



DEVELOPER CLUB

Systems Workshop -
Fall 2025

03

Meet the Systems Team!

Build to Learn



Leads



Workshops



Nov 12, 2025



Techs



Hands On Opportunities

- Work on the Server Hardware management and spinning up new services
- Work on the Automation API Project
- Learn and work on the various Embedded Projects

What do we do in the Systems Community?

- Build and Maintain Club Infrastructure
- Explore Devops, Embedded, Networking and much more
- Work with various OS, develop sysadmin skills
- Develop systemic thinking and able to see the bigger picture
- Develop system design skills (given a problem come up with efficient and reliable ways to solve it with set of tools & methodologies)

What are we gonna make and learn today?

- Learn about some of the common hardware terminologies
- Work your way around **hardware specification sheets**
- Learn using **Arduino C** lang (an implementation extention of C lang) a
- Hardware and Software Interrupt Cycles
- Common communication protocols (**I2C**, **SPI**, **MQTT**, **Zigbee**, etc) and debugging techniques
- Introduction to **IoT**, **Cloud** and implementation using **AWS IoT Core**
- Learn about **MQTT** protocol what is a '**thing**', '**topics**', '**publish**', '**subscribe**', etc operations
- Discussion on **IoT security** and importance of securing hardware and endpoints
- Some advice regarding IoT design in general (open debatable topic)
- **Bonus:** How to design your own PCB (if time permits)

Lets get started with the setup!

Checklist

- Arduino IDE installed
- CH340G / CP2102 Driver installed
- AWS Console Access confirmed (please no AWS outage this time lol)
- ESP32-WROOM board devkit install on Arduino IDE
- Libraries installation
 - Adafruit DHT-sensor-library
 - Adafruit Sensor Library
 - Adafruit GFX Library
 - Adafruit SSD1306
 - Adafruit BusIO
- Verify ESP32 board connectivity by running the test sketch from repo link provided in setup doc

Please use the following link to download the starter repository!

<https://github.com/Developer-Club-WMU/SystemsCommunityWorkshopFA-25>

Please note that for this you can use
either Git or Download it as a Zip
option from Web

Git option is recommended!

