JFWM2025 @ ANNECY, FRANCE 16 – 24 SEPT
JAPANESE FRENCH WEEK ON MECHATRONICS
メカトロニクスの日本フランス週間

Lecture and tutorial:

"IoT modules and its tutorial by using ~~SBC~~ MCU"

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Professor, Deputy Director

AMERI
University of Hyogo
Himeji, JAPAN

Contents

- Introduce myself
- Overview of IoT/MEMS
- Instruction for IoT tutorial

University of Hyogo

Graduate School of Engineering

Hyogo prefecture

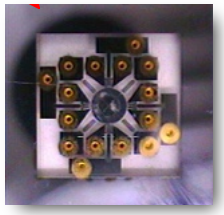
Sapporo
Aomori
Akita
Morioka
Sendai
Niigata
Fukushima
Nagano
Utsunomiya
Tokyo
Nagoya
Chiba
Shizuoka
Tottori
Osaka
Hiroshima
Tsu
Fukuoka
Matsuyama
Saga
Oita
Nagasaki
Kumamoto
Kagoshima
Miyazaki

Himeji castle

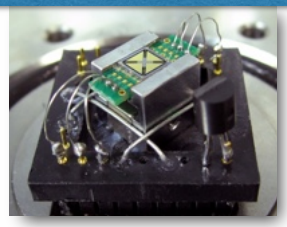
Kobe Beef

My research history

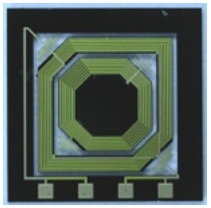
- MEMS physical sensors W
  - Gyroscope
  - Accelerometers
- MEMS actuators
  - Mirror device
  - PID control system
- Environmental sensor
  - Multi sensor module for health monitoring



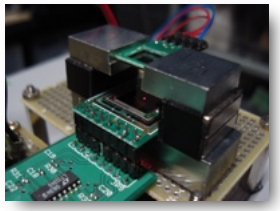
2D gyroscope



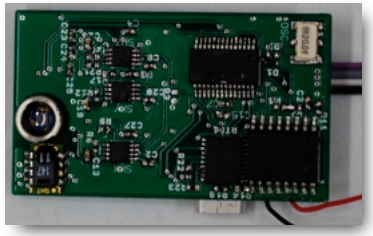
Vibratory beam accelerometer



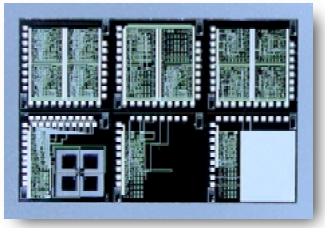
Electromagnetic MEMS mirror



Mirror control system



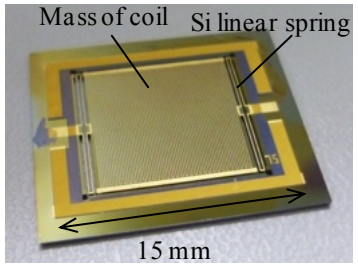
Multi-sensor module

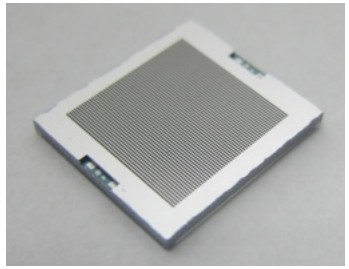


Environmental sensor

Recently, working on

- **Vibration MEMS energy harvester**
- **IoT systems for Medical applications**





Vibration energy harvester

Clean room facilities for MEMS

CleanRoom for MEMS

- Operated & managed by
  - 3 faculties
  - 1 technician
  - ~20 students

- **Full MEMS fabrication process on site**
  - Photomask fabrication, photolithography
  - Deep-RIE, dry etching, wet etching
  - Metallization, Magnetic/PZT film sputtering
  - Electroplating, Polymer-flexible electronics

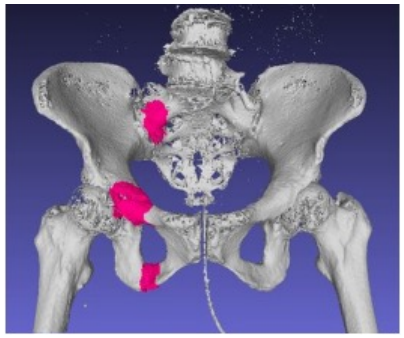
AMERI, U-Hyogo

Move to New institute
open Apr. 2022

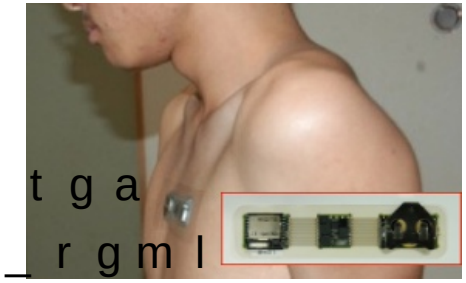
Advanced **M**edical **E**ngineering
Research **I**nstitute,
University of Hyogo

In the 2nd largest prefectural hospital in Hyogo

Research Topics of AMERI



Healthcare and rehabilitation Eng.



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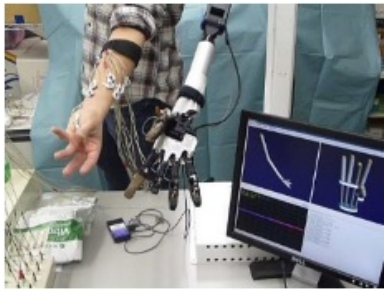

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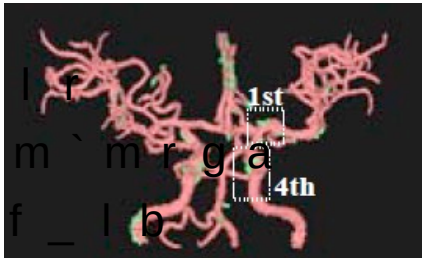

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AI related topic from AMERI will be presented on Monday's Keynote talk

Contents

- Introduce myself
- **Overview of IoT/MEMS**
- Instruction for IoT tutorial

IoT (Internet of Things)

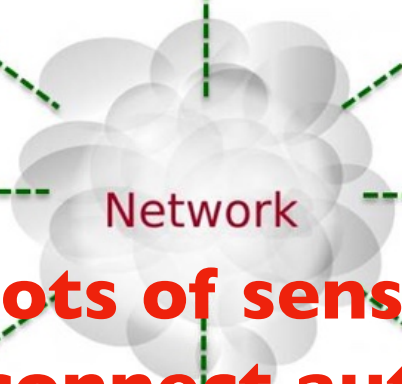
Human uses the Internet

Smartphone, Tablet, PC

G m

Internet connection for everything not limited to Human operated device

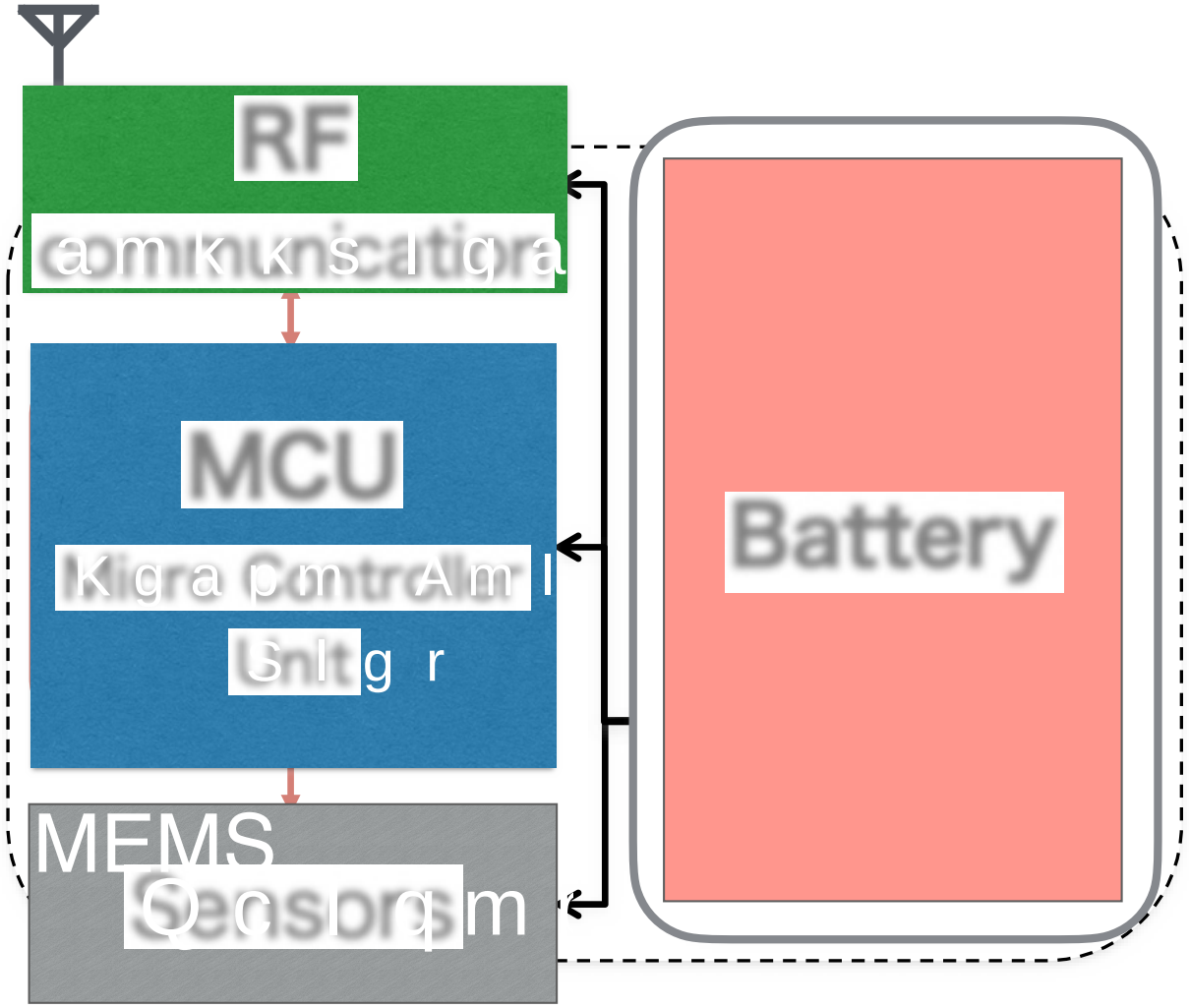
IoMT



Lots of sensors connect autonomously

IoT node architecture

Typical architecture of IoT node



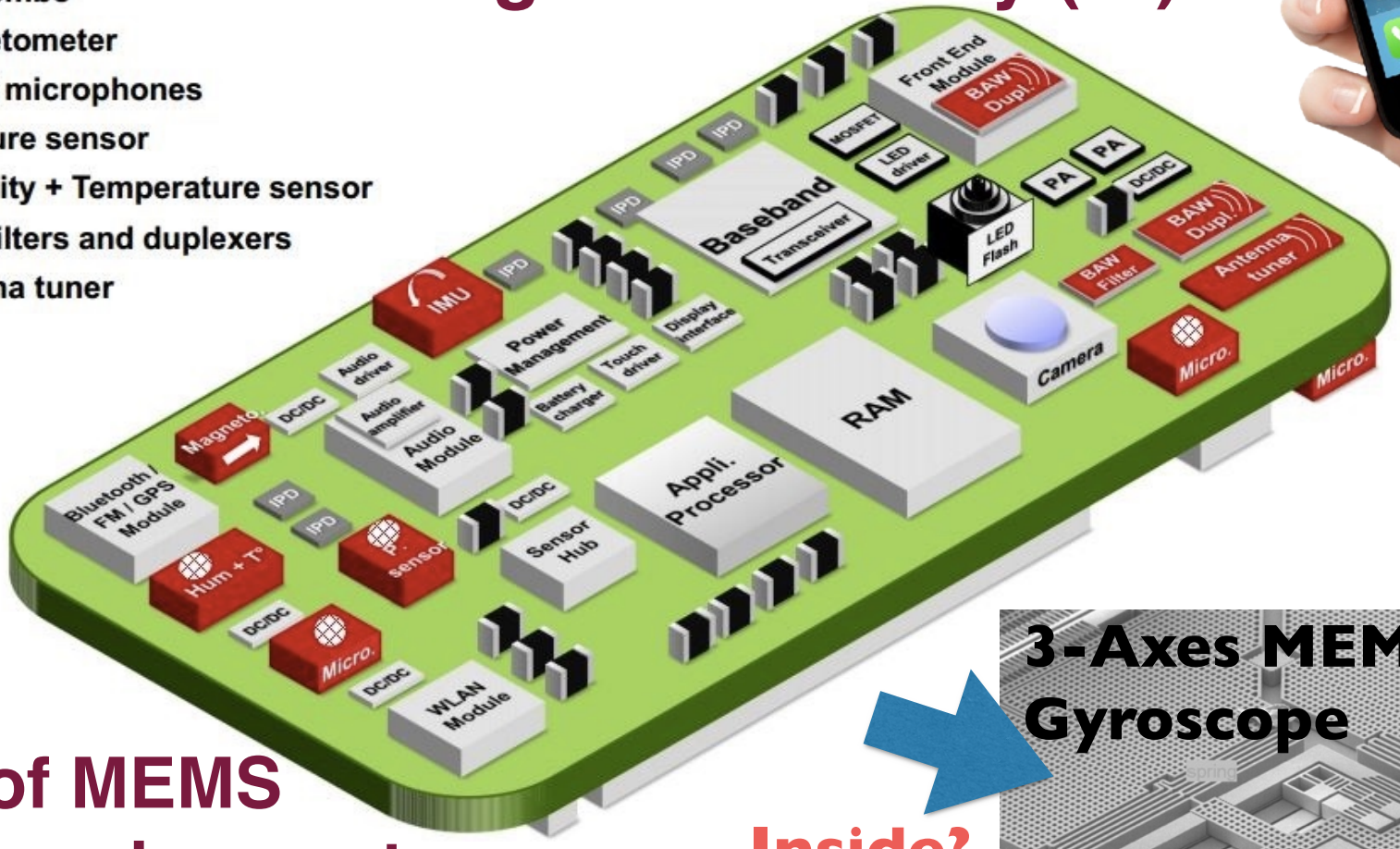
Architecture of a sensor node

IoT has developed dramatically thanks to **MEMS**

MEMS - Micro Electromechanical Systems

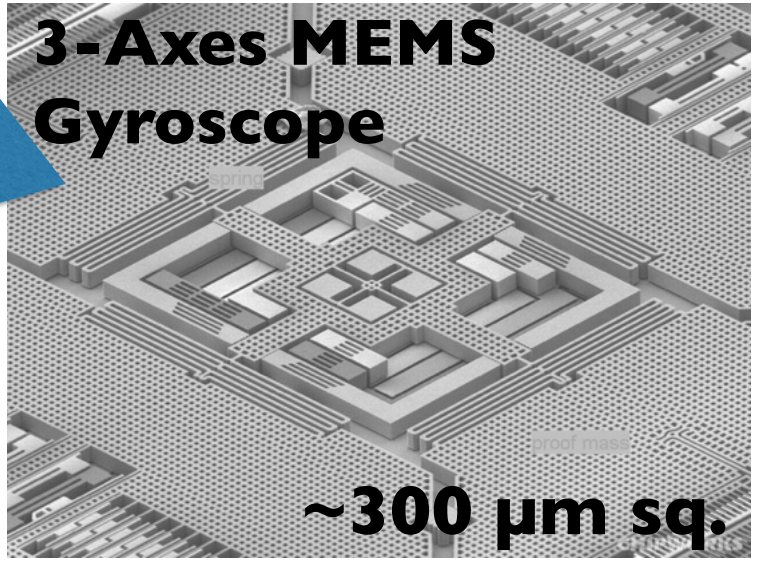
MEMS = Fusion of ultra small machine and Integrated Circuity (IC)

- IMU combo
- Magnetometer
- MEMS microphones
- Pressure sensor
- Humidity + Temperature sensor
- BAW filters and duplexers
- Antenna tuner



Full of MEMS sensors in smart phone

Inside?



at least <u>5 MEMS sensors</u>

History of MEMS application

Automotive

13 wpq

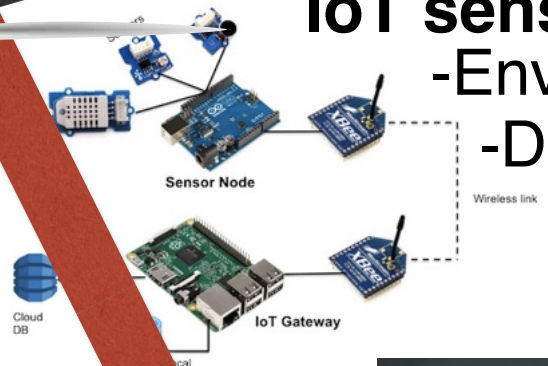
-**Airbag** control
-Electronic stability control
-Rollover detection
-Navigation (GPS support)

Performance & Number ↑
Size & Cost ↓

Mobilephone / Entertainment

-Input device
-Navigation

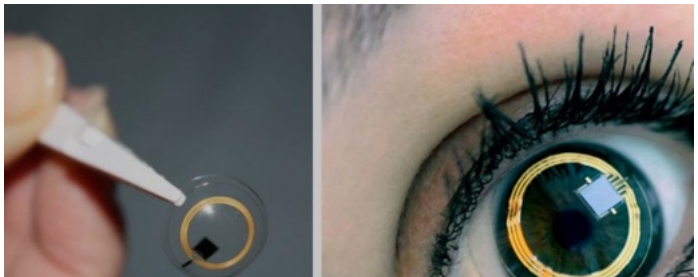
IoT sensor node



-Environmental sensing
-Drones

Health

-Medical devices

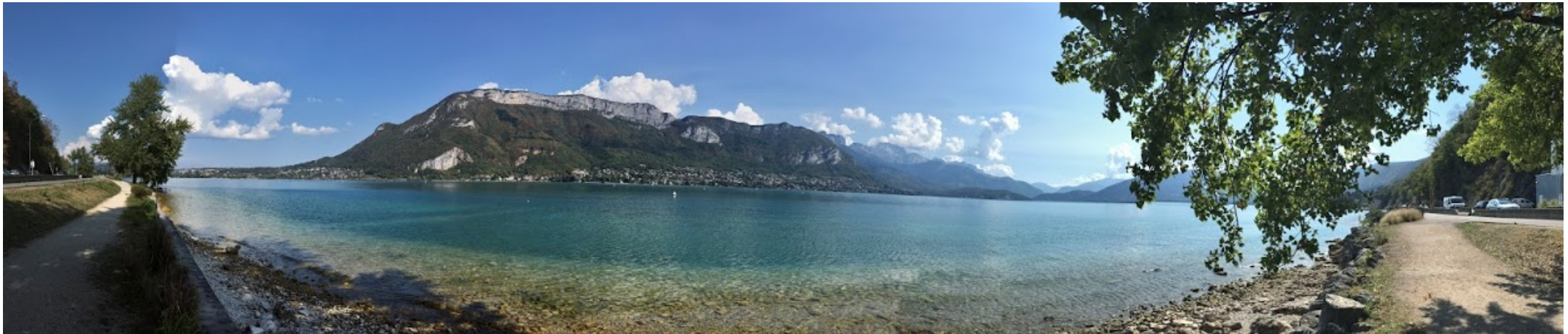


MEMS application > Navigation

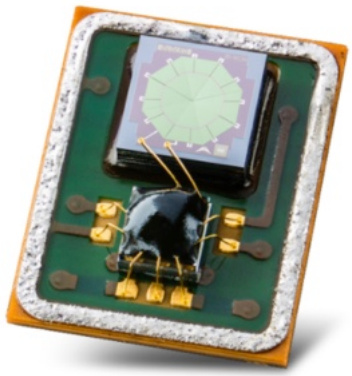
Tracking: Cycling around the Lac d'Annecy

Position tracking by combined sensor info.

- **GPS** ⛔
- Celler
- WiFi
- Geomagnetic
- **Gyroscope**
  - **Angular velocity ∫ Angle**
- **Accelerometer**
  - **Acceleration ∫ Velocity ∫ Position**



MEMS device 1: Microphone



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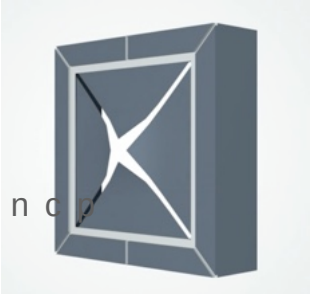

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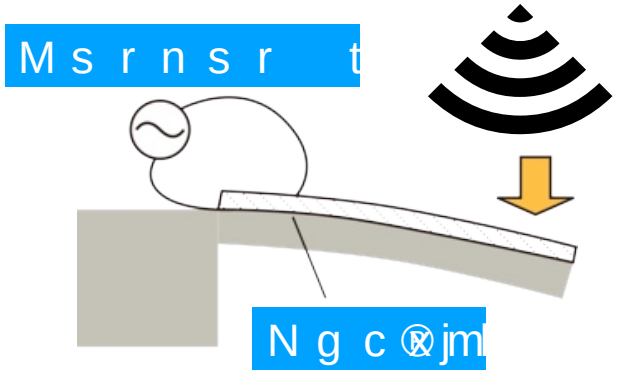

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MEMS device 2: Apple watch etc.

Activity tracking for health care

Similar technology

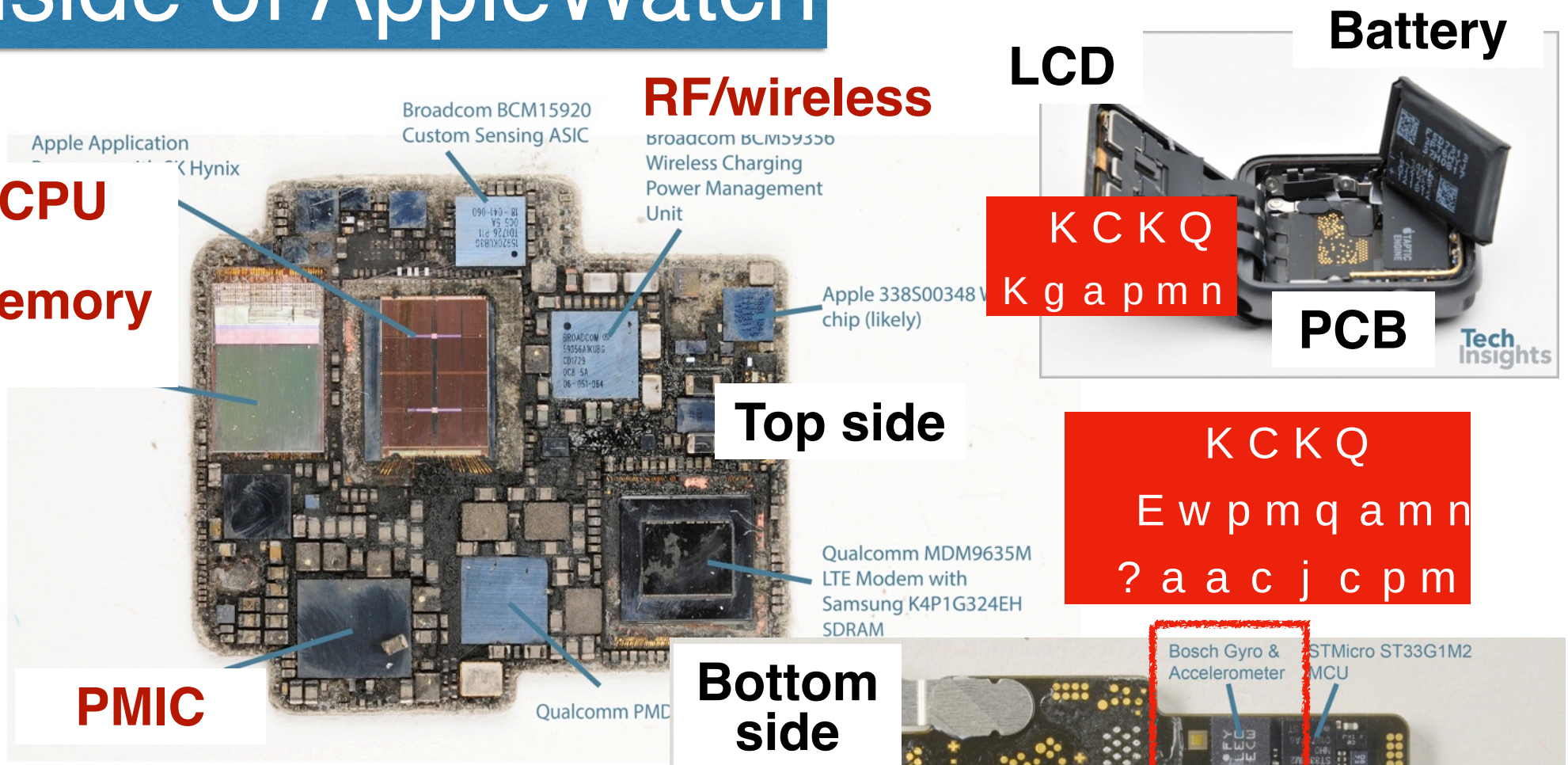
RF, MCU, battery
&
MEMS sensors
Acc. Gyro,

Optical sensor
For SPO_2, heart rate

Various devices of "healthy gadgets"

Inside of AppleWatch

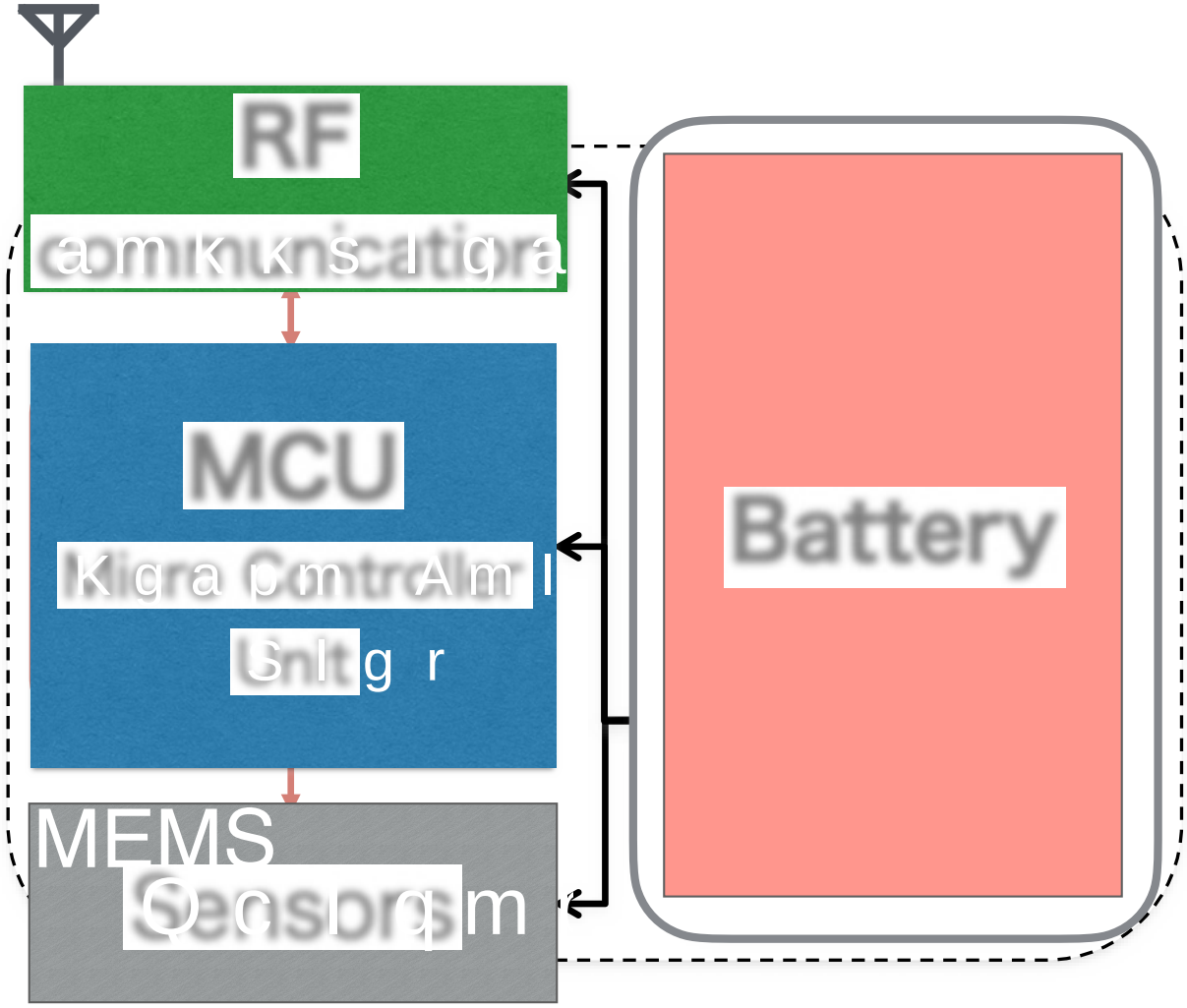
&A' RcafGlqgefrq



AppleWatch 3rd gen.

