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ELSE PRO
WEBINAR 3 – PART 2
Communications Technologies

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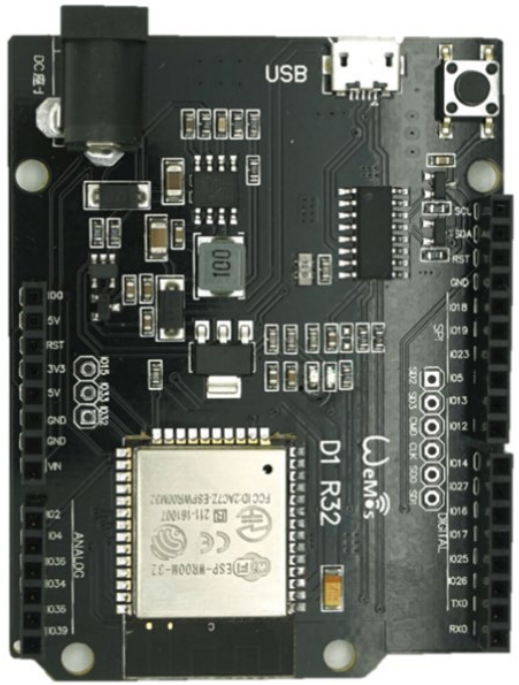

Wemos D1 R32 (based on ESP32)

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Welcome to the world of communications technologies

- ✓ The ESP32 device is a powerful microcontroller that can connect to a wide range of communication technologies, including **serial**, **Bluetooth**, and **Wi-Fi**

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Some fundamental concepts...

- ✓ **Communications**: transmission of signals using a common code between the **sender** and the **receiver**.

- ✓ The **transmission speed** is measured in changes of state (1 or 0) per second (**hertz: Hz**), or in **bits per second** (**bps**) **or bauds**
- ✓ **Point-to-point** or **multipoint** communications with **wired** or **wireless** connections.

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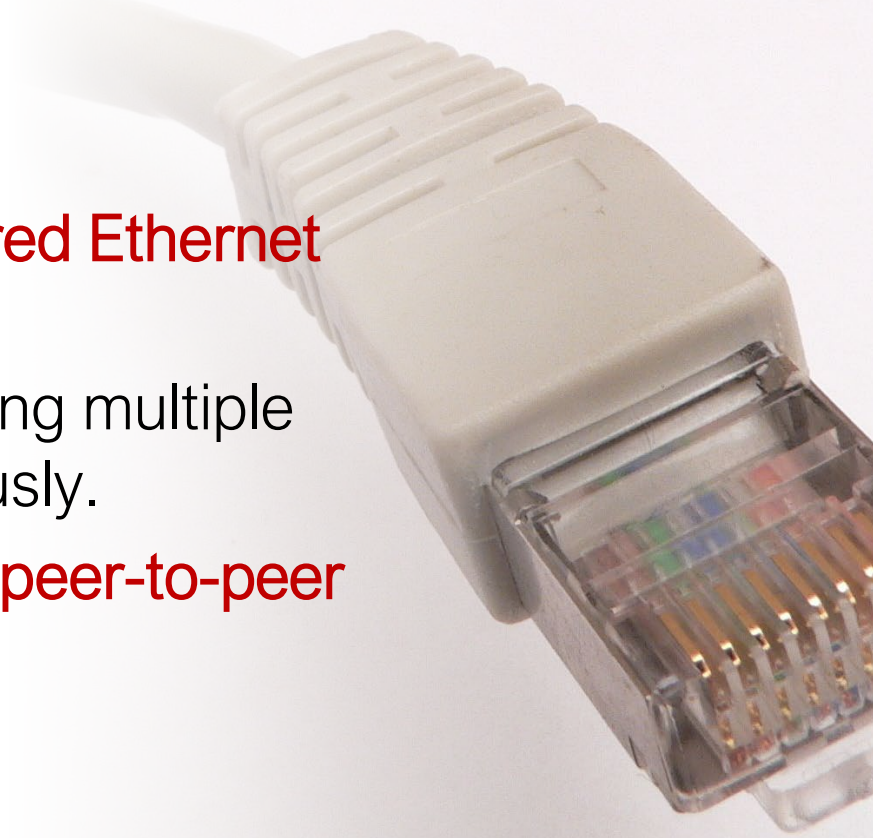
Some fundamental concepts...

