ESP32 Microcontroller

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A Computer System

A **computer** is a programmable machine that receives input, stores and manipulates data//information, and provides output in a useful format.

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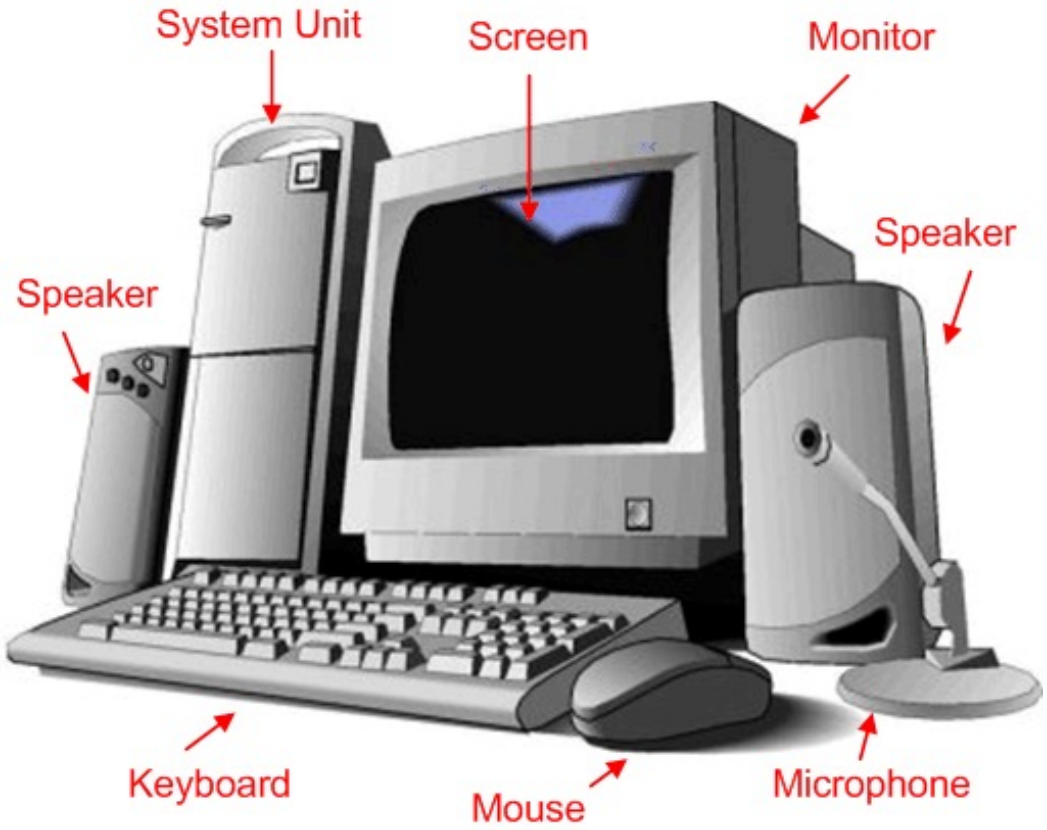
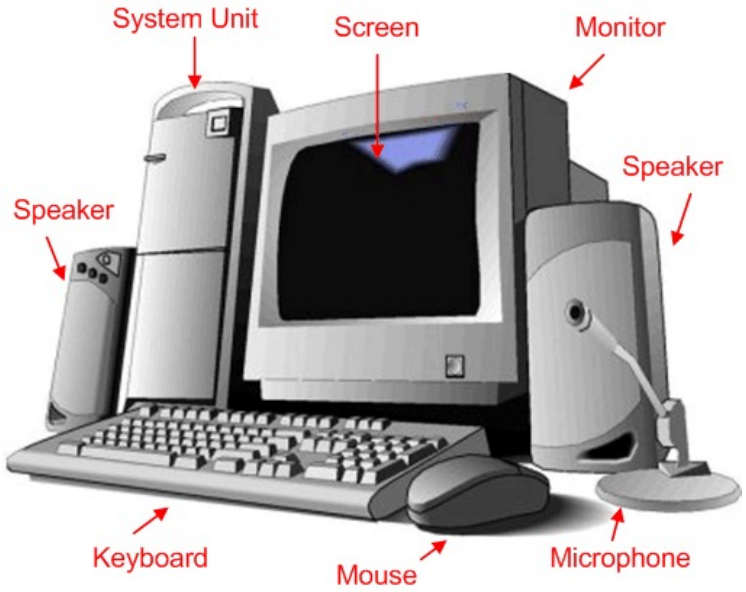


