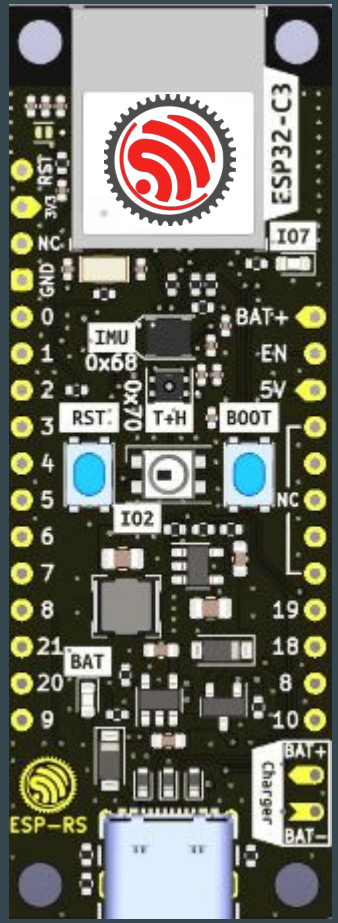
ESP32 Ecosystem



2024-10-24
FEKT VUT - Brno

Juraj Michálek & Team - Espressif Systems

Espressif team

Juraj Michálek - ESP32 Ecosystem Introduction & Matter

Sudeep Mohanty - ESP32-C6 Low Power cores

Peter Dragúň - IDF Monitor Tips & Tricks

Jan Beran - ESP32-C6 Workshop

Bonus: Stay tuned, some cool demos at the end with many pixels ;-)

Who are you?

Favorite programming language?

Favorite IDE / Editor?

Operating system?

Espressif System

Espressif Systems (688018.SH) is a public multinational, fabless semiconductor company established in 2008, with offices in China, the Czech Republic, India, Singapore and Brazil.

ESP8266 - WiFi

ESP32 - dual-core

ESP32-S - Xtensa arch

ESP32-C, ESP32-H and ESP32-P series - RISC-V

Open source: https://github.com/espressif

Espressif in Brno

Vlněna Office Park

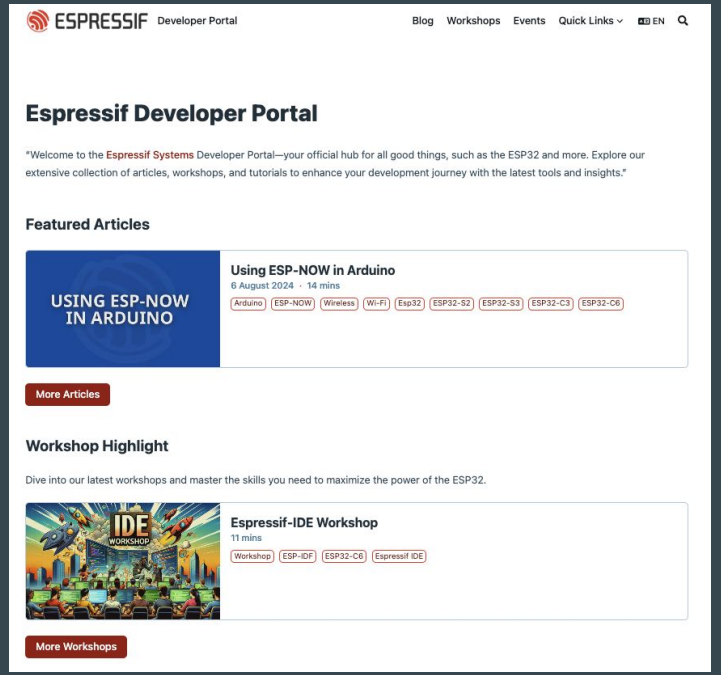
Espressif Systems (Czech) s.r.o.

