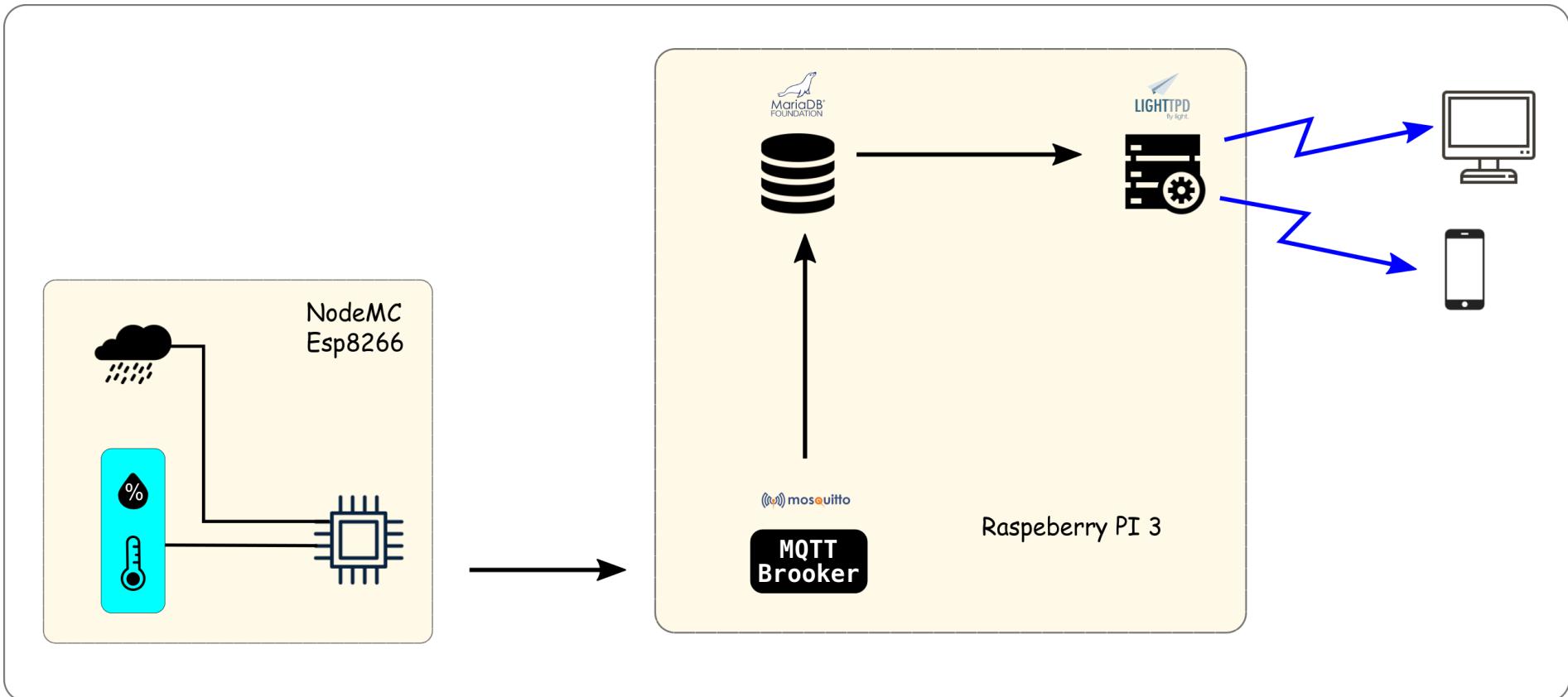




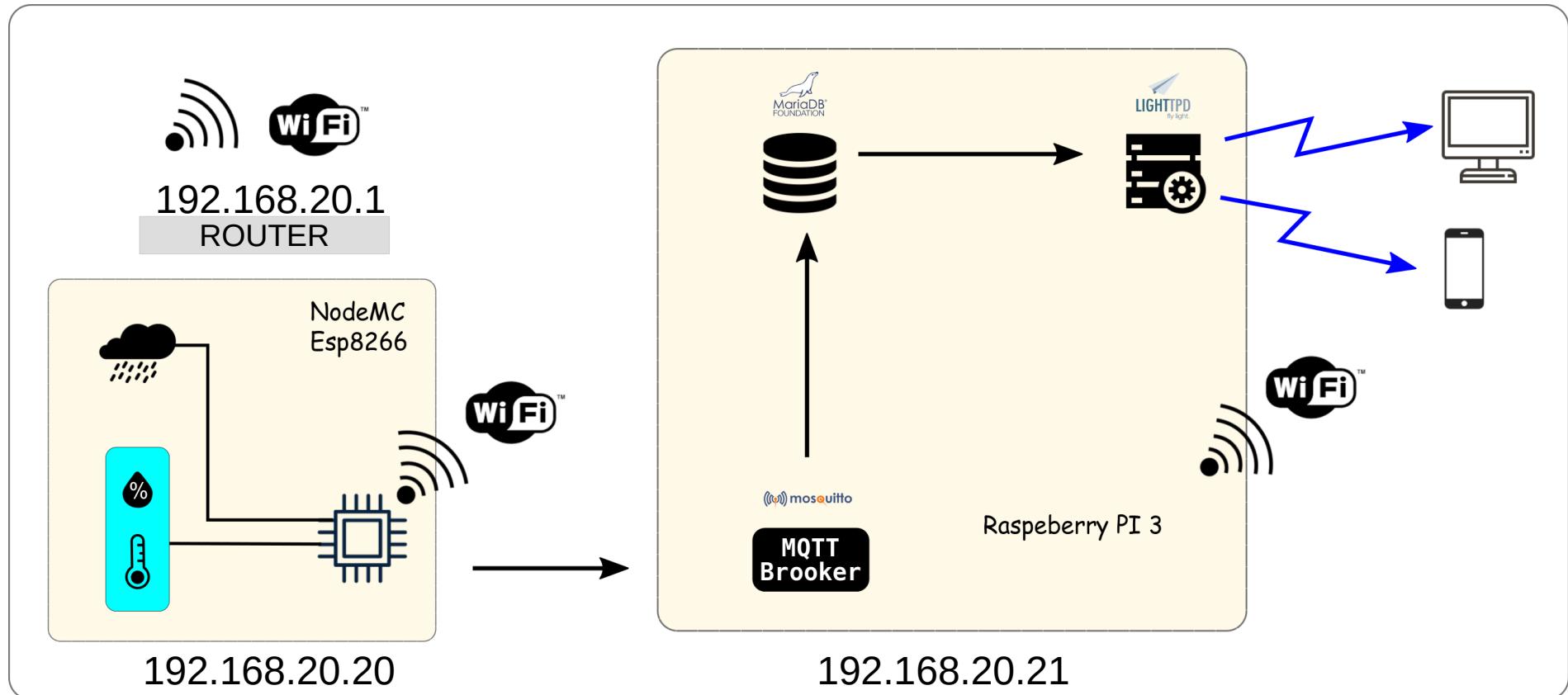
Piccolo esperimento IoT

LINUX DAY 2018

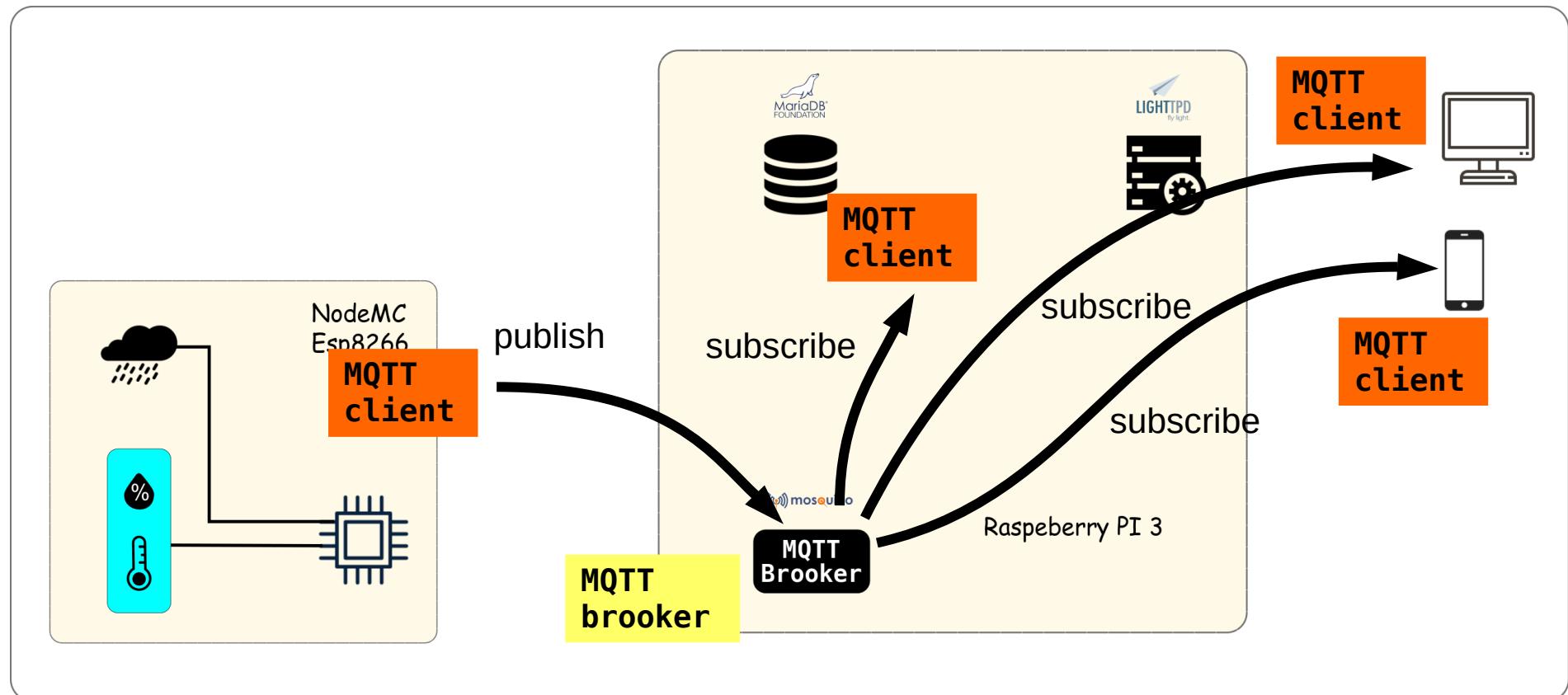
data path



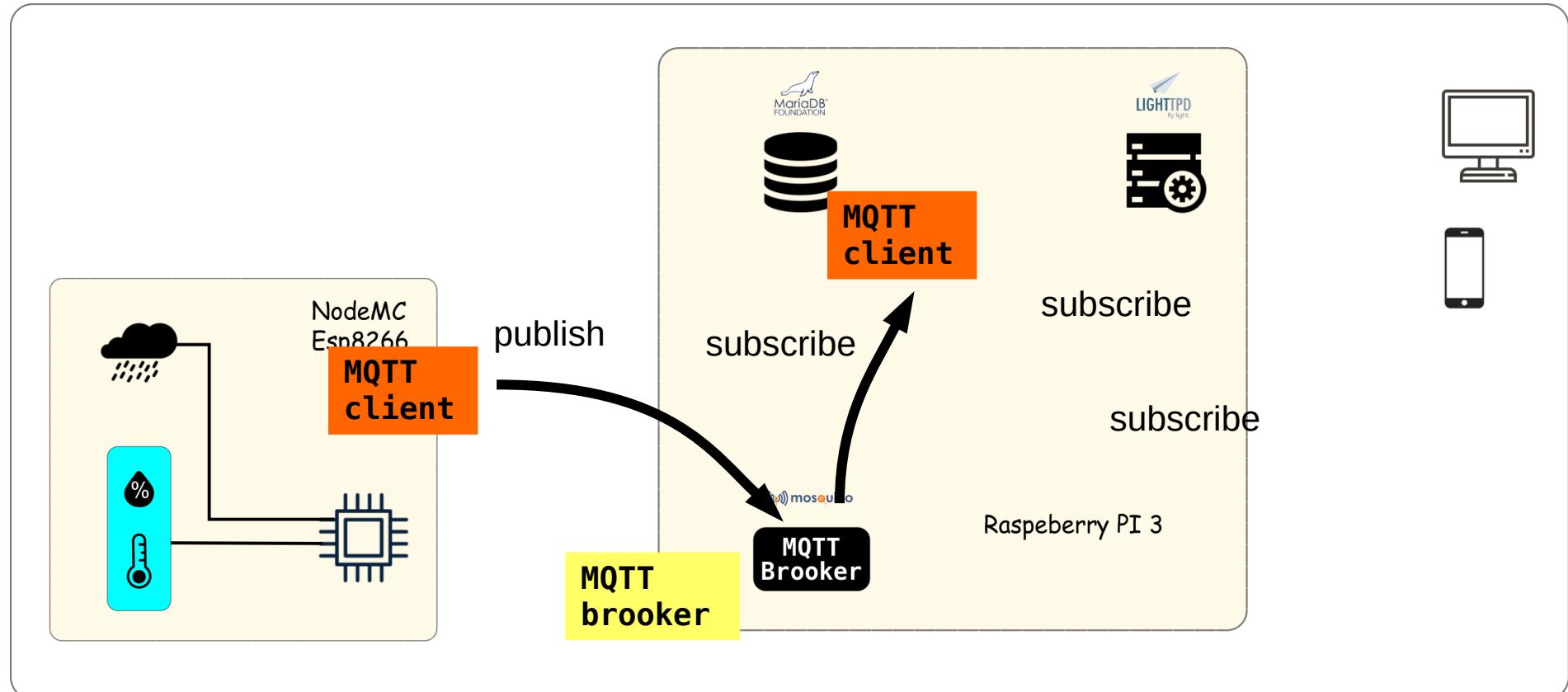
