

The Things Network

https://www.thethingsnetwork.org

70%

Cerca



[COMMUNITIES](#) [LABS](#) [LEARN](#) [SUPPORT](#) [FORUM](#) [SHOP](#)

[SIGN UP](#)

[LOGIN](#)



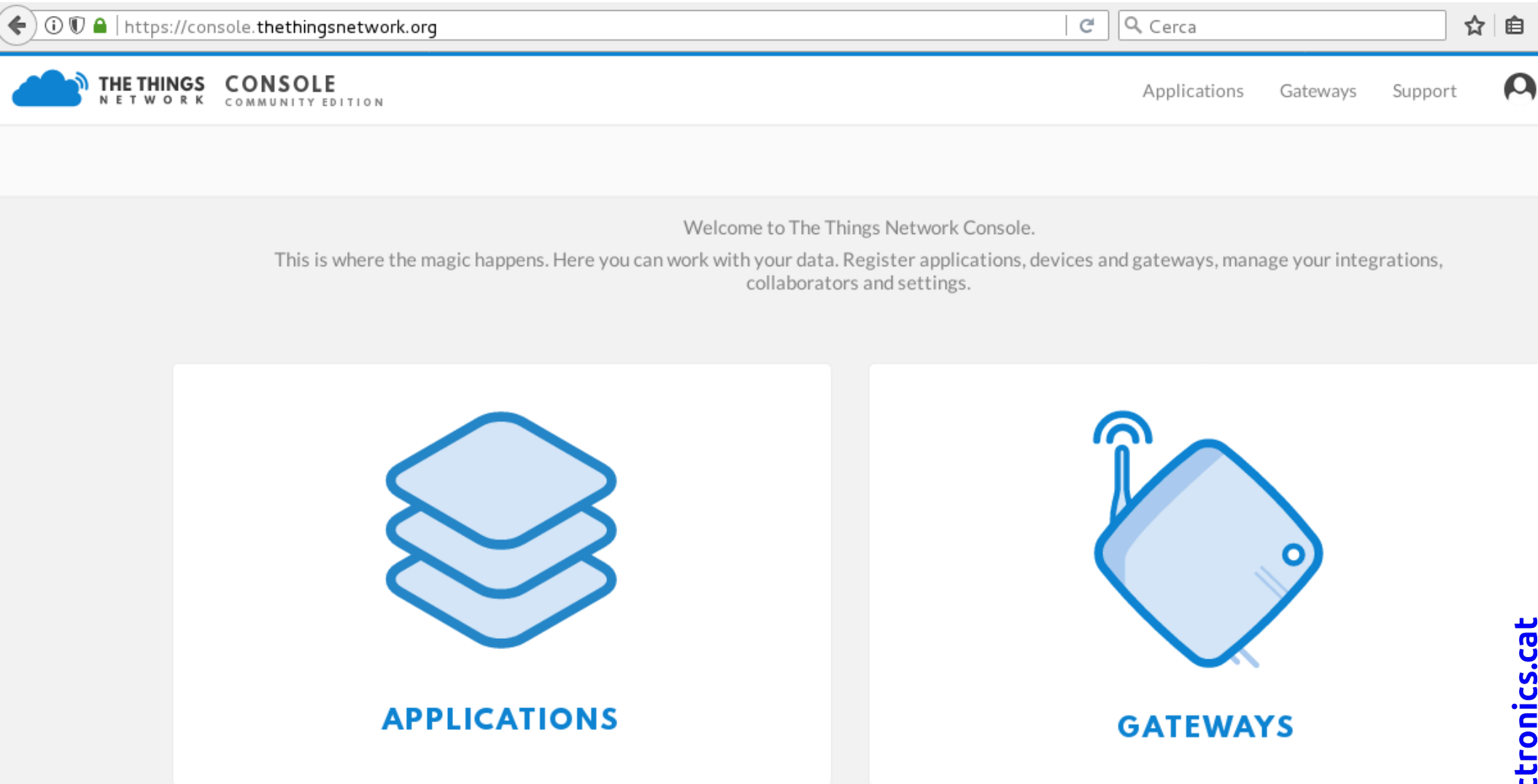
**BUILDING A GLOBAL INTERNET OF
THINGS NETWORK TOGETHER.**

[Learn More →](#)

**BUILDING A FULLY DISTRIBUTED INTERNET OF THINGS DATA
INFRASTRUCTURE.**

<https://www.thethingsnetwork.org/>

La cònsola de The Things Network



Nova aplicació a The Things Network

← ⓘ 🔒 | https://console.thethingsnetwork.org/applications | 🔍 Cerca ☆ 📄

 **THE THINGS NETWORK** **CONSOLE** COMMUNITY EDITION Applications Gateways Support 👤

Applications

APPLICATIONS [+ add application](#)

