Hardware Zoo

Operating Systems & Middleware Group

IoT-Vitrine

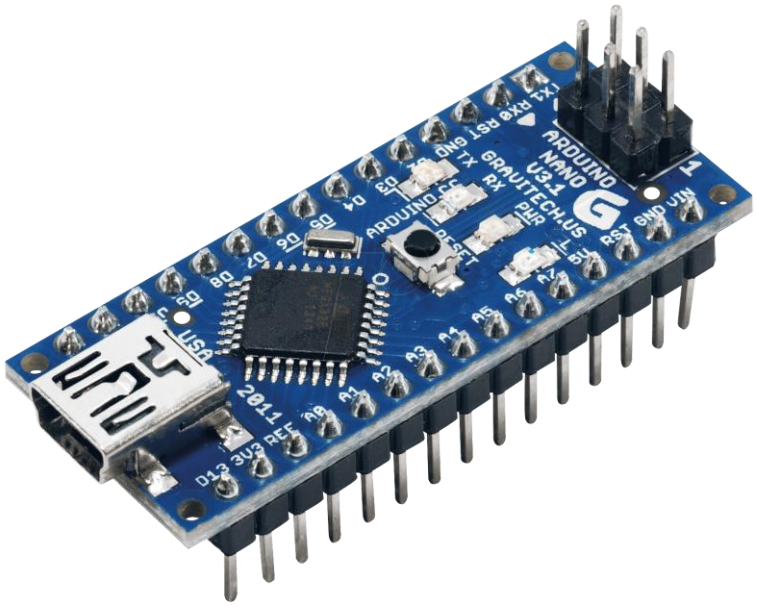
- 5V-Geräte
  - 2x ODROID C2
  - 4x ODROID XU4
  - 4x Parallella
  - 4x Jetson Nano
- 12V-Geräte
  - 4x ODROID N2
  - 4x Ultra96
  - 1x Jetson TX2
  - 1x Intel Edison Board
  - 1x Jetson AGX Xavier
  - 1x EOMA68

Arduino Uno

- ATmega328P
- 16 MHz
- 32 KB flash
- 2 KB SRAM
- 1 KB EEPROM

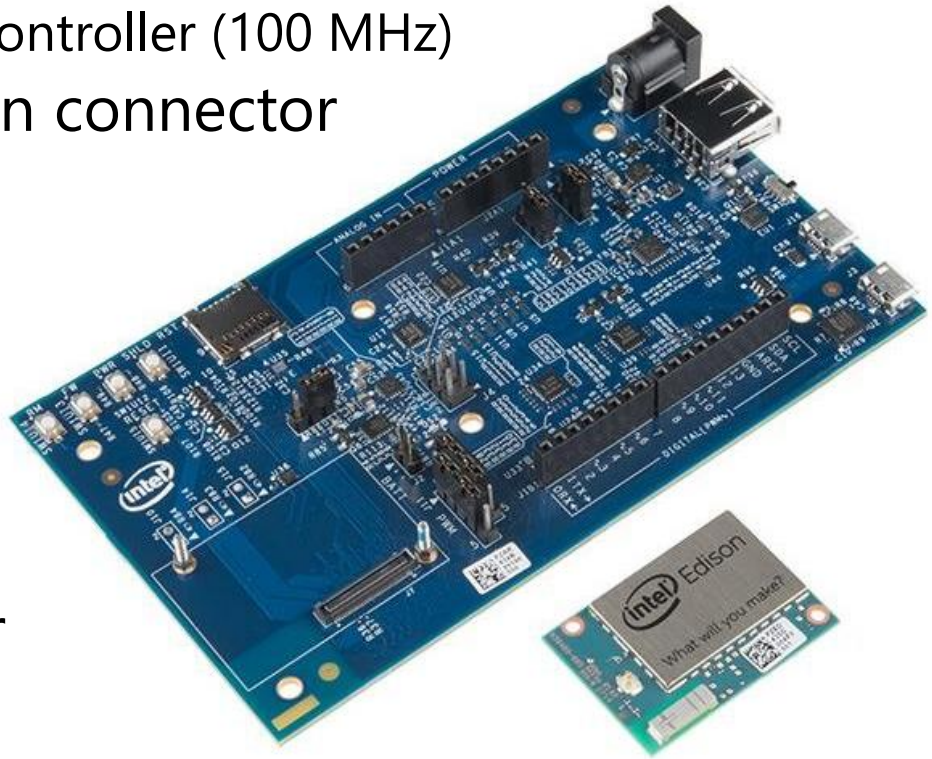
Arduino Nano

- ATmega328
- 16 MHz
- 32 KB flash
- 2 KB SRAM
- 1 KB EEPROM



Intel Edison (Arduino Breakout)