network



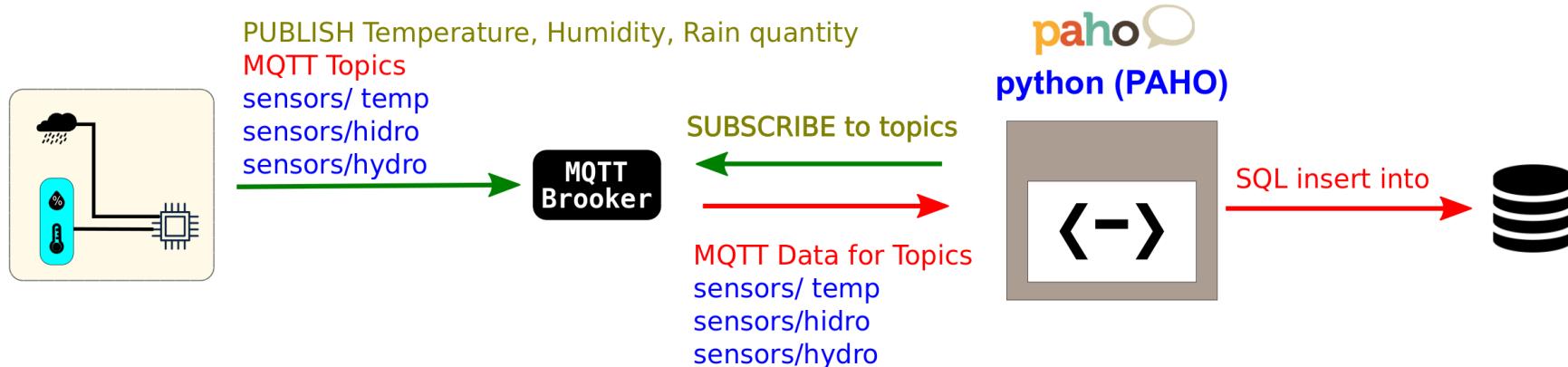
MQTT actors



MQTT message path

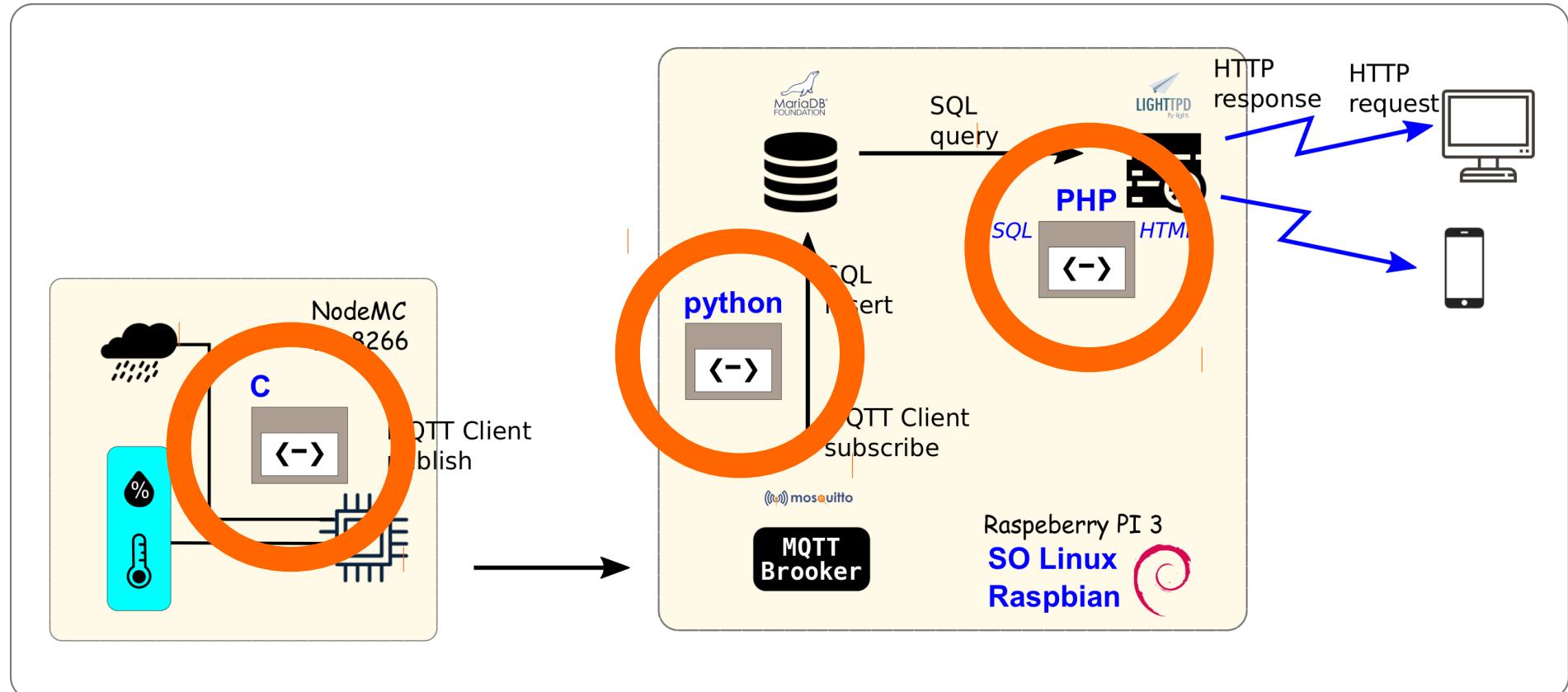


MQTT message path

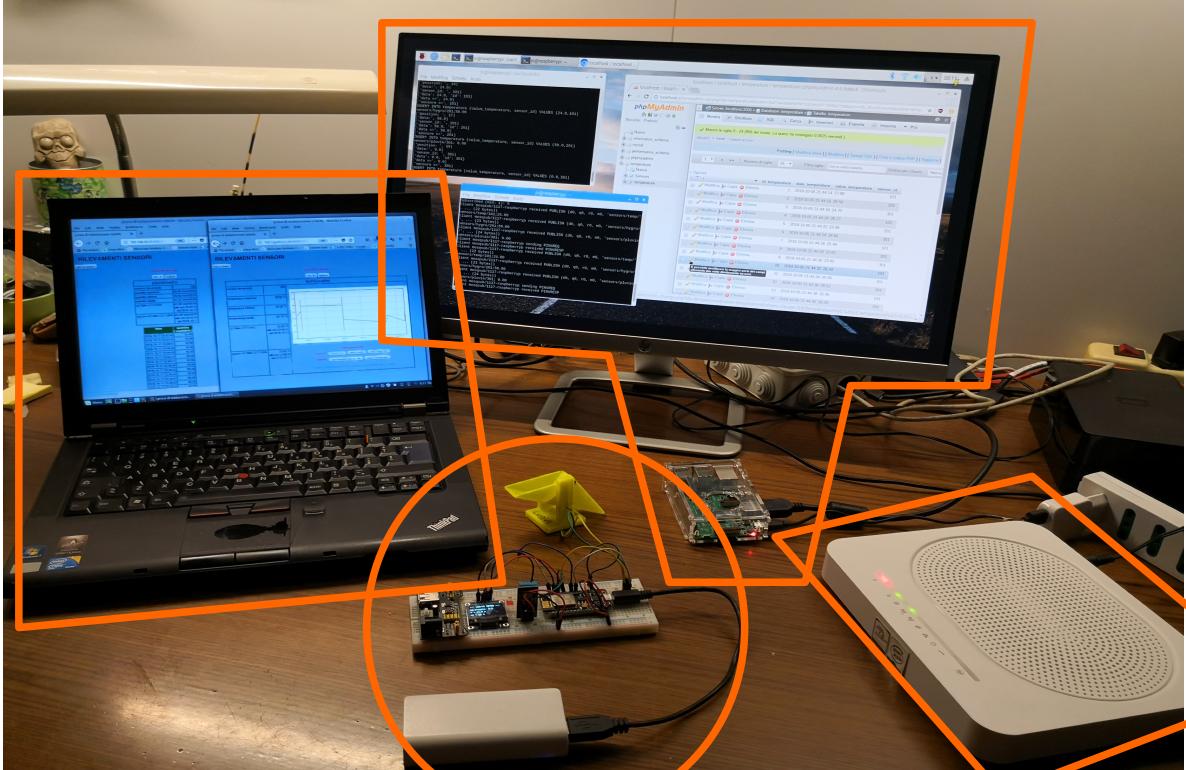


The Eclipse Paho project provides open-source client implementations of MQTT and MQTT-SN messaging protocols aimed at new, existing, and emerging applications for the Internet of Things (IoT).

