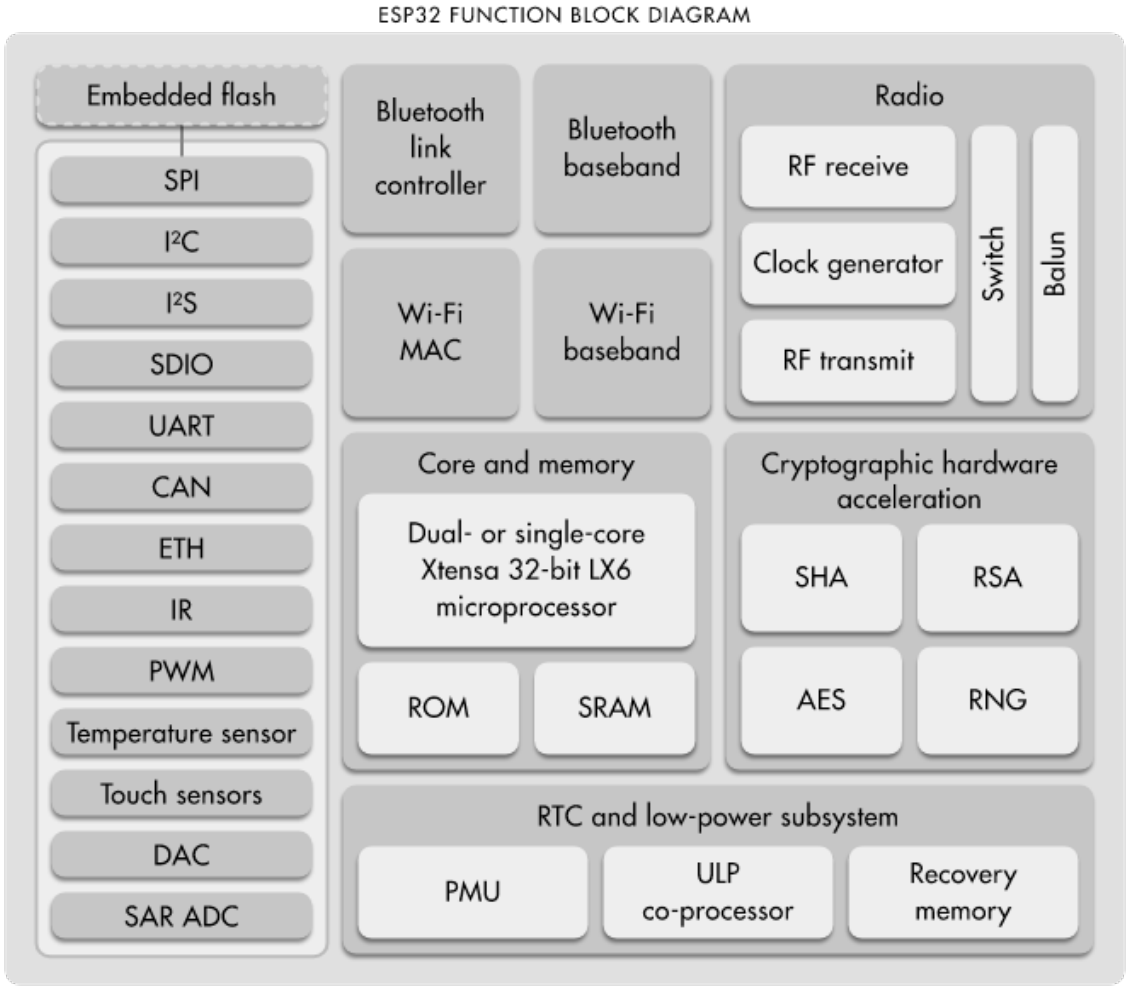
Embedded Systems

Master 's Degree in Informatics Engineering

ESP-32 Platform

ESP32 Block Diagram



http://www.esp32.net

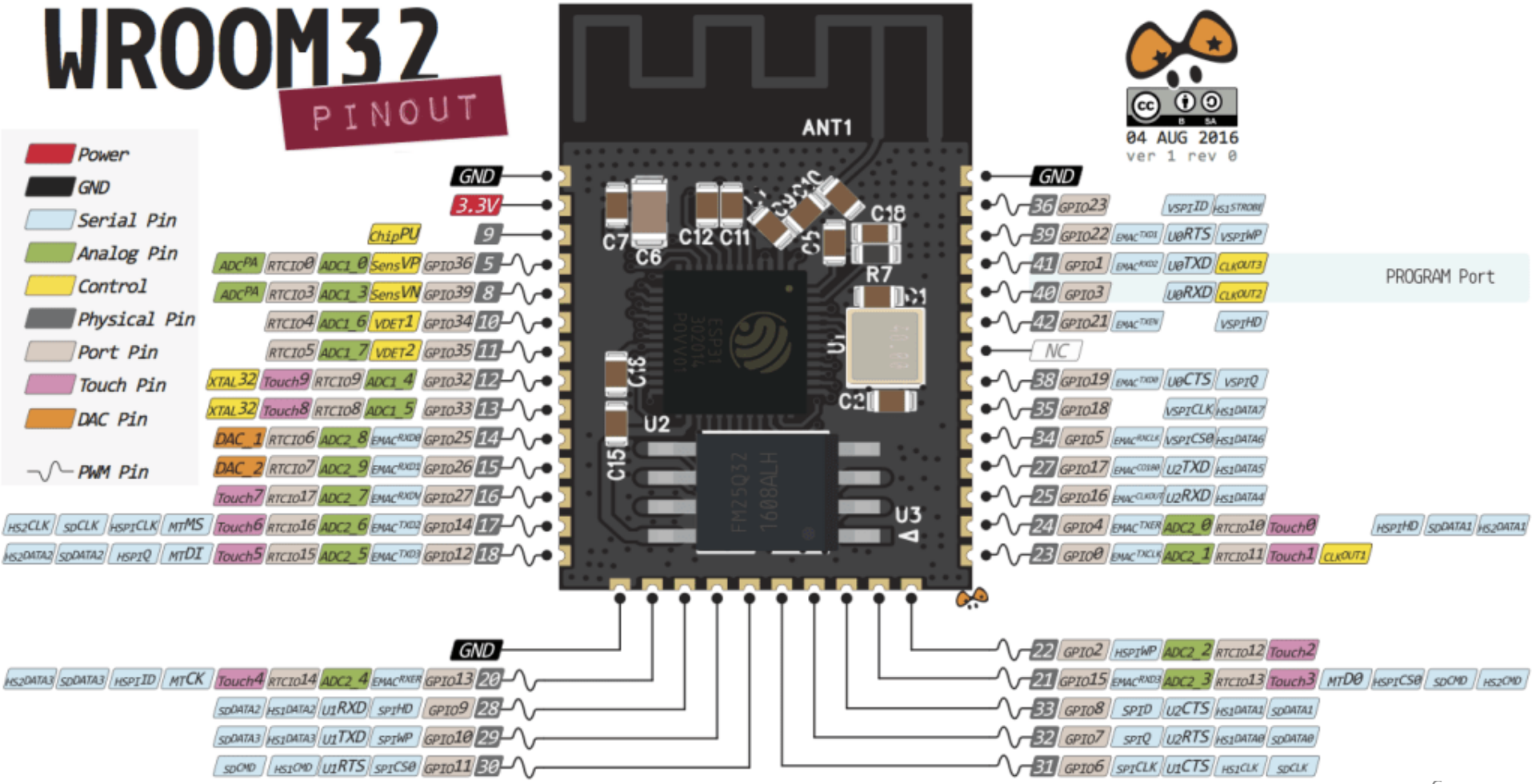
ESP-01 vs NodeMCU?

	NodeMCU v1.0 (ESP8266)	ESP-32
CPU	Tenselica Xtensa LX106	Tenselica Xtensa LX6
CPU Clock	80MHz/160MHz	up to 240MHz
Instruction SRAM	64KBytes (<36KB Stat Mode)	
Data SRAM	96KBytes	520KBytes
Flash Memory	4MBytes	
GPIO Pins	11	39
ADC	1	18
USB-to-Serial	CH340G	CP210x
UART/SPI/I2C/I2S	1/1/1/0	3/4/2/2
WiFI Built-In	802.11 b/g/n	
Bluetooth	-	V4.2 BLE