- Intel Edison
  - Intel SoC dual-core CPU
    - Intel Atom CPU (500 MHz)
    - 32-bit Intel Quark microcontroller (100 MHz)
  - WiFi, Bluetooth LE, 70-pin connector
  - 1 GB RAM
  - 4 GB flash
  - Yocto Linux* v1.6
- Arduino Breakout
  - Arduino 1.0 pinout
  - micro SD card connector
  - 2x micro USB, 1x USB-A

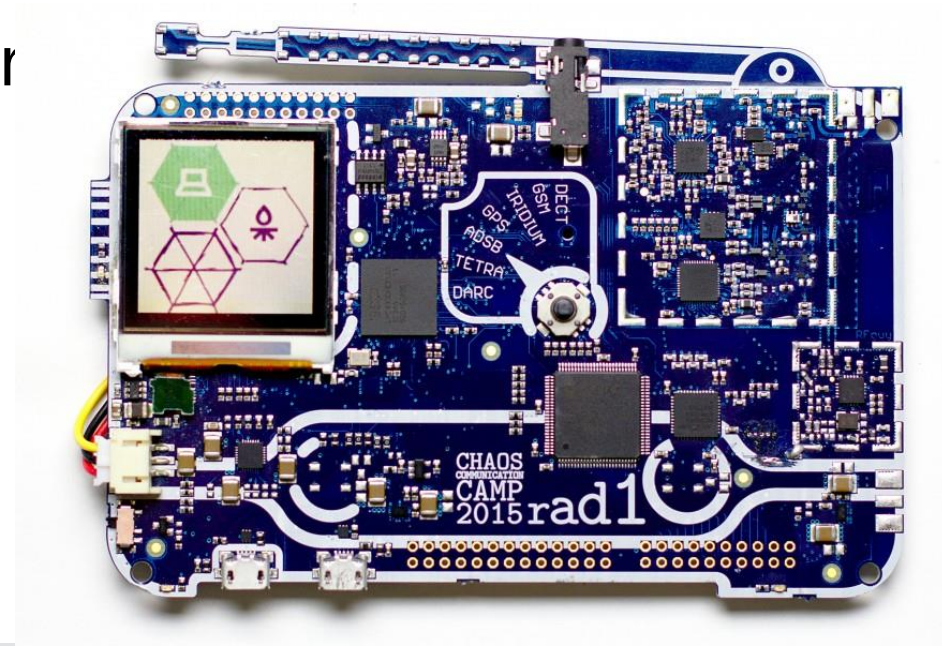


LEGO EV3

- TI Sitara AM1808 (ARM926EJ-S core)
- 300 MHz
- 64 MB RAM
- 16 MB Flash
- microSDHC Slot

