

# Embedded Systems Overview

Pavol Rusnak

@pavolrusnak

**ARM**

Acorn RISC Machine

Advanced RISC Machine

# ARM Architectures

ARMv1	ARM1
ARMv2	ARM2, ARM3
ARMv3	ARM6, ARM7
ARMv4	StrongARM, ARM7TDMI, ARM9TDMI
ARMv5	ARM7EJ, ARM9E, ARM10E, XScale
ARMv6	ARM11, ARM Cortex-M
ARMv7	ARM Cortex-A, ARM Cortex-M, ARM Cortex-R
ARMv8	No cores yet - 64-bit data and addressing

# ARM Extensions

Thumb

Jazelle / ThumbEE

VFP

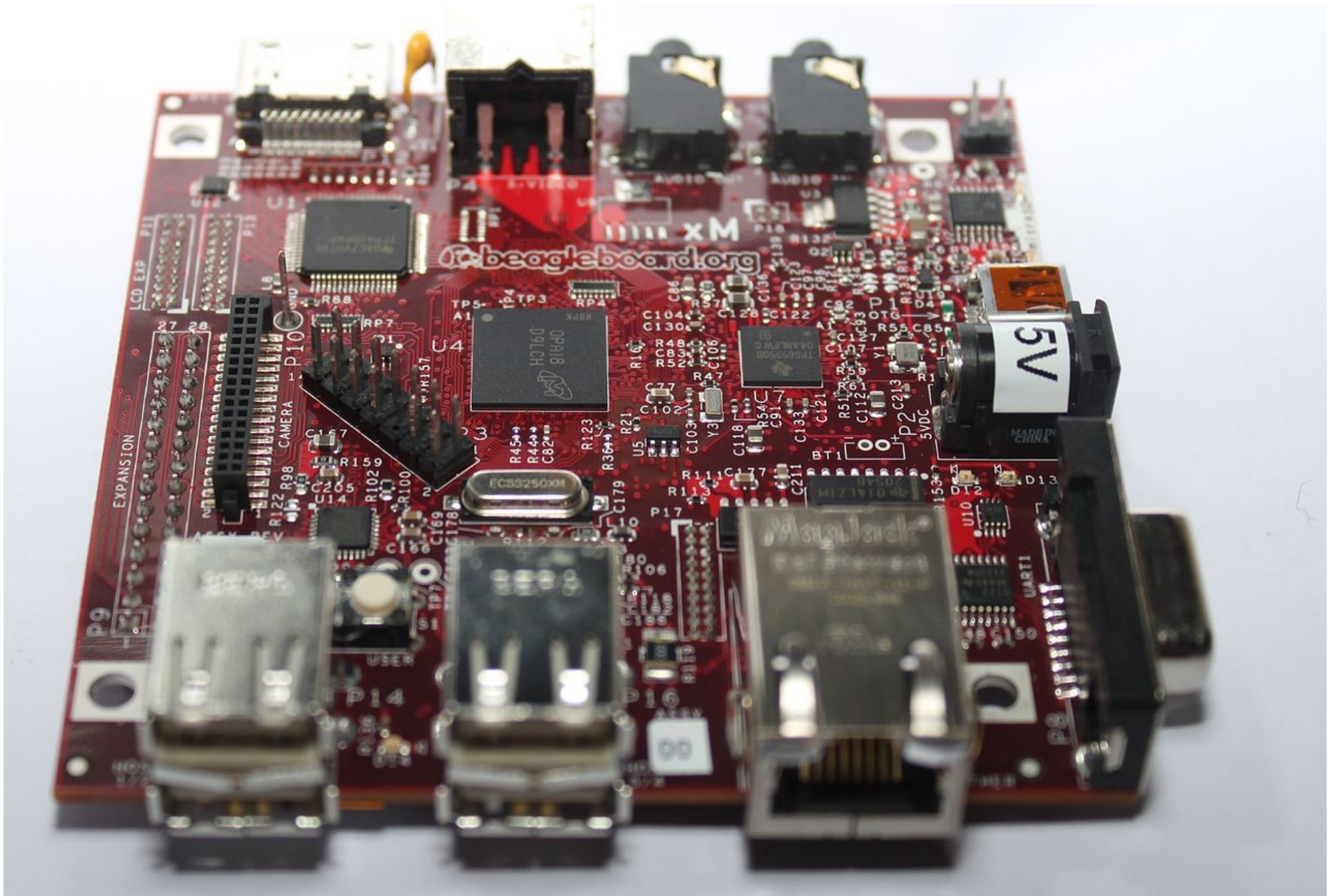
NEON

TrustZone

A64

crypto

# Beagleboard

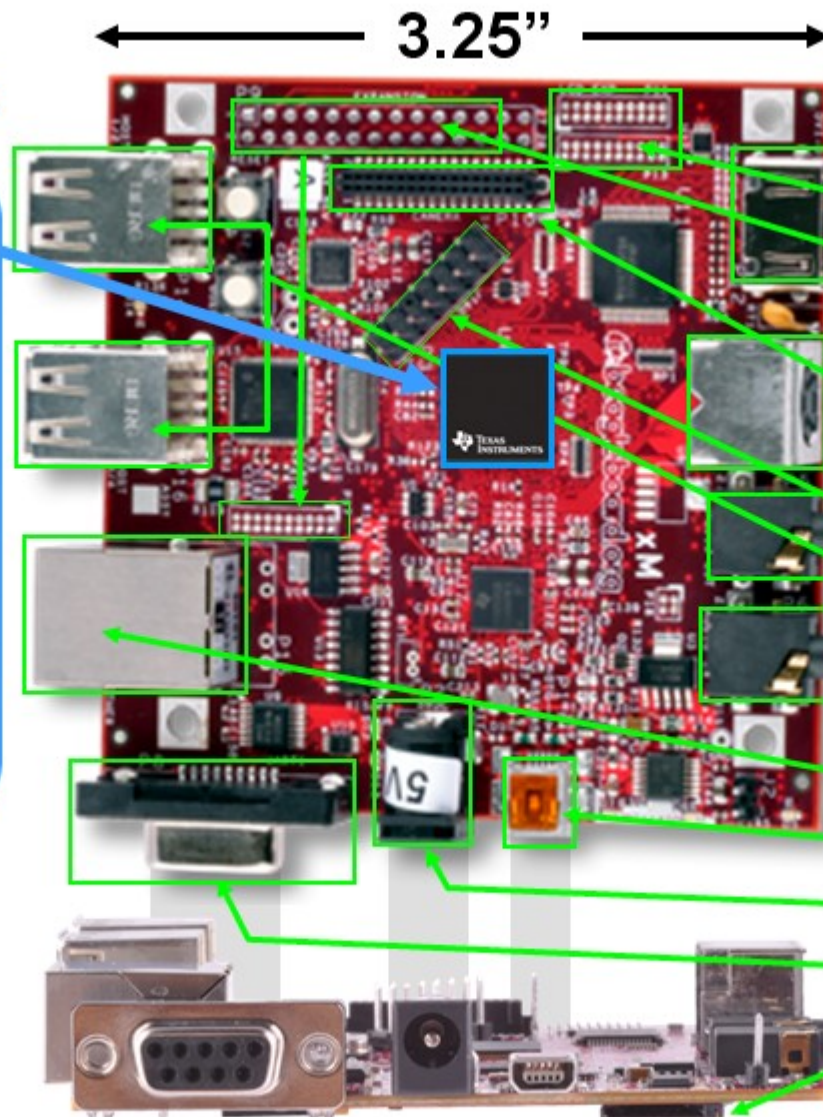




# Beagleboard

## Laptop-like performance

- Super-scalar ARM® Cortex™ -A8
- More than 2,000 Dhrystone MIPS
- Up to 20 Million polygons per sec graphics
- HD video capable C64x+™ DSP core
- 512 MB LPDDR RAM