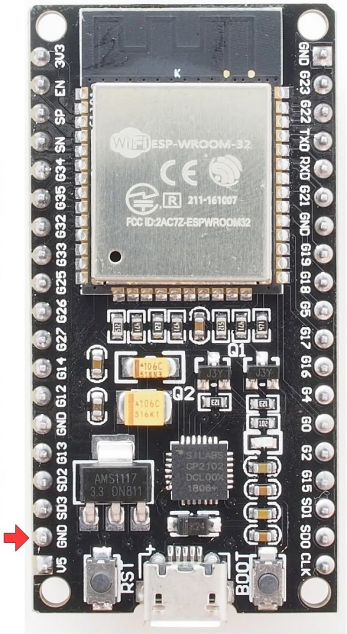
ESP-32 WROOM-32D

- Low cost, compact that includes Wi-Fi and BT-BLE Modules
- Power Supply: +3.3V only
- Built-in low power dual core 32-bit MCU from 80MHz to 240MHz
- Extremely low power co-processor to monitor peripherals
- Supports Deep sleep (<5uA)
- Similar WiFi features than the ESP8266 family, and encrypted acceleration.
- Integrates capacitive touch sensors, HALL sensor, SD card interface
- Support freeRTOS

ESP32 – WROOM-32D

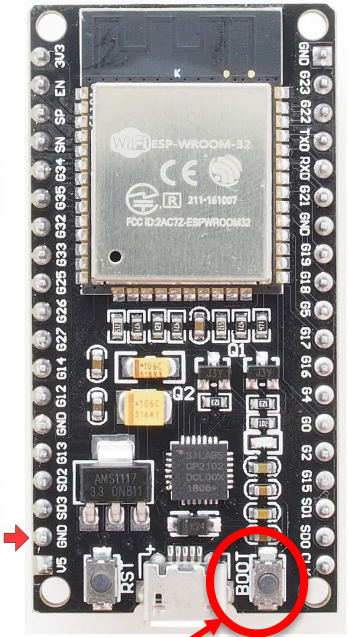


ESP32 – WROOM-32D



ESP32-D2WD is the chip with embedded 2MB flash and the internal flash is connected to different pins (GPIO16, GPIO17, SD_CMD, SD_CLK, SD_DATA_0 and SD_DATA_1)

ESP32 – WROOM-32D



ESP32-D2WD is the chip with embedded 2MB flash and the internal flash is connected to different pins (GPIO16, GPIO17, SD_CMD, SD_CLK, SD_DATA_0 and SD_DATA_1)

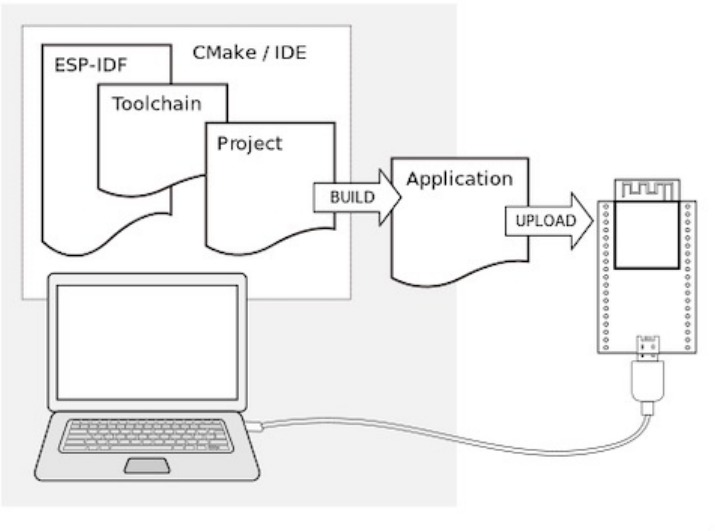
Programming ESP32

ESP – IDF (IoT Development Framework)