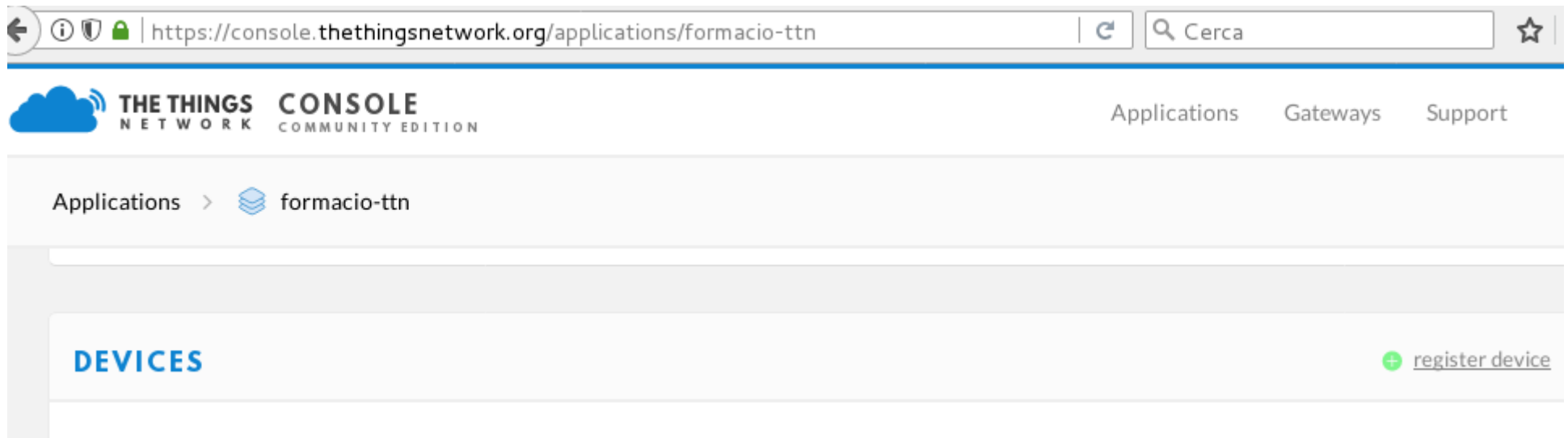
formacio-ttn

Formació sobre The Things Network

ttn-handler-eu

70 B3 D5 7E

Registre de dispositiu a l'aplicació a The Things Network





Registre de dispositiu a l'aplicació a The Things Network (TTN)

← ⓘ 🔒 | https://console.thethingsnetwork.org/applications/formacio-ttn/devices/register | 🔍 Cerca ☆ 📄

THE THINGS NETWORK **CONSOLE** COMMUNITY EDITION Applications Gateways Support 👤

Applications > formacio-ttn > Devices

Overview **Devices** Payload Formats Integrations Data Settings

REGISTER DEVICE [bulk import devices](#)

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

esp32-rfm95-07 ✓

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

⌵ 65 43 61 74 30 30 30 37 ✓ 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

Cancel Register

Registre de dispositiu a l'aplicació a TTN

Applications >  formacio-ttn > Devices >  esp32-rfm95-07

DEVICE OVERVIEW

Application ID formacio-ttn

Device ID esp32-rfm95-07

Activation Method OTAA

Device EUI <> ↔ 65 43 61 74 3 00 00 00 📋

Application EUI <> ↔ 70 B3 D5 7E D0 00 00 00 📋

App Key <> ↔ 👁 📋

Status ● never seen

Frames up 0 [reset frame counters](#)

Frames down 0

OTAA i ABP

OTAA (Over The Air Authentication): Aquest mètode consisteix en que un node prova de connectar-se a una passarel·la LoRaWAN emprant les claus **APPEUI** i **APPKEY**. Si les claus són correctes, la passarel·la contestarà al node amb un missatge d'acceptació (join) i des d'aquest moment el node pot rebre i trametre des de la passarel·la.

ABP (Authentication By Personalisation): L'autenticació per personalització consisteix en que les claus de xifratge es configuren manualment al dispositiu, permetent la comunicació directa a les passarel·les LoRaWAN sense necessitat de demanar permís.

Registre de dispositiu a l'aplicació a TTN

Applications >  formacio-ttn > Devices >  esp32-rfm95-07 > Settings

DEVICE SETTINGS

General

Location

SETTINGS

Description
A human-readable description of the device

Placa ESP32-LoRa-07 (ESP32 i placa RFM95) 

Device EUI
The serial number of your radio module, similar to a MAC address

 65 43 61 74 30 30 30 37  8 bytes

Application EUI

70B3D57ED000B108 

Activation Method

OTAA **ABP**

Device Address

Registre de dispositiu a l'aplicació a TTN

Applications > formacio-ttn > Devices > esp32-rfm95-07 > Settings

Activation Method

☐ OTAA ☒ ABP

Device Address

The device address will be assigned by the network server

Network Session Key

Network Session Key will be generated

App Session Key

App Session Key will be generated

Frame Counter Width

☐ 16 bit ☒ 32 bit

☐ **Frame Counter Checks**

Disabling frame counter checks drastically reduces security and should only be used for development purposes

Delete Device Cancel Save

Registre de dispositiu a l'aplicació a TTN

Applications >  formacio-ttn > Devices >  esp32-rfm95-07

DEVICE OVERVIEW

Application ID formacio-ttn

Device ID esp32-rfm95-07

Description Placa ESP32-LoRa-07 (ESP32 i placa RFM95)