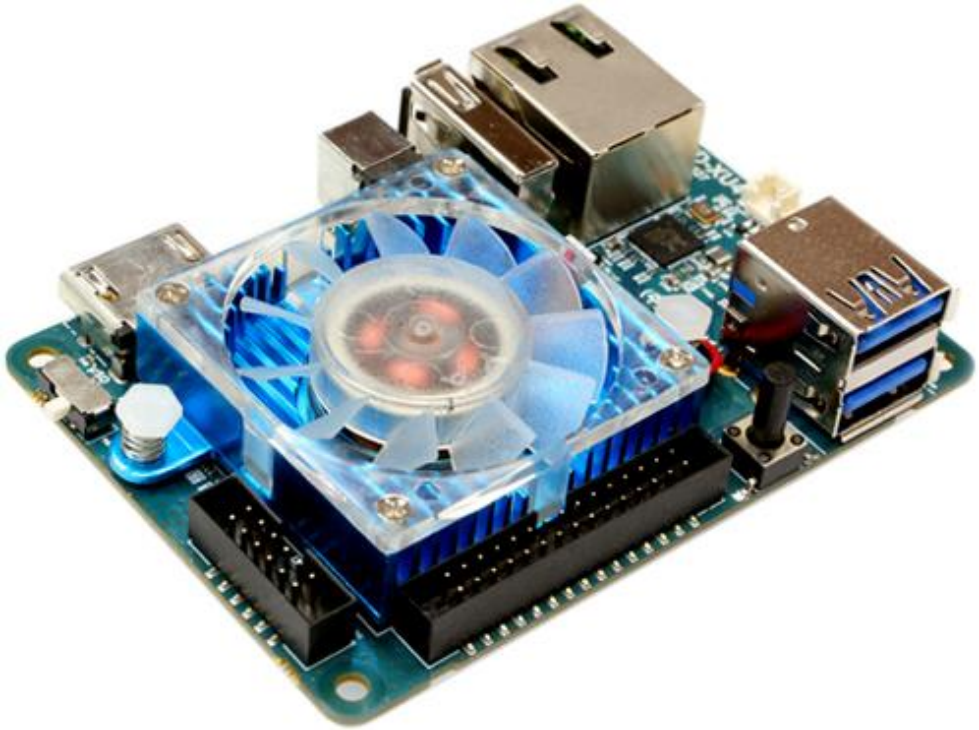
CCCamp 2015 rad1o Badge

- full-featured SDR (software defined radio) half-duplex transceiver (50 MHz - 4000 MHz)
- ARM Cortex M4 CPU
- Nokia 6100 130×130 pixel LCD
- 3.5 mm audio connector
- 2 micro USB ports
- joystick



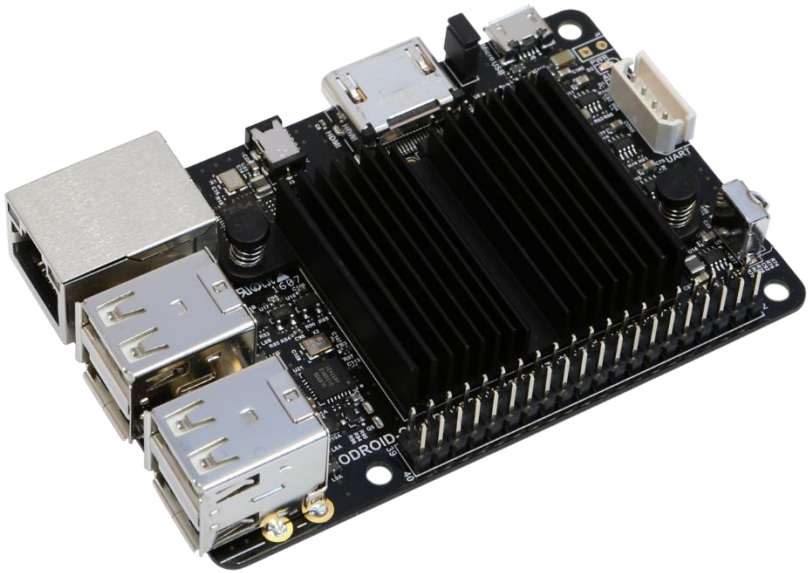
Odroid XU4 – ARM big.LITTLE

- Samsung Exynos5422 Cortex-A15 2Ghz & Cortex-A7 Octa core CPUs
- Mali-T628 MP6 (OpenGL & OpenCL)
- 2 GB RAM
- Flash Storage
- 2 x USB 3.0,
  1 x USB 2.0,
  Gigabit Ethernet,
  HDMI
- Mint Linux 16.04



ODROID-C2

- 64-bit quad-core single board computer (SBC)
- ARM Cortex-A53(ARMv8) 1.5Ghz quad core CPUs
- Mali-450 GPU
- 2 GB RAM
- 40pin GPIOs + 7pin I2S
- Mint Linux 16.04 (64 bit)
- 4x USB 2.0, 1x USB OTG, Gigabit Ethernet, HDMI, IR Receiver, Flash Storage slot, MicroSD Card slot



Parallella Board

- 16-core Epiphany RISC SOC
- Zynq SOC (FPGA + ARM A9)
- Gigabit Ethernet
- 1GB SDRAM
- Micro-SD storage
- Up to 48 GPIO pins
- HDMI, USB (optional)

Ultra96

- 4x Cortex-A53, 2x Cortex-R5*, Mali-400MP2 GPU, Xilinx Zynq UltraScale+ FPGA
- 2 GB Memory
- MiniDP,
  1x USB 3.0 Micro-B,
  2x USB 3.0 A,
  1x USB 2.0,
  expansion headers

- 802.11b/g/n & Bluetooth 4.2 + BLE
- PetaLinux or bare-metal

*) ARM *Cortex-R* Series is a family of embedded processors for *real-time* systems