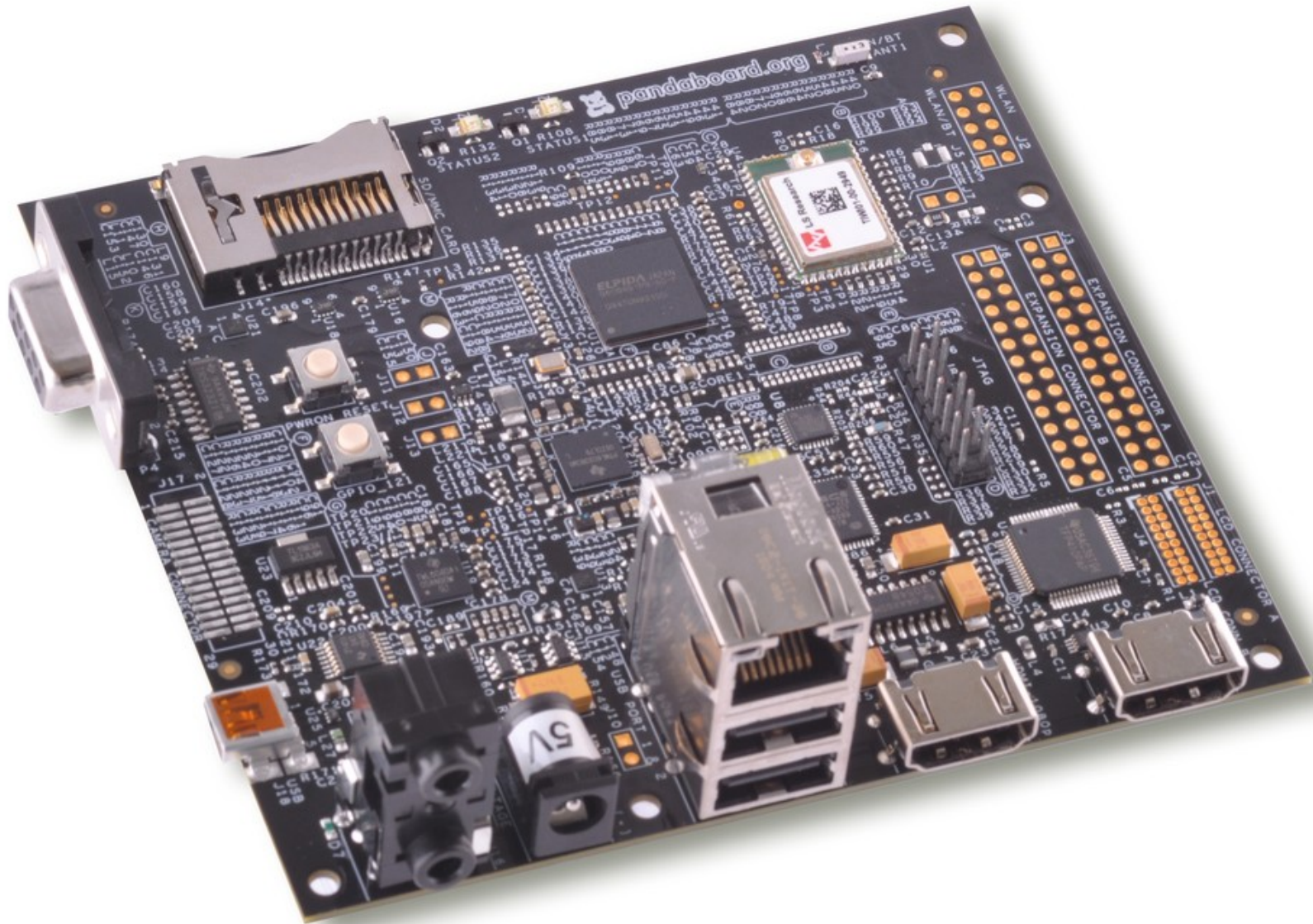


## Typical PC peripherals via high-speed USB

- LCD Expansion
- I<sup>2</sup>C, I<sup>2</sup>S, SPI, MMC/SD Expansion
- DVI-D
- Camera Header
- S-Video
- JTAG
