

LoRa (-WAN)

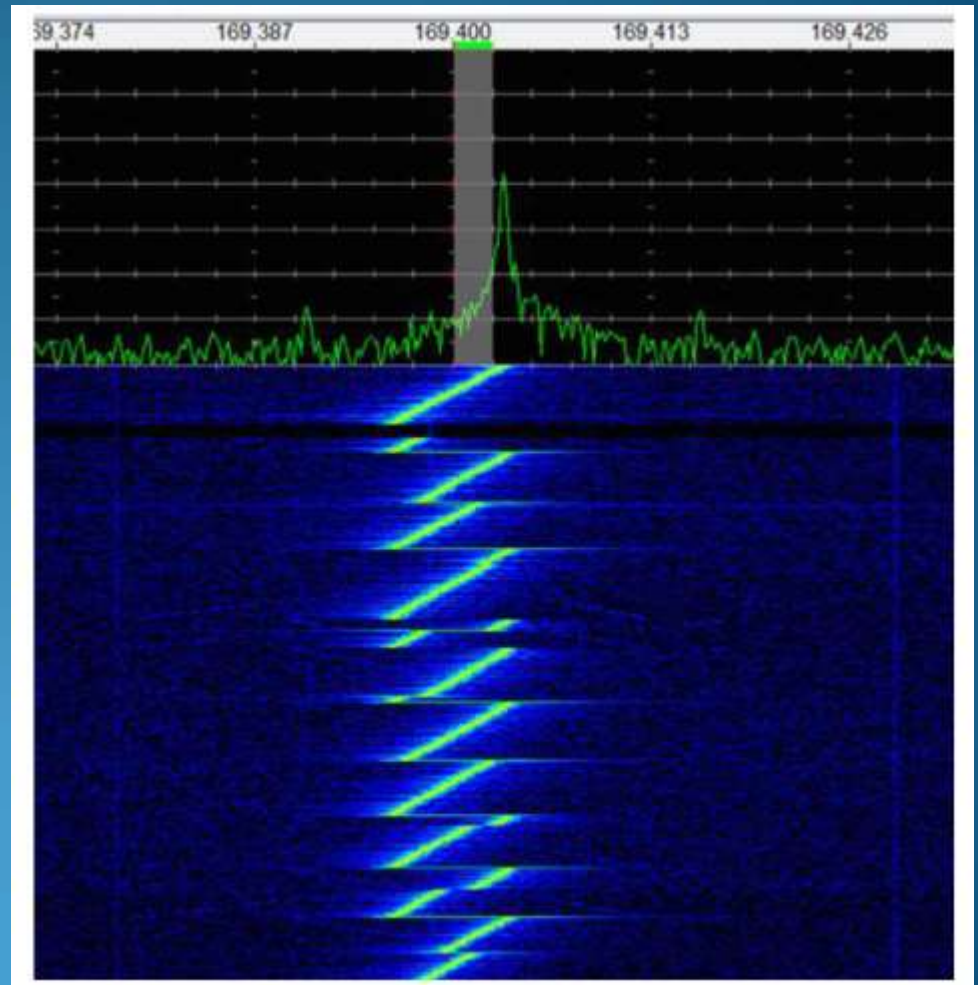
Eine kurze Vorstellung
Andreas Bieri HB9TSS