- ✓ **Point-to-point** communication:
  - Connection between only two devices, such as a **wired serial** connection (e.g. **USB**) or a **wireless Bluetooth** connection
  - **Data** is transmitted **directly** between the two devices without any intermediaries.
- ✓ **Multipoint** communication:
  - Connection of more than two devices, such as a **wired Ethernet** connection or a **wireless Wi-Fi** connection
  - **Data** is transmitted through a network or **bus**, allowing multiple devices to communicate between them simultaneously.
  - Models for exchanging information: **client-server** vs **peer-to-peer** (P2P)



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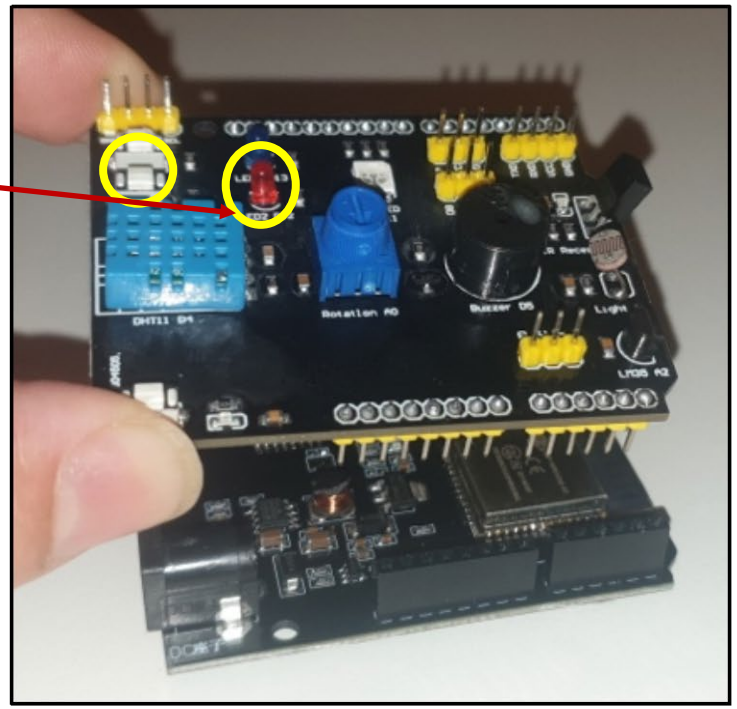
How are we going to test the different communications technologies?

- ✓ With a code which turns on an LED



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How are we going to test the different communications technologies?

We will activate the LED of the ESP32
1) using the PC, 2) when we press the button of another different ESP32, 3) or when we order it from our mobile phone.

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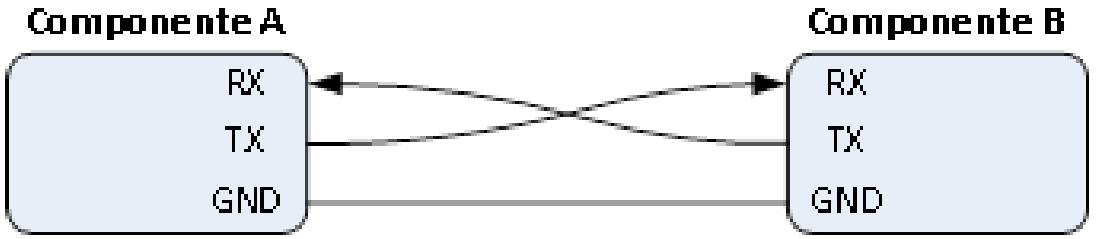
1) Wired serial communications



- ✓ We can easily establish a connection between two ESP32s or even between an ESP32 and a computer
- ✓ This is a great way to send and receive data in a simple and reliable way
- ✓ It involves using two wires, one for transmitting data (TX) and the other for receiving data (RX), in addition to a shared ground wire (GND)