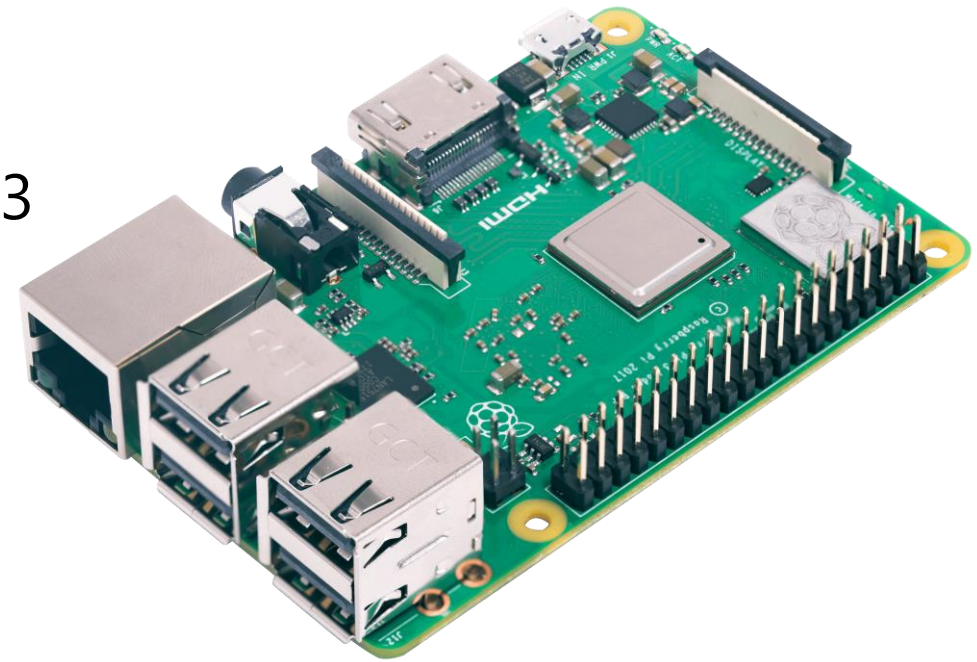
ARIS-EDGE

- ARM Cortex-M0+
  (up to 32 MHz, 128 kB Flash, 16 kB RAM)
- Bosch BNO055 (Smart 9-DOF IMU with sensor fusion and absolute orientation sensing)
- Bosch BME280 (accurate pressure, humidity, & temperature sensor)
- Silicon Labs MGM111 (multi-protocol RF module, supporting latest Thread, BLE, & ZigBee stacks)

Raspberry Pi 3 (B & B+)

Model B

- 1024 MB DDR2-RAM
- 1,2 GHz ARM Cortex-A53 Quad-Core-CPU
- WLAN 802.11 b/g/n
- LAN RJ45 10/100 Mbit

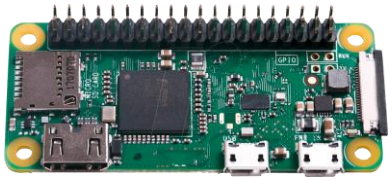


Model B+

- 1024 MB DDR2-RAM
- 1,4 GHz ARM Cortex-A53 Quad-Core-CPU
- WLAN 802.11 b/g/n/ac (2,4 + 5,0 GHz)
- LAN RJ45 10/100/1000 Mbit

Raspberry Pi 3 (A+ & Zero W)

