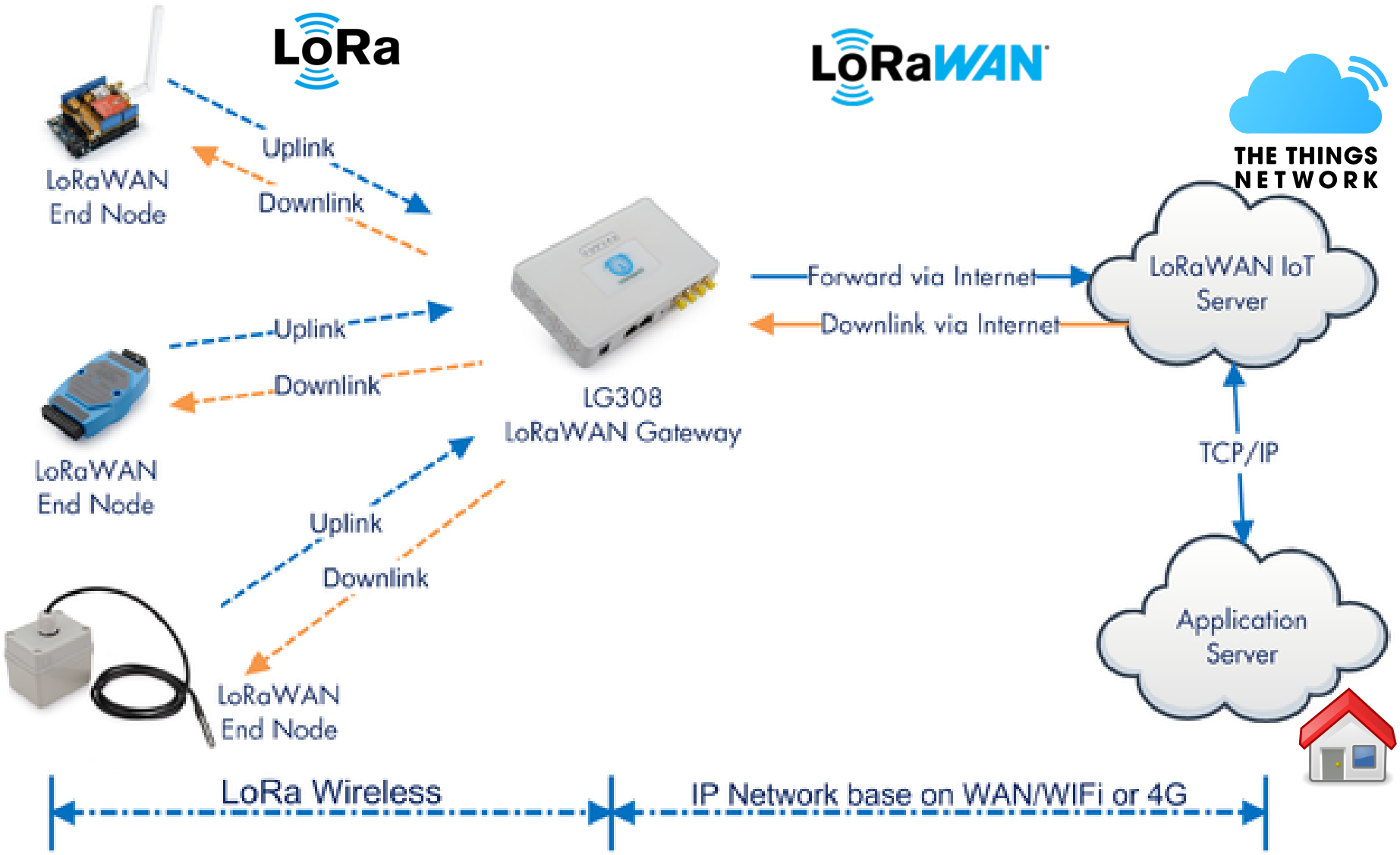
LoRa WAN
The Things Network
MQTT / Node-Red

Unterschied LoRa / LoRaWAN?

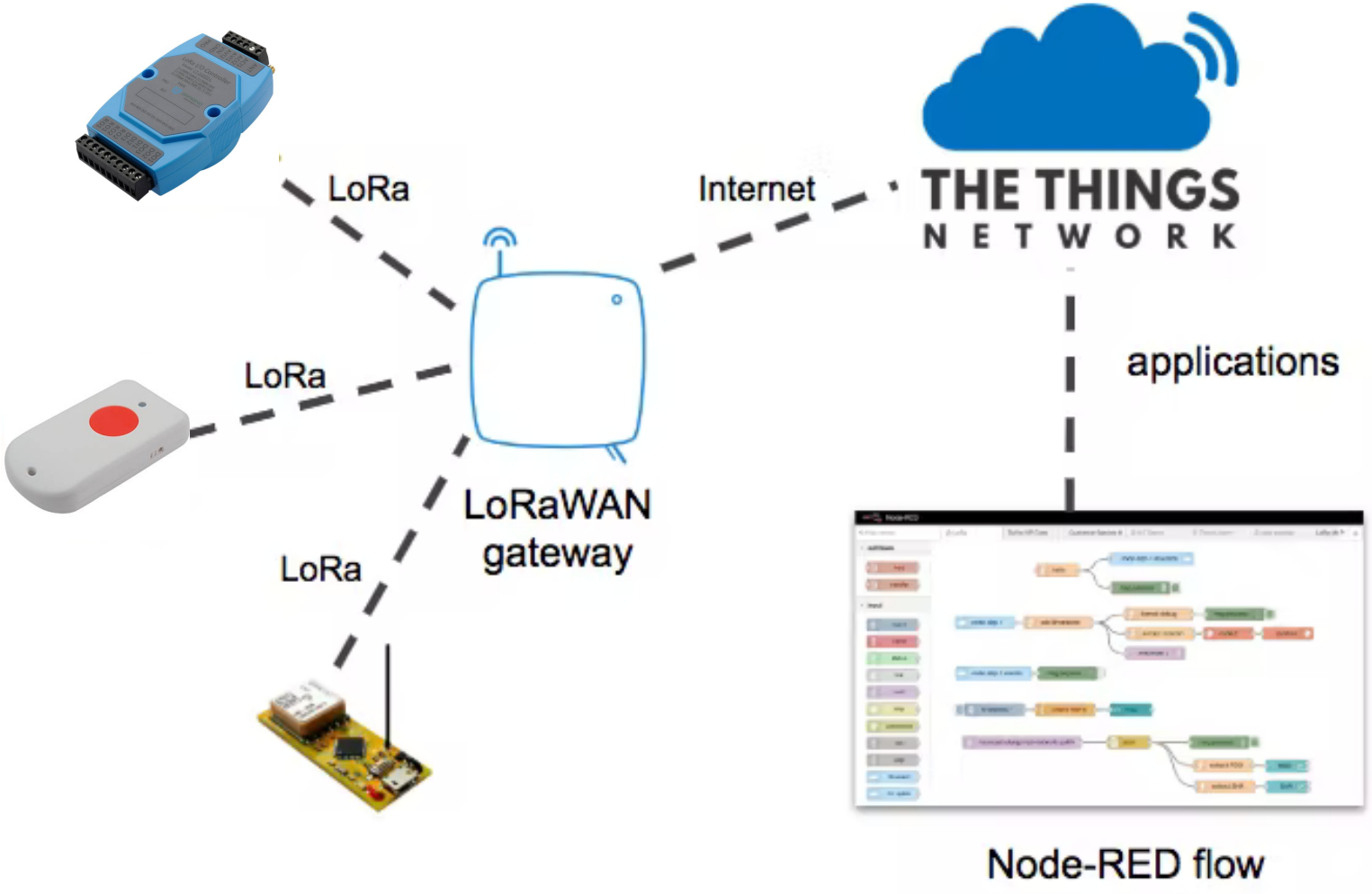
- **LoRa** beschreibt die physikalische Schicht, welche die „**long range**“ Kommunikationsverbindung ermöglicht (HF-Strecke).

- **LoRaWAN** definiert das Standard Kommunikationsprotokoll und die Systemarchitektur für das Netzwerk (HF und Netzwerk).

LoRa / LoRaWAN



Sensors - Gateway - Network - Node-Red



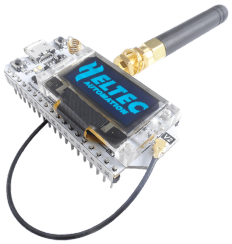
Reichweite / Datenrate

- Europa: lizenzfreie Frequenzen 867-869 MHz.
- Die Reichweite beträgt im Stadtgebiet etwa 2 km, im Umland werden 10 bis 15 km erreicht, auf dem Land bis zu 40 km.
- Die maximale Datenrate liegt zwischen 0,2 und 10 kBit/s.
- LoRa ist zum Senden von kleinen Datenpaketen gedacht, etwa für Sensoren, die nur melden ob etwas ein- oder ausgeschaltet ist.

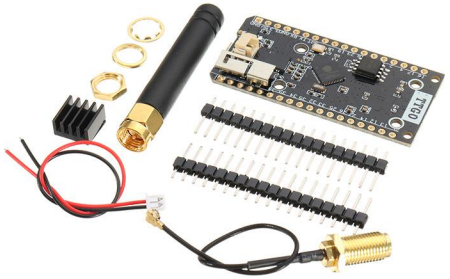
Sensors (Beispiele)

GPS Modul mit Notruftaste
Dragino LGT-92

I/O Controller Node
Dragino LT-22222-L



ESP32 Modul mit OLED Display
Heltec



ESP32 Modul ohne Display
TTGO

Gateway (Beispiele)

Indoor Gateway
LPS8 Indoor Multichannel LoRaWAN Gateway

Anschluss SMA für externe Antenne

Outdoor Gateway
DLOS8 Outdoor Multichannel LoRaWAN Gateway

Wichtig nur Multichannel (8 Kanäle) verwenden

Radio configurations

SF: Spreading Factor
BW: Bandbreite

Configuration	Bitrate (bits/sec)	Max payload size (bytes)	Airtime (ms)
SF12 / 125 kHz	250	51	2793.5
SF11 / 125 kHz	440	51	1560.6
SF10 / 125 kHz	980	51	698.4
SF9 / 125 kHz	1760	115	676.9
SF8 / 125 kHz	3125	222	655.9
SF7 / 125 kHz	5470	222	368.9
SF7 / 250 kHz	11000	222	184.4

The Things Network

SF 12 or SF 11 are not allowed.
Use SF9 or SF7

Datarate used: SF7BW125

Fair use policy

On The Things Network's **public community network** a Fair Use Policy applies which limits the uplink **airtime to 30 seconds per day** (24 hours) per node and the downlink messages to **10 messages per day** (24 hours) per node.

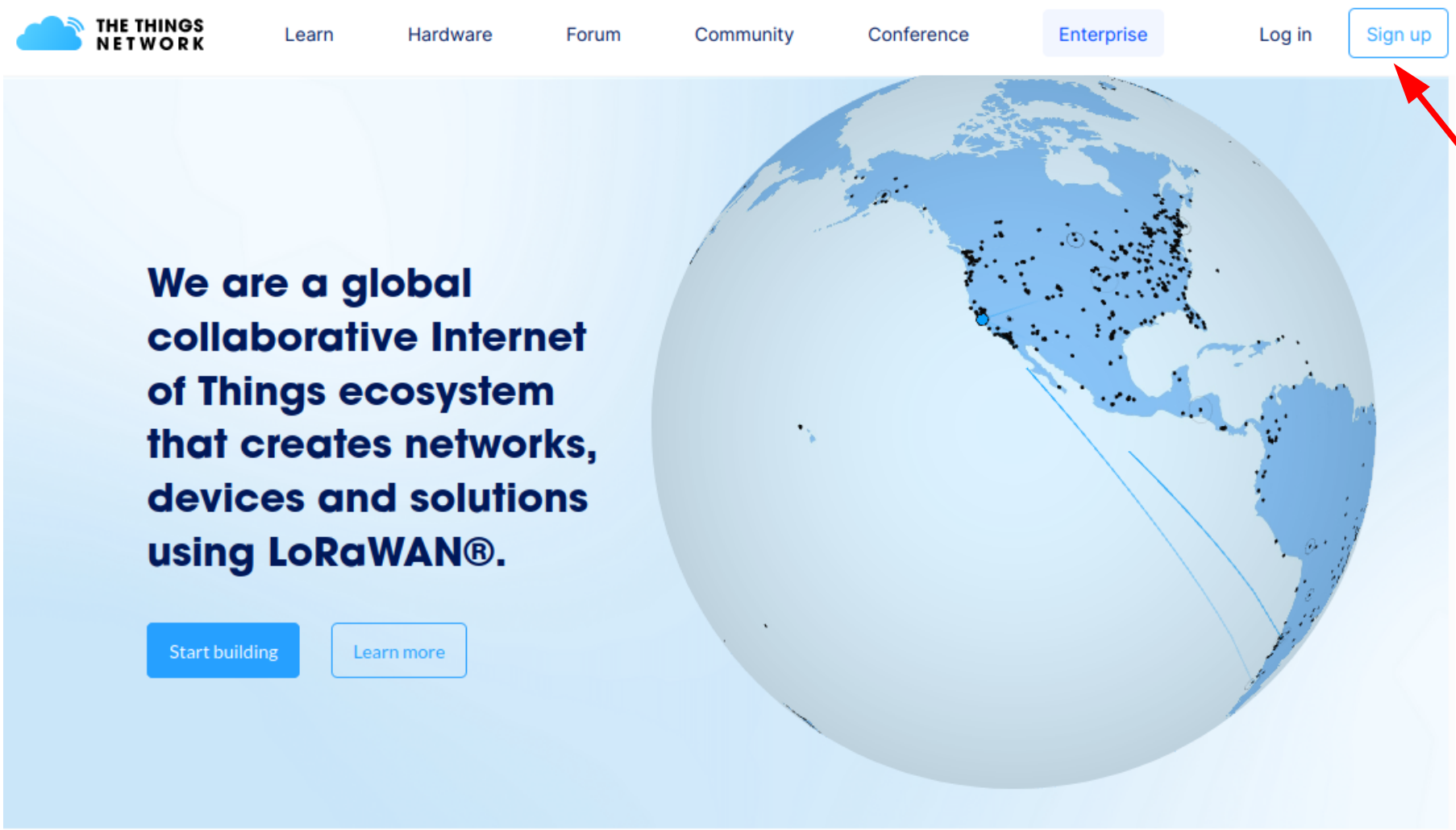
Transmit 16 Bytes Payload + 13 Bytes Overhead

SF7 BW125	Max 448 Msg/24h	18.7 Msg/h	1 Msg alle 3,3 Min
SF12 BW125	Max 18 Msg/24h	0.8 Msg/h	1 Msg alle 80 Min

LoRaWAN airtime calculator
https://avbentem.github.io/airtime-calculator/ttn/eu868