Activation Method ABP

Device EUI <> ↔ 65 43 61 74 3 📋

Application EUI <> ↔ 70 B3 D5 7E D 📋

Device Address <> ↔ 26 01 📋

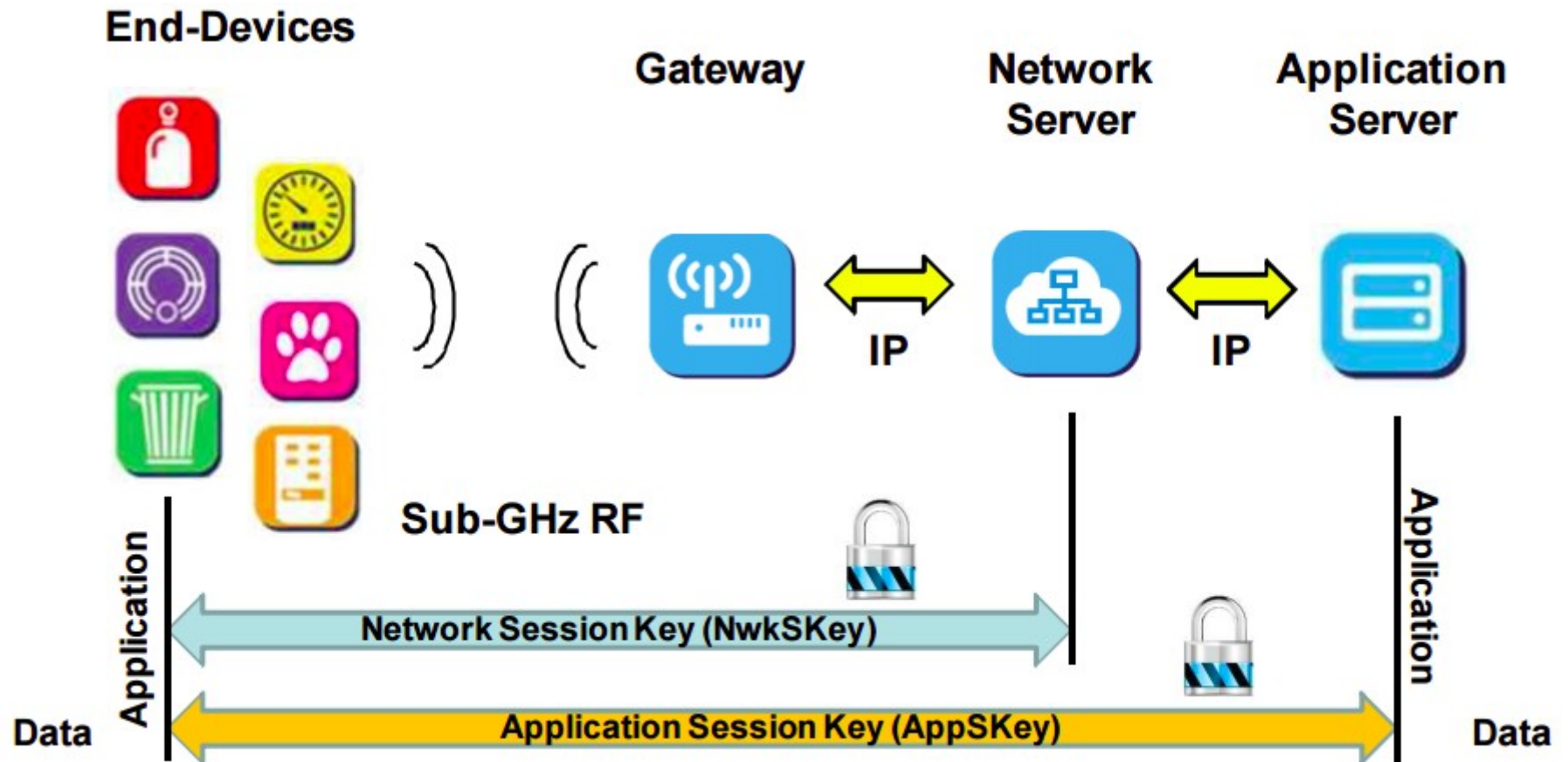
Network Session Key <> ↔ 👁 📋

App Session Key <> ↔ 👁 📋

Status ● never seen

Frames up 0 [reset frame counters](#)

Frames down 0



Registre de dispositiu a l'aplicació a TTN

Applications > formacio-ttn > Devices > esp32-rfm95-07

DEVICE OVERVIEW

Application ID formacio-ttn

Device ID esp32-rfm95-07

Description Placa ESP32-LoRa-07 (ESP32 i placa RFM95)

Activation Method ABP

Device EUI <> 65 43 61 74 3 [copy]

Application EUI <> 70 B3 D5 7E [copy]

Device Address <> 26 01 1 [copy]

Network Session Key <> [eye] msb { 0xB7, 0x30, 0xAF, 0x7B, 0xEE, 0x7A, 0x20, 0x... [copy]

App Session Key <> [eye] msb { 0x12, 0x5C, 0x41, 0x0C, 0x7E, 0x30, 0x8F, 0x... [copy]

Status ● never seen

Frames up 0 [reset frame counters](#)

Frames down 0

Registre de dispositiu a l'aplicació a TTN

```
lorawan_ttnEsp32_rfm95_01_multichannel-esp32-rfm95-07 - credentials.h | Arduino 1.8.5

Fitxer Edita Esbós Eines Ajuda

lorawan_ttnEsp32_rfm95_01_multichannel-esp32-rfm95-07 credentials.h pinMapping.h

#define LORA_MODE_ABP 0
#define LORA_MODE_OTAA 1

#define LORA_MODE LORA_MODE_ABP

#if LORA_MODE == LORA_MODE_ABP
    static const PROGMEM u1_t NWKSKEY[16] = { 0xB7, 0x30, 0xAF, 0x7B, 0xEE, 0x7A, 0x20, 0x11, 0x11, 0x11, 0x11, 0x11, 0x11, 0x11, 0x11, 0x11 };
    static const u1_t PROGMEM APPSKEY[16] = { 0x12, 0x5C, 0x41, 0x0C, 0x7E, 0x30, 0x8F, 0x11, 0x11, 0x11, 0x11, 0x11, 0x11, 0x11, 0x11, 0x11 };
    static const u4_t DEVADDR = 0x26011111 ;
#endif

#if LORA_MODE == LORA_MODE_OTAA
    // De moment no és operatiu a aquesta versió
    const char *appEui = "";
    const char *appKey = "";
#endif
```

Uplink des del node a l'aplicació a TTN

Applications > formacio-ttn > Devices > esp32-rfm95-07 > Data

APPLICATION DATA

Filters:

	time	counter	port	
▲	11:12:40	1	1	payload: 00 00 00 01
▲	11:11:57	0	1	retry payload: 00 00 00 00

Fitxer Edita Esbós Eines Ajuda

lorawan_ttnEsp32_rfm95_01_multichar

```
#define LORA_MODE_ABP 0
#define LORA_MODE_OTAA 1

#define LORA_MODE LORA_MODE_ABP

#if LORA_MODE == LORA_MODE_ABP
    static const PROGMEM u1_t NWKSKEY[]
    static const u1_t PROGMEM APPSKEY[]
    static const u4_t DEVADDR = 0x2601
#endif

#if LORA_MODE == LORA_MODE_OTAA
    // De moment no és operatiu a aql
    const char *appEui = "";
    const char *appKey = "";
```

```
[MAIN] Startup
[RFM95] Packet queued
135590: [RFM95] EV_TXCOMPLETE (includes waiting for RX windows)
TXRX_ACK confirmed UP frame was acked

TX complete .....
0 0

[RFM95] Packet queued
2839919: [RFM95] EV_TXCOMPLETE (includes waiting for RX windows)
TXRX_ACK confirmed UP frame was acked

TX complete .....
0 0
```

Downlink des de l'aplicació TTN al node

Applications >  formacio-ttn > Devices >  esp32-rfm95-07

DOWNLINK

Scheduling

[replace](#) [first](#) [last](#)

FPort

1  

☒ **Confirmed**

Payload

[bytes](#) [fields](#)

