td>
<td>868.10000</td>
</tr>
<tr>
<td>temperature</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Deployment Strategy

- Deploy or use the network that you need
- Control the required quality of service
- Control the required security level per app
- Add capacity where you need it
Public Community Network
Managed Keychain
Public Community Network
Private Key

App
Private Attached Network
Private Network
LoRaWAN Device Classes

• **Class A**: Each device's uplink transmission is followed by two short downlink receive windows

• **Class B**: In addition to the Class A functionality, Class B devices open extra receive windows at scheduled times

• **Class C**: These devices have a continuous open receive window, except when transmitting
LoRaWAN Class A
Security

Keys

• Remember: LoRa is low power and low cost

• LoRaWAN supports end-to-end encryption from device to application

• Shared key: **AppKey**

• Derived session keys:
  
  • **NwkSKey**: device identification, message integrity check using CMAC and MAC command encryption
  
  • **AppSKey**: payload encryption
  
  • Every session has a public **DevAddr** with network identifier
  
  • 128-bit key length, AES encryption
Security

Two flavours of provisioning

• **Over the air activation (OTAA)**; the device activates itself and creates a new session
  • Pro: keys are regenerated for each session
  • Con: needs downlink for join accept

• **Activation by personalization (ABP)**; the device is preconfigured with session keys
  • Pro: no need for downlink
  • Con: requires persistent session state, harder to provision
Security
Support for end-to-end encryption

Device

AppKey

NwkSKey

AppSKey

App

Join request

NwkSKey

Join accept

NwkSKey

AppKey

AppSKey
Limitations

data rate * payload size = airtime

airtime <= 30 seconds per day
payload size <= 51 bytes
data rate is variable
Don’t waste your airtime

Simple:

• `{ “Count”: 1234, "Temperature": 20.635 }`

• 40 bytes: 292 messages per day (SF7)

Remove counter, spaces, and compress names:

• `{“t”:20.63}`

• 11 bytes: 486 messages per day
Don’t waste your airtime

No JSON:

• 20.63

• 5 bytes: 582 messages per day

Signed 16 bit integer

• 0x080F

• 2 bytes: 648 messages per day
Sensor Fleet

Sensor Fleet Library

Radio Module
LoRaWAN, BTLE, WiFi

Sensor Fleet API

Sensor Fleet App

User App

Database

THE THINGS NETWORK
The user configures the (group of) device(s) as temperature sensor with GPS, and only send changes of more than 5%.

The Sensor Fleet API selects the concerning devices and encodes the instruction using the open protocol specification.

The Things Network broadcasts a small message like 0x8A4663AC8E20.

The open source Sensor Fleet Library decodes the instruction.

The device configures the sensors and configures its behavior according to instructions.
The Usual Suspects
Don’t worry, we’ve got them

✓ Parking space monitoring
✓ Smart trashcans
✓ Air quality in buildings
It’s Moving Forward, Looking Backward
Innovate
Our **mission**

is to build

a **decentralized, open and crowd sourced**

IoT data network

Owned and operated by its users
Smart parking with zero coding! Less code is more. @thethingsntwrk @jomhackmy
You are the network
Let’s build this thing together

@johanstokking @thethingsntwrk