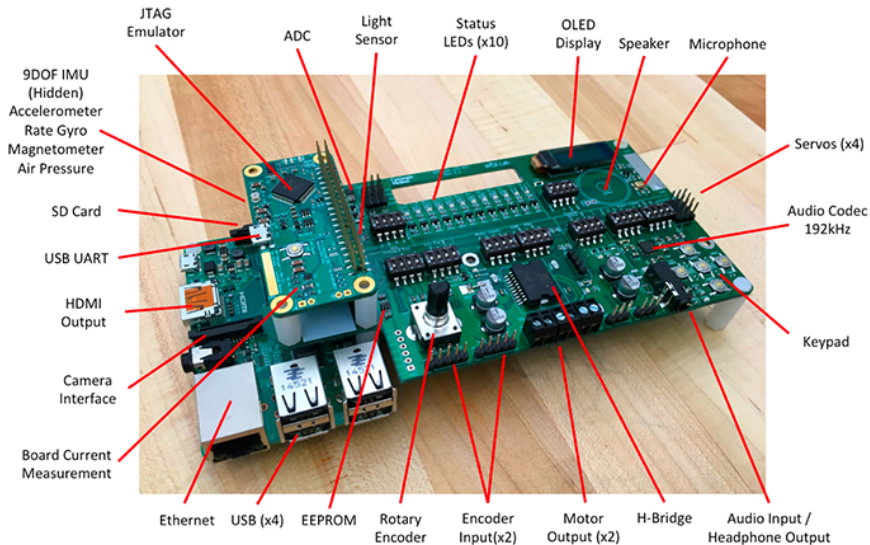



Hardware platforms and interfaces



Presentation plan: microcontrollers

- Speed vs latency
- Price
- IO
- Arduino ecosystem 
- Microcontrollers review: STM32
- Microcontrollers review: NodeMCU

Presentation plan: embedded computers

- How do they differ?
- What to be careful about
- What to be really careful about
- Family / manufacturer review
- Multimedia support

Presentation plan: embedded computers review

- Review: Raspberry PI (Broadcom)
- Review: Jetson (Nvidia)
- Review: UP board (Intel)
- Review: Banana/Orange/Nano PI (Allwinner)
- Review: Odroid (Samsung)
- Review: PINE (Rockchip)

Presentation plan: protocols

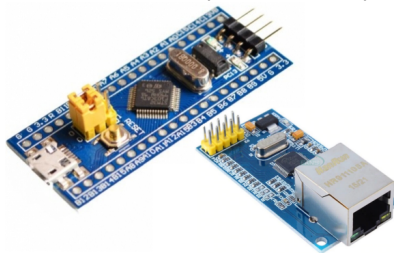
- Device discovery and configuration
- Differences in physical layer
- I2C, SPI, UART
- CAN bus

Presentation plan: peripherals

- Relay
- Motor (DC, Stepper motor, BLDC)
- Servo
- LED
- WiFi, Ethernet, Bluetooth
- Loud speakers ;)

Microcontroller vs embedded computer

Microcontroller (STM32F103)



Cost:	5.50\$
Power:	0.1W
Boot time:	instant

Raspberry PI

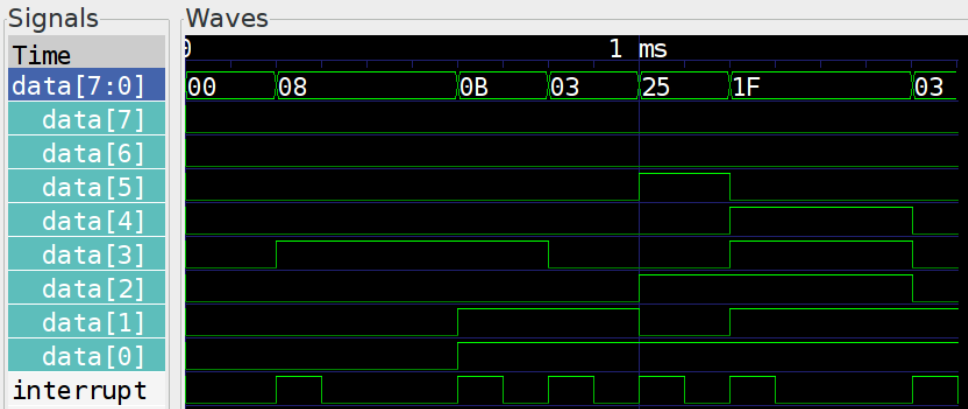


40.00\$
2.5W
≈ 10s

Microcontroller vs embedded computer

- Lower computational power, but faster reaction
- Real time capability
- Complete datasheet for everyone (!!!)
- Enviromental resistance
- More low-level IO
- Faster low-level IO