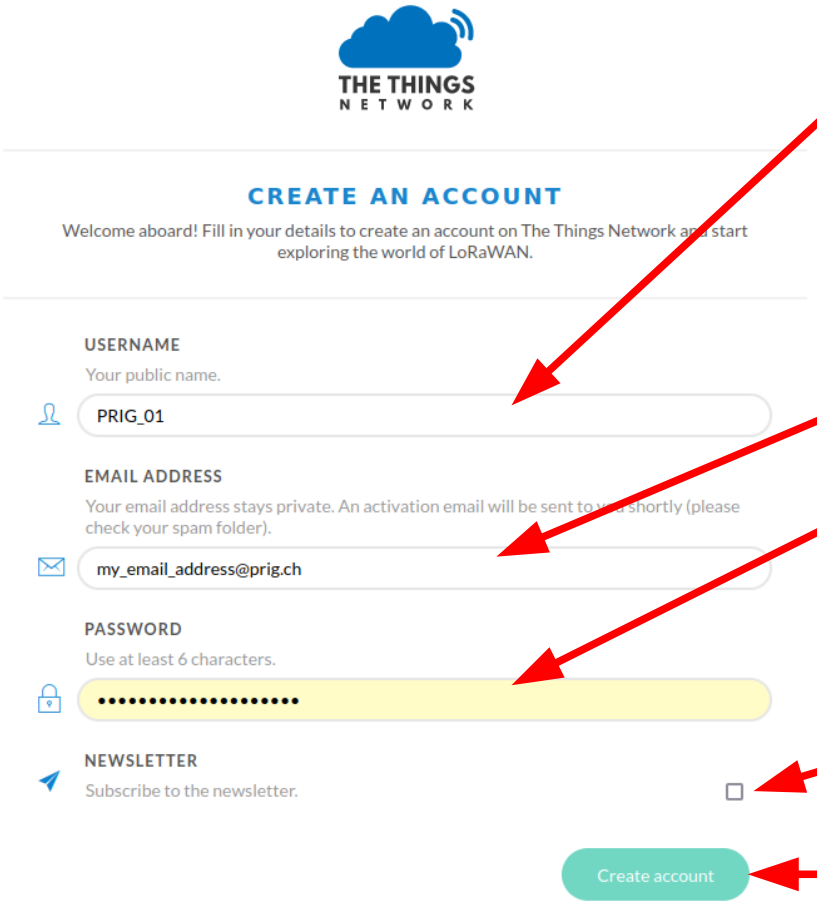
The Things Network Homepage

https://www.thethingsnetwork.org/



Sign up klicken

Konto eröffnen



Benutzername wählen

(Sonderzeichen vermeiden)
Bsp «prig-01» und nicht «PRIG_01»

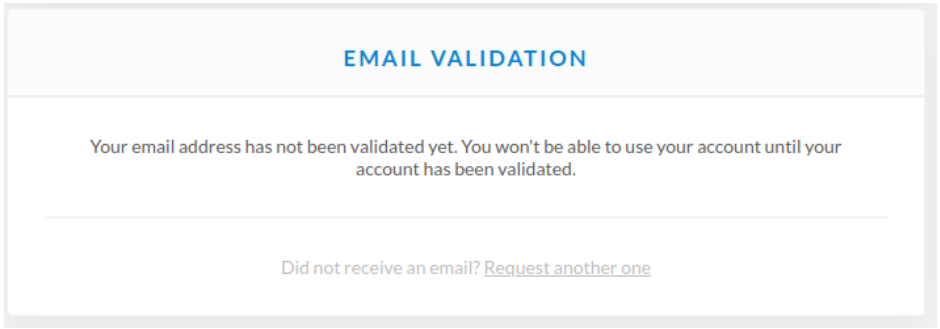
E-Mail Adresse eingeben

Passwort wählen

Newsletter (Optional)

[Create account] klicken

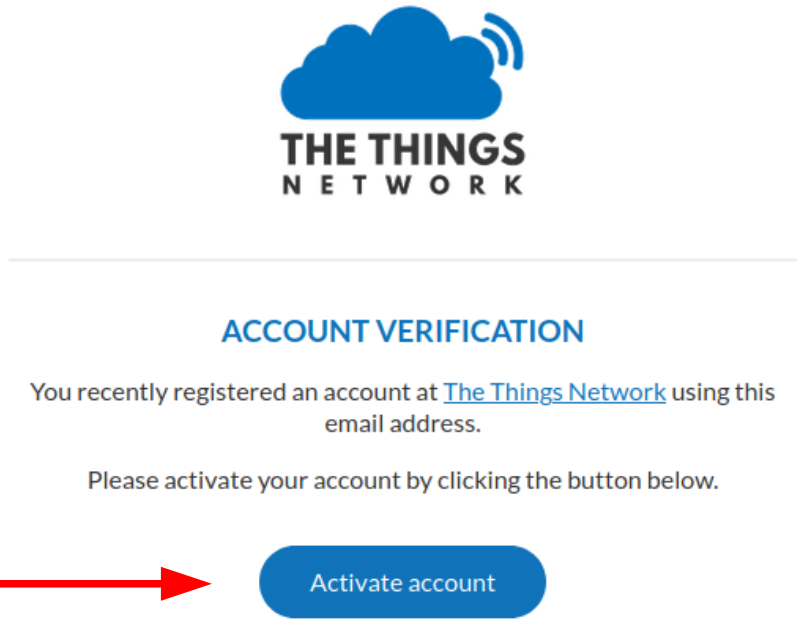
Konto aktivieren (E-Mail)



E-Mail öffnen

[Activate account] klicken

E-Mail Inhalt



Sonderzeichen in Benutzername

Ausgewählt: PRIG_01

Login mit PRIG_01 Nicht möglich…

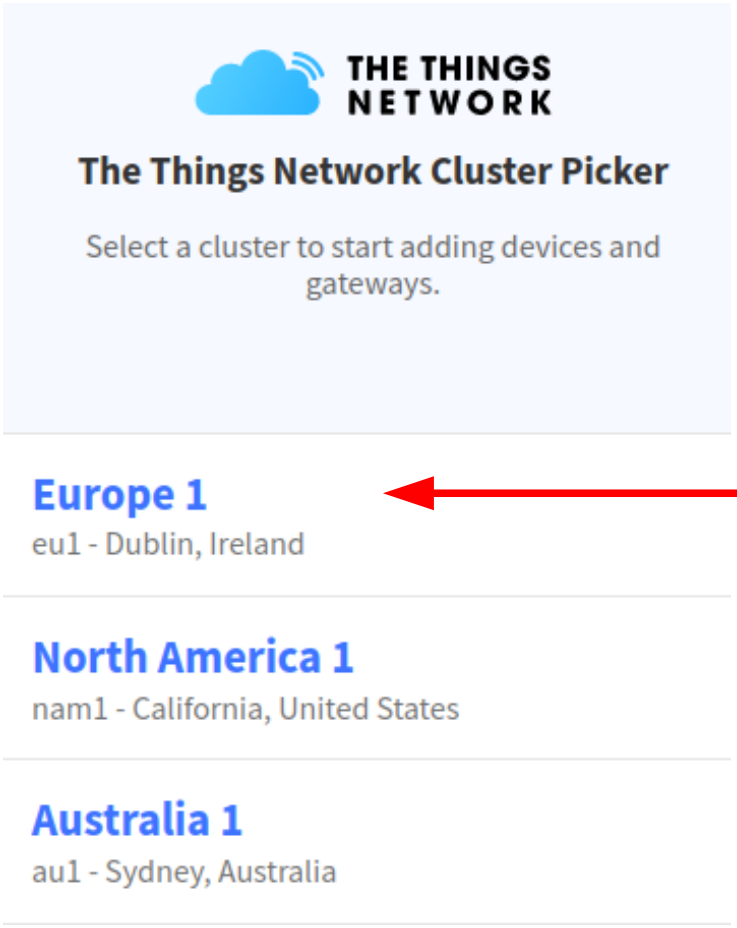
Wurde im Hintergrund geändert zu:

PRIG-01 oder prig-01

Hinweis:

Sonderzeichen in Benutzername vermeiden.

Login



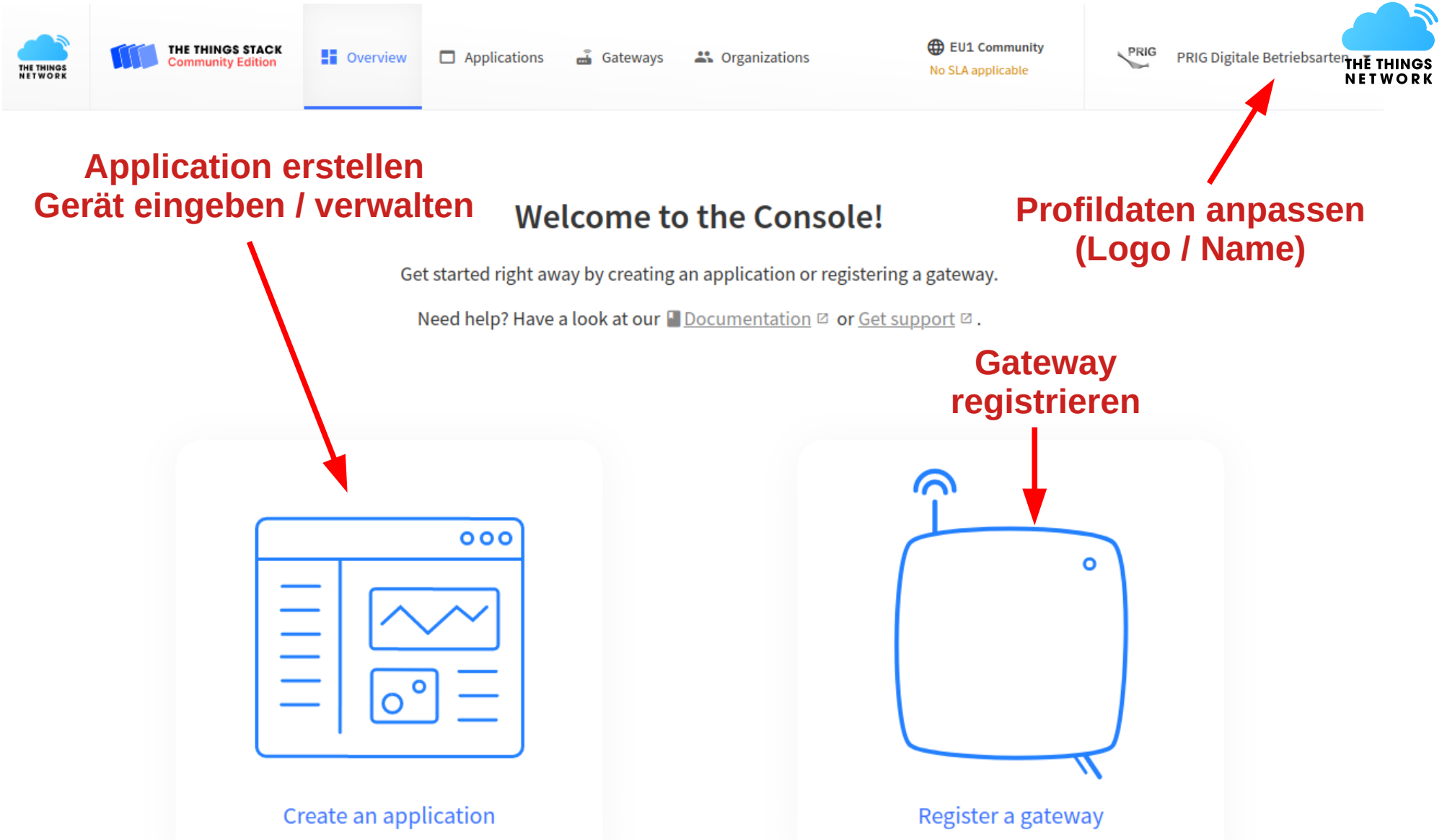
Login to:
https://console.cloud.thethings.network/

Europe 1
wählen

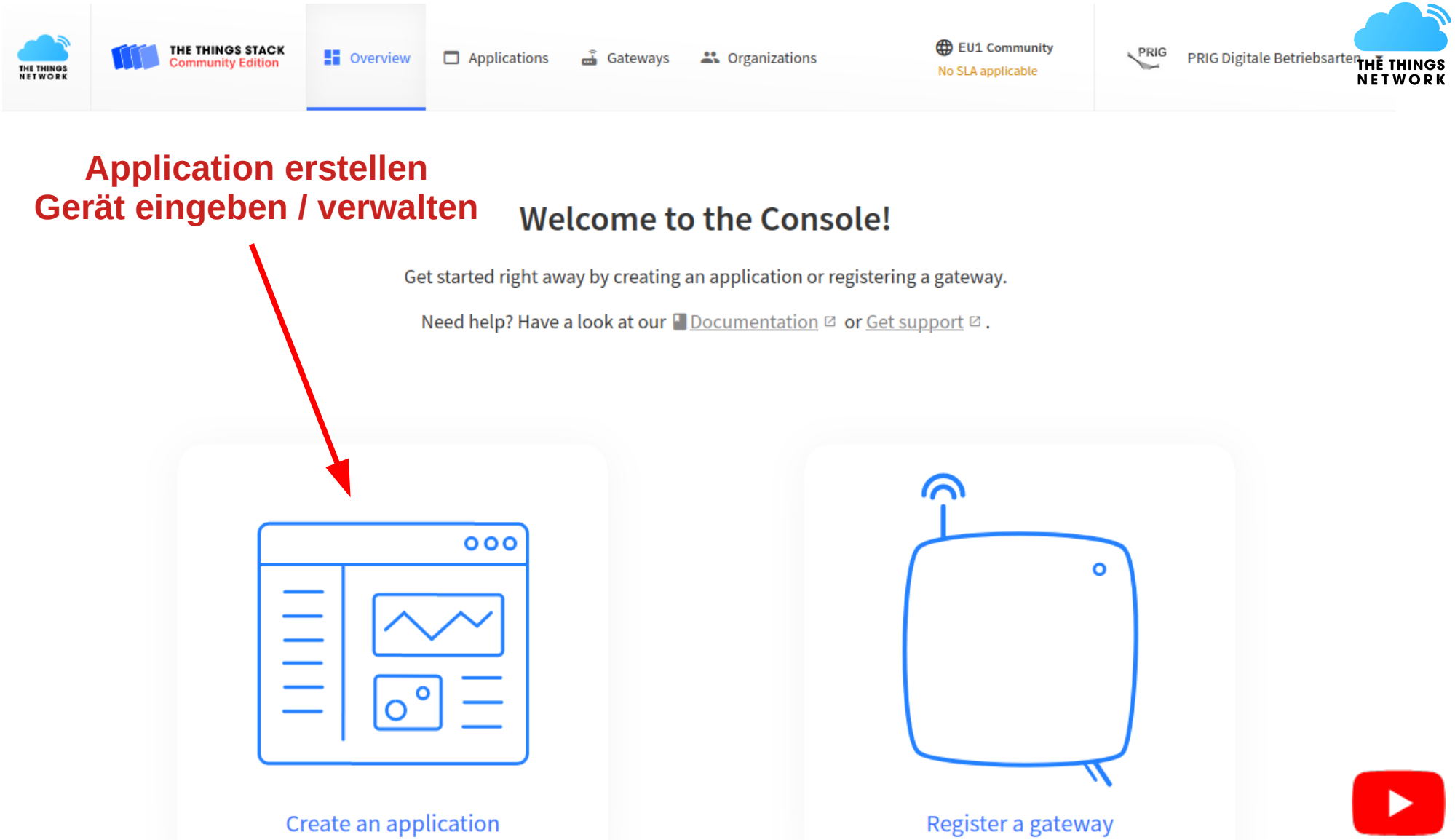
oder direkt einloggen bei:

https://eu1.cloud.thethings.network/console/

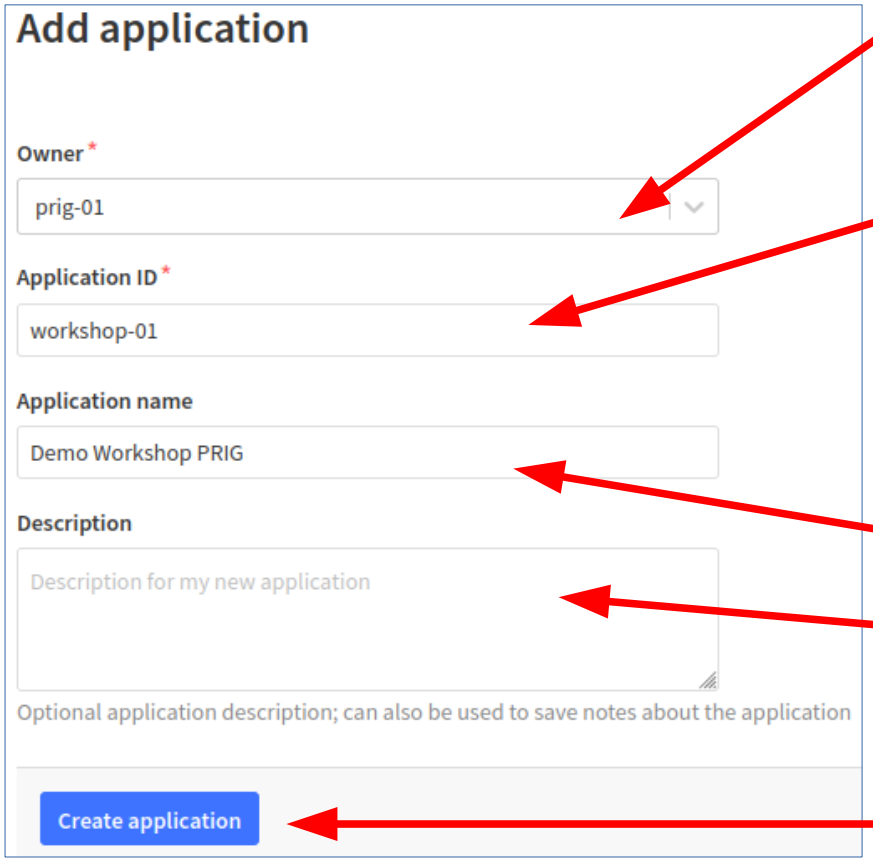
Console Overview



Console Overview



Application erstellen



Owner:
Konto Name «prig-01»

Application ID:
Name darf nur 1x existieren
Nur Kleinbuchstaben
Kein Leerschlag

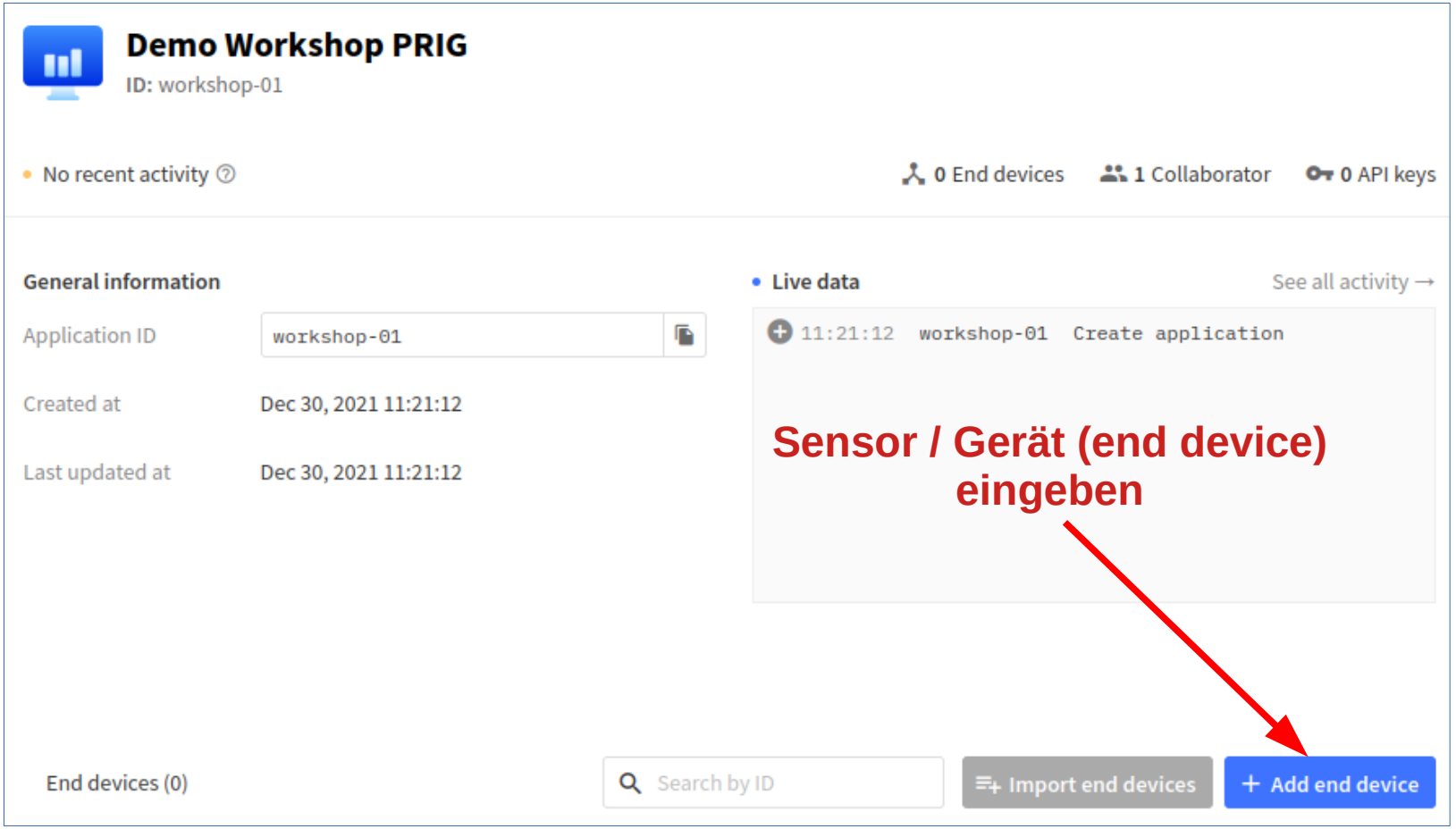
Application name: optional
Description: optional

[Create application] klicken

(Sonderzeichen vermeiden)

Sensor / Gerät einfügen (Device)

Eine «Application» kann mehrere «Devices» enthalten



Benötigte Informationen

Marke / Typ / Version: Dragino / LT22222-L / FW 1.5.6

Frequency Plan: Europe 863-870 MHz
(SF9 for RX2 – recommended)

DevEUI:
AppEUI:
AppKey:
AppSKey:

Kleber auf Verpackung.
Alternative: vom Gerät ablesen/eingeben
mit Serielle Schnittstelle

Auswahl nach Marke / Typ

Register end device

From The LoRaWAN Device Repository | Manually

1. Select the end device

Brand *	Model *	Hardware Ver. *	Firmware Ver. *	Profile (Region) *
Dragino Technology Co.,...	LT22222-L	Unknown ...	1.5.6	EU_863_870

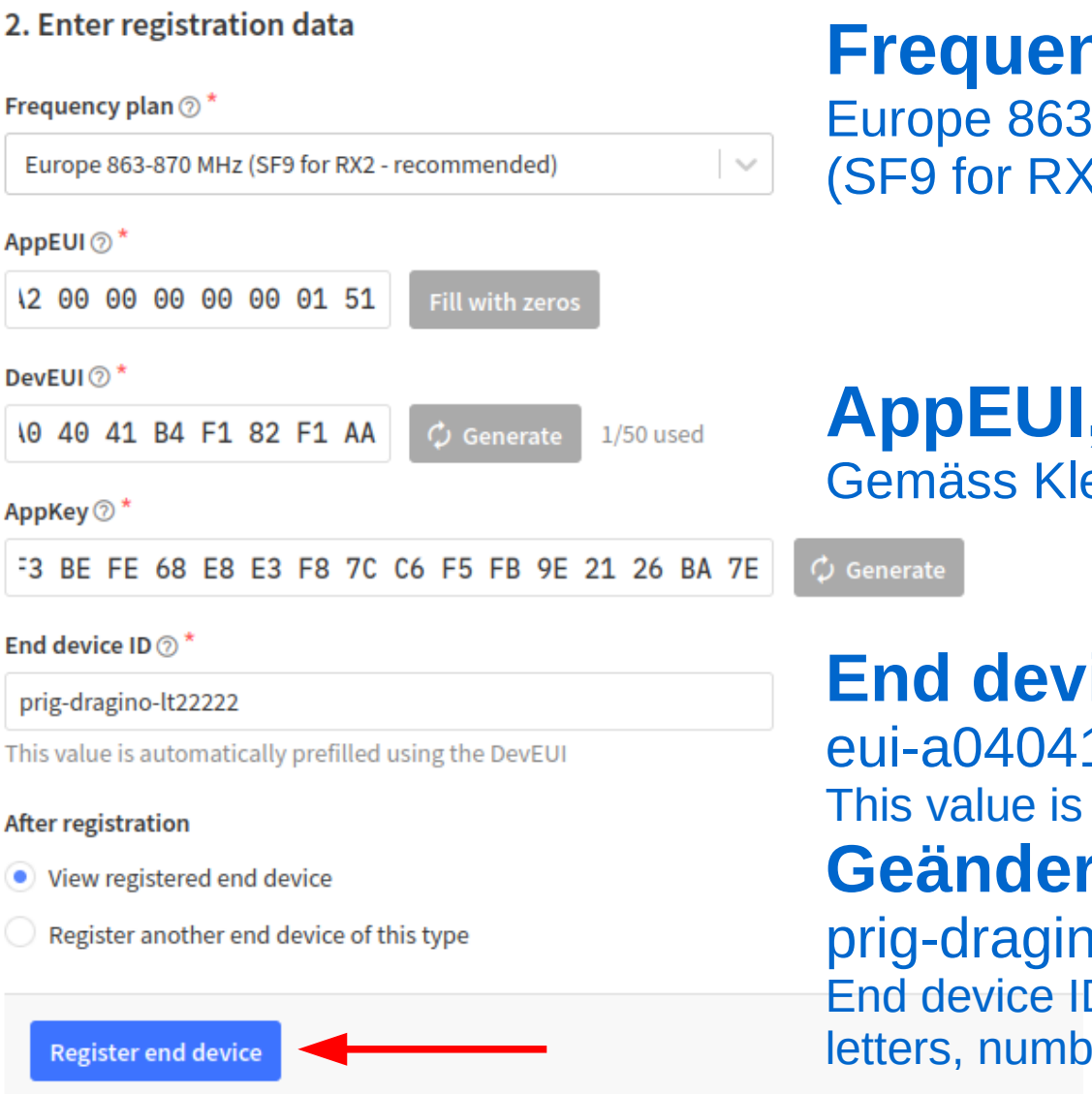
LT22222-L

MAC V1.0.3, PHY V1.0.3 REV A, Over the air activation (OTAA), Class C

The Dragino LT22222-L is a LoRaWAN® I/O module that contains different I/O Interfaces such as analog current input, analog voltage input, relay output, digital input, and digital output. The LT series I/O modules are designed to simplify the installation of I/O monitoring.

Product website Data sheet

Geräte Daten eingeben (1)



Frequency Plan:

Europe 863-870 MHz
(SF9 for RX2 – recommended)

AppEUI, DevEUI, AppKey

Gemäss Kleber auf Verpackung

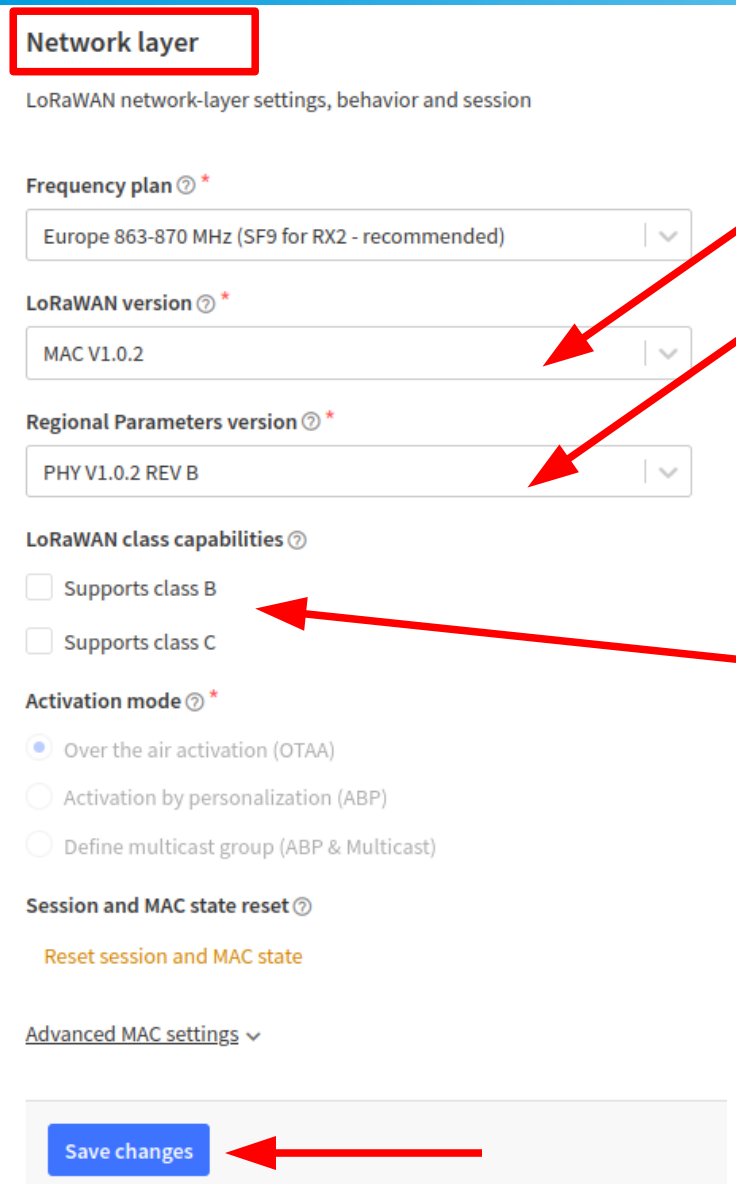
End device ID:

eui-a04041b4f182f1aa
This value is automatically prefilled using the DevEUI

Geändert auf:

prig-dragino-lt22222
End device ID must contain only lowercase letters, numbers and dashes (-)