01 65 43 61 74 02  6 bytes

[Send](#)

Downlink des de l'aplicació TTN al node

Applications > formacio-ttn > Devices > esp32-rfm95-07 > Data

APPLICATION DATA

Filters: uplink downlink activation ack error

	time	counter	port	
▲	11:16:54	6	0	payload: [not provided]
✓	11:16:54		1	confirmed ack appid: formacio-ttn
▼	11:16:49		1	confirmed payload: 0165 43 61 74 02
▲	11:16:49	5	1	payload: 0000 00 05
▼	11:15:47		1	confirmed payload: 0165 43 61 74 02
▲	11:15:47	4	1	payload: 0000 00 04
▼	11:15:13		1	scheduled confirmed payload: 0165 43 61 74 02
▲	11:14:45	3	1	payload: 0000 00 03

```
#define LORA_MODE_OTAA 1
#define LORA_MODE LORA_MODE_ABP

#if LORA_MODE == LORA_MODE_ABP
    static const PROGMEM u1_t MNKSKEY[
    static const u1_t PROGMEM APPSKEY[
    static const u4_t DEVADDR = 0x2601;
#endif

#if LORA_MODE == LORA_MODE_OTAA
    // De moment no és operatiu a aq
    const char *appEui = "";
    const char *appKey = "";
#endif

[RFM95] Packet queued
[RFM95] Pending message
18295111: [RFM95] EV_TXCOMPLETE (incl
TXRX_ACK confirmed UP frame was acked
TX complete .....
6 1
1654361742
[RFM95] Received 6 bytes of payload
01 65 43 61 74 02
18678004: [RFM95] EV_TXCOMPLETE (incl
TXRX_ACK confirmed UP frame was acked
TX complete .....
0 0
```

Adaptació del node de multicanal a monocanal

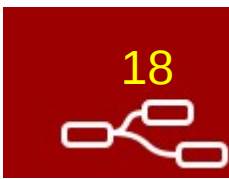
```
LMIC_setupChannel(0, 868100000, DR_RANGE_MAP(DR_SF12, DR_SF7), BAND_CENTI); // g-band
/*
LMIC_setupChannel(1, 868300000, DR_RANGE_MAP(DR_SF12, DR_SF7B), BAND_CENTI); // g-band
LMIC_setupChannel(2, 868500000, DR_RANGE_MAP(DR_SF12, DR_SF7), BAND_CENTI); // g-band
LMIC_setupChannel(3, 867100000, DR_RANGE_MAP(DR_SF12, DR_SF7), BAND_CENTI); // g-band
LMIC_setupChannel(4, 867300000, DR_RANGE_MAP(DR_SF12, DR_SF7), BAND_CENTI); // g-band
LMIC_setupChannel(5, 867500000, DR_RANGE_MAP(DR_SF12, DR_SF7), BAND_CENTI); // g-band
LMIC_setupChannel(6, 867700000, DR_RANGE_MAP(DR_SF12, DR_SF7), BAND_CENTI); // g-band
LMIC_setupChannel(7, 867900000, DR_RANGE_MAP(DR_SF12, DR_SF7), BAND_CENTI); // g-band
LMIC_setupChannel(8, 868800000, DR_RANGE_MAP(DR_FSK, DR_FSK), BAND_MILLI); // g2-band
*/
LMIC_setupChannel(1, 868100000, DR_RANGE_MAP(DR_SF12, DR_SF7), BAND_CENTI); // g-band
LMIC_setupChannel(2, 868100000, DR_RANGE_MAP(DR_SF12, DR_SF7), BAND_CENTI); // g-band
LMIC_setupChannel(3, 868100000, DR_RANGE_MAP(DR_SF12, DR_SF7), BAND_CENTI); // g-band
LMIC_setupChannel(4, 868100000, DR_RANGE_MAP(DR_SF12, DR_SF7), BAND_CENTI); // g-band
LMIC_setupChannel(5, 868100000, DR_RANGE_MAP(DR_SF12, DR_SF7), BAND_CENTI); // g-band
LMIC_setupChannel(6, 868100000, DR_RANGE_MAP(DR_SF12, DR_SF7), BAND_CENTI); // g-band
LMIC_setupChannel(7, 868100000, DR_RANGE_MAP(DR_SF12, DR_SF7), BAND_CENTI); // g-band
LMIC_setupChannel(8, 868100000, DR_RANGE_MAP(DR_SF12, DR_SF7), BAND_CENTI);
```

Enllaç al [codi multicanal](#)
Enllaç al [codi monocanal](#)
Biblioteca [arduino-lmic](#)

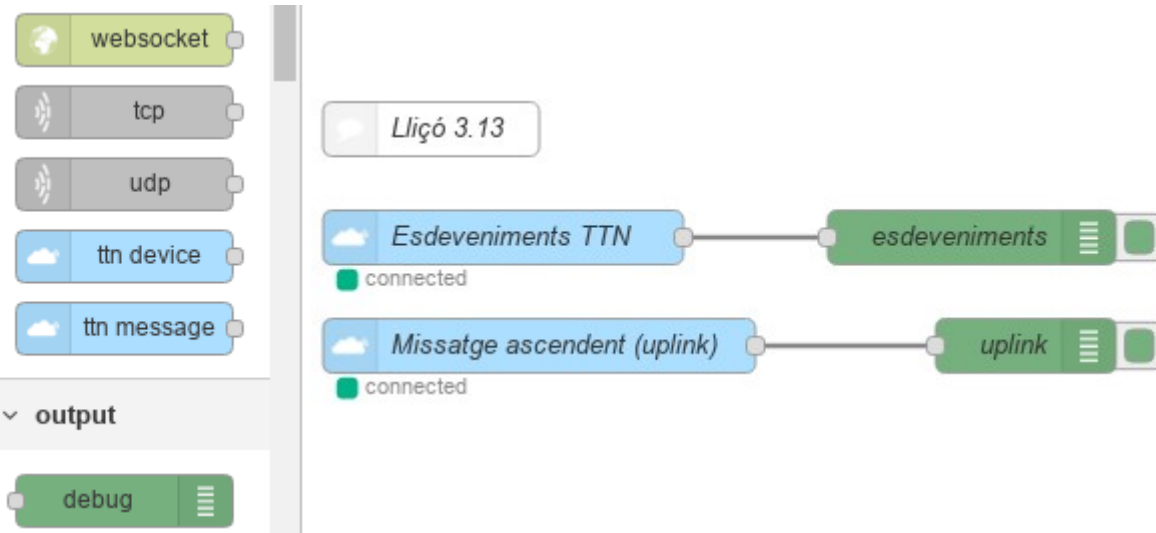


Node-RED

LoRaWAN



Nodes 'ttn device' i 'ttn message'