PRIG GV 20171111

Agenda

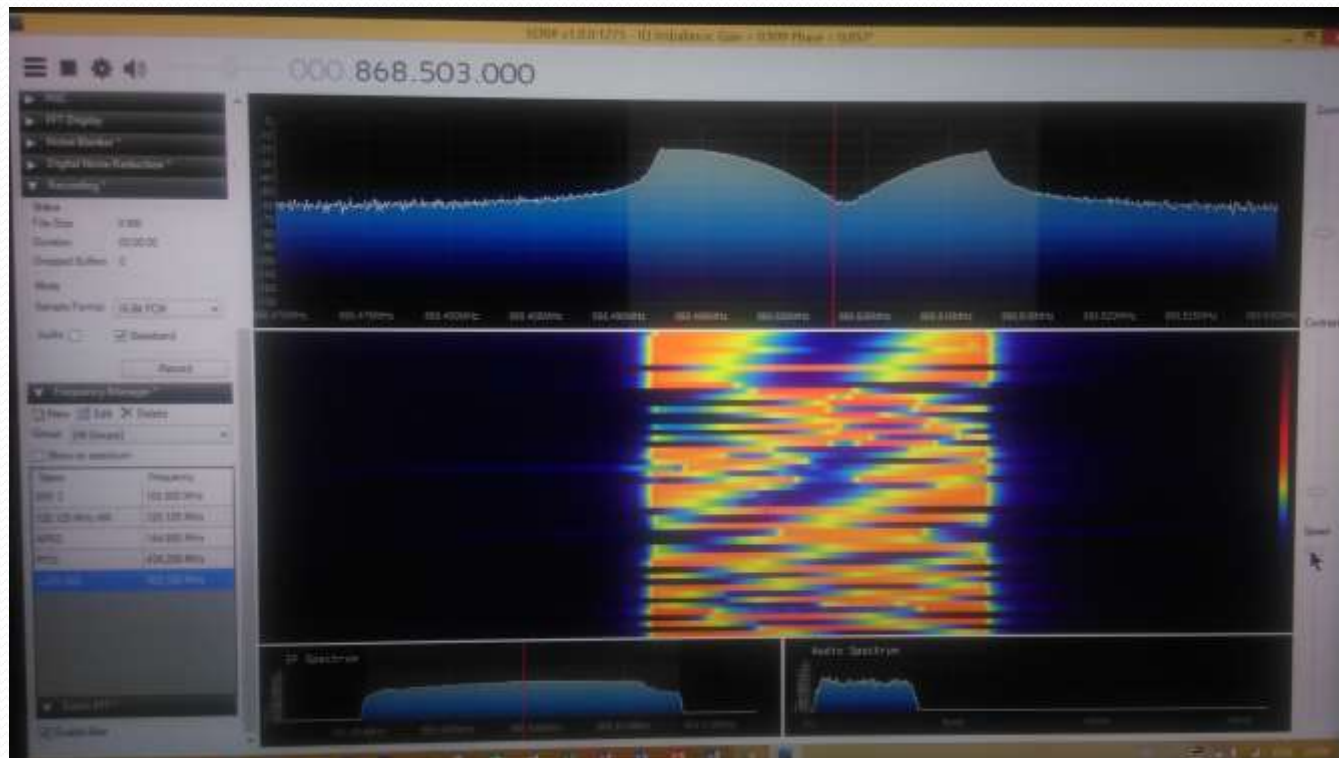
- LoRa Funktechnik
- LoRa Module (HW)
- Kommentare zu LoraWAN
- Demos/Ausstellungsobjekte

LoRa – Funkprotokoll Modulation



Modulation

RFS_L250	RF sensitivity, Long-Range Mode, highest LNA gain, LNA boost for higher bands, using split Rx/Tx path 250 kHz bandwidth	SF = 6	-	-115	-	dBm
		SF = 7	-	-120	-	dBm
		SF = 8	-	-123	-	dBm
		SF = 9	-	-125	-	dBm
		SF = 10	-	-128	-	dBm
		SF = 11	-	-130	-	dBm
		SF = 12	-	-133	-	dBm
		SF = 6		-111		dBm