Diagram Of A Computer System

Computer System Vs Microcontroller



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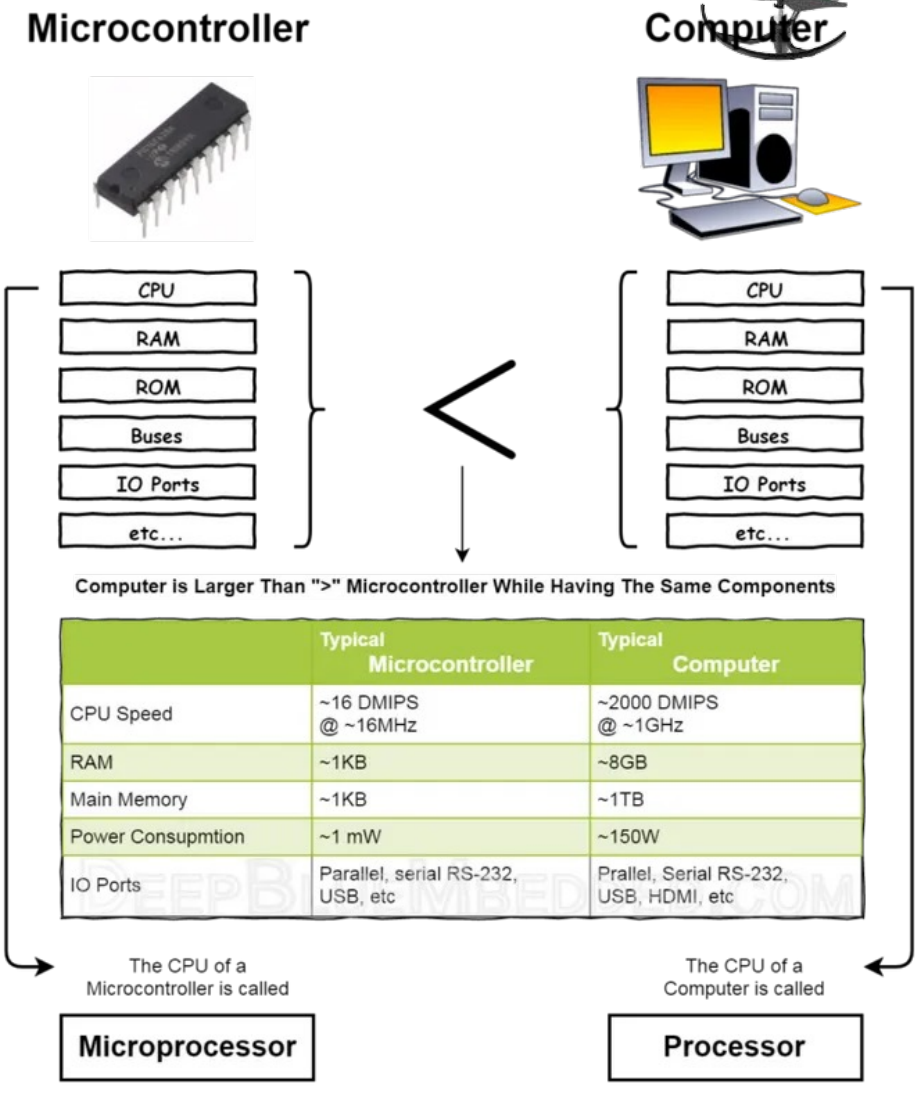

Both are built around a processor

- It is a programmable, multipurpose, clock -driven, register-based electronic device that reads binary instructions from a storage device called memory, accepts binary data as input and processes data according to those instructions and provides results as output.