- CSI, Audio, microSD, GPIO (40 Pin), no LAN
- 512 MB DDR2-RAM



Zero

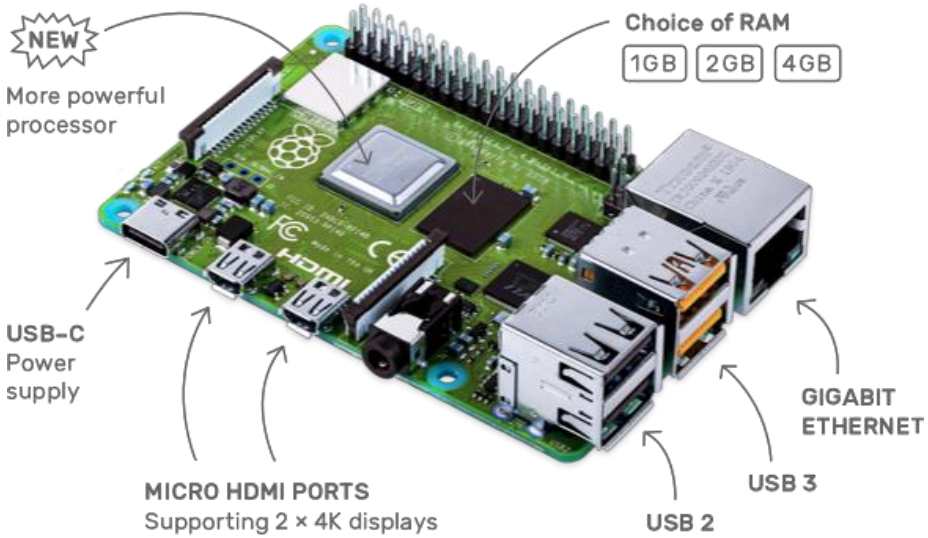
- 1,0 GHz BCM2853
- WLAN 802.11 b/g/n, BT 4.1
- mini-HDMI, 2x micro-USB

Model A+

- 1,4 GHz ARM Cortex-A53 Quad-Core-CPU 8
- WLAN 802.11 b/g/n/ac, BT 4.2
- HDMI, 1x USB 2.0

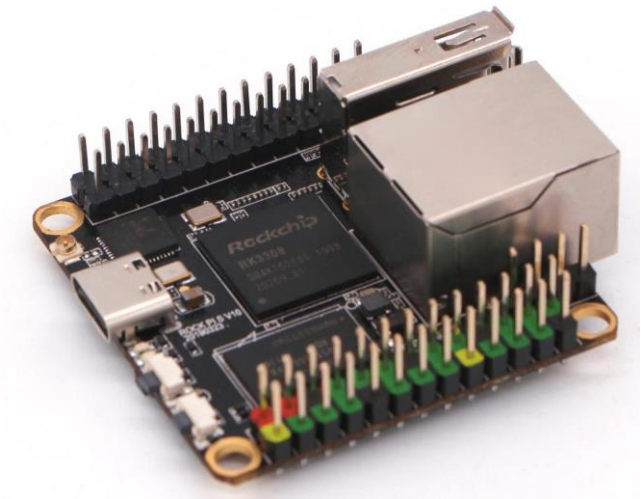
Raspberry Pi 4 (Model B)

- 1,5 GHz ARM Cortex-A72 Quad-Core-CPU
- 4 GB LPDDR4 SDRAM
- Gigabit LAN RJ45,
- Bluetooth 5.0
- 2x USB 2.0 / 2x USB 3.0
- 5V/3A @ USB Typ- C
- 2x microHDMI
  (1x 4k @60fps oder 2x 4k @30fps) H.265/H.264



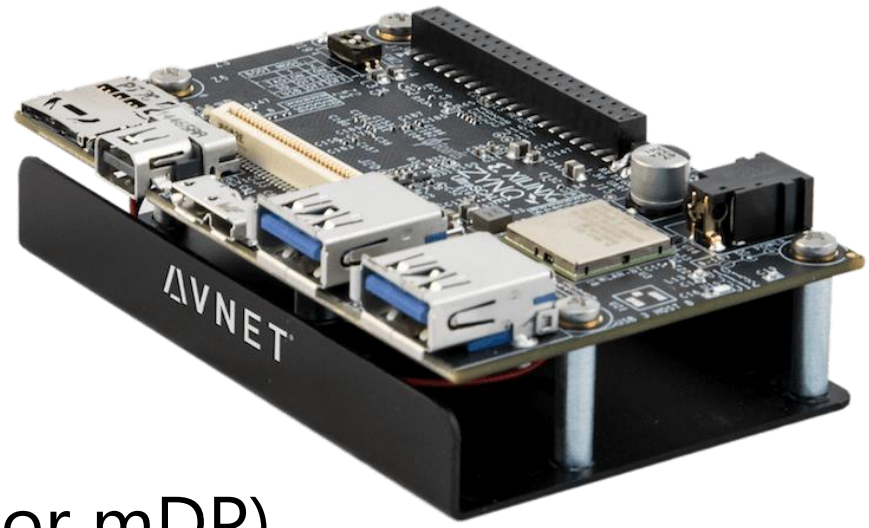
Rock Pi S

- Rockchip RK3308 Quad A35 64bit CPU with built-in Voice Activity Detection (VAD)
- USB 2.0 OTG (Typ C) + USB 2.0 HOST (Typ A)
- 512 MB RAM
- RJ45 10/100Mbit Ethernet
- 802.11 b/g/n Wifi, Bluetooth 4.0 external antenna connector
- 26 pin GPIO header
- 26 pin voice/audio header includes I2S, PCM, TDM, PDM, SPDIF, and HDMI ARC