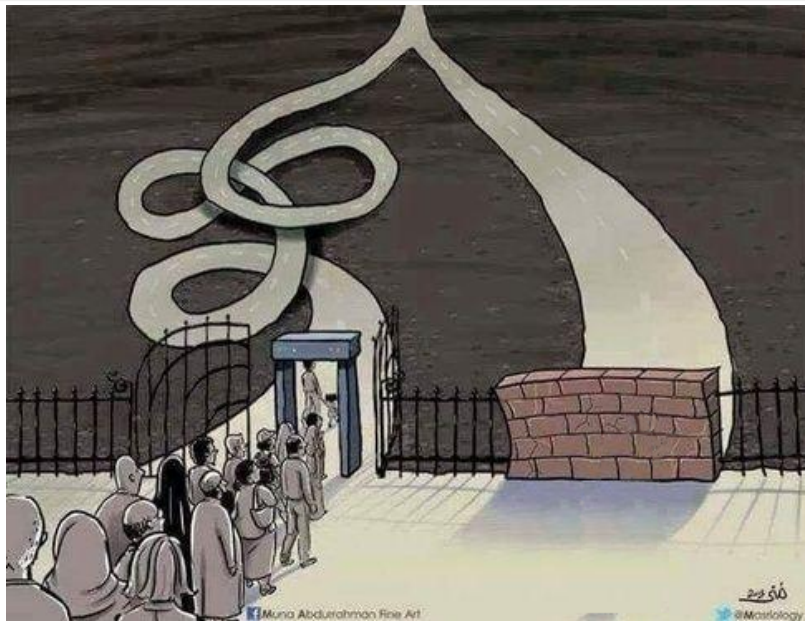
Lower computational power, but faster reaction





Subjective statements ahead!

Arduino ecosystem



Pros:

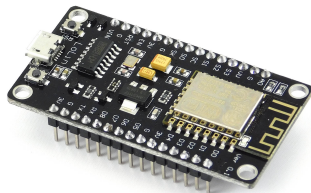
- Extremely easy to start using
- A lot of libraries (of various quality)
- A lot of tutorials / people willing to help

Cons:

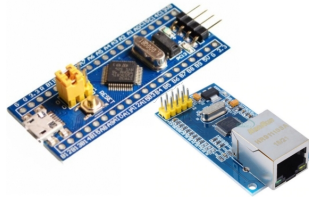
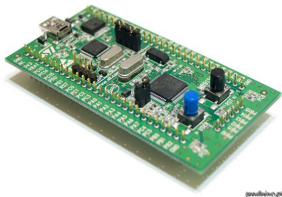
- Atmel's microcontrollers are primitive
- Buildsystem that hides everything from you
- Mandatory C++ (wtf)
- License restrictions
- Interface incompatibility on purpose

Review: NodeMCU

- Has WiFi.
- Programmable in C or Lua.
- 4.00\$ (!)

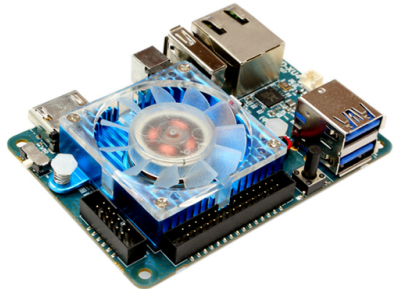
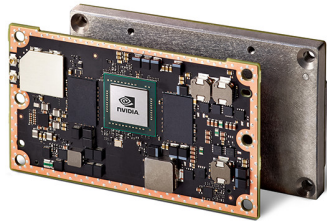
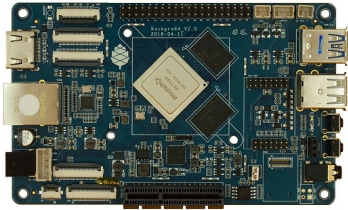


Review: STM32



- ARM based
- Compatible with standard GNU toolchain
- Wide MCU selection
- Hardware Abstraction Library
- CubeMX

How do embedded computers differ?



What to be careful about?