Edit debug node

Delete Cancel Done

Output complete msg object

to debug tab

Name esdeveniments

Edit ttn device node

Delete Cancel Done

Name Esdeveniments TTN

App formacio-ttn

Device ID

Event activations

Edit ttn message node

Delete Cancel Done

Name Missatge ascendent (uplink)

App formacio-ttn

Device ID

Field

Codi Node-RED: https://binefa.cat/IoT/nodeRed/03_nodeRed_13.txt

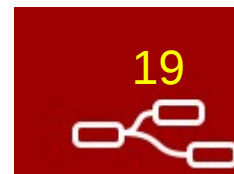
Codi d'Arduino IDE per a l'ESP32: https://binefa.cat/IoT/esp32/lorawan_ttnEsp32_rfm95_01_multichannel-llico_3_13.tar.gz



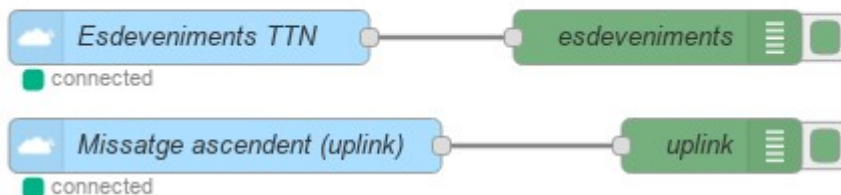
Node-RED

LoRaWAN

App ID



Lliçó 3.13



Applications > formacio-ttn

ttn device > Edit ttn app node

Delete

Cancel

Update

App ID formacio-ttn

Region or Broker eu

Access Key

Overview

APPLICATION OVERVIEW

Application ID formacio-ttn

Description Formació sobre The Things Network

Created 7 days ago

Handler ttn-handler-eu (current handler)

Codi Node-RED: https://binefa.cat/loT/nodeRed/03_nodeRed_13.txt

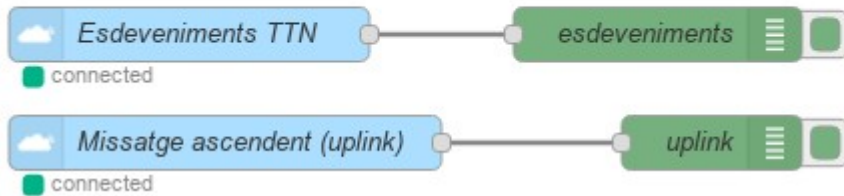
Codi d'Arduino IDE per a l'ESP32: https://binefa.cat/loT/esp32/lorawan_ttnEsp32_rfm95_01_multichannel-llico_3_13.tar.gz

Node-RED

LoRaWAN

Access Key

Lliçó 3.13



ttn device > Edit ttn app node

Delete Cancel Update

App ID formacio-ttn

Region or Broker eu

Access Key

Applications > formacio-ttn

ACCESS KEYS

[manage keys](#)

default key

devices

messages

..... base64

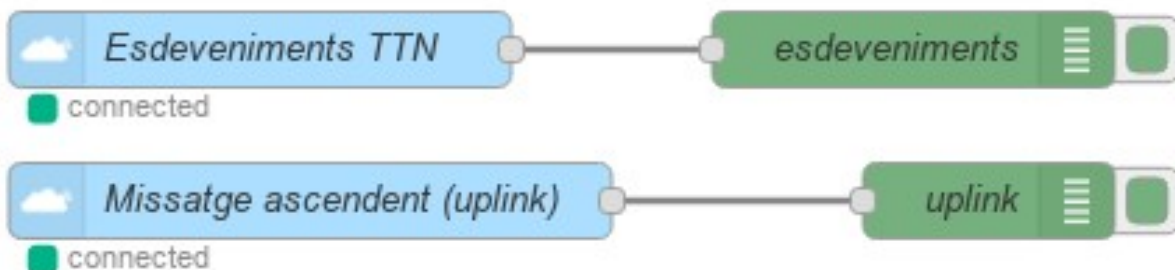


Node-RED

LoRaWAN



Lliçó 3.13



```
/dev/ttyUSB0
```

```
[RFM95] Packet queued
160030409: [RFM95] EV_TXCOMPLETE (includes waiting for RX windows)
TXRX_ACK confirmed UP frame was acked

TX complete .....
0 0

[RFM95] Packet queued
161409360: [RFM95] EV_TXCOMPLETE (includes waiting for RX windows)
TXRX_ACK confirmed UP frame was acked

TX complete .....
0 0
```

☒ Desplaçament automàtic Ambdós NL & CR

```
29/3/2018, 20:59:56 node: uplink
msg: Object
{ app_id: "formacio-ttn", dev_id: "ttgo-01", hardware_serial:
"6543617430303031", port: 1, counter: 38 }

29/3/2018, 21:00:58 node: uplink
msg: Object
object
  app_id: "formacio-ttn"
  dev_id: "ttgo-01"
  hardware_serial: "6543617430303031"
  port: 1
  counter: 39
  payload_raw: buffer[4]
    0: 0
    1: 0
    2: 0
    3: 39
  metadata: object
    time: "2018-03-29T19:00:58.270307023Z"
    frequency: 867.9
    modulation: "LORA"
    data_rate: "SF7BW125"
    airtime: 51456000
    coding_rate: "4/5"
    gateways: array[1]
      0: object
        gtw_id: "eui-b827ebfffe875de4"
        timestamp: 4290676260
        time: "2018-03-29T19:00:58.247289Z"
        channel: 7
        rssi: -48
        snr: 9.5
```