Ultra96

- Xilinx Zynq UltraScale+ MPSoC ZU3EG SBVA484
- Micron 2 GB (512M x32) LPDDR4 Memory
- Wi-Fi / Bluetooth
- Mini DisplayPort (MiniDP or mDP)
- 1x USB 3.0 Micro-B, 2x USB 3.0 A, 1x USB 2.0 HS
- 40-pin 96Boards Low-speed expansion header
- 60-pin 96Boards High speed expansion header



HPE Edgeline EL1000

HPE Edgeline EL1000 Converged Edge System

- Storage
- High-Density Compute Nodes
- Mechanical and Power
- Environmental
- Built-in I/O
- Expansion Slots

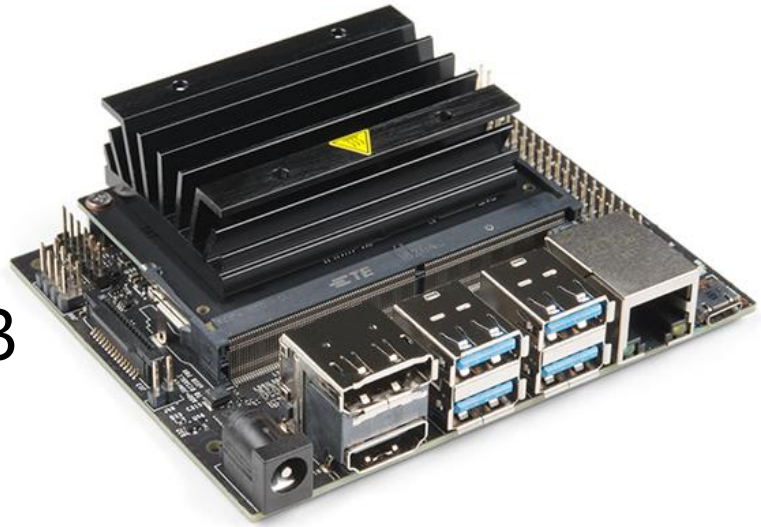
HPE EL20

HPE GL20 IoT Gateway
(formerly HPE EL20 Intelligent Gateway)

- Intel Core i5 CPU
- 8GB RAM, 64 GB SDD Storage
- 4 PCI Express Mini-card slots
- 4 PoE ports, 8-bit DIO
- 9 to 36 Volts DC input

Nvidia Jetson Nano

- 128-core Maxwell CPU
- Quad-core ARM A57 @ 1.43 GHz GPU
- 4 GB 64-bit LPDDR4 25.6 GB/s
- 1x MIPI CSI-2 DPHY lanes,
- Gigabit Ethernet, M.2 Key E
- HDMI 2.0 and eDP 1.4
- 4x USB 3.0, USB 2.0 Micro-B
- GPIO, I2C, I2S, SPI, UART