- USB Hosts
- Stereo Out
- Stereo In
- 10/100 Ethernet
- USB 2.0 HS OTG\*
- Alternate Power
- RS-232 Serial\*
- Micro-SD Slot\*

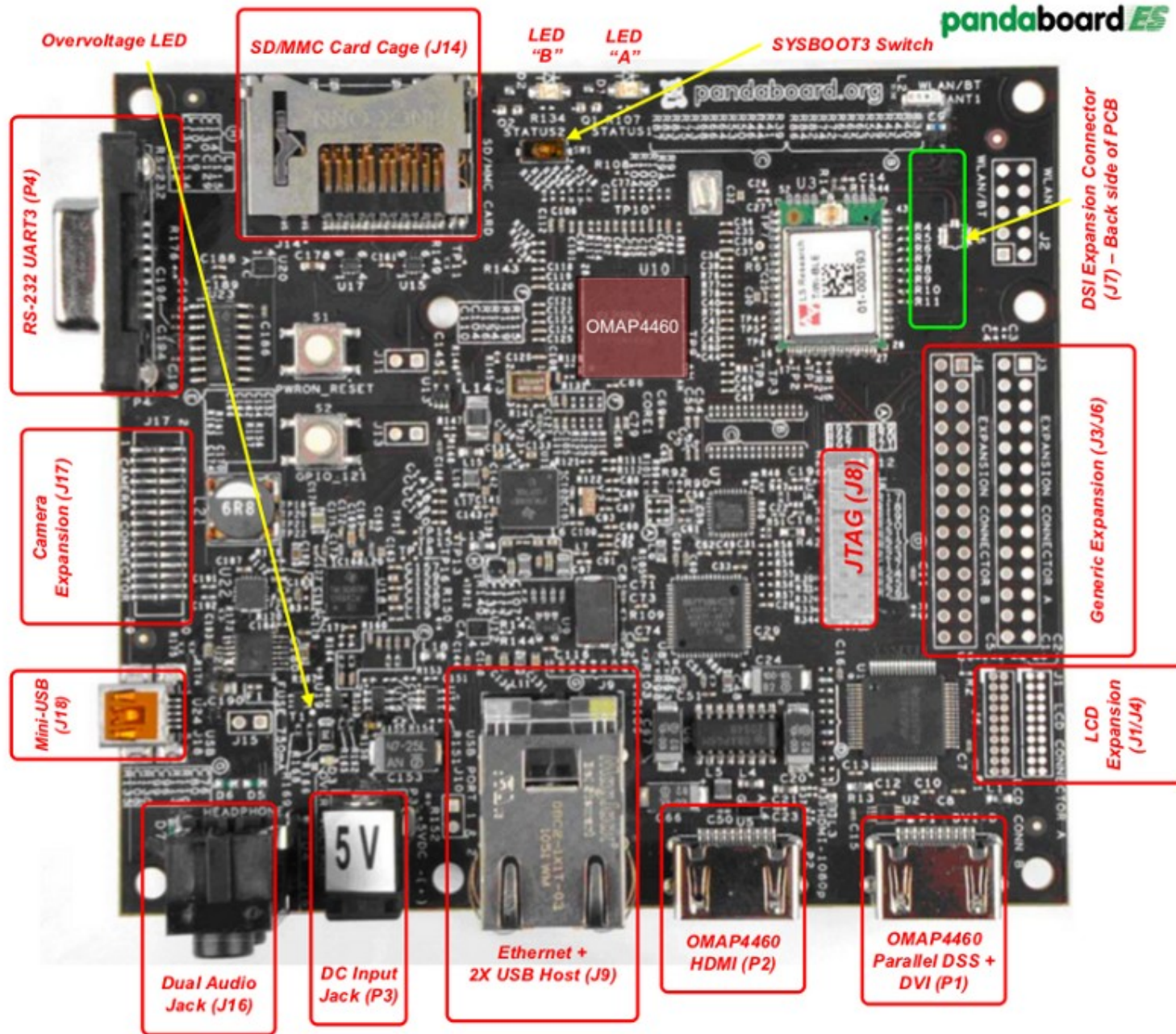
\* Supports booting from this peripheral