https://docs.espressif.com/projects/esp-idf/en/stable/esp32/index.html

Native Expressig SDK

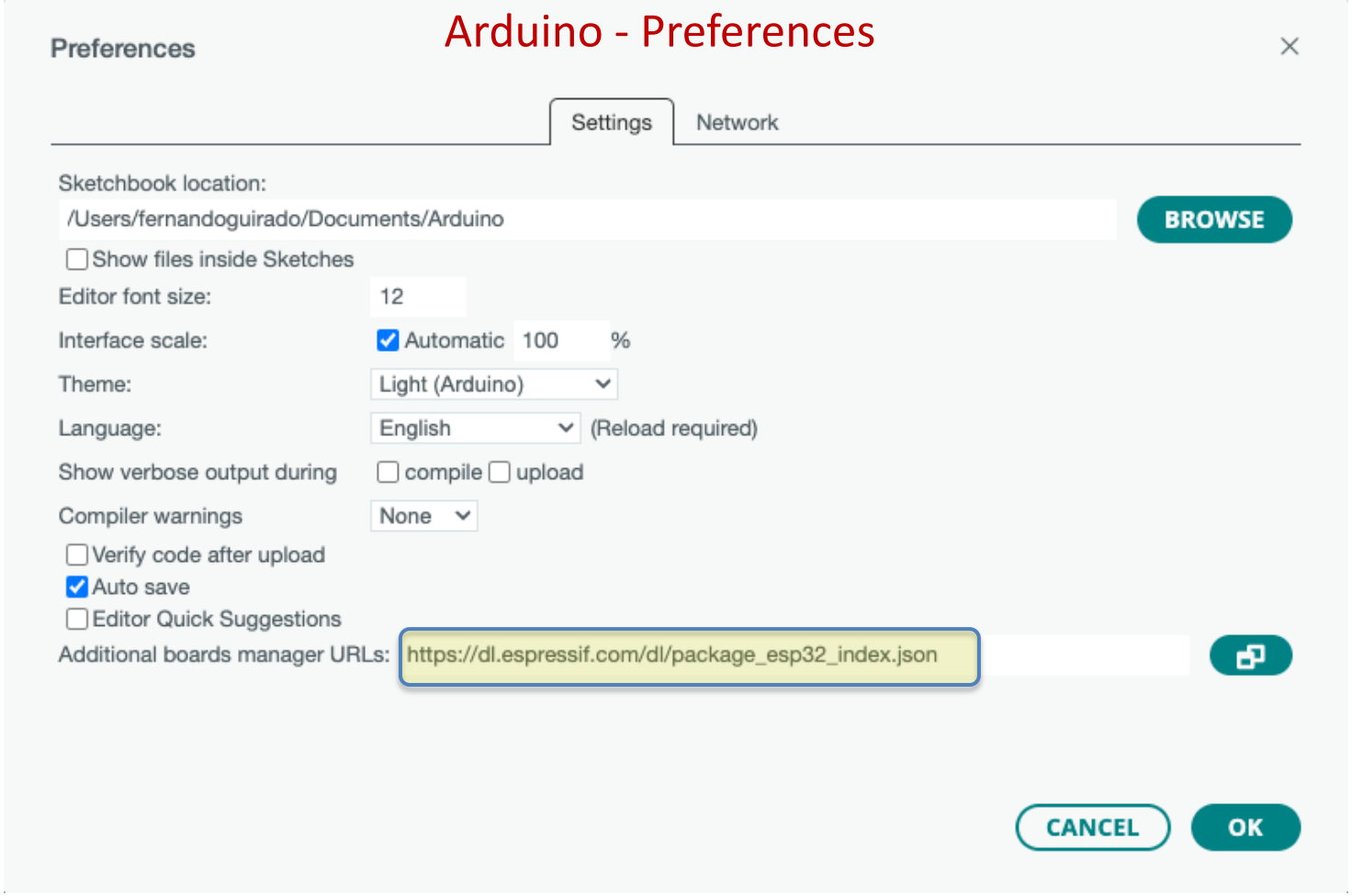
https://docs.espressif.com/projects/esp-idf/en/stable/esp32/get-started/