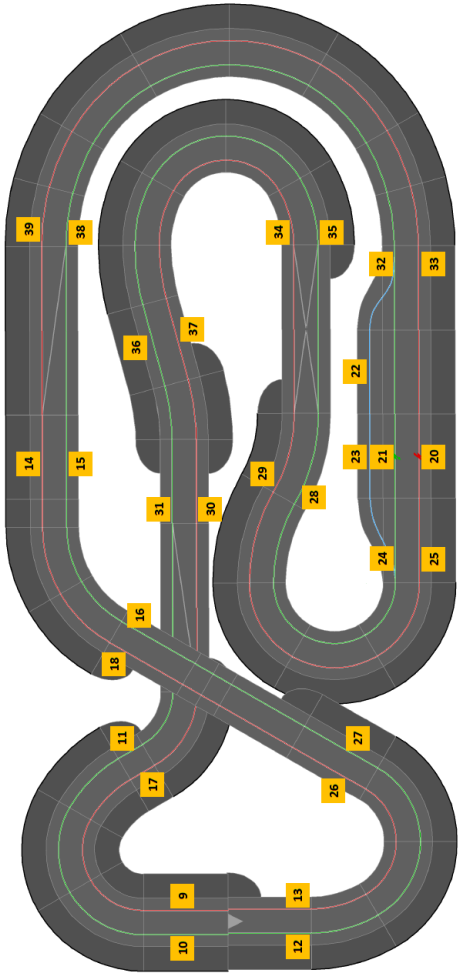
Nvidia Jetson TX2

- NVIDIA Pascal™ Architecture GPU
- 2 Denver 64-bit CPUs + Quad-Core A57 Complex
- 8 GB L128 bit DDR4 Memory
- 32 GB eMMC 5.1 Flash Storage
- 802.11ac Wi-Fi, Bluetooth
- 10/100/1000BASE-T Ethernet
- USB 3.0 Type A, USB 2.0 Micro AB, HDMI, M.2 Key E, PCI-E x4, Gigabit Ethernet, Full-Size SD, SATA Data and Power, GPIOs, I2C, I2S, SPI, CAN, TTL UART, Display + Camera Expansion

Nvidia AGX Xavier

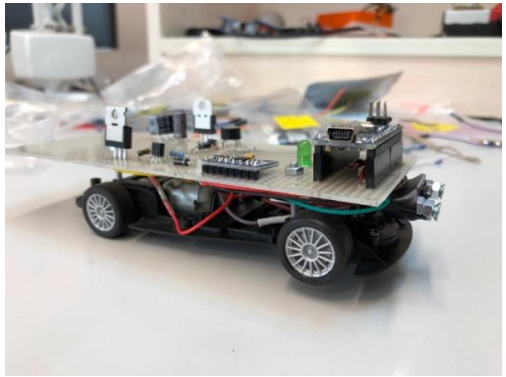
- GPU: 512-core Volta GPU with Tensor Cores
- CPU: 8-core ARM v8.2 64-bit CPU,
- 32GB 256-Bit LPDDR4x
- 32GB eMMC 5.1
- (2x) NVDLA Engines
- Vision Accelerator
- x8 PCIe Gen4/x8 SLVS-EC, Gigabit Ethernet, NVMe, PCIe x1 + USB 2.0 + UART, UART + SPI + CAN + I2C + I2S + DMIC + GPIOs

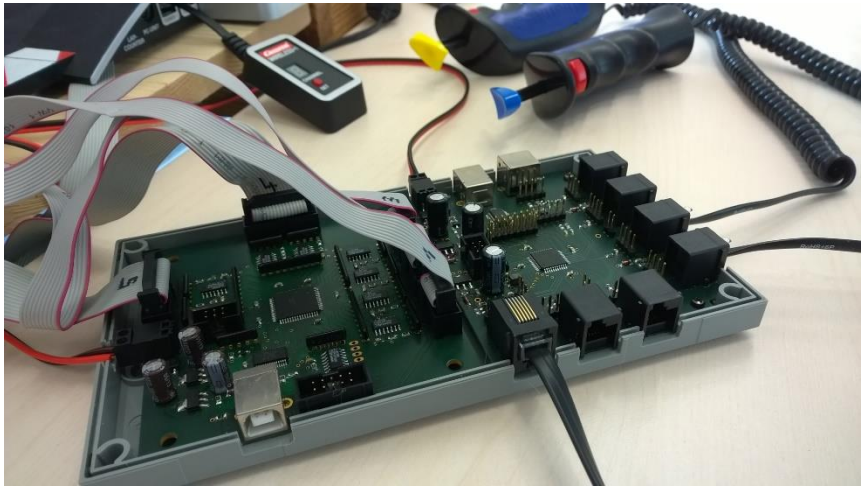
Carrera D132 (Customized)