Demo mit Pi-in-the Sky

Empfang mit Pi-Ballon SW

```
LoRa Habitat and SSDV Gateway by MORPI, MORJX - V1.8.6

Channel 1 868.505.3 MHz
Implicit, 20.80, SF6, EC4:5
Telemetry 69 bytes
  0.00000,  0.00000, 00000
SSDV PI9TSS: Image 13, Packet 58

Telem Packets = 14 (0s)
Image Packets = 13 (1s)
Bad CRC = 77 Bad Type = 1
Packet SNR = 7, RSSI = -49
Freq. Error =  0.1kHz AFC
Current RSSI = -43

17:51:21 Ch1: SSDV Packet, Callsign PI9TSS, Image 12, Packet 24
17:51:23 Ch1: $$pi9tss,333,00:00:00,0.00000,0.00000,00000,0,0,0,32.9,4.1,0.175*2438
17:51:24 Ch1: SSDV Packet, Callsign PI9TSS, Image 12, Packet 25
17:51:25 Ch1: $$pi9tss,334,00:00:00,0.00000,0.00000,00000,0,0,0,32.9,4.1,0.175*BBAF
17:51:27 Ch1: SSDV Packet, Callsign PI9TSS, Image 12, Packet 26
17:51:28 Ch1: $$pi9tss,335,00:00:00,0.00000,0.00000,00000,0,0,0,32.9,4.1,0.175*3453
17:51:29 Ch1: SSDV Packet, Callsign PI9TSS, Image 12, Packet 27
17:51:31 Ch1: $$pi9tss,336,00:00:00,0.00000,0.00000,00000,0,0,0,32.9,4.1,0.175*B476
17:51:32 Ch1: SSDV Packet, Callsign PI9TSS, Image 12, Packet 28
17:51:34 Ch1: $$pi9tss,337,00:00:00,0.00000,0.00000,00000,0,0,0,32.9,4.1,0.175*3B8A
17:51:35 Ch1: SSDV Packet, Callsign PI9TSS, Image 13, Packet 0
Started image 13
```

Rechtliches

<https://www.ofcomnet.ch/info.html?>

RIR	Frequenz	Leistung	DC	Bandbreite
1008-19	434.040-434.790	10mW	100%	25kHz
1008-05	433.050-434.790	10mW	10%	25kHz
1008-09	869.400-869.650	500mW	10%	25/250kHz
1008-10	869.700-870.000	5mW	100%	frei
1008-06	868.000-868.600	25mW	1%	frei
1008-21	865.000-868.000	25mW	1%	50kHz/FHSS
1008-27	869.700-870.000	25mW	1%	frei
1008-42	870.000-873.000	25mW	1%	600kHz

LoRa – Hardware



DORJI DRF1278DM is based on Semtech SX1278 LoRa 433MHz



Libelium LoRa is based on Semtech SX1272 LoRa 863-870 MHz for Europe



inAir9 based on SX1276



Froggy Factory LoRa module (Arduino)



HopeRF RFM series



HopeRF HM-TRLR-D



Link Labs Symphony module



IMST IM880A-L is based on Semtech SX1272 LoRa 863-870 MHz for Europe



Embit LoRa



LoRa™ Long-Range Sub-GHz Module (Part # RN2483)