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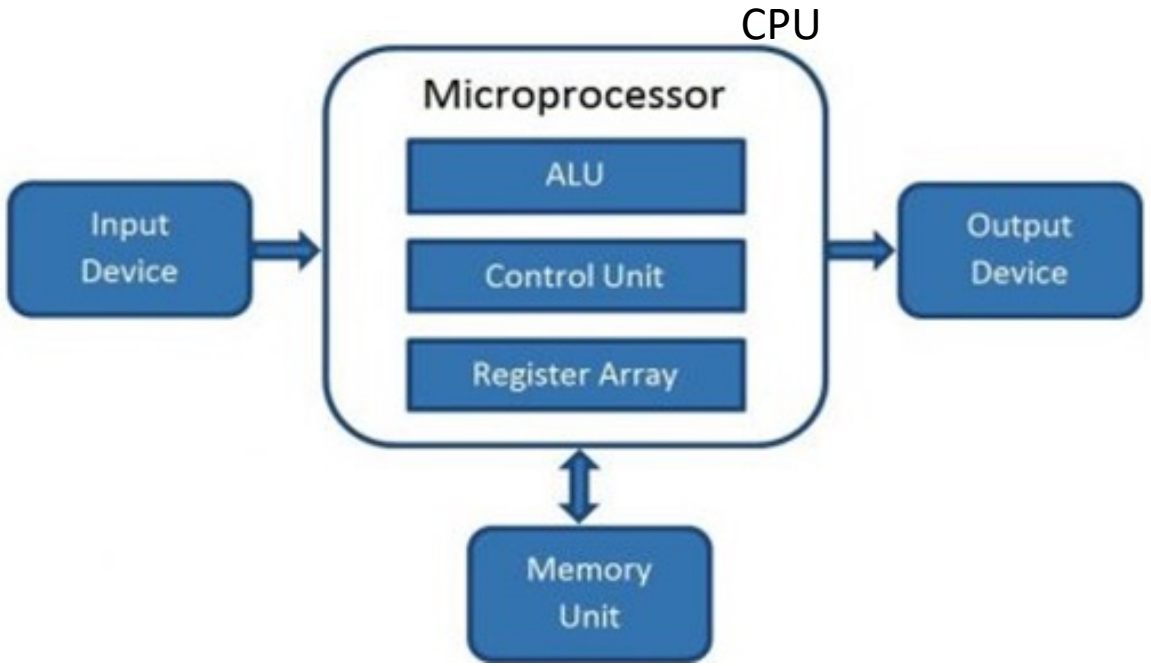

ESP8266 & ESP32

	ESP8266	ESP32
MCU	Xtensa Single-core 32-bit L106	Xtensa Dual-Core 32-bit LX6 with 600 DMIPS
802.11 b/g/n Wi-Fi	HT20	HT40
Bluetooth	**No**	Bluetooth 4.2 and BLE
Typical Frequency	80 MHz	160 MHz
SRAM	**No**	**Yes**
Flash	**No**	**Yes**
GPIO	17	36
Hardware /Software PWM	None / 8 channels	None / 16 channels
SPI/I2C/I2S/UART	2/1/2/2	4/2/2/2
ADC	10-bit	12-bit
CAN	**No**	**Yes**
Ethernet MAC Interface	**No**	**Yes**
Touch Sensor	**No**	**Yes**
Temperature Sensor	**No**	**Yes**
Hall effect sensor	**No**	**Yes**
Working Temperature	-40°C to 125°C	-40°C to 125°C

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ESP32 Communications

Application	#Devices	Chipset	Protocol	Data Rate	Range
Remote Controller	1	ESP8266	ESP-NOW	<10 kbps	<50m
Security Key Fob	1	ESP32	Wi-Fi + ESP-NOW	<10 kbps	100m
Intelligent Weighing Scale	<5	ESP32	Wi-Fi + BLE	<1 Mbps	<100m
Smart Lighting (Mesh)	<100	ESP8266	Wi-Fi + ESP-MESH + ESP-NOW	<1 Mbps	>100m
Home Automation	100+	ESP8266	Wi-Fi + ESP-MESH	~1 Mbps	>100m
Home Automation with Sensor Network	500+	ESP8266 + ESP32	Wi-Fi + ESP-MESH + ESP-NOW + BLE	~1 Mbps	>300m
Smart Lighting	<10	ESP8266	Wi-Fi	<10 Mbps	100m
Wi-Fi Camera	1	ESP32	Wi-Fi HT40	~100 Mbps	<30m
Wi-Fi Audio	1	ESP32	Wi-Fi HT40 + BLE	~100 Mbps	<30m

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Espressif IoT Boards

DOIT DEVKIT V1

ESP32 DevKit

ESP-32S NodeMCU

ESP32 Thing

WEMOS LOLIN32

"WeMos" OLED

HUZZAH32

(...)