Přízova 3, 602 00 Brno

Czechia, Europe

Developer Portal

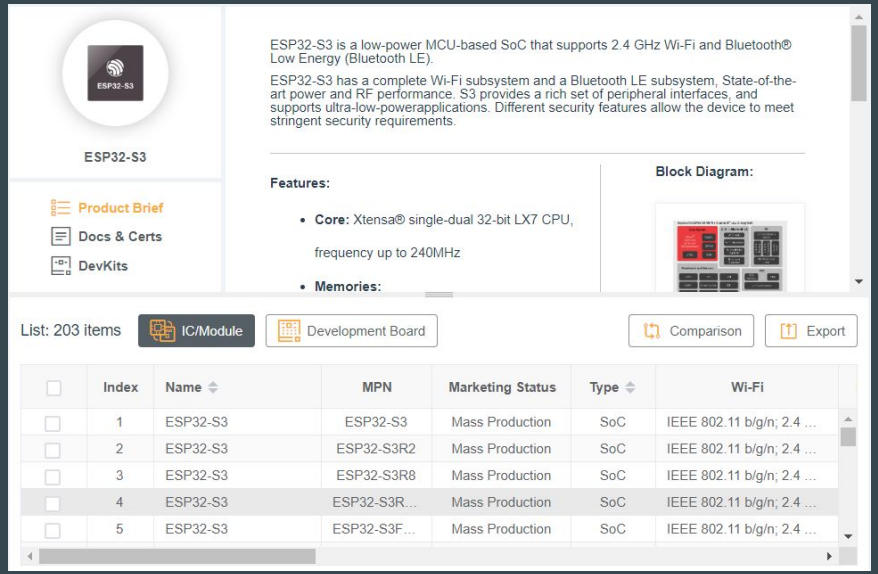
developer.espressif.com

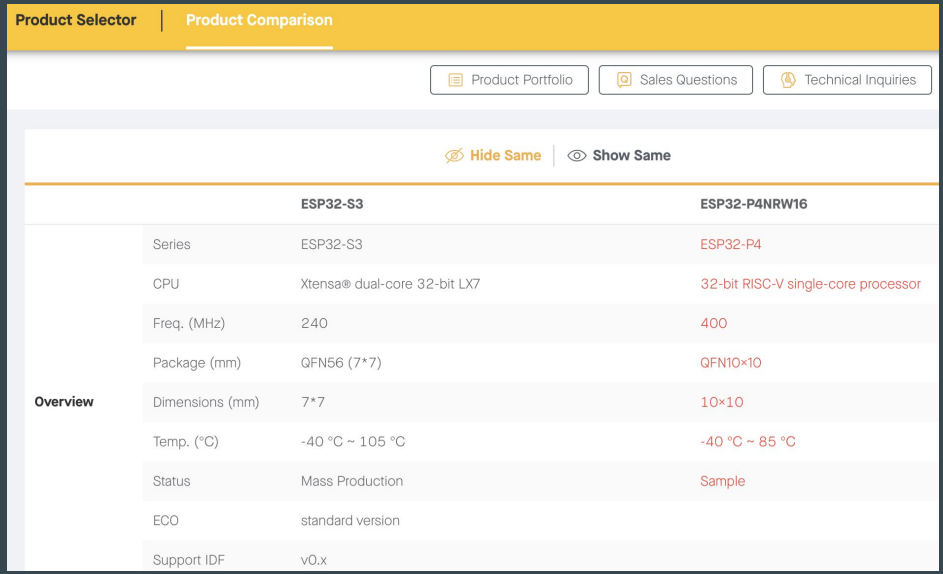


GitHub: https://github.com/espressif/developer-portal/

ESP Product Selector + Product Comparison

https://products.espressif.com/





OSes and integration

ESP-IDF (OS based on FreeRTOS) - https://github.com/espressif/esp-idf

no_std a.k.a. bare metal with Rust - https://github.com/esp-rs/esp-hal (minimalistic)

Zephyr - https://zephyrproject.org/

- https://developer.espressif.com/tags/zephyr/
- https://wokwi.com/projects/325751453458104914

NuttX - https://nuttx.apache.org/ (as app, Linux-like OS)

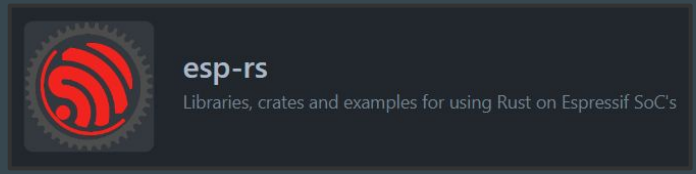
- https://developer.espressif.com/tags/nuttx/

SVD files: https://github.com/espressif/svd

Programming languages

Active support by Espressif teams

- C/C++
  - most common choice - https://github.com/espressif/esp-idf
- Rust
  - recommended for new design evaluation - https://github.com/esp-rs
  - security and memory guaranties of Rust
  - multi-target Xtensa, RISC-V, plus WASM, desktops or mobile
- Arduino - Maker choice
  - Arduino IDE 2.x
  - note: check the license for production



Languages and frameworks

Compiled:

- Embedded Swift
- Ada/Spark - from AdaCore
- Zig

VM based:

- CircuitPython and MicroPython - Python-like language
- Toit
- Nanoframework - C# language
- Mongoose OS
- Lua
- downside: bigger VM
- upside: more robust, comes with OTA and monitoring

IDE

Supported by Espressif:

- VS Code with Espressif Extension - https://developer.espressif.com/tags/vscode/
- Espressif IDE - https://developer.espressif.com/tags/espressif-ide/

Supported by JetBrains:

- CLion - https://www.jetbrains.com/help/clion/esp-idf.html

Supported by SysProgs

- Visual Studio with VisualGDB - https://visualgdb.com/

Supported by TARA Systems

- Embedded Wizard - https://www.embedded-wizard.de/

SysProgs

wokwi.com/esp32

Contribute: https://github.com/wokwi

EDC24: Flash Less, Do More: The Magic of Virtual Hardware

EDC22: Your browser is ESP32 - Wokwi

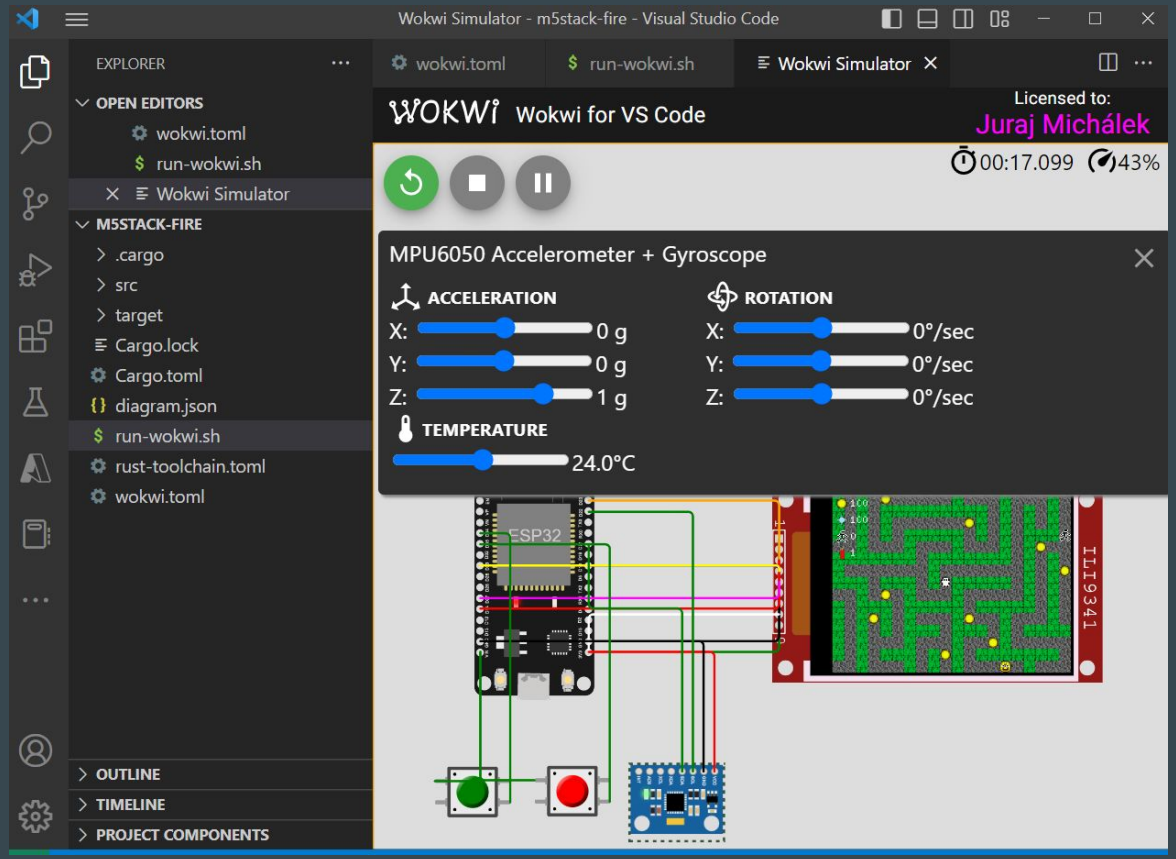
Wokwi - VS Code Plugin

Add wokwi.toml and diagram.json

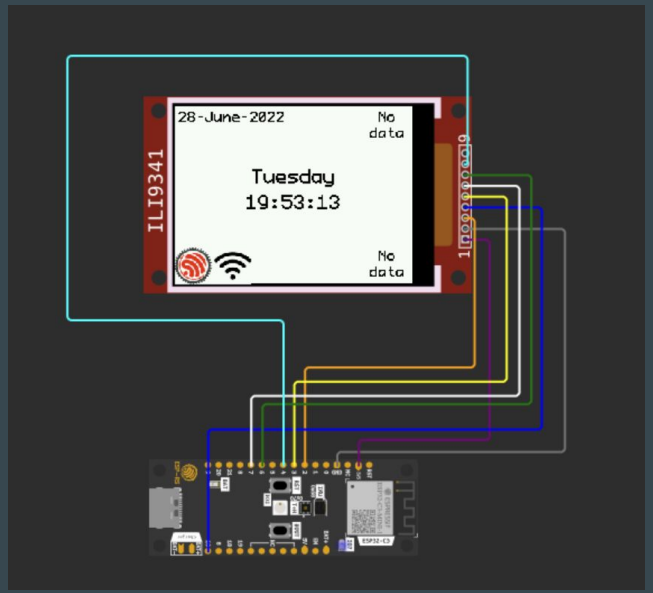
to your project

wokwi-cli init

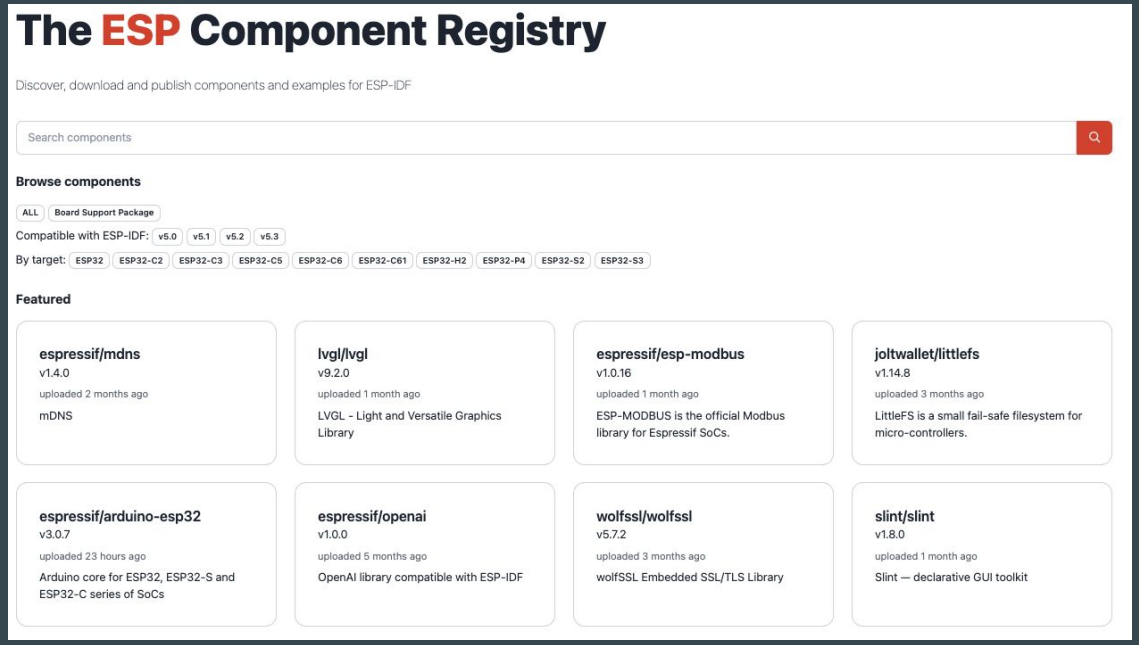
CTRL+Shift+P - Wokwi: Start Simulator



Development containers and Wokwi