# Pandaboard





# Pandaboard



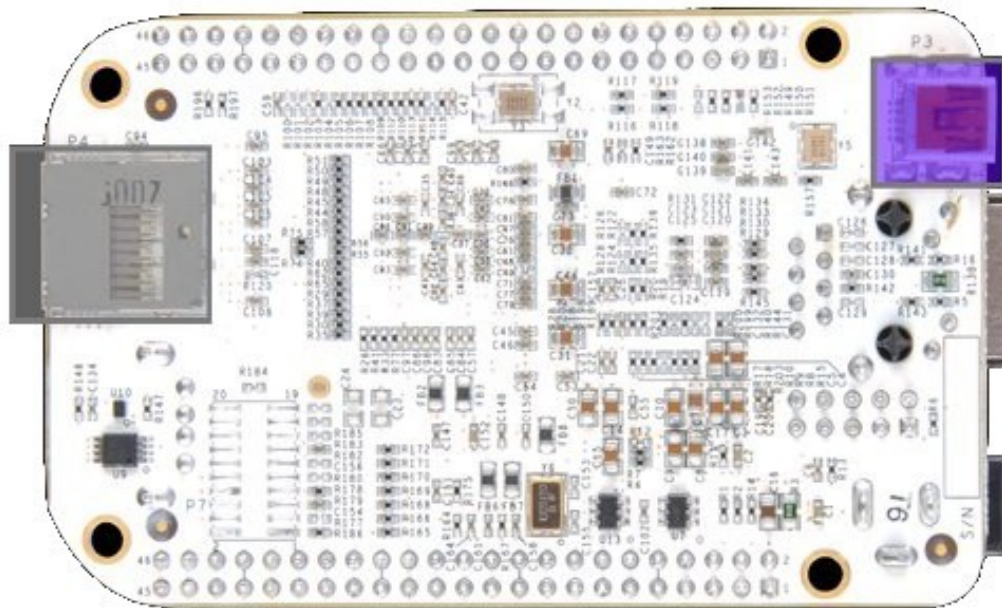
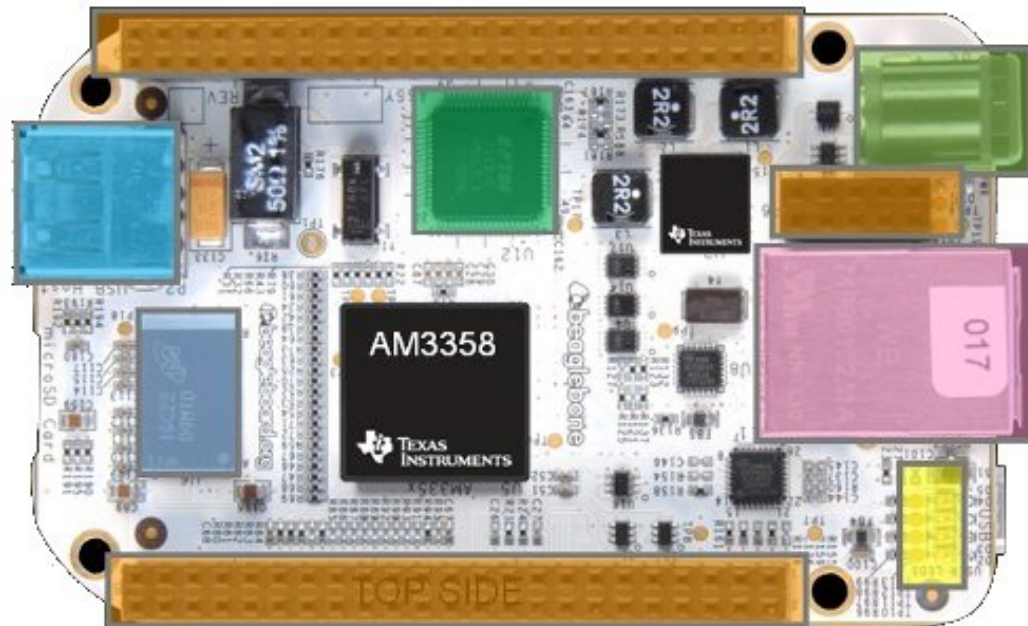
# Beaglebone





# Beaglebone

- USB 2.0 Host
- 5V Power Supply (opt.)
- 10/100 Ethernet
- TI Power Mgmt
- On-board emulator
- 256MB DDR2
- LEDs
- Expansion (3)
- MicroSD
- USB 2.0 Client