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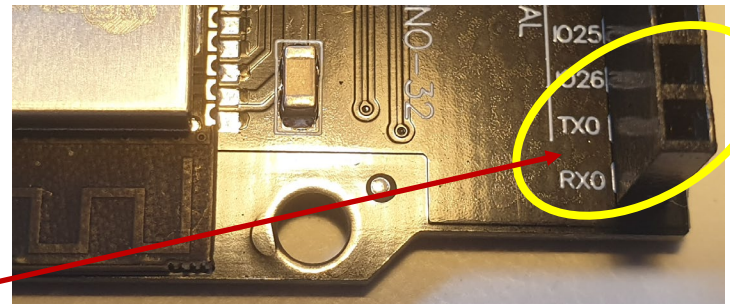
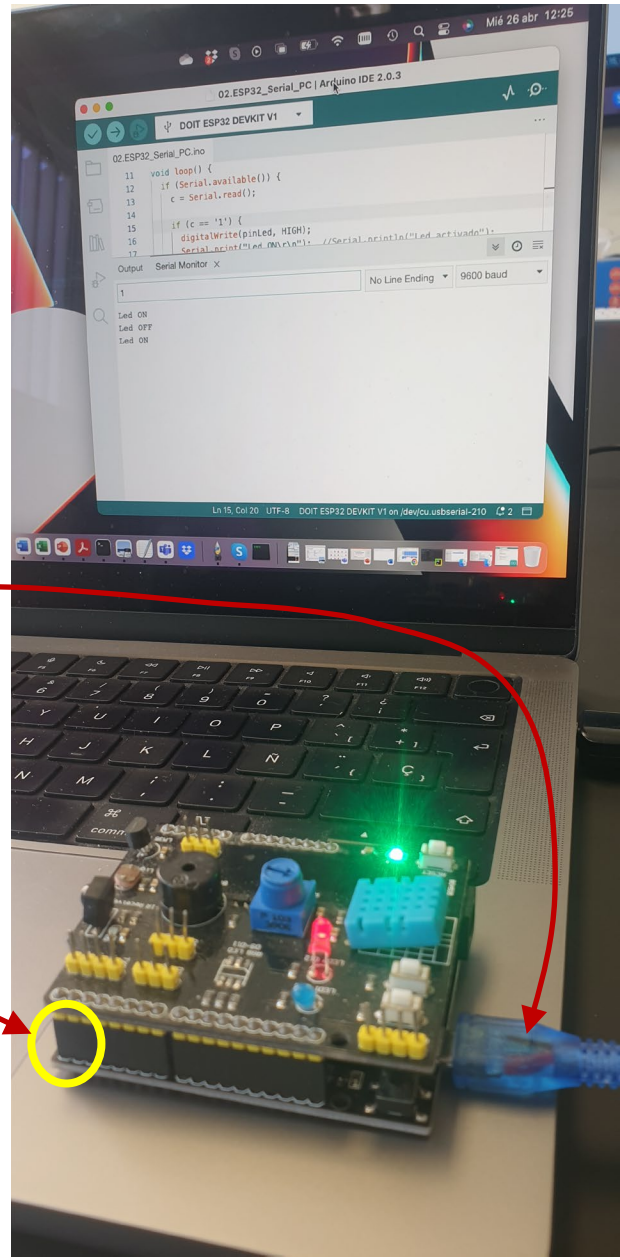
Serial communications between the ESP32 and the PC

- ✓ We have the "**serial**" **library** that provides functions to transmit and receive data over a physical serial connection made between a ESP32's serial port and a PC's USB port **using a USB cable**
  - *Serial.begin()*
  - *Serial.print()*
  - *Serial.read()*
- ✓ The "serial" library uses **pins 0 and 1** internally for the USB connection