https://github.com/playfulFence/esp-clock#dev-containers



https://components.espressif.com/

Example: https://components.espressif.com/components/espressif/i2c_bus/

Example: ESP32 + SDL3 components

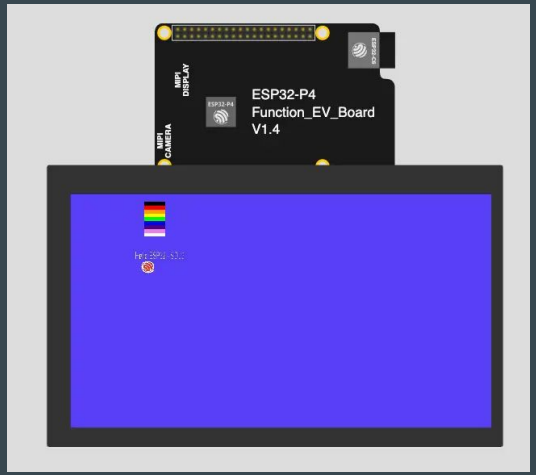
https://github.com/georgik/esp32-sdl3-example

main/idf_component.yml

Wrapping components:

https://github.com/georgik/esp-idf-component-SDL

https://github.com/georgik/esp-idf-component-lua



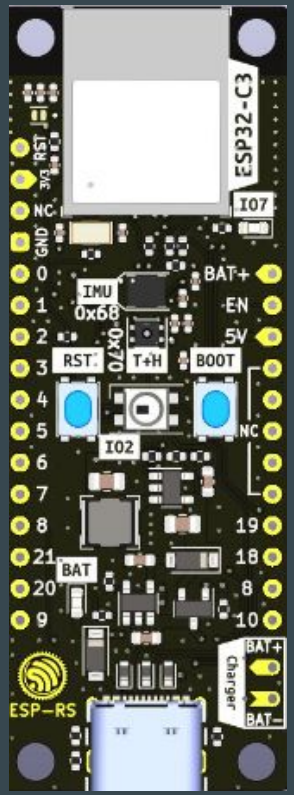
Designing Open Hardware - esp-rust-board

KiCad templates

https://github.com/esp-rs/esp-rust-board

ESP32-C3-DevKit-RUST-1 (available at Mouser, AliExpress)