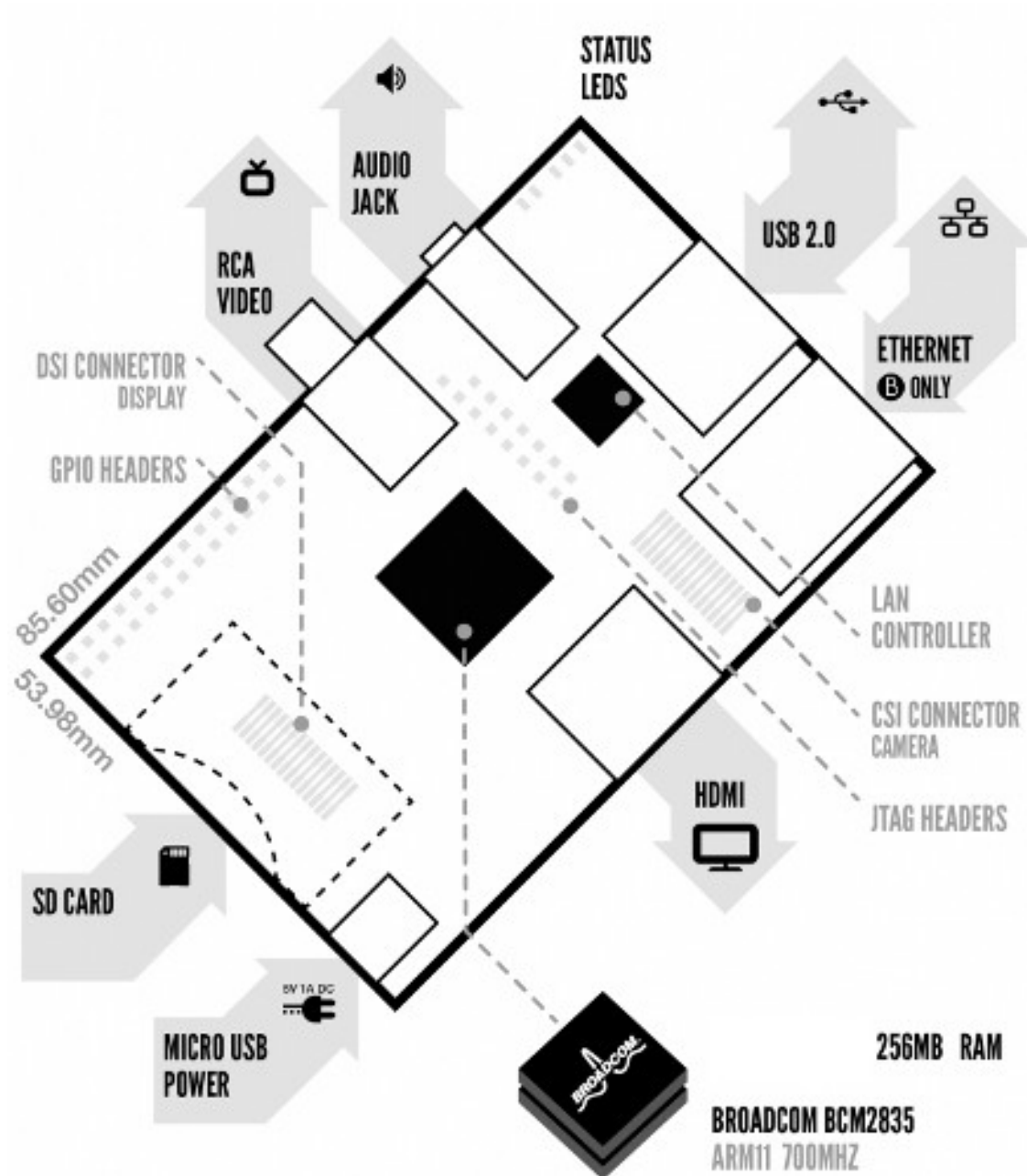


# Raspberry Pi

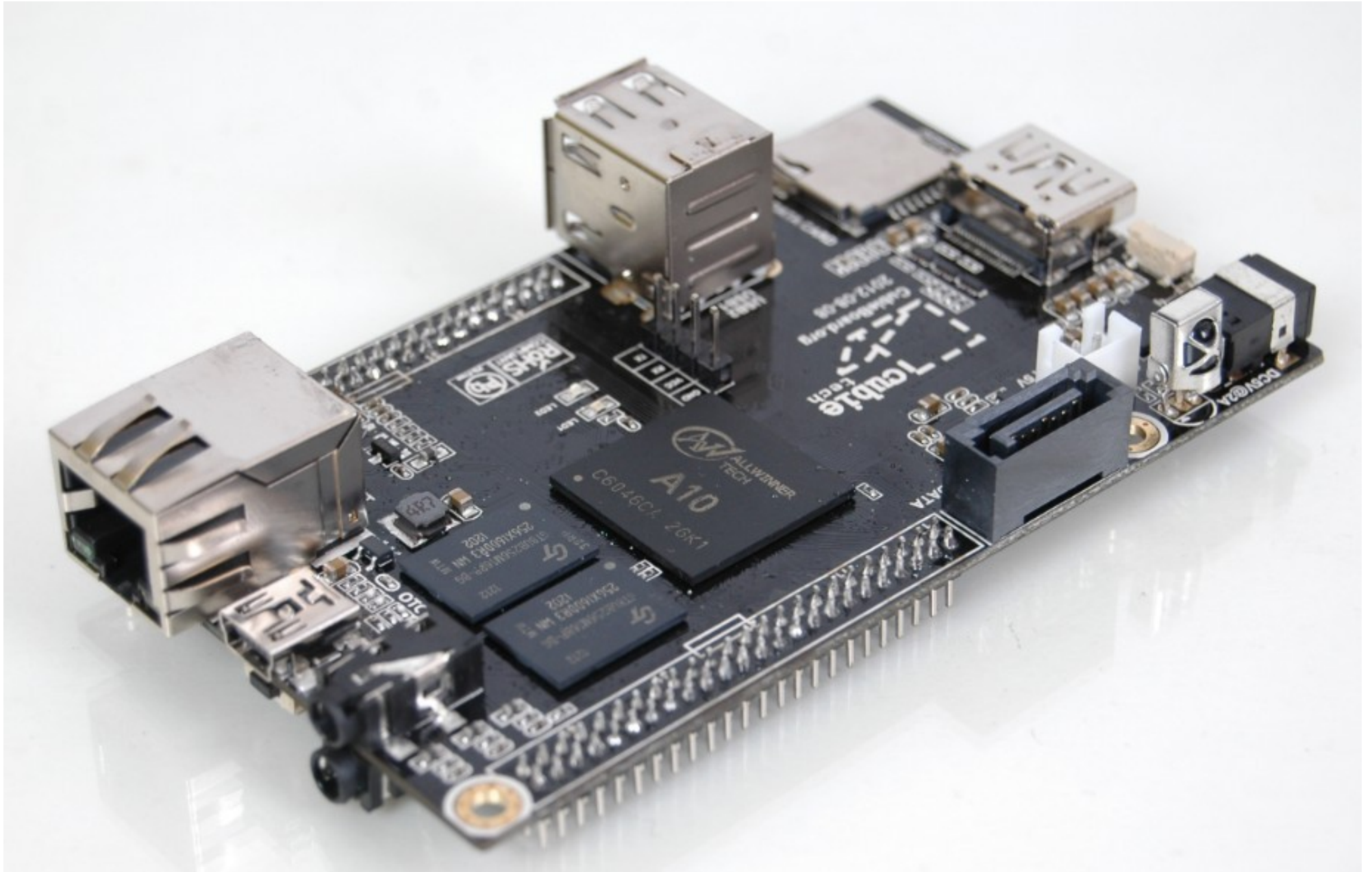




# Raspberry Pi

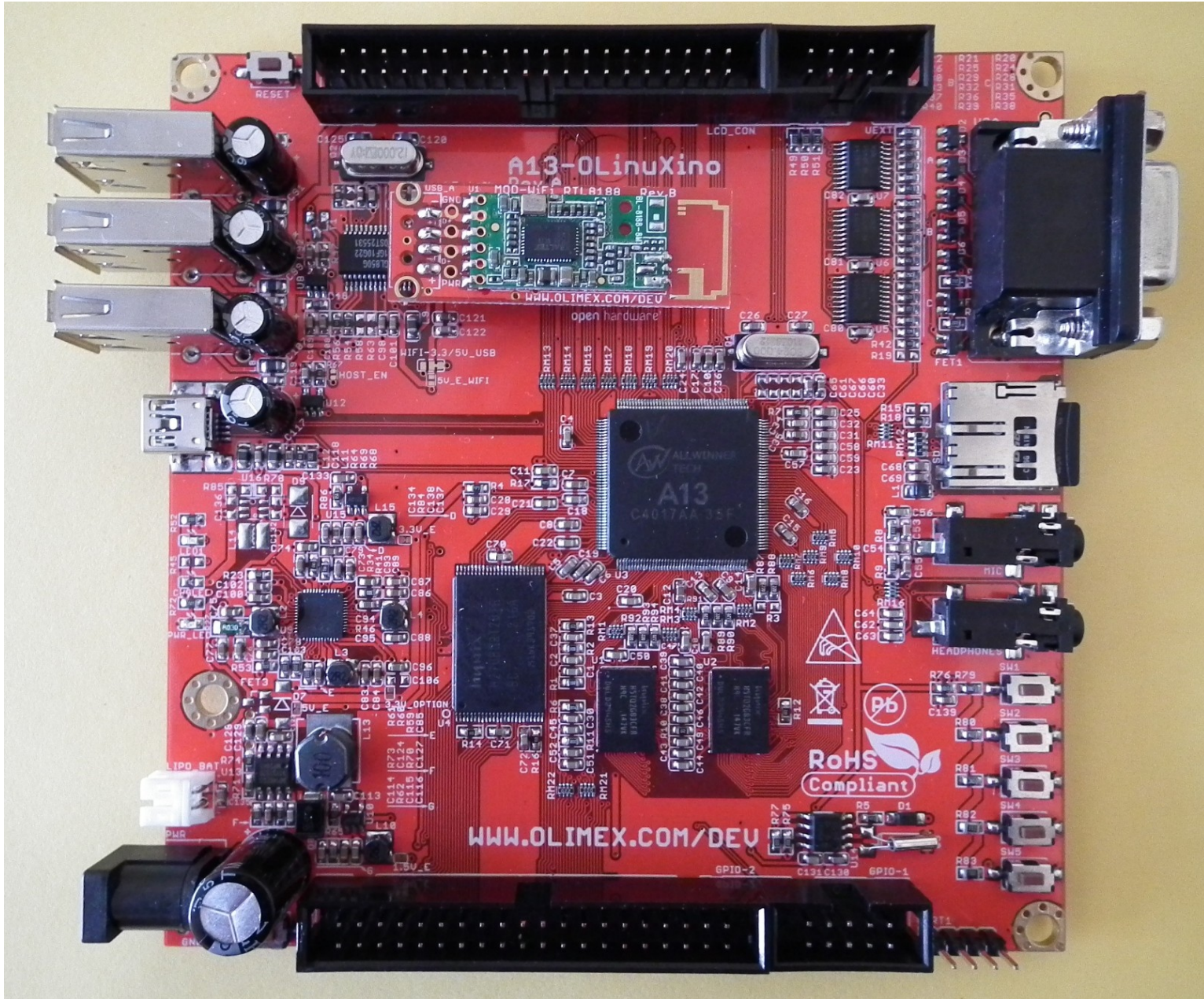


# Cubieboard

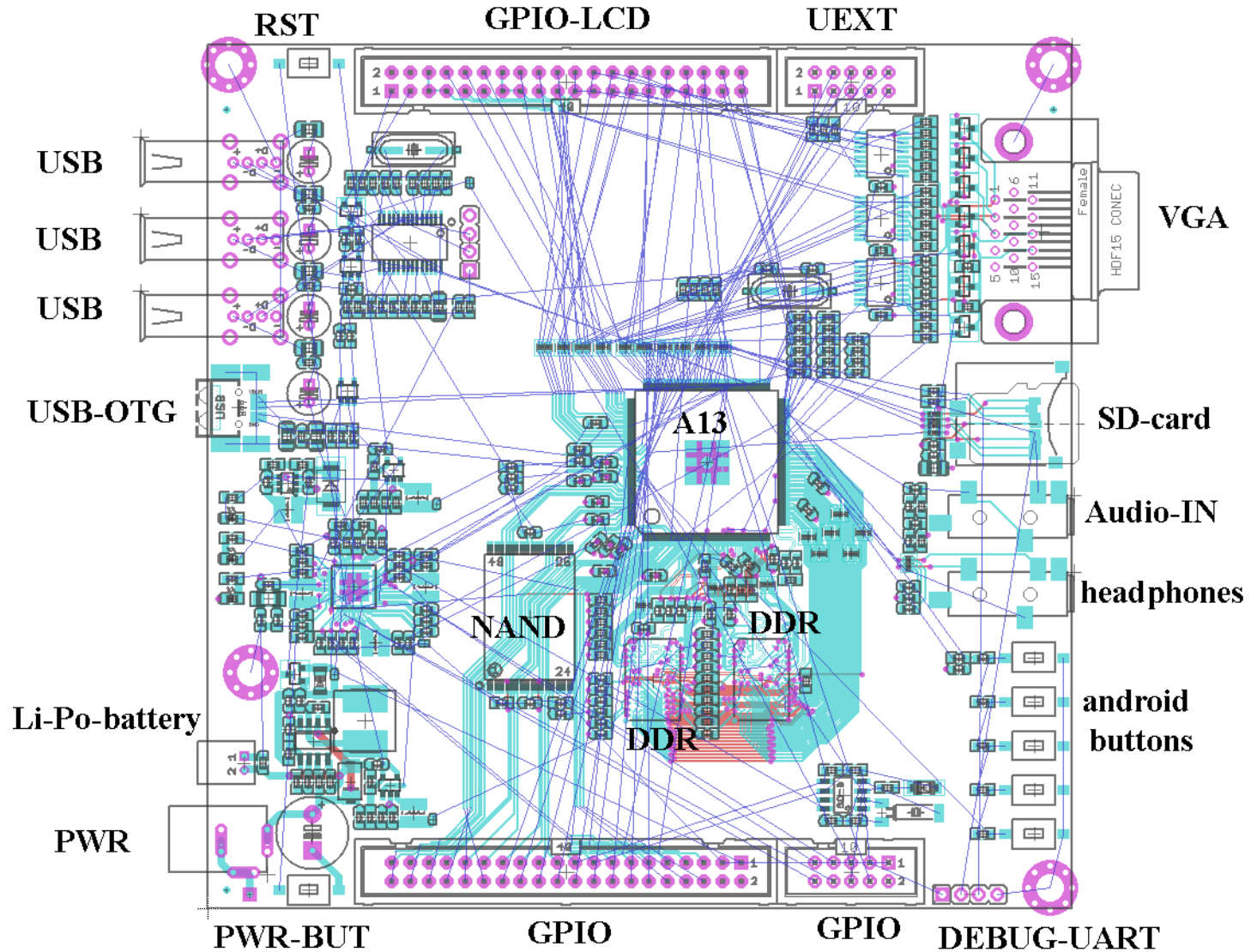




# A13-LinuXino

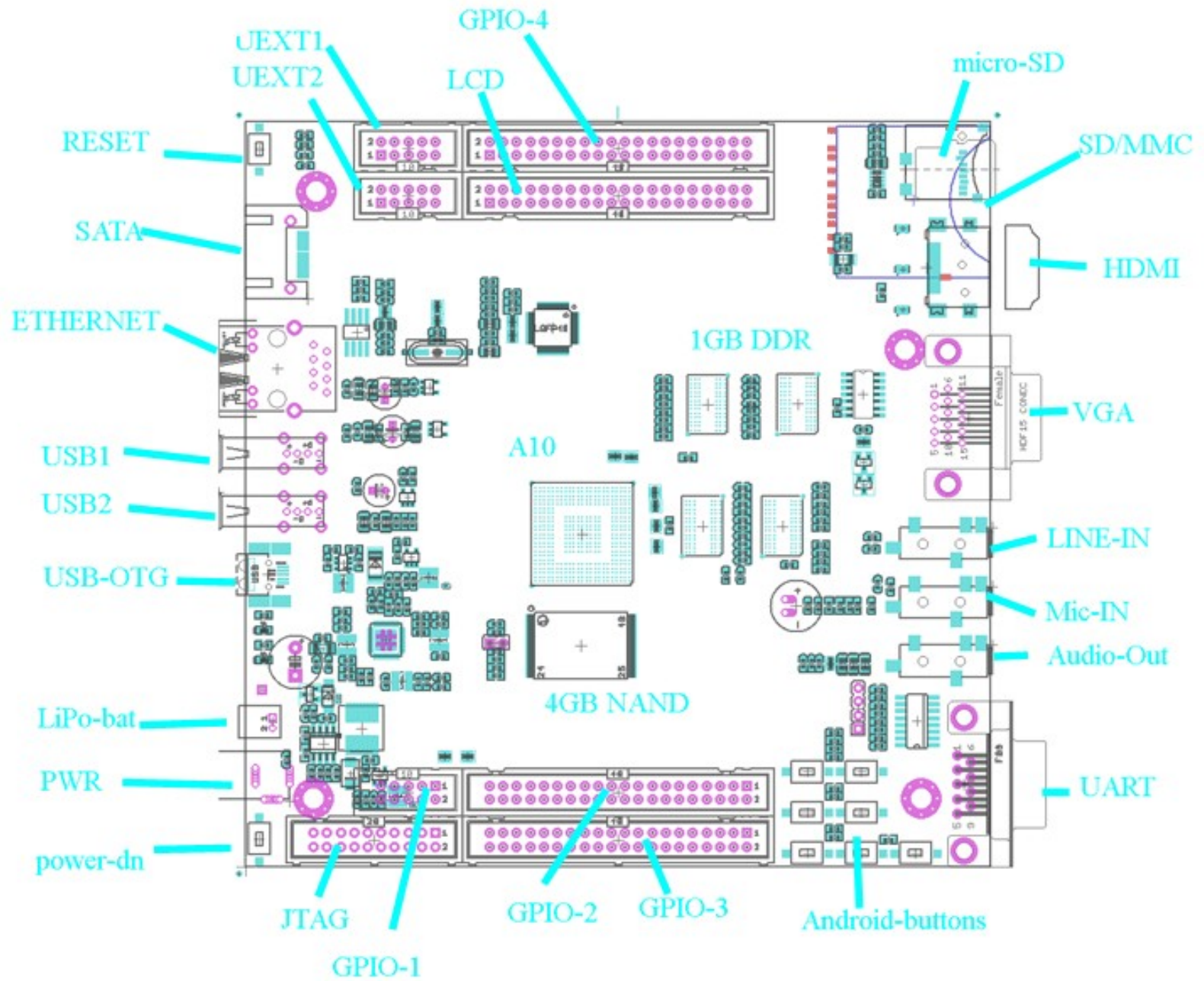


# A13-LinuXino





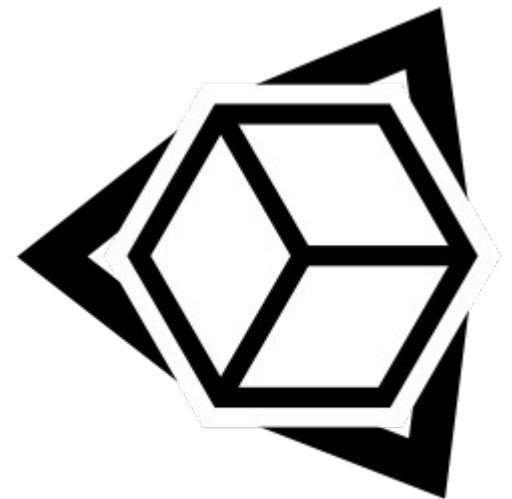
# A10-LinuXino



-	BeagleBone	BeagleBoard (orig/xM)	PandaBoard (orig/ES)	Raspberry Pi (model A/B)	CubieBoard	A13-OLinuXino