Eclipse Plugin
> https://github.com/espressif/idf-eclipse-plugin

VS Code Extension
> https://github.com/espressif/vscode-esp-idf-extension

Arduino IDE – ESP32 – WROOM32-D



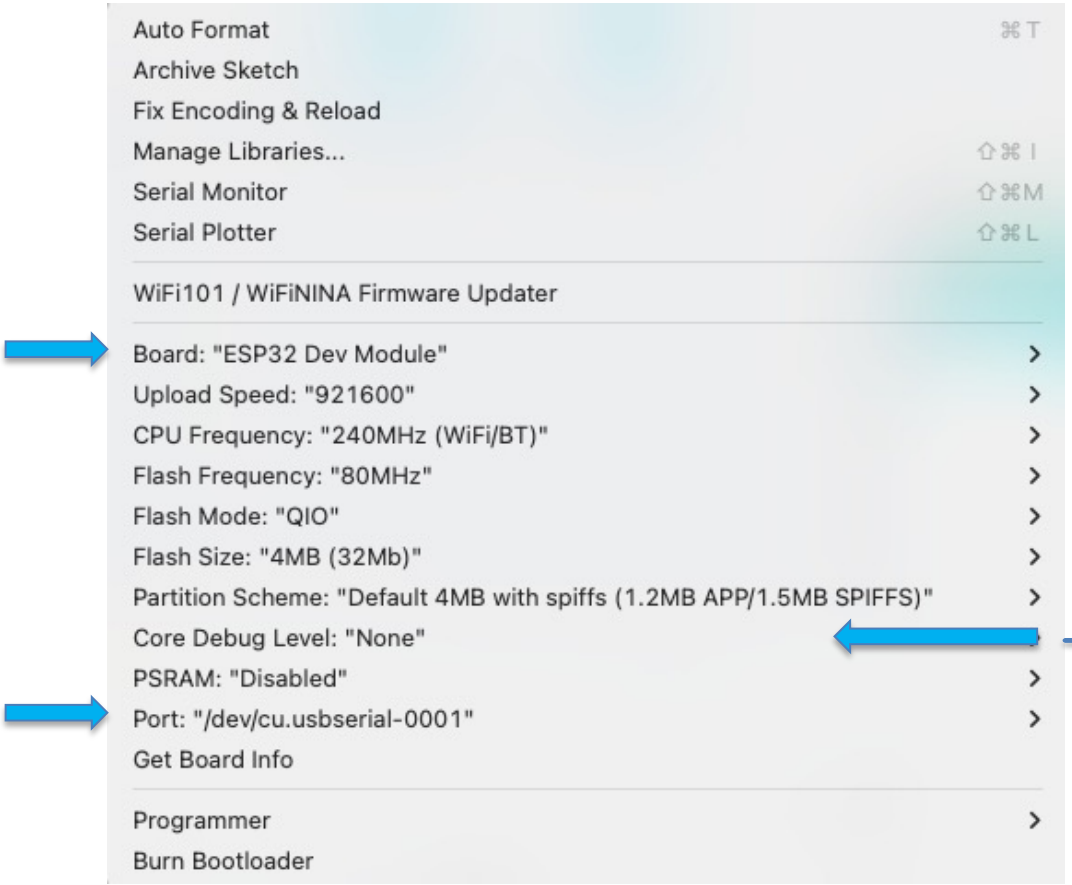
https://dl.espressif.com/dl/package_esp32_index.json