https://www.espressif.com/en/products/devkits



Embedded Wizard

GUI Solutions by TARA Systems

Embedded Wizard

Quick prototyping

Free for small, medium projects

Supports ESP32, WASM or Desktop

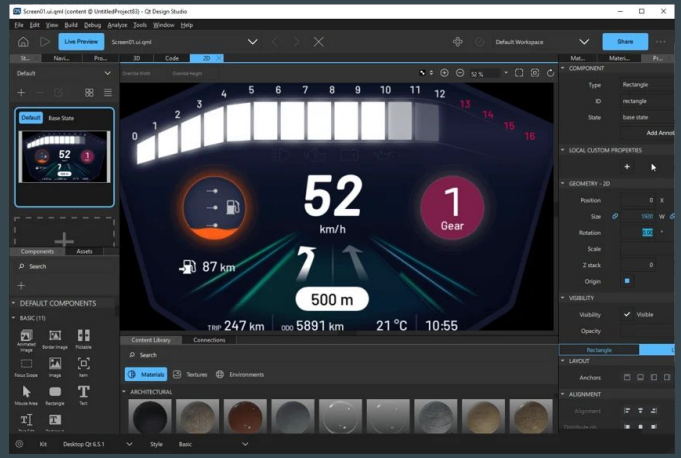
Qt

Qt for MCUs

Similar to Qt for desktop

Free for students

Supports ESP32-S3



slint
GUI toolkit

Slint

Quick prototyping

Free and commercial version

Rust, C++

Rust Bare Metal - Embedded Graphics

Source: https://github.com/georgik/esp32-spooky-maze-game

Idea: sharing business logic in Rust between multiple targets

https://github.com/espressif/esp-box

Some examples of ESP32 based projects

CTAG-TBD

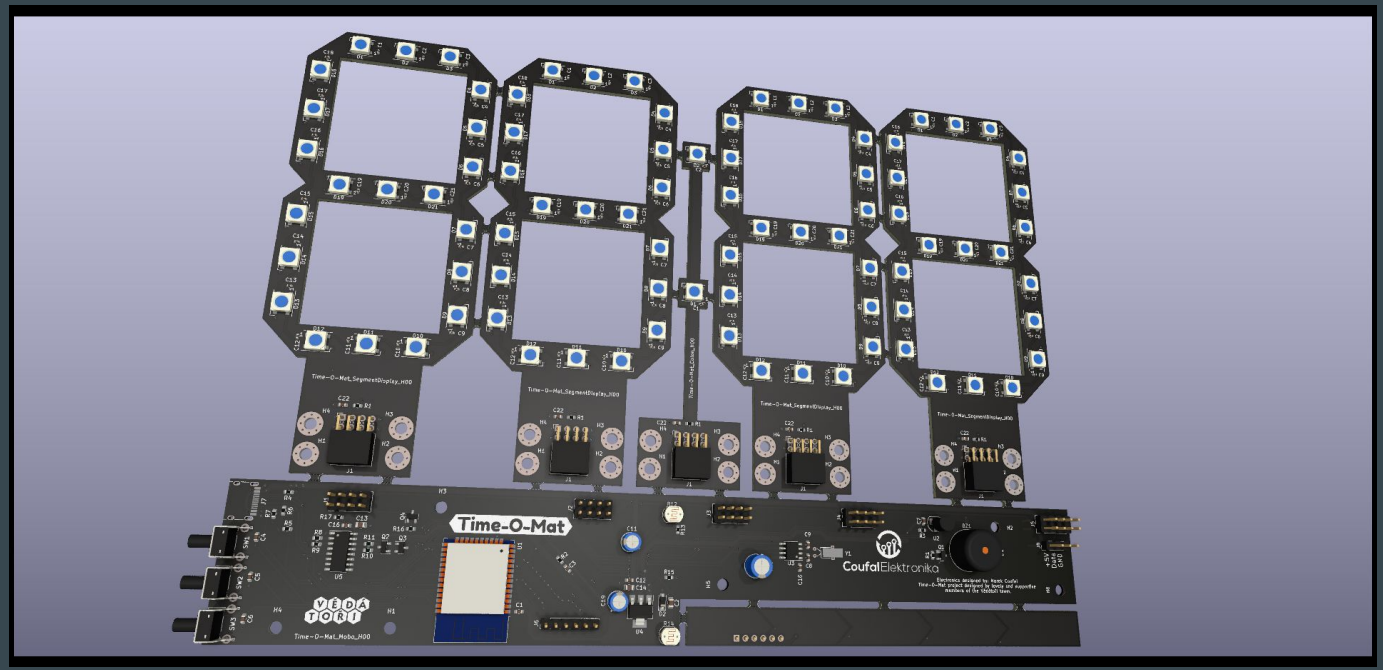
CTAG TBD >>to be determined<< an extendible

open source Eurorack sound module

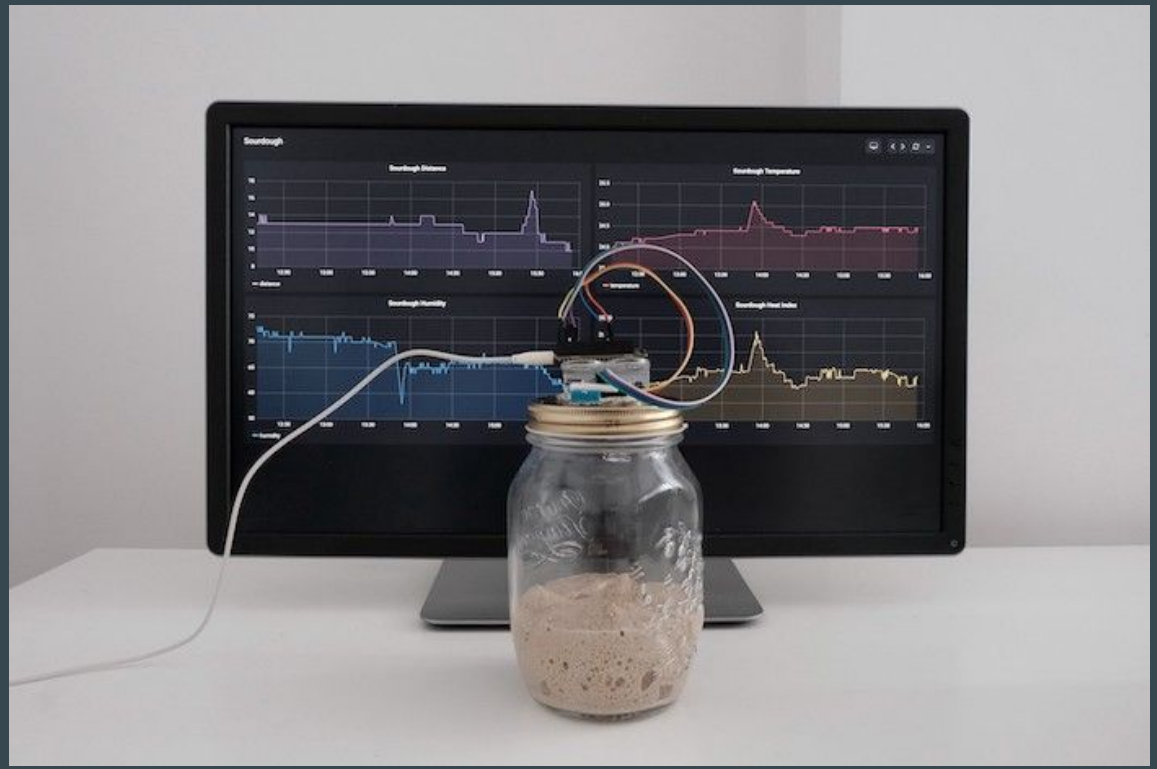
https://github.com/ctag-fh-kiel/ctag-tbd