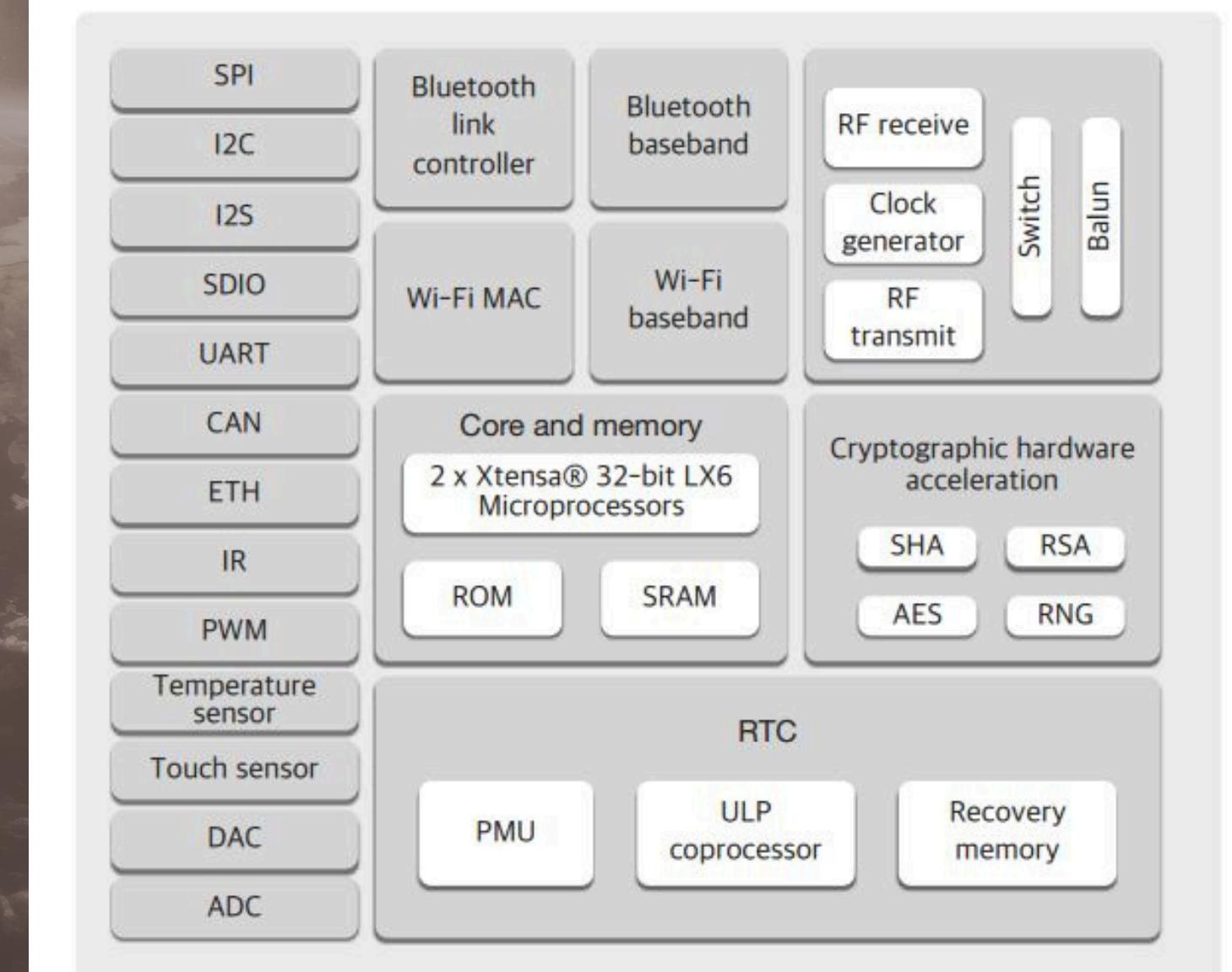
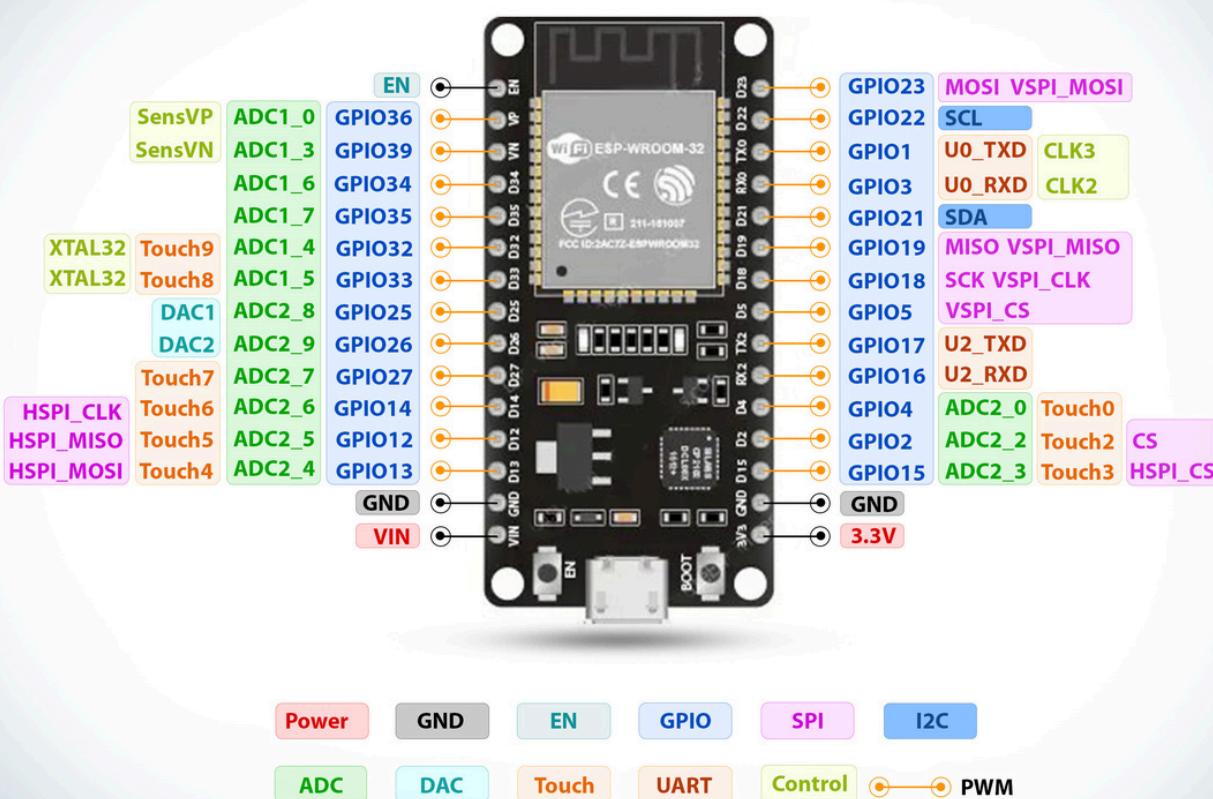