Codi Node-RED: https://binefa.cat/loT/nodeRed/03_nodeRed_13.txt

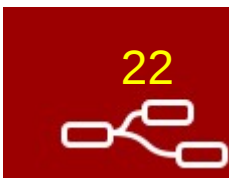
Codi d'Arduino IDE per a l'ESP32: https://binefa.cat/loT/esp32/lorawan_ttnEsp32_rfm95_01_multichannel-llico_3_13.tar.gz



Node-RED

LoRaWAN

Missatge descendent (*downlink*)



Lliçó 3.14

Esdeveniments TTN connected esdeveniments

Missatge ascendent (uplink) connected uplink

0 cap a TTN Missatge descendent connected
1

```
return {
  dev_id: msg.dev_id,
  port: msg.port,
  schedule: "replace",
  confirmed: false,
  payload: Buffer.from([msg.payload ? 0x71 : 0x51])
}
```

0101 0000	80	50	P	0111 0000	112	70	p
0101 0001	81	51	Q	0111 0001	113	71	q
0101 0010	82	52	R	0111 0010	114	72	r

```

29/3/2018, 21:30:26 node: uplink
msg: Object
  { app_id: "formacio-ttn", dev_id: "ttgo-01", hardware_serial:
    "6543617430303031", port: 1, counter: 74 ... }

29/3/2018, 21:30:42 node: uplink
msg: Object
  { app_id: "formacio-ttn", dev_id: "ttgo-01", hardware_serial:
    "6543617430303031", port: 1, counter: 75 ... }

```

/dev/ttyUSBO

```

TX complete .....
1 1
51
[RFM95] Received 1 bytes of payload
51
[RFM95] Packet queued
252489096: [RFM95] EV_TXCOMPLETE (includes waiting for RX windows)
TXRX_ACK confirmed UP frame was acked

TX complete .....
1 1
71
[RFM95] Received 1 bytes of payload
71

```

☒ Desplaçament automàtic Ambdós NL & CR

Codi Node-RED: https://binefa.cat/loT/nodeRed/03_nodeRed_14.txt

Codi d'Arduino IDE per a l'ESP32: https://binefa.cat/loT/esp32/lorawan_ttnEsp32_rfm95_01_multichannel-llico_3_13.tar.gz

LoRaWAN / Missatge descendent (*downlink*)



Applications > formacio-ttn > Devices > ttgo-01 > Data

APPLICATION DATA

Filters: uplink downlink activation ack error

	time	counter	port	
▲	21:34:49	79	1	payload: 0000004E
▲	21:33:47	78	1	payload: 0000004D
▲	21:32:45	77	1	payload: 0000004C
▲	21:31:43	76	1	payload: 0000004B
▼	21:30:42		1	payload: 71
▲	21:30:42	75	1	payload: 0000004A
▼	21:30:39		1	scheduled payload: 71
▼	21:30:26		1	payload: 51
▲	21:30:26	74	1	payload: 00000049
▼	21:30:17		1	scheduled payload: 51
▲	21:29:45	73	1	payload: 00000048

Codi Node-RED: https://binefa.cat/IoT/nodeRed/03_nodeRed_14.txt

Codi d'Arduino IDE per a l'ESP32: https://binefa.cat/IoT/esp32/lorawan_ttnEsp32_rfm95_01_multichannel-llico_3_13.tar.gz



Node-RED

LoRaWAN

Missatge descendent (downlink)



Edit function node

Delete Cancel Done

Name cap a TTN

Function

```
1 - return {  
2   dev_id: msg.dev_id,  
3   port: msg.port,  
4   schedule: "replace",  
5   confirmed: false,  
6   payload: Buffer.from([msg.payload ? 0x71 : 0x51])  
7 }
```

Edit inject node

Delete

Cancel

Done

Payload

0

Topic

Repeat

none

☐ Inject once at start?

Name

0

0101 0000	80	50	P	0111 0000	112	70	p
0101 0001	81	51	Q	0111 0001	113	71	q
0101 0010	82	52	R	0111 0010	114	72	r

DEVICE OVERVIEW

Application ID formacio-ttn

Device ID ttgo-01

Description Placa TTGO-01

Activation Method ABP

Edit ttn send node

Delete

Cancel

Done

Name

Missatge descendent

App

formacio-ttn

Device ID

ttgo-01

Port

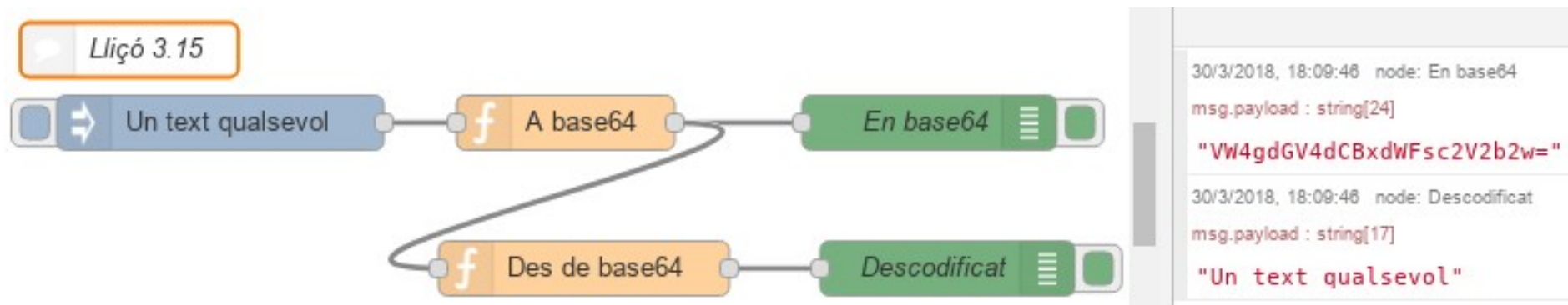
1

Codi Node-RED: https://binefa.cat/loT/nodeRed/03_nodeRed_14.txt

Codi d'Arduino IDE per a l'ESP32: https://binefa.cat/loT/esp32/lorawan_ttnEsp32_rfm95_01_multichannel-llico_3_13.tar.gz