Geräte Daten eingeben (2)



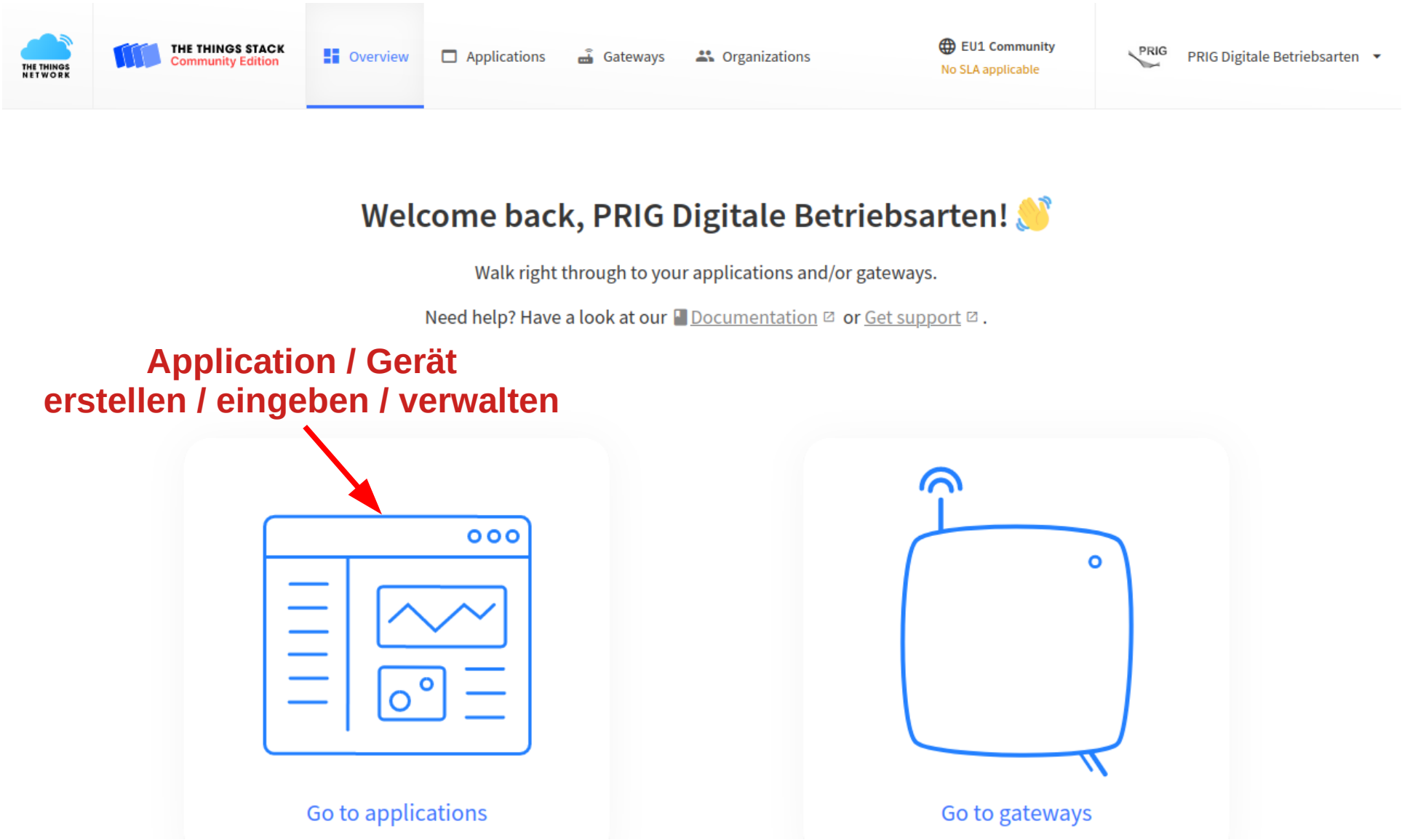
LoRaWAN version:
MAC V1.0.2

Regional Parameters version;
PHY V1.0.2 REV B

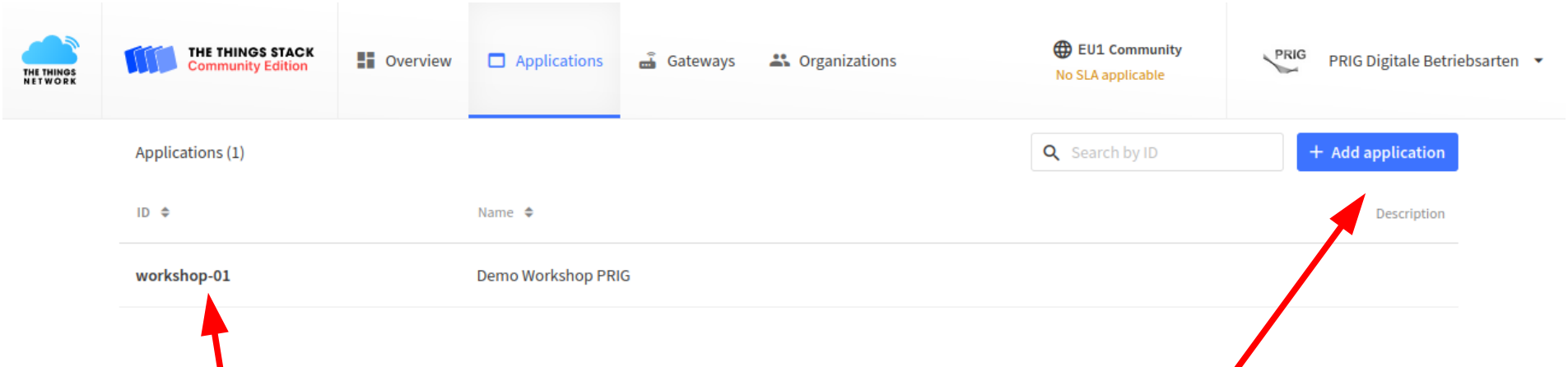
LoRaWAN class capabilities:

- ☐ Support class B (Nicht ankreuzen)
- ☐ Support class C (Nicht ankreuzen)

2. Gerät eingeben



Applications / Device



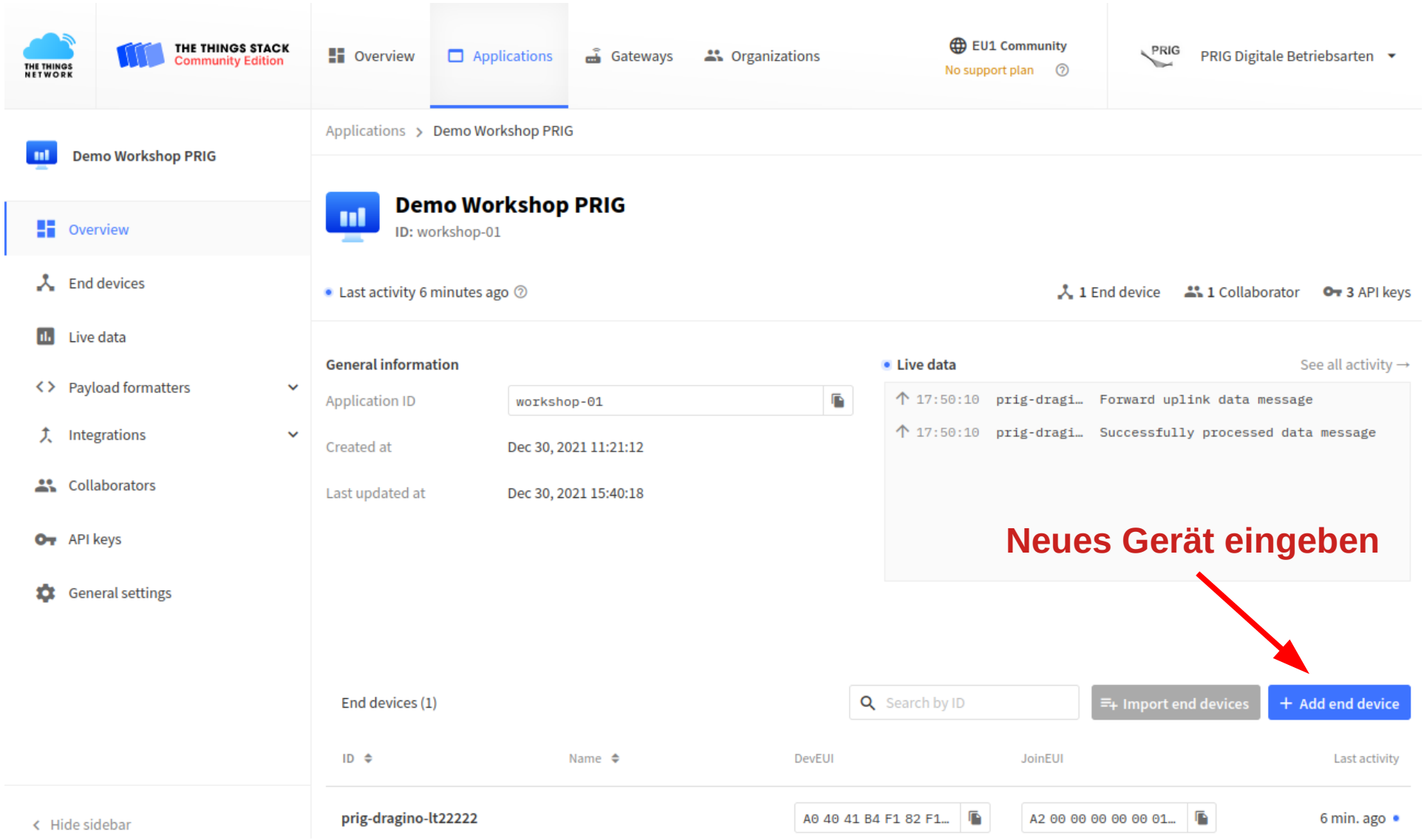
Neue «Application» erstellen

oder

Gerät im bestehende «Application» einfügen

(Besser alle Geräte im gleichen «Application» gruppieren)

Gerät im bestehende «Application» einfügen



Teil 4
Gateway registrieren
“The Things Network” (TTN)

Gateway Beispiel

Wichtig
nur Multichannel
(8 Kanäle)
verwenden

Preis (Nov. 2021):
159.- CHF bastelgarage.ch
148 - 164 CHF AliExpress

Indoor Gateway
LPS8 Indoor Multichannel LoRaWAN Gateway.

Anschluss SMA für externe Antenne.

GSM Antennen 880-960 MHz kann man teilweise auch für LoRa 868 MHz verwenden.

Stromverbrauch
Speisung: 5V, 2A (USB-C)
Gemessen auf 230V: 5.5-6.4 Watts
ca. 50 kWh / Jahr
ca. CHF 11.- / Jahr je nach Strompreis.

Anmelden zum lokalen Gateway

Login über LAN (Kabel):
http://192.168.xx.xx:8000

Hinweis:
http:// (nicht https)
Port: :8000

Default:
User Name: root
Password: dragino

Login auch möglich über WLAN:
http://192.168.xx.xx/ ← ohne Port 8000

Bei mir WLAN deaktiviert. WLAN hat APRS Empfang gestört.

Benutzeroberfläche

LoRaWAN auswählen

WLAN deaktiviert.
WLAN hat APRS Empfang gestört.

Konfiguration

DRAGINO | LoRa | LoRaWAN | MQTT | TCP | Custom | Network

LoRaWAN Configuration

General Settings

Email: dragino-20467c@dragino.com

Gateway ID: A8404120467C4150

Gateway ID (Gateway EUI bei TTN)
= *MAC Adresse + 4150*
Notieren / kopieren

Primary LoRaWAN Server

Service Provider: The Things Network V3

Server Address: eu1.cloud.thethings.network

Uplink Port: 1700

Downlink Port: 1700

The Things Network V3 auswählen
Falls nicht Verfügbar: Firmware updaten oder
Custom / Private LoRaWAN auswählen
(The Things Network V2 ist nicht mehr in Betrieb)