Time-O-Mat - built at summer camp

https://github.com/vedatori/Time-O-Mat



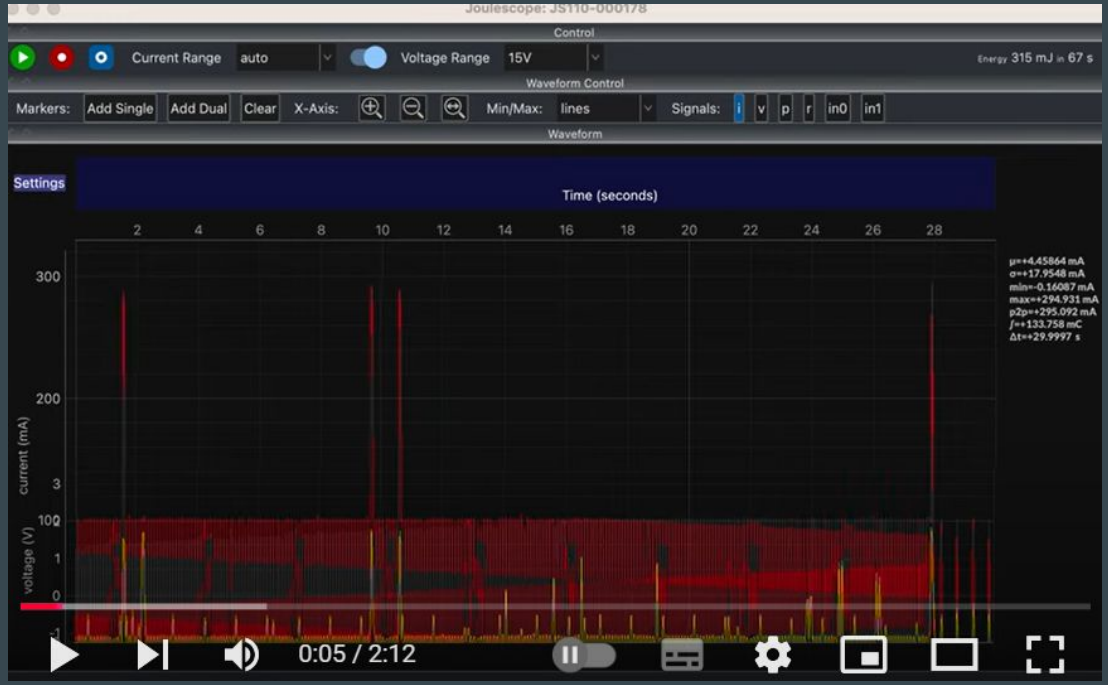
Grafana



https://grafana.com/blog/2020/06/17/how-to-monitor-a-sourdough-starter-with-grafana/

https://github.com/grafana/diy-iot - Arduino now. We're not Rust yet :)