IoT node architecture

Typical architecture of IoT node



Architecture of a sensor node

- NEXT

  Explains the internal details of IoT applications in the market

IoT on market : IoT Body scale

¥20,000
(USD 150)
worth the price

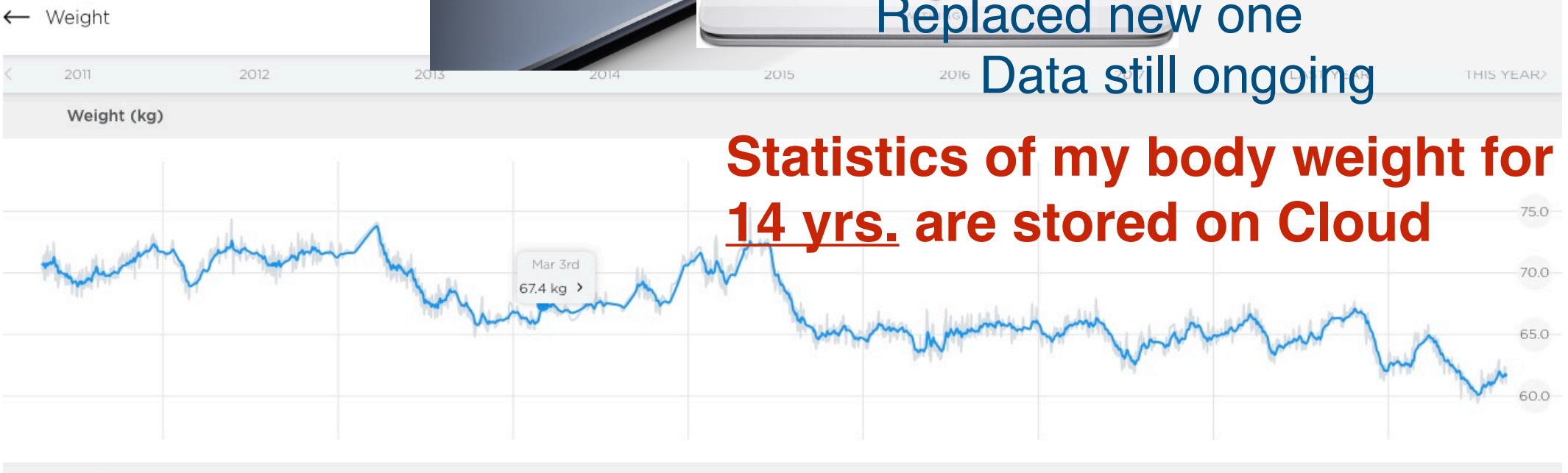
Withings

Made in France

- **WiFi connection**
- **No switch, Easy to use**
- **Automatically data upload**

Replaced new one

Data still ongoing



Statistics of my body weight for 14 yrs. are stored on Cloud

Inside of Withings IoT scale

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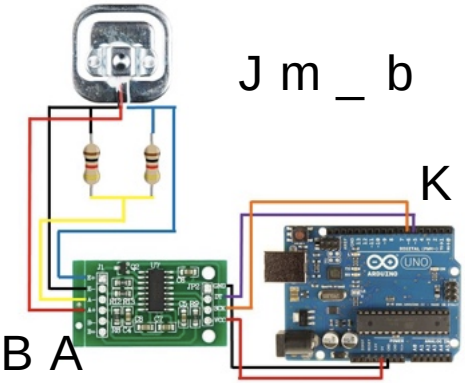

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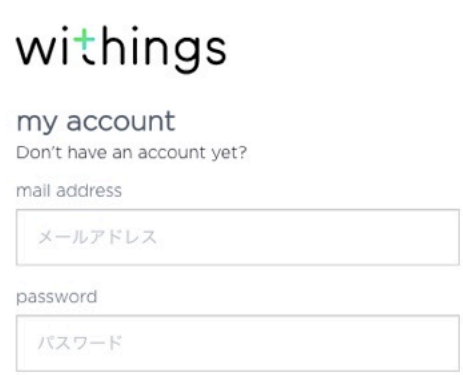

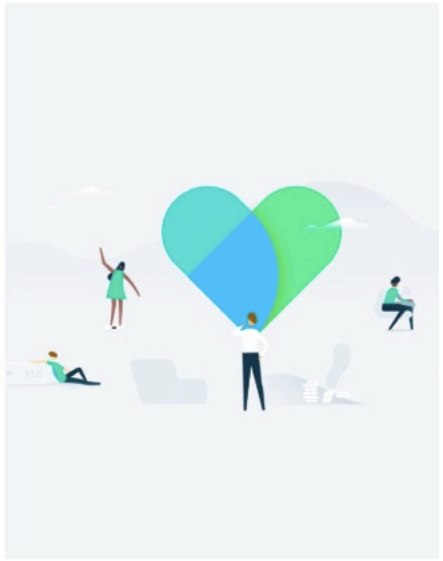

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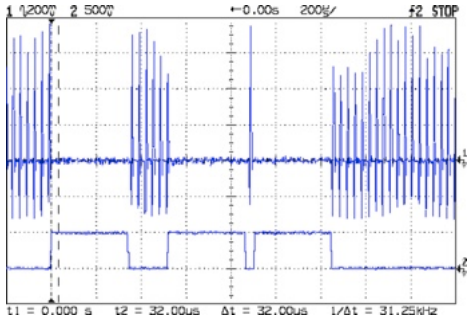

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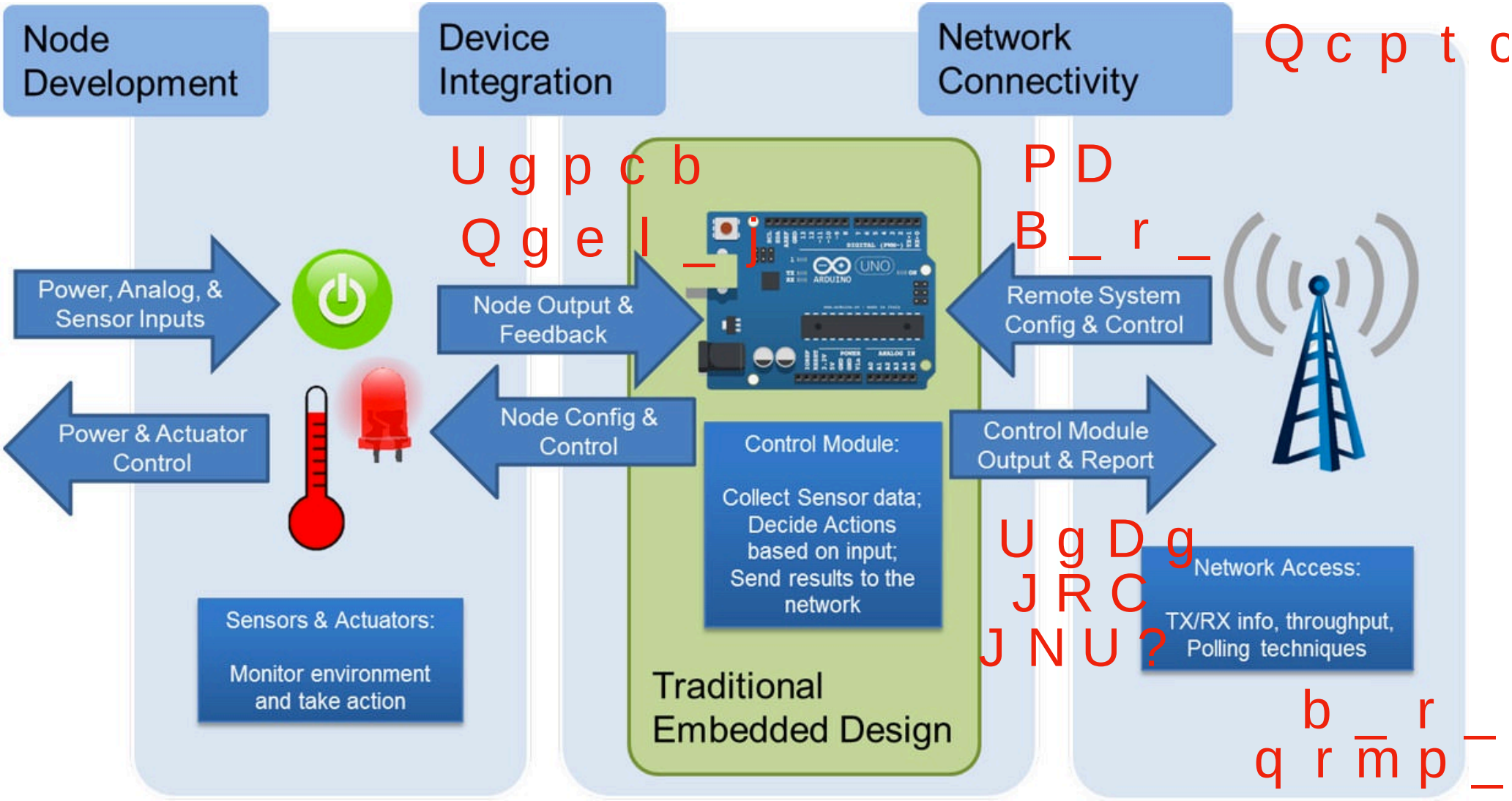
Typical configuration IoT



NEXT

Temperature measurement (primitive method)

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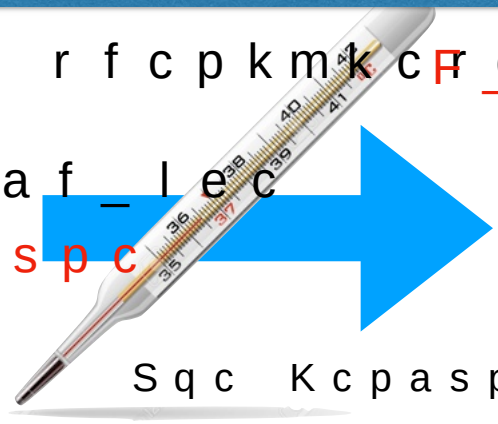

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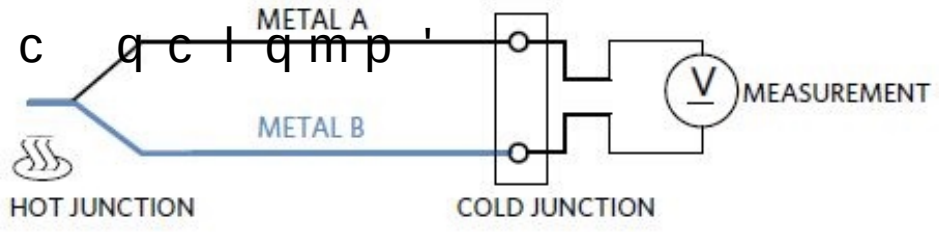

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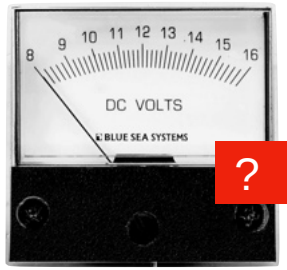

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Temperature measurement (w/ ADC)

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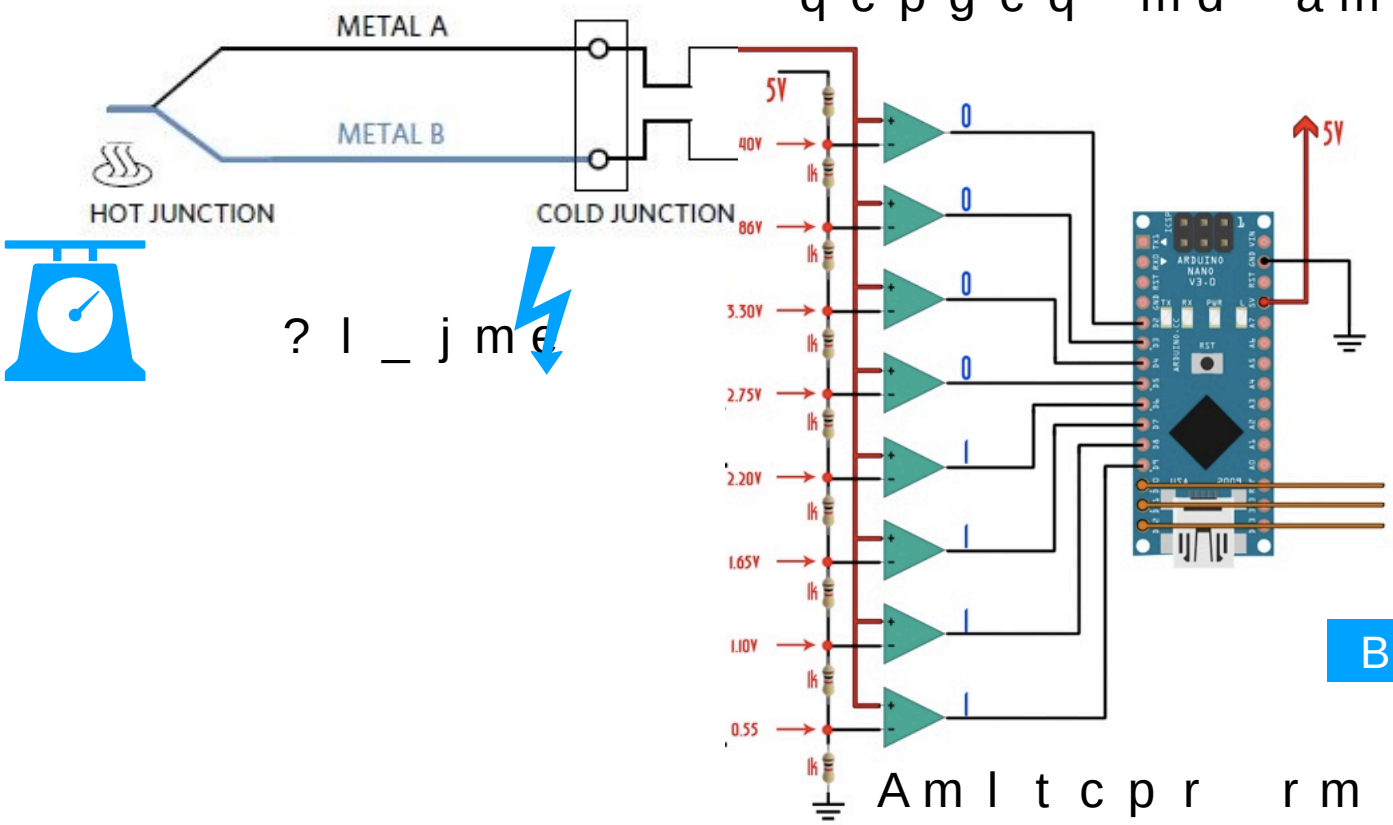

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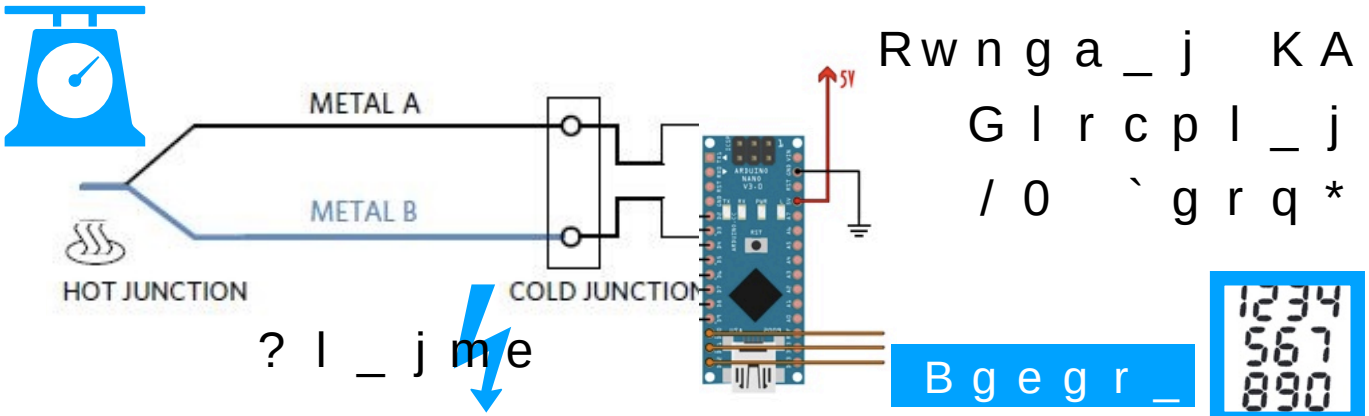

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Recent digital output MEMS sensor

BOSCH
Invented for life

@KC06.
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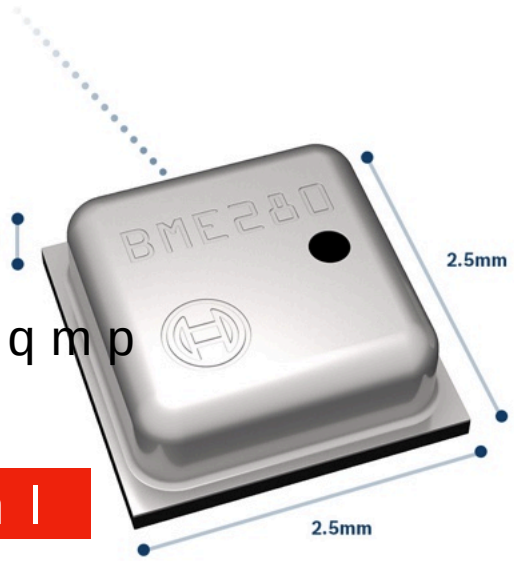

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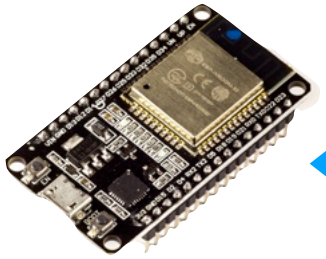
Main features

Relative Humidity
Measures relative humidity with a fast response time

Pressure
Measures barometric pressure and altitude

Temperature
Measures ambient temperature



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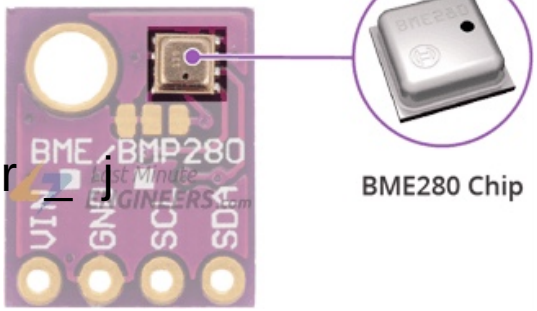

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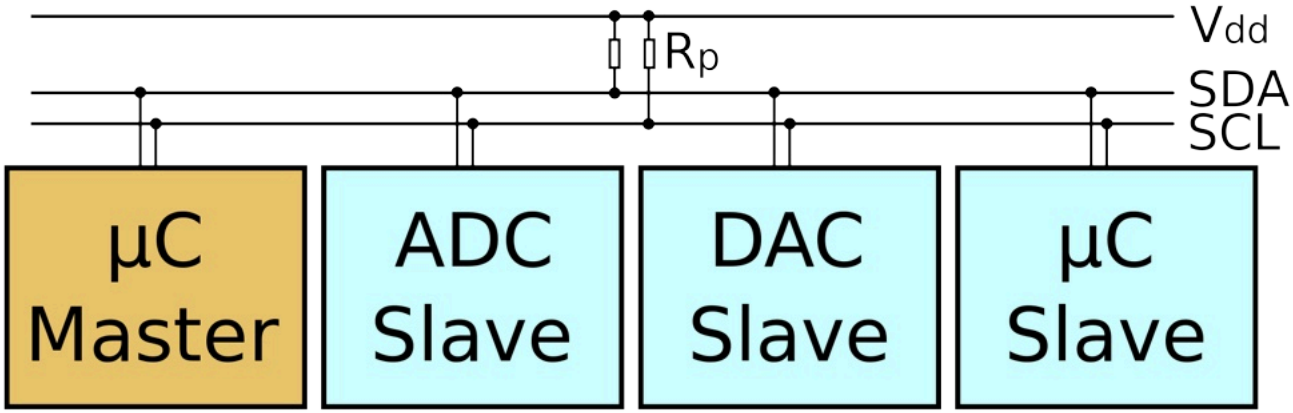
1) Inter-Integrated Circuit (I²C)

I²C (**Inter-Integrated Circuit**), pronounced *I-squared-C*, is a synchronous, multi-master, multi-slave, packet switched, single-ended, serial computer bus. It is widely used for attaching lower-speed peripheral ICs to processors and microcontrollers in short-distance, intra-board communication. Alternatively I²C is spelled **I2C** (pronounced I-two-C) or **IIC** (pronounced I-I-C).



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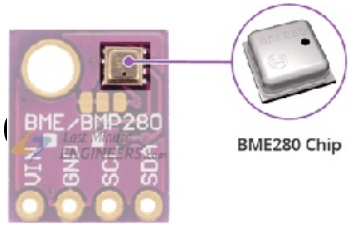
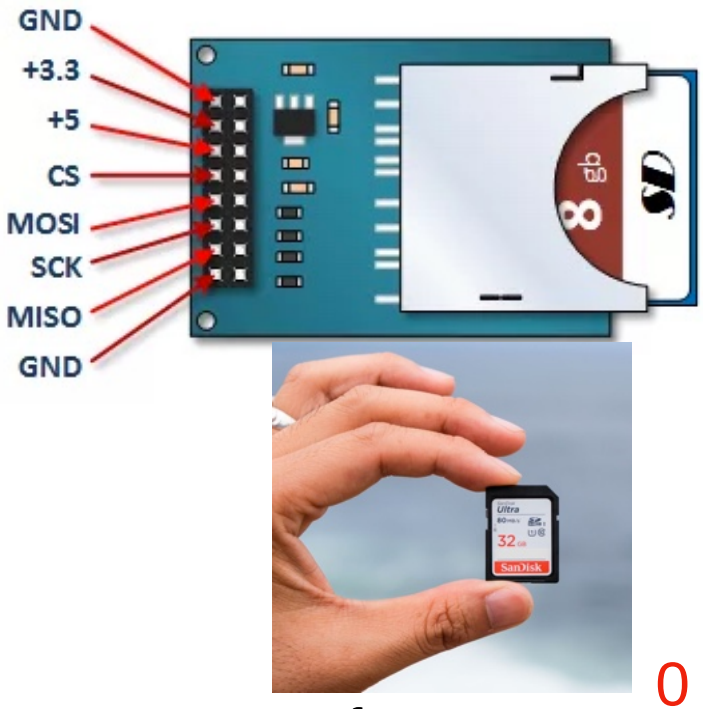
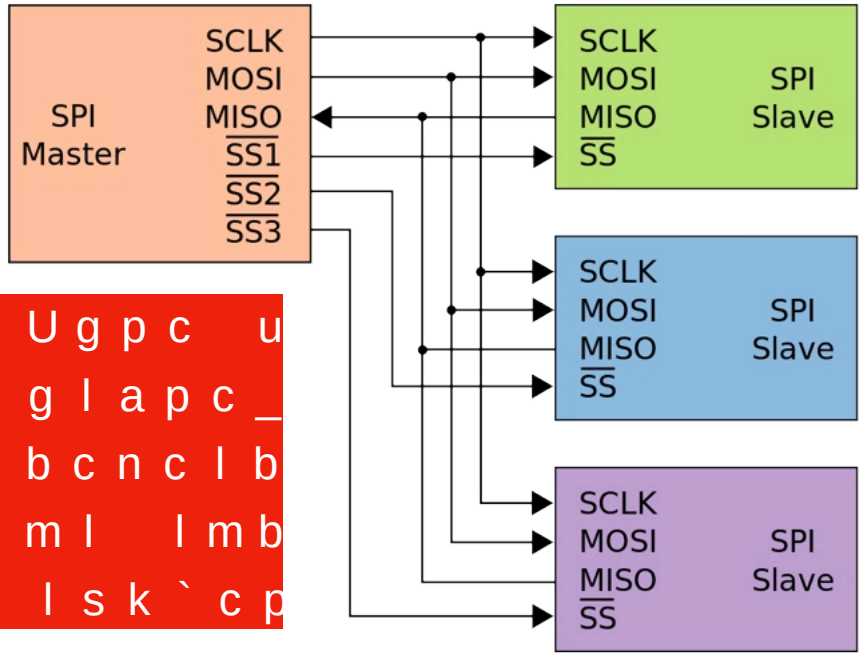


2) Serial Peripheral Interface (SPI)

The **Serial Peripheral Interface** (**SPI**) is a synchronous serial communication interface specification used for short-distance communication, primarily in embedded systems. Typical applications include Secure Digital cards and liquid crystal displays. SPI devices communicate in full duplex mode using a master-slave architecture with a single master. The master device originates the frame for reading and writing. Multiple slave-devices are supported through selection with individual slave select (SS), sometimes called chip select (CS), lines.