complete layout

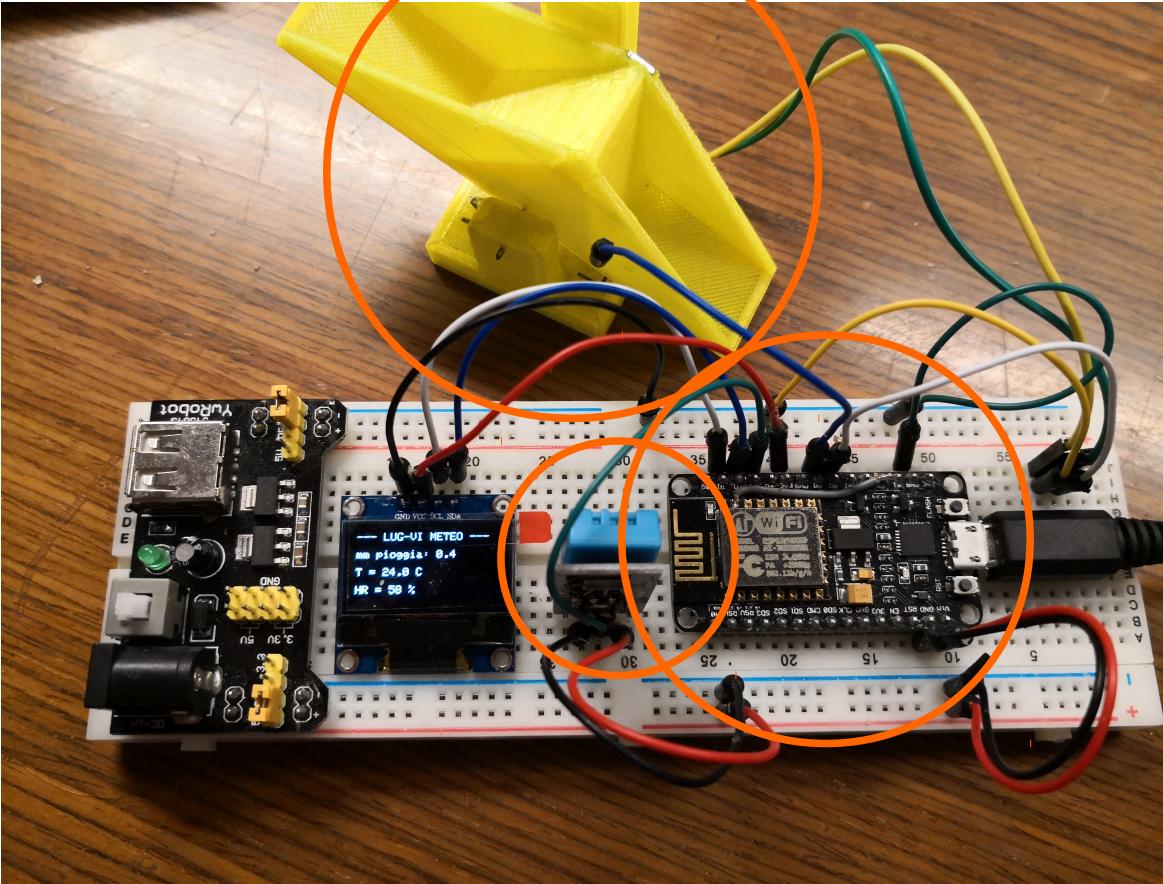


real things

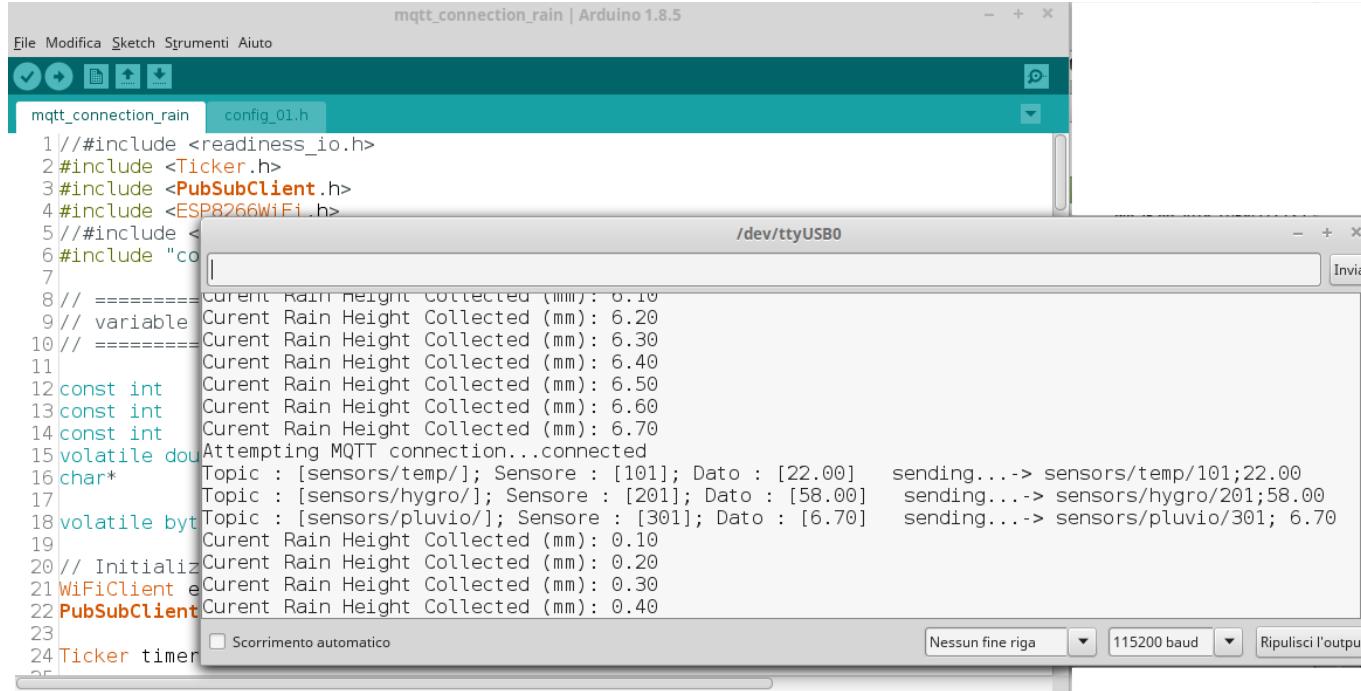


LINUX DAY 2018

real things



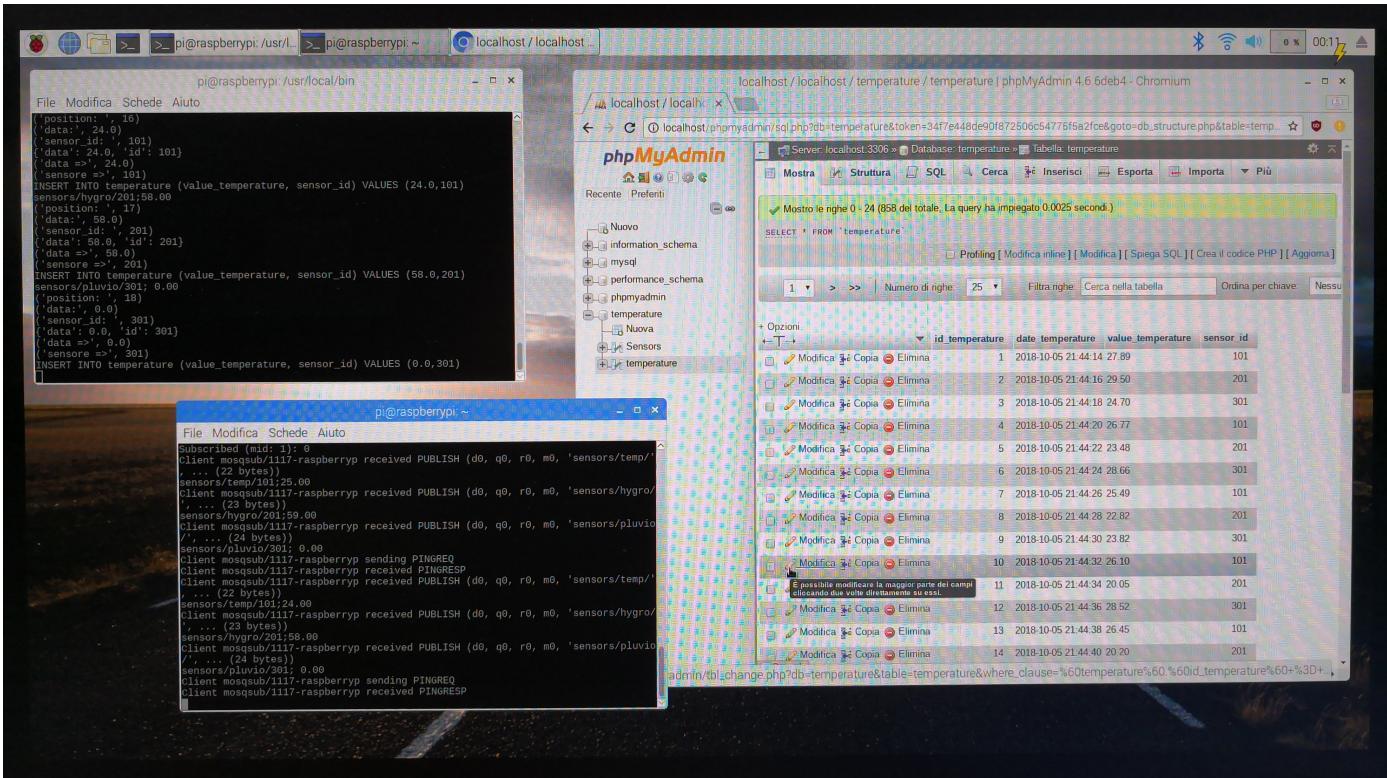
running program on ESP8266



The screenshot shows the Arduino IDE interface with the sketch named "mqtt_connection_rain" open. The code includes headers for readability, Ticker, PubSubClient, and WiFi. It defines variables for temperature (22.00), humidity (58.00), and rainfall (6.70). The setup initializes WiFi and sets up a PubSubClient. The loop reads rainfall data from a sensor and publishes it to an MQTT topic. The serial monitor window shows the current rain height collected in millimeters (0.10 to 0.40) and the data being sent to the MQTT broker.

```
mqtt_connection_rain | Arduino 1.8.5
File Modifica Sketch Strumenti Aiuto
 mqtt_connection_rain config_01.h
1 // #include <readiness_io.h>
2 #include <Ticker.h>
3 #include <PubSubClient.h>
4 #include <ESP8266WiFi.h>
5 // #include <
6 #include "co
7
8 // =====
9 // variable
10 // ======
11
12 const int
13 const int
14 const int
15 volatile dou
16 char*
17
18 volatile byt
19
20 // Initializ
21 WiFiClient e
22 PubSubClient
23
24 Ticker timer
    /dev/ttyUSB0
    Invia
    Current Rain Height Collected (mm): 0.10
    Current Rain Height Collected (mm): 0.20
    Current Rain Height Collected (mm): 0.30
    Current Rain Height Collected (mm): 0.40
    Attempting MQTT connection...connected
    Topic : [sensors/temp/]; Sensore : [101]; Dato : [22.00] sending...-> sensors/temp/101;22.00
    Topic : [sensors/hygro/]; Sensore : [201]; Dato : [58.00] sending...-> sensors/hygro/201;58.00
    Topic : [sensors/pluvio/]; Sensore : [301]; Dato : [6.70] sending...-> sensors/pluvio/301; 6.70
    Current Rain Height Collected (mm): 0.10
    Current Rain Height Collected (mm): 0.20
    Current Rain Height Collected (mm): 0.30
    Current Rain Height Collected (mm): 0.40
    Nessun fine riga 115200 baud Ripulisce l'output
    Scorrimento automatico
```