Microship RN2483



Multi-Tech MultiConnect mDot



habSupplies



Adeunis ARF8030AA- Lo868



ARM-Nano N8 LoRa module from ATIM



SODAQ LoRaBee Embit

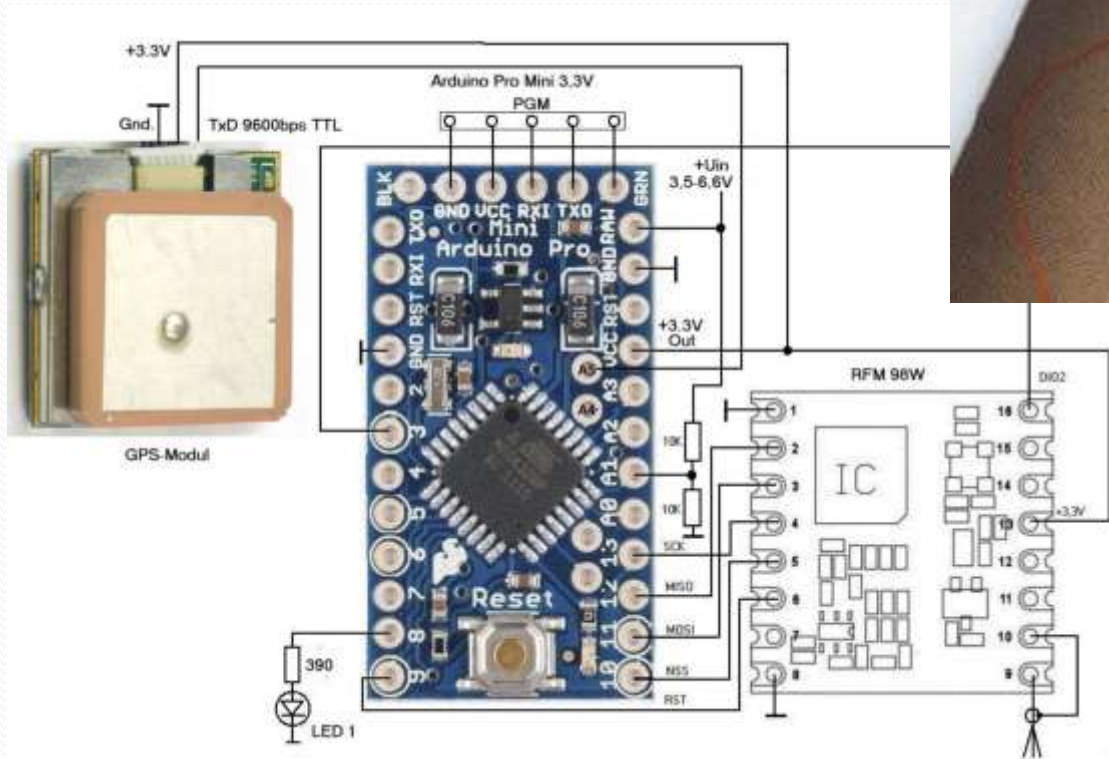


SODAQ LoRaBee RN2483



AMIHO AM093

Tracker



OSH Park
RFM95 Breakout Board

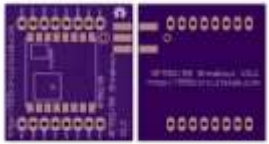
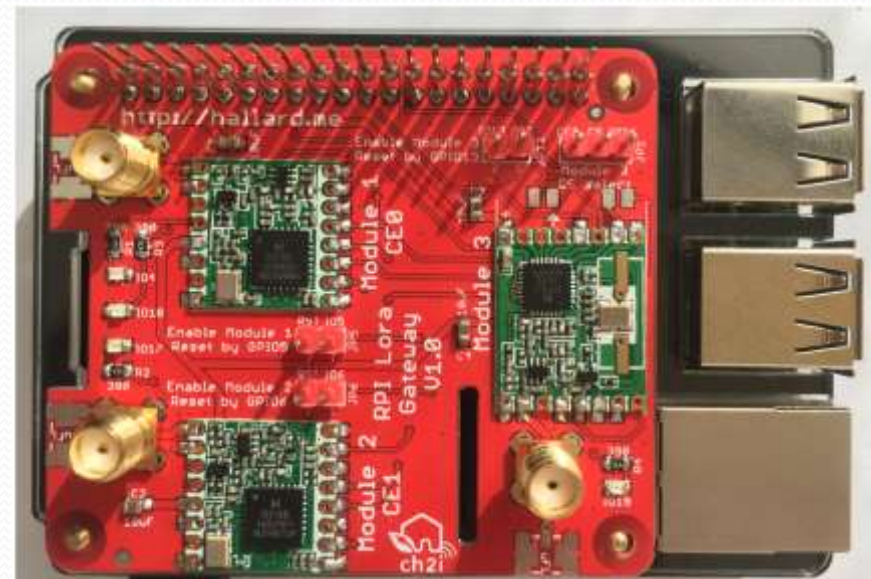
RFM95 Breakout Board

By [enduropraxis](#)

2 layer board of 1.14x1.32 inches (29.01x33.01 mm).
Shared on April 2nd, 2016 17:25.