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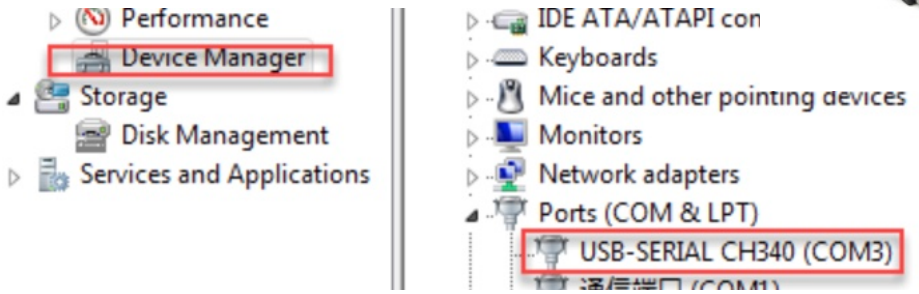
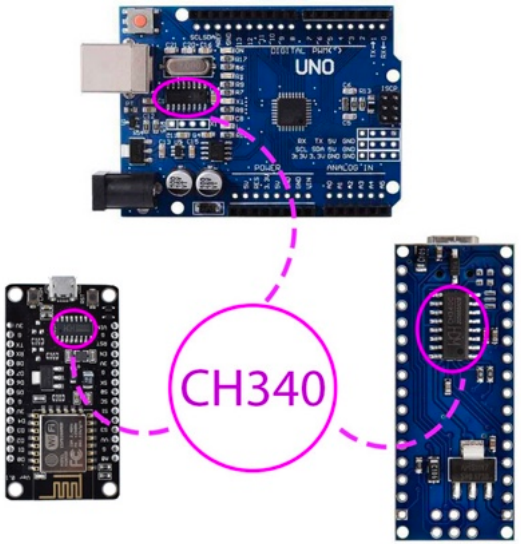
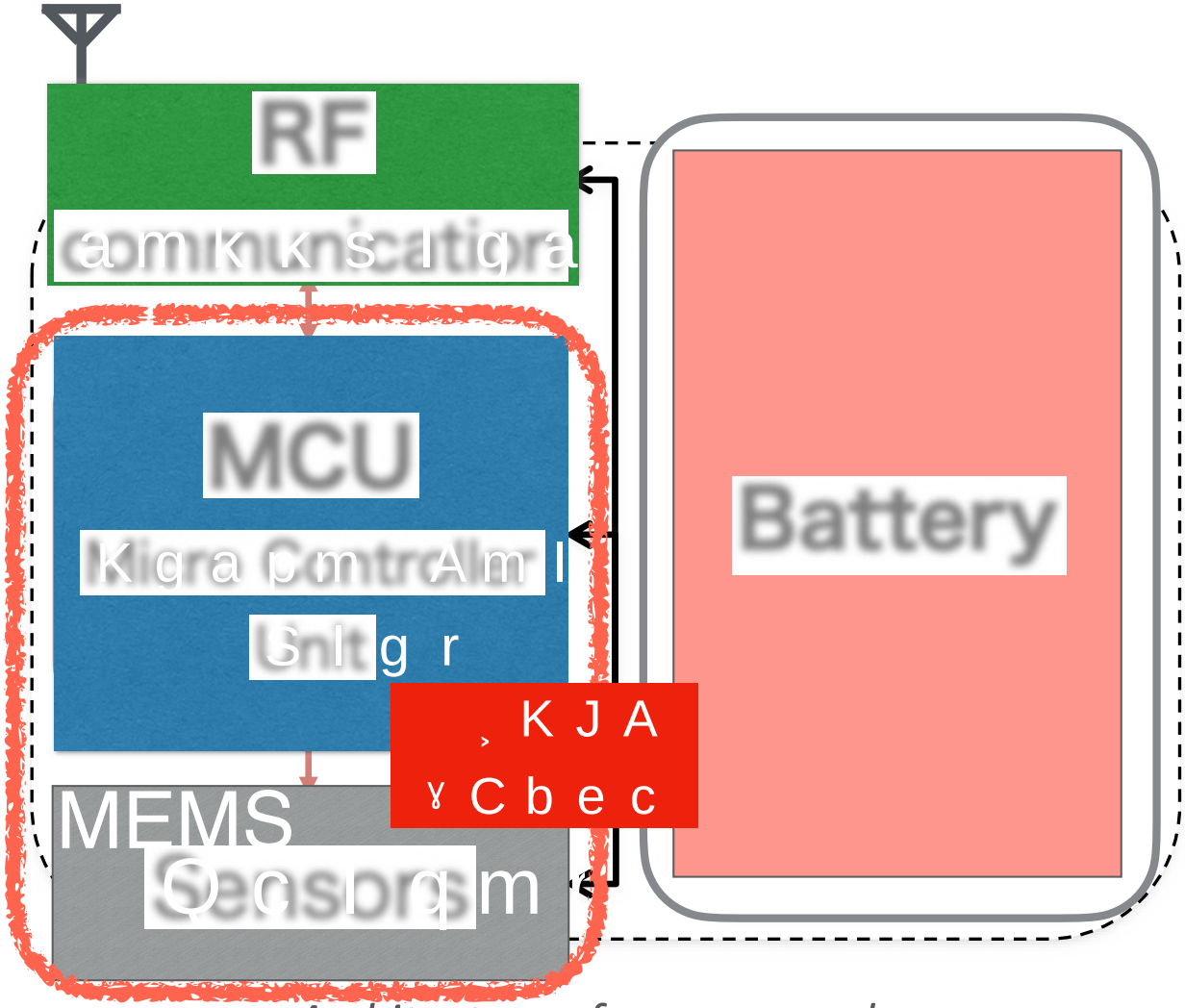
3) Universal Asynchronous Receiver/Transmitter (UART)





Cutting edge IoT node architecture

Edge AI



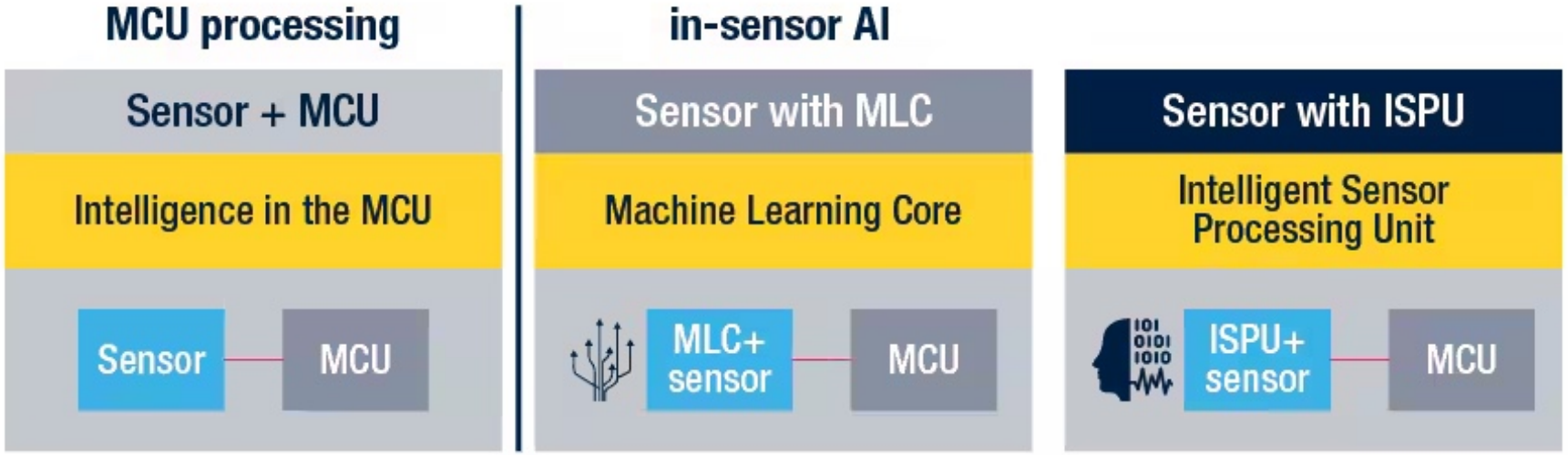
Architecture of a sensor node

Explains the internal details of IoT applications in the market

Commercial Edge AI from STMicro

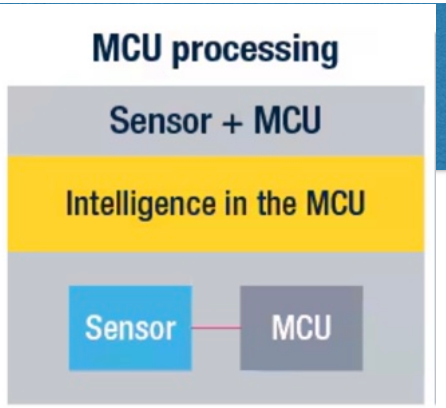
A leading company of MEMS sensor & Edge AI

To ensure developers find the most effective solution in terms of computing capacity and flexibility in programming, ST offers a choice of several technologies for in-sensor processing: sensors with an embedded **machine learning core (MLC)** and sensors with an **intelligent sensor processing unit (ISPU).**



Edge AI on market

N _ l _ q m l g a c + ` g i c



DETECTING LOW TIRE PRESSURE ON E-BIKES VIA EDGE AI

Problem: Electric-assist bicycles in Japan often suffer punctures caused by low tire pressure.

Approach (no pressure sensor needed):

- Compare rear-wheel motor RPM with front-wheel speed sensor data
- AI detects abnormal differences → indicates low pressure in either front or rear tire

Implementation:
Edge AI processes data locally and triggers a warning alarm

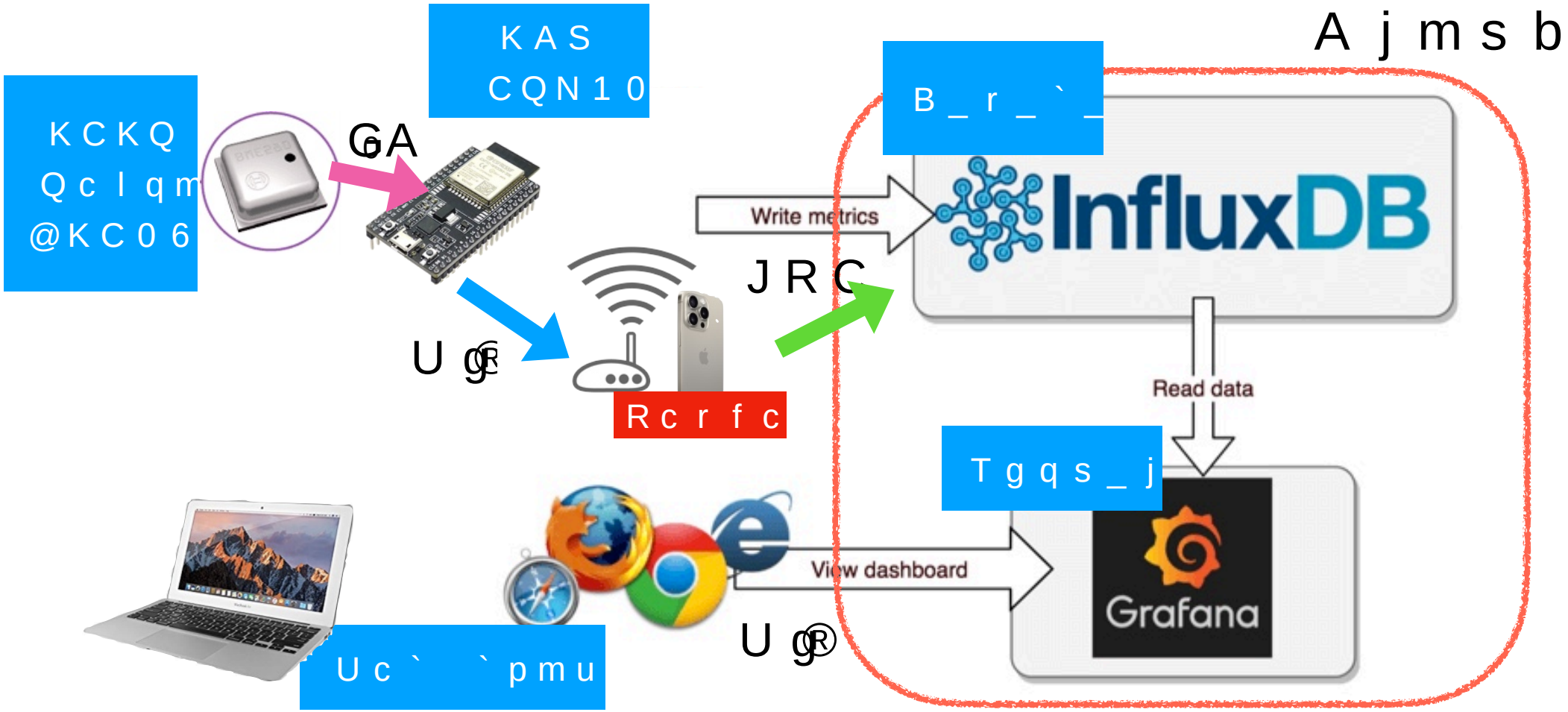
E c l c p _ r c b ` w

Contents

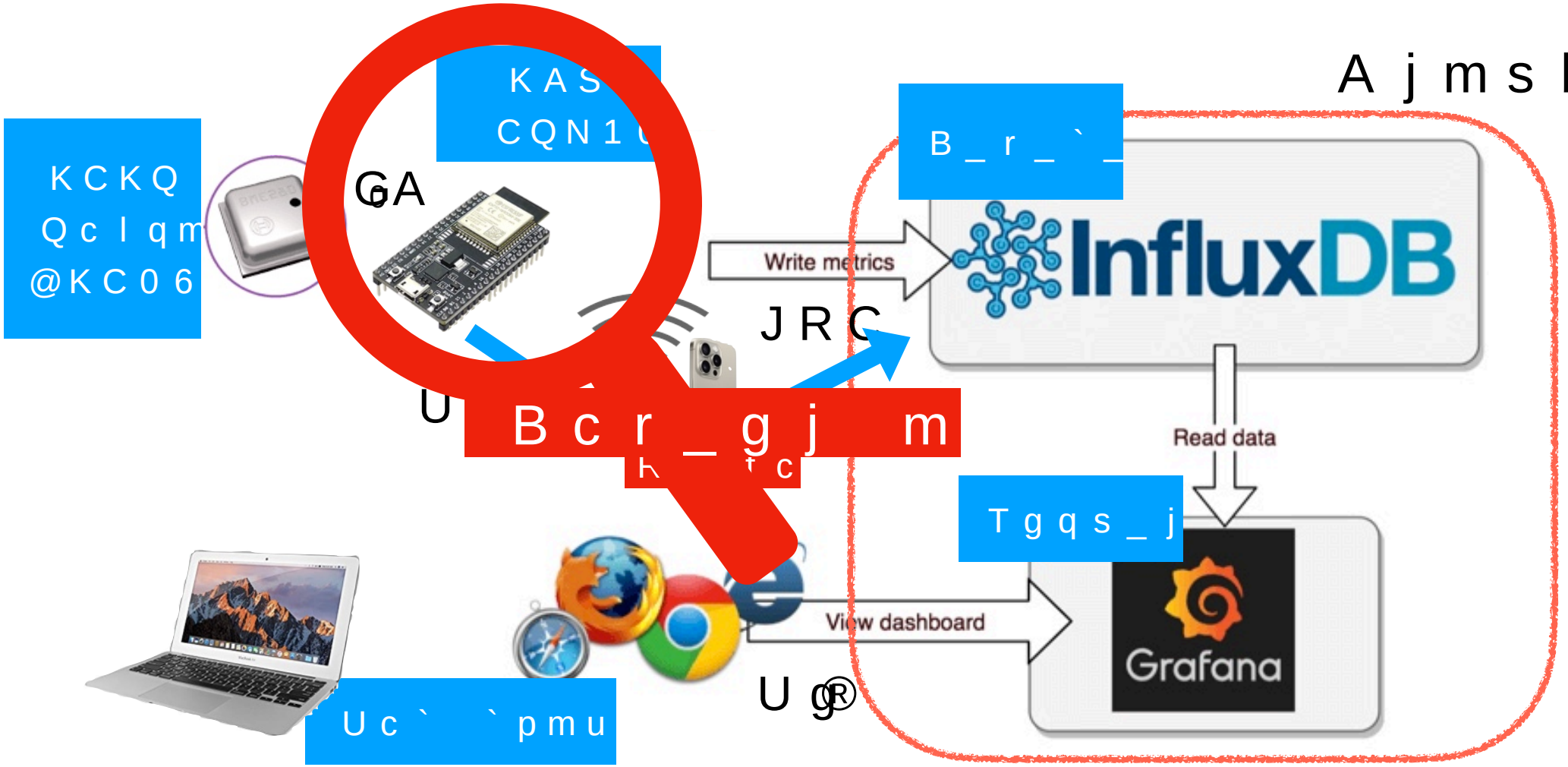
- Introduce myself
- Overview of IoT/MEMS

- **Instruction for IoT tutorial**

Goal of tutorial



Goal of tutorial



Wide variety of MCU variations

?PK+`_qcb KAS gq nmnsj
b_wq

?_npn jrcf cgq jcg a m+
?PK `_qcb ampc

P_qn`cppw

CQN1

Sqc rfg
rsrmpg

IPD306

C_af amkn_lw%q mpgegl_j GBC `c sqcb g
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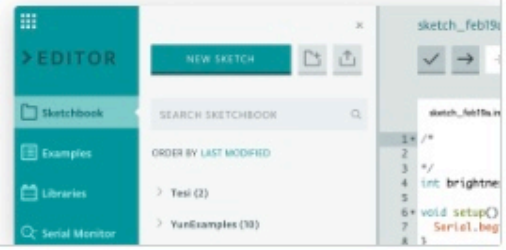
HARDWARE | SOFTWARE | CLOUD | DOCUMENTATION | COMMUNITY | BLOG | ABOUT

Arduino Web Editor

Start coding online and save your sketches in the cloud. The most up-to-date version of the IDE includes all libraries and also supports new Arduino boards.

CODE ONLINE GETTING STARTED



Mpgegl_jjw ?pbsglm Bctcjmnk

Downloads

@srjg`p_pgcq Qsnnmpr

Arduino IDE 2.2.1

The new major release of the Arduino IDE is faster and even more powerful! In addition to a more modern editor and a more responsive interface it features autocompletion, code navigation, and even a live debugger.

For more details, please refer to the **Arduino IDE 2.0 documentation**.

Nightly builds with the latest bugfixes are available through

DOWNLOAD OPTIONS

Windows Win 10 and newer, 64 bits
Windows MSI installer
Windows ZIP file

Linux AppImage 64 bits (X86-64)
Linux ZIP file 64 bits (X86-64)

macOS Intel, 10.14: "Mojave" or newer, 64 bits
macOS Apple Silicon, 11: "Big Sur" or newer, 64 bits

Release Notes

Help

@_qcb ml A-A)) j_les_ec

Comparison of SBC and MCU

Q@A

K A S

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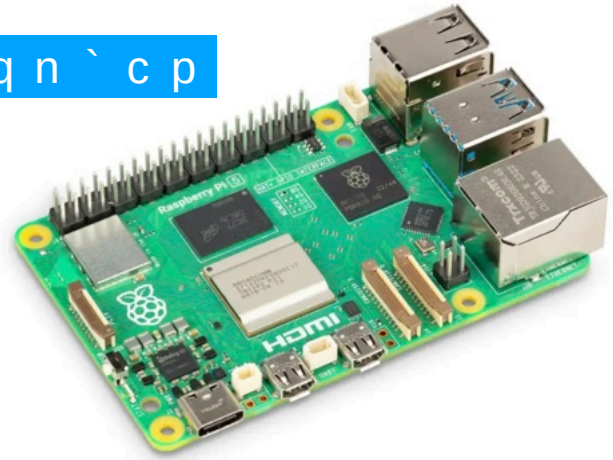

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T c p w c v g ` j c m n c p _ r g m l

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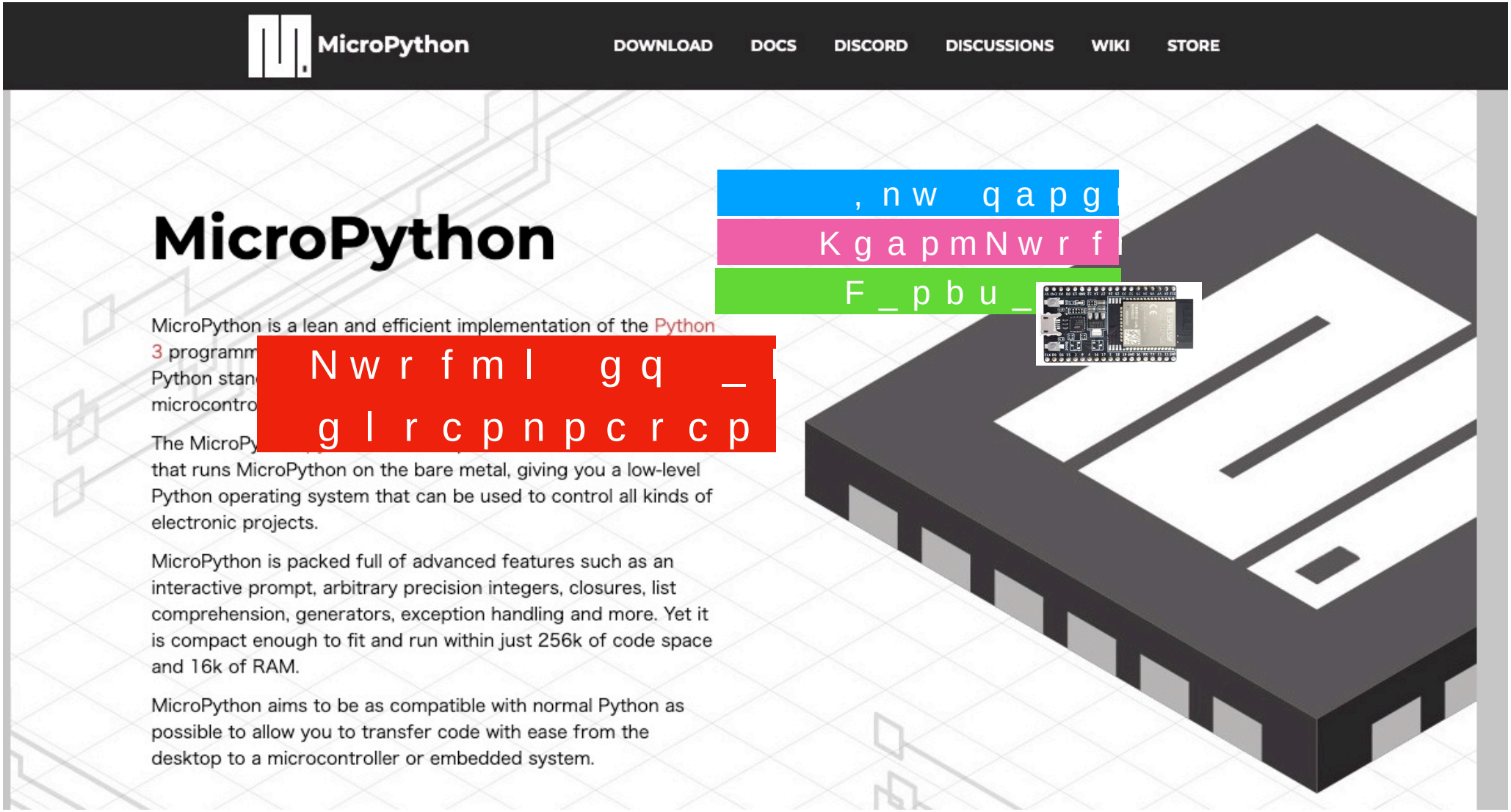
This tutorial uses Python on the MCU as an alternative solution



Programming language for small resources compatible with Python

Run within just 256k of code space and 16k of RAM.