ESP32 DevKitC
(ESP32 Core Board)

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ESP32

- Espressif ESP32 Single and Dual Core Processors in 5x5mm Package.
- Espressif ESP32 Dual Core SoC Features Faster WiFi, Bluetooth 4.0 LE, and More Peripherals
  - ESP32-S0WD: Xtensa single–core 32-bit LX6 microprocessor, up to 200 DMIPS
  - 448 KB ROM
  - 520 KB SRAM
  - 16 KB SRAM in RTC
  - QSPI flash/SRAM, up to 4 x 16 MB
  - Power supply: 2.3V to 3.6V

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ESP32 Block Diagram

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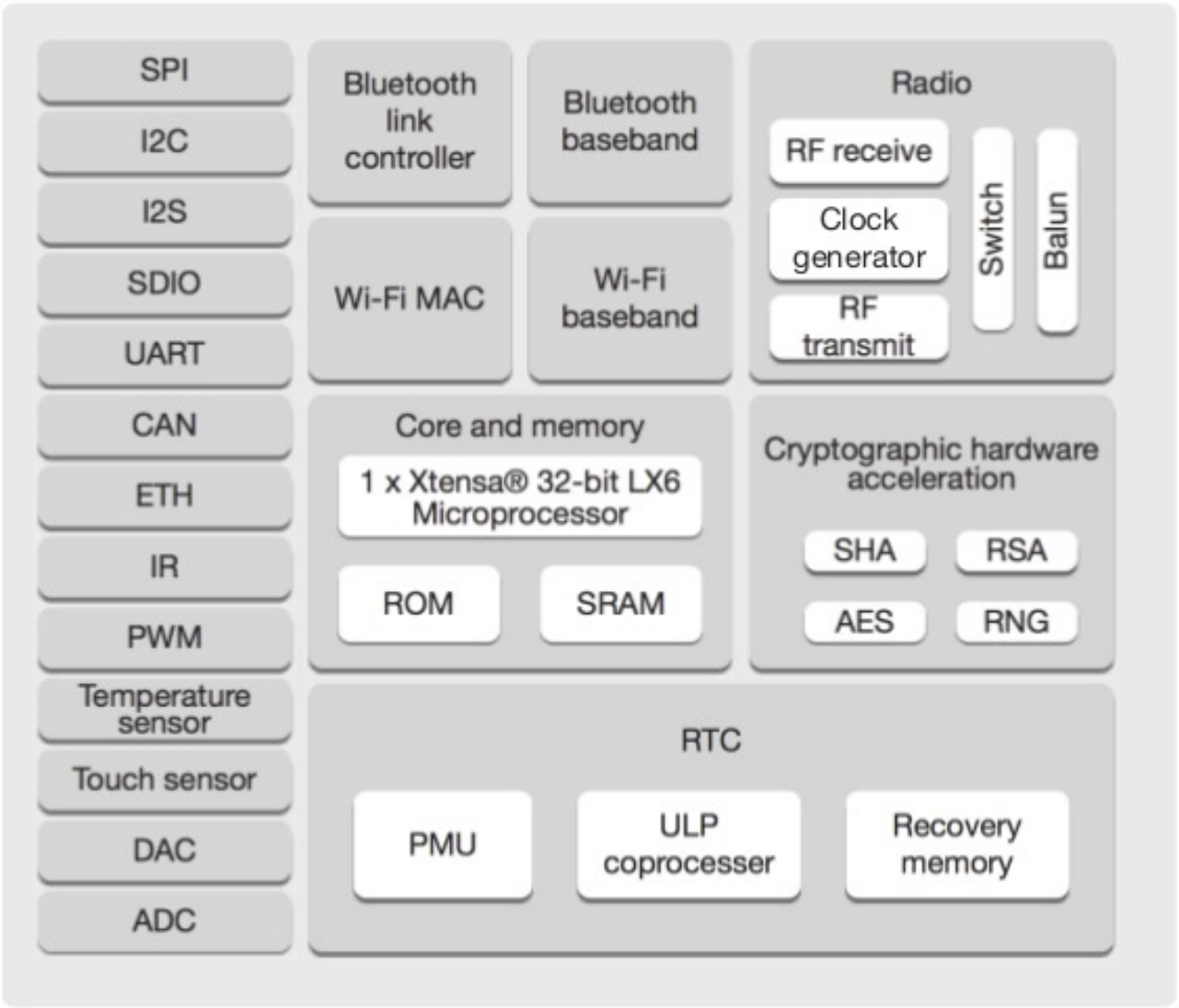