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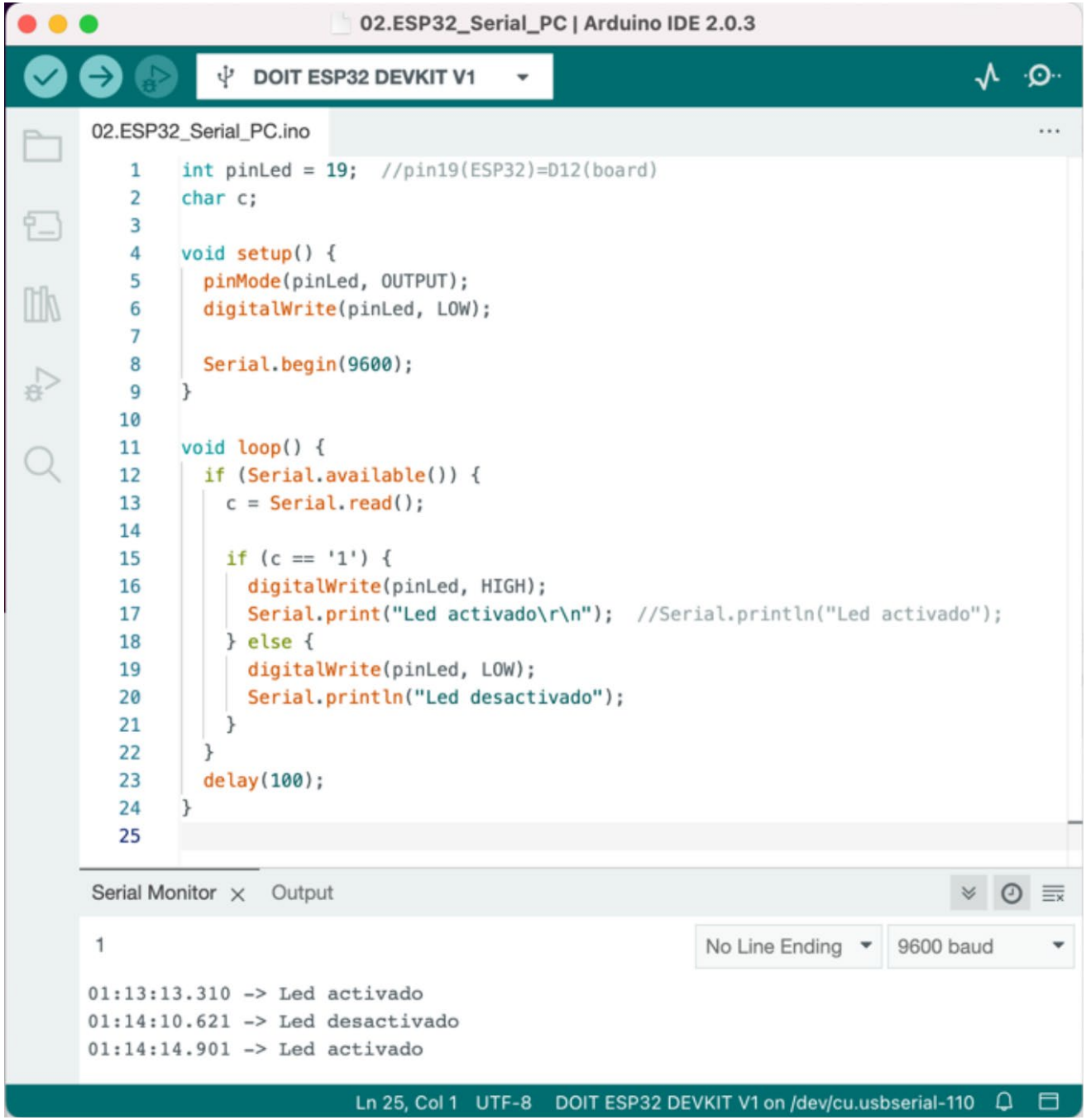
- ✓ This code activates the LED when the ESP32 receives the value 1 from the keyboard and deactivate the LED if it receives any other value.
- ✓ It also displays the LED's status on the screen.



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2) Bluetooth communications

- ✓ Bluetooth communication takes things to the next level, allowing you to connect your ESP32 to other devices like smartphones and tablets.
- ✓ This opens a whole new world of possibilities for remote control and monitoring of your projects.
- ✓ It allows for short-range data transmission between devices in a similar way to serial communication, but without the need for cables or physical connections

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Bluetooth Library

- ✓ "Bluetooth Serial" library
  - Slave Mode: it can be connected to by other Bluetooth devices
  - Master Mode: it can connect to other Bluetooth slaves
  - Once connected, ESP32 devices can send and receive data

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```ino
// Slave
#include "BluetoothSerial.h"

BluetoothSerial BT;
int pinLed = 19;  //pin19(ESP32)=D12(board)
char c;

void setup() {
  pinMode(pinLed, OUTPUT);
  digitalWrite(pinLed, LOW);
  BT.begin("My_ESP32_Bluetooth");  //Name and Slave configuration by default
  Serial.begin(9600);
  Serial.println("ESP32 Bluetooth is ready to pair");
}

void loop() {
  if (BT.available()) {
    c = BT.read();

    if (c == '1') {
      digitalWrite(pinLed, HIGH);
      Serial.print("Led ON\r\n");  //Serial.println("Led ON");
    } else {
      digitalWrite(pinLed, LOW);
      Serial.println("Led OFF");
    }
  }
  delay(100);
}
```

Important! Replace with your name

```ino
// Master
#include "BluetoothSerial.h"

BluetoothSerial BT;
String slaveName = "My_ESP32_Bluetooth";
int pinButton = 25;  //pin25(ESP32)=D3(board)
int buttonState;

void setup() {
  pinMode(pinButton, INPUT);


  BT.begin("ESP32 BT Master", true);  //Name and Master configuration
  Serial.begin(9600);
  Serial.print("Connecting to Bluetooth slave ESP32...");

  while (!BT.connect(slaveName))
    Serial.print("...");
  Serial.println("...connected!");
}

void loop() {
  buttonState = digitalRead(pinButton);
  if (buttonState == 0)
    BT.write('1');
  else
    BT.write('0');
  delay(100);
}
```

MASTER

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3) Bluetooth with mobile phones

- ✓ We don't need to develop new code for this, as we will use the ESP32 with the compiled and uploaded slave code
- ✓ We will install a Serial connection program via Bluetooth on our mobile phone:
  - *Serial Bluetooth terminal*

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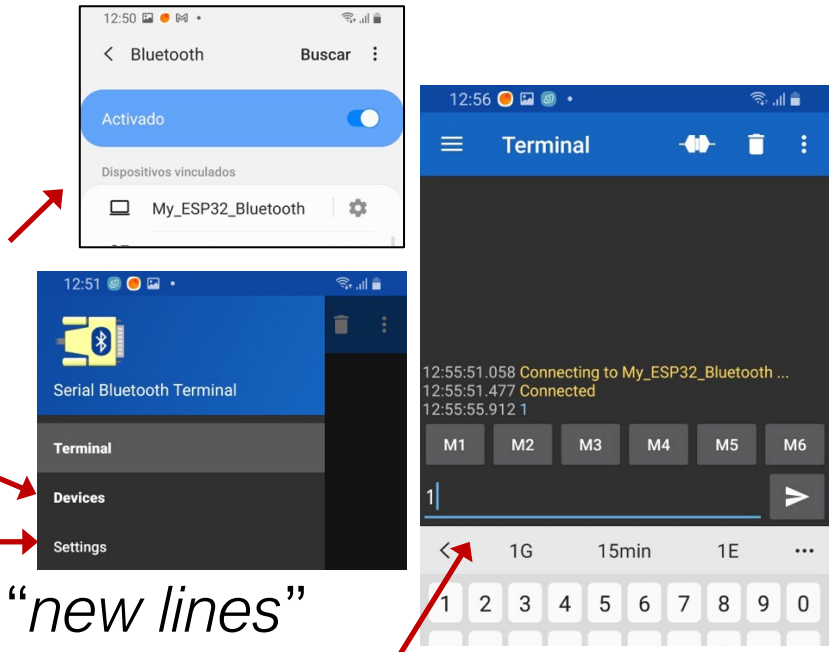
- ✓ Pair the Slave ESP32 with your smartphone
- ✓ Configure the application:
  - "*Devices*" menu: connect to the Slave ESP32
  - "Settings" menu: configure the way to send **text data without** adding **control chars** to indicate "*new lines*"



we can send messages (i.e.: characters '1' or '0') to the ESP32 to turn on or turn off the LED

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So whether you're building a robot, monitoring environmental conditions, or creating a home automation system, the ESP32's communication capabilities will make your project come alive

I encourage you to explore the power of ESP32 communications and see what amazing things you can create!

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THANK YOU

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