Node-RED

Codificació i descodificació en base64



Edit function node

Delete Cancel Done

Name A base64

Function

```
1 var b = new Buffer(msg.payload);
2 msg.payload = b.toString('base64');
3
4 return msg;
```

Edit function node

Delete Cancel Done

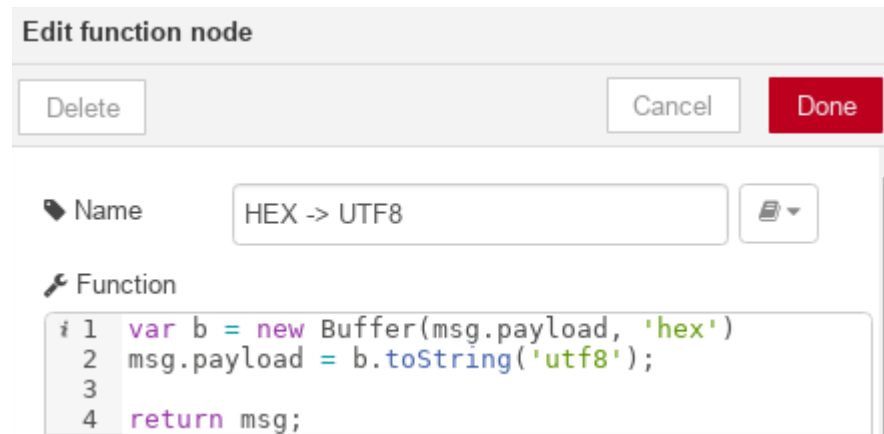
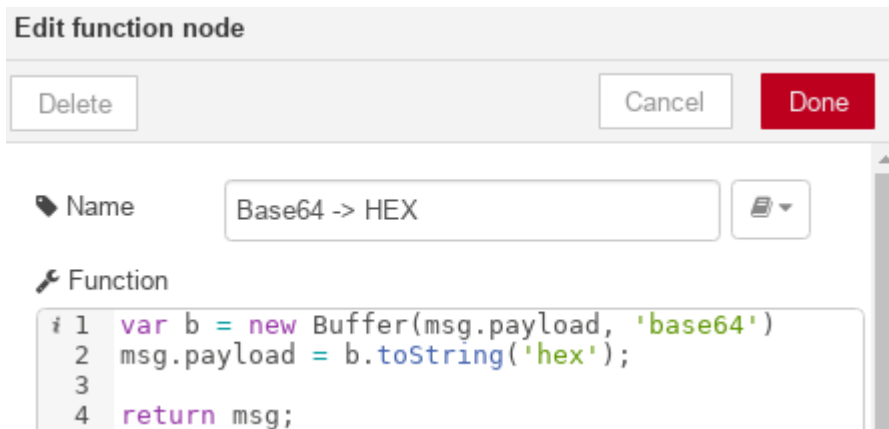
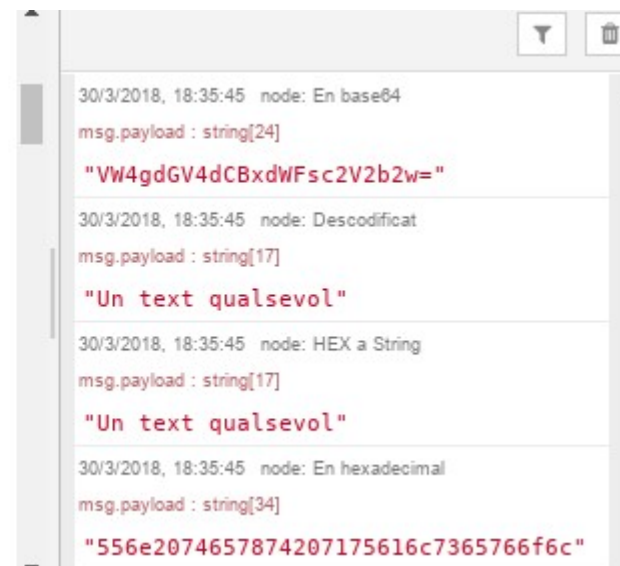
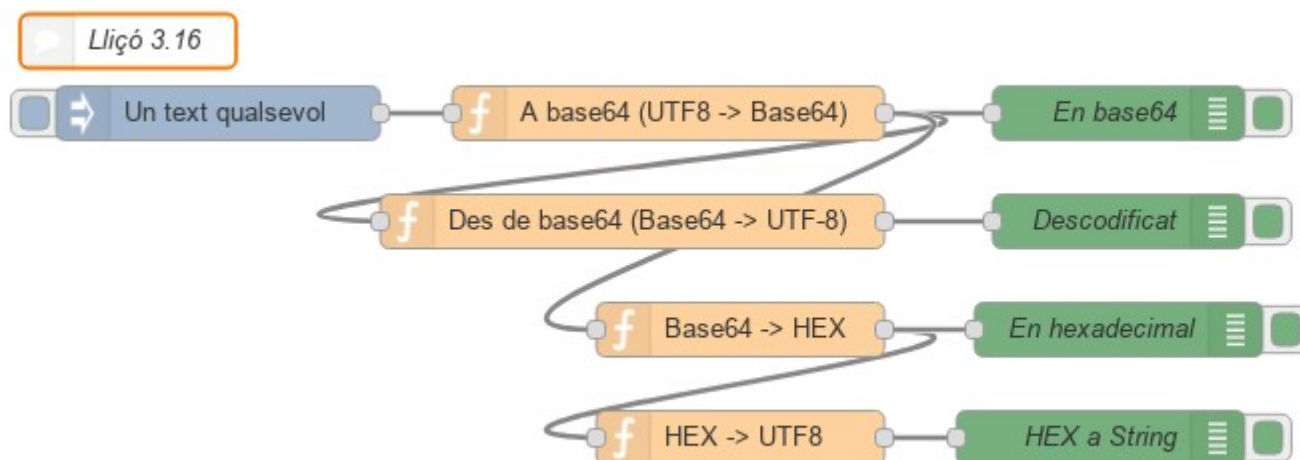
Name Des de base64