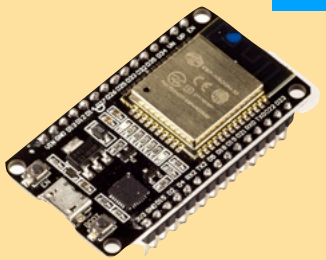
C++ IDE vs. *µ*Python for development

A))

M l N

Arduino IDE

M l K A



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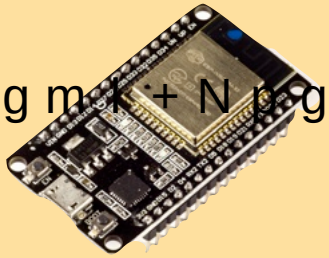

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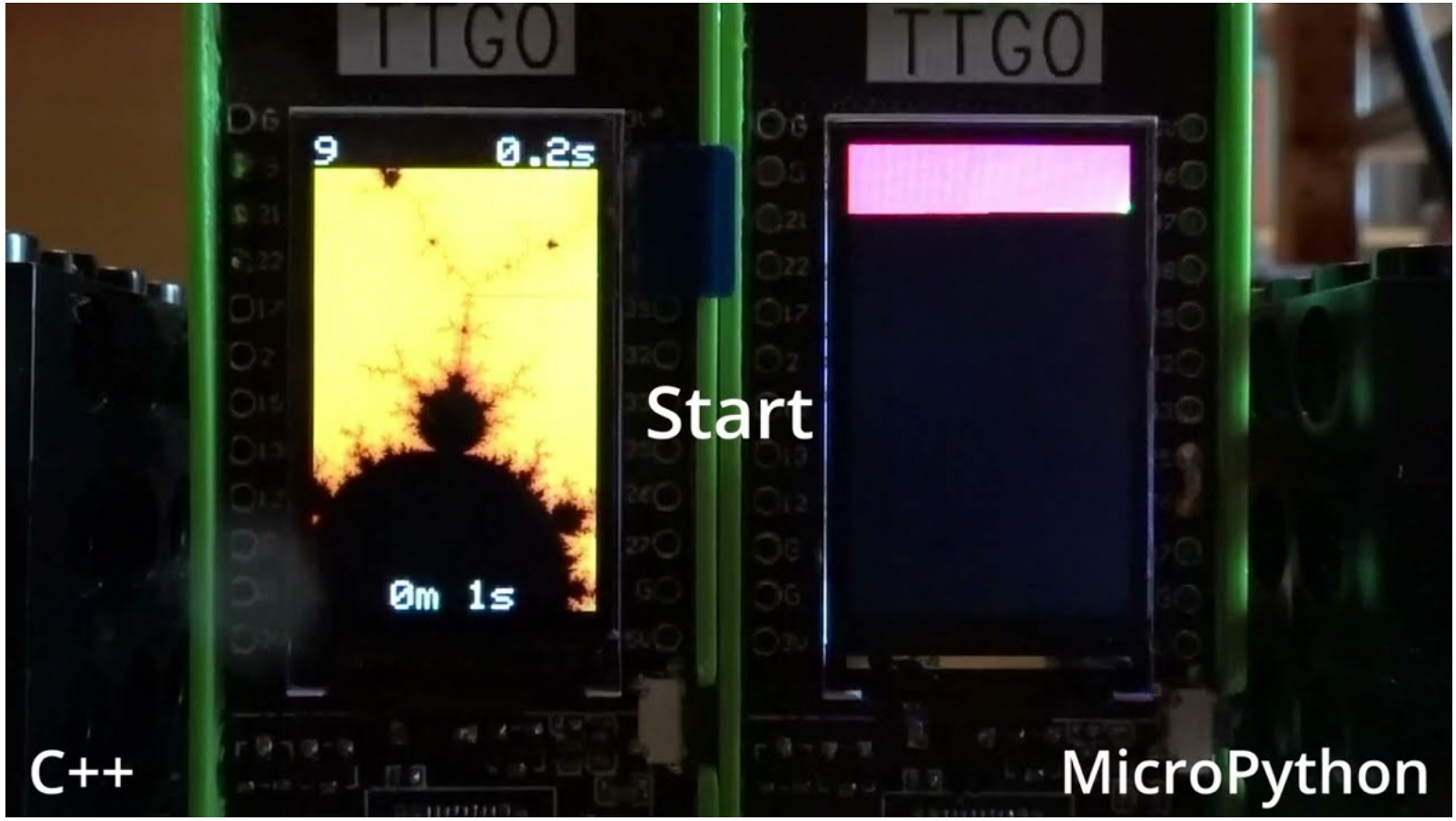
C++ IDE vs. *µ*Python (performance)

r/esp32 · 2 yr. ago
TomFlatterhand

How fast is Python - MicroPython versus C++



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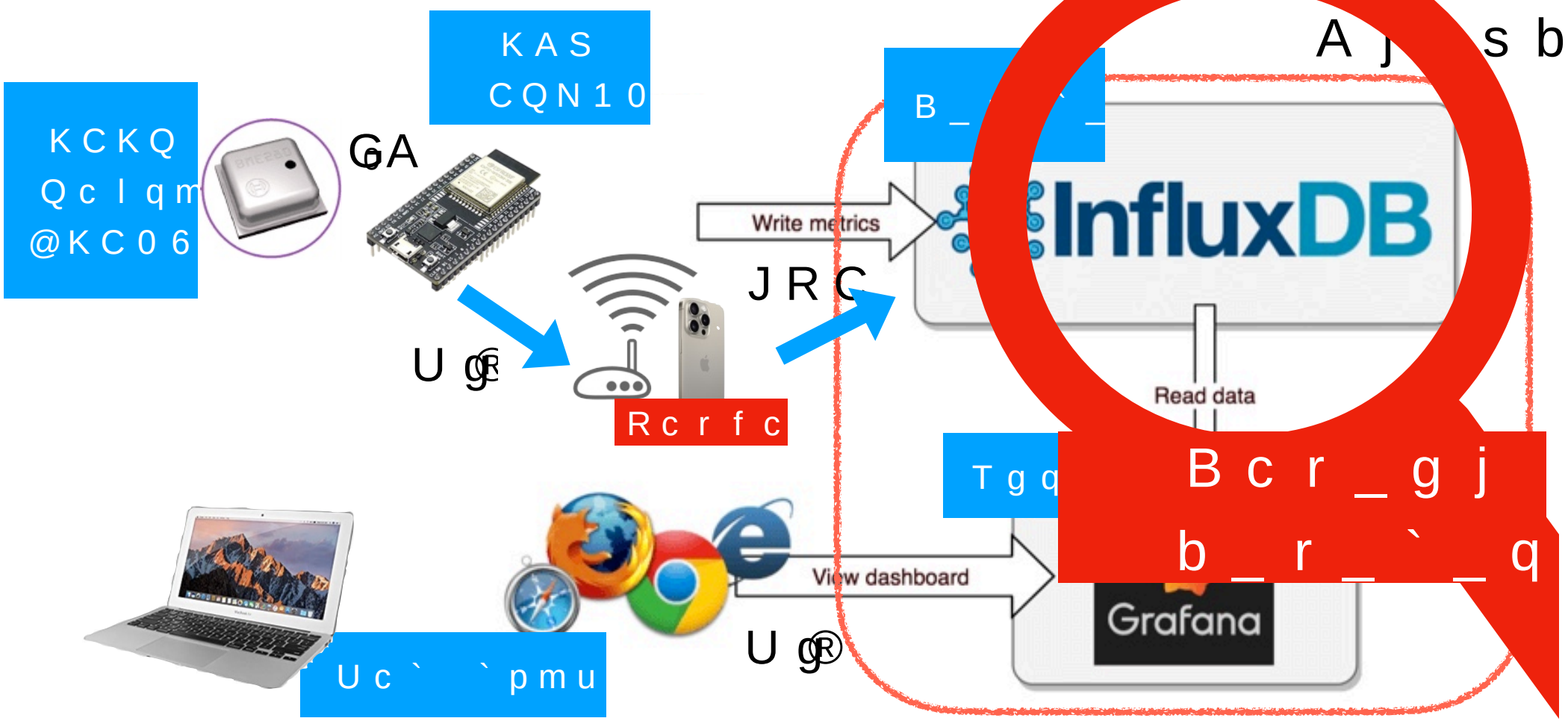
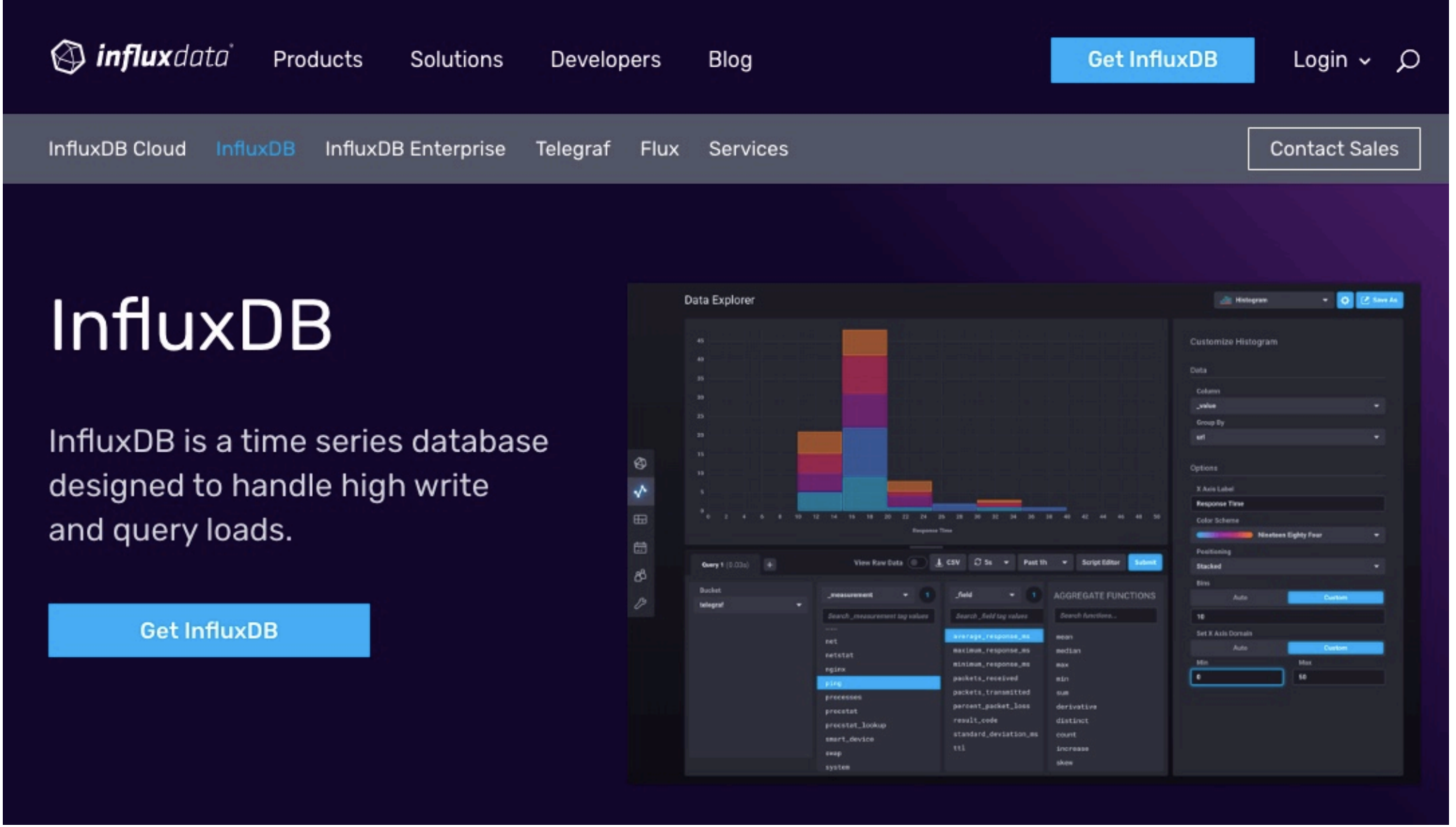
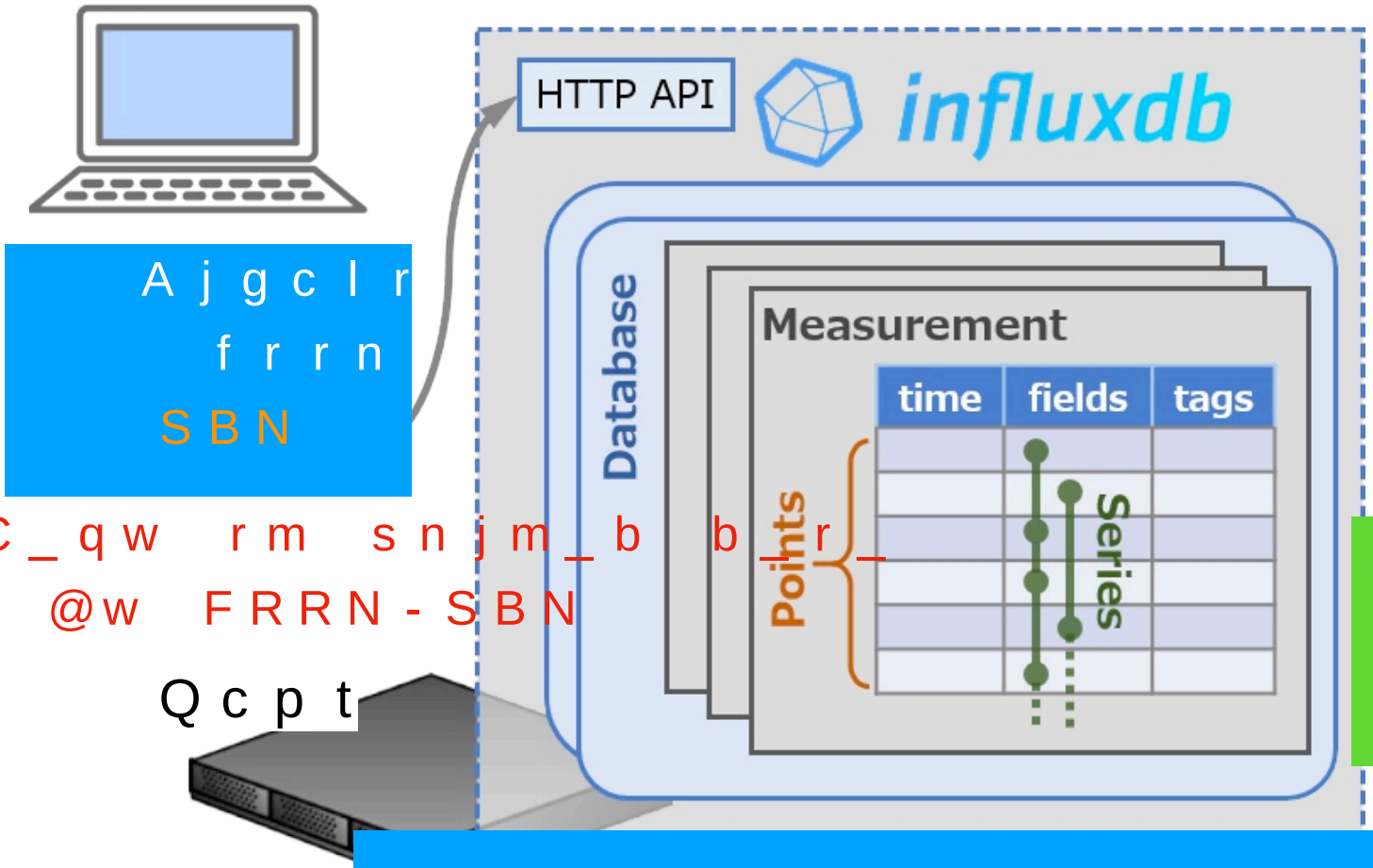
Goal of tutorial





InfluxDB is a high-performance data store written specifically for time series data. It allows for high throughput ingest, compression and real-time querying. InfluxDB is written entirely in Go and compiles into a single binary with no external dependencies. It provides write and query capabilities with a command-line interface, a built-in HTTP API.



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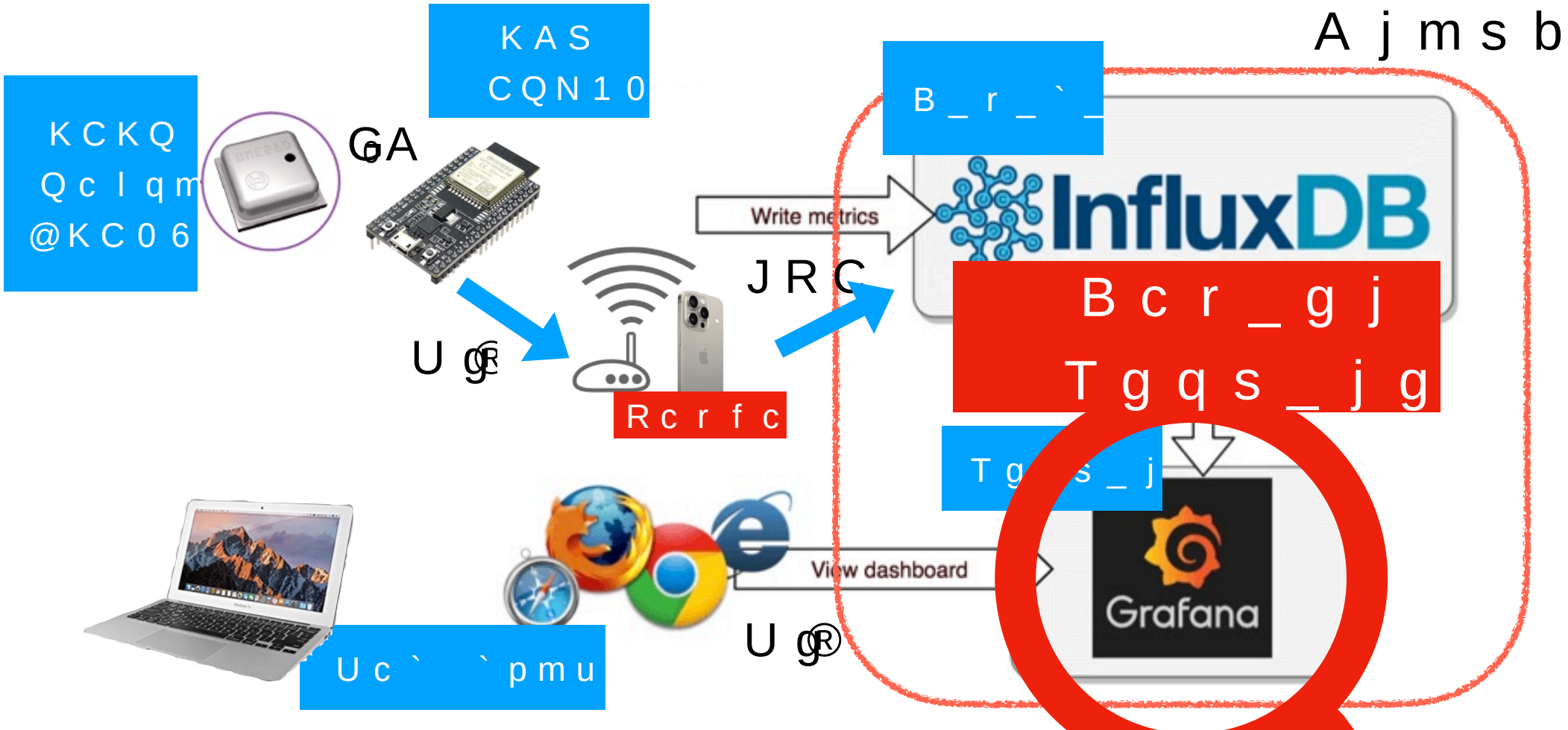
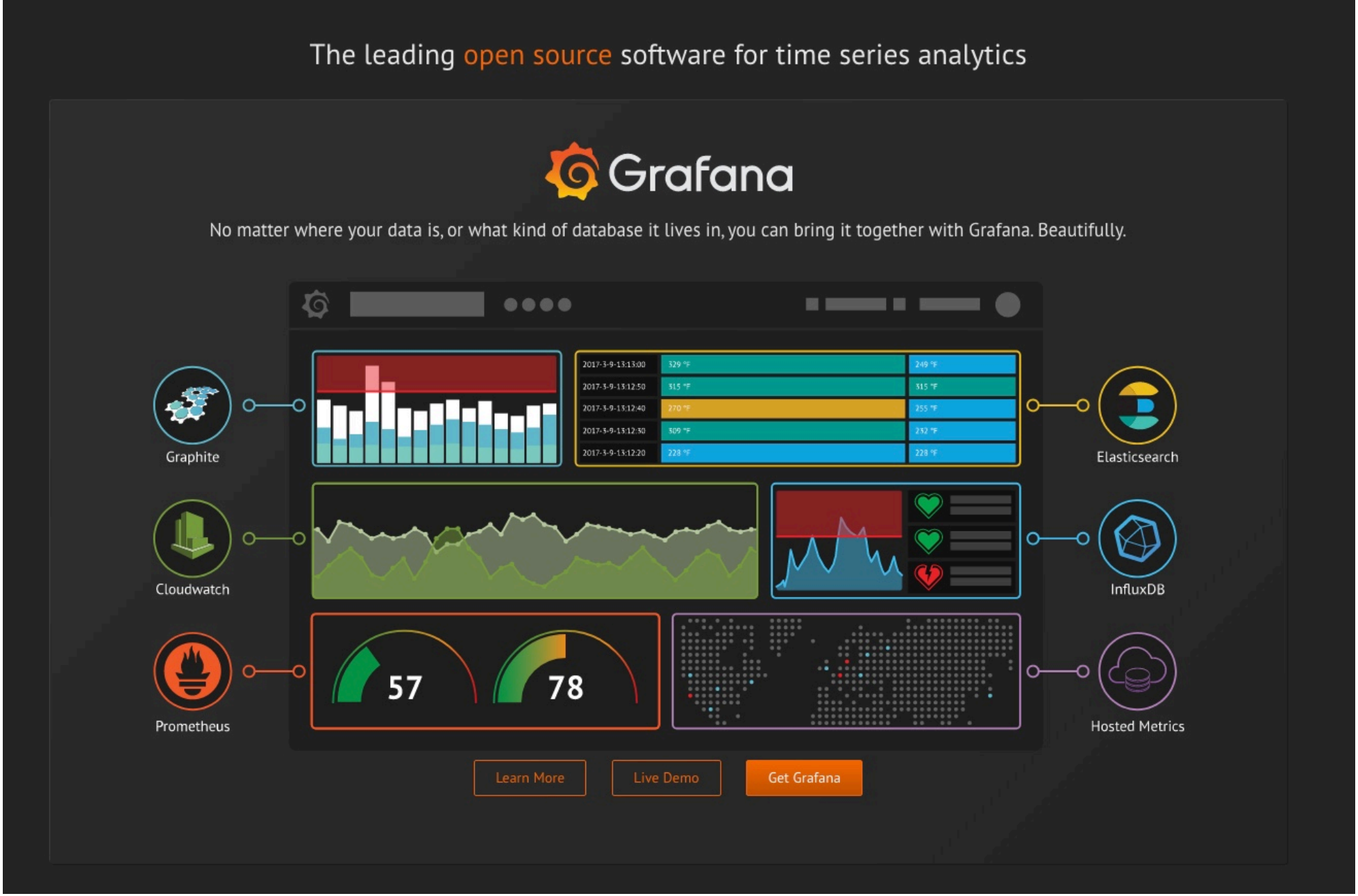
	Timestamp	Location	Temperature	Humidity	Barometer
Point	1597746439000000000	bedroom	23.4	67.8	1023.4
	1597746499000000000	bedroom	23.5	67.9	1023.6
	1597746559000000000	bedroom	23.5	68.1	1023.7

Goal of tutorial





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Example of Grafana (my home env.) on RPi

@cdmpc rfc

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GROUP A				TEAM
PHILIPPE	Nicolas	MAM2	FRA	? /
ENATSU	Koichi	Tokyo	JPN	
TAKAGI	Yukihiro	Waseda	JPN	A1
CRIADO	Romain	FISA5	FRA	
GHERBI	Choayb	FISA5	FRA	? /
VALLIER	Lucillien	FISA5	FRA	
REY	Dimitri	FISA5	FRA	

GROUP B				TEAM
NOIREAUX-FATTAZ	Julien	MAM2	FRA	@ /
RAJERISON	Lorry	FISA5	FRA	
AMANO	Sota	Waseda	JPN	
NAGAMINE	Yuma	Waseda	JPN	B1
UMEKI	Shusuke	Tokyo	JPN	
PESSÉ	Victor	FISA5	FRA	@ /
BAZIN	Khalil	FISA5	FRA	
DOIX	Paul	FISA5	FRA	

GROUP C				TEAM
THIAW	Sidy	MAM2	FRA	A /
SALAMEH	Ahmad	MAM2	FRA	
OKAWA	Yutaro	Waseda	JPN	
TSUDA	Kaoru	Waseda	JPN	C1
CARRERA	Alexis	FISA5	FRA	
BEAUTIER	Antoine	FISA5	FRA	A /
LO	Baye Djily	FISA5	FRA	
FRANCHINI	Antoine-Hugo	FISA5	FRA	

DJERABE	Gauthier	MAM2	FRA	
WANG	Koichi	Tokyo	CHN	? 0
TODA	Ittetsu	Waseda	JPN	
SHIOKAWA	Yuma	Waseda	JPN	A2
GUIA	Nicolas	FISA5	FRA	
ANANI	Nawel	FISA5	FRA	? 0
BERNIER	Théo	FISA5	FRA	
MIRET	Thibault	FISA5	FRA	

PALLIER	Tristan	MAM2	FRA	
SATAKE	Rito	Waseda	JPN	@ 0
KAWAHARA	Yuto	Waseda	JPN	
LEMOS	Hervé	FISA5	JPN	
BEAUFORT	Nicolas	FISA5	FRA	B2
FONSECA SOUSA	Lucas	FISA5	FRA	@ 0
KHATRI	Khaoula	FISA5	FRA	
MOUHAMMAD	Hamza	MAM2	FRA	

LATRECHE	Zakaria	MAM2	LBN	
CHIKUSA	Yuto	Waseda	JPN	A 0
YUZAWA	Koki	Waseda	JPN	
SHIMURA	Yuto	Tokyo	JPN	
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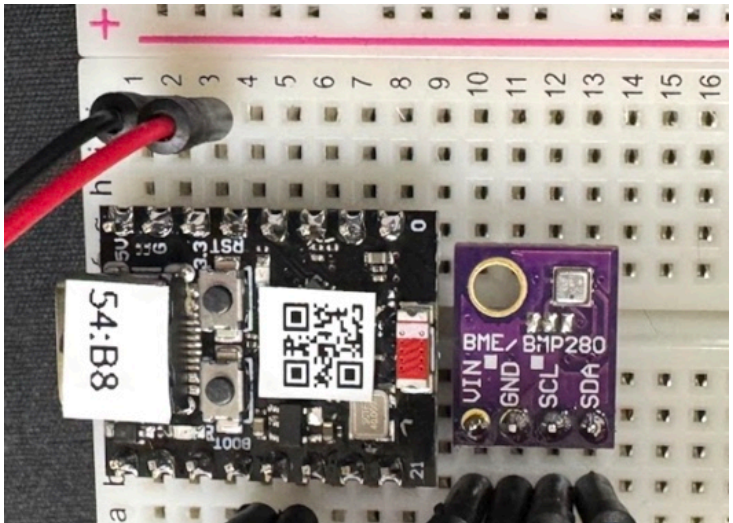

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90' Lecture
10:00 - 11:30
T. Fujita, University of Hyogo, JP
IoT modules & its tutorial by using SBC
BXXX

Lunch break
11:30-13:15

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Challenge
13:15 - 14:45
Group : C

90' Tutorial - 13:15 - 14:45
H. Sawada
Image processing for Mechatronics
CXXX - Group : B

90' Practical work
13:15 - 14:45
T. Fujita
IoT modules tutorial using SBC
CXXX - Group : A
?