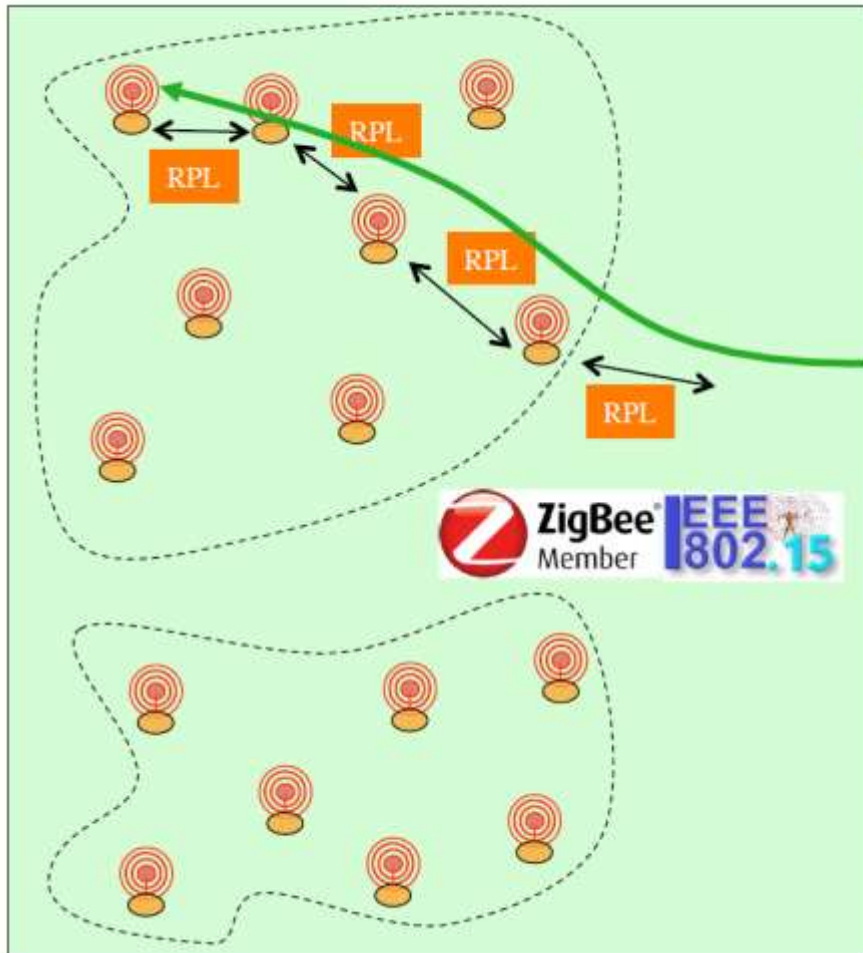
RFM95 Breakout Board V2.1

[Order board](#) [Download](#) [Permalink](#) [Embed order link](#)

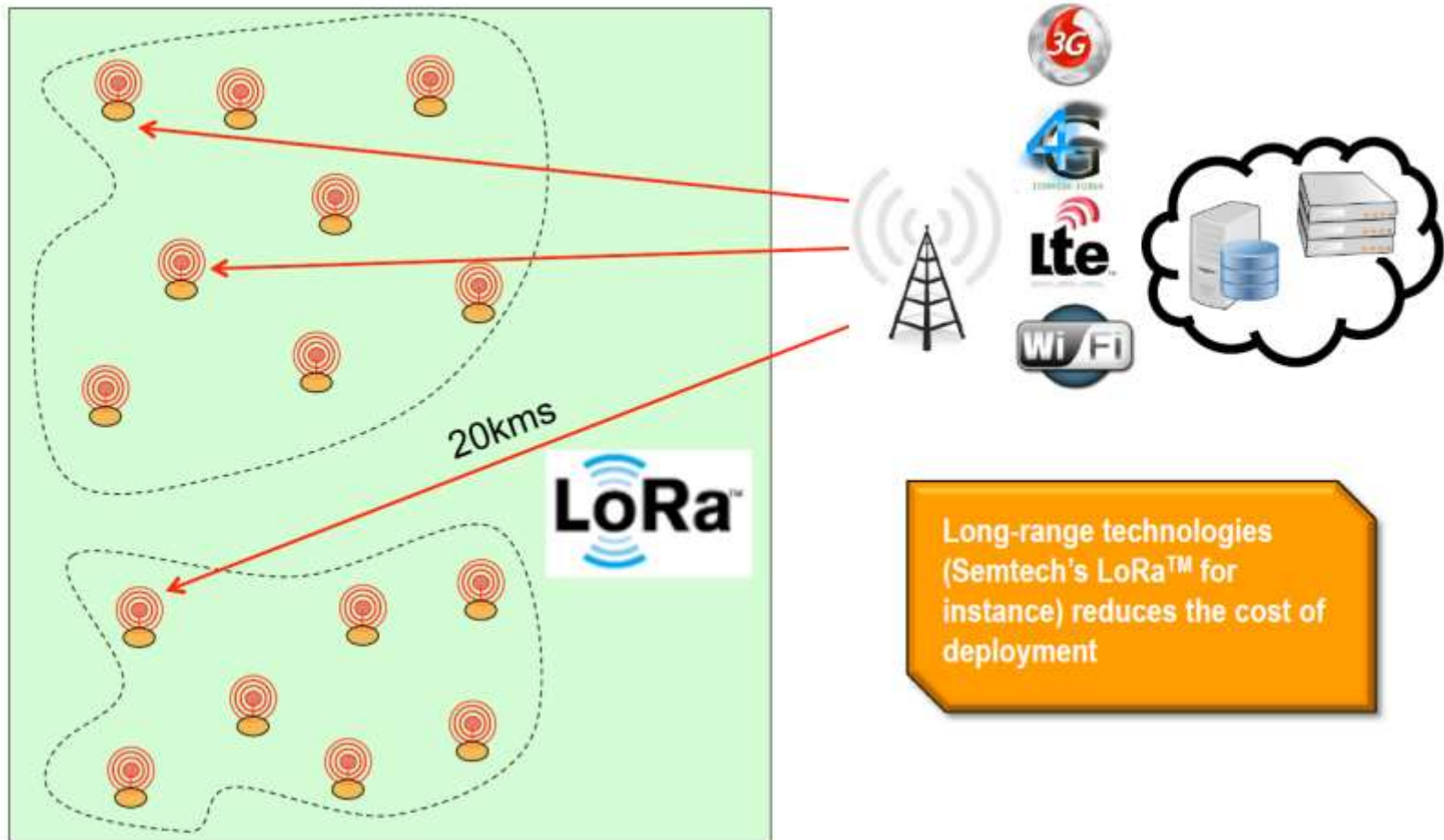
LoRa – LoRaWAN?