Some basics about the ESP series of MCU's

- Manufactured by the **ESPRESSIF Systems Organization**
- Offers various **MCU's tailored for multiple use cases such as:**
 - **ESP32:** Low-cost, low-power dual-core microcontroller with Bluetooth and Wi-Fi for rapid prototyping.
 - **ESP32-H Series:** Single-core RISC-V based SoC with BLE and Wi-Fi for efficient wireless applications.
 - **ESP32-P Series:** ARM or RISC-V based multicore SoC designed for high-performance embedded systems.
 - **ESP32-S Series:** Dual-core Wi-Fi and Bluetooth SoC optimized for general-purpose IoT and smart device applications.
- All **ESP chips use a highly integrated SoC architecture combining CPU, memory, and wireless modules for efficient IoT processing.**
- **Fun facts:**
 - **ESP chips can run web servers, games, and even AI models on just a few dollars of hardware.**
 - **Millions of ESP boards power IoT devices worldwide, from smart bulbs to satellites.**

ESP-32 WROOM Architecture and Pinout

ESP32 DEV. BOARD PINOUT



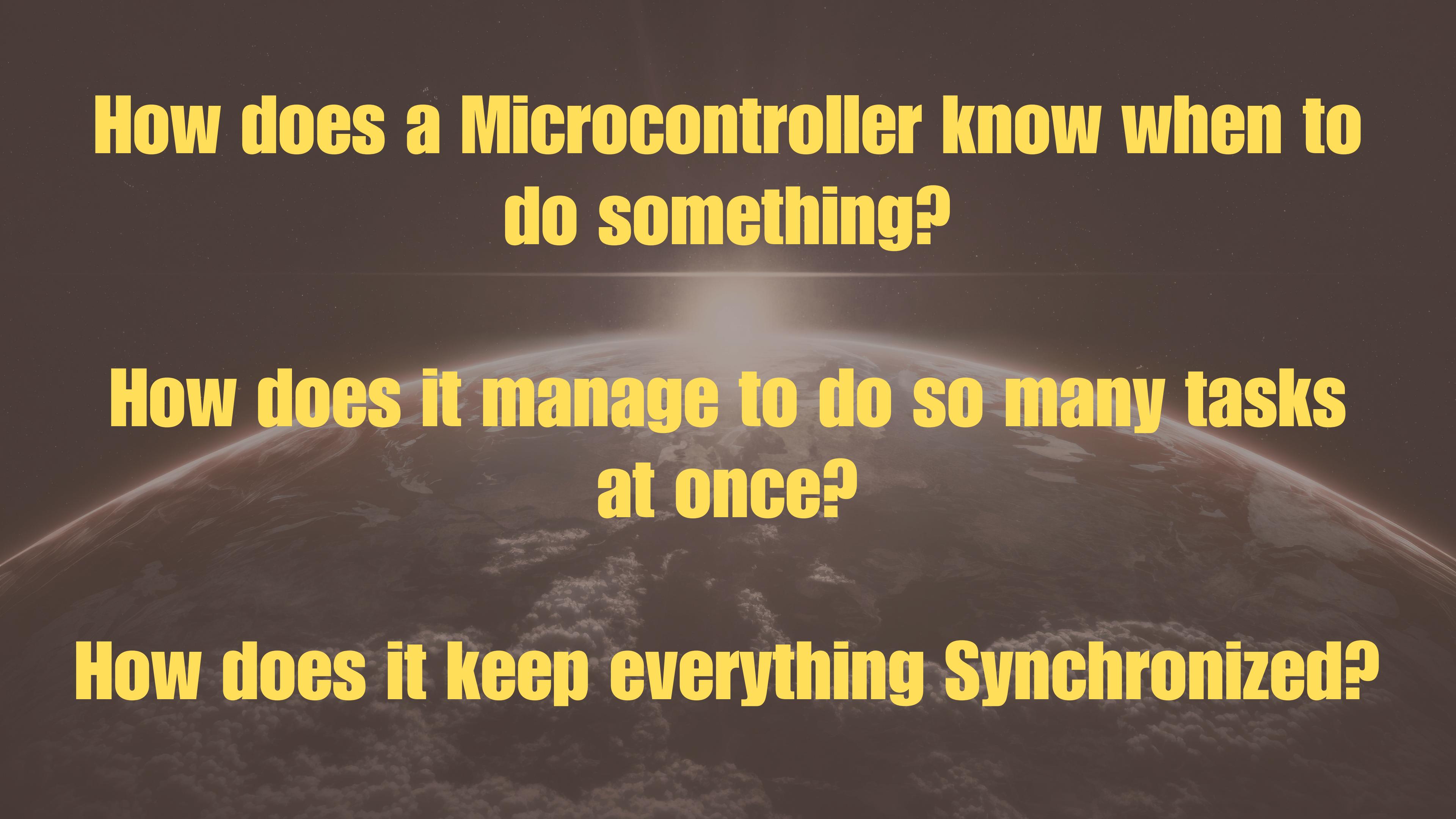
Common Communication Protocols

- **Hardware Communication Protocols**

- **I2C**
- **SPI**
- **UART**
- **PATA**
- **IDE**

- **Wireless Communication Protocols**

- **Bluetooth**
- **Wifi**
- **LoRa/LoRaWAN**
- **Zigbee**
- **MQTT**
- **HTTP/Web Sockets**



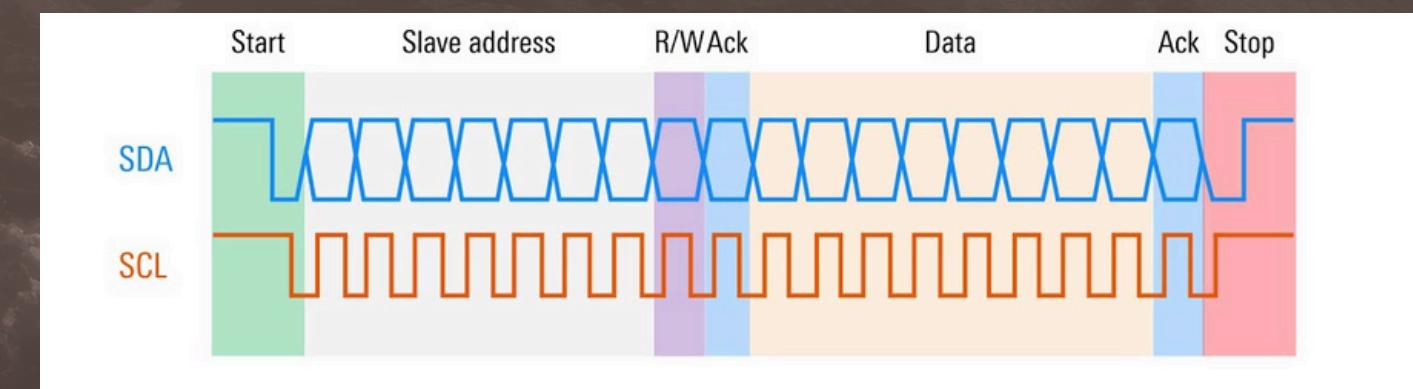
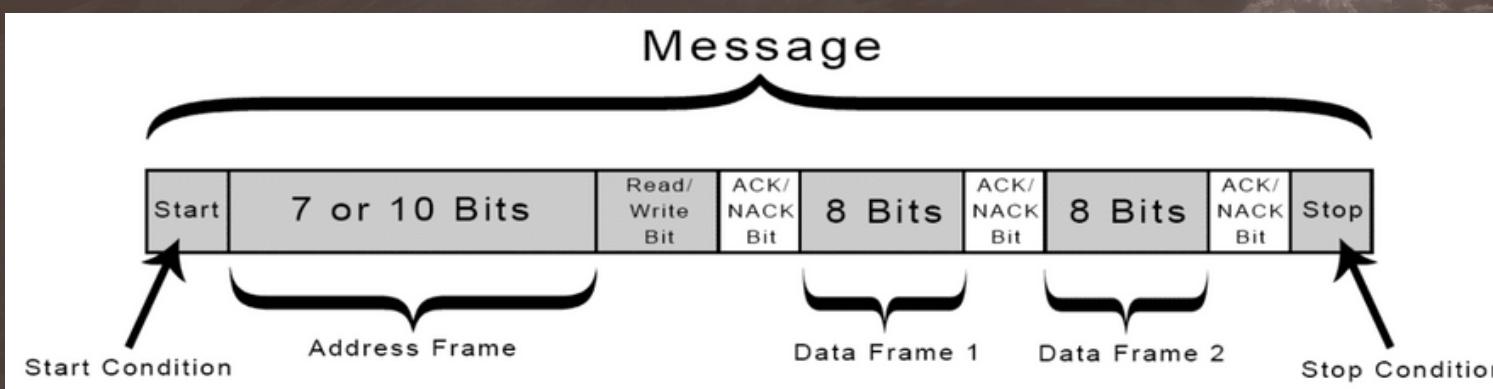
**How does a Microcontroller know when to
do something?**