eu1.cloud.thethings.network

Packet Filter

Fport Filter ? 0

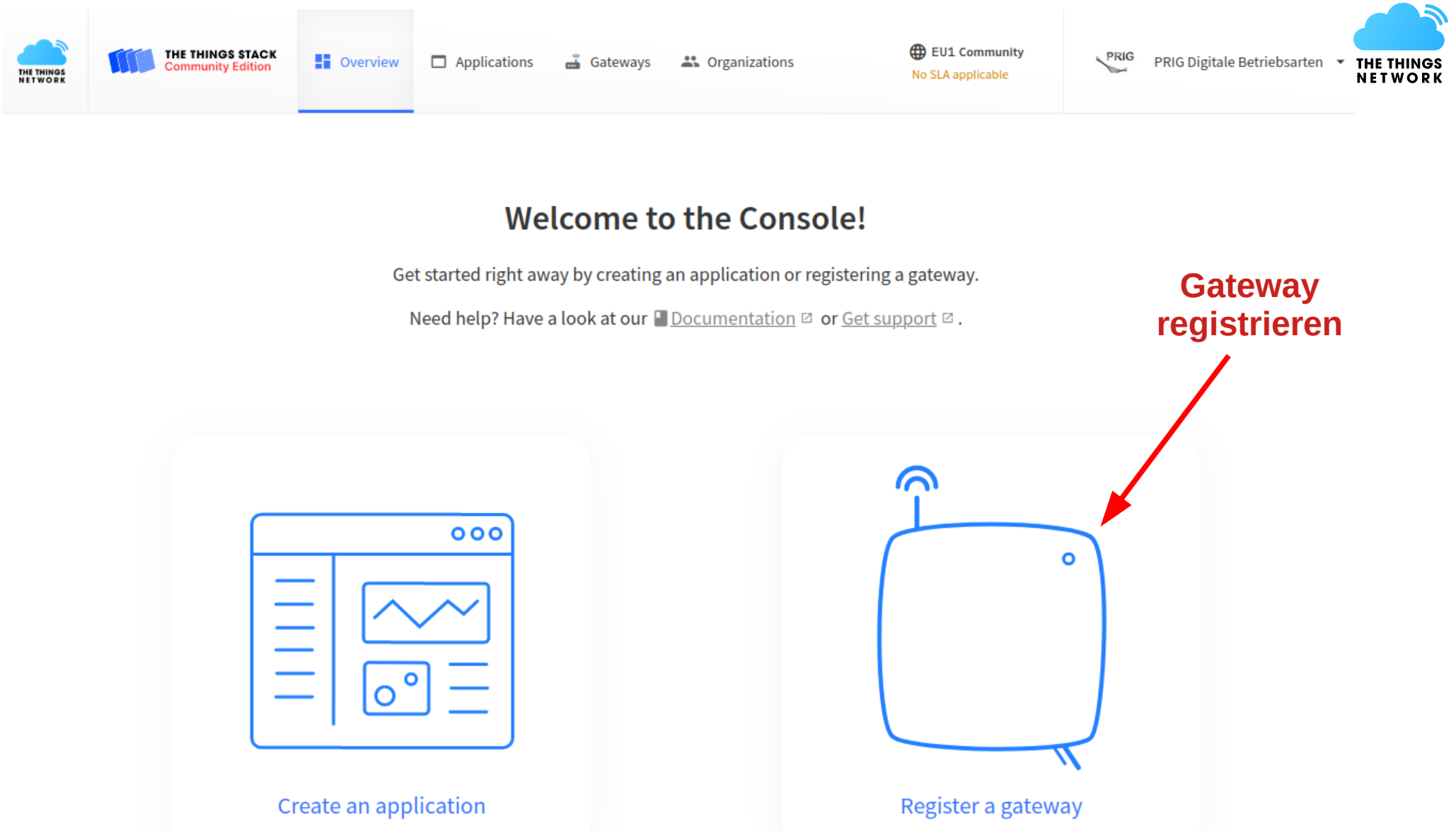
DevAddr Filter ? 0

Current Mode:LoRaWAN Semtech UDP

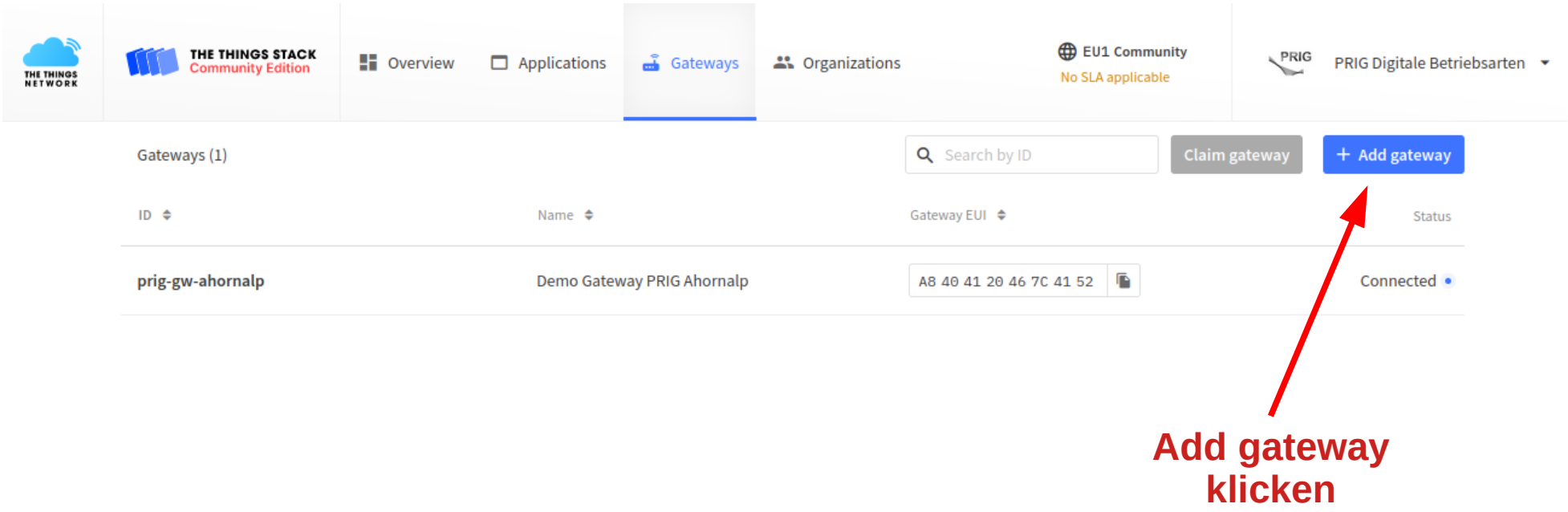
Save&Apply | Cancel

Save&Apply

Console Overview



Neue Gateway registrieren



Add gateway klicken

Gateway registrieren

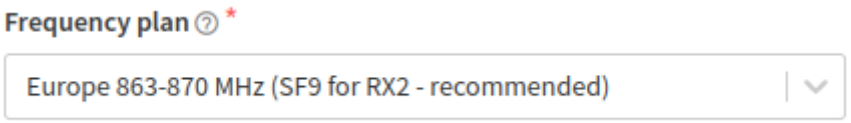
Owner:
Konto Name «prig-01»

Gateway ID:
Name darf nur 1x existieren
Nur Kleinbuchstaben
Kein Leerschlag

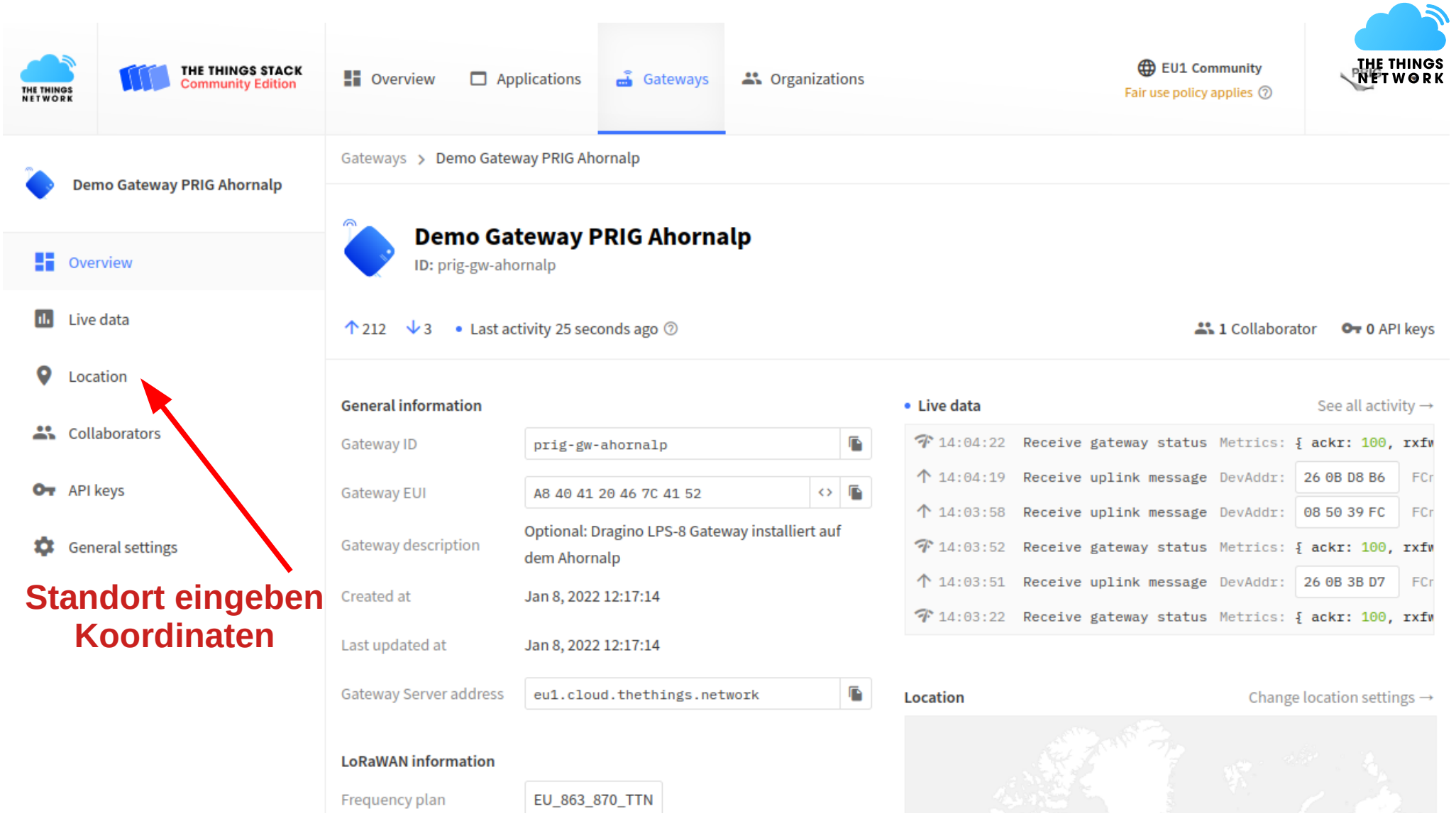
Gateway EUI:
Gateway ID kopiert vom Gerät

Gateway Name:
Lesbarer Name

Nach unten scrollen...



Übersicht, weitere Einstellungen

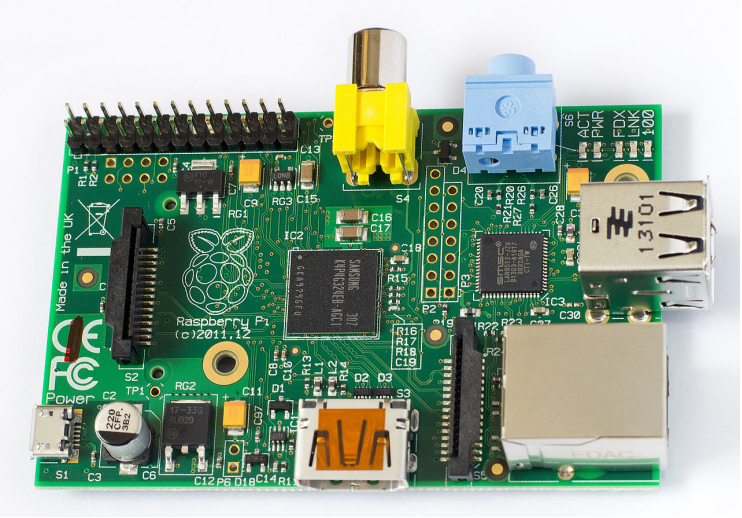


Standort eingeben Koordinaten

Teil 5
Raspberry Pi
Node-Red installieren

Hardware

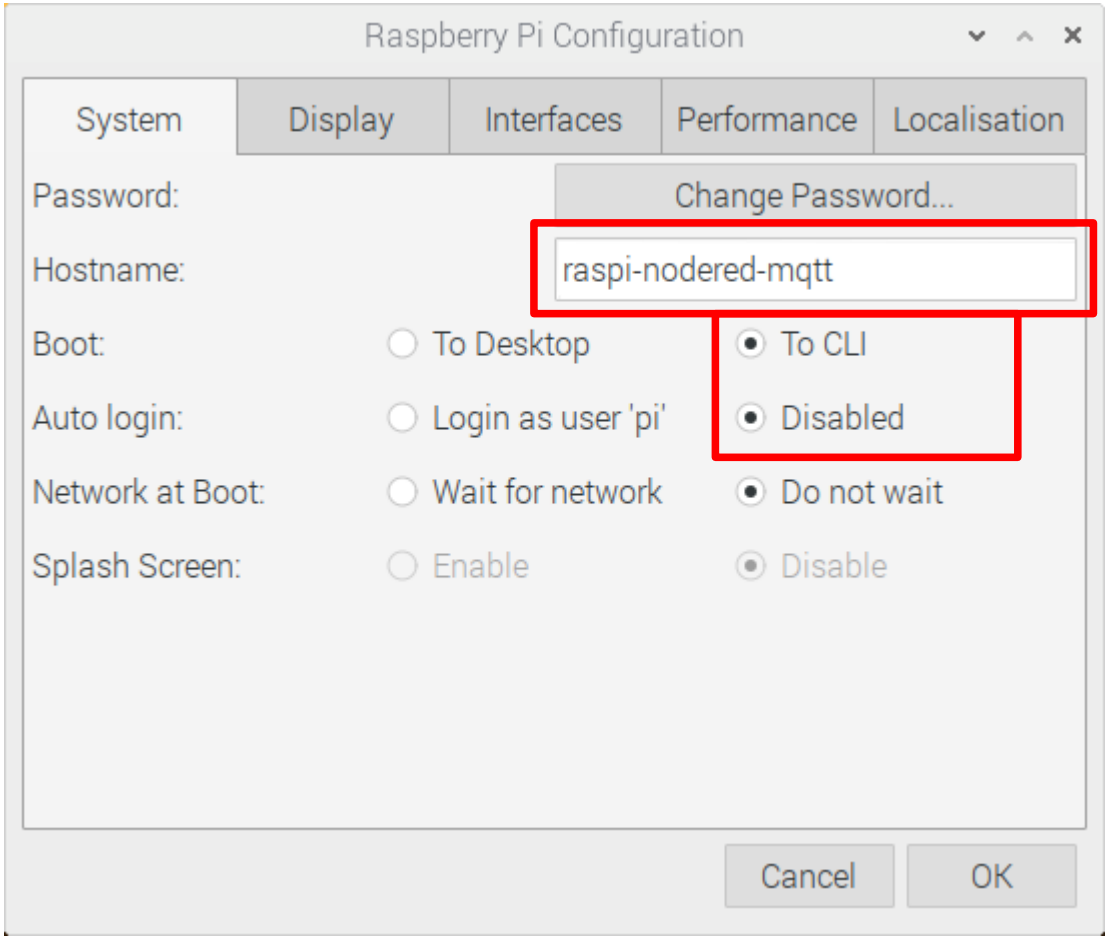
- Demo mit RaspberryPi 1 Model B
  RAM: 512 MB RAM, SD Card 8 GB