Raspberry Pi 2 Model B



Banana Pi



Processor

ARM Cortex A7 – 900 MHz – quad core

Allwinner A20 – Cortex A7 – 1 GHz – dual core

RAM

1 GB LPDDR2

1 GB DDR3

External storage

MicroSD

SD Card, 2.5" SATA

GPU

VideoCore IV – dual core

Mali 400 MP2 – dual core

USB

4 x USB 2.0

2 x USB 2.0

Video out

1 x HDMI – 1.3 or 1.4

1 x HDMI, 1 x Composite

GPIO

40-pin expansion header

26-pin expansion headers

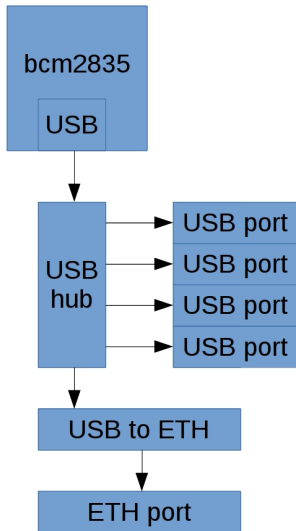
Network

1 x 10/100 Ethernet

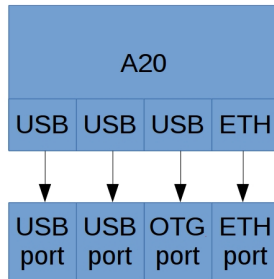
1 x 10/100/1000 Ethernet (802.11n on Pro)

What to be careful about?

Raspberry PI:



Banana PI:



What to be careful about?



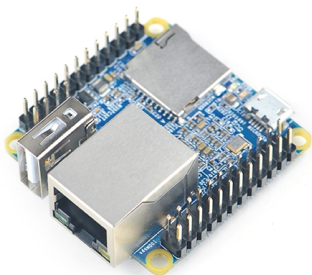
Moduł podłączany jest do dedykowanego złącza w **Banana Pi** za pomocą taśmy.

Specyfikacja

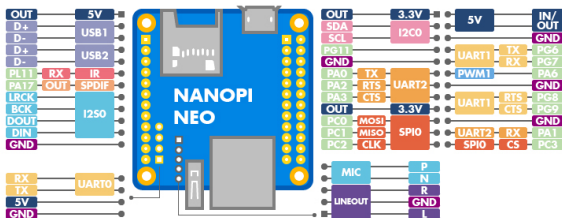
- Chip: OV5640
- Matryca: 5 Mpx
- **Wspiera tryb HD 1080p dla 30 fps**
- Złącze: 40 pinowa taśma FFC (w zestawie)
- Kompatybilna ze złączem Banana Pi
- Temperatura pracy: od -30 °C do 70 °C
- Wymiary: 36 x 32 x 10 mm
- Masa: 8 g



Board review Nano Pi



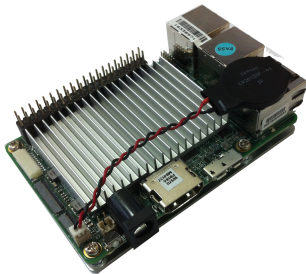
NanoPi NEO v1.3 pinout diagram



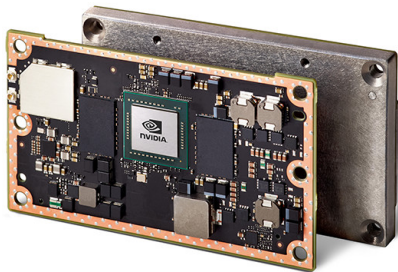
- Small and cheap (55PLN)
- Faster than Raspberry PI Zero
- Good IO, especially 3x USB 3.0
- Heats up badly under load

UP Board

- The only open source board on this presentation (software-wise)
- x86 – excellent support for OpenGL and OpenCL
- Good performance

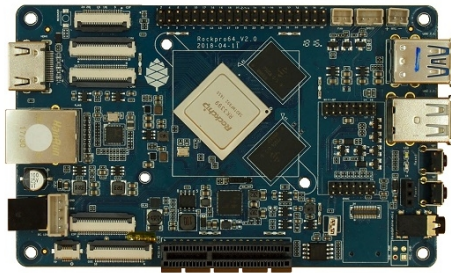


Nvidia Jetson TX2



- Best computational power
- CUDA
- Excellent IO: PCI-E, SATA, USB 3.0, CSI: up to 6 1080p cameras, 2x CAN
- Proprietary kernel
- Ridiculously expensive

PINE Rockpro64



- Excellent performance
- OpenCL
- Excellent IO: PCI-E, SATA, USB 3.0, CSI: up to 2 4K cameras
- Ridiculously affordable (80\$)