ESP32-C6 TWT



https://www.youtube.com/watch?v=FA1jqZLig4s


matter

Many Problems of Home Automation and IoT

Silos

Fragmentation

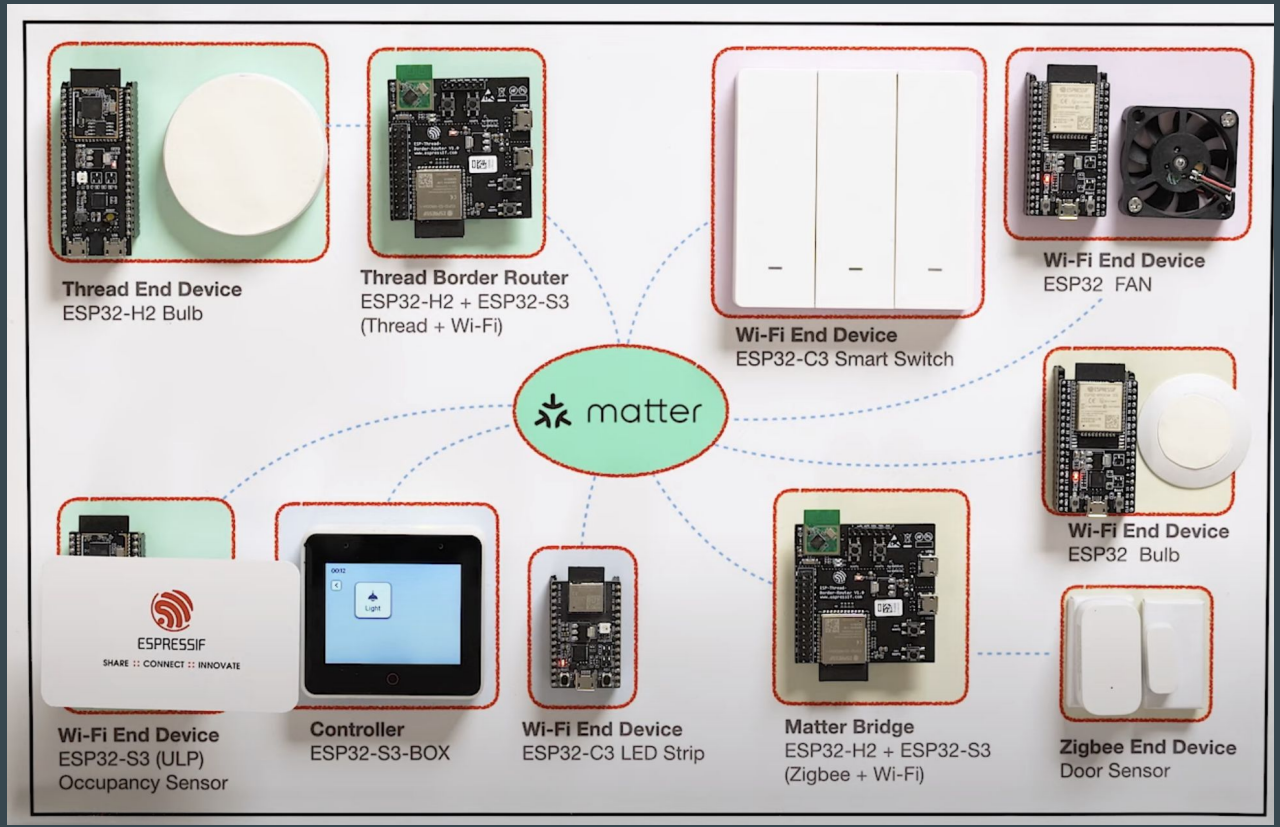
Security

UX

Development

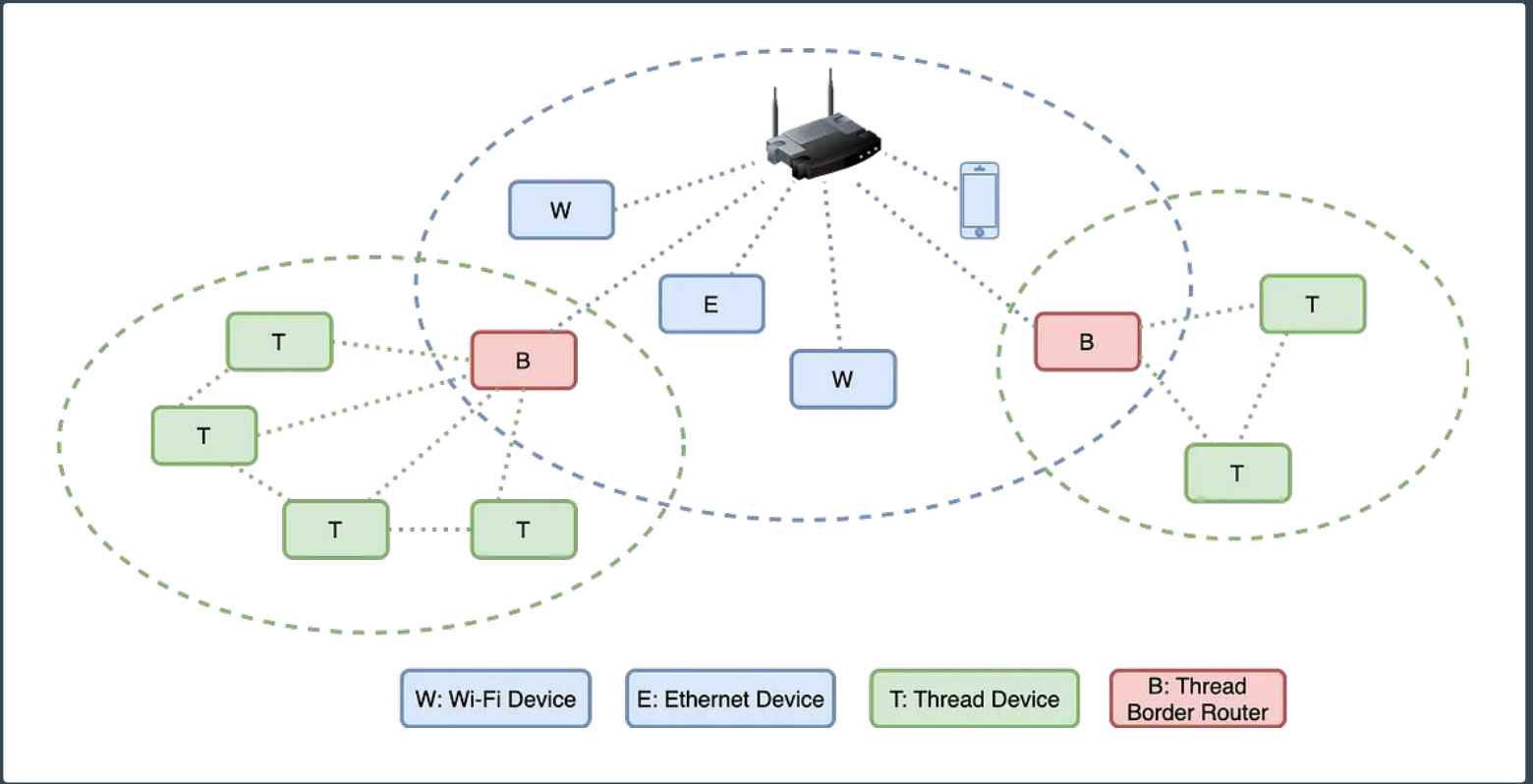
Certification

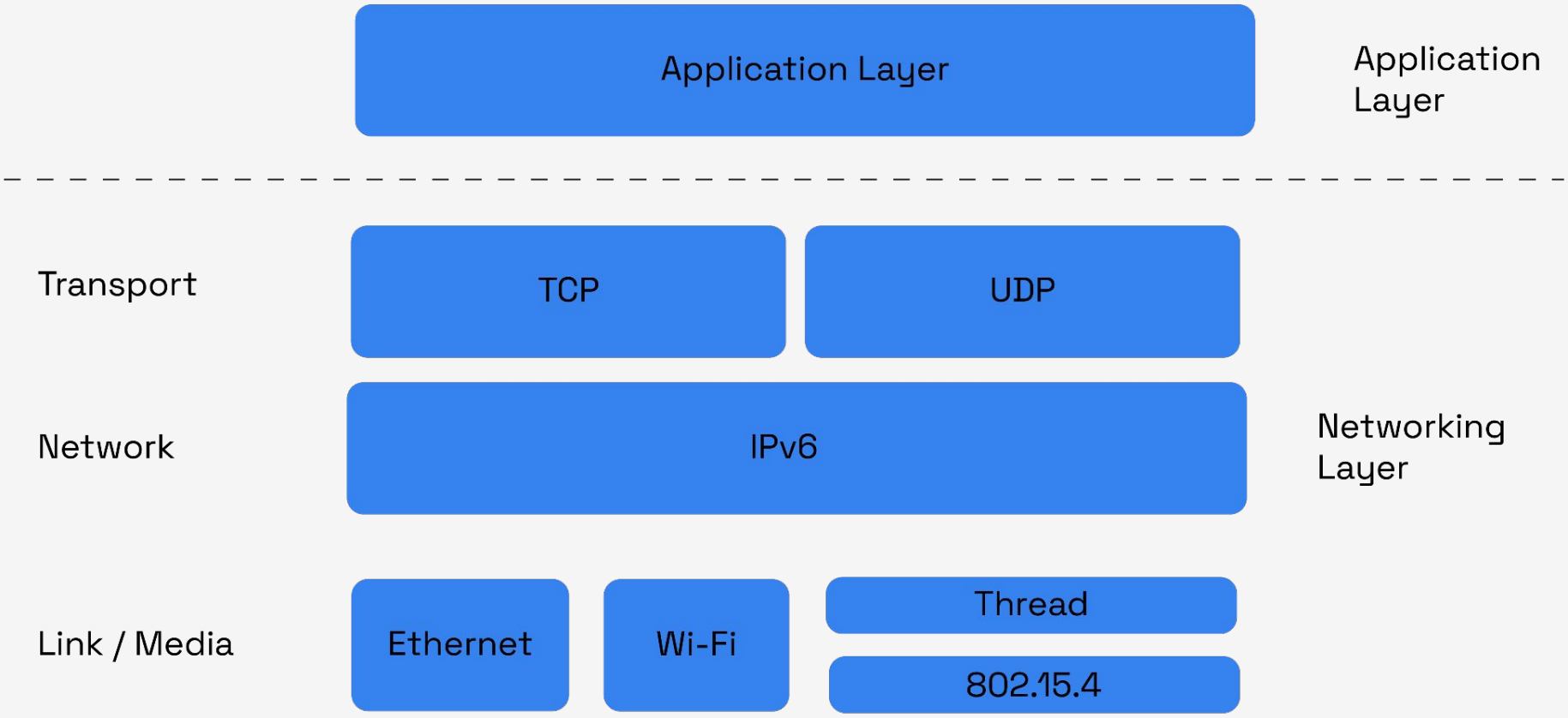
...



Espressif's Matter Demo - https://youtu.be/Jr4Lut_NgqA

Matter topology




Application Layer
Application Layer
Transport
TCP
UDP
Network
IPv6
Networking Layer
Link / Media
Ethernet
Wi-Fi
Thread
802.15.4

Quick start

esp-matter: https://github.com/espressif/esp-matter

Launchpad for flashing light and light_switch:

- https://espressif.github.io/esp-launchpad/?flashConfigURL=https://espressif.github.io/esp-matter/launchpad.toml

matter-rs

Early development

https://github.com/project-chip/matter-rs

ESP chips not supported yet

Join Rust ESP32 Community Meeting to see the progress:

https://github.com/esp-rs/rust/discussions

Async with Embassy

Embassy: https://github.com/embassy-rs/embassy

Embassy (EMBedded ASYnc)

- We need an EXECUTOR to be able to use async
- Controlling which task should run

- Embassy consists of multiple crates (Executor, HALs, Networking,...)
- no_std
- Can be (relatively) easily extendable/configurable with other public crates
- https://embassy.dev

Espressif Developer Conference 2022-2024 - recording

https://www.youtube.com/@EspressifSystems

https://devcon.espressif.com/

Embedded World 2025

Meet us in Nuremberg, Germany

Visit us in Brno

Espressif Systems (Czech) s.r.o.

Přízova 3, 602 00 Brno

Czechia, Europe