- Empfohlen RaspberryPi 3 Model B oder höher

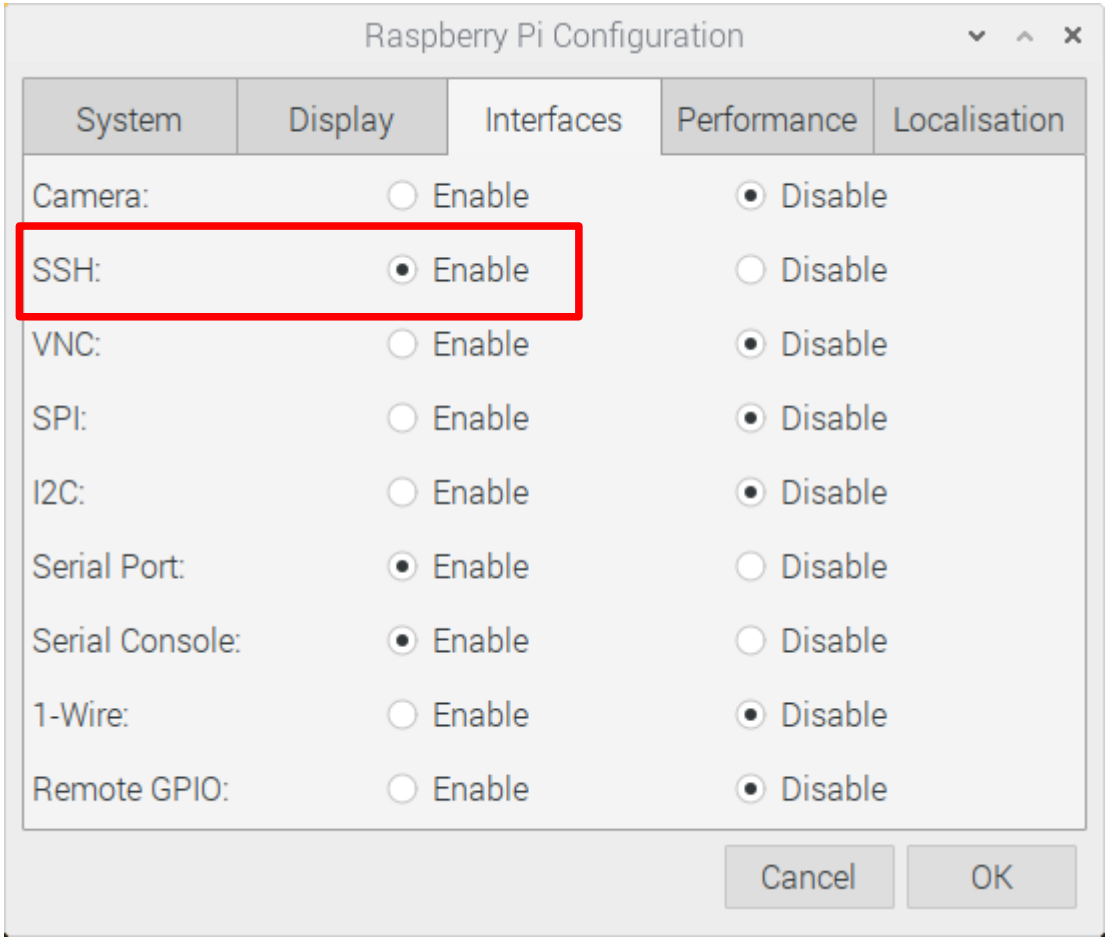
Konfiguration

- Hostname definieren
- GUI (Desktop) deaktivieren (optional)
- Auto login deaktivieren



Remote Access aktivieren

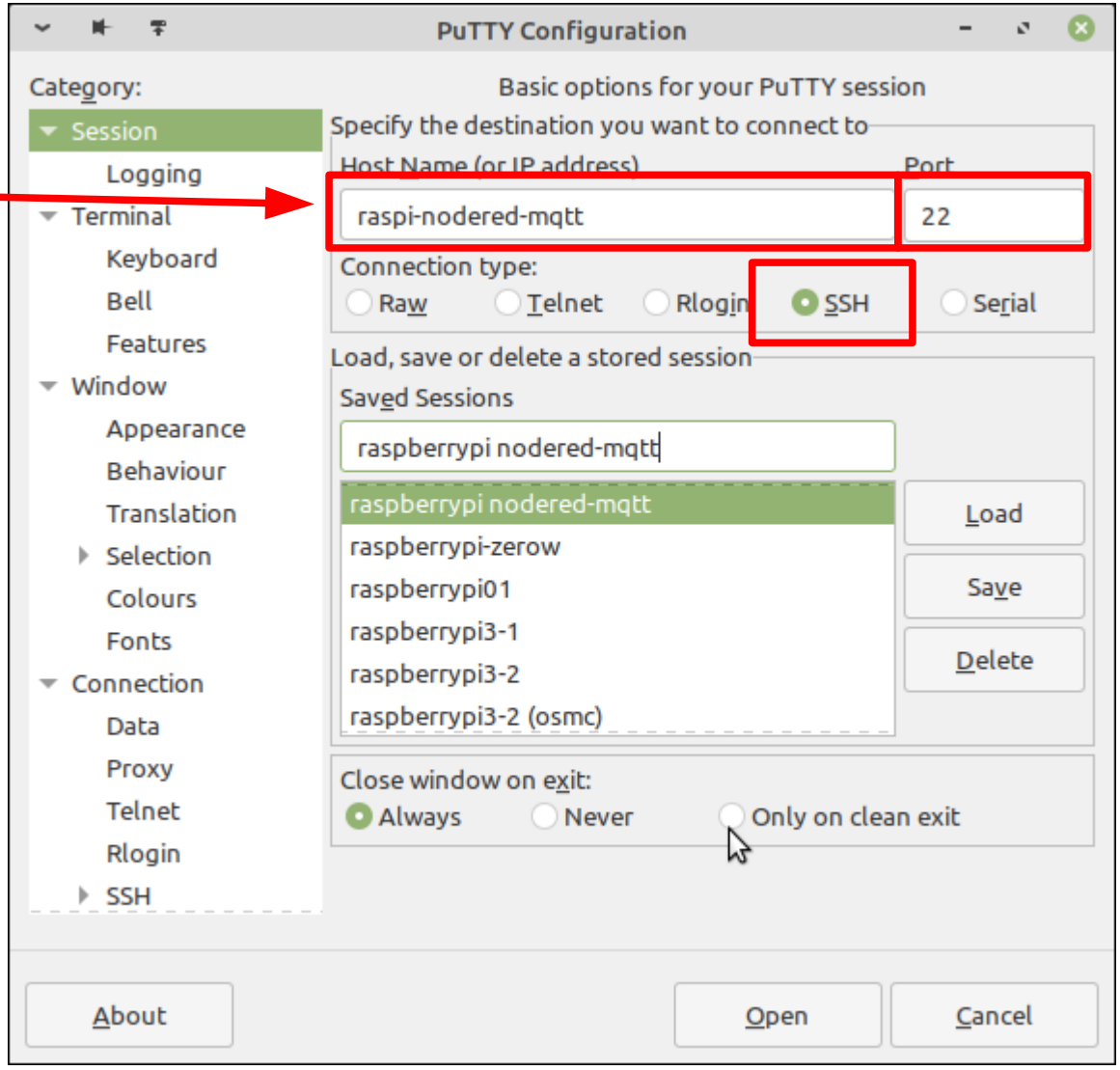
- SSH aktivieren



Remote Verbindung mit Putty

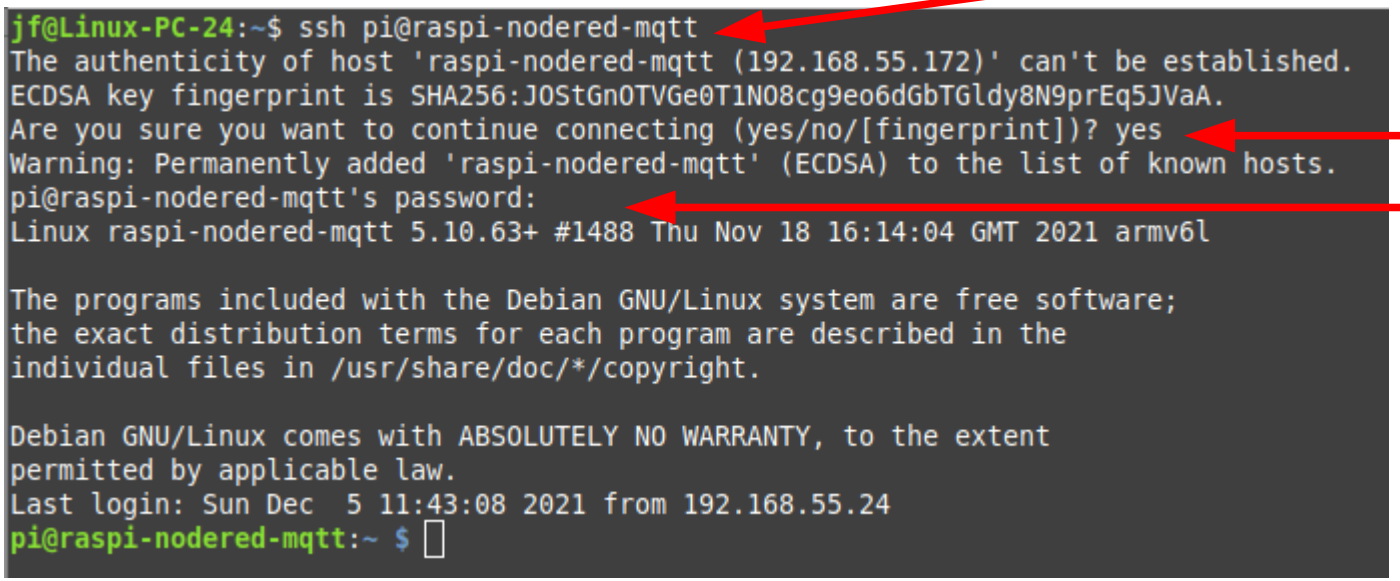
Hostname oder IP-Address
Beispiel :
raspi-nodered-mqtt
oder
192.168.xxx.xxx

- Windows :
  mit Putty
- Linux :
  Kommandozeile
- Mac :
  mit «Terminal»



Remote Verbindung mit Terminal

- Befehl:
  ssh pi@raspi-nodered-mqtt
  oder
  ssh pi@192.168.xxx.xxx



Node-Red installieren

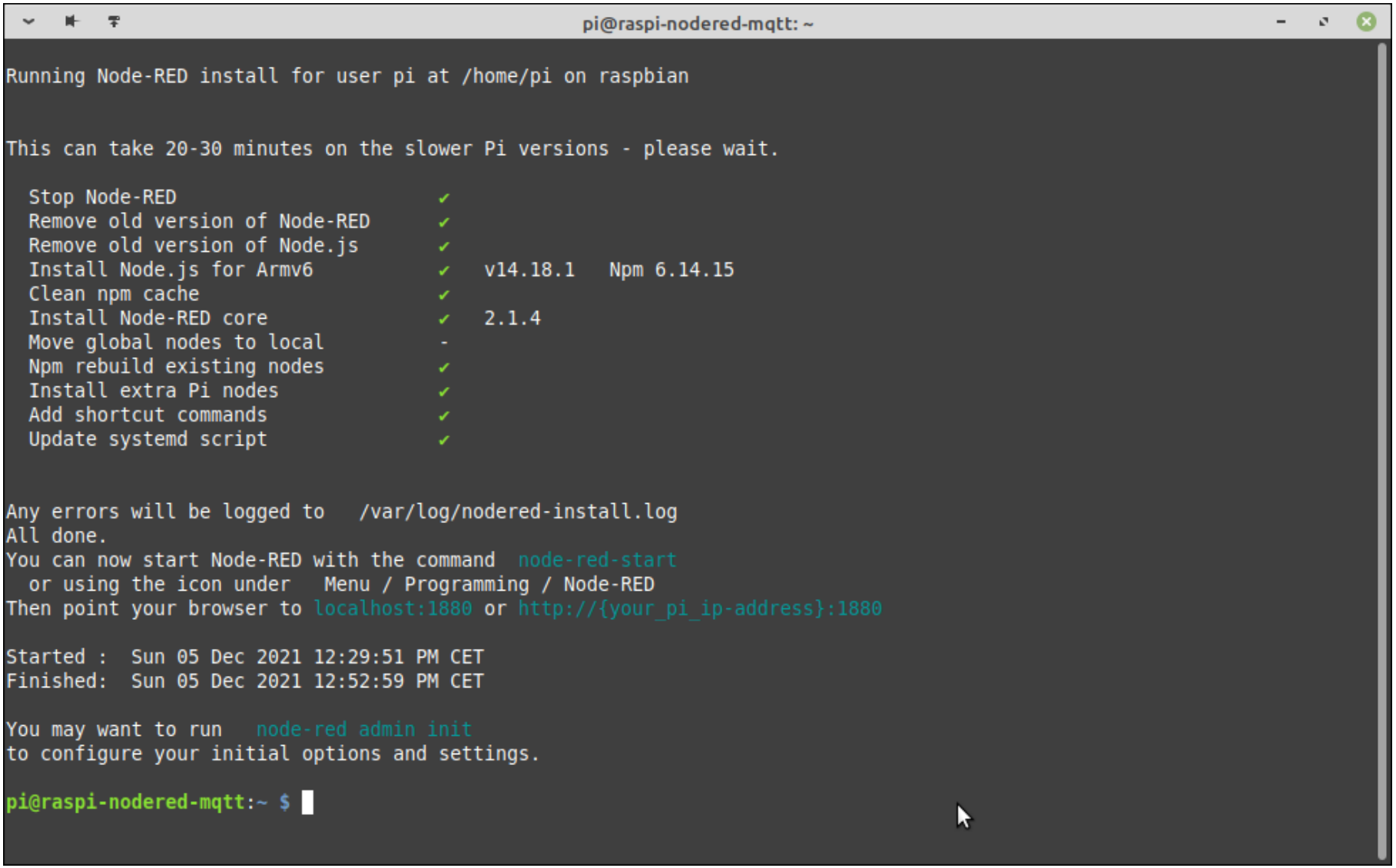
Link: https://nodered.org/docs/getting-started/raspberrypi

- Terminal:
  bash <(curl -sL https://raw.githubusercontent.com/node-red/linux-installers/master/deb/update-nodejs-and-nodered)

```
pi@raspi-nodered-mqtt:~ $ bash <(curl -sL https://raw.githubusercontent.com/node-red/linux-installers/master/deb/update-nodejs-and-nodered)


This script checks the version of node.js installed is 12 or greater. It will try to
install node 14 if none is found. It can optionally install node 12, 14 or 16 LTS for you.

If necessary it will then remove the old core of Node-RED, before then installing the latest
version. You can also optionally specify the version required.

It also tries to run 'npm rebuild' to refresh any extra nodes you have installed
that may have a native binary component. While this normally works ok, you need
to check that it succeeds for your combination of installed nodes.

To do all this it runs commands as root - please satisfy yourself that this will
not damage your Pi, or otherwise compromise your configuration.
If in doubt please backup your SD card first.

See the optional parameters by re-running this command with --help

Are you really sure you want to do this ? [y/N] ? y

Would you like to install the Pi-specific nodes ? [y/N] ?
```

- 20-30 Minuten warten...