Arduino IDE - NodeMCU

Arduino – Tools > Boards > Boards Manager

Arduino IDE – ESP32

Arduino – Select Board and Serial Port



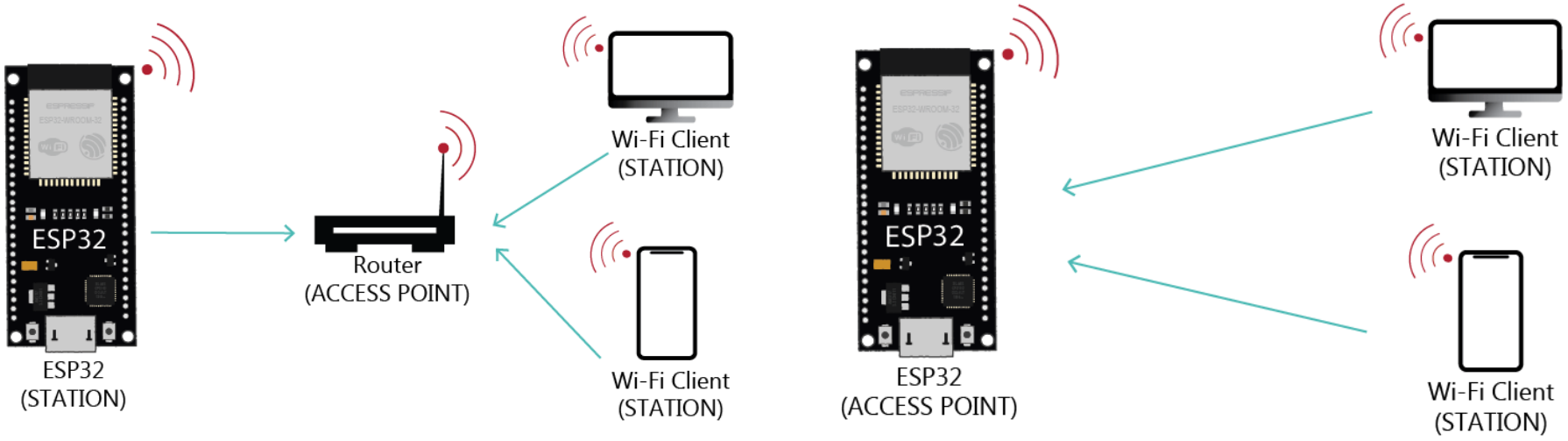
Debugging feature is controllable over the IDE menu. The new menu points manage the real-time Debug messages.

The Serial port must be initialized by the user at the highest baudrate > Serial.begin(115200)
and selected in the Debug Port menu

Debugging level is user selected

ESP32 WROOM-32D - WiFi

Station Mode (WIFI_STA) → It can connect to the Wi-Fi network as any other device
Access Point (WIFI_AP) → It establishes its own Wi-Fi network, then any other device can connect to the ES32
Both Station and Access Point (WIFI_AP_STA) → It operates as both a station and a soft access point mode. This provides the possibility of building e.g. mesh networks.




```
#include "WiFi.h"
```

WiFi Station

WiFi.begin(ssid, password, channel, bssid, connect) / WiFi.begin(ssid, password) / WiFi.begin()

- ssid - a character string containing the SSID of Access Point we would like to connect to, may have up to 32 characters
- password to the access point, a character string that should be minimum 8 characters long and not longer than 64 characters
- channel of AP, if we like to operate using specific channel, otherwise this parameter may be omitted
- bssid - mac address of AP, this parameter is also optional
- connect - a boolean parameter that if set to false, will instruct module just to save the other parameters without actually establishing connection to the access point

WiFi.config(local_ip, gateway, subnet, [dns1], [dns2])

> Disable DHCP client and set the IP configuration of station interface to user defined arbitrary values.

- local_ip - enter here IP address you would like to assign the ESP station's interface
- gateway - should contain IP address of gateway (a router) to access external networks
- subnet - this is a mask that defines the range of IP addresses of the local network
- dns1, dns2 - optional parameters that define IP addresses of Domain Name Servers (DNS) that maintain a directory of domain names (like e.g. www.google.co.uk) and translate them for us to IP addresses

WiFi Access Point

WiFi.softAP(ssid) / WiFi.softAP(ssid, psk, channel, hidden, [max_connection])

- ssid - character string containing network SSID (max. 32 characters)
- psk - optional character string with a pre-shared key. For WPA2-PSK network it should be minimum 8 characters long and not longer than 64 characters. If not specified, the access point will be open for anybody to connect.
- channel - optional parameter to set Wi-Fi channel, from 1 to 13. Default channel = 1.
- hidden - optional parameter, if set to true will hide SSID.
- max_connection - optional parameter to set max simultaneous connected stations, from 0 to 8. Defaults to 4. Once the max number has been reached, any other station that wants to connect will be forced to wait until an already connected station disconnects.

*There are other overloaded methods

WiFi. softAPConfig (local_ip, gateway, subnet)

- local_ip - enter here IP address you would like to assign the ESP station's interface
- gateway - should contain IP address of gateway (a router) to access external networks
- subnet - this is a mask that defines the range of IP addresses of the local network

>Not using this method the network established by softAP will have default IP address of 192.168.4.1

WiFi Server & Client

It provides functionality to other programs or devices, called clients
Methods come directly from the Arduino library

WiFiServer server(port) → Creates a new server port

- port - the port to listen on (int)

WiFiClient client → Creates a client able to be connected to any server