running program on Raspberry



Running program on Raspberry

```
mosquitto_sub -d -t sensors/# -h 192.168.20.21
```

```
pi@raspberrypi: ~
```

```
File Modifica Schede Aiuto
Subscribed (mid: 1): 0
Client mosqsub/1117-raspberryp received PUBLISH (d0, q0, r0, m0, 'sensor/101;25.00', ... (22 bytes))
Client mosqsub/1117-raspberryp received PUBLISH (d0, q0, r0, m0, 'sensor/201;59.00', ... (23 bytes))
Client mosqsub/1117-raspberryp received PUBLISH (d0, q0, r0, m0, 'sensor/301; 0.00', ... (24 bytes))
Client mosqsub/1117-raspberryp sending PINGREQ
Client mosqsub/1117-raspberryp received PINGRESP
Client mosqsub/1117-raspberryp received PUBLISH (d0, q0, r0, m0, 'sensor/101;24.00', ... (22 bytes))
Client mosqsub/1117-raspberryp received PUBLISH (d0, q0, r0, m0, 'sensor/201;58.00', ... (23 bytes))
Client mosqsub/1117-raspberryp received PUBLISH (d0, q0, r0, m0, 'sensor/301; 0.00', ... (24 bytes))
Client mosqsub/1117-raspberryp sending PINGREQ
Client mosqsub/1117-raspberryp received PINGRESP
```

```
pi@raspberrypi: /usr/local/bin
```

```
File Modifica Schede Aiuto
('position: ', 16)
('data:', 24.0)
('sensor_id: ', 101)
{'data': 24.0, 'id': 101}
('data =>', 24.0)
('sensore =>', 101)
INSERT INTO temperature (value_temperature, sensor_id) VALUES (24.0,101)
sensors/hygro/201;58.00
('position: ', 17)
('data:', 58.0)
('sensor_id: ', 201)
{'data': 58.0, 'id': 201}
('data =>', 58.0)
('sensore =>', 201)
INSERT INTO temperature (value_temperature, sensor_id) VALUES (58.0,201)
sensors/pluvio/301; 0.00
('position: ', 18)
('data:', 0.0)
('sensor_id: ', 301)
{'data': 0.0, 'id': 301}
('data =>', 0.0)
('sensore =>', 301)
INSERT INTO temperature (value_temperature, sensor_id) VALUES (0.0,301)
```

Python code to insert data in the database



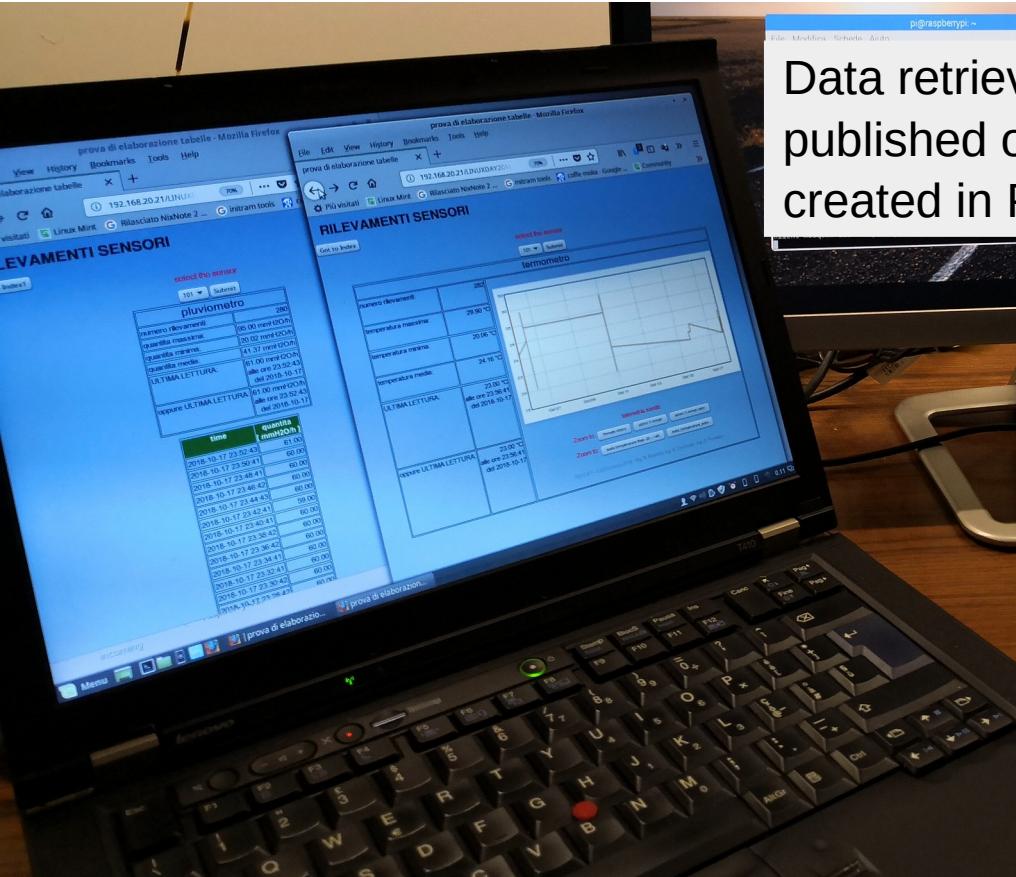
a view into the database

The screenshot shows the phpMyAdmin interface for a MySQL database named 'temperature'. The left sidebar lists databases like 'information_schema', 'mysql', 'performance_schema', 'phpmyadmin', and the current 'temperature' database. The main area displays the 'temperature' table with 24 rows of data. The columns are 'id_temperature', 'date_temperature', 'value_temperature', and 'sensor_id'. The data shows temperature readings from 21.00 to 60.00 at various dates and times, with sensor IDs 101, 201, and 301.

	id_temperature	date_temperature	value_temperature	sensor_id
1	1	2018-10-25 20:15:25	21.00	101
2	2	2018-10-25 20:15:25	62.00	201
3	3	2018-10-25 20:15:25	10.00	301
4	4	2018-10-25 20:17:27	21.00	101
5	5	2018-10-25 20:17:27	62.00	201
6	6	2018-10-25 20:17:27	9.60	301
7	7	2018-10-25 20:19:26	21.00	101
8	8	2018-10-25 20:19:26	61.00	201
9	9	2018-10-25 20:19:26	9.30	301
10	10	2018-10-25 20:21:26	21.00	101
11	11	2018-10-25 20:21:26	61.00	201
12	12	2018-10-25 20:21:26	7.40	301
13	13	2018-10-25 20:23:25	21.00	101
14	14	2018-10-25 20:23:25	60.00	201



remote data visualization via web pages



Data retrieved by the database and published on web page created in PHP/html language

- MQTT stands for Message Queuing Telemetry Transport. It is a publish/subscribe, extremely simple and lightweight messaging protocol, designed for constrained devices and low-bandwidth, high-latency or unreliable networks. The design principles are to minimise network bandwidth and device resource requirements whilst also attempting to ensure reliability and some degree of assurance of delivery. These principles also turn out to make the protocol ideal of the emerging “machine-to-machine” (M2M) or “Internet of Things” world of connected devices, and for mobile applications where bandwidth and battery power are at a premium.