Bisher: viele Knoten



**TOO COMPLEX AND TOO
COSTLY TO DEPLOY AND
MAINTAIN INTERMEDIATE
NODES!**

LoRa: 1 Hop



LoRa-LoRaWAN Sender



Application

LoRa® MAC

MAC options

Class A
(Baseline)

Class B
(Baseline)

Class C
(Continuous)

LoRa® Modulation

Regional ISM band

EU 868

EU 433

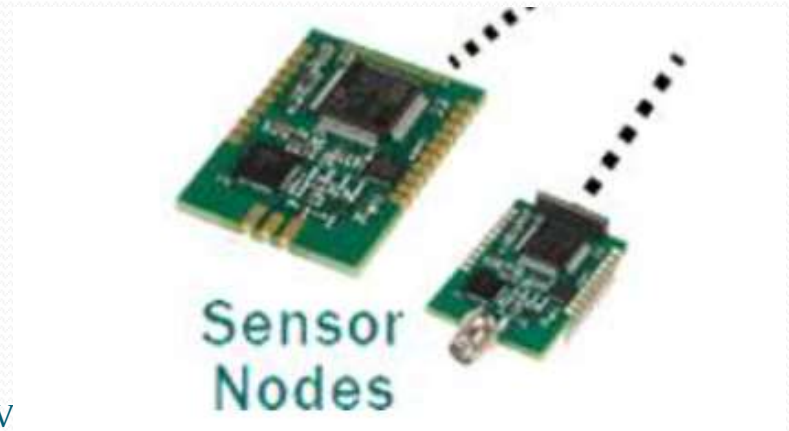
US 915

AS 430

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LoRaWAN Module Microchip



❑ EU 863-870MHz ISM Band

DataRate	Configuration	Indicative physical bit rate [bit/s]
0	LoRa: SF12 / 125 kHz	250
1	LoRa: SF11 / 125 kHz	440
2	LoRa: SF10 / 125 kHz	980
3	LoRa: SF9 / 125 kHz	1760
4	LoRa: SF8 / 125 kHz	3125
5	LoRa: SF7 / 125 kHz	5470
6	LoRa: SF7 / 250 kHz	11000
7	FSK: 50 kbps	50000
8..15	RFU	

Table 14: Data rate and TX power table

TXPower	Configuration
0	20 dBm (if supported)
1	14 dBm
2	11 dBm
3	8 dBm
4	5 dBm
5	2 dBm
6..15	RFU

❑ Minimum set

Modulation	Bandwidth [kHz]	Channel Frequency [MHz]	FSK Bitrate or LoRa DR / Bitrate	Nb Channels	Duty cycle
LoRa	125	868.10 868.30 868.50	DR0 to DR5 / 0.3-5 kbps	3	<1%

Table 12: EU863-870 default channels



LoRA GATEWAYS (NON EXHAUSTIVE LIST)



Multi-Tech Conduit



Embedded Planet
EP-M2M-LORA



Ideetron Lorank 8



LinkLabs Symphony



Kerlink IoT Station



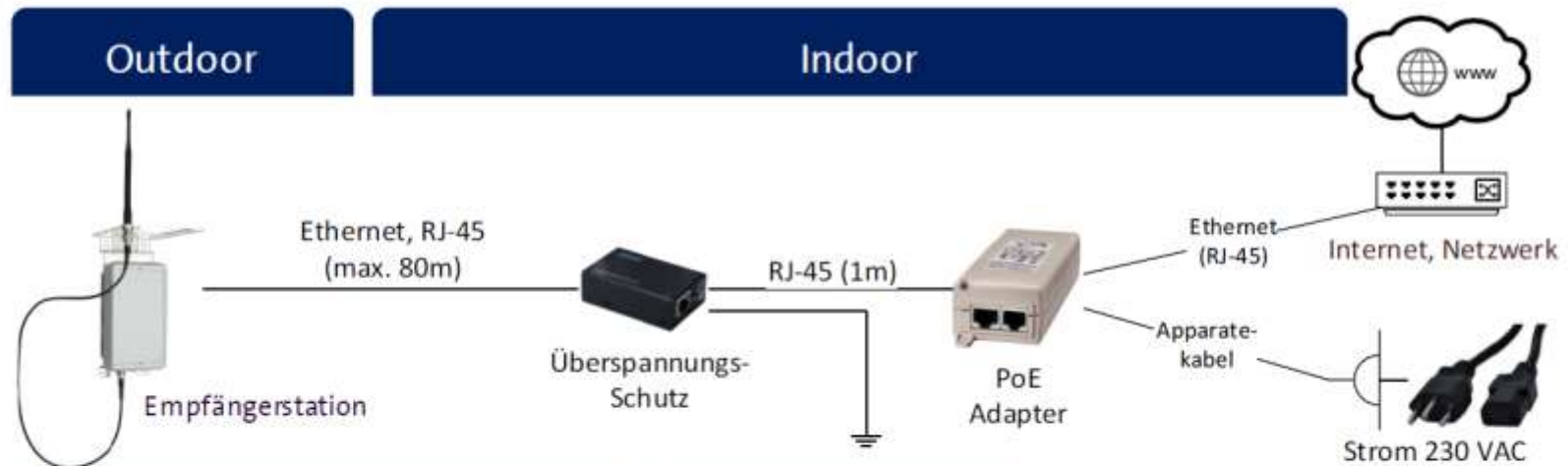
PicoWAN from
Archos



TheThingNetwork

Or build your own one:
Arduino, Raspberry PI, ...

LoRaWAN – LPN Swisscom



Parameter	Werte
Genutztes Frequenzband	ISM Band (868 MHz)
Maximale Sendeleistung	500 mW
Leistungsverbrauch	< 15 Watt
Abmessungen in mm (B x H x T)	210 x 310 x 170
Standard-Antenne in mm (Höhe)	210
Gewicht (komplett mit Mounting Kit)	ungefähr 2kg
Geräuschpegel	Geräuschlos (keine drehenden Teile)



LoRaWAN – LPN Swisscom

Physical Layer

Frequenz: ISM band (868MHz)

Modulation: CSS und FSK

Theoretisches Link budget

- RX: -142dBm
- TX: 14dBm

Daten Rate: 300bps-50kbps

Power Consumption

- Active 10mA RX / 32mA (14dBm) TX
- Sleep: <1uA

Class Name	Intended Usage
A («all»)	Battery powered sensors , or actuators with no latency constraint Most energy efficient communication class. Must be supported by all devices
B («beacon»)	Battery powered actuators Energy efficient communication class for latency controlled downlink. Based on slotted communication synchronized with a network beacon.
C («continuous»)	Mains powered actuators Devices which can afford to listen continuously. No latency for downlink communication.