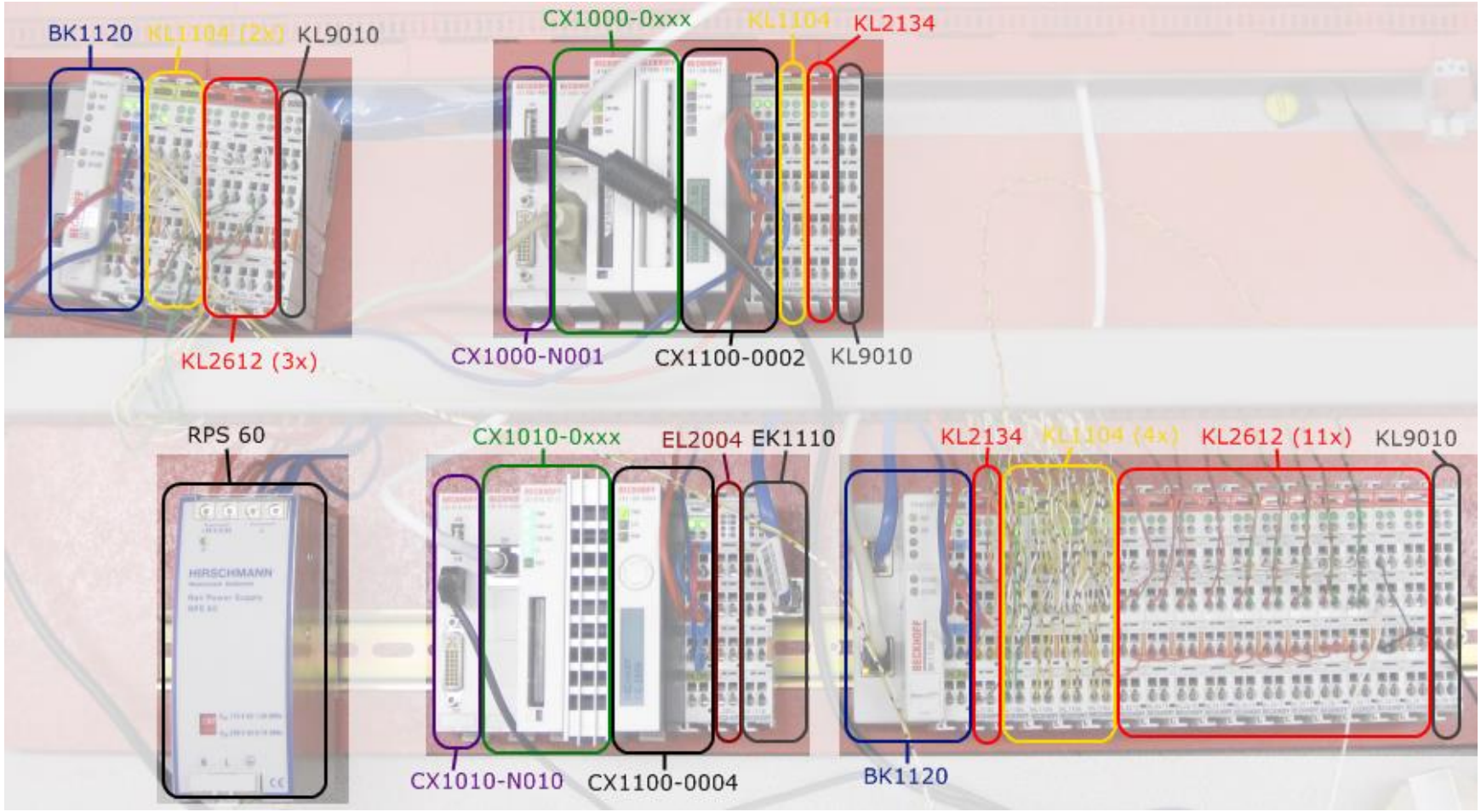
Carrera D132 (Customized)

- off-the-shelf *Carrera Digital 132* race-track including "Carrera control unit" extended with several additional position sensors
- various handcrafted sensor & actuator boards
  - 8/16-bit AVR XMEGA A3 microcontroller, FT245R USB FIFO IC, RS232 interface, four RJ-12 interfaces, …
- self-driving car





Beckhoff SPS



Beckhoff SPS

RPS 60	Hirschmann Rail-Power-Supply RPS-60 24V DC Hutschienen-Netzteil
CX1100-0002	Stromversorgung mit K-Bus-Interface
CX1100-0004	Stromversorgung mit E-Bus-Interface
CX1000-0xxx	CPU-Grundmodul
CX1010-0xxx	CPU-Grundmodul
CX1000-N001	Systemschnittstelle (DVI/USB-Anschluss)
CX1010-N010	Systemschnittstelle (DVI/USB-Anschluss)
BK1120	EtherCAT-Buskoppler
KL1104	4-Kanal-Digital-Eingangsklemme 24 V DC
KL2612	2-Kanal Relais Ausgangsklemme 125 V AC (2x Wechsler)
KL2134	4-Kanal-Digital-Ausgangsklemme 24 V DC
KL9010	Busendklemme
EL2004	4-Kanal-Digital-Ausgangsklemme 24 V DC, 0,5 A
EL6001	Serielle Schnittstelle RS232
EK1110	EtherCAT-Verlängerung