3. Hardware: What are the target technologies in the Embedded Systems?

Hardware to target an embedded system

- Based on an microprocessor/computer (SBC)
- Based on a microcontroller
- Based on a DSP
- Based on a SoC: FPGA or ASIC

Technology (SBC)

➢Based on an Single-Board Computer (SBC)

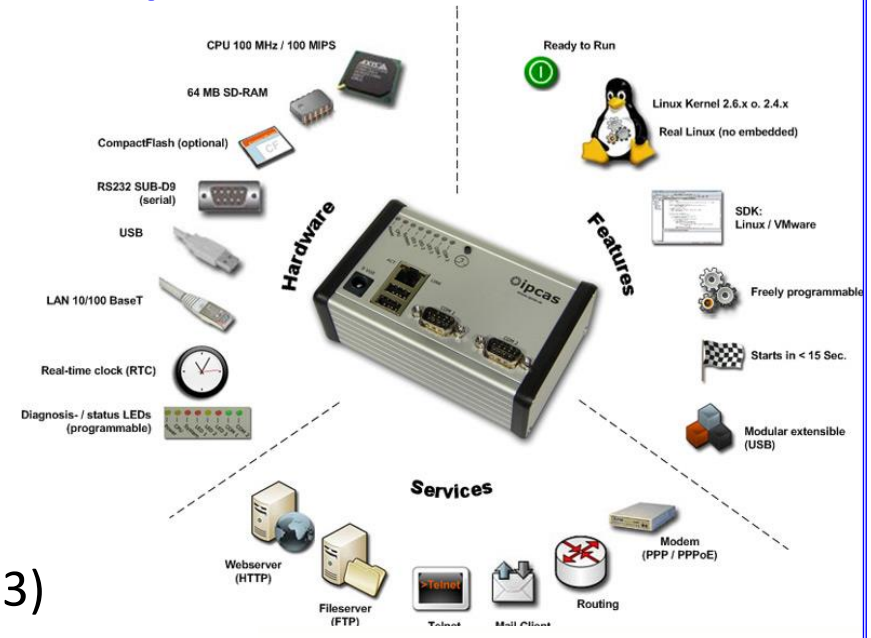
- Small board --> processor + memory + peripherals
- Familiar enviroment (IDE)
- General purpose processor:
  - x86
  - ARM
- Not suitable → size and consumption
- Sensores and actuators → SBC interfaces/connectors.
- Not recommendable for portable devices.
- Whatever programming language
- Standard S.O. → Windows, Linux…

Technology (SBC)

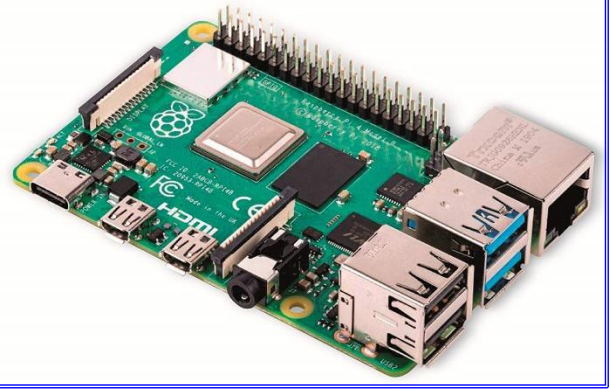
➢Based on an embedded computer (SBC)

- Model PC/104 → x86 architecture
- Mini-ITX (x86)

- Open platforms (ARM)
  - Suitable for not tough requirements
  - BeagleBoard (1 GHz ARM-CortexA8)
  - Raspberry Pi 4
    (1.5GHz Quad core ARM Cortex-A7)
  - Raspberry Pi 3
    (1.4 GHZ Quad core ARM Cortex-A53)



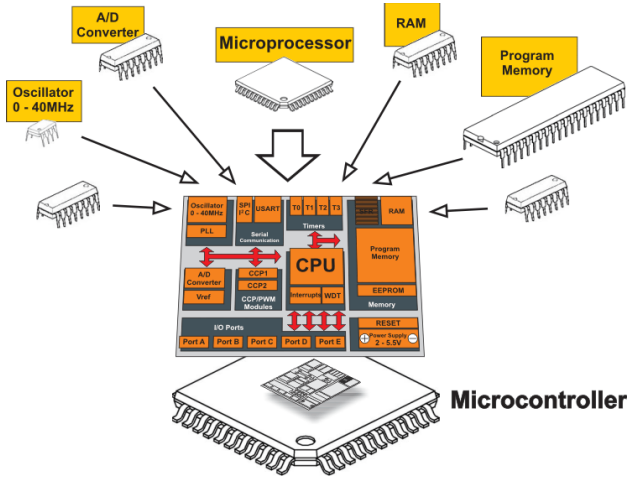
- Raspberry Pi is the most popular
  - Developing community
  - S.O. --> Linux
  - Programming --> C and Python.



Technology (Microcontroller)

➢Based on a microcontroller

- All in one chip → Processor + Memo + ADC, SPI, I2C, Bluetooth, Timers, etc
- Best choice to interact with sensors and actuators
- Advanced IDE → C or Assembly
- 8-bit, 16-bit, 32-bit.
- Microcontroller vendors :
  - Microchip: PIC,dsPIC
  - Microchip/ATMEL: AVR, Tiny…
  - NXP: ARM - LPC4088
  - Intel: 8051
- Development boards based on microcontrollers:
  - Maple based on ARM
  - Arduino based on ATMega



Technology (DSP)

➢Based on a specific microprocessor DSP

- Specialized microprocessor → architecture for digital signal processing
  - MAC hardware
  - DSP instructions

- High performance and intensive task are supported.

- Principales fabricantes de procesadores DSP:
  - Texas Instruments
  - Analog Devices
  - Microchip: dsPIC

Technology (SoC)

➢Based on a SoC (ASIC or FPGA)

- System on a chip (SoC)
  - One chip
  - Include a MMU
  - High volumen → low prices
  - Optimized for time and consumption
  - ARM and MIPs
- They are divide into:
  - ASIC, *Application Specific Integrated Circuit*
    - Designed for a specific device
    - Designed by means of a *Hardware Description Language* (HDL)
  - FPGA, *Field programmable gate array*
    - Programmable by the user
    - ASIC prototypes are based in FPGA
    - They are used in final products also

A technologies comparative

SBC	Microcontroller	DSP	SoC
Low production	Only the software is designed	High performance	S.O., software, drivers and peripherals as a processor
S.O. , driver, general purpose software	Low cost and consumption		
Short-time development	Flexible	Often accompanied by another processor	High performance
High consumption	Different sizes		Small size
Large form factor	Low frequencies and small memory capacity		Long-time development