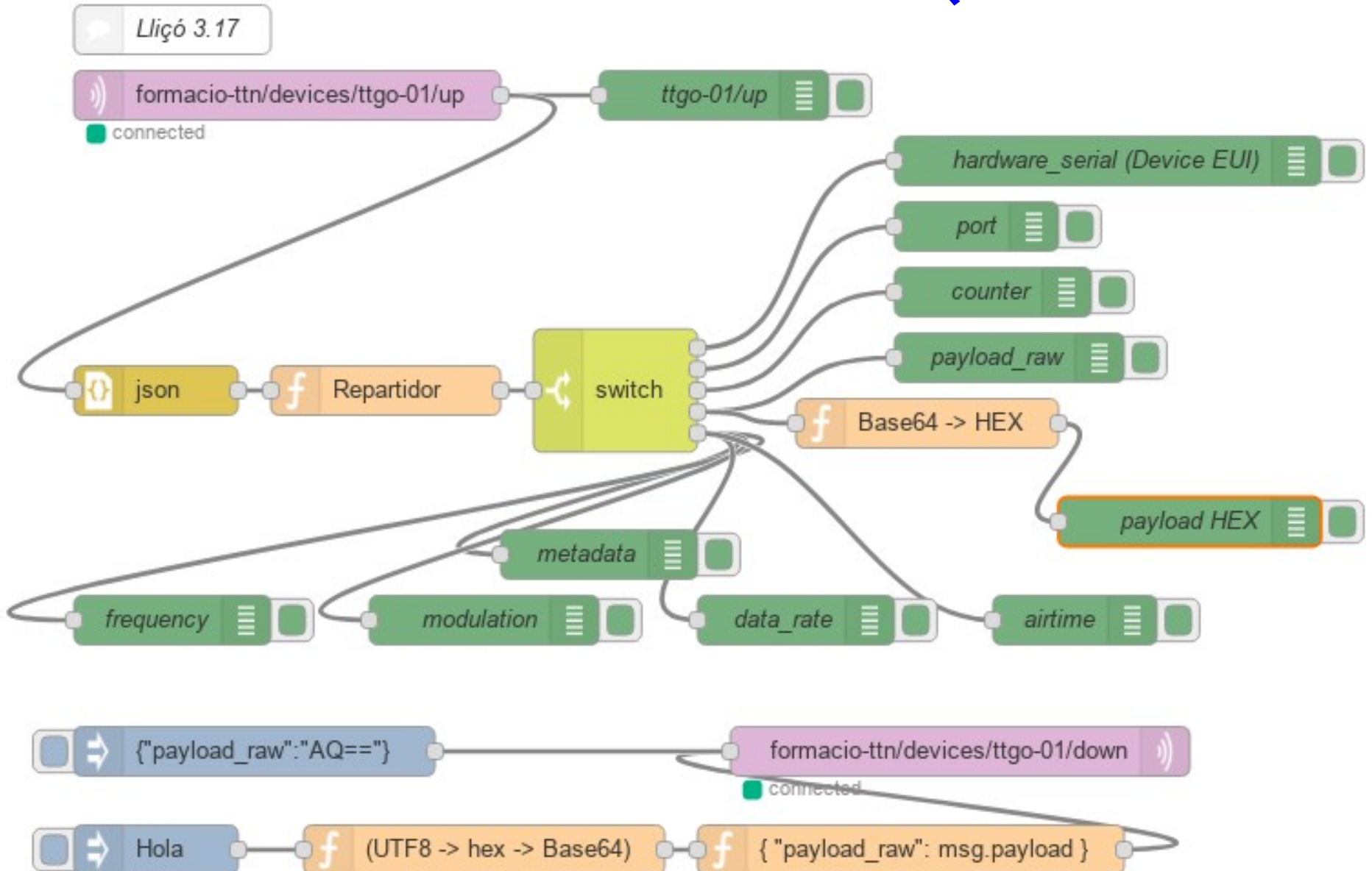
Function

```
1 var b = new Buffer(msg.payload, 'base64');
2 msg.payload = b.toString();
3
4 return msg;
```

Node-RED

Codificació i descodificació en base64 Presentació en hexadecimal







Node-RED

LoRaWAN

TTN fent servir MQTT



Edit mqtt in node

Delete Cancel Done

Server eu.thethings.network:1883

Topic formacio-ttn/devices/ttgo-01/up

QoS 2

Name Name

Edit mqtt out node

Delete Cancel Done

Server eu.thethings.network:1883

Topic formacio-ttn/devices/ttgo-01/down

QoS Retain

Name Name

Tip: Leave topic, qos or retain blank if you want to set them via msg properties.

mqtt in > **Edit mqtt-broker node**

Delete Cancel Update

Connection Security Birth Message Will Message

Server eu.thethings.network Port 1883

☐ Enable secure (SSL/TLS) connection

Client ID Leave blank for auto generated

Keep alive time (s) 60 ☒ Use clean session

☒ Use legacy MQTT 3.1 support

mqtt in > **Edit mqtt-broker node**

Delete Cancel Update

Connection Security Birth Message Will Message

Username formacio-ttn

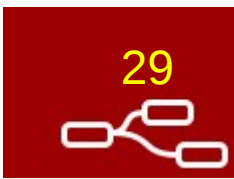
Password



Node-RED

LoRaWAN

TTN fent servir MQTT



Edit function node

Delete Cancel Done

Name Repartidor

Function

```
1 var keys = Object.keys(msg.payload);
2
3 var msgs = keys.map(function(key) {
4   return { topic: key, payload: msg.payload[key] };
5 });
6 return [msgs];
```

Edit function node

Delete Cancel Done

Name (UTF8 -> hex -> Base64)

Function

```
1 var b = new Buffer(msg.payload);
2 msg.payload = b.toString('base64');
3
4 return msg;
```

Edit function node

Delete Cancel Done

Name { "payload_raw": msg.payload }

Function

```
1 msg.payload = { "payload_raw": msg.payload };
2
3 return msg;
```

Edit switch node

Delete Cancel Done

Name

Property msg.topic

==	hardware_serial	→ 1	x
==	port	→ 2	x
==	counter	→ 3	x
==	payload_raw	→ 4	x
==	metadata	→ 5	x