<http://mqtt.org/>

NodeMCU



- NodeMCU is an open source Lua based firmware for the ESP8266 WiFi SOC from Espressif and uses an on-module flash-based SPIFFS file system. NodeMCU is implemented in C and is layered on the Espressif NON-OS SDK.
- The firmware was initially developed as is a companion project to the popular ESP8266-based NodeMCU development modules, but the project is now community-supported, and the firmware can now be run on any ESP module.
- Arduino-like hardware IO
- Advanced API for hardware IO, which can dramatically reduce the redundant work for configuring and manipulating hardware. Code like arduino, but interactively in Lua script.

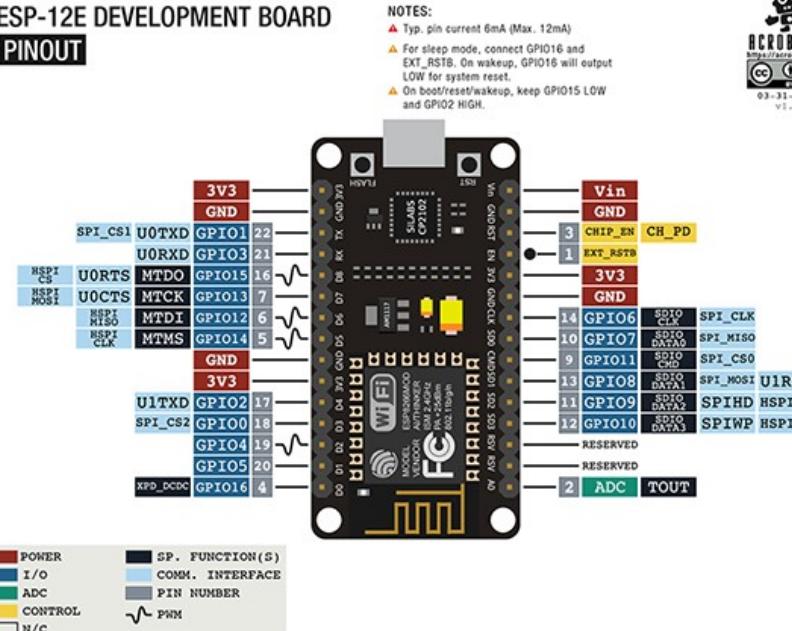
<https://nodemcu.readthedocs.io/en/master/>

NodeMCU

- The Development Kit based on ESP8266, integrates GPIO, PWM, IIC, 1-Wire and ADC all in one board



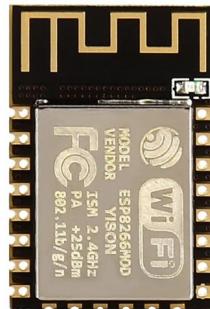
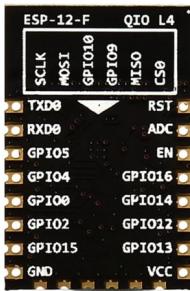
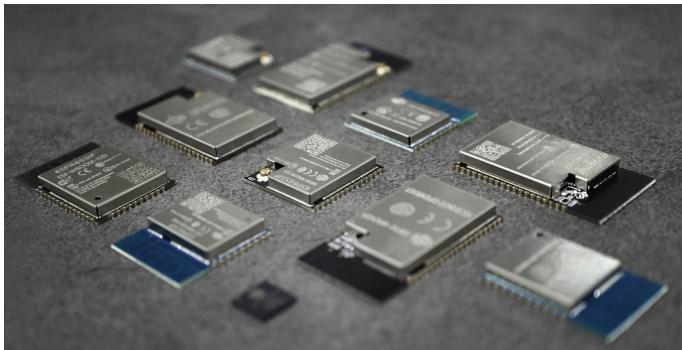
ESP-12E DEVELOPMENT BOARD
PINOUT



<https://nodemcu.readthedocs.io/en/master/>
<https://github.com/nodemcu>



ESP8266



Size

Package size 18 mm x 20 mm x 2.80 mm

Wi-Fi

Wi-Fi protocols 802.11 b/g/n

Frequency range 2.4 GHz ~ 2.5 GHz (2400M ~ 2483.5M)

Peripheral interface

UART/HSPI/I2C/I2S/IR Remote Control

GPIO/PWM

Software

Wi-Fi mode: Station/SoftAP/SoftAP + Station

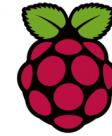
Security: WPA/WPA2

Encryption: WEP/TKIP/AES

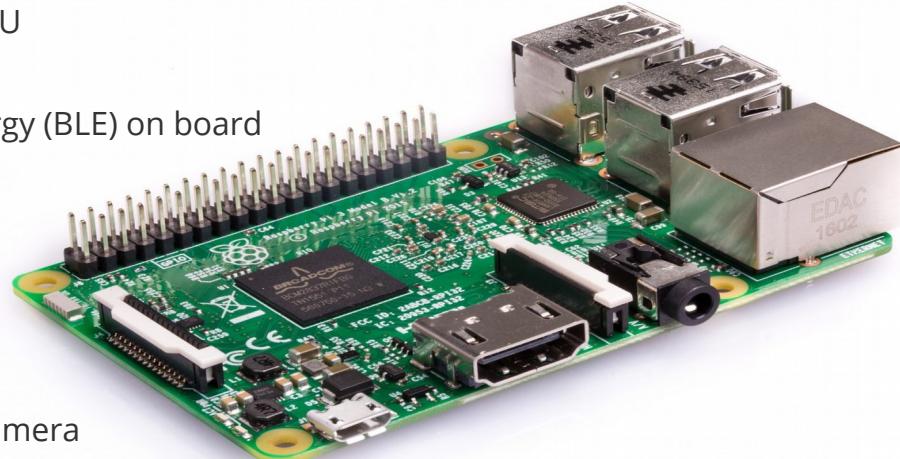
Network protocols: IPv4, TCP/UDP/HTTP/FTP

<https://www.espressif.com/>

Raspberry Pi



- **Raspberry Pi 3 Model B+**
- Quad Core 1.2GHz Broadcom BCM2837 64bit CPU
- 1GB RAM
- BCM43438 wireless LAN and Bluetooth Low Energy (BLE) on board
- 100 Base Ethernet
- 40-pin extended GPIO
- 4 USB 2 ports
- 4 Pole stereo output and composite video port
- Full size HDMI
- CSI camera port for connecting a Raspberry Pi camera
- DSI display port for connecting a Raspberry Pi touchscreen display
- Micro SD port for loading your operating system and storing data
- Upgraded switched Micro USB power source up to 2.5A



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

• DEBIAN



debian

- The Debian Project is an association of individuals who have made common cause to create a free operating system. This operating system that we have created is called Debian.
- An operating system is the set of basic programs and utilities that make your computer run. At the core of an operating system is the kernel. The kernel is the most fundamental program on the computer and does all the basic housekeeping and lets you start other programs.
- Debian systems currently use the Linux kernel or the FreeBSD kernel. Linux is a piece of software started by Linus Torvalds and supported by thousands of programmers worldwide. FreeBSD is an operating system including a kernel and other software.
- Of course, the thing that people want is application software: programs to help them get what they want to do done, from editing documents to running a business to playing games to writing more software. Debian comes with over 51000 packages (precompiled software that is bundled up in a nice format for easy installation on your machine), a package manager (APT), and other utilities that make it possible to manage thousands of packages on thousands of computers as easily as installing a single application. All of it free.