Installation Node-Red beendet



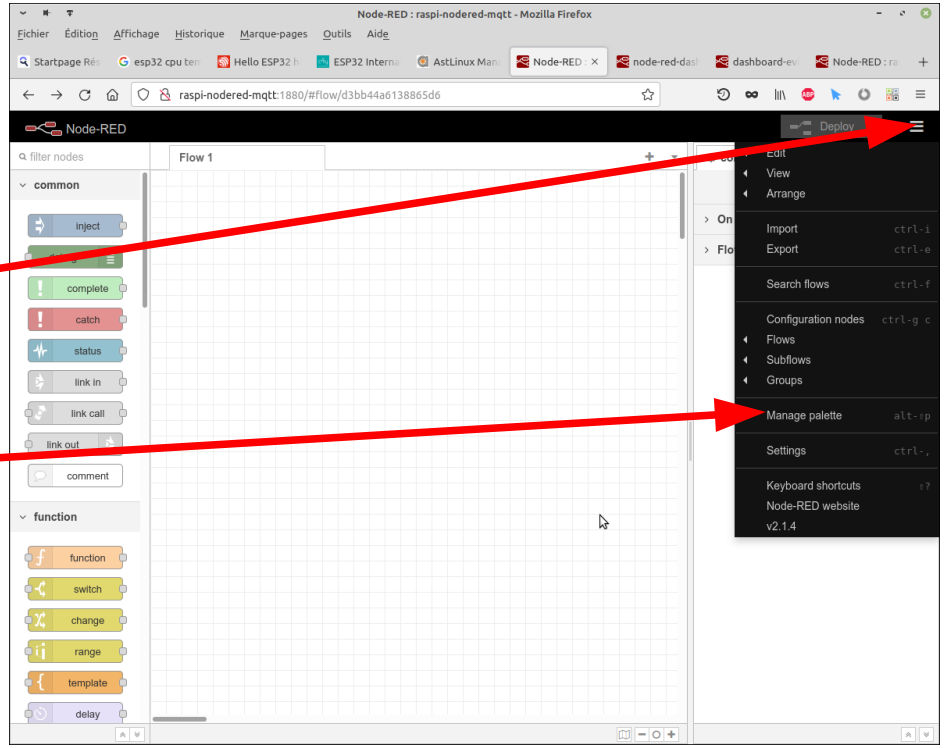
Node-Red Befehle

- Node-Red starten:
  node-red-start
- Link in Internet Browser öffnen (z.B. Firefox):
  http://raspi-nodered-mqtt:1880
  http://{your_pi_ip-address}:1880

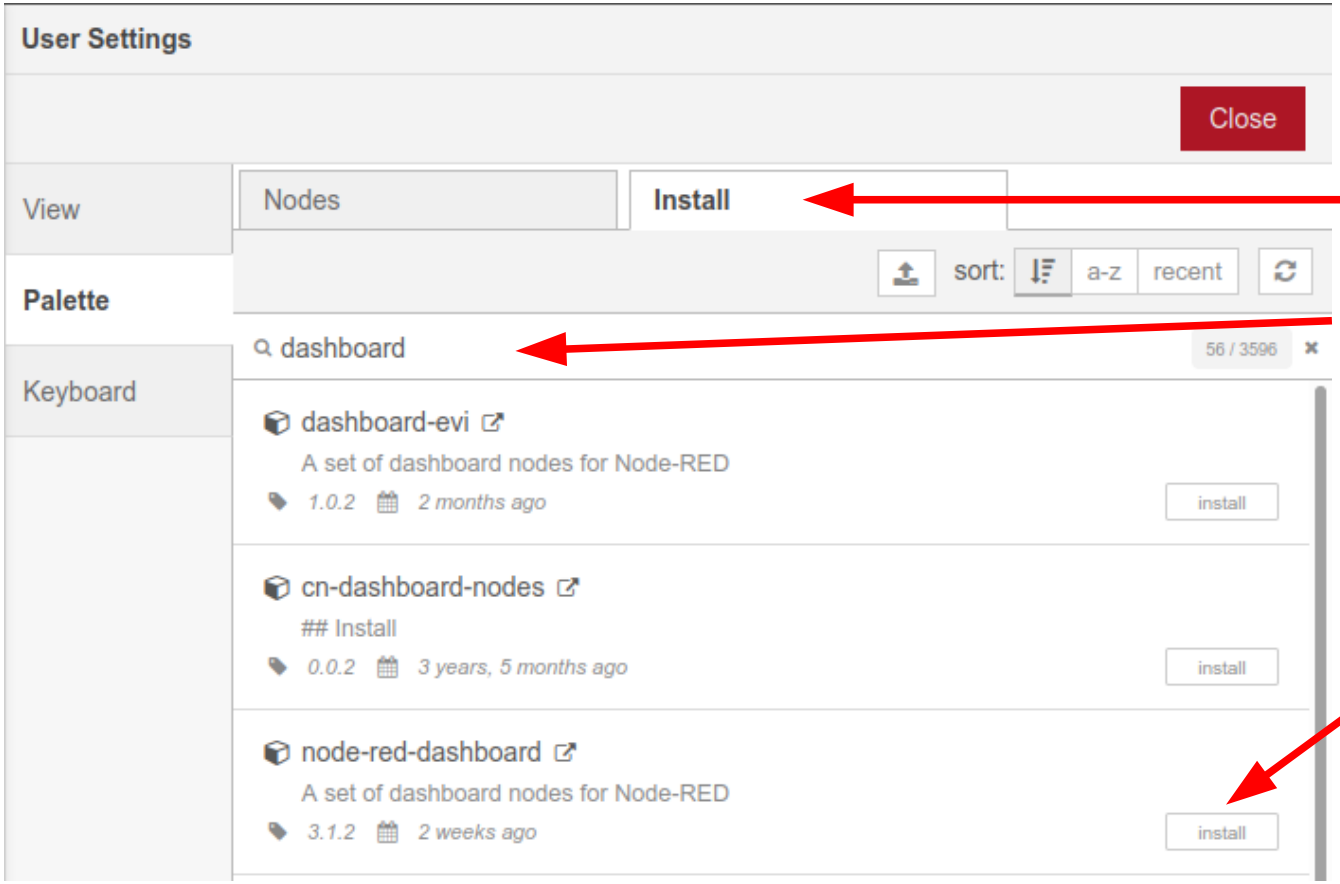
- Node-Red automatisch starten:
  sudo systemctl enable nodered.service

Node-Red Dashboard installieren

- Link in Internet Browser öffnen (z.B. Firefox): http://raspi-nodered-mqtt:1880
- Menu öffnen
- Manage Palette wählen



Node-Red Dashboard installieren



Install wählen

dashboard suchen

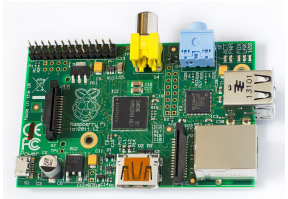
node-red-dashboard installieren

Node-Red empfohlene Module

- Node-red-contrib-moment
  (Datum/Zeit formatieren / anzeigen)

Teil 6
Node-Red & MQTT

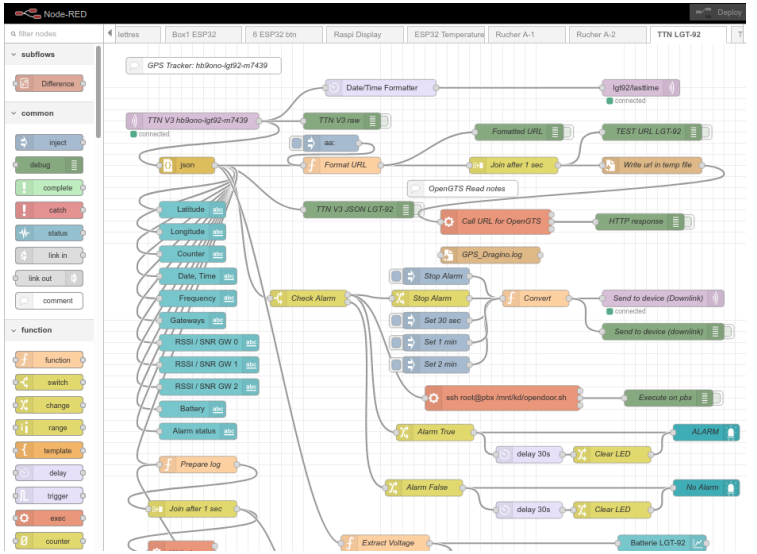
Node-Red



Konfiguration:

http://raspi-nodered-mqtt:1880/

http://raspberrypi3-1:1880/ui/

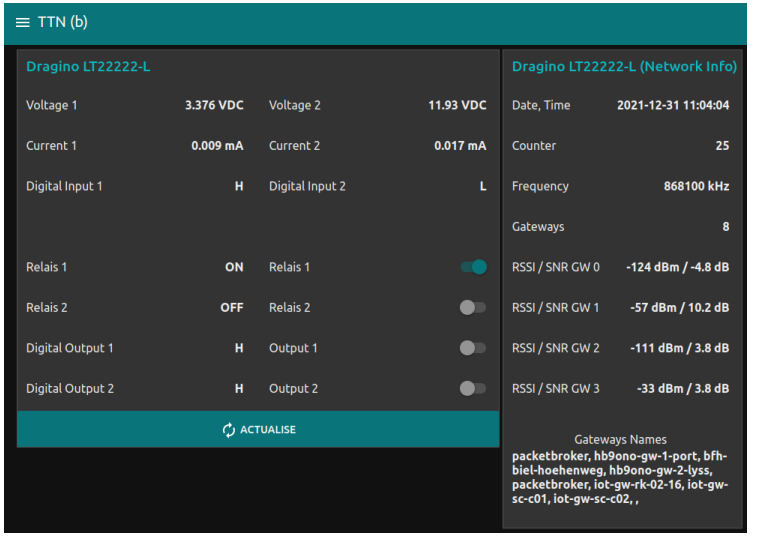


Dashboard:

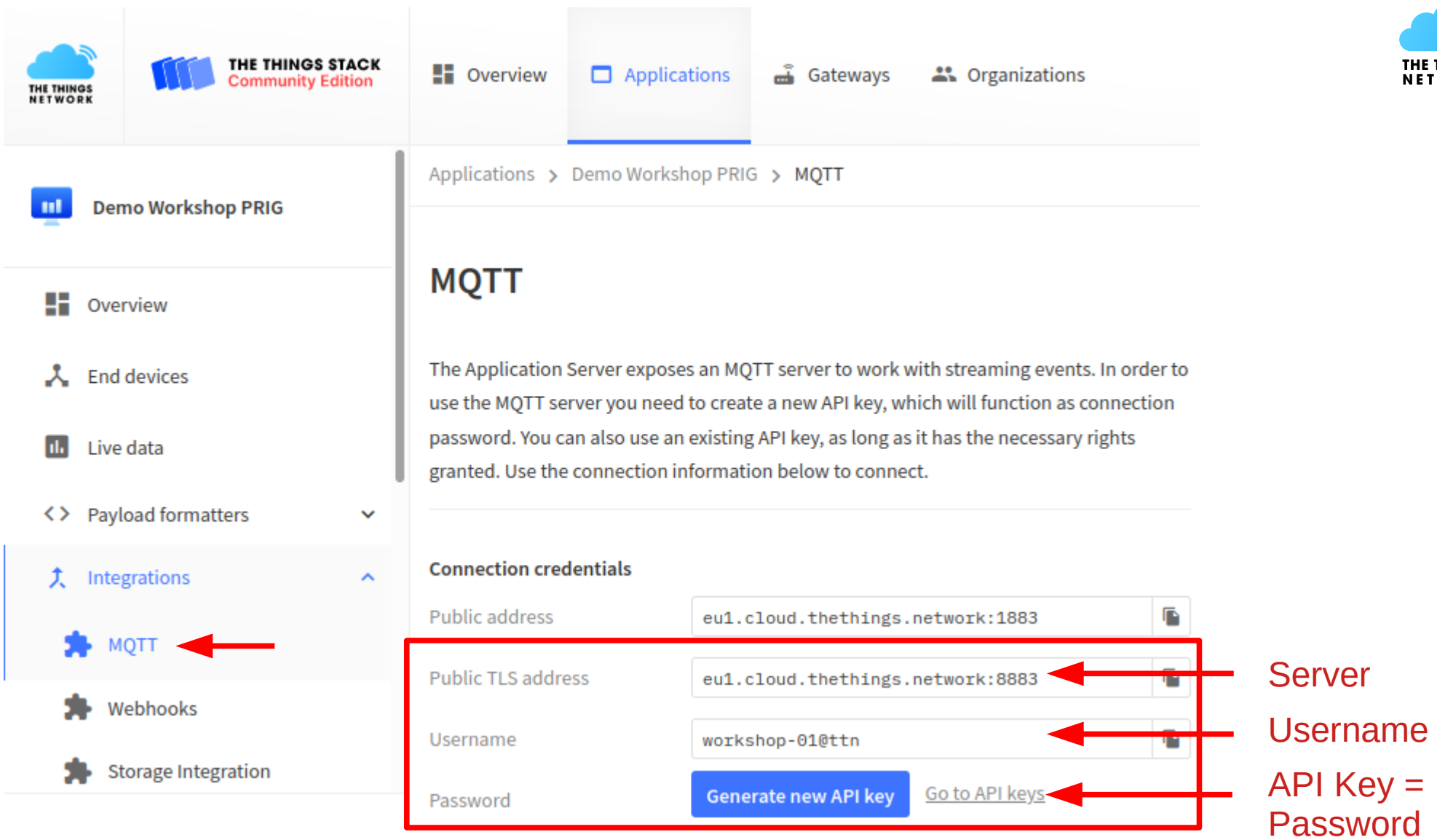
(Armaturenbrett / Anzeigetafel)

http://raspi-nodered-mqtt:1880/ui/

http://raspberrypi3-1:1880/ui/



MQTT Server bei TTN



Node-Red MQTT Login

Wichtg: API Key (MQTT Password) lokal abspeichern.
Kann nicht mehr im TTN Console gelesen werden.