Raspberry PI 3



- Great camera support
- Terrible IO bandwidth
- Wifi and Bluetooth
- Affordable

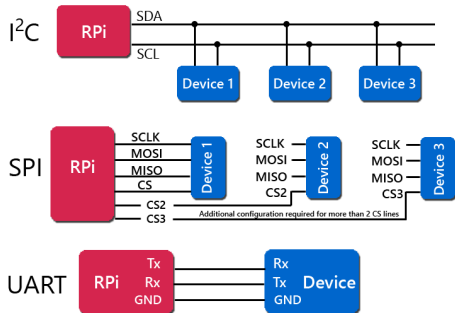
Knock, knock. Who's there? hid-generic 0003:1532:0016

- Metadata in specification

- USB
- PCIe

- Metadata not defined

- SPI
- UART
- I2C
- CAN



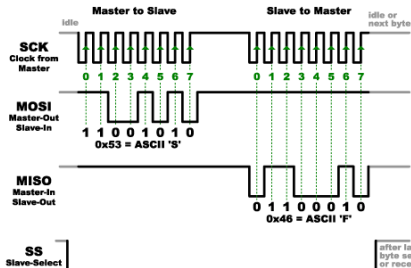
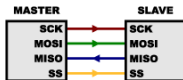
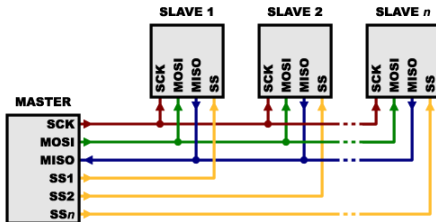
How to recognize and talk to the device?

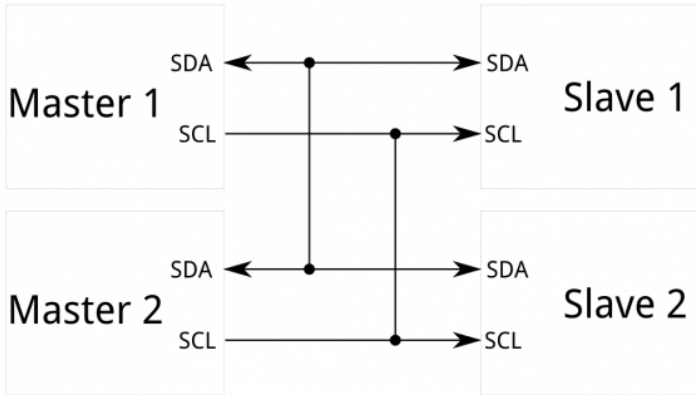
- Normal way
- Device tree
- Register harassment 💣



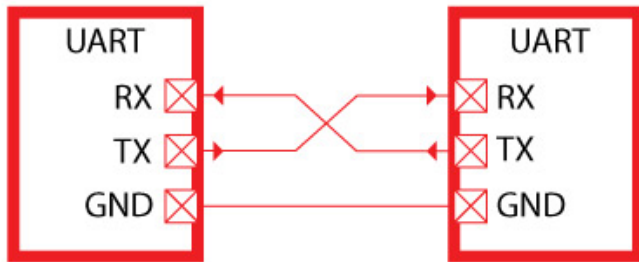
You must choose, but choose wisely.

SPI

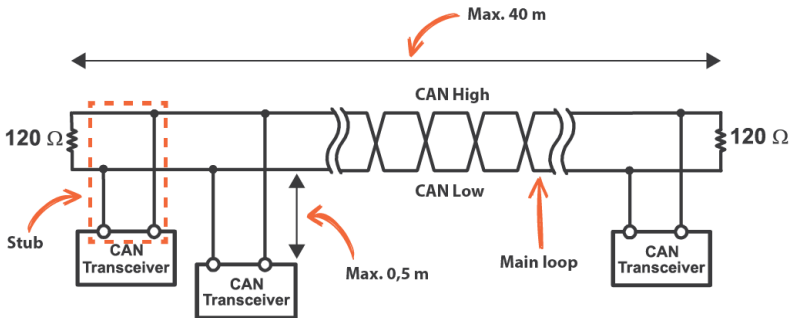




UART



CAN bus



Maybe you want to hear about...

- Motor control
- Cameras and video transmission
- Sound
- Safety critical systems
- Batteries
- Politics and RISC V
- FPGAs
- I want to go home