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Thursday Sept 18

45' Keynote
9:00 - 9:45
H. Sawada
AI

Coffe Break

enge: Start
15 - 11:45
oups : B

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8:15 - 9:45
Y. Suzuki, University of Tokyo
Design of broadband vibration energy harvesting device
BXXX

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REY	Dimitri	FISA5	FRA	

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PALLIER	Tristan	MAM2	FRA	
SATAKE	Rito	Waseda	JPN	@ 0
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BEAUFORT	Nicolas	FISA5	FRA	B2
FONSECA SOUSA	Lucas	FISA5	FRA	@ 0
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CHIKUSA	Yuto	Waseda	JPN	A 0
YUZAWA	Koki	Waseda	JPN	
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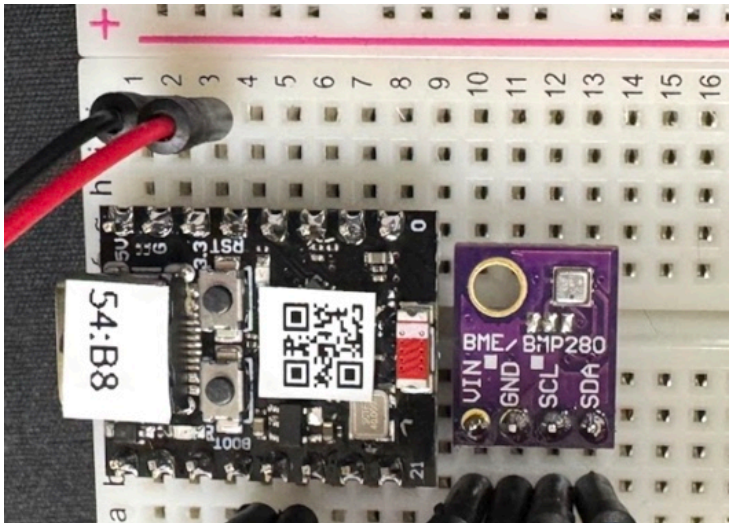
HEBERT	Tanguy	FISA5	FRA	A 0
SAUNIER	Jérémie	FISA5	FRA	



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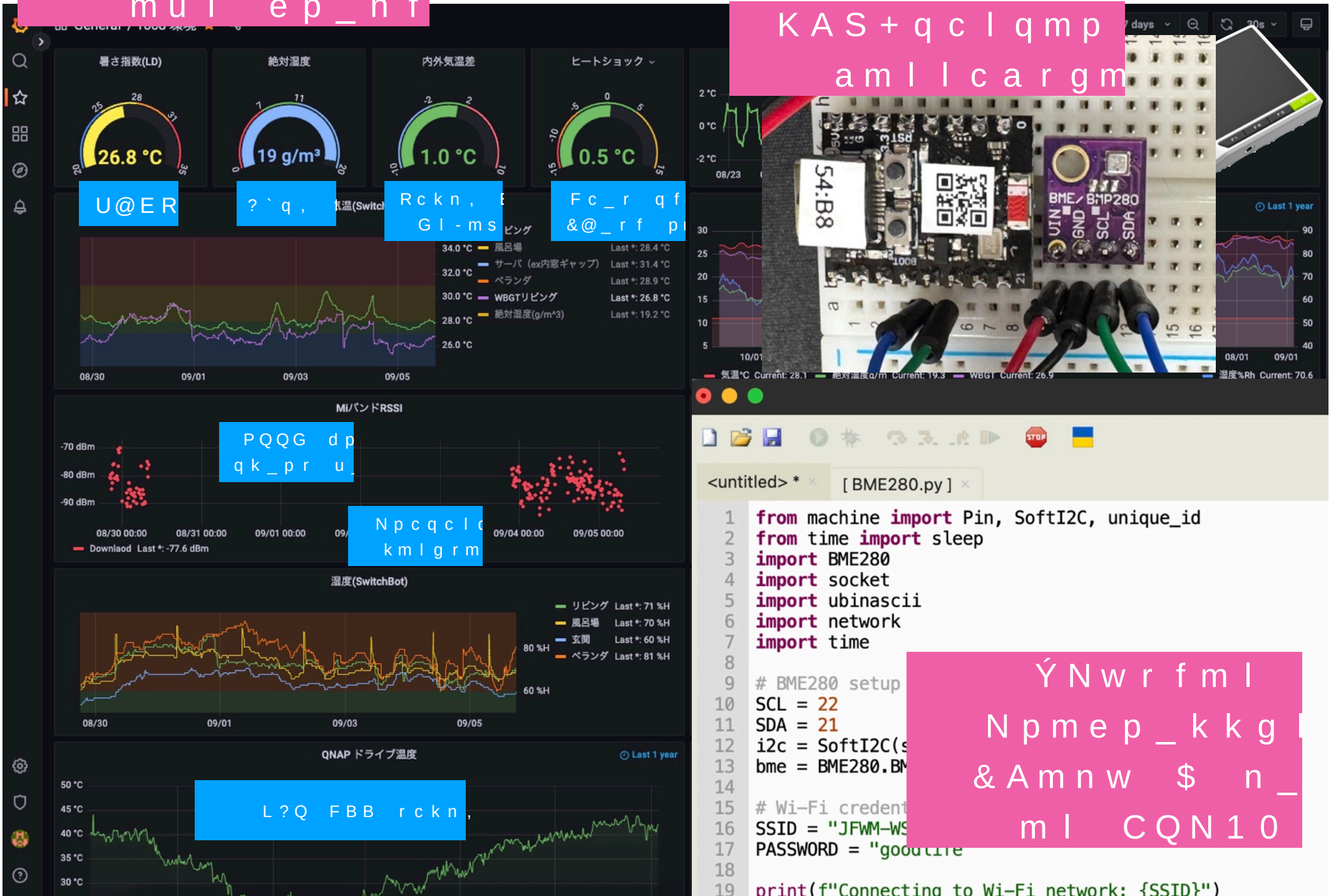
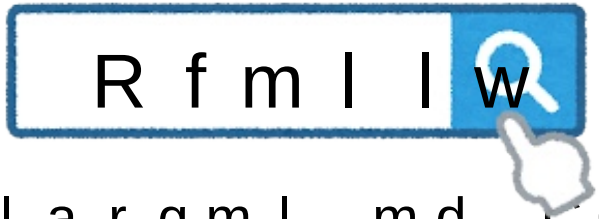



```
1  from machine import Pin, SoftI2C, unique_id
2  from time import sleep
3  import BME280
4  import socket
5  import ubinascii
6  import network
7  import time
8
9  # BME280 setup
10 SCL = 22
11 SDA = 21
12 i2c = SoftI2C(s
13 bme = BME280.BM
14
15 # Wi-Fi credent
16 SSID = "JFWM-WS
17 PASSWORD = "goodlife"
18
19 print(f"Connecting to Wi-Fi network: {SSID}")
```

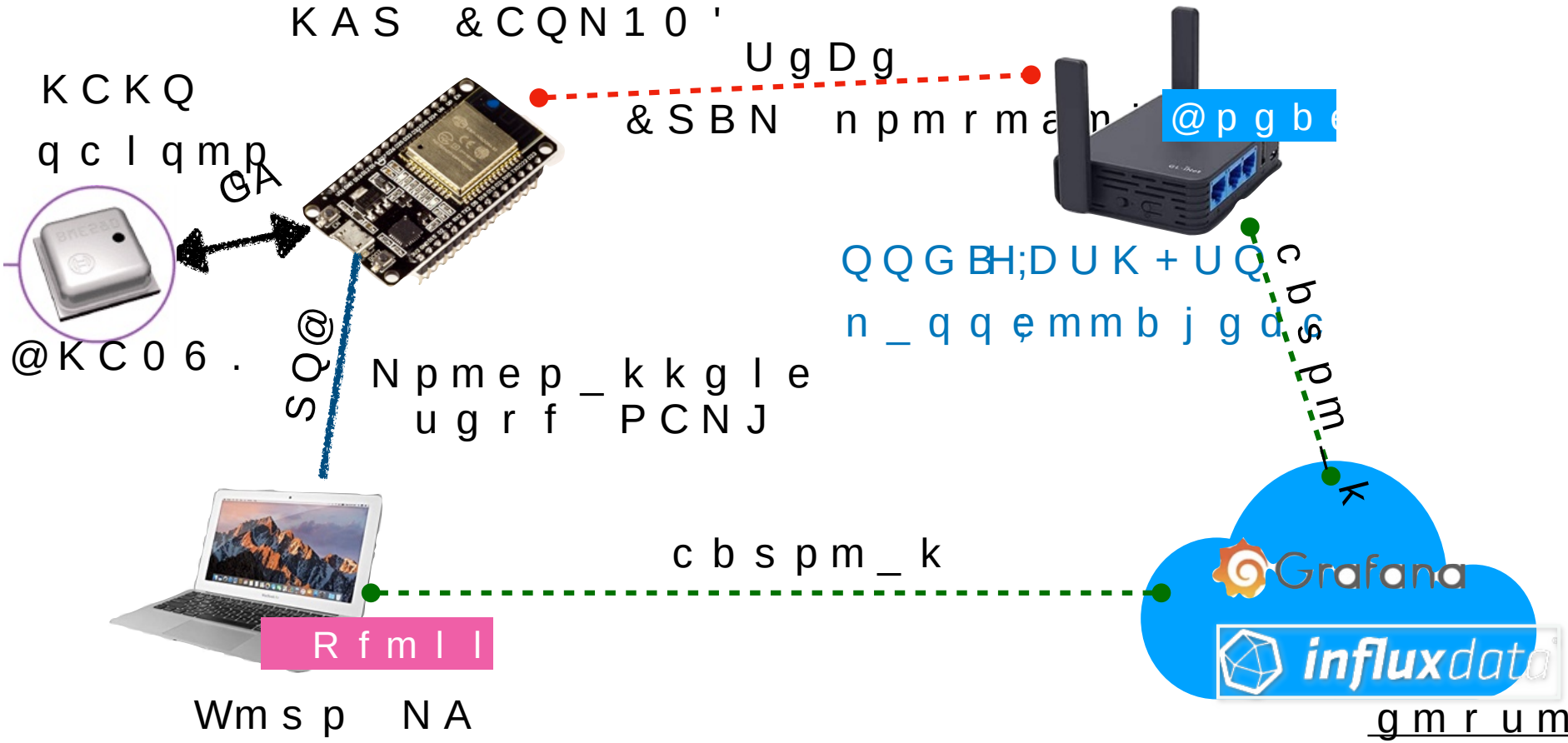
Ý Nwr fml Npmep_kkg l &Amnw $ n_ ml CQN10

Tutorial list



(Extra) BLE Beacon RSSI monitoring on Grafana

Overview of connections



gmrumpi,m

&/4/,12,.,

Njc_qc rpw amllca

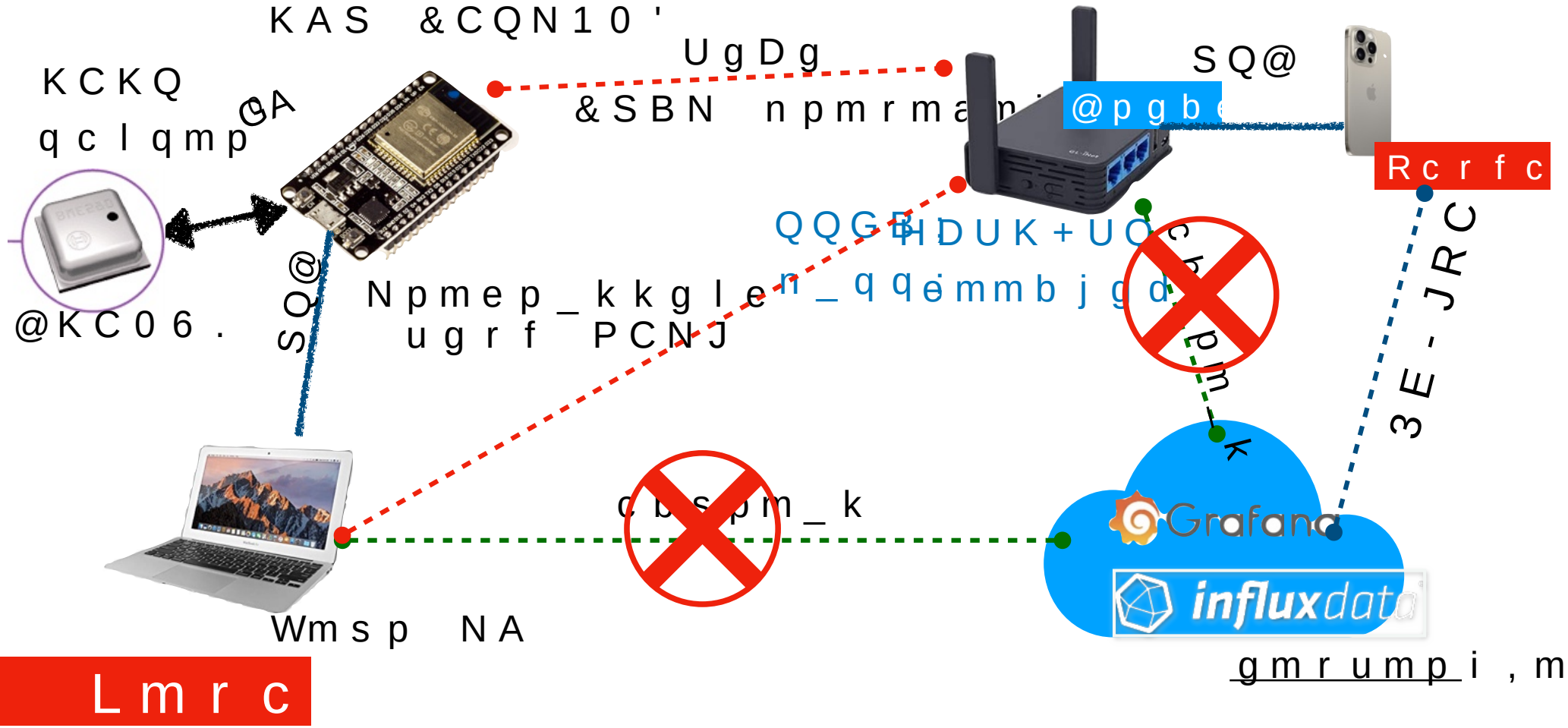
/'A_l wms rm famrlrl&a-rgmrumpi,dmpegdkqrpsa

Wc

0' A_l wms rmfrarmml8l-c-agmr8u1mp.i.,mqpmep Ep_(

Kgefr

Overview of connections (revised)



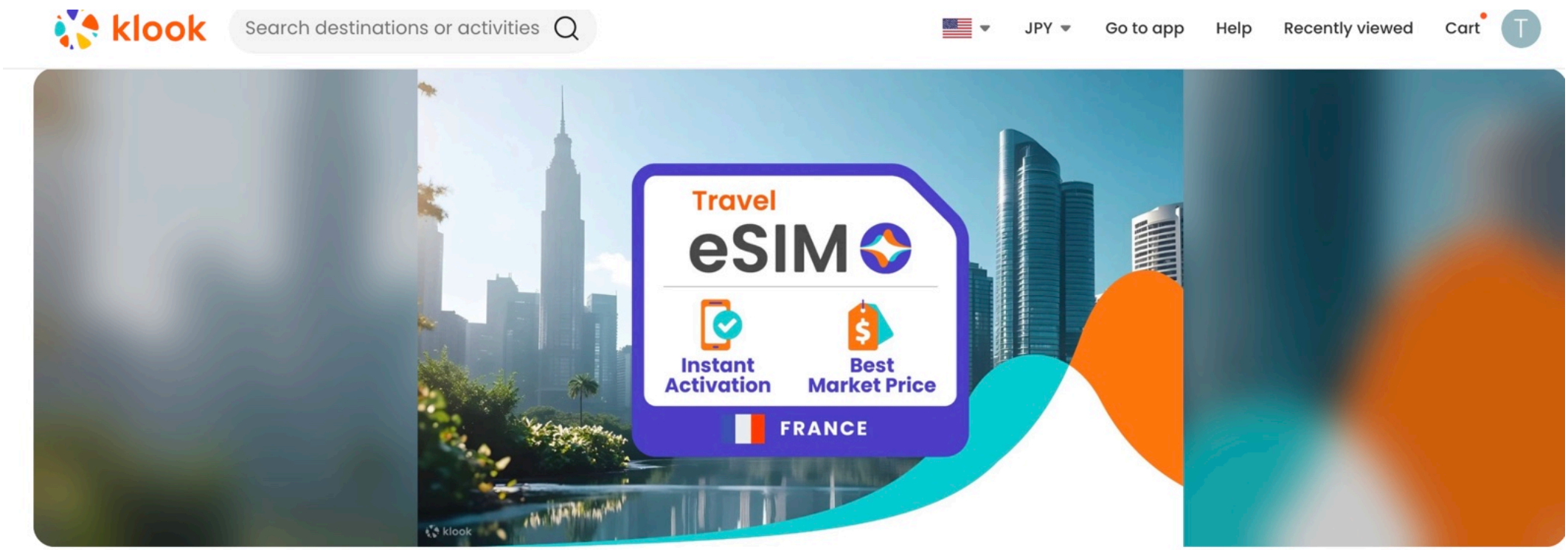
L m r c

g m r u m p i , m p

c b s p m _ k > S Q K @ % q q c a s p p g c r q w r p n g m a j r f g a c l w e E g p q _ d _ l _ a m k

N j c _ q c a m l H c a r % b % s p g l e r f c r s r m p g _ j r m a

G n p m t g b c b c Q g k d m p 1 b _ w q s l



Klook Travel

5G France eSIM | Orange SFR

★ 4.8 (29 reviews) · 4K+ booked

♡ Save to wishlist

¥ 1,018

See selected options

Let’s connect ESP32 to PC

Am®pkAMK nmpr lsml`cp

Bctgac K_l_ecp

Rpms`jc==

Google

cp210x driver windows

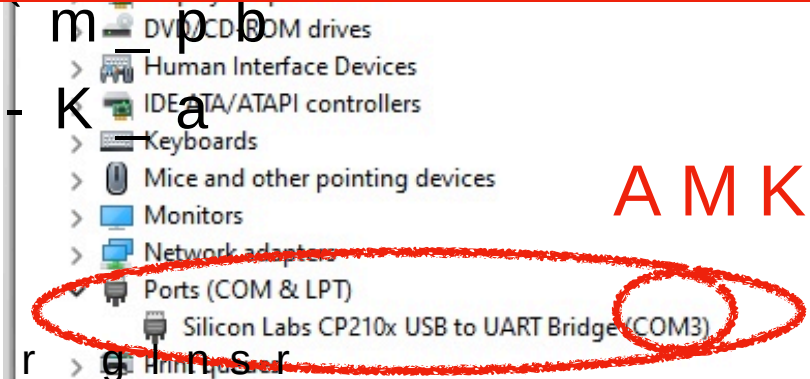
Bmuljm_b rf

®pqr* G ugj_

Aml lcar CQN10 `m_pb

rm Uglbmuq NA -K—a

u-Ý+SQ@ a_`jc



AMK1(

Ml K_aMQ Rcpkgl_j ?nn, hsqr gl nsr

jq -bct

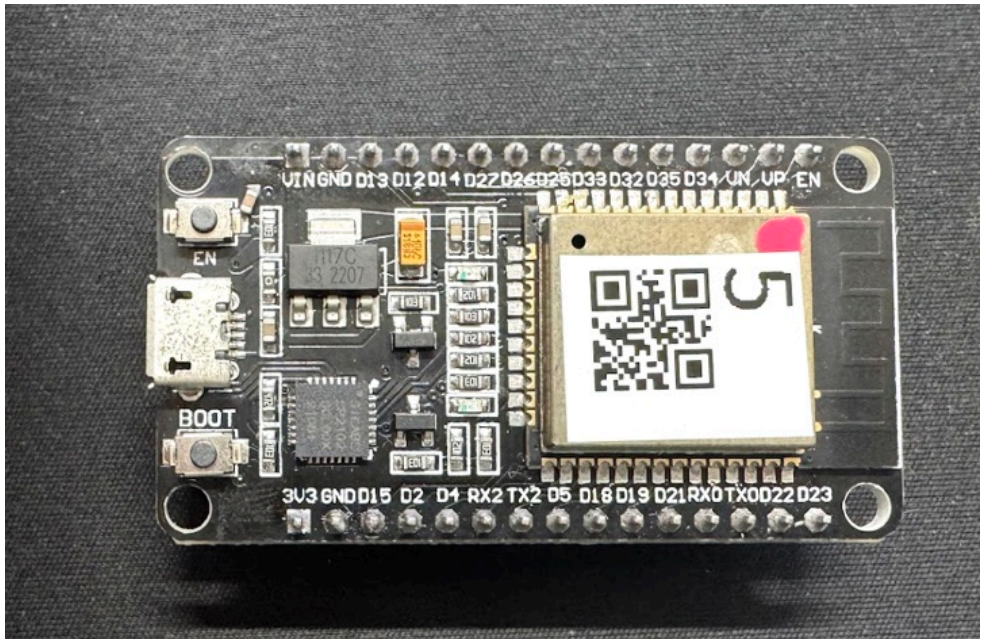
amjskl8 ufw qr_p

```
(base) takayukifujita@MacBook-Air ~ % ls /dev/cu.*
/dev/cu.BNO085-BT                 /dev/cu.usbserial-0001
/dev/cu.Bluetooth-Incoming-Port
```

(bcnclbq m

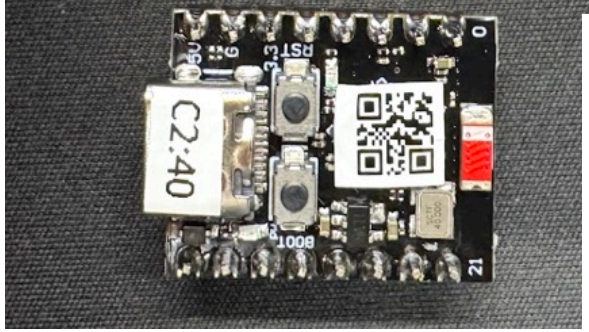
cltgpmlkcl

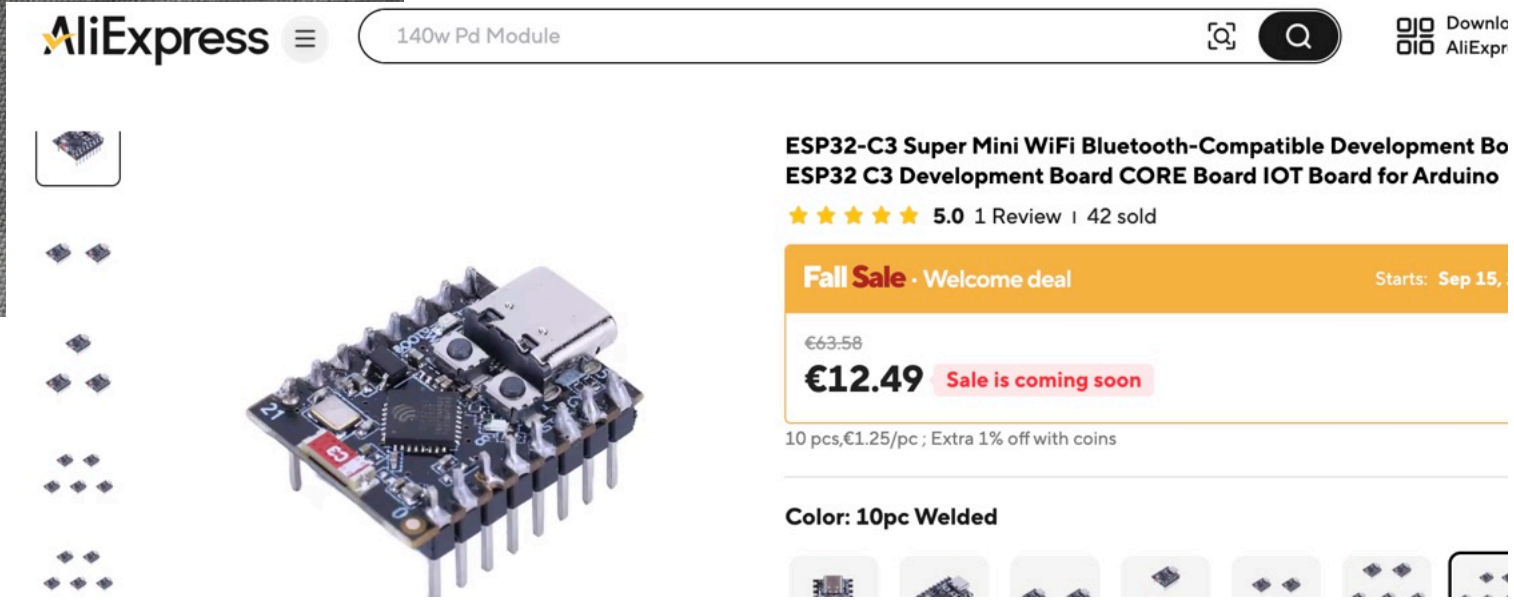
ESP32 -> ESP32C3 super mini



A 1 q s n c p k g l g g l H D U K (
t c p w a f c _ n _ l b q k _ j j
/ , 0 3 C S P M N C - a

@ S R ° U g D g a m l l c a r g m





Tutorial list

Glqrpsargml $ q_knjc npmep

frrn8--gmrumpi,mp

Npcn_p_rgml

.,KgapmNwrfml glqr_jj ml CQN

Cvncpgkclrq

Rfmll w

Glqr_jj

/,@jgli JCB ml CQN10

0,Afcaigle rfc UgDg dsla.gm.l m.d CQN

1,Ugpc @KC06. rm ecr b_r_

&@KC06.,nw jg`p_pw glqr_jj_rgm

2,Snjm_b @KC06. b_r_ rm ajmsb tg_ S

Pctgqcb < B_r_ qclb `w S?PR rm N

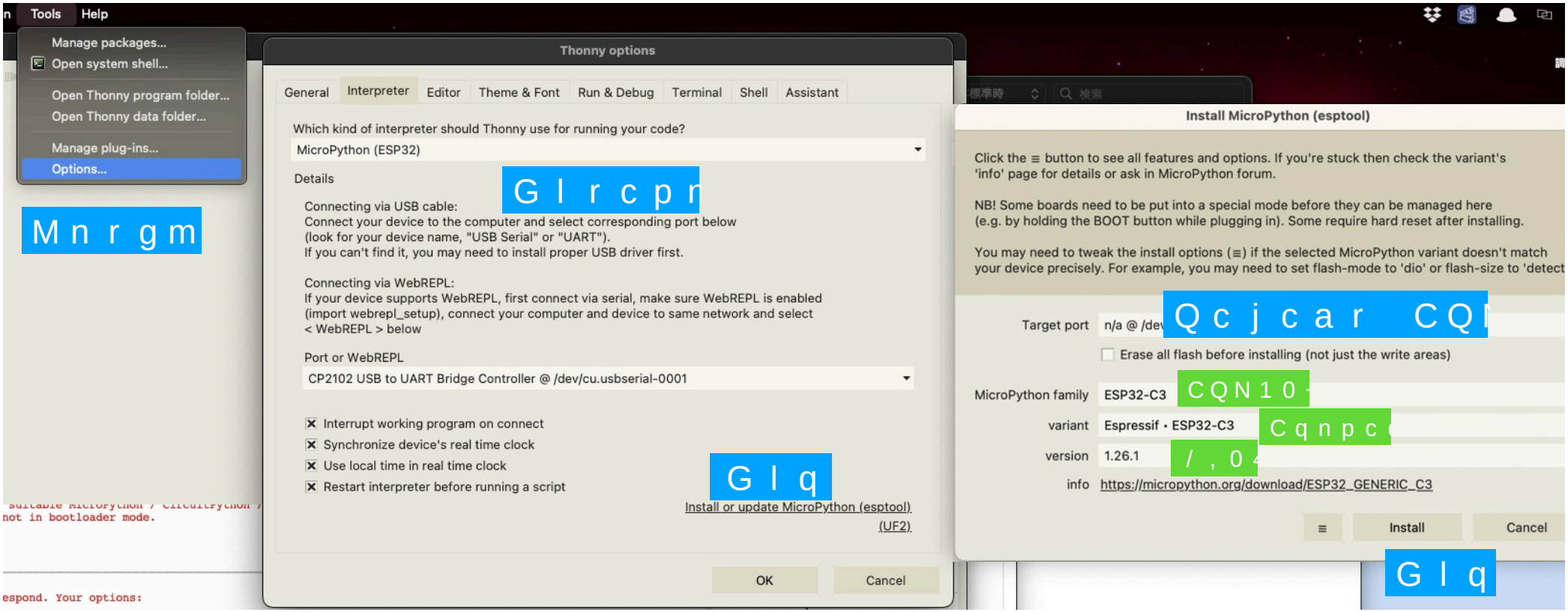
3,Tgqs_jgx_rgml ml Ep_d_l_

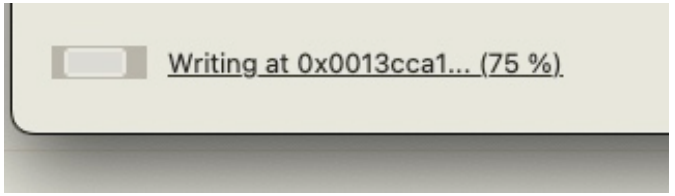
(Extra) BLE Beacon RSSI monitoring on Grafana