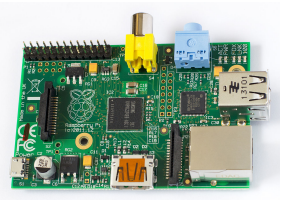
Login Daten:

Server: eu1.cloud.thethings.network
Port: 8883 (1883 = insecure)
Username: workshop-01@ttn
Password: API Key

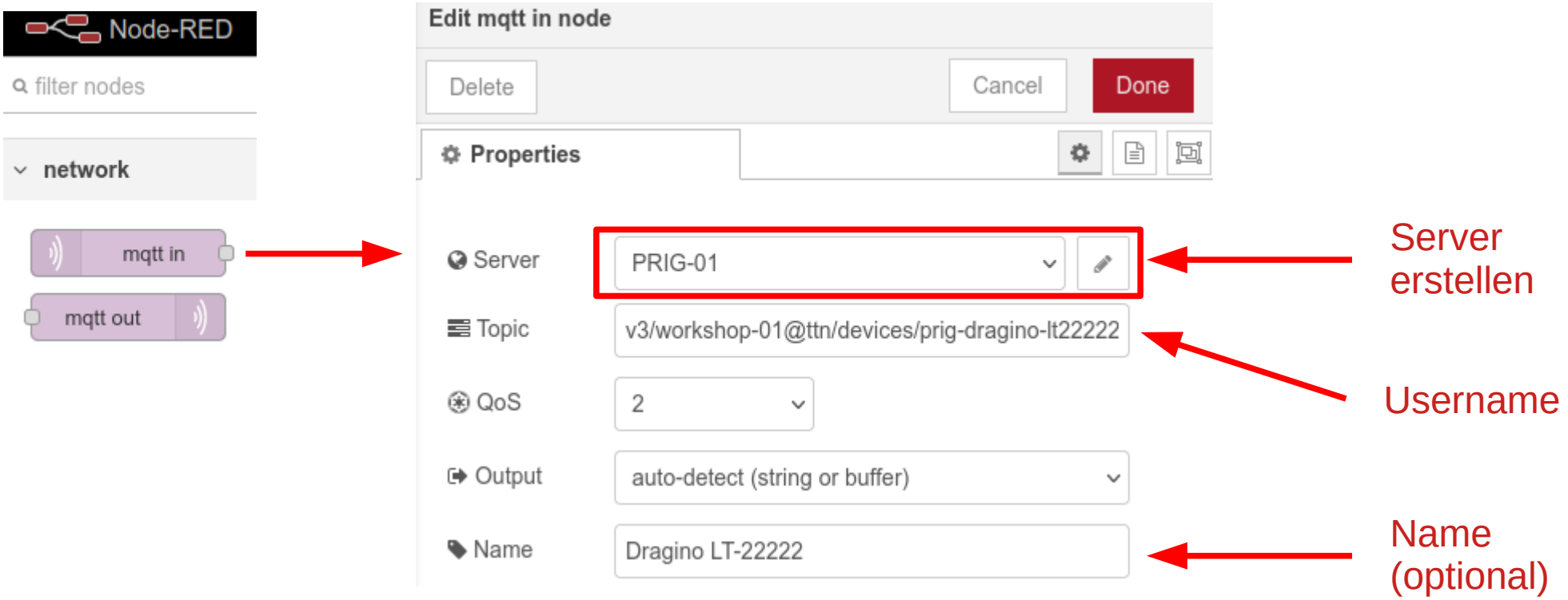
Topic: v3/Username/devices/DeviceID/up

Beispiel:
v3/workshop-01@ttn/devices/prig-dragino-lt22222/up

Node-Red Daten von TTN abholen

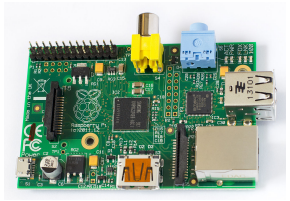


Node «mqtt in» einfügen und konfigurieren



The Things Stack supports the MQTT Standard Version 3.1.1 and QoS 0 only.

Node-Red Login to MQTT Server



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

Delete | Cancel | Update

Properties

Name: PRIG-01

Name
Beispiel PRIG-01

Connection | Security | Messages

Server: eu1.cloud.thethings.network Port: 8883

Server / Port

Enable secure (SSL/TLS) connection

TLS Configuration: TLS configuration

Security klicken
Username / Password eingeben

Client ID: Leave blank for auto generated

Keep alive time (s): 60 Use clean session

Use legacy MQTT 3.1 support

Name: PRIG-01

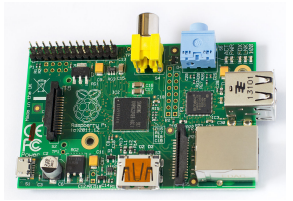
Connection | **Security**

Username: workshop-01@ttn

Password: ••••••••

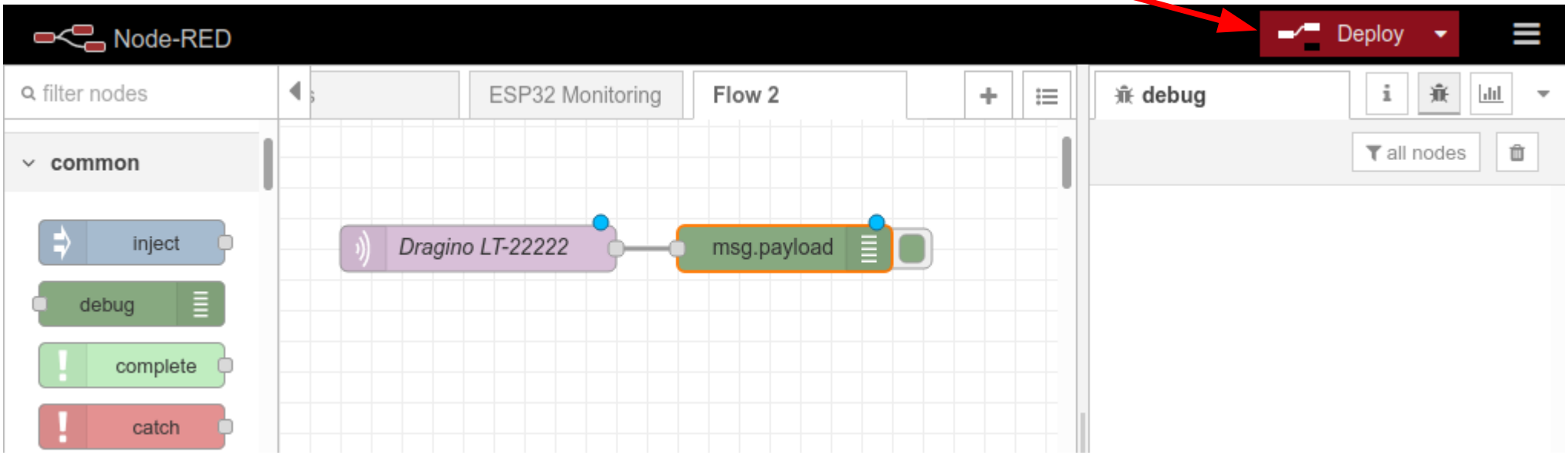
Password:
API Key

MQTT Daten in Debug lesen

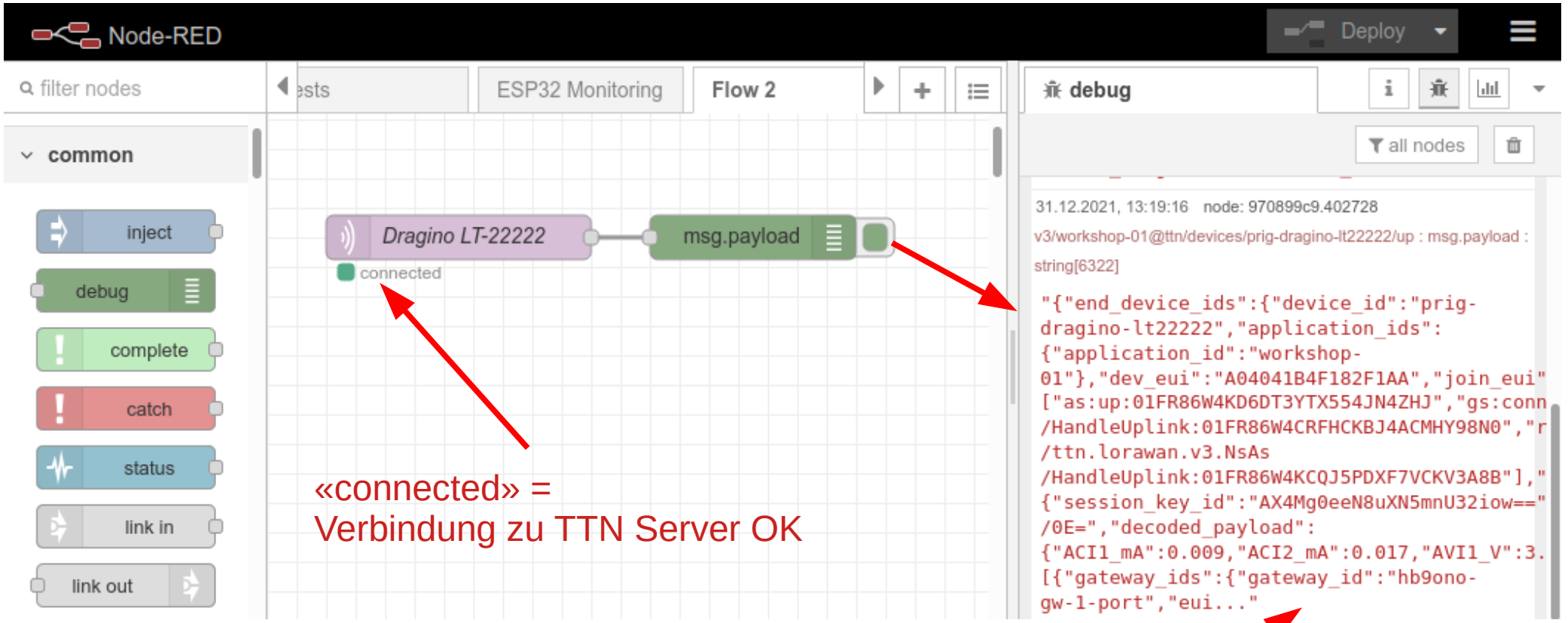


«Debug» einfügen und verbinden.

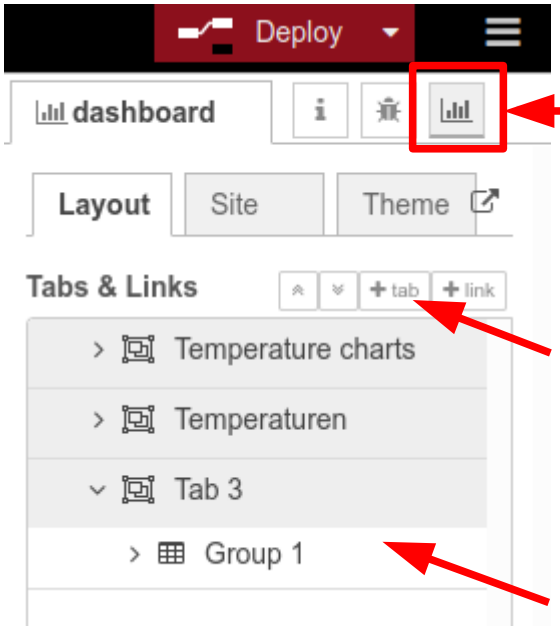
Deploy klicken



MQTT Daten von TTN



MQTT Daten anzeigen



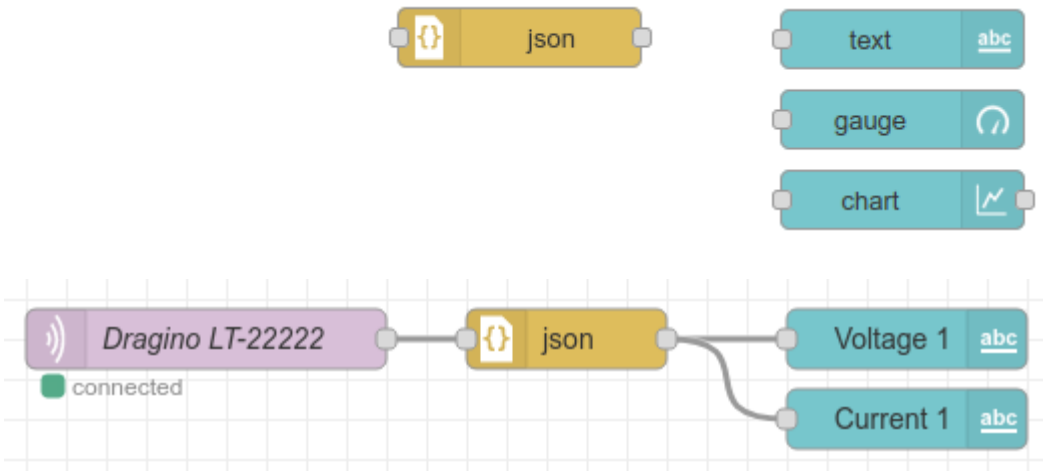
Layout klicken

Tab einfügen

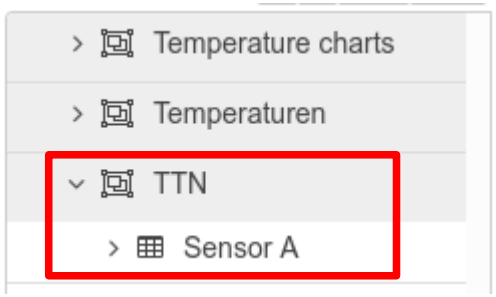
Group einfügen

Json parser einfügen

Ausgabe einfügen



Tab & Group umbenennen (optional)



Value Format:

Voltage 1:
{{payload.uplink_message.decoded_payload.AVI1_V}} VDC

Current 1:
{{payload.uplink_message.decoded_payload.ACI1_mA}} mA

Links The Things Network

Gateways Map
https://www.thethingsnetwork.org/map
https://ttnmapper.org/

Spreading Factors
https://www.thethingsnetwork.org/docs/lorawan/spreading-factors/

Regional Parameters
https://www.thethingsnetwork.org/docs/lorawan/regional-parameters/

Modulation & Data Rate
https://www.thethingsnetwork.org/docs/lorawan/modulation-data-rate/

LoRaWAN airtime calculator
https://www.thethingsnetwork.org/airtime-calculator

USKA Hamgroups

IoT Internet of Things (LoRa LoRaWAN)

Erfahrungs-Austausch unter Hams, die sich mit LoRa, LoRaWAN und IoT (“Industrie 4.0”) beschäftigen.

https://www.hamgroups.ch/lora-lorawan-iot/

Moderator: Andreas Spiess HB9BLA

“the guy with the Swiss accent”

Links

https://www.lora-wan.de/

https://de.wikipedia.org/wiki/Long_Range_Wide_Area_Network

https://www.schmidiger.ch/blog/lora-funktechnologie-wie-gut-ist-sie-wirklich

https://www.hackster.io/nootropicdesign/using-lorawan-end-devices-on-the-things-network-206a86

LoRa Video Andreas Spiess (HB9BLA)
https://www.youtube.com/watch?v=hMOwbNUpDQA

Youtube Channels Andreas Spiess (HB9BLA)
https://www.youtube.com/AndreasSpiess
https://www.youtube.com/c/HB9BLAWireless

Geräte gekauft bei:
https://www.bastelgarage.ch/

Ende

- Fragen ?

- Danke für Ihre Aufmerksamkeit