<b>CPU (platform)</b>	ARM Cortex-A8	ARM Cortex-A8	ARM Cortex-A8	ARM1176JZF-S	ARM Cortex-A8	ARM Cortex-A8
<b>CPU (model)</b>	TI AM335x	OMAP3530	OMAP4430 (orig) OMAP4460 (ES)	BCM2835	Allwinner A10	Allwinner A13
<b>CPU (MHz)</b>	500 (on USB) 720 (adapter)	600 (orig) 1000 (xM)	1000 (orig) 1200 (ES)	700 1000 (clocked)	1000	1000
<b>Graphics</b>	-	PowerVR SGX	PowerVR SGX540	Broadcom VideoCore IV	Mali 400	Mali 400
<b>RAM (MB)</b>	256	512	1024	256/512	1024	512
<b>Ethernet</b>	yes	yes	yes	no (A) yes (B)	yes	no
<b>Audio out</b>	no	jack	jack, HDMI	jack, HDMI	jack, HDMI	jack
<b>Audio in</b>	no	jack	jack	no	jack	jack
<b>Video</b>	no	S-Video, HDMI	HDMI	RCA, HDMI	HDMI	VGA
<b>USB</b>	yes	yes	yes	yes	yes	yes
<b>SD card</b>	microSD	microSD	SD	SD	microSD	microSD
<b>Flash</b>	no	no	no	no	4 GB	no
<b>SATA</b>	no	no	no	no	yes	no
<b>Wireless</b>	no	no	yes	no	no	optional
<b>Bluetooth</b>	no	no	yes	no	no	no
<b>ADC</b>	7	0	0	0	yes	?
<b>CAN</b>	2	0	0	0	?	?
<b>GPIO</b>	66	?	?	8	96	20+4
<b>I2C</b>	2	1	1	1	yes	3
<b>PWM</b>	8	?	?	0	?	?
<b>SPI</b>	2	1	1	1	yes	?
<b>UART</b>	5	1	1	1	yes	2
<b>Price (\$)</b>	89	149	179	25 (A) 35 (B)	49	59

# Resources

- <http://elinux.org/>
- <http://linux-sunxi.org/>
  
- [http://brmlab.cz/kb/arm\\_guide](http://brmlab.cz/kb/arm_guide)
  
- <http://beagleboard.org/>
- <http://pandaboard.org/>
- <http://beagleboard.org/bone/>
- <http://raspberrypi.org/>
- <http://cubieboard.org/>



**GK2.5K**