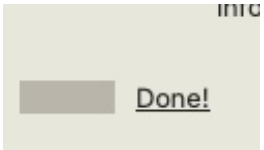
Install *μ*Python via Thonny app

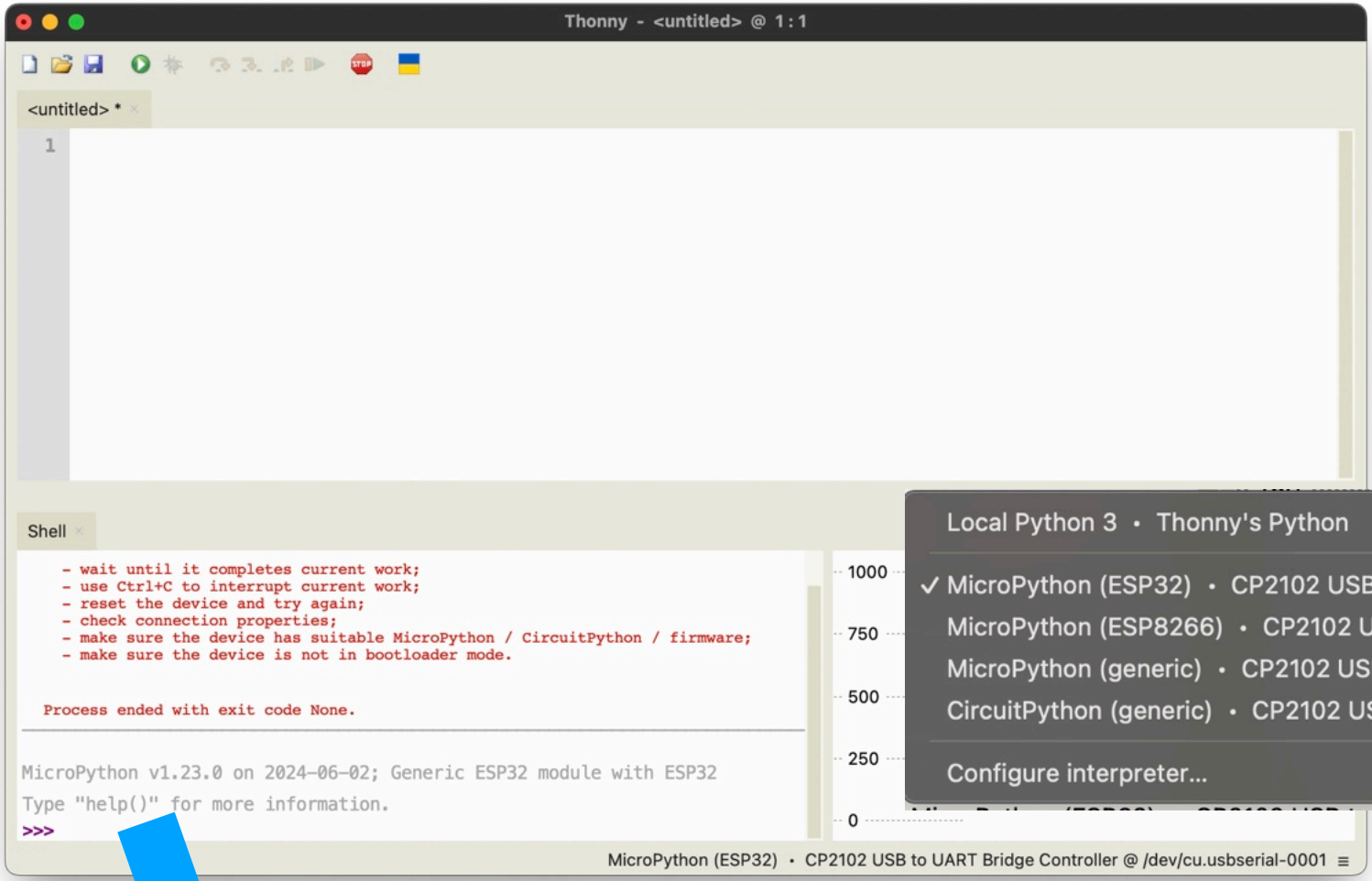
Q _ k n j c m d R f m l l w } q u g l b m u

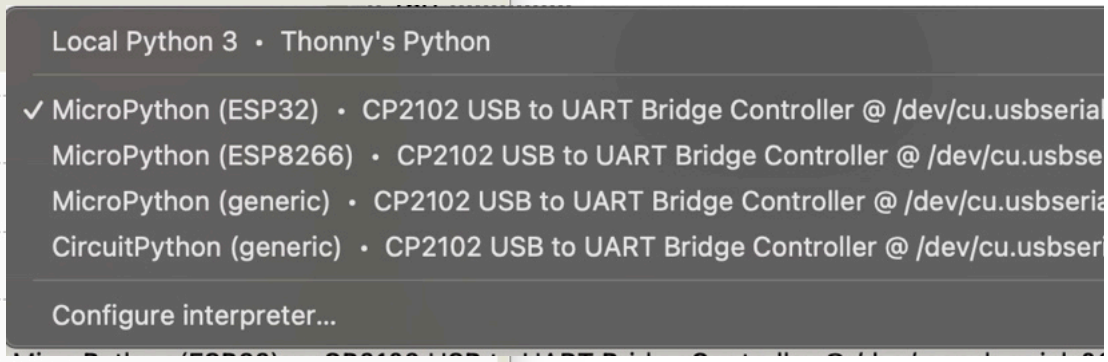
Install μPython via Thonny app











A j g a i r f c p g e f r ` m r r m l
& C Q N 1 0 m l q

L m u w m s a _ l s q c Ý N w r f m l m l

```
MicroPython v1.23.0 on 2024-06-02; Generic ESP32 module with ESP32
Type "help()" for more information.
>>>
```

Tutorial list

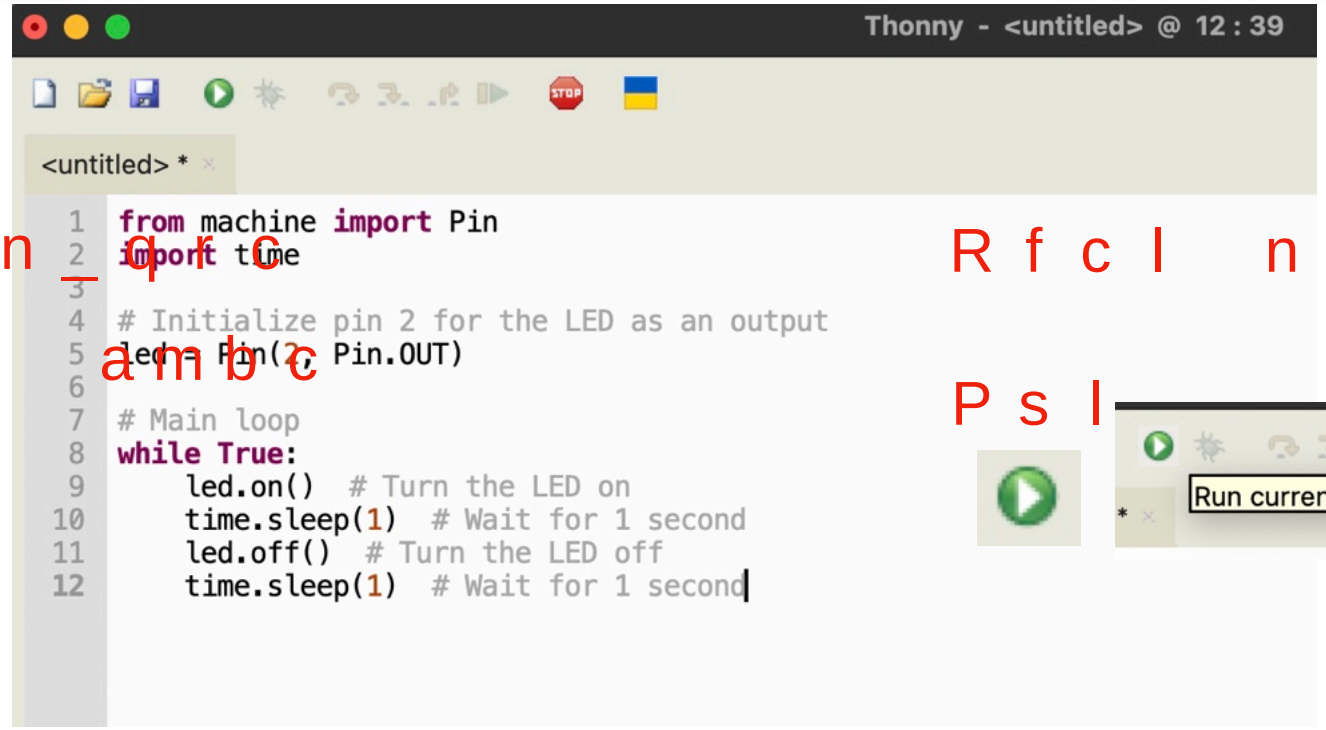
Rfmll w

(Extra) BLE Beacon RSSI monitoring on Grafana

Ex1) Blink LED

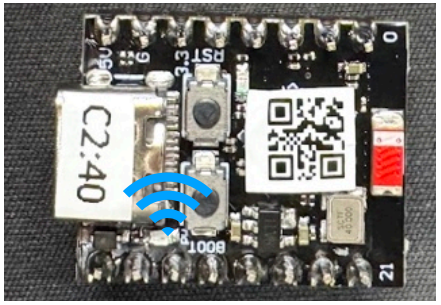
Amnw $ n_qfc

Nwrfml amb c



Rfcl nsqf

Psl

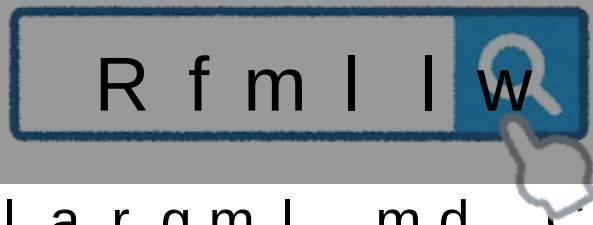


@jsc JCB&ngl 0' `

Rpw rm af_lec `jgli glrcpt_jq

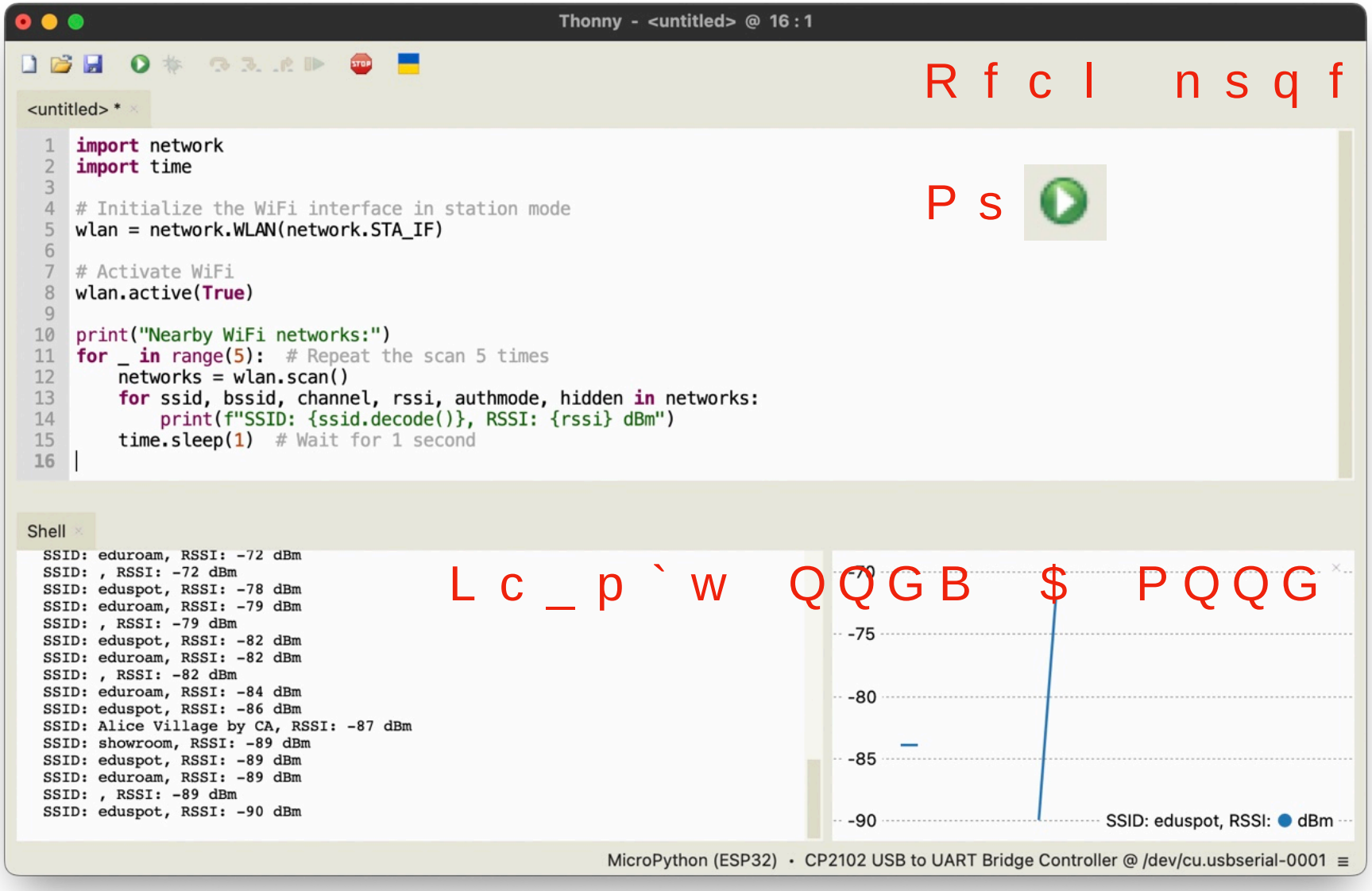
Hsqr af_lec rgkc, ccn _l

Tutorial list



Ex2) Wi-Fi finder nearby

A m n w $ n _ q r c
N w r f m l a m b c



R f c l n s q f

P s

L c _ p ` w Q Q G B $ P Q Q G u g j j q

D g l b g l e Q Q G B ª H D U K + U Q

Tutorial list

Glqrpsargml $ q_knjc ep

frrn8--/4/,1 ,

Npcn_p_rgml

KgapmNwrfml glqr_jj ml CQN1

Cvncpgkclrq

/,@jglli JCB ml CQN10

0,Afcaigle rfc UgDg dslargml mc

1,Ugpc @KC06. rm ecr b_r_

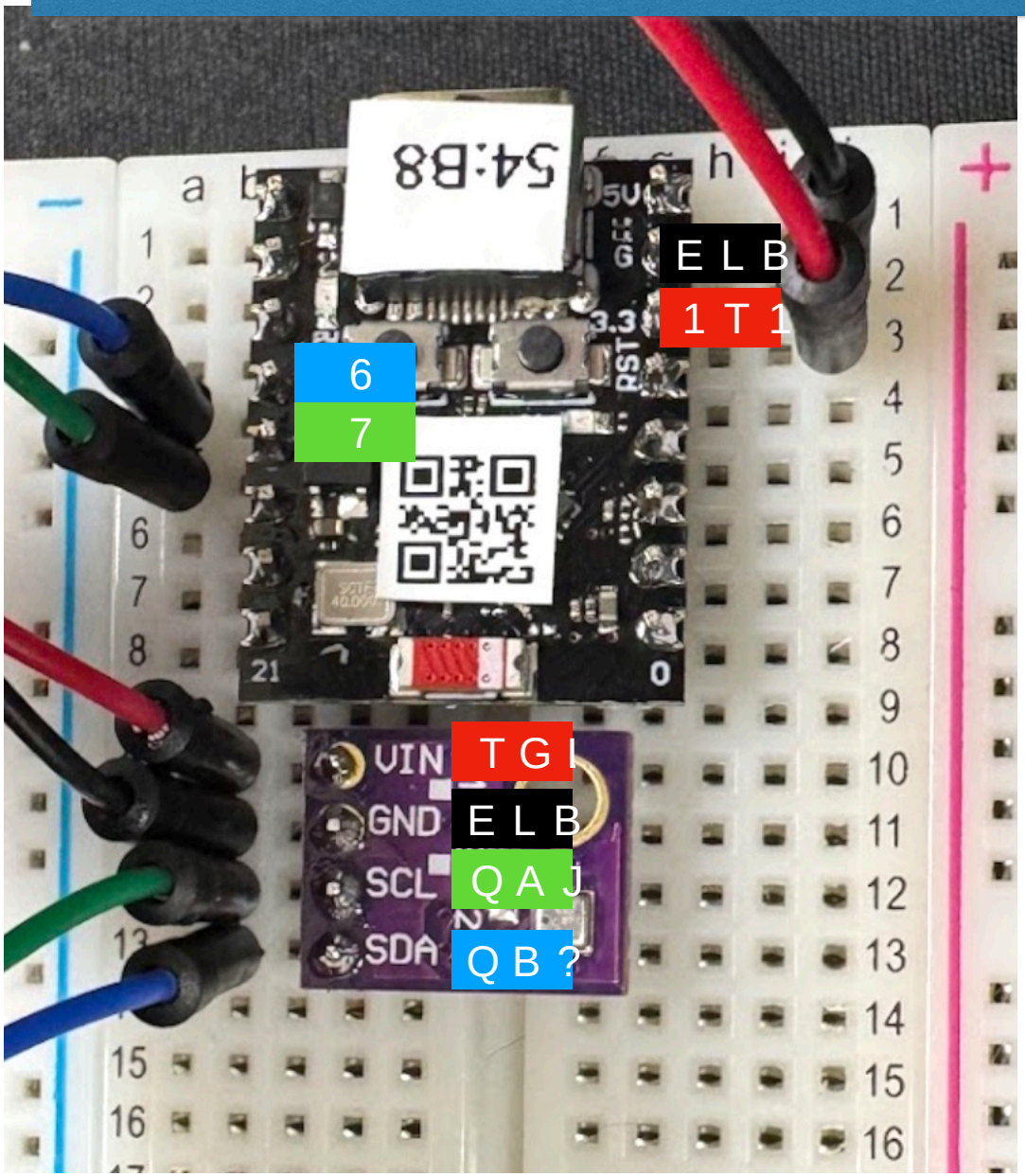
&@KC06.,nw jg`p_pw glqr_j

2,Snjm_b @KC06. b_r_ rm ajmsb t

3,Tgqs_jgx_rgml ml Ep_d_l_

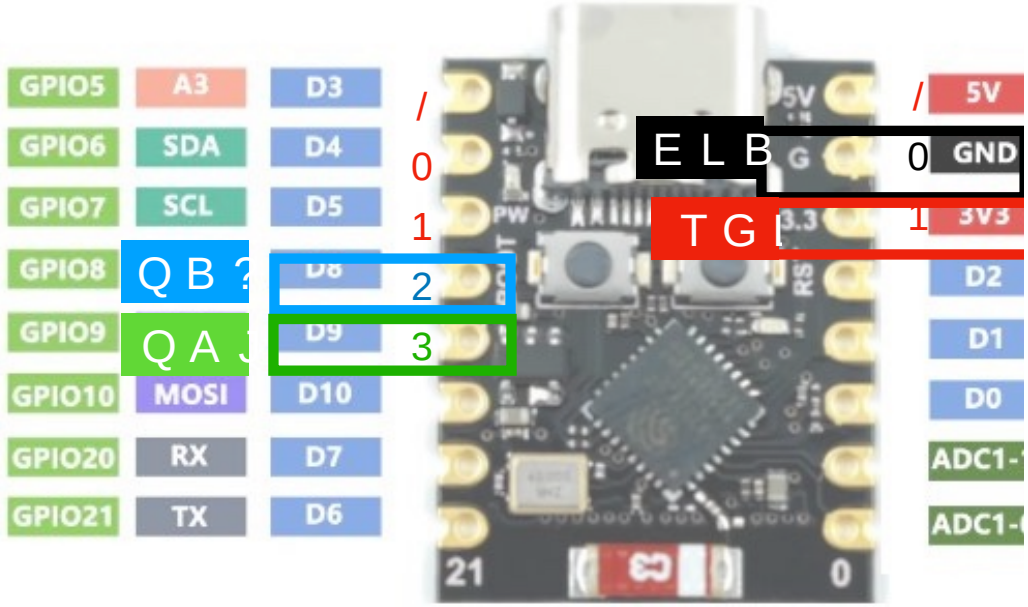
(Extra) BLE Beacon RSSI monitoring on Grafana