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





- Raspbian is a free operating system based on Debian optimized for the Raspberry Pi hardware. An operating system is the set of basic programs and utilities that make your Raspberry Pi run. However, Raspbian provides more than a pure OS: it comes with over 35,000 packages, pre-compiled software bundled in a nice format for easy installation on your Raspberry Pi.
- The initial build of over 35,000 Raspbian packages, optimized for best performance on the Raspberry Pi, was completed in June of 2012. However, Raspbian is still under active development with an emphasis on improving the stability and performance of as many Debian packages as possible.
- Note: Raspbian is not affiliated with the Raspberry Pi Foundation. Raspbian was created by a small, dedicated team of developers that are fans of the Raspberry Pi hardware, the educational goals of the Raspberry Pi Foundation and, of course, the Debian Project.

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

• Eclipse Mosquitto™



- An open source MQTT broker
- Eclipse Mosquitto is an open source (EPL/EDL licensed) message broker that implements the MQTT protocol versions 3.1 and 3.1.1. Mosquitto is lightweight and is suitable for use on all devices from low power single board computers to full servers.
- The MQTT protocol provides a lightweight method of carrying out messaging using a publish/subscribe model. This makes it suitable for Internet of Things messaging such as with low power sensors or mobile devices such as phones, embedded computers or microcontrollers.
- The Mosquitto project also provides a C library for implementing MQTT clients, and the very popular `mosquitto_pub` and `mosquitto_sub` command line MQTT clients.
- Mosquitto is part of the Eclipse Foundation and is an iot.eclipse.org project.

<https://projects.eclipse.org/projects/technology.mosquitto>

• Brooker Alternative



VerneMQ is first and foremost a MQTT publish/subscribe message broker which implements the OASIS industry standard [MQTT protocol](#).

<https://vernemq.com/>

EMQ

The Massively Scalable MQTT Broker for IoT and Mobile Applications

<http://emqttd.io/>





• Python™

- Python is an interpreted high-level programming language for general-purpose programming.
- Comes with a large standard library that supports many common programming tasks such as connecting to web servers, searching text with regular expressions, reading and modifying files.
- Python's interactive mode makes it easy to test short snippets of code. There's also a bundled development environment called IDLE.
- Is easily extended by adding new modules implemented in a compiled language such as C or C++.
- Can also be embedded into an application to provide a programmable interface.
- Runs anywhere, including Mac OS X, Windows, Linux, and Unix, with unofficial builds also available for Android and iOS.
- Is free software in two senses. It doesn't cost anything to download or use Python, or to include it in your application. Python can also be freely modified and re-distributed, because while the language is copyrighted it's available under an open source license.

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



• MariaDB®

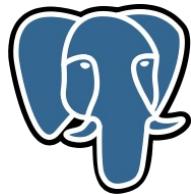


- MariaDB Server is one of the most popular database servers in the world. It's made by the original developers of MySQL and guaranteed to stay open source. Notable users include Wikipedia, WordPress.com and Google.
- MariaDB is developed as open source software and as a relational database it provides an SQL interface for accessing data. The latest versions of MariaDB also include GIS and JSON features.

<https://mariadb.org/>



• Database Alternative



PostgreSQL is a powerful, open source object-relational database system with over 30 years of active development that has earned it a strong reputation for reliability, feature robustness, and performance.

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

MySQL Community Edition is a freely downloadable version of the world's most popular open source database that is supported by an active community of open source developers and enthusiasts.

<https://dev.mysql.com/>





• LIGHTTPD

- Security, speed, compliance, and flexibility -- all of these describe lighttpd (pron. lighty) which is rapidly redefining efficiency of a webserver; as it is designed and optimized for high performance environments. With a small memory footprint compared to other web-servers, effective management of the cpu-load, and advanced feature set (FastCGI, SCGI, Auth, Output-Compression, URL-Rewriting and many more) lighttpd is the perfect solution for every server that is suffering load problems. And best of all it's Open Source licensed under the revised BSD license.

<https://www.lighttpd.net/>



• Database Alternative



nginx [engine x] is an HTTP and reverse proxy server, a mail proxy server, and a generic TCP/UDP proxy server.

<https://nginx.org/en/>



The Apache HTTP Server is an open-source HTTP server for modern operating systems including UNIX, Microsoft Windows, Mac OS/X and Netware.

<https://httpd.apache.org/>



• PHP[©]



- PHP is a popular general-purpose scripting language that is especially suited to web development.
- Fast, flexible and pragmatic, PHP powers everything from your blog to the most popular websites in the world.
- PHP code may be embedded into HTML code, or it can be used in combination with various web template systems, web content management systems, and web frameworks. PHP code is usually processed by a PHP interpreter implemented as a module in the web server or as a Common Gateway Interface (CGI) executable. The web server combines the results of the interpreted and executed PHP code, which may be any type of data, including images, with the generated web page.

<https://secure.php.net/>



• SQL

- SQL Structured Query Language) is a language used in programming and designed for managing data held in a relational database management system (RDBMS), or for stream processing in a relational data stream management system (RDSMS). It is particularly useful in handling structured data where there are relations between different entities/variables of the data.
- With SQL we can:
 - Create and modify databases sheme (DDL - Data Definition Language);
 - Insert, modify and manage the storered data (DML - Data Manipulation Language);
 - Query on stored data (DQL - Data Query Language);
 - Create and manage control tools and data access tools (DCL - Data Control Language).

<https://secure.php.net/>





• HTML

- Hypertext Markup Language (HTML) is the standard markup language for creating web pages and web applications.
- Web browsers receive HTML documents from a web server or from local storage and render the documents into multimedia web pages. HTML describes the structure of a web page semantically and originally included cues for the appearance of the document.
- HTML elements are the building blocks of HTML pages. With HTML constructs, images and other objects such as interactive forms may be embedded into the rendered page. HTML provides a means to create structured documents by denoting structural semantics for text such as headings, paragraphs, lists, links, quotes and other items. HTML elements are delineated by tags, written using angle brackets. Tags such as `` and `<input />` directly introduce content into the page. Other tags such as `<p>` surround and provide information about document text and may include other tags as sub-elements. Browsers do not display the HTML tags, but use them to interpret the

<https://secure.php.net/>



▪ tools

phpMyAdmin is a free software tool written in PHP, intended to handle the administration of MySQL over the Web. phpMyAdmin supports a wide range of operations on MySQL and MariaDB. Frequently used operations (managing databases, tables, columns, relations, indexes, users, permissions, etc) can be performed via the user interface, while you still have the ability to directly execute any SQL statement.



<https://www.phpmyadmin.net/>



Inkscape is a professional vector graphics editor for Windows, Mac OS X and Linux. It's free and open source.

<https://inkscape.org/>

▪ **tools**



LibreOffice is a powerful office suite – its clean interface and feature-rich tools help you unleash your creativity and enhance your productivity.

LibreOffice includes several applications that make it the most powerful Free and Open Source office suite on the market.

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