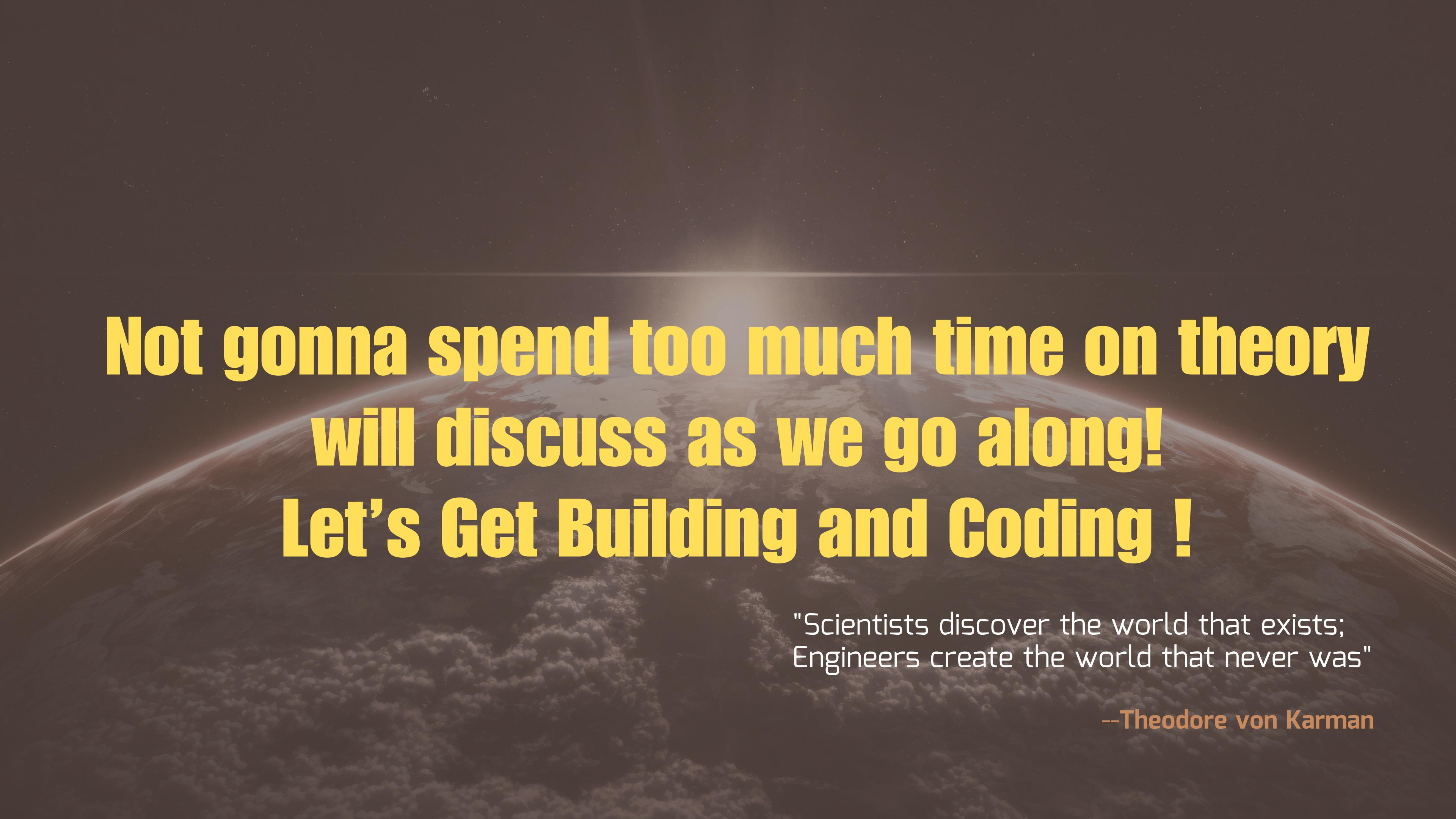
**How does it manage to do so many tasks
at once?**

How does it keep everything Synchronized?

Clock Cycles!!!

- Used for synchronizing all the processes
- Used by time dependent communication protocols like I2C
- Data we know is represented as 0's and 1's. How do they look like in real life
 - Pulses of Highs and Lows in a given waveform
 - High Pulses of a specified height are taken as 1
 - Low Pulses of the same can be considered as zeros
- All the data sent is synchronized via this clock
 - Can be hardware based (DS1307 / PCF8523 / etc)
 - Can be Software based (NTP: Network Time Protocol)
- We will discuss more later in the workshop as we integrate the display module.





**Not gonna spend too much time on theory
will discuss as we go along!
Let's Get Building and Coding !**

"Scientists discover the world that exists;
Engineers create the world that never was"

--Theodore von Karman