Wire connection on bredboard



2 u g p c q d m p G 0

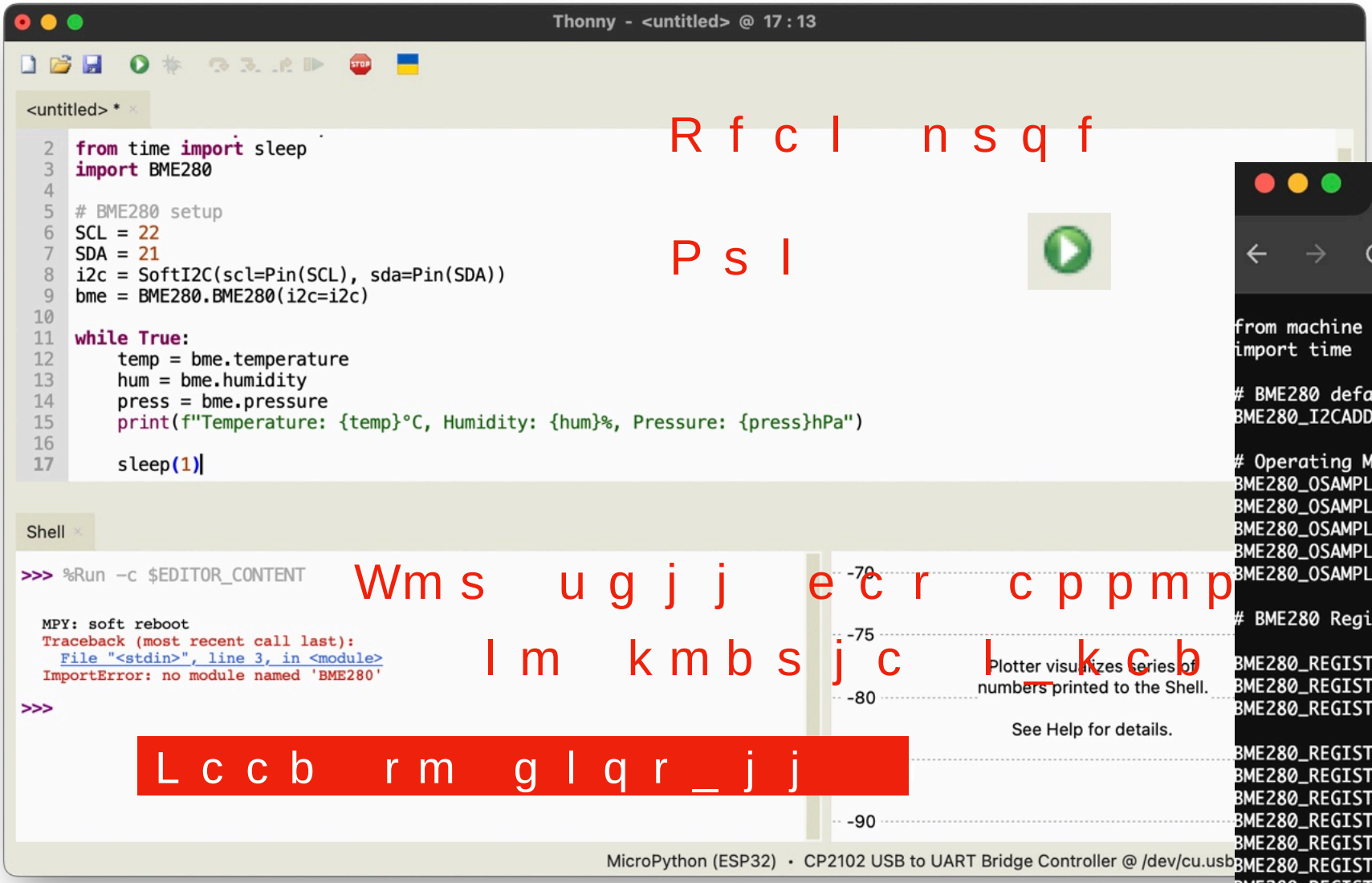
a m l l c a r u m l



Ex3) BME280 data get

A m n w $ n _ q r c

N w r f m l a m b c



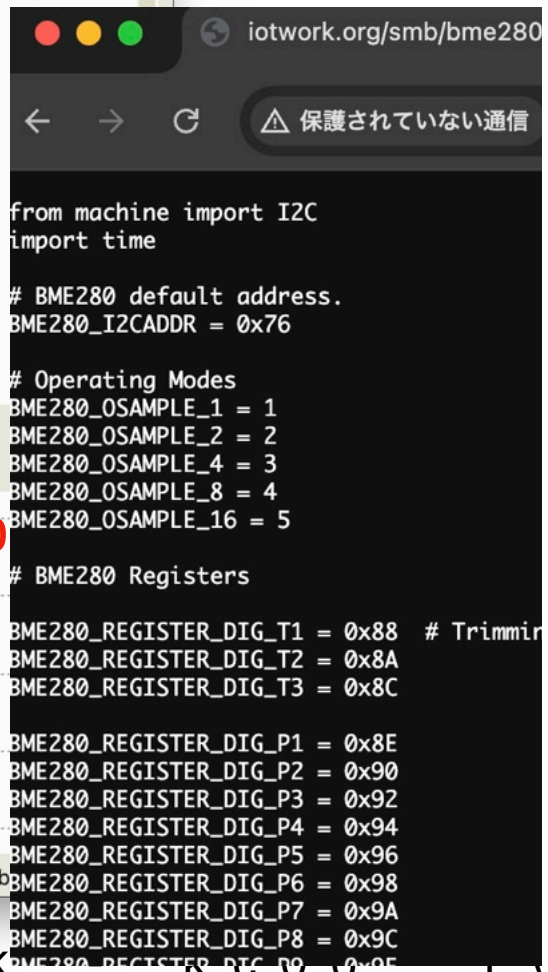
R f c l n s q f

P s l

W m s u g j j e c r c p p m p

l m k m b s j c l _ k c b

L c c b r m g l q r _ j j

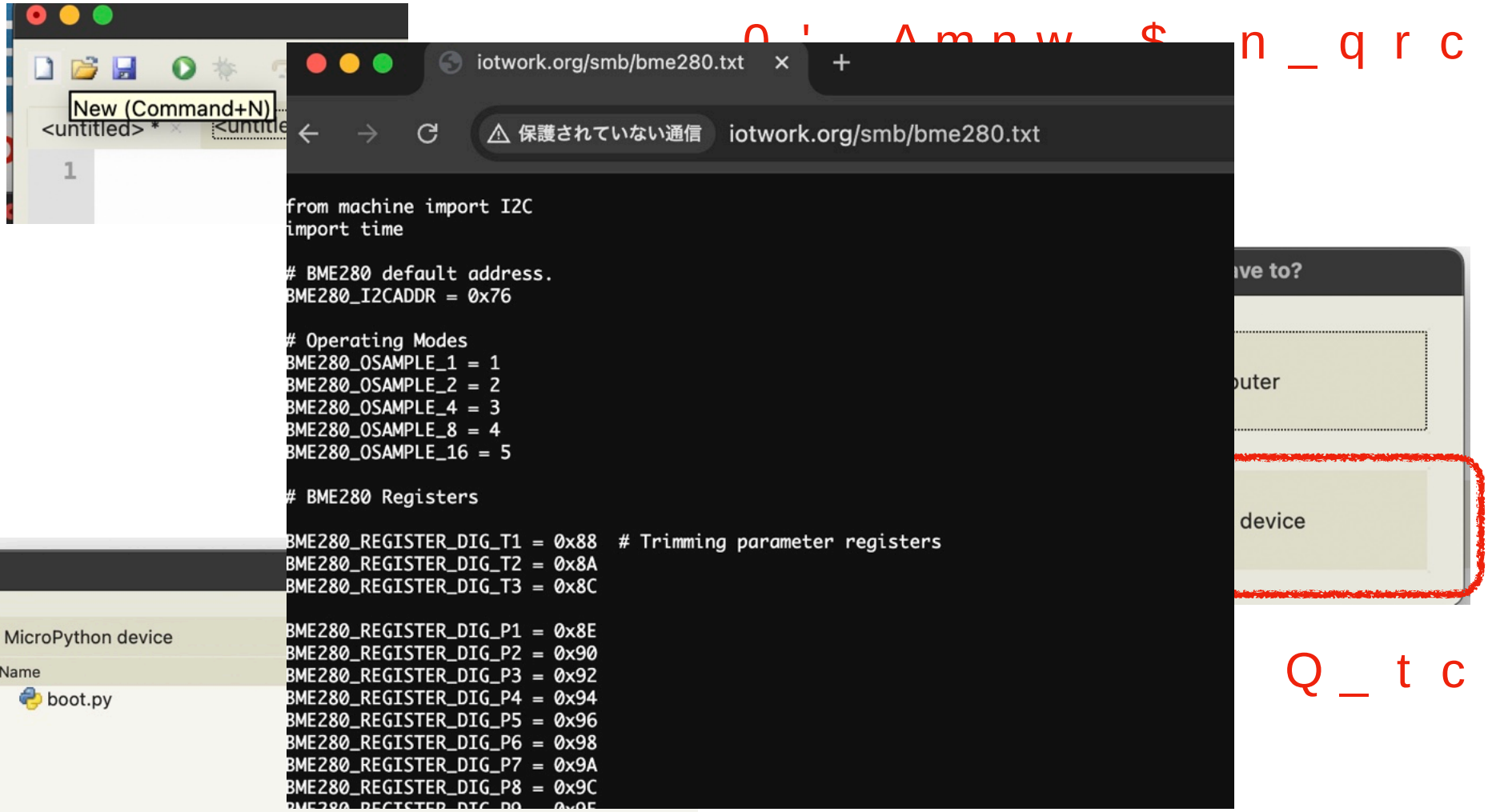


f r r n 8 - - g m r u m p i , m p e - q k

A m n w m l a j g n + ` m _ p b

Ex3) BME280 data get

/ ' A p c _ r c l c u c b g r m p u g l b m u



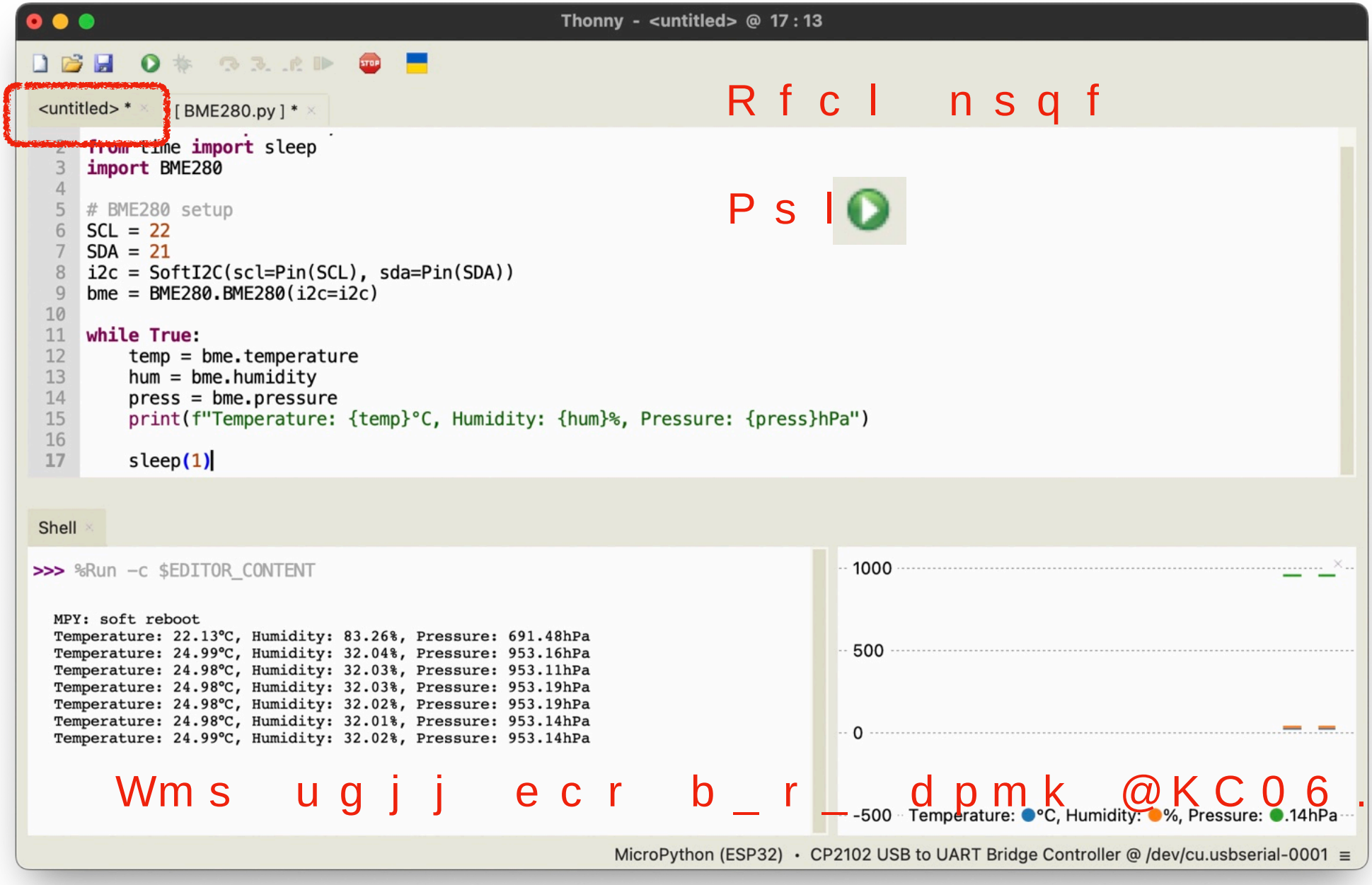
Q _ t c g r

2 ' Q®cj rc l _ k c @ K C 0 6 . , n w }

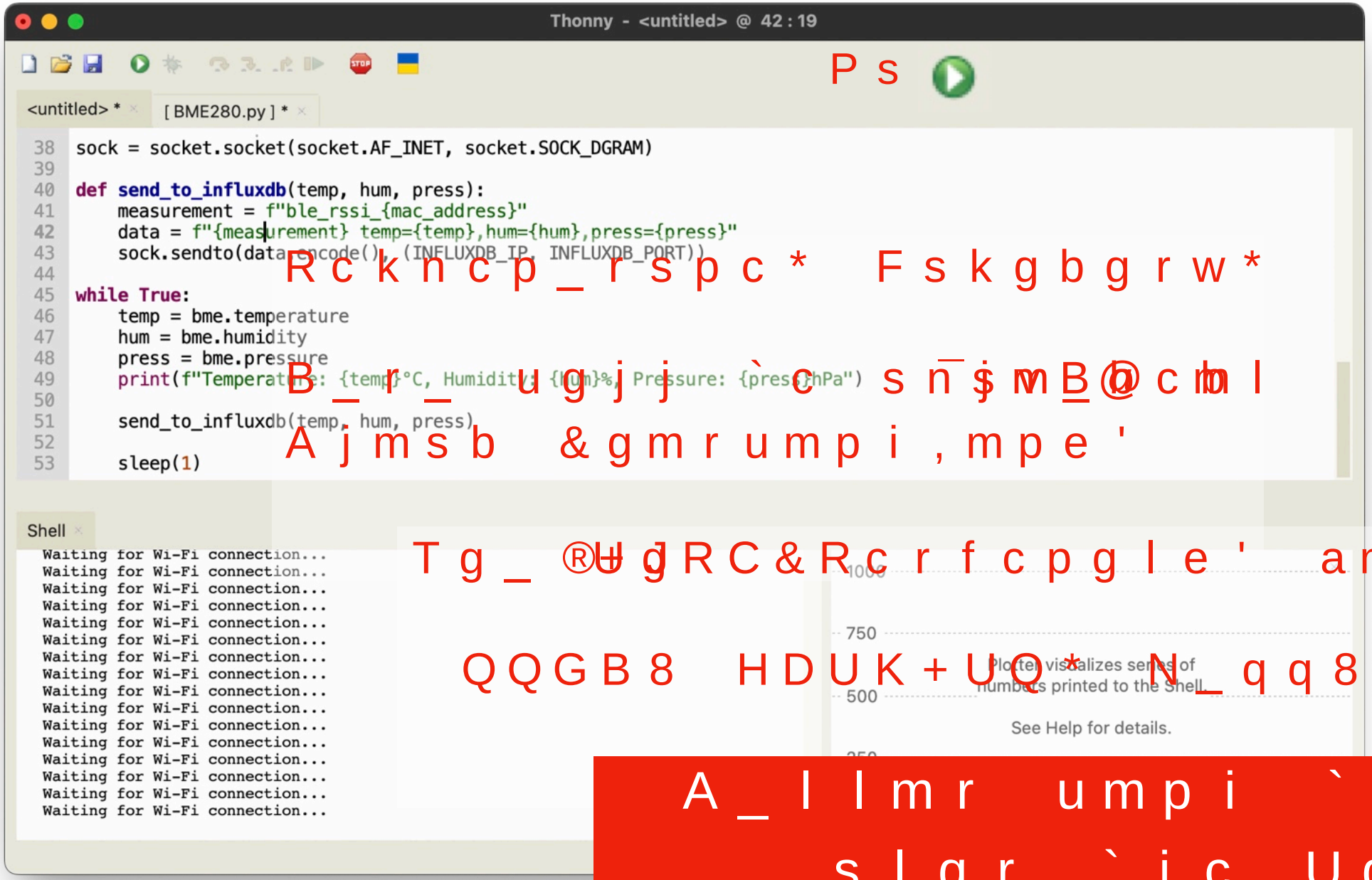
Q _ t c < Y M I [

Ex3) Get BME280 data

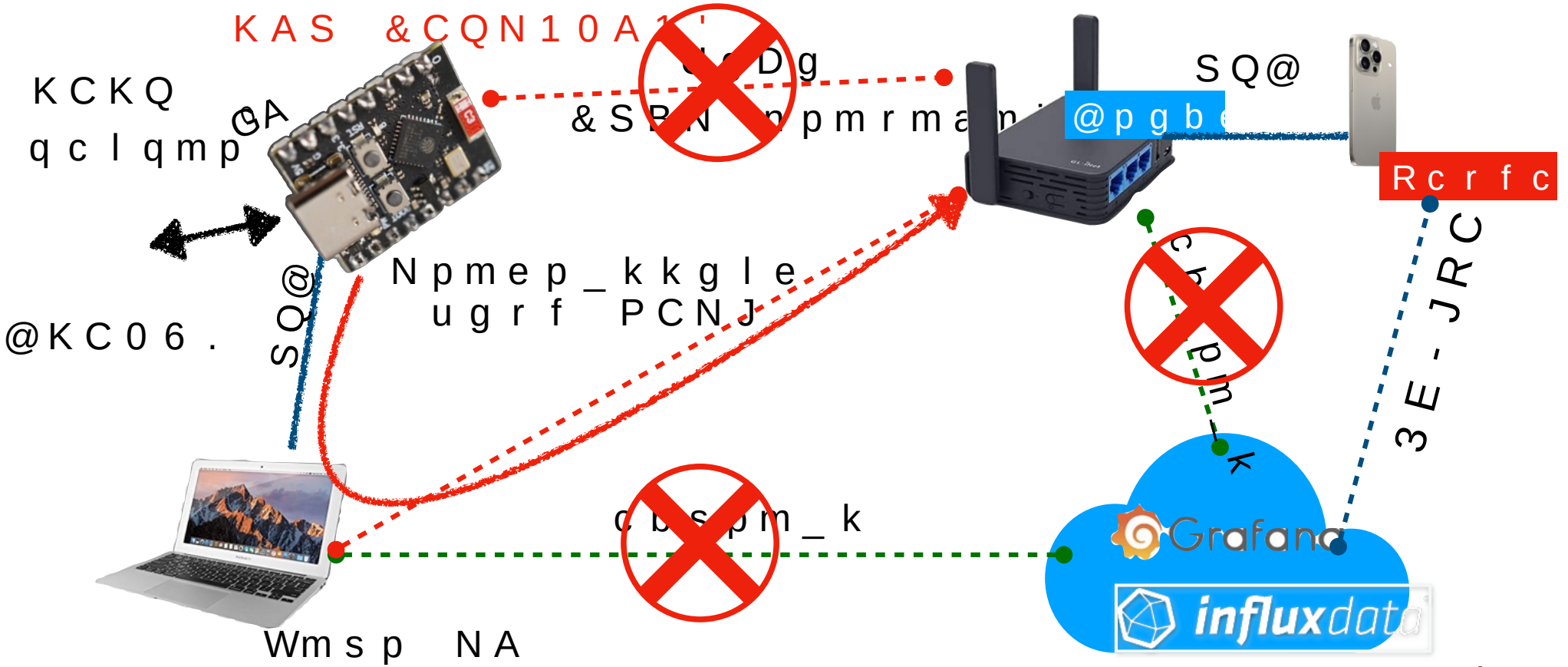
N p c q q g l g r g _ j r _ ` &S I r g r j c b , , '



Ex4) BME280 data upload to InfluxDB



Overview of connections (revised)



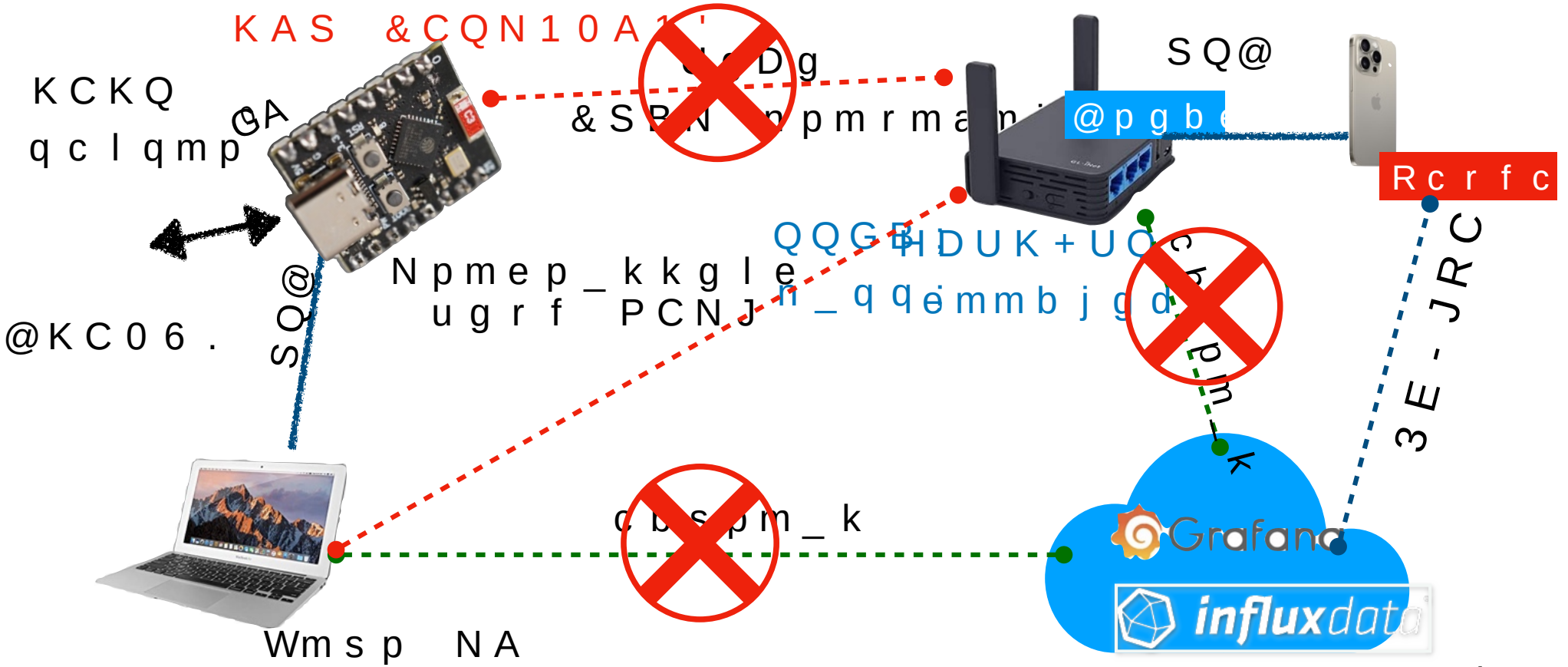
P c t g q

@c a _ s q c m d r f c j m u o s _ j g r w U g D g m a m l l c a r g m l s l q r _ ` j c

C Q N 1 0 A 1 e c r b _ r _ d p m k @K C 0 6 . < q c

C Q N 1 0 A 1 m n c p _ r c u g r f q r _ l b _ j m l

Overview of connections (revised)



Pctgq

@ca_sqc md rfc jmu os_jgrw UgDg m amllcargml slqr_`jc

CQN10A1 ecr b_r_ dpmk @KC06.< qc

CQN10A1 mncp_rc ugrf qr_lb_jml

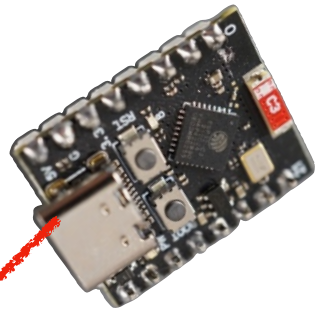
R u m n w r f m l q a p g n r q _ t c b g

k _ g l , n w &@mm r _ l b p s l

k _ g l] n w + @ K C 0 6 . + Q c p g

@ K C 0 6 . , n w

@ K C 0 6 .] n w + C Q N



S Q @

Q c p g _ j

R c r f c

U g + D g

S B N q c l b q a p g n r

m l R f m l l w N A

S Q @

3 E - J R C

A j m s

Q c p g _ j + S B N + s n + R

[main.py] × [BME280.py] × <untitled> * × <untitled> * ×

```
1  # forward_serial_to_udp_simple.py
2  import socket, sys, time
3  import serial
4
5  # ==== Adjust these settings to your environment ====
6  SERIAL_PORT = "/dev/tty.usbmodem1101"       # Windows → "COM7"
7  #SERIAL_PORT = "/dev/ttyACM0"      # Linux
8  #SERIAL_PORT = "/dev/tty.usbmodem11101"  # macOS
9
10 BAUD = 115200
11 UDP_HOST = "iotwork.org"   # InfluxDB server host
```

A f _ l e c Q c p g _ j n r

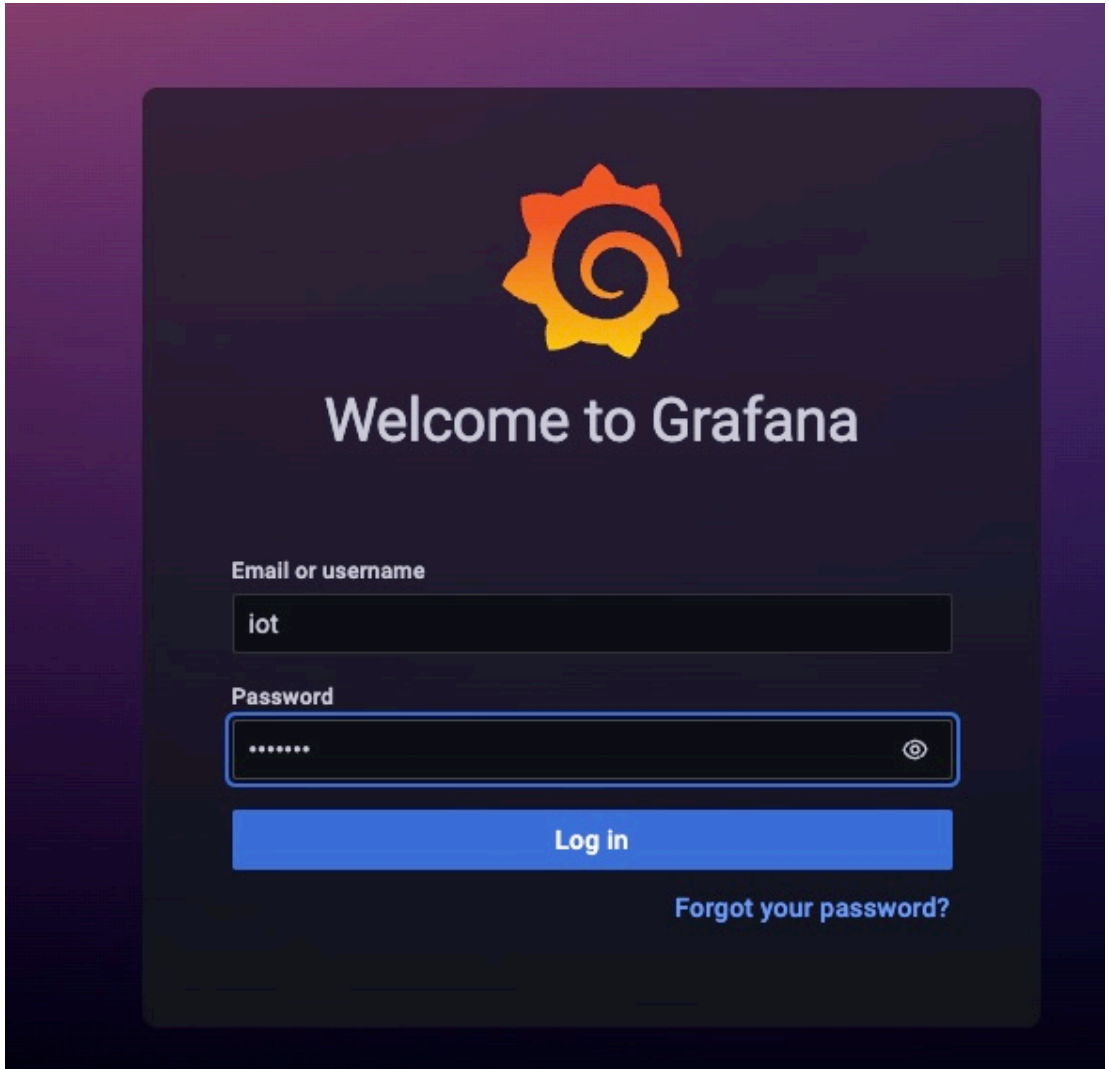
influxdata

Data visualization on Grafana

? a a c q q e p _ d _ l _ q c p t c p m l a j m s b t g _

& Q Q G B 8 H D U K + U Q * n _ q q 8 e m m b j g d c '

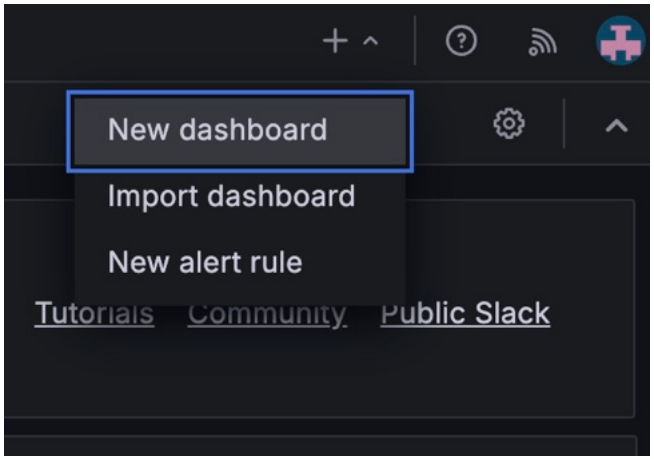
f r r n 8 - - g m r u m p i , m p e 8 1 . . . -



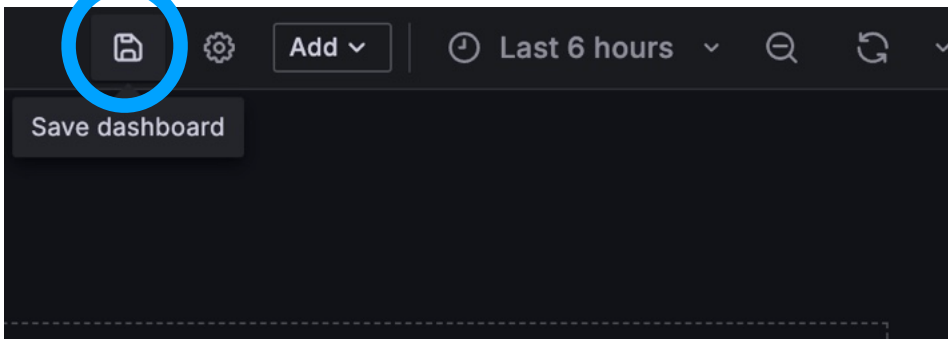
s q c p 8 g m k

n _ q q 8 g m k r 0

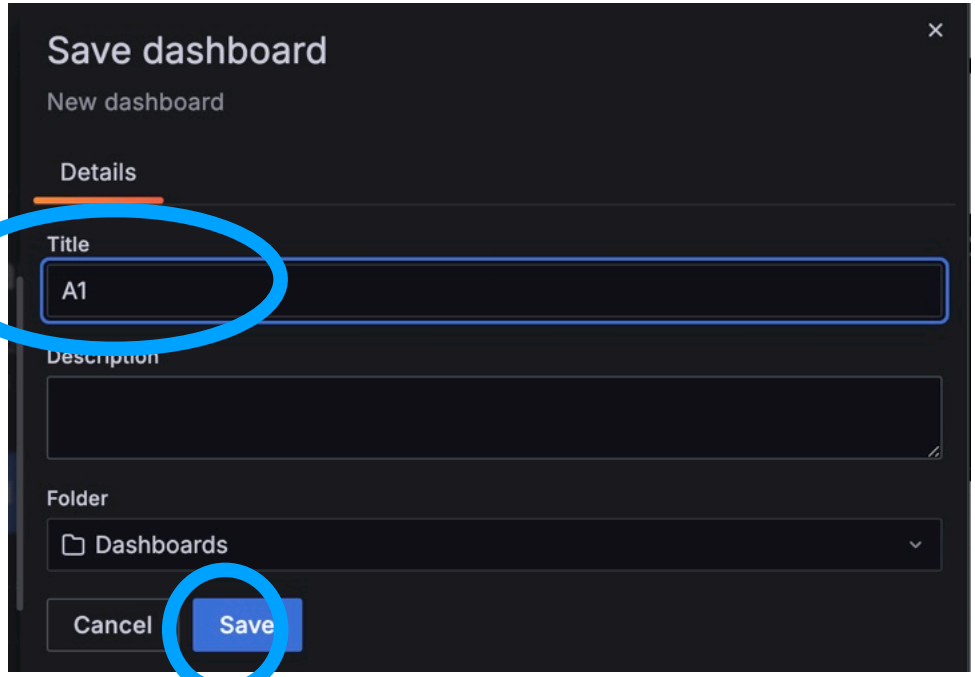
&/' apc_rc ªB_qf`m_pb¸ dpmk)



&0' Q_tc°

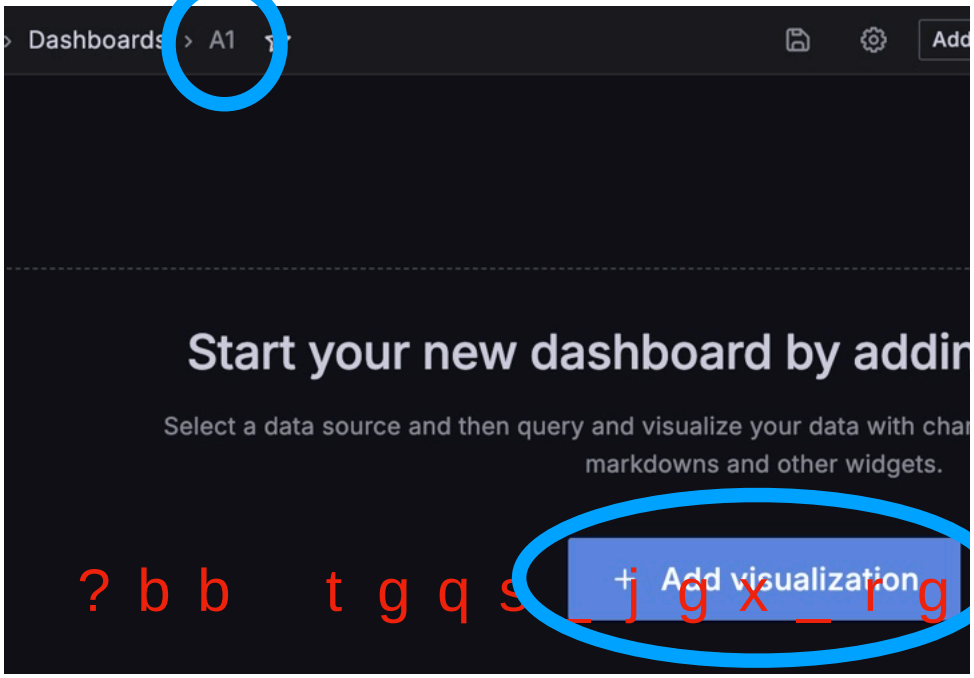


&1' Glnsr rgrjc _q wmsp epmsn ?/_*



&2' Q_tc

Am®pk wmsp epmsn

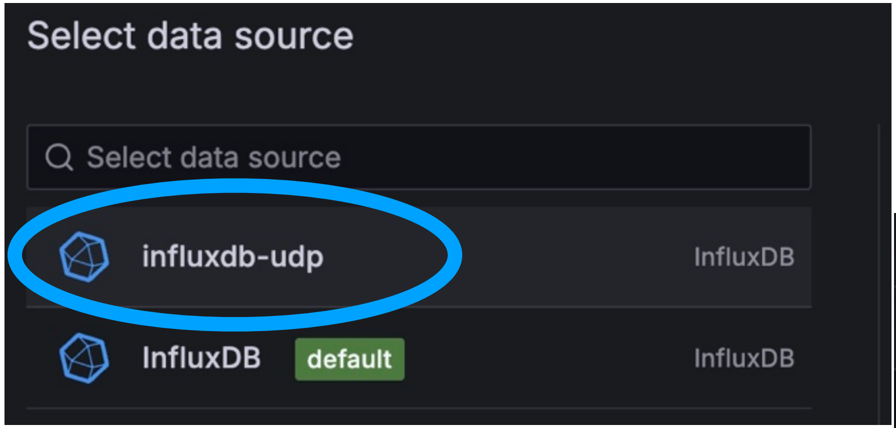


&3' ?bb tgqs_jgx_rg

&4' Qcjcar b_r_ qmspac

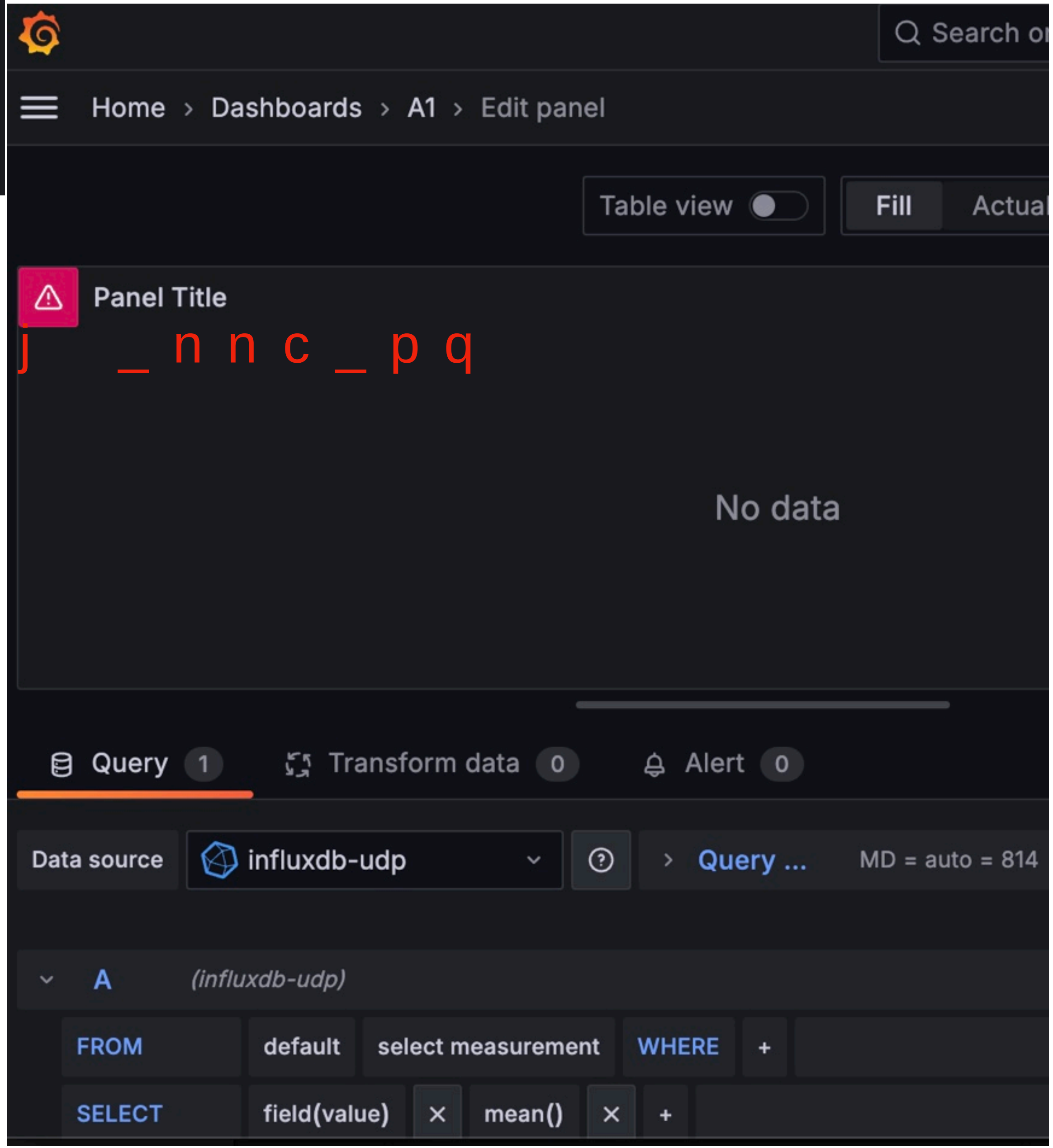
B_r_ ~~dpmk~~ CQN10 Rfr

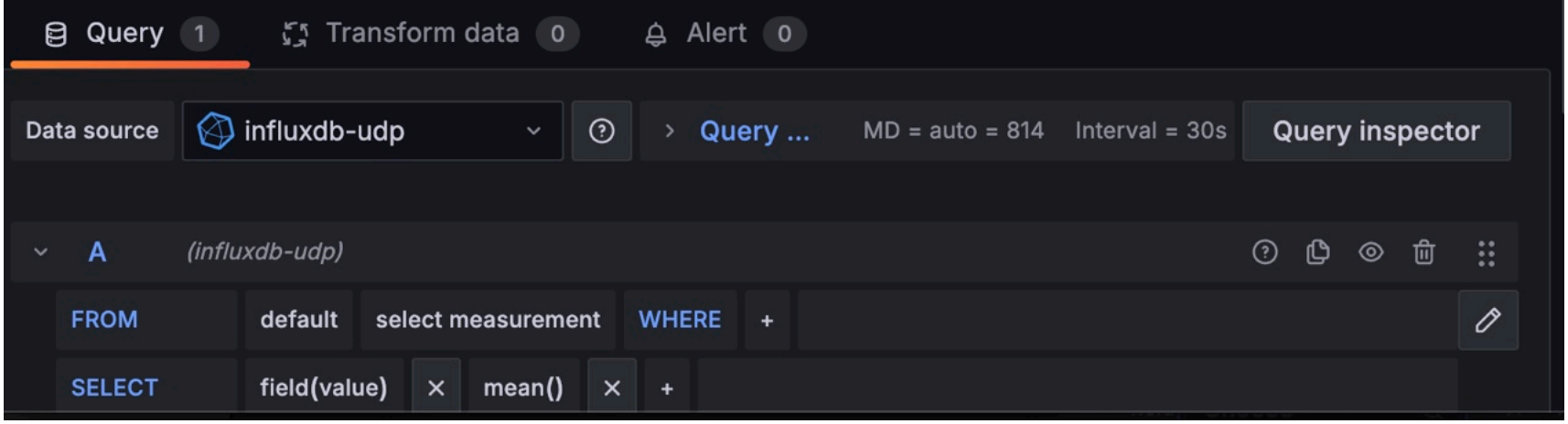
qrmpcb ¯syb`gb n



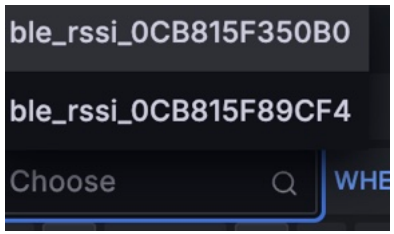
&5' Npc¯syb`gb

< Cbgr n_lcj _nnc_pq





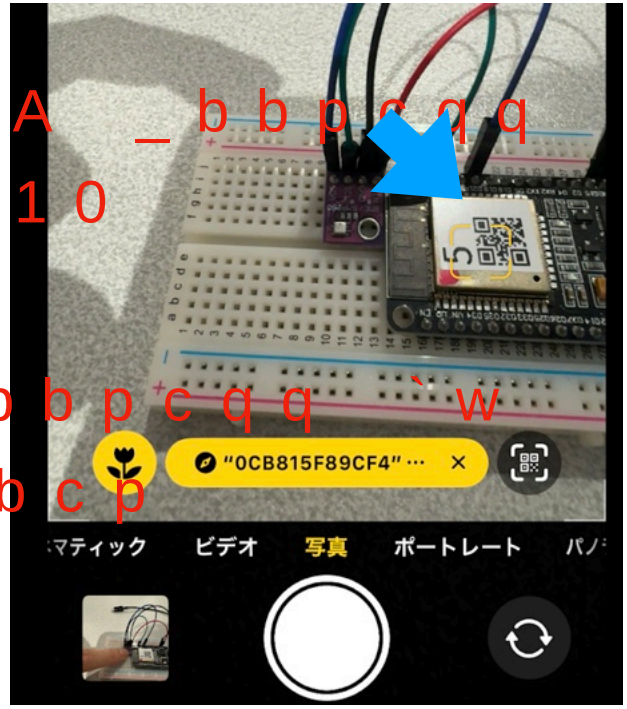
& 6 ' Q c j c a r k c _ q s p c k c l r



D g l b g l e ` j c] p q q g] = = = = = = =

= = = = = = = = g q K ? A _ b b p c q q

m d w m s p C Q N 1 0



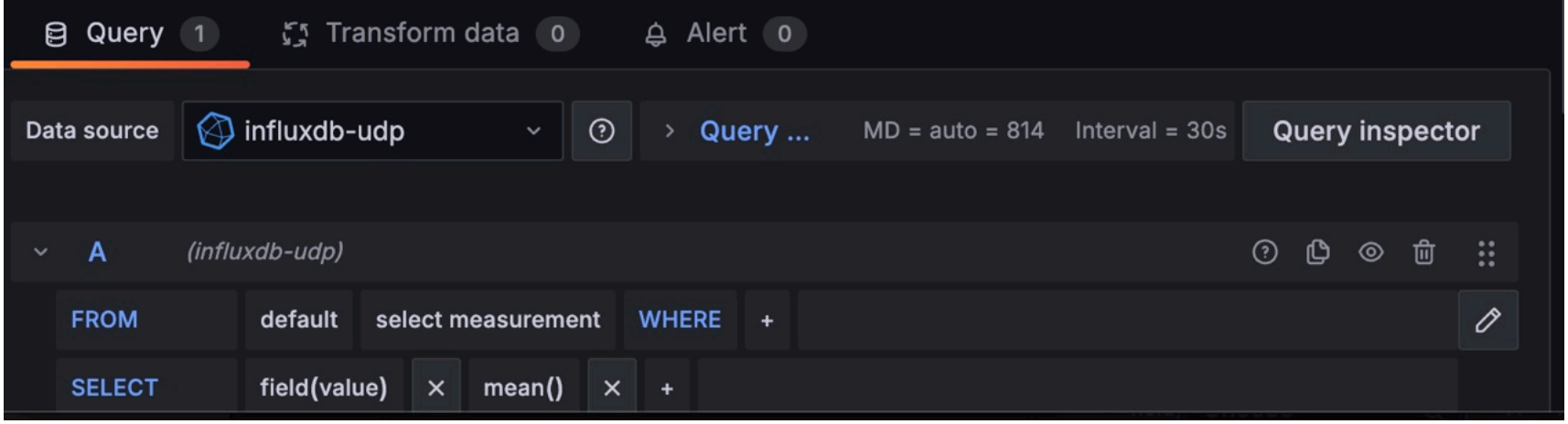
M p j _ ` c j j c b l

C Q N 1 0 _ l b _ b b

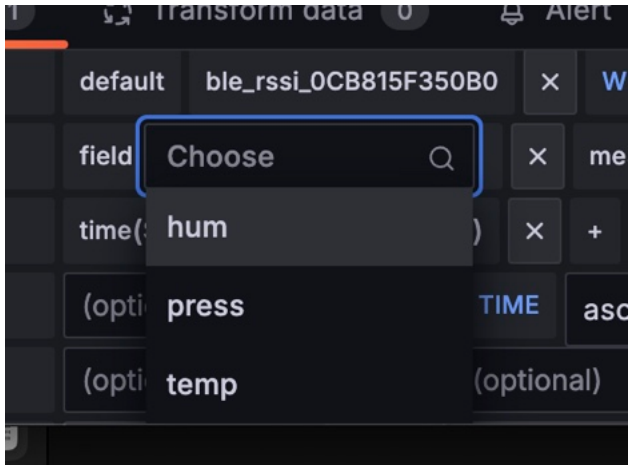
W m s a _ l e c r _ b b p c q q ` w

O P a m b c p c _ b c p

Q c j c a r w m s p e p m s n } q _ b b p c q q



& 7 ' Q c®jc cj ab r & t _ j s c '



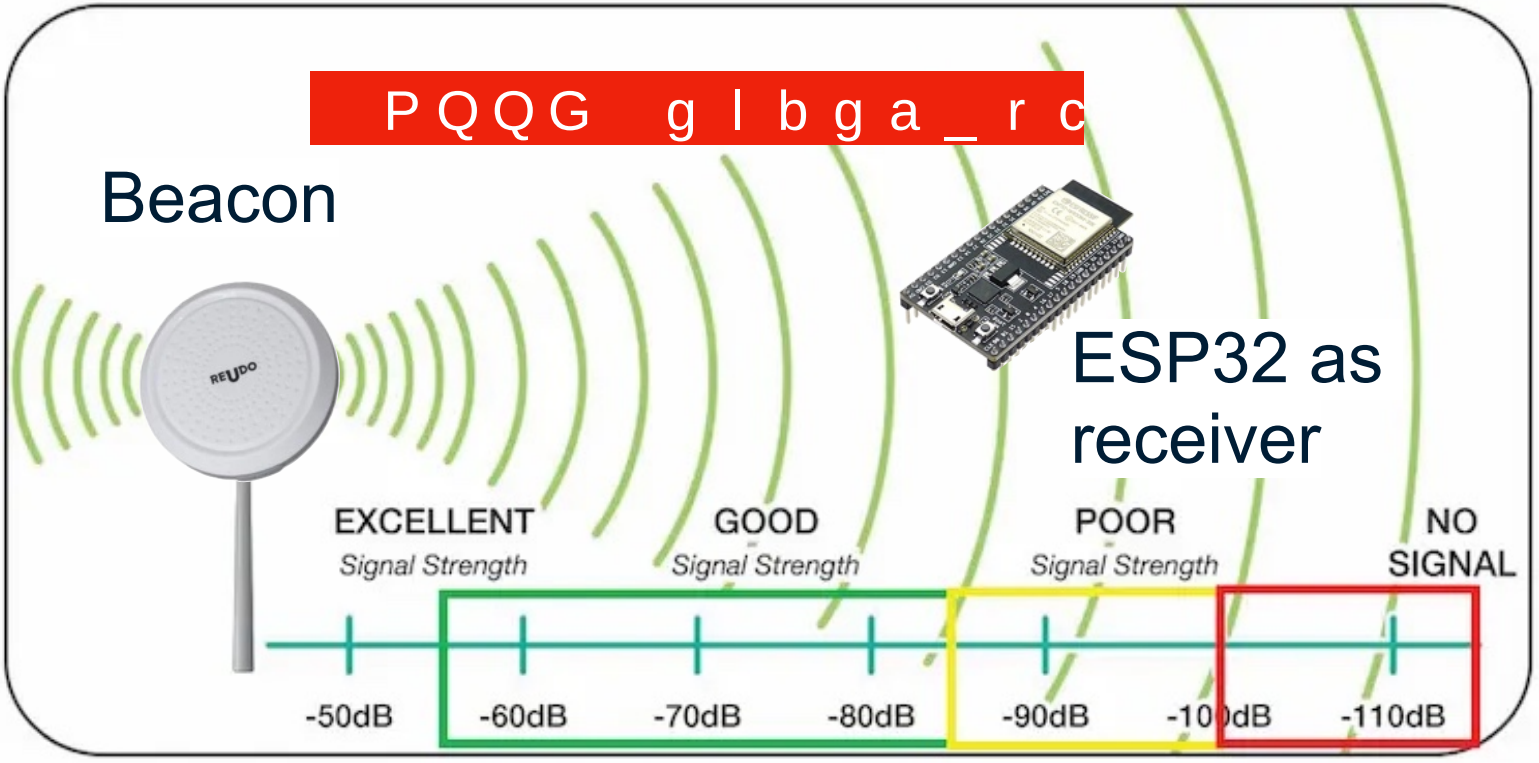
Wm s a _ l a f mm
f s k 8 F s k g b g
n p c q q 8 N p c q c
r c k n 8 R c k n c p _ r s p c

B c r _ g j
` c c v n j
m l q g

& / . '
D g l _ j j w * e c r _ e p _ n f
d m p q c j c a r g m l

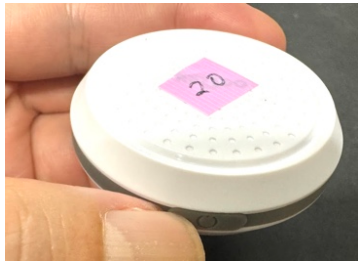
Opt) Beacon RSSI upload InfluxDB

Bluetooth Low Energy (BLE) beacons are small, battery-powered devices that transmit data using Bluetooth Low Energy.

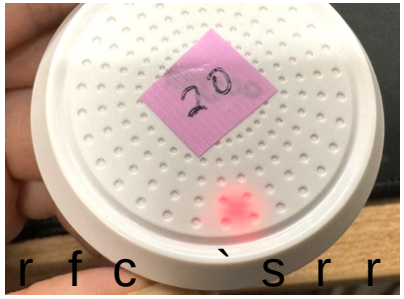


Before programing

Power on Beacon



N p c q q _ l b f m j b



J C B _ q f c

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Opt) Beacon RSSI upload InfluxDB

Amnw $ n_qrc Rfcl nsqf

Ps

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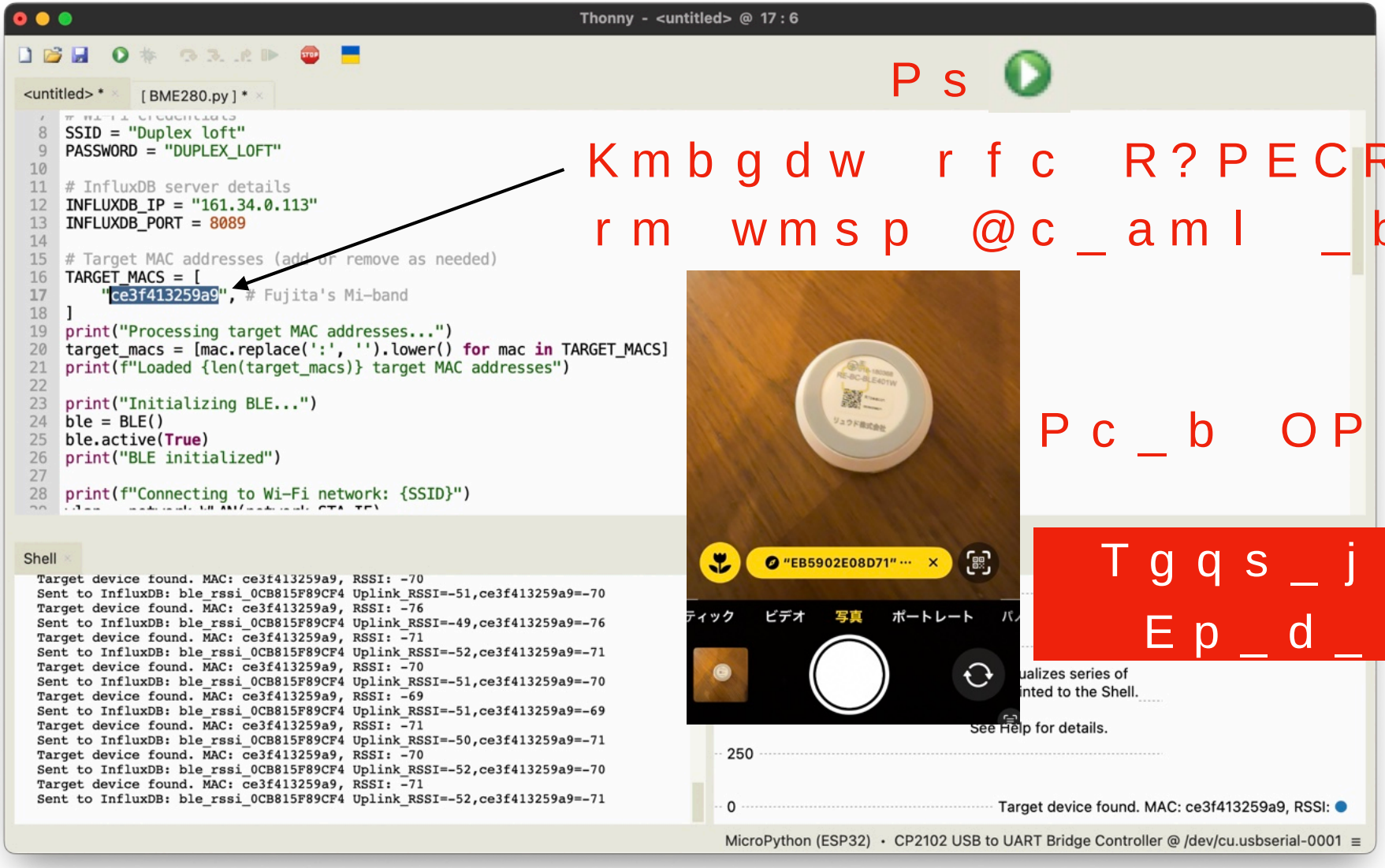

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