Figure 1: ESP32-S0WD Function Block Diagram

ESP32 Spec Summary

Category	Feature	Spec
Wireless Para meters	Certifications	FCC/CE coming soon
	Wireless Standard	802.11 b/g/n/e/i Bluetooth 4.2 (BR/EDR/BLE)
	Frequency	2.4GHz-2.5GHz (2400M-2483.5M)
Hardware Para meters	Data Interface	UART/SPI/I2C/I2S/IR/CAN
		GPIO/PWM
	Working Voltage	3.0~3.6V
	Working Current	Average： 90mA
	Working Temperature	-40°~125°
	Storage Temperature	normal temperature
	Size	16mm * 24mm * 3mm
Software Para meter	Wireless Network Model	Station/SoftAP/SoftAP+station
	Security	WFA、WPA/WPA2,WAPI
	Encryption Type	WEP/TKIP/AES
	Update Firmware	Local Serial Download / OTA / Host Download Burn
	Software Development	Support customized servers Provide SDK for secondary development
	Network Protocol	IPv4, TCP/UDP/HTTP/FTP
	User Configuration	AT+ instructions, cloud server, Android/iOS AP P

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ESP32 Boards

Why choose ESP32?

- **Wireless connectivity**
  - **WiFi**: 150.0 Mbps data rate with HT40
  - **Bluetooth**: BLE (Bluetooth Low Energy) and legacy Bluetooth.
- **Processor**: Tensilica Xtensa Dual-Core 32-bit LX6 microprocessor, running at 160 or 240 MHz
- **ROM**: 448 KB
- **SRAM**: 520 KB
- **Low Power**: ensures that you can still use ADC conversions, for example, during deep sleep.
- **Peripheral Input/Output:** peripheral interface with DMA that includes capacitive touch, ADCs (Analog-to-Digital Converter), DACs (Digital-to-Analog Converter), I²C (Inter-Integrated Circuit), UART (Universal Asynchronous Receiver/Transmitter), SPI (Serial Peripheral Interface), I²S (Integrated Interchip Sound), RMII (Reduced Media-Independent Interface) and PWM (Pulse-Width Modulation).
- **Security**: hardware accelerators for AES and SSL/TLS
- **Cost:** $2 (bulk)
- **Programing Support:** C, C++, Lua, Python, etc.

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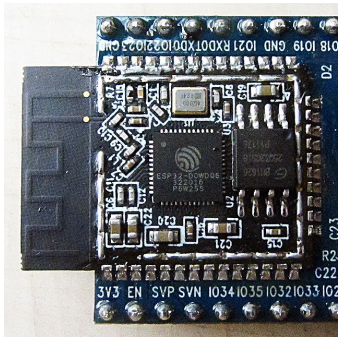
ESP32-?

- Processer: Tensilica LX6 dual core processer (One for high speed connection; one for independent programing).
- Frequency: 240MHz
- SRAM: 520KB
- Flash: 16Mbit
- Operating voltage: 3.3V
- Input voltage: 3.3V~5.5V



- Support electric current of low power consumption: 10 μA
- Support maximum discharge current: 600mA@3.3V LDO
- Support maximum charge current: 500mA
- Wi-Fi standard - Wi-Fi protocol: 802.11 b/g/n/d/e/I/k/r
- Frequency range: 2.4~2.5 GHz
- Bluetooth protocol: Comply with BR/EDR/BLE standard of Bluetooth v4.2.

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Programming the ESP32

- Espressif ESPIDF
  - https://github.com/espressif/esp-idf
  - ESP-IDF is the official Espressif development framework for the ESP32.
- ArduinoESP32
  - https://github.com/espressif/arduino-esp32
  - The Arduino-ESP32 project allows you to program the ESP32 from the popular Arduino IDE.
- MicroPython
  - https://github.com/micropython/micropython/
  - The MicroPython project provides a very rich Python 3 environment for small microcontrollers.
- Nodemcu/Lua
  - https://github.com/nodemcu/nodemcu-firmware/tree/dev-esp32
  - NodeMCU is an open source Lua based firmware for the ESP32

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