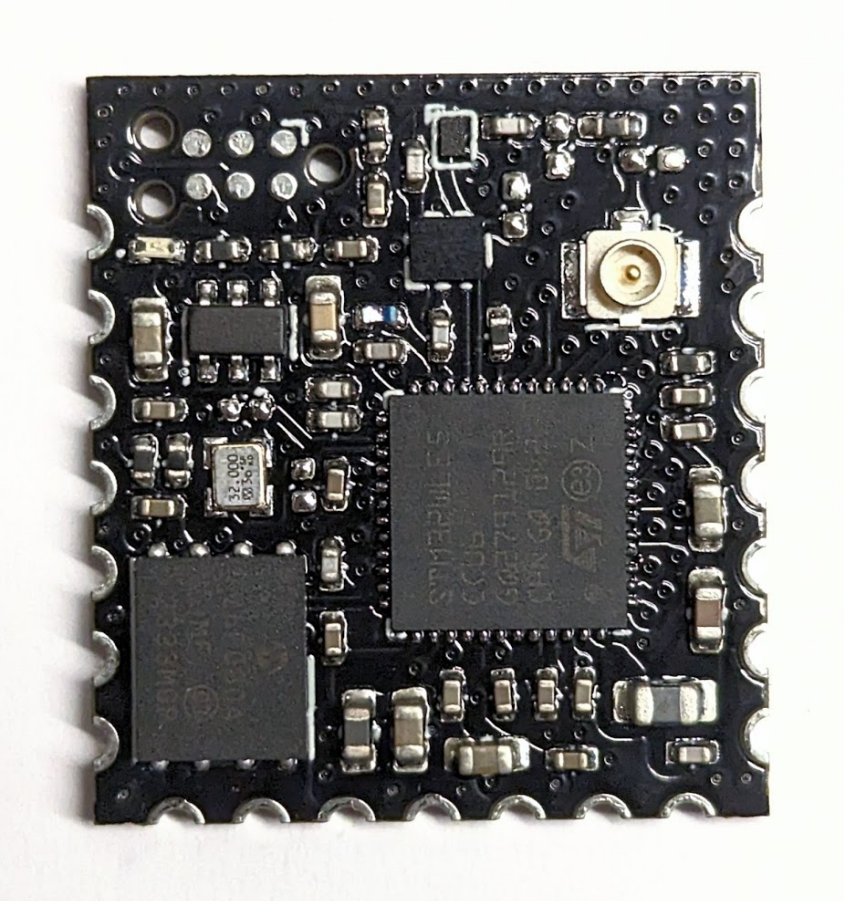
Sensor Network for Smart Agriculture

Jiří Maňák

June 4, 2024



Goals

Custom soil moisture sensor network

- Able to cover large–enough area
- Zero–maintenance, no external dependency
- Potentially expandable with more sensor types

Cover large–enough area with no external dependency

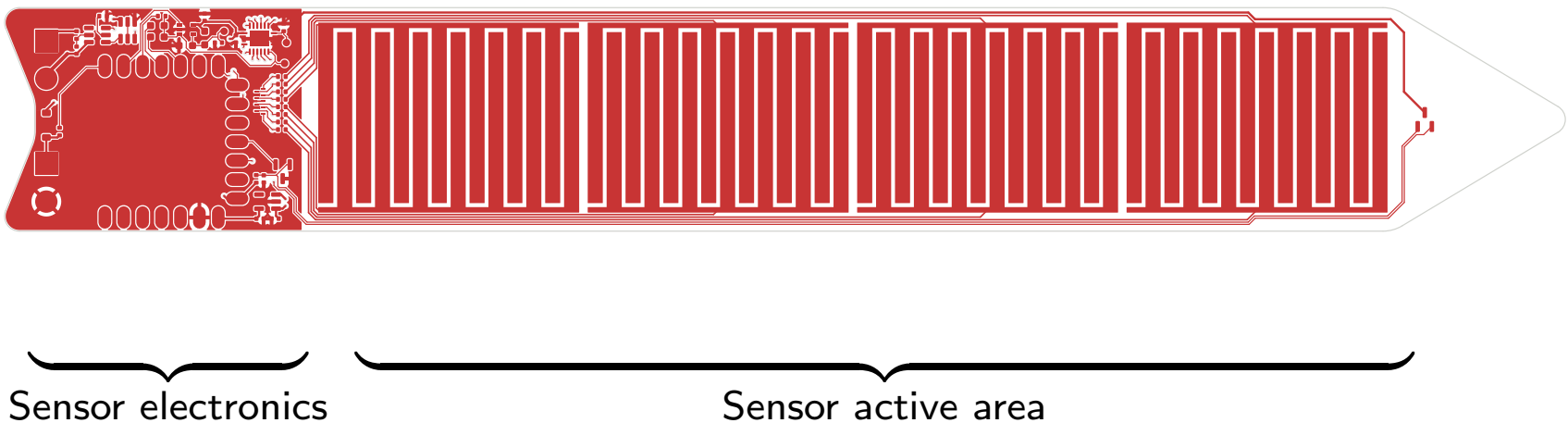
- LoRa
- Custom protocol

Zero–maintenance and expandable

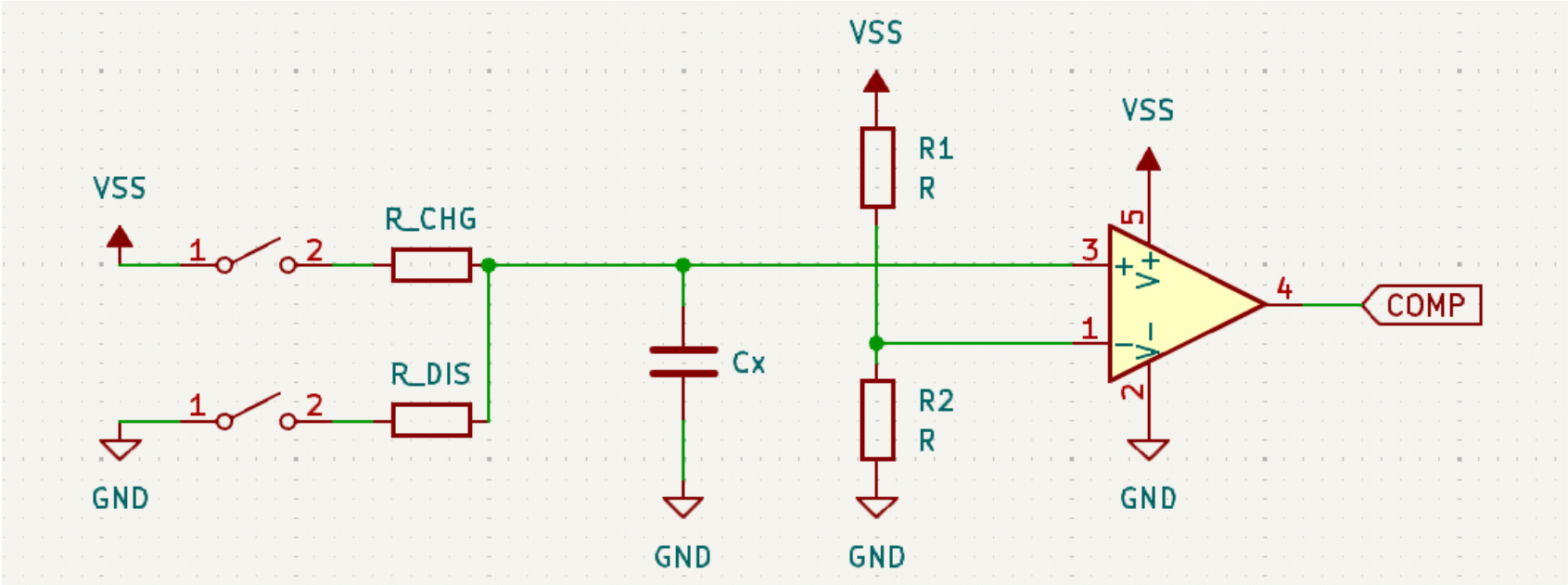
- Solar power
- OTA updates

Soil Moisture Sensor

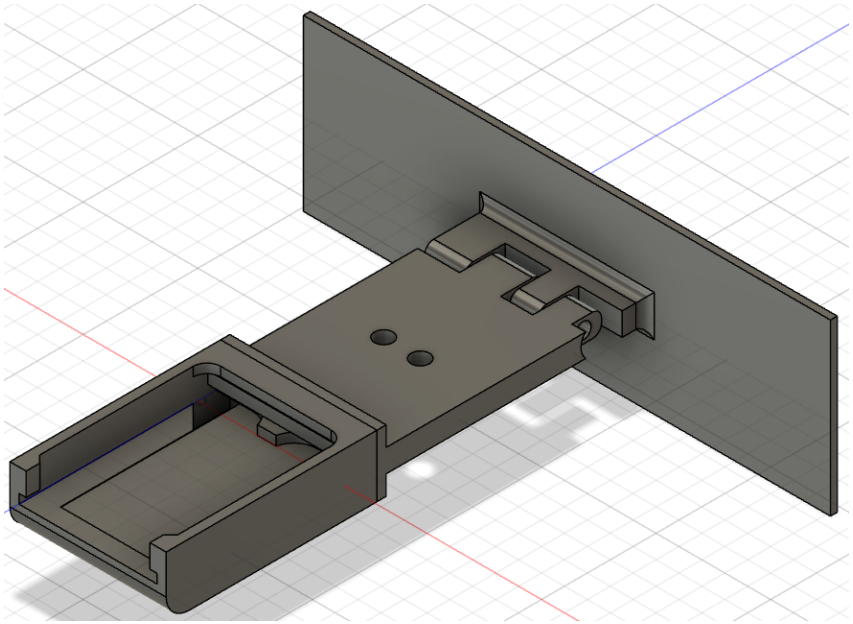
- PCB construction
- 4 capacitive zones (15 cm total depth)
- 330 mAh lithium cell, 150 mWp solar panel



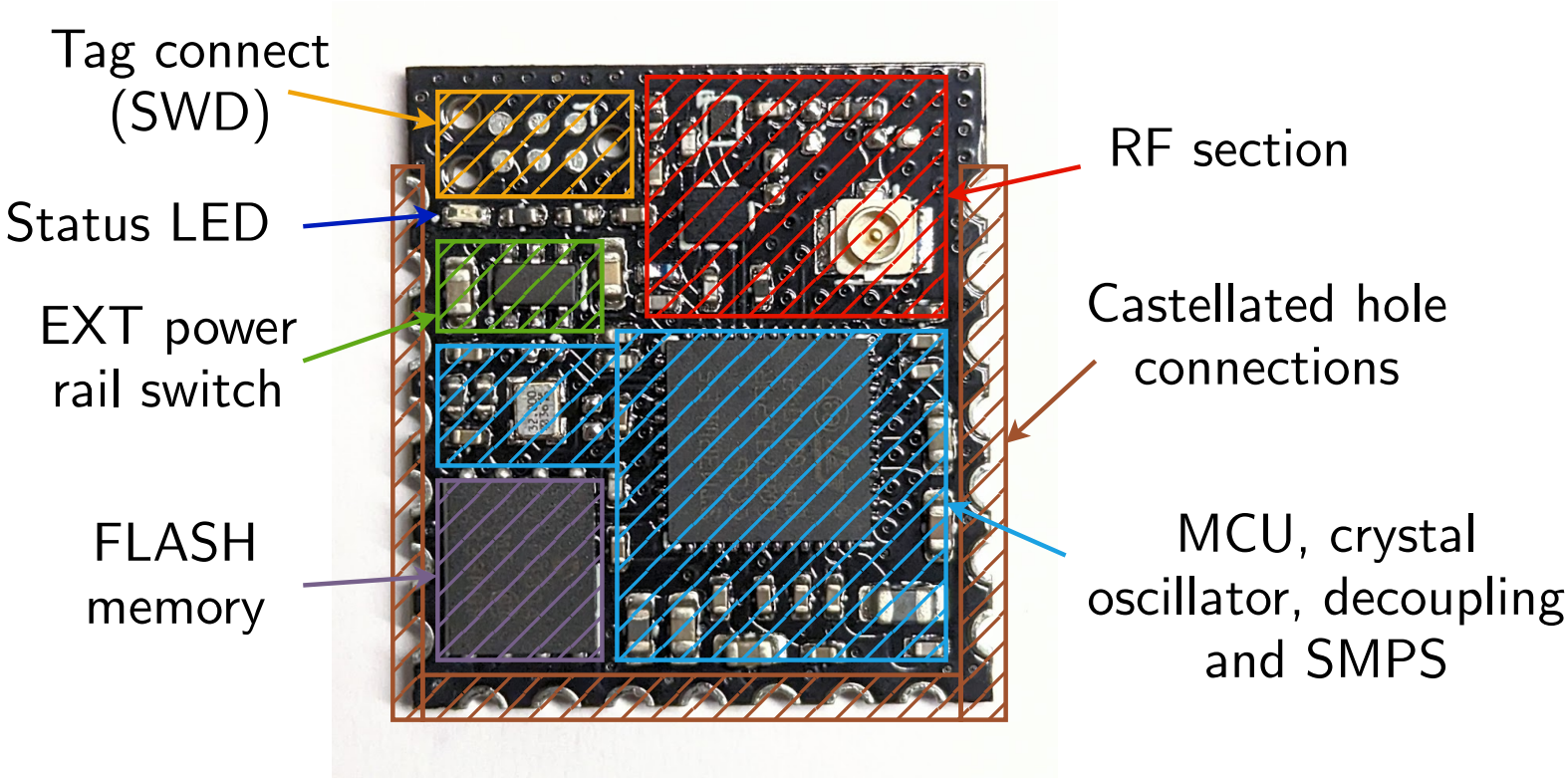
Soil Moisture Sensor



Soil Moisture Sensor

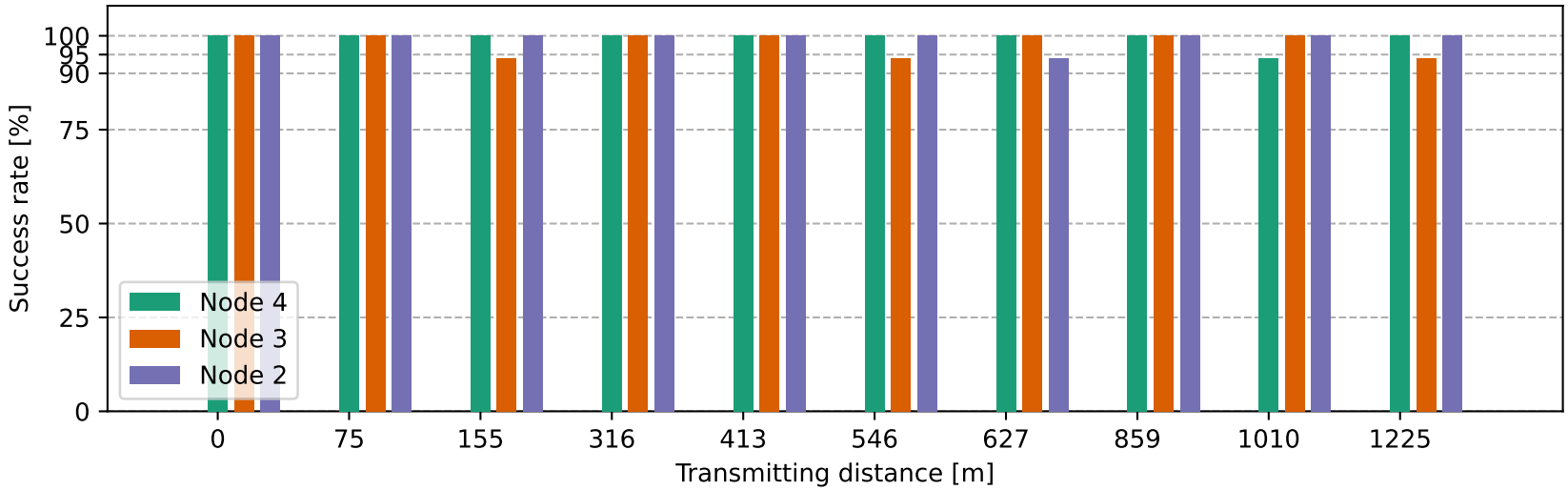


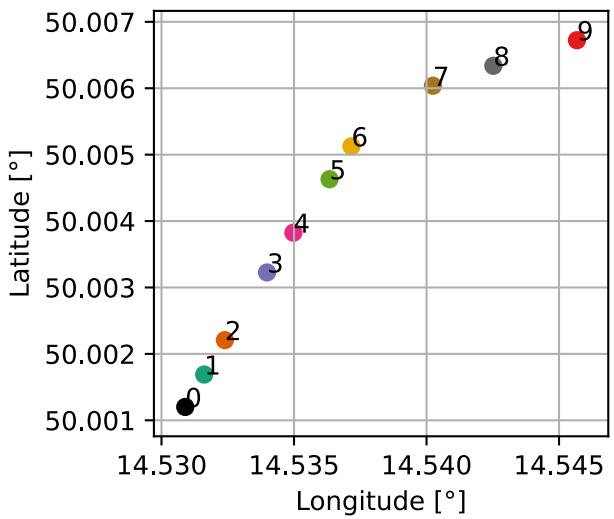
LoRa Module

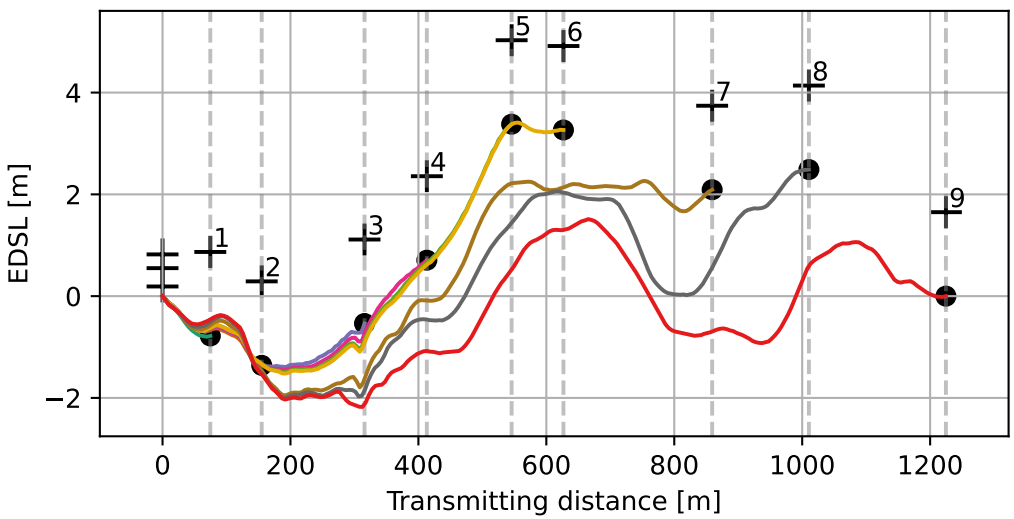


- **STM32WLE5CC**
- 868 MHz, 15 dBm
- **20.32×22.48 mm**
- 1 MB FLASH
- 2.3–3.5 V
- 16 IO pins

LoRa Module


Success rate [%]
100
95
90
75
50
25
0
Node 4
Node 3
Node 2
0
75
155
316
413
546
627
859
1010
1225
Transmitting distance [m]

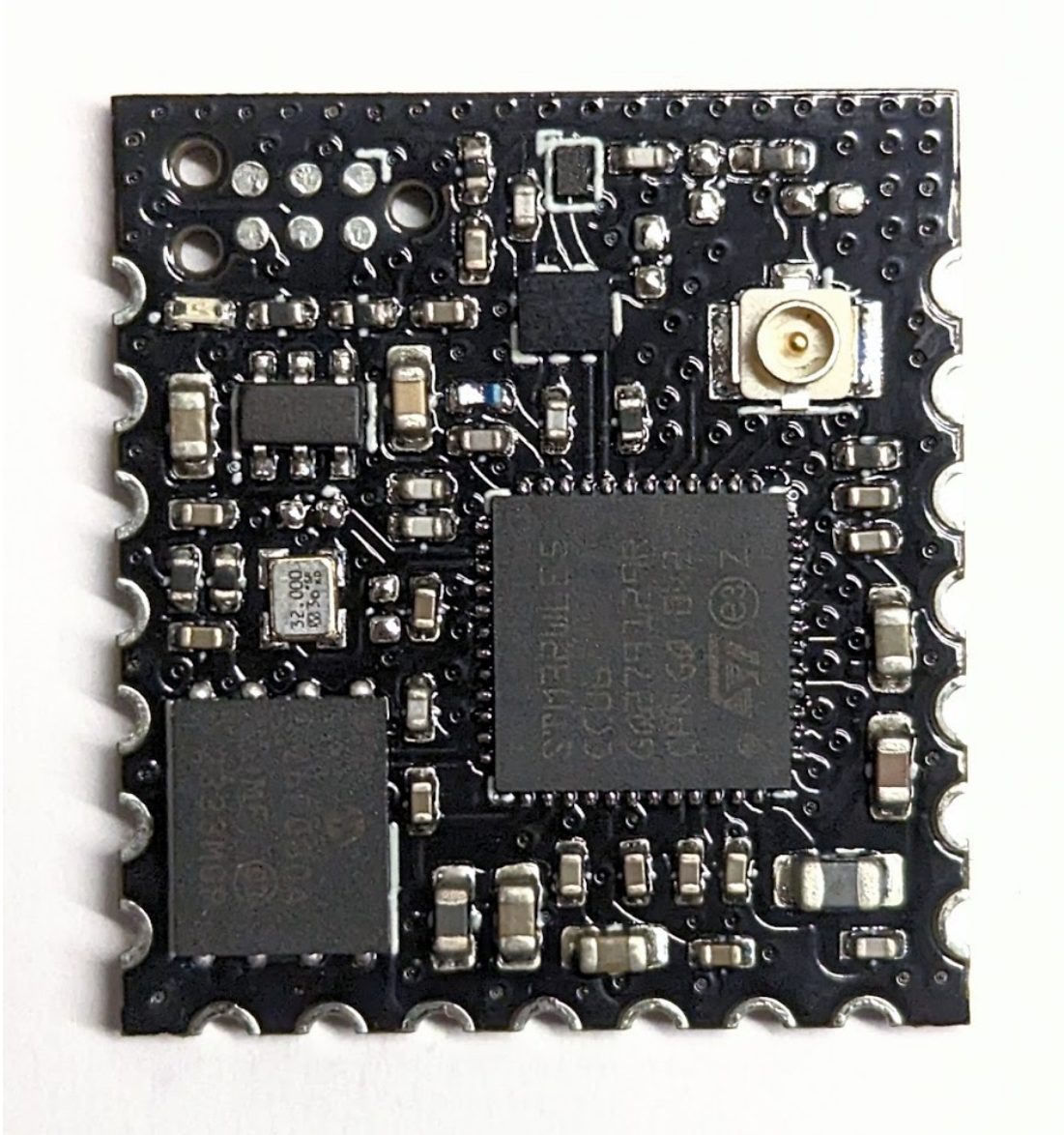

Latitude [°]
50.007
50.006
50.005
50.004
50.003
50.002
50.001
14.530
14.535
14.540
14.545
Longitude [°]


EDSL [m]
4
2
0
−2
0
200
400
600
800
1000
1200
Transmitting distance [m]

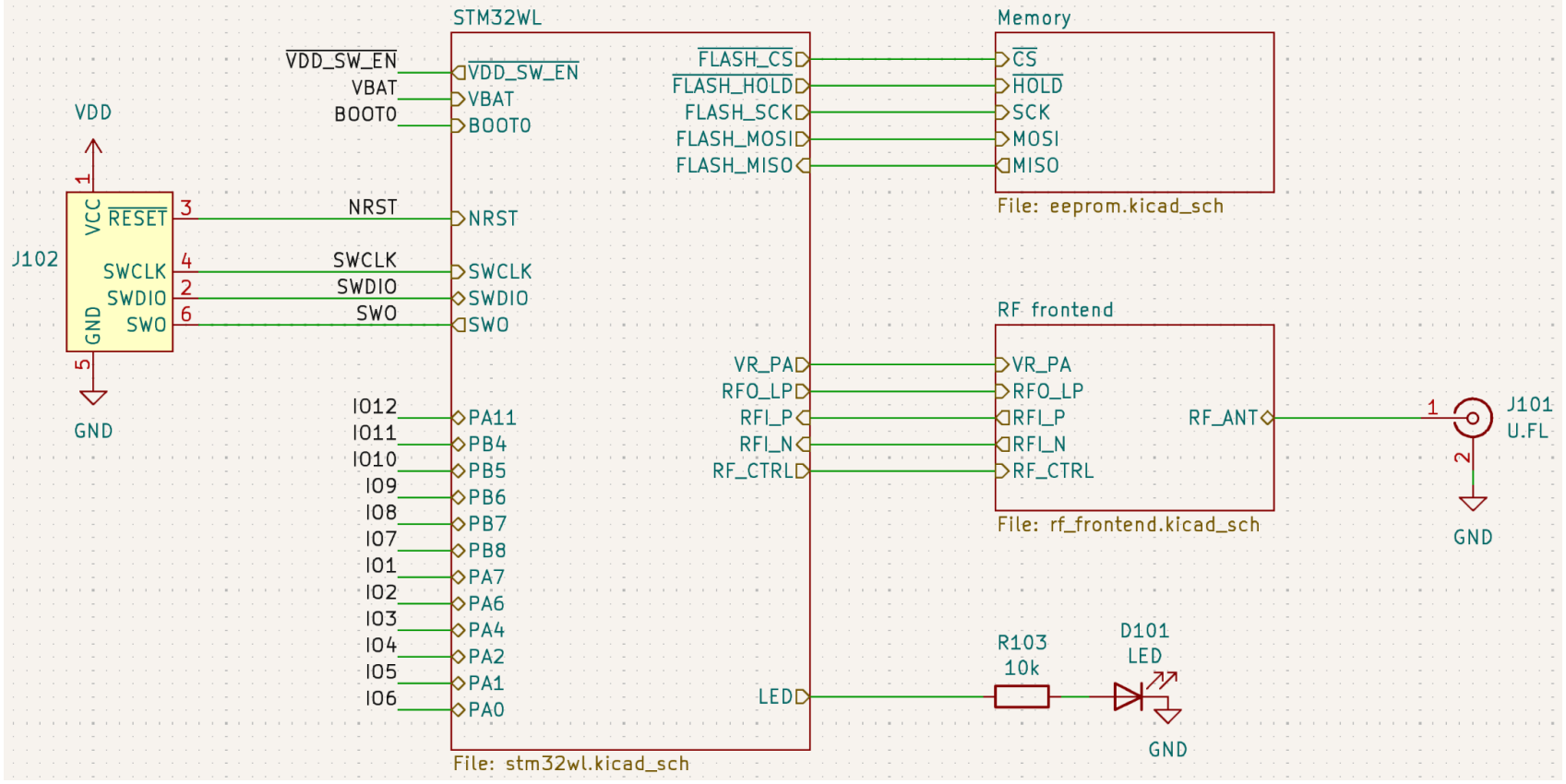
Live Demo

(or visit the link)

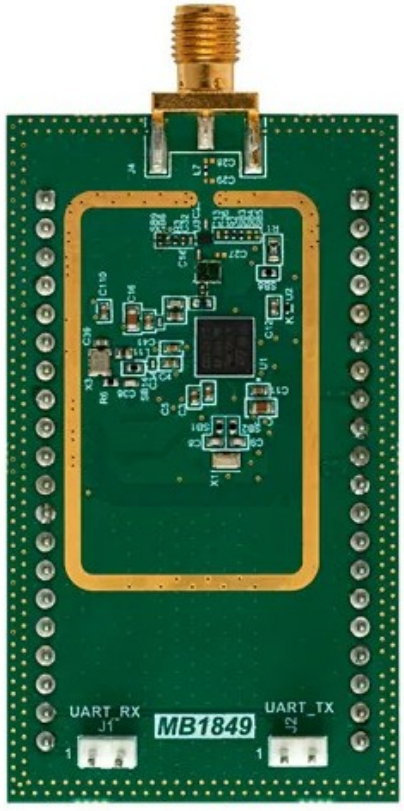
Motivation



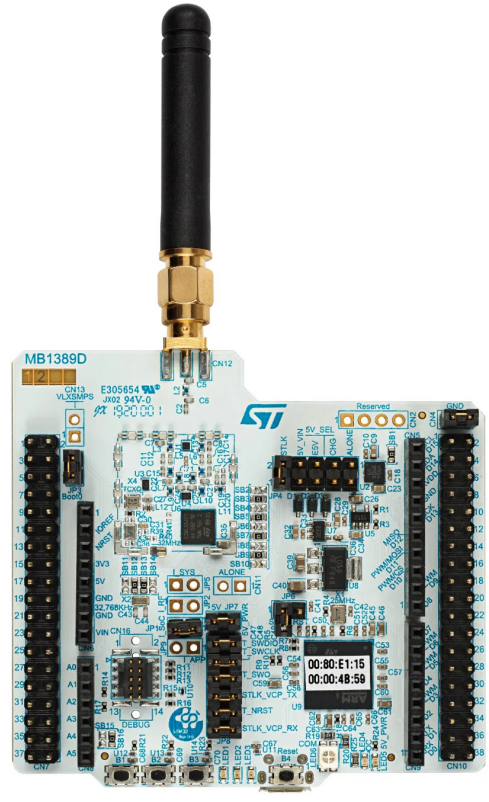
LoRa Module


STM32WL
Memory
VDD_SW_EN
VBAT
BOOT0
FLASH_CS
FLASH_HOLD
FLASH_SCK
FLASH_MOSI
FLASH_MISO
CS
HOLD
SCK
MOSI
MISO
File: eeprom.kicad_sch
VDD
J102
VCC
RESET
SWCLK
SWDIO
GND
SWO
NRST
SWCLK
SWDIO
SWO
RF frontend
VR_PA
RFO_LP
RFI_P
RFI_N
RF_CTRL
RF_ANT
J101
U.FL
GND
File: rf_frontend.kicad_sch
IO12
IO11
IO10
IO9
IO8
IO7
IO1
IO2
IO3
IO4
IO5
IO6
PA11
PB4
PB5
PB6
PB7
PB8
PA7
PA6
PA4
PA2
PA1
PA0
LED
R103
10k
D101
LED
GND
File: stm32wl.kicad_sch

LoRa Module

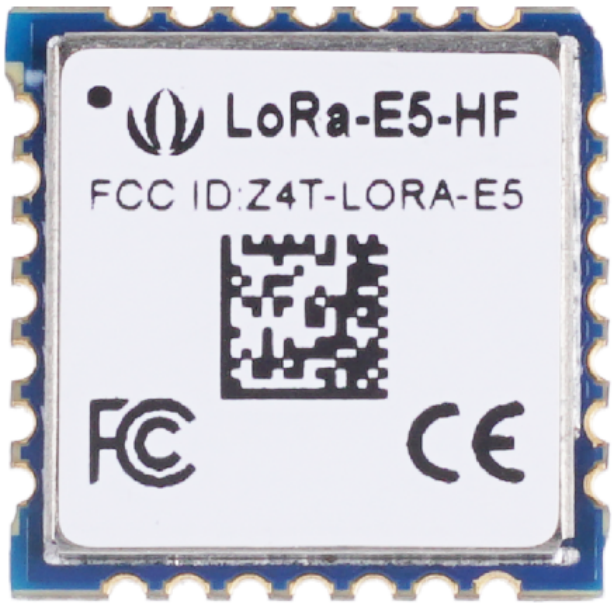


STDES-WL5U4ILH



Nucleo-WL55JC

Existing solution?

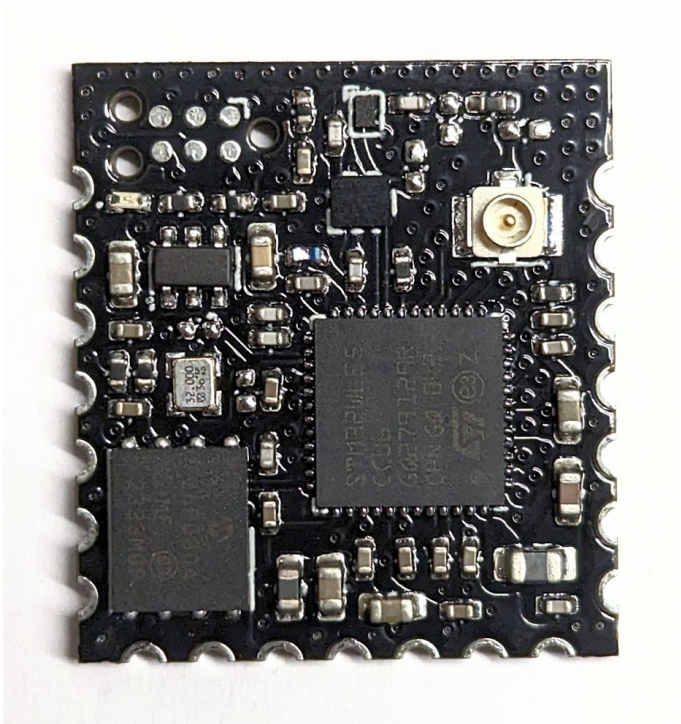


Seeed Studio Wio-E5

$>$

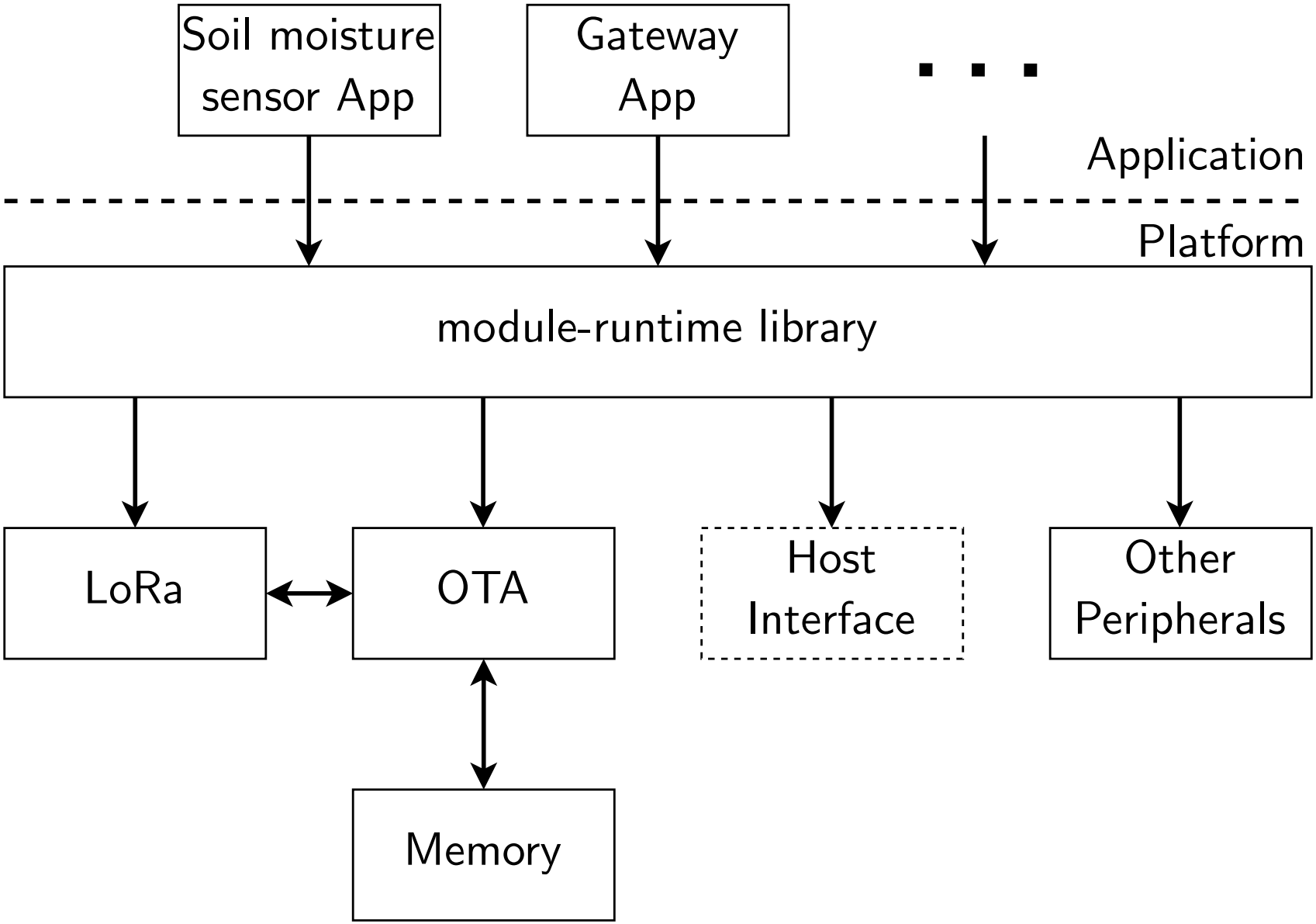
?

$<$

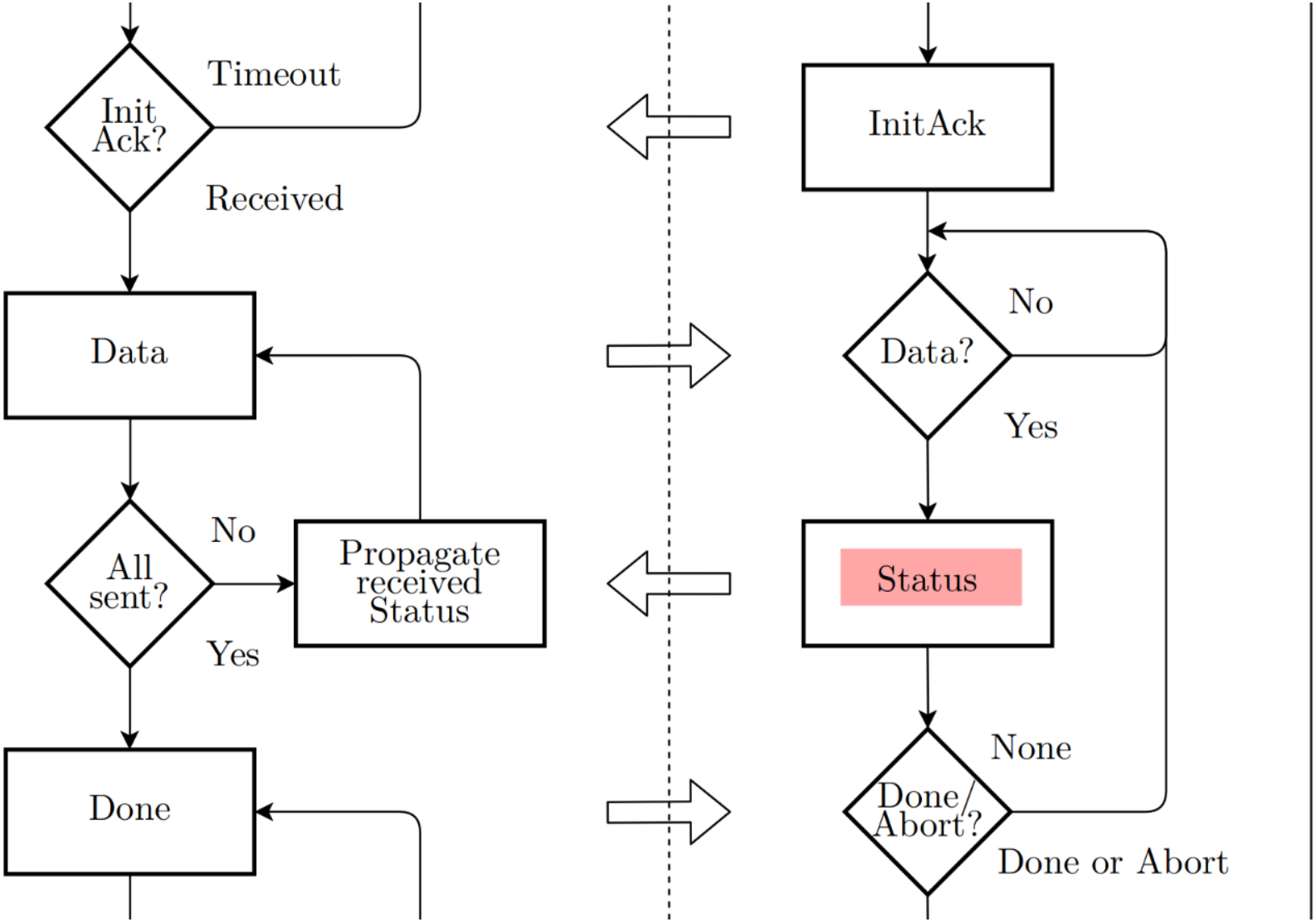


My LoRa Module

Firmware


Soil moisture sensor App
Gateway App
Application
Platform
module-runtime library
LoRa
OTA
Host Interface
Other Peripherals
Memory

Over The Air Update



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Soil Moisture Sensor

LoRa Module

- 2.8–3.3 V nominal voltage range,
- low power design - support for switchable power rails,
- target the EU868,
- wide temperature range
- minimize the amount of specialized hardware,
- support for OTA updates,
- integrated RF,
- host communication interface,
- minimal